City of Cupertino

STEVENS CREEK TRAIL FEASIBILITY STUDY:
ECOLOGICAL RESTORATION AND ENHANCEMENT REPORT

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INTRODUCTION

This report is a supplement to the earlier ecological document provided to the City of Cupertino titled, *Assessment of Biological Opportunities and Constraints: Report for the City of Cupertino, Stevens Creek Trail Feasibility Study* (dated May 10, 2001). In the *Biological Assessment* document, a number of ecological restoration opportunities in the Stevens Creek Trail corridor were identified. This *Ecological Restoration and Enhancement Report* provides more specific details on restoration locations and implementation.

Restoration and Enhancement Regions. Restoration work along the Stevens Creek Trail route can be divided into discrete projects and this report will identify such projects. However, the restoration literature makes it very clear that for *projects* to be successful, the condition of the *region* in which the projects are located must be considered. With this larger landscape scale in mind, the restoration projects and practices identified here are organized around three regions, defined by drainages, which include major habitat or natural community types. Each project will contribute to the overall ecological health of the region and the habitats existing there. The three restoration regions are (see Figure 1-Map of the Study Area):

- Cristo Rey Wetland Drainage—Study Area A
- Riparian Corridor/In-stream Habitat—Study Areas C and D
- Quarry Slope/Wetland Drainage—Study Area B

For each restoration region, the following information is provided:

I. *Region Summary*

- Location/characteristics of the restoration region
- Conditions in need of attention
- Benefits of restoration
- Experts required for planning and implementation
- Agencies to be consulted during planning

II. *Specific Restoration Projects*

For each restoration project, basic information is provided on potential implementation methods, timing issues, likely agency consultation and expertise needed, volunteer opportunities, and monitoring. These descriptions indicate the basic scope and difficulty of each project. The ultimate specifications for each project can be determined only through a process involving the city, the permitting agencies, the restoration experts, and the public.

What is Restoration?

Ecologic restoration is a relatively new scientific and practical field that has emerged from disciplines such as ecology, hydrology, and geology. The purpose of restoration is to reestablish the structures and functions of the native, indigenous ecosystem of an area to the greatest extent feasible. For creeks, this definition includes restoring not only the native species, but also the original hydrology and morphology of the stream and its associated natural communities. Of course, restoring the native ecosystem of our area as the European settlers first saw it is impossible. Rather, restorationists seek to improve the quality of existing habitats, protect and increase biodiversity, and improve overall ecological health *within the existing constraints* of time, money, and adjacent land uses. Because full ecosystem restoration along the Stevens Creek trail is not possible, restoration in the context of this report is more often means habitat *enhancement* and/or *revegetation*. These terms indicate that activities will focus on improving existing habitat conditions and reestablishing native vegetation.

Conditions in Need of Attention. The *Biological Assessment* for the Cupertino Stevens Creek Trail corridor identified several major conditions that result in ecological degradation of the corridor. These include loss of native habitat, invasion by non-native species, impacts from adjacent land uses, and damaging resource management practices. The direct loss of habitat to human land uses is the single greatest cause of habitat loss and degradation, and is the primary reason species become rare or extinct. The corridor through Blackberry Farm and Golf Course is an area with tremendous restoration potential, as a significant amount of the riparian habitat has been lost or degraded but could be reestablished. Another major problem for native habitats is invasion by non-native species. California has shown itself to be very susceptible to invasion by species from other parts of the world. For example, non-native grasses from Mediterranean Europe have virtually replaced native California grasses; only 1% of the historic native grassland remains. Many restoration projects have the removal of non-native species as a major component of the work. Riparian corridors are especially vulnerable to non-native invaders. Significant plant invaders throughout the Stevens Creek corridor include giant reed (*Arundo donax*), periwinkle (*Vinca major*), German ivy (*Senecio mikaniodes*), and tree-of-heaven (*Ailanthus altissima*).

Adjacent land uses directly degrade riparian and wetland zones as a result of pollutant runoff. Pesticides, herbicides, fertilizers, oil, grease, and heavy metals to name a few pollutants, run directly off adjacent houses, landscaping, and roads into watercourses. Adjacent land uses can also be sources of non-native invasive plants and animals, especially domestic animals. Along the Cupertino Stevens Creek Trail corridor, adjacent land uses, such as the golf courses, present opportunities to effect changes to land management that could benefit the creek. Finally, resource management practices themselves can destroy habitat value. For example, restricting water flows in creeks and using rip-rap to armor banks are two stream management methods used in Stevens Creek that are damaging to the native ecosystem. Removing or changing these practices to allow natural processes to operate can, in some instances, be nearly all that is needed to restore a degraded habitat or system.

Restoration Benefits for Trails and Vise Versa. The benefits of ecological restoration are so significant that non-profit organizations, for-profit entities, and governments at all levels devote funding, time and personnel to the practice. The most obvious benefit of restoration is that it reestablishes or improves native habitats to protect natural biodiversity. In particular, habitat restoration is essential to protecting rare species, such as steelhead trout (*Onchorynchus mykiss*), from becoming extinct. Restoration attracts wildlife by reestablishing or enhancing native plant communities to provide cover, shade, and forage. Establishing natural plant communities along a trail

provides habitat continuity and sense of identity to the trail. Restoration is also well known for the community involvement it fosters. Around the U.S., hundreds of grass-roots restoration groups have come together to improve the quality of their local environment. Such groups foster stewardship for the area, involve people in nature, and are community-building experiences. Because of strong citizen commitment to the environment, the San Francisco Bay area is one of the nation's most active centers of restoration.

While it is clear that restoration efforts benefit trail corridors, it is also true that trails can promote restoration. Trails bring people to places, such as creek corridors, that they might never have visited. Many trail users develop a sense of stewardship for the area and can become enthusiastic restoration volunteers. Trail projects focus interest and money on degraded areas; as a result, restoration of the natural environment is a typical component of trail projects.

It is important to realize that trails can have negative impacts on natural communities. Therefore, any impacts of the Stevens Creek Trail must not only be adequately mitigated, but mitigated in such a way that the functioning of the local natural communities are improved over pre-trail conditions. Including restoration as part of the trail project will achieve this environmentally important goal.

Experts and Agencies. Restoring natural ecosystems is both technically and socially complex. Such projects often involve a number of experts who work together to identify the conditions resulting in degradation of the natural system and to develop methods to rectify those problems. Successful restoration in the Stevens Creek Trail area in Cupertino will require hydrologists, geotechnical experts, native plant restorationists, rare species experts, engineers, planners, and regulatory experts.

Regulatory experts are essential members of restoration teams because, in the Bay Area, projects must comply with a number of laws. While it is true that the purpose of restoration is to benefit the environment, not destroy it, such projects may still require a number of permits, some which are difficult to obtain. Because wetlands, rare species, and sensitive habitats all occur in the Stevens Creek Trail corridor, many resource agencies will be involved. Early consultation with the agencies will help projects progress as smoothly as possible. Restoration work for the Stevens Creek Trail is likely to involve the Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, the California Department of Fish and Game, and Santa Clara Valley Water District.

Planning and Integration. Successful restoration projects are dependent on good planning. In determining which restoration projects to implement, restoration planners must be fully informed of the trail plans and the impacts that require mitigation. Planners must also investigate what restoration-type activities already being planned or implemented by other organizations. For example, the Santa Clara Valley Audubon Society is currently mapping the occurrences of non-native vegetation along the Stevens Creek corridor; such information could be very valuable in planning Stevens Creek Trail restoration projects. Also, the Santa Clara Valley Water District will, in the future, be implementing a number of steelhead trout habitat improvement projects in Stevens Creek as a result of the Fish and Aquatic Habitat Collaborative Effort (FAHCE). Any fish habitat enhancement projects Cupertino would like to implement should be coordinated with the FAHCE process. Also in the planning stage, goals and *measurable objectives* must be set to allow assessment of the extent to which projects were successful. Restoration projects should be integrated into the overall trail planning and should be built into trail plans and specifications for implementation; restoration projects tacked onto the back end of

trail work as a after-thought are less likely to be successful and will probably be more expensive than they need to be. In the planning stage, be sure to consult with agencies that may require permits, agreements, or involvement. Finally, restoration planning, implementation, monitoring and maintenance all require money. Sufficient funds for short and long-term phases of restoration projects should be secured in the planning stage, if possible.

Guiding Principles. Ecological restoration is a very rewarding and worthy enterprise. However, such work is often difficult, requiring dedicated staff, volunteers, and financial support to be successful. For each project described, these principles apply:

- Restoration requires planning, which must include goals and measurable objectives.
- Landscape-level planning is needed in order to have successful local projects.
- Agencies must be involved early in the process.
- Maintenance and monitoring will be necessary.
- Restoration is a team effort including project managers, restoration experts, and the community.
- Long-term funding for habitat management must be included.

See Appendix A for a list of 10 important guiding principles that apply to restoration projects, in general. Below are several references that are useful in understanding how to undertake restoration in the types of habitats found along the Cupertino Stevens Creek Trail. An especially pertinent source is Ann Riley's *Restoring Streams in Cities: A Guide for Planners, Policymakers, and Citizens*.

Selected References

Federal Interagency Stream Restoration Working Group. 1998. *Stream Corridor Restoration: Principles, Processes, and Practices*. http://www.usda.gov/stream_restoration/newgra.html.

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Petts, G. and P. Calow, eds. 1996. *River Restoration*. Blackwell Science, Cambridge, Massachusetts.

Riley, Ann. 1998. *Restoring Streams in Cities: A Guide for Planners, Policymakers, and Citizens*. Island Press, Covelo, California.

Red-legged Frog (*Rana aurora draytoni*)

Insert Figure 1—Map of the Study Area

RESTORATION REGION 1: Cristo Rey Wetland Drainage—Study Area A

I. REGION 1 SUMMARY

The Cristo Rey Wetland Drainage is a small basin that provides a number of restoration opportunities. This area is of significance as the red-legged frog (*Rana aurora draytoni*), a federally-listed threatened species, has been found on-site. The drainage is degraded by a number of impacts that habitat restoration can help correct. Specific projects that can improve the drainage and wetland are gully repair, non-native species removal, riparian and wetland species planting, oak planting, and community education on reducing use of pesticides and fertilizers. Parts of this site may be slated to be a storm water retention area for the new development. Restoration work must be coordinated with this use.

- **LOCATION/CHARACTERISTICS**

This small drainage is found between Cristo Rey Drive on the north, new homes on the south and two small ridges on the east and west (see Figure 2—Cristo Rey Drainage Looking South). In 1994, red-legged frogs were found in the small freshwater wetland that exists at the bottom of the draw and extends from south to north. Red-legged frogs were also found nearby, on the Lands of the Diocese, in 2000. The Cristo Rey wetland is fed by freshwater seeps and run-off from roads and new houses. Riparian, wetland, and non-native plant species are found in and along the wetland. Blue oak woodland and grassland extend up the slopes on either side of the wetland. An eroding farm road used by hikers and equestrians runs down the west hill and up the east side. The drainage is designated as public open space and is bordered by open space on the northeast and northwest sides. Development surrounds the wetland on the south end. New houses were recently built and others are under construction on the southeast and southwest ends of the draw.

- **NATURAL COMMUNITIES/HABITATS**
  - Freshwater wetland community, which includes red-legged frog habitat
  - Blue oak woodland/non-grassland savanna
  - Open grassland dominated by non-native species

- **PROBLEMS AFFECTING HABITATS IN THIS DRAINAGE**
  - Eroding farm road
  - Direct wetland impacts of trail users
  - Invasion by non-native wetland species
  - Loss of wetland and riparian habitat
  - Loss of oak woodland habitat
  - Run-off impacts from new development

- **BENEFITS OF RESTORATION IN THIS REGION**
  - Protect and improve red-legged frog habitat
  - Enhance native plant diversity
  - Protect/improve wetland water quality
  - Provide community restoration projects

- **AGENCIES/EXPERTS TO INVOLVE IN PLANNING**
  - *Agencies*: Army Corps of Engineers, California Department of Fish and Game, U.S. Fish and Wildlife Service

- *Experts*: Wetland/riparian restoration specialist, red-legged frog expert, geotechnical expert, grassland expert, oak woodland restoration specialist, volunteer coordinator

II. SPECIFIC RESTORATION PROJECTS

Project 1: Repair Farm Road

- **Description of Problem**
  - Location--along dirt road down the hill on the west side of the wetland
  - Gully 2 to 3 feet deep down entire slope and hillside erosion next to the road (Figure 3—Farm Road Gully)
  - Soil erodes directly into the wetland below

- **Project Goals**
  - Stop erosion
  - Fill gully and recontour slope to remove road and eroded slope next to the road
  - Redirect trail use to protect the habitat values of the wetland

- **Potential Methods**
  - Back-fill gully and road cut with native soil that has non-native seeds removed, if possible.
  - Cover with biodegradable stabilizing material; seed with a mix of fast-growing, non-invasive grass or other cover species
  - Collect local plant material from native annual and perennial plants; have native plant nursery grow seedlings for planting
  - Plant with seeds and plugs of native annual and perennial plants

- **Timing Issues**
  - Allow 1 year for growing plants in a nursery
  - Implement gully repair after rainy season ends
  - Seed or plant in fall/early winter
  - This is a relatively rapid project that should be completed within a year.

- **Agencies to Consult/Potential Permits**
  - None/none

- **Experts Needed**
  - Geotechnical specialist for physical gully repair
  - Native grassland expert for choosing/collecting best species to stabilize slopes
  - Native plant nursery to grow native plant plugs
  - Volunteer coordinator

- **Volunteer Opportunities**
  - Assist grassland expert with collecting seeds
  - Assist nursery with growing seedlings
  - Assist in planting seeds and/or seedlings

- **Monitoring/Maintenance Needed**
  - Monitor for development of new gullies
  - Monitor plant growth; remove non-natives; replant with natives if needed.

- **Project Difficulty: __X__ Relatively Simple ____Moderately Difficult ____Difficult**

<u>Project 2: Improve Wetland Habitat</u>

- **Description of Problem**
  - Location—along the length of the wetland
  - Non-native wetland species are crowding out native plants (See Figure 4—Non-natives clog the wetland)
  - Riparian vegetation cover is missing in some areas

- **Project Goals**
  - Reestablish native wetland species throughout wetland
  - Reestablish riparian species cover, such as willows, where appropriate
  - Improve the habitat for red-legged frogs and other wetland/riparian species

- **Potential Methods**
  - Remove non-native species by hand or other effective method as prescribed by restoration experts; use chemical means as a last resort
  - Collect local plant material from native wetland and riparian areas; treat and install plant material as recommended by restoration experts
  - Plant with seeds and plugs of native annual and perennial plants

- **Timing Issues**
  - Avoid any potential impacts to red-legged frogs, especially during the breeding season
  - Install plant material in fall/winter
  - This is a relatively long-term project, which will take approximately 2-4 years to complete.

- **Agencies to Consult/Potential Permits**
  - Army Corps of Engineers/Clean Water Act, Section 404 Permit
  - U.S. Fish and Wildlife Service/Federal Endangered Species Act
  - California Department of Fish and Game/DFG Code

- **Experts Needed**
  - Wetland restoration expert for non-native removal and native species recovery
  - Riparian restoration expert for reestablishment of riparian species
  - Red-legged frog expert for advice on providing high-quality frog habitat
  - Volunteer coordinator

- **Volunteer Opportunities**
  - Assist in removing non-native species

- Assist in planting native species materials

- **Monitoring/Maintenance Needed**
  - Monitor for invasion by non-native species; remove as needed
  - Monitor plant survival and replant as needed

- **Project Difficulty: __X__ Relatively Simple ____Moderately Difficult ____Difficult**

The actual non-native species removal is relatively straightforward. Consultations with agencies may take some time.

Project 3: Enhance Blue Oak Woodland

- **Description of Problem**
  - Location—hillsides adjacent to the wetland
  - Most endemic California oak species are not regenerating
  - Most oak habitat in the Bay Area has been lost (see Figure 4—Oaks seem to be missing)

- **Project Goals**
  - Establish young blue oaks that could one day replace aging oaks
  - Create more hillside and wetland shading

- **Potential Methods**
  - Collect acorns on site and within the watershed
  - Treat acorns to find nonviable ones and to enhance chances of germination
  - Grow some acorns into seedlings and plant acorns on site as recommended by the restoration expert
  - Protect acorns and seedlings from herbivores with below-ground cages and above-ground tubes
  - Water regularly through the first summer

- **Timing Issues**
  - Collect acorns in fall as determined by oak restoration specialist
  - Allow at least 1 year for seedling growth
  - Install plant material in fall/winter
  - This is a very long-term project that will take a decade or more of work to produce results

- **Agencies to Consult/Potential Permits**
  - None/None

- **Experts Needed**
  - Oak woodland restoration expert
  - Native plant nursery to grow saplings
  - Restoration volunteer coordinator

- **Volunteer Opportunities**
  - Assist in collecting, treating and growing acorns

- Assist in planting native species materials
- Assist in watering oaks and monitoring oak survival

- **Monitoring/Maintenance Needed**
  - Monitor and repair herbivore guards
  - Monitor plant survival and replant as needed
  - Water regularly through the first year

- **Project Difficulty: ___Relatively Simple __X__ Moderately Difficult ___Difficult**
  While oak planting projects are easy and fun for volunteers to implement, oak survival is often low and growth is usually very slow. It may take more than a decade to know if the plantings are succeeding.

Project 4: Inform Local Homeowners about Watershed Protection Measures

- **Description of Problem**
  - Location—Cristo Rey Drainage
  - Adjacent land uses can degrade the wetland. In particular, new homes are located directly adjacent to the wetland; storm water runoff is directed into this wetland and pollutants from residents' cars and lawn maintenance are likely to degrade the wetland habitat (See Figure 2)

- **Project Goals**
  - Determine what pollutants could come from new homes and landscaping
  - Identify solutions homeowners could take to reduce pollutant loading
  - Inform local homeowners about the solutions

- **Potential Methods**
  - Work with a watershed expert to determine the pollutants likely to come from new homes and develop solutions for homeowners to take.
  - Develop an informational packet and survey to give to local homeowners to inform them about impacts to wetlands and what they can do.
  - Deliver the information and survey (methods include door-to-door, a community meeting, a mailing).
  - Follow-up, after an appropriate period, to determine homeowner views and actions.

- **Timing Issues**
  - Can be done any time of the year
  - This project can be done quickly, within a year

- **Agencies to Consult/Potential Permits**
  - None/None Maybe use materials already developed by SCVWD

- **Experts Needed**
  - Restoration expert to help with developing watershed protection measures
  - Volunteer coordinator to organize and support volunteers

- **Volunteer Opportunities**
  - Develop questionnaire and administer it
  - Help with information analysis
  - Revisit households for follow-up interview

- **Follow-up Needed**
  - Return to households to find out if homeowners implemented any of the recommendations and to assess their views of changing their yard care practices.

- **Project Difficulty: __X__ Relatively simple ____ Moderately difficult ____Difficult**
  This project is relatively easy to implement, but assessing effectiveness can be difficult.

Figure 2—Cristo Rey Drainage looking south

Figure 3—Farm road gully and bank erosion

Figure 4—Non-native vegetation clogs the wetland.

RESTORATION REGION 2: Riparian Corridor/In-stream Habitat—Study Areas C and D

I. REGION 2 SUMMARY

For restoration purposes, Stevens Creek can be viewed as a corridor of stream-side vegetation (the riparian forest corridor) and the aquatic or in-stream habitat. Both zones are closely linked, but enhancement in each zone focuses on different activities and species. The Creek habitats are harmed by non-native invasive species, loss of riparian vegetation, in-stream fish barriers and other structures that degrade fish habitat, poor management practices, and some adjacent land uses. Restoration work in these habitats will require close coordination with resource agencies and other existing habitat improvement efforts.

- **LOCATION/CHARACTERISTICS**

The Stevens Creek watershed in Cupertino is the focus of this restoration region. Specifically, restoration/enhancement would occur in and adjacent to the Creek corridor, which runs from Deep Cliff Golf Course to Stevens Creek Boulevard (see Figure 1—Map of the Study Area). The Creek flows from the reservoir in Stevens Creek County Park, which regulates water levels. It is also fed by springs and seeps from the closed quarry. Adult and juvenile steelhead trout (*Onchorhynchus mykiss*), a federally-listed threatened species, occur along the entire length of the Creek; however, Stevens Creek could provide higher quality breeding and rearing habitat, if properly managed. A recent lawsuit to protect and enhance steelhead habitat resulted in a process called the Fish and Aquatic Habitat Collaborative Effort (FAHCE). The Santa Clara Valley Water District is a key player in this process. FAHCE studies have identified high water temperatures and barriers to fish movement as current constraints fish use of the Creek. Other rare species likely to occur in the corridor are red-legged frogs and the western pond turtle (*Clemmys marmorata*), a California species of special concern. The riparian forest, dominated by native sycamores, live oaks, elderberry and box elder, lines the Creek banks. Some stretches, especially through Blackberry Farm and Golf Course have little to no vegetation. Non-native plant species found in the corridor include periwinkle, german ivy, giant reed, and tree-of-heaven. The corridor is bordered by public open space including McClellan Farm and the orchard at the Stocklmeir property. Other than these parcels, the Creek is surrounded by suburban development, two golf courses, and the large parking and picnic area of Blackberry Farm, a city-owned park.

- **NATURAL COMMUNITIES/HABITATS**
  - Freshwater stream community, which includes steelhead habitat
  - Sycamore/live oak riparian forest
  - Open grassland dominated by non-native species

- **PROBLEMS AFFECTING HABITATS IN THIS DRAINAGE**
  - Invasion by non-native species in the riparian corridor
  - Riprap along stream banks
  - Loss of riparian habitat
  - Fish barriers, especially old dams
  - Low-flow auto crossings through the Creek
  - Degraded fish habitat
  - Run-off impacts from golf courses and suburban development

- **BENEFITS OF RESTORATION IN THIS REGION**
  - Protect and improve steelhead habitat
  - Enhance native plant and animal diversity
  - Improve shade and cover for trail users and other recreationists
  - Provide community restoration projects

- **AGENCIES/EXPERTS TO INVOLVE IN PLANNING**
  - *Agencies*: Army Corps of Engineers, California Department of Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Santa Clara Valley Water District
  - *Experts*: Riparian restoration specialist, steelhead and western pond turtle experts, geotechnical expert, hydrologist, engineer, volunteer coordinator

II. SPECIFIC RESTORATION PROJECTS

Project 1: Remove Non-native Species

- **Description of Problem**
  - Location—along the riparian corridor, especially McClellan Ranch (periwinkle, german ivy, tree-of-heaven), Blackberry Golf Course (german ivy, periwinkle) and Stocklmeir property (giant reed) (see Figure 5—Periwinkle).
  - Non-native vegetation species are usurping habitat from natives

- **Project Goals**
  - Use mechanical and other non-chemical removal methods whenever possible
  - Significantly reduce or eliminate the occurrences of non-native plants in target areas and allow more room for native species cover

- **Potential Methods**
  - Focus on specific areas to thoroughly remove the non-native species targeted; move out from there to expand the non-native plant-free zone
  - Different non-native species will have different methods for removal; work with a restoration expert to develop an effective plan for the target non-natives
  - Use chemical methods of removal as a last resort; if chemicals are used, develop a plan with an expert in the use of the chemical and consult with DFG and NMFS
  - Replant areas cleared of non-natives with native riparian species as quickly as possible

- **Timing Issues**
  - If chemicals are used, application may need to be timed to avoid breeding seasons and other sensitive life cycle phases of native animals
  - This is a very long-term project, which could continue for many years

- **Agencies to Consult/Potential Permits**
  - Santa Clara Valley Water District for other projects
  - Santa Clara Valley Audubon Society for map of non-native species occurrences
  - Department of Fish and Game and National Marine Fisheries Service, if herbicides are used

- **Experts Needed**
  - Restoration expert, volunteer coordinator, possibly an herbicide expert

- **Volunteer Opportunities**
  - Mechanical or hand removal of non-natives

- **Monitoring/Maintenance Needed**
  - Monitor for regrowth of non-natives
  - Plant native species as quickly as possible to avoid regrowth of invasives and to avoid erosion

- **Project Difficulty: __X__ Relatively Simple ____Moderately Difficult ____Difficult**

Non-native species removal methods are well established; can be effective when vigorously pursued.

Project 2: Remove Rip-rap/Resculpt Creek Banks

- **Description of Problem**
  - Location—Rip-rap occurs in Blackberry Farm; creek banks in Blackberry Farm, the Golf Course and Deep Cliff Golf course need resculpting
  - Installing rip-rap and compacted soil banks resulted in the loss of riparian species, contributing to high water temperatures and degradation of steelhead habitat

- **Project Goals**
  - Reestablish a more natural riparian edge, which allows growth of native species
  - Provide bank edge habitat for turtles and steelhead
  - Protect banks from scour and erosion

- **Potential Methods**
  - Examine historical photos of original stream morphology to guide restoration
  - Have hydrologist develop estimates of scour and erosion rates to determine type of structures that will be adequate
  - Remove rip-rap with heavy equipment; try to integrate some of the material in the resculpting work to keep costs down
  - Recreate creek meanders, if possible, to dissipate flow energy and allow more natural stream functioning
  - Create more gentle bank slopes and soften the consolidated bank soil; add soil that supports native riparian species
  - Stabilize banks with geotechnical material, root wads, logs, willow wattling or other methods effective in preventing erosion while promoting the growth of native species and providing bank habitat for native animals
  - Replant banks as quickly as possible with native riparian species

- **Timing Issues**
  - Conduct construction to avoid impacts to steelhead, pond turtles, and red-legged frogs
  - Avoid construction in the rainy season, if possible
  - This is a medium length project that will take approximately 2 to 4 years to complete.

- **Agencies to Consult/Potential Permits**
  - Santa Clara Valley Water District/local permits, coordinate with FAHCE
  - Army Corps of Engineers/Clean Water Act, Section 404 permit
  - Department of Fish and Game/Stream Alteration Agreement, consultation on pond turtle protections
  - National Marine Fisheries Service/Endangered Species Act, Section 7 consultation

- **Experts Needed**
  - Restoration expert, permits specialist, geotechnical expert, hydrologist, engineer

- **Volunteer Opportunities**
  - None

- **Monitoring/Maintenance Needed**
  - Monitor scour and erosion around new features; repair if needed

- **Project Difficulty: ____Relatively Simple ____ Moderately Difficult __X__ Difficult**

Heavy equipment and engineering are needed. Getting engineers to use good bioengineering approaches (rather than traditional "hardscape" engineering) can be difficult. These projects are expensive and require many permits.

Project 3: Revegetate with Native Riparian Species

- **Description of Problem**
  - Location—along creek corridor through Study Areas C and D, but especially through Blackberry Farm and through both golf courses
  - Loss of riparian vegetation results in bank erosion, has degraded steelhead habitat through lack of shading, has reduced habitat for riparian species such as migratory birds, and has reduced shading and aesthetic value for people

- **Project Goals**
  - Reestablish a diversity of upper and lower canopy plant species that are native to the corridor
  - Provide shade over the creek to improve steelhead habitat and shade for the trail, if possible
  - Provide as wide a riparian buffer as possible between the creek and adjacent land uses, to help protect creek water quality
  - Reestablish a continuous riparian habitat for resident and migratory species, especially birds

- **Potential Methods**
  - Pull parking lot and picnic areas at Blackberry Farm back from the creek edge to allow a 100 foot riparian corridor
  - Remove Blackberry Farm parking lot and replace with a permeable material that reduces runoff
  - Collect native plant materials from Stevens Creek corridor, whenever possible, or failing that, from other South San Francisco Bay watersheds
  - Have a native plant nursery grow seedings
  - Collect information on the soil types and water table location along the corridor
  - Plant species in acceptable locations based on correct soil type, stream bank elevation, frequency of flooding, and water table level
  - Plant native species after non-natives have been removed and creek bank has been resculpted

- **Timing Issues**
  - Allow 1 year for growing plants in a nursery
  - Plant seeds and seedlings during the rainy season or when most appropriate for each species
  - This is a long-term, multi-year project

- **Agencies to Consult/Potential Permits**
  - Santa Clara Valley Water District (on potential impediments to creek flow)

- **Experts Needed**
  - Riparian restoration expert**, v**olunteer coordinator**,** engineer

- **Volunteer Opportunities**
  - Plant material collection
  - Nursery assistance
  - Planting, watering, weeding
  - Monitoring for plant health and growth

- **Monitoring/Maintenance Needed**
  - Watering and weeding may be needed
  - Monitor number of plants of each species surviving and growth rate of survivors

- **Project Difficulty: ____Relatively Simple __X__ Moderately Difficult ____ Difficult**

Collecting, growing, and planting riparian species is relatively straight-forward. A number of factors can result in the death of plants and, therefore, slow success of the project.

<u>Project 4: Remove Fish Barriers and Low-Flow Auto Crossings</u>

- **Description of Problem**
  - Location—A small dam, which is a fish barrier, and several low-flow auto crossings are located in Blackberry Farm. Other barriers and low-flow crossing may be located in the two golf courses.
  - Structures impede fish passage upstream and reduce habitat quality for adult and juvenile fish

- **Project Goals**
  - Remove these structures that prevent steelhead from having full access to the creek
  - Prepare creek bed for further fish habitat enhancement

- **Potential Methods**
  - Methods to remove the barriers with the least damage possible to the creek morphology, water quality or vegetation will be determined by a hydrologist, geologist, steelhead expert, and engineer

- **Timing Issues**
  - Avoid impacts to steelhead, pond turtles or red-legged frogs
  - Removing structures can be done relatively quickly and should be completed in one season.

- **Agencies to Consult/Potential Permits**
  - Santa Clara Valley Water District/local permits, coordinate with FAHCE
  - Army Corps of Engineers/Clean Water Act, Section 404 permit

- Department of Fish and Game/Stream Alteration Agreement, consultation on pond turtle protections
- National Marine Fisheries Service/Endangered Species Act, Section 7 consultation

- **Experts Needed**
  - Hydrologist, geotechnical expert, steelhead expert, engineer, permits expert

- **Volunteer Opportunities**
  - None

- **Monitoring/Maintenance Needed**
  - None

- **Project Difficulty: __X__ Relatively Simple ____Moderately Difficult ____Difficult**

Removing the structures is relatively easy. Receiving permits and approvals from agencies is likely to be the greatest hurtle.

Project 5: Enhance Degraded Fish Habitat

- **Description of Problem**
  - Steelhead habitat has been degraded by changes to the creek structure and vegetation.
  - Water management practices that damage steelhead population

- **Project Goals**
  - Increase survival of adults and juvenile steelhead by providing habitat needed at each phase of their lives
  - Increase steelhead productivity by increasing breeding habitat

- **Potential Methods**
  - Work with a steelhead expert to determine what habitat needs are lacking in the creek
  - Work with FAHCE to ensure that enough water is released from the dam to support year-round fish habitat
  - Work with FAHCE to determine which habitat enhancements are being implemented by FAHCE members and which ones remain to be done
  - Enhancement may include a number of methods. Several typical enhancement features are: adding appropriately sized gravel to the creek bed to create spawning habitat, installing check dams, gravel and pools to make pool and riffle habitat, installing root wads to create cover habitat for fry and juveniles

- **Timing Issues**
  - Time work to avoid impacts to steelhead
  - Structures can be put in quickly, within a season. Monitoring fish use and changing or adding structures to meet fish requirements make this a multi-year project.

- **Agencies to Consult/Potential Permits**
  - Santa Clara Valley Water District/local permits, coordinate with FAHCE
  - Army Corps of Engineers/Clean Water Act, Section 404 permit
  - Department of Fish and Game/Stream Alteration Agreement, consultation on pond turtle protections
  - National Marine Fisheries Service/Endangered Species Act, Section 7 consultation

- **Experts Needed**
  - Steelhead expert, engineer, hydrologist, geotechnical expert

- **Volunteer Opportunities**
  - None

- **Monitoring/Maintenance Needed**
  - Monitor the use of new habitat by fish; modify or add other features as needed
  - Monitor the integrity of the new features and fix them if they degrade

- **Project Difficulty: ____Relatively Simple __X__ Moderately Difficult ____Difficult**

Salmon and steelhead biologists have developed and tested a wide range of habitat enhancement features. Appropriate features can be very successful in improving steelhead productivity and survivorship. Close coordination with many agencies will be a challenge for these projects.

<u>Project 6: Educate Adjacent Land Owners and Managers about Runoff Impacts</u>

- **Description of Problem**
  - Pesticide and herbicides runoff from residential and golf course land uses into Stevens Creek, reducing water quality and the overall health of the creek and riparian system

- **Project Goals**
  - Determine what pollutants could come from homes, landscaping, and golf courses
  - Identify solutions homeowners and golf course managers could take to reduce pollutant use
  - Inform local homeowners and land managers about the solutions

- **Potential Methods**
  - Work with a watershed expert to determine the pollutants likely to come from homes and golf courses and develop solutions.
  - Develop an informational packet and survey to give to local homeowners and golf course managers to inform them about impacts to wetlands and what they can do.
  - Deliver the information and survey (methods include door-to-door, a community meeting, a mailing).
  - Follow-up, after an appropriate period, to determine homeowner/land manager views and actions taken.

- **Timing Issues**

- Can be done any time of the year
- This project can be done quickly, within a year

- **Agencies to Consult/Potential Permits**
  - None/None Maybe use materials already developed by SCVWD

- **Experts Needed**
  - Restoration expert to help with developing watershed protection measures
  - Volunteer coordinator to organize and support volunteers

- **Volunteer Opportunities**
  - Develop questionnaire and administer it
  - Help with information analysis
  - Revisit households for follow-up interview

- **Follow-up Needed**
  - Return to households to find out if homeowners implemented any of the recommendations and to assess their views of changing their yard care practices.
  - Follow-up with golf course managers.

- **Project Difficulty: __X__ Relatively simple ____ Moderately difficult ____Difficult**
  This project is relatively easy to implement, but assessing effectiveness can be difficult.

Figure 5—Periwinkle (*Vinca major*) is a common non-native invasive species of the Stevens Creek corridor.

Figure 6—Rip-rap in the Blackberry Farm section of the Creek reduces the stream's habitat quality

Figure 7—Fish barriers, such as this dam, and low-flow auto crossings can be removed to benefit steelhead trout.

RESTORATION REGION 3: Quarry Slope/Wetland Drainage—Study Area B

I. REGION 3 SUMMARY

The Quarry Drainage is a basin formed by former quarry operations. A wetland at the bottom of the quarry is potential red-legged frog habitat. The drainage is degraded by a number of impacts especially eroding slopes and loss of chaparral vegetation along those slopes. Specific projects that can improve the region are geotechnical slope stabilization, revegetation with native species, and protection of the wetland from sedimentation. This site may be subject to future development; restoration work must be coordinated with this potential use.

- **LOCATION/CHARACTERISTICS**

This drainage basin is bounded by Linda Vista Park on the north, a bluff with homes on the east, and Stevens Creek County Park on the south. There are several poorly consolidated terraces in the center of the basin that step down to the elevation of Stevens Creek, which passes on the west side of the drainage. The steep topography on three sides of the basin and the terracing are all a result of former quarry operations. The slope on the north side lacks the native chaparral vegetation and is eroding. Erosion is also occurring down the terraces in the basin. Non-native grasses and several invasive non-native plants have colonized the eroding slopes and the bottom of the quarry. Native chaparral and coast live oak woodland occur on the south slope and the esst side of the quarry basin. A freshwater wetland, fed by seeps, occurs at the bottom of the drainage in the center and on the south side. Water from the wetlands eventually flows into Stevens Creek. The wetland vegetation is dominated by cattails and rushes; willows, cottonwoods, and alders form a riparian edge. This wetland is potential red-legged frog habitat. Hikers have produced many "social" trails down the north side from Linda Vista and up the south face of the drainage to the County Park, probably contributing to erosion. The slopes of the quarry are public open space. The bottom of the quarry is privately owned.

- **NATURAL COMMUNITIES/HABITATS**
  - Freshwater wetland community, which includes potential red-legged frog habitat
  - Willow riparian community
  - Chaparral and coast live oak woodland (see Figures 8 & 9—Native chaparral/oak woodland)
  - Non-native grassland

- **PROBLEMS AFFECTING HABITATS IN THIS DRAINAGE**
  - Eroding slope
  - Sedimentation impacts to the wetland
  - Invasion by non-native species
  - Loss of chaparral

- **BENEFITS OF RESTORATION IN THIS REGION**
  - Protect and improve wetland habitat
  - Enhance chaparral native plant diversity
  - Provide community restoration projects

- **AGENCIES/EXPERTS TO INVOLVE IN PLANNING**
  - *Agencies*: Army Corps of Engineers, Dept. of Fish and Game, US Fish and Wildlife Service

- *Experts*: Wetland restoration specialist, red-legged frog expert, geotechnical expert, chaparral restoration specialist, volunteer coordinator

II. SPECIFIC RESTORATION PROJECTS

Project 1: Recontour and Stabilize Eroding Slopes and Terraces

- **Description of Problem**
  - Eroding slopes
  - Sedimentation impacts to the wetland
  - Invasion by non-native species, especially pampas grass and French broom)

- **Project Goals**
  - Stabilize eroding areas with geotechnical methods
  - Establish cover crop of non-invasive plants to hold soil
  - Prepare soil for native plant species

- **Potential Methods**
  - Have geotechnical firm assess the current condition of the slopes and terraces, then develop an erosion control/slope stabilization plan using ecologically-sensitive engineering methods
  - Use historical photos of the site to help determine final contours
  - Use heavy equipment, geotechnical materials, or other approaches to produce stable slopes, prepare for trail access, and prepare for native species planting
  - Remove non-native invasive species whenever possible
  - Hydroseed (or other seeding method) with a cover crop, probably non-native but certainly non-invasive, which grows fast, holds soil and improves soil condition (example: red clover); cover crop must allow the future planting of native chaparral species

- **Timing Issues**
  - Grading and earth work must be completed during the dry season
  - Seeding/planting should occur at the beginning of the rainy season

- **Agencies to Consult/Potential Permits**
  - Army Corps of Engineers/Clean Water Act, Section 404

- **Experts Needed**
  - Geotechnical experts, revegetation specialists

- **Volunteer Opportunities**
  - Probably none

- **Monitoring/Maintenance Needed**
  - Soil stability and gullying must be monitored
  - Establishment of cover crop must be monitored

- **Project Difficulty: ____Relatively Simple ____Moderately Difficult __X__ Difficult**

While the methods for slope stabilization are well known and effective, the quarry is a very large and steep area that will require significant work. The geotechnical firm should be familiar with steep slope projects and restoration goals.

Project 2: Remove Non-native Vegetation

- **Description of Problem**
  - Non-native species, such as pampas grass and French broom

- **Project Goals**
  - Remove invasive species from the basin
  - Prepare sites for replanting with natives
  - Control erosion

- **Potential Methods**
  - Hand pulling or mechanical methods such as "weed wrenches" or pulaskis
  - Spot application of herbicides by an expert may be used for some species

- **Timing Issues**
  - None for mechanical methods; can be done at any time of the year
  - Herbicide applications must be timed to protect the environment while having a lethal effect on the invasive plant

- **Agencies to Consult/Potential Permits**
  - None/None for mechanical methods
  - Herbicide applications must be conducted by a professional with proper licenses

- **Experts Needed**
  - Restoration expert, volunteer coordinator, possibility an herbicide expert

- **Volunteer Opportunities**
  - Removing non-native plants by hand or with simple tools

- **Monitoring/Maintenance Needed**
  - Constant removal of non-natives as they reoccur

- **Project Difficulty: __X__Relatively Simple ____Moderately Difficult ____Difficult**

Project 3: Revegetate with Native Chaparral/Oak Woodland Species

- **Description of Problem**
  - Loss of native chaparral and coast live oak woodland vegetation

- **Project Goals**
  - Reestablish a diversity of native chaparral and oak woodland species
  - Choose species able to survive with minimum maintenance
  - Allow for natural succession of ecological communities

- **Potential Methods**
  - Determine appropriate species mix by looking at reference sites that provide models for the restoration, such as habitat on Stevens Creek County or Linda Vista Parks (Figures 8 & 9)
  - Consult with a chaparral ecologist to determine which early colonizing, hardy species to plant first and which later succession species to plant in the future
  - Collect plant materials locally, such as in Linda Vista or Stevens Creek County Parks
  - Treat materials; grow seedlings in a greenhouse, lath house or nursery
  - Treat soils as needed to prepare them for native species
  - Plant seeds, seedings, or other materials
  - Use above- and below-ground herbivore protectors as recommended by a restoration expert
  - Weed, water, replant with successful species as needed
  - When early colonizing plants establish, begin growing and planting species indicative of a more mature chaparral/oak woodland community

- **Timing Issues**
  - Allow at least1 year for growing plants in a greenhouse/nursery
  - Plant species at the appropriate time in the yearly rainfall cycle

- **Agencies to Consult/Potential Permits**
  - None/None

- **Experts Needed**
  - Chaparral/oak woodland restoration expert, volunteer coordinator

- **Volunteer Opportunities**
  - Collecting plant materials for propagation
  - Assisting with greenhouse duties and planting seedlings
  - Monitoring survival and growth rates of plantings
  - Maintenance such as weeding, putting up herbivore protectors, occasional watering

- **Monitoring/Maintenance Needed**

- Monitoring survival and growth rates of plantings
- Maintenance such as weeding, putting up herbivore protectors, occasional watering
- Replanting with species that survive well or with species that achieve other restoration goals

- **Project Difficulty: ____Relatively Simple ____Moderately Difficult __X__ Difficult**

This project is more of a true native community restoration than any other project described. Reestablishing species diversity can be difficult; chaparral restoration is not common in the South Bay.

Figure 8—Native chaparral community Stevens Creek County Park

Figure 9—Native chaparral and coast live oak woodland at Linda Vista Park

APPENDIX 1.

Restoration Guiding Principles

Prepared by: Watershed Ecology Team, US EPA Office of Wetlands, Oceans and Watersheds

Preserve and protect aquatic resources. Existing, relatively intact ecosystems are the keystone for conserving biodiversity, and provide the biota and other natural materials needed for the recovery of impaired systems. Thus, restoration does not replace the need to protect aquatic resources in the first place. Rather, restoration is a complementary activity that, when combined with protection and preservation, can help achieve overall improvements in a greater percentage of the Nation's waters. Even with waterbodies for which restoration is planned, the first objective should be to prevent further degradation.

Restore ecological integrity. Restoration should reestablish insofar as possible the ecological integrity of degraded aquatic ecosystems. Ecological integrity refers to the condition of an ecosystem -- particularly the structure, composition, and natural processes of its biotic communities and physical environment. An ecosystem with integrity is a resilient and self-sustaining natural system able to accommodate stress and change. Its key ecosystem processes, such as nutrient cycles, succession, water levels and flow patterns, and the dynamics of sediment erosion and deposition, are functioning properly within the natural range of variability. Biologically, its plant and animal communities are good examples of the native communities and diversity found in the region. Structurally, physical features such as the dimensions of its stream channels are dynamically stable. Restoration strives for the greatest progress toward ecological integrity achievable within the current limits of the watershed, by using designs that favor the natural processes and communities that have sustained native ecosystems through time.

Restore natural structure. Many aquatic resources in need of restoration have problems that originated with harmful alteration of channel form or other physical characteristics, which in turn may have led to problems such as habitat degradation, changes in flow regimes, and siltation. Stream channelization, ditching in wetlands, disconnection from adjacent ecosystems, and shoreline modifications are examples of structural alterations that may need to be addressed in a restoration project. In such cases, restoring the original site morphology and other physical attributes is essential to the success of other aspects of the project, such as improving water quality and bringing back native biota.

Restore natural function. Structure and function are closely linked in river corridors, lakes, wetlands, estuaries and other aquatic resources. Reestablishing the appropriate natural structure can bring back beneficial functions. For example, restoring the bottom elevation in a wetland can be critical for reestablishing the hydrological regime, natural disturbance cycles, and nutrient fluxes. In order to maximize the societal and ecological benefits of the restoration project, it is essential to identify what functions should be present and make missing or impaired functions priorities in the restoration. Verifying whether desired functions have been reestablished can be a good way to determine whether the restoration project has succeeded.

Work within the watershed and broader landscape context. Restoration requires a design based on the entire watershed, not just the part of the waterbody that may be the most degraded site. Activities throughout the watershed can have adverse effects on the aquatic resource that is being restored. A localized restoration project may not be able to change what goes on in the whole watershed, but it can be designed to better accommodate watershed effects. New and future urban development may, for example, increase runoff volumes, stream downcutting and bank erosion, and pollutant loading. By considering the watershed context in this case, restoration planners may be able to design a project for the desired benefits of restoration, while also withstanding or even helping to remediate the effects of adjacent land uses on runoff and nonpoint pollution. For example, in choosing a site for a wetland restoration project, planners should consider how the proposed project

may be used to further other related efforts in the watershed, such as increasing riparian habitat continuity, reducing flooding, and/or enhancing downstream water quality. Beyond the watershed, the broader landscape context also influences restoration through factors such as interactions with terrestrial habitats in adjacent watersheds, or the deposition of airborne pollutants from other regions.

Understand the natural potential of the watershed. A watershed has the capacity to become only what its physical and biological setting -- its ecoregion's climate, geology, hydrology, and biological characteristics -- will support. Establishing restoration goals for a waterbody requires knowledge of the historical range of conditions that existed on the site prior to degradation and what future conditions might be. This information can then be used in determining appropriate goals for the restoration project. In some cases, the extent and magnitude of changes in the watershed may constrain the ecological potential of the site. Accordingly, restoration planning should take into account any irreversible changes in the watershed that may affect the system being restored, and focus on restoring its remaining natural potential.

Address ongoing causes of degradation. Restoration efforts are likely to fail if the sources of degradation persist. Therefore, it is essential to identify the causes of degradation and eliminate or remediate ongoing stresses wherever possible. While degradation can be caused by one direct impact such as the filling of a wetland, much degradation is caused by the cumulative effect of numerous, indirect impacts, such as changes in surface flow caused by gradual increases in the amount of impervious surfaces in the watershed. In identifying the sources of degradation, it is important to look at upstream and up-slope activities as well as at direct impacts on the immediate project site. Further, in some situations, it may also be necessary to consider downstream modifications such as dams and channelization.

Develop clear, achievable, and measurable goals. Restoration may not succeed without good goals. Goals direct implementation and provide the standards for measuring success. Simple conceptual models are a useful starting point to define the problems, identify the type of solutions needed, and develop a strategy and goals. Restoration teams should evaluate different alternatives to assess which can best accomplish project goals. The chosen goals should be achievable ecologically, given the natural potential of the area, and socioeconomically, given the available resources and the extent of community support for the project. Also, all parties affected by the restoration should understand each project goal clearly to avoid subsequent misunderstandings. Good goals provide focus and increase project efficiency.

Focus on feasibility. Particularly in the planning stage, it is critical to focus on whether the proposed restoration activity is feasible, taking into account scientific, financial, social and other considerations. Remember that solid community support for a project is needed to ensure its long-term viability. Ecological feasibility is also critical. For example, a wetlands restoration project is not likely to succeed if the hydrological regime that existed prior to degradation cannot be reestablished.

Use a reference site. Reference sites are areas that are comparable in structure and function to the proposed restoration site before it was degraded. As such, reference sites may be used as models for restoration projects, as well as a yardstick for measuring the progress of the project. While it is possible to use historic information on sites that have been altered or destroyed, historic conditions may be unknown and it may be most useful to identify an existing, relatively healthy, similar site as a guide for your project. Remember, however, that each restoration project will present a unique set of circumstances, and no two aquatic systems are truly identical. Therefore, it is important to tailor your project to the given situation and account for any differences between the reference site and the area being restored.

Anticipate future changes. The environment and our communities are both dynamic. Although it is impossible to plan for the future precisely, many foreseeable ecological and societal changes can and should be factored into restoration design. For example, in repairing a stream channel, it is important to take into account potential changes in runoff resulting from projected increases in upstream impervious surface area due to development. In addition to potential impacts from changes in watershed land use, natural changes such as plant community succession can also influence restoration. For instance, long-term, post-project monitoring should take successional processes such as forest regrowth in a stream corridor into account when evaluating the outcome of the restoration project.

Involve the skills and insights of a multi-disciplinary team. Restoration can be a complex undertaking that integrates a wide range of disciplines including ecology, aquatic biology, hydrology and hydraulics, geomorphology, engineering, planning, communications and social science. It is important that, to the extent that resources allow, the planning and implementation of a restoration project involve people with experience in the disciplines needed for the particular project. Universities, government agencies, and private organizations may be able to provide useful information and expertise to help ensure that restoration projects are based on well-balanced and thorough plans. With more complex restoration projects, effective leadership will also be needed to bring the various disciplines, viewpoints, and styles together as a functional team.

Design for self-sustainability. Perhaps the best way to ensure the long-term viability of a restored area is to minimize the need for continuous maintenance of the site, such as supplying artificial sources of water, vegetation management, or frequent repairing of damage done by high water events. High maintenance approaches not only add costs to the restoration project, but also make its long-term success dependent upon human and financial resources that may not always be available. In addition to limiting the need for maintenance, designing for self-sustainability also involves favoring ecological integrity, as an ecosystem in good condition is more likely to have the ability to adapt to changes.

Use passive restoration, when appropriate. "Time heals all wounds" applies to many restoration sites. Before actively altering a restoration site, determine whether passive restoration (i.e., simply reducing or eliminating the sources of degradation and allowing recovery time) will be enough to allow the site to naturally regenerate. Many times there are reasons for restoring a waterbody as quickly as possible, but there are other situations when immediate results are not critical. For some rivers and streams, passive restoration can reestablish stable channels and floodplains, regrow riparian vegetation, and improve in-stream habitats without a specific restoration project. With wetlands that have been drained or otherwise had their natural hydrology altered, restoring the original hydrological regime may be enough to let time reestablish the native plant community, with its associated habitat value. It is important to note that, while passive restoration relies on natural processes, it is still necessary to analyze the site's recovery needs and determine whether time and natural processes can meet them.

Restore native species and avoid non-native species. American natural areas are experiencing significant problems with invasive, non-native (exotic) species, to the great detriment of our native ecosystems and the benefits we've long enjoyed from them. Many invasive species outcompete natives because they are expert colonizers of disturbed areas and lack natural controls. The temporary disturbance present during restoration projects invites colonization by invasive species which, once established, can undermine restoration efforts and lead to further spread of these harmful species. Invasive, non-native species should not be used in a restoration project, and special attention should be given to avoiding the unintentional introduction of such species at the restoration site when the site is most vulnerable to invasion. In some cases, removal of non-native species may be the primary goal of the restoration project.

Use natural fixes and bioengineering techniques, where possible. Bioengineering is a method of construction combining live plants with dead plants or inorganic materials, to produce living, functioning systems to prevent erosion, control sediment and other pollutants, and provide habitat. Bioengineering techniques can often be successful for erosion control and bank stabilization, flood mitigation, and even water treatment. Specific projects can range from the creation of wetland systems for the treatment of storm water, to the restoration of vegetation on river banks to enhance natural decontamination of runoff before it enters the river.

Monitor and adapt where changes are necessary. Every combination of watershed characteristics, sources of stress, and restoration techniques is unique and, therefore, restoration efforts may not proceed exactly as planned. Adapting a project to at least some change or new information should be considered normal. Monitoring before and during the project is crucial for finding out whether goals are being achieved. If they are not, "mid-course" adjustments in the project should be undertaken. Post-project monitoring will help determine whether additional actions or adjustments are needed and can provide useful information for future restoration efforts. This process of monitoring and adjustment is known as adaptive management. Monitoring plans should be feasible in terms of costs and technology, and should always provide information relevant to meeting the project goals.

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