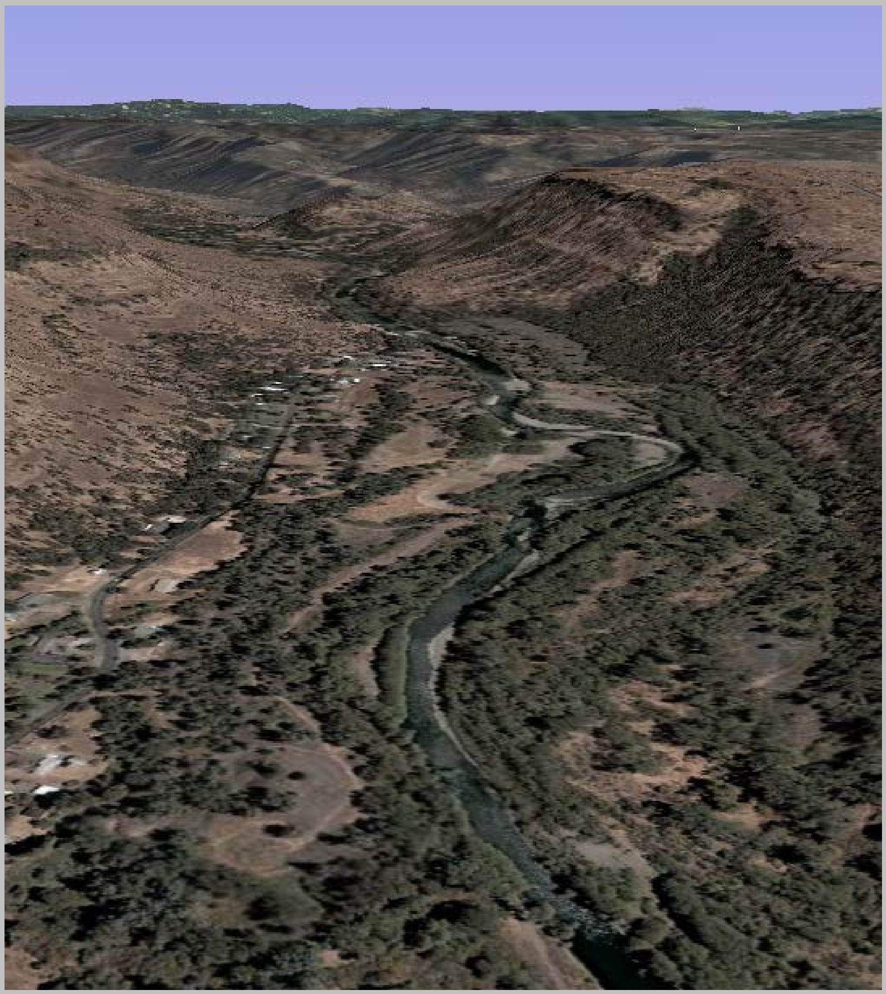
Cursory Assessment of the Butte Creek Ecological Preserve



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Butte Creek Ecological Preserve Assessment

Purpose

The primary objective of this assessment is to provide a set of recommendations for the future management and conservation activities at the Butte Creek Ecological Preserve, Honey Run Unit (BCEP). This assessment was developed based on a series of cursory observations at the BCEP; observations from reference sites; relevant literature; and, observations of regional mined sites and concurrent restoration activities at those sites. As a cursory review, this assessment is not based on quantitative analysis of any attribute of the BCEP. Further analysis may be warranted prior to embarking on specific management actions.

Background and Site Description

The Honey Run Unit of the Butte Creek Ecological Preserve is part of a complex of ecological reserves situated along Butte Creek in Butte County, California. The complex is generally divided between the Canyon and Valley units (Schwein 2001b). Ownership and management of the reserve complex within the Canyon Unit is shared between the California Department of Fish and Game (CDFG) and California State University, Chico (CSU Chico). The later is responsible for the management of the Honey Run Unit. The Honey Run Unit is comprised of 93 acres of land occupying portions of the north and south banks of Butte Creek for approximately 4,000 feet (1219 meters) of riparian frontage and is contiguous with conservation lands located downstream managed by the CDFG. This preserve was established in 1998 with the primary purpose of conserving habitat for anadromous fish, enhancement of ecological processes and functions, and to facilitate research, outreach and education opportunities.

Within the watershed and region, several documents (*e.g.*, Schwein 2001b; Conservancy 1998, 2000) have been developed to address the conservation needs and management objectives for the watershed, and to provide general information on topics such as hydrology, vegetation and land use history. A summary of some of the key information is provided below to frame the discussion for this assessment.

Portions of the BCEP have been heavily disturbed by human activities. Specifically, gold, sand and gravel mining have severely altered the physical characteristics of the terrain and soils. Throughout the BCEP excess cobbles and overburden material piles are ubiquitous. Soils within the general vicinity of the BCEP are classified as Xerothents tailings and Redsluff gravelly loams (see figure 1 for numbers 118 and 300 respectively). According to Holtgrieve *et al*. (2000) the areas where undisturbed soils have been found are comprised of gravelly-sandy loam and silty-clay loams buried under approximately 5-6 feet (1.5-1.8 meters) of cobble and overburden. Gallaway in Stemen *et al.* (2005) verified this by conducting soil profile analysis within a proposed mitigation site. The findings for this site (which is presumably located in the overflow channel [see figure 2]) indicated that the top 12 inches (30.5 centimeters) of the profile were comprised of embedded sands, gravel and cobble over a layer of sandy loam. While neither of these analyses is comprehensive of the entire preserve, it could be assumed that the general findings are an indication of soil profiles elsewhere on the preserve. As stated in Holtgrieve *et al*. (2000), the lack of developed soils should be a key consideration for any restoration projects at the preserve as this could hinder restoration implementation and success.

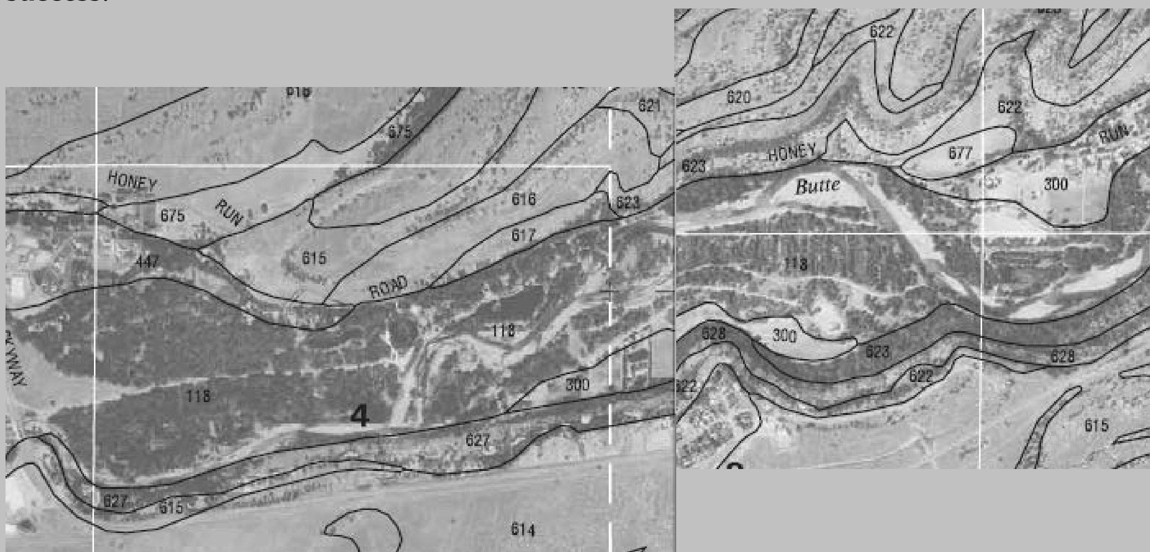

Figure 1. Soil map of Butte Creek from NRCS 2006.

Butte Creek is a perennial stream with an average annual discharge of 294,000 acre feet (362,644 meters^3). As such, portions of the BCEP are frequently inundated by fluctuations in flows triggered primarily by rainfall and snow. Several dams and diversions exist upstream from the BCEP, which partially regulate the flows in the vicinity of the BCEP. According to Stemen *et al.* (2005) the groundwater level at the BCEP is between 0-20 feet throughout the preserve.

Within the BCEP, several vegetation communities can be found. Based on the California Wildlife Habitat Relations (Mayer and Laudenslayer 1988) vegetation classification system the vegetation communities found within the boundaries of the preserve include annual grasslands, blue oak-gray (digger) pine, valley oak woodlands, valley foothill riparian, riverine and a minor component of mixed chaparral. The physical constraints of the landscape within this stretch of Butte Creek contribute to the relatively close proximity of upland vegetation to the riparian corridor as well as the diversity of community types coexisting on the 93-acre preserve. With respect to soils, the dominance of cobbles and gravels in some areas in addition to the embedded nature of much of this substrate has limited the regeneration of native vegetation.

Several reclamation, restoration and mitigation projects have been implemented at the BCEP. Many of these projects have been implemented with the assistance of school groups from K-12 institutions as well as university-based courses and organizations. In some instances, the plants used for restoration have undergone genetic screening to ensure the plantings are of local ecotypes or are not hybrids (M. Stemen pers. comm. 2006). However, in some instances the source material for revegetation projects is either not known or not from local ecotypes. For instance, I question the occurrence of what appear to be yellow bush lupines (*Lupinus arboreus*) in one of the annual grassland areas. This species' range is coastal areas from central to southern California, and has become invasive in some areas where it has become established outside of its range.

Portions of the BCEP have been utilized to mitigate impacts from projects offsite. For instance, Mexican elderberry (*Sambucus mexicana*) has been translocated to the BCEP from local sites as mitigation for development impacts to the federally threatened Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). Currently, the California Department of Transportation is mitigating for wetland impacts by restoring and enhancing approximately 7.72 acres of riparian and upland habitat at the BCEP (Stemen *et al*. 2005).

Several rare, threatened or endangered species occur, or have the potential to occur, within the boundary of the BCEP. These species include the Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), Central Valley steelhead (*Oncorhynchus mykiss*), Central Valley spring-run and late fall-run Chinook salmon (*Oncorhynchus tshawywtscha*), bald eagle (*Haliaeetus leucocephalus*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) and foothill yellow-legged frog (*Rana boylii*). The existence of the BCEP within the complex of ecological reserves aids in the recovery and conservation of these species. The species list provided in the appendix provides a thorough list of federally listed and candidate species that could be found at the BCEP. While not all of these species currently occur at the BCEP, it is possible that with some habitat improvements or other management actions, some of these species could inhabit the preserve. Through coordination with other entities (*e.g.,* private landowners, non-governmental organizations, local, state and federal agencies) support and compliance for management and conservation activities can be gained.

Perhaps the most central species to the BCEP are the steelhead and Chinook salmon. Extensive monitoring of populations along Butte Creek have been ongoing since 1960. During this period, the average low production of approximately 1,032 individuals occurred between 1967 and 1991; however, from 1992 to 2003 the average productivity reached 11,266 individuals (R. Guinee pers. comm. 2006). The productivity of salmonids within the Butte Creek watershed is truly an indicator of the health of the ecosystem. Merz and Moyle (2006) found that salmon productivity is linked to adjacent riparian and upland ecosystem health and services through the input of nutrients from spawned individuals into the surrounding environment. Specifically, plants and animals in these systems benefit from the presence of anadromous salmonids.

Methods

I visited the BCEP on five occasions from May through December 2006. During my visits, I traversed the preserve north of Butte Creek noting my observations and assessing the current status of the areas I visited. Photographs were taken of key areas of interest throughout the preserve. Conducting my observations over this period of time provided an opportunity to interpret seasonal variation of certain aspects of the preserve. Due to stream flows during my visits I was unable to visit the southern limits of the preserve.

Aside from visiting the BCEP, I also visited and/or recalled my personal observations of other sites supporting riparian and upland vegetation within the Sacramento Valley and Bay-Delta region (*i.e.,* the American River, Mokelumne River, Cache Creek, Big Chico Creek, Little Chico Creek, Deer Creek, Sacramento River and other locations along Butte Creek). I visited these sites in order to develop a sense of the reference conditions for Butte Creek. Many of the sites visited are comparable to the BCEP due to land use history (*e.g.,* past mining activity, agricultural uses and recreation). Additionally, I visited mining and restoration sites owned and managed by Teichert Construction, and met with restoration professionals and mine operators to discuss successes and failures of their operations in Yolo and Yuba counties. Specifically, I visited sites where upland and riparian restoration or reclamation had occurred or is scheduled to occur. During these visits I observed several methods of reclamation and restoration activities as well as interpreted the successes and failures of these actions. No assessments of the existing research, outreach or education program content or curricula were made.

Findings and Recommendations

General:

The BCEP resembles many sites disturbed by mining within the greater Sacramento Valley including the American River parkway between Sacramento and Folsom and the Cache Creek Nature Preserve in Woodland. Respectively, these sites exist among tailings and exhibit degradation from past mining activities, have recreational uses, and provide key habitats for local species. At each of these locations, natural processes and active restoration and reclamation projects have facilitated the successful recovery of ecosystem processes, structures and functions. Furthermore, both sites offer opportunities for research, education and outreach activities similar to those occurring at the BCEP. As such, they provide excellent comparisons to the BCEP. Among the other sites visited the primary influences were generally agricultural activities. With the exception of Cache Creek and possibly the American River, where restoration or reclamation activities are occurring at these sites, the constraints to restoration (*i.e.,* lack of well developed soils) found at the BCEP were not present. Natural habitats at each of these locations provide excellent examples of appropriate riparian and upland species assemblages, which can serve as a reference for restoration at the BCEP. Other sites along Butte Creek and other local streams could similarly be utilized for reference conditions.

It appears that the existing management plan by Holtgrieve et al. (2000) has been generally neglected. Similarly, the Draft Butte Creek Ecological Reserve Canyon Unit Management Plan (Schwein 2001a) outlines two work plans (year one and annual) for the reserve complex. It is unclear which, if any, of these tasks have been accomplished. The tasks identified within these work plans are a good starting point for prioritizing needs and tracking implementation and management success. One of the weakest components of these plans is the lack of measurable objectives (*i.e.,* discreet and implementable). I have provided examples of a decision matrix and implementation plan, which could be used to frame and prioritize future management actions. Within an adaptive management framework, it is also important to reevaluate existing management plans and update or amend them periodically.

Soils:
As previously mentioned, the lack of developed soils should be a key consideration for any restoration projects at the preserve. The lack of developed soils throughout the BECP appears to hinder the establishment of desirable native vegetation; this is particularly apparent within the annual grassland dominated areas (see figure 3 below). Field visits to several of Teichert Construction's restoration sites provided some insight to how related issues could be handled. Where a developed soil horizon is lacking (as is the case in most locations of the BCEP), Teichert has salvaged topsoil for the purpose of restoring and mitigating project impacts. Where soils are not present, Teichert has attempted to replenish the soil with borrowed soil. Conversely, the current practice at the BCEP is to attempt to build soils by planting below grade and filling to grade with soil, mulch and other organic matter (M. Stemen pers. comm. 2006). Baba (pers. comm. 2006) has found that over dense gravel lens it is important to lay 3-5 feet of topsoil over the gravel to aid in the establishment and long-term success of plantings. Less topsoil is needed if there is greater clay content. Obviously, clay will contribute to increased soil moisture. Where topsoil is unavailable, Teichert has utilized overburden and dredge materials from siltation ponds mixed with organic material as a surrogate. These materials may be mineral or nutrient deficient (B. Baba pers. comm. 2006), and may require additional treatments (*i.e.,* chemical or other) to make them productive. Baba has found cover cropping on soil mounds prior to use in restoration to be successful on new soils (including overburden and silt pond materials) in order to build up organics and nutrients. As an innovative approach to restoring a site with embedded cobbles, similar to those found in the annual grasslands and levees at the BCEP, Teichert is planning to use deep rippers or a plow to break up embedded cobbles. In this process soil and organics will be added and mixed in to facilitate restoration of suitable planting substrates.

Overburden (topsoils/dredge spoils) and siltation pond sediments are available from various gravel mining operations nearby (*e.g.,* Teichert's Hallwood site in Marysville). It is estimated that the cost for the acquisition and transport of these materials would be approximately $25.00/load and $60.00-$80.00 /truck hour. While this could be a costly approach to establishing a soil profile suitable to restoration, it could be done in a phased manner to defer the costs.

Exposed tailings dominate the landscape of the preserve. These tailings create an unnatural topography for the setting. In most locations, the tailings support upland vegetation. Where swales exist within this landscape, wetland vegetation (*e.g.,* willows [*Salix* spp.]) has become established in some areas. Particularly where the swale's bottom is near the groundwater. Recontouring of these features as a component of restoration would improve natural characteristics of the preserve (see discussion of wetland/pond creation below).

Further mining of remaining gravels and cobbles are also an alternative to achieving restoration and management goals. In order to restore an area, it may be appropriate to remove and sell the materials that are problematic. These materials could partially fund the restoration activities.

Erosion and deposition are natural processes within healthy riparian ecosystems. However, some erosion or deposition can trigger undesirable outcomes. While assessing the bank downstream of the overflow channel outfall, I observed sloughing and undercutting of the bank (see figure 2). Holtgrieve *et al*. 2000 suggests that bank stabilization should occur as a means to protect fish habitat. This could be naturally occurring due to channel migration; however, it could be caused by debris upstream on the opposite bank or possibly by returning water from the overflow channel. The cause of this erosion should be investigated and efforts to stabilize the bank utilizing natural reinforcement methods (*e.g.,* root wads or willow wattle walls) should be implemented as discussed below. If the overflow channel is determined to be a significant contributor to this erosion, then slowing the velocity of flows in the overflow channel with methods previously described may reduce the erosive forces.

Figure 2. Erosion and undercutting of bank.

Hydrology/Water Quality:

Site hydrology may be highly variable between disturbed and undisturbed sites. Specifically, water tables at mined sites tend to fluctuate more than at undisturbed sites (B. Baba pers. comm. 2006). Installation of peizometers to assess seasonal variation in the water table may be a valuable exercise prior to future restoration activities. For instance, it would not make sense to develop a wetland in areas where the presence of water is not reliable. Similarly, the planting of upland vegetation in frequently saturated soils may result in failure to meet success criteria.

The U.S. Fish and Wildlife Service (Service) (2001) ranked the development of land use plans to buffer between riparian areas and developed areas as a high priority in order to maintain water quality. Furthermore, they identified the need to develop a watershed management program for Butte Creek. As a stakeholder in the management of Butte Creek, the BCEP is integral to the implementation of any watershed management program. It is not clear what coordination with private landowners, non-governmental organizations, and local, state and federal agencies has continued beyond the initial planning stages for the preserve, however, it is important to remain an active participant in watershed-wide conservation and management efforts.

Vegetation:
As stated previously, the vegetation communities at the BCER include valley foothill riparian, blue oak-gray pine, annual grassland and riverine habitats. Figure 3 below provides a general reference to the extent of these communities within the areas of the preserve visited for this assessment.

Figure 3. Shaded areas represent major vegetation communities and areas discussed in this assessment. BG = Blue Oak-Grey Pine, VFR = Valley Foothill Riparian, RIV = Riverine, AGS = Annual Grassland.

Much of the woody vegetation at the preserve exists in apparently even age class stands. Diversification of age class structure through thinning or other treatments would improve the overall cover structure within the preserve and would ensure maintenance of existing vegetation community types.

Riparian vegetation is quite resilient to disturbance. Specifically, recruitment and recovery of vigorous riparian vegetation occurs naturally within the active floodplain of the preserve. Within the riparian corridor it is appropriate to allow for the recruitment of fine sediments and organic matter in order to develop soils. Established vegetation such as sedges and willows facilitate the recruitment of sediments and organic material. Monitoring of sediment and organic materials recruitment should be conducted to assess system inputs. If system inputs are low, it is possible to utilize rock weirs or willow wattle structures to direct flows, dissipate flood energy, and aid in the recruitment of sediments and organic matter. Further, willow wattle structures can be anchored with live pole cuttings, which could aid in the establishment of woody vegetation if appropriate. Where disturbed substrates exist, colonization by invasive vegetation is common. This is evident in the overflow channel and lower floodplain areas. Thus, primary management concern within a disturbed floodplain (or any disturbed) is the establishment of invasive plants.

The Conservancy (2000), Holtgrieve *et al.* (2000) and Service (2001) are suggestive of the management of shaded riverine habitat. Along the banks of the creek, there are numerous areas that are exposed wide point bars. The width depth ratio of the primary overflow channel could be improved to provide better flood plain and rearing habitat for fisheries resources, as described previously. While natural recruitment will occur in time, rapid establishment of vegetation on these exposed areas will minimize establishment of invasive vegetation within these areas. Similarly, the establishment of vegetation will improve buffering from adjacent areas as well as provided shaded riverine habitat essential for salmonids.

Often, the vegetation that has become established in disturbed or embedded soils is dominated by non-native species such as Spanish broom (*Spartium junceum*), yellow star thistle (*Centaurea solstitialis*) and Himalayan blackberry (*Rubus discolor*).   Invasive species including Himalaya blackberry (*Rubus discolor*), vinca (*Vinca* sp.), cocklebur (*Xanthium spinosum*), yellow star thistle (*Centauria solstitialis*) and Spanish broom are present throughout the preserve. In many locations monotypic stands of these plants dominate the understory of the riparian forest. Patches of native species including Santa Barbara sedge (*Carex barbarae*), mugwort (*Artemesia douglasiana*) and others, which persist in isolated patches among the invasive plants.

Figure 4. Spanish Broom growing along the floodplain of Butte Creek

Figure 5. Vinca competing with Santa Barbara sedge.

The existing weed management practices do not appear focused. Piles of pulled weeds were observed along the overflow channel. The primary vegetation within these weed piles was grasses and forbs. It appears that there are some threats existent from major invasive species such as Spanish broom, which are being overlooked. Many of the grasses and forbs within the observed weed piles are nearly naturalized into the annual grassland ecosystem. Development of a weed management program with specific management plans and direction would greatly increase the success of invasive species eradication. Some of the management tools could include hand pulling, the use of goats or other livestock, mechanical, chemical, or prescribed fire treatments. In addition to eradication of invasive species, proactive measures to ensure invasive seed introduction does not occur. Some measures to minimize introductions might include interpretive signage for visitors to make them aware of invasive species identification and impacts, and the development of a protocol to request shoes and clothing be cleaned of seeds prior to entering the preserve.

The upland restoration activities occurring within the areas dominated by annual grasslands east of the “native plant garden” (see AGS2 in figure 2) could include more plantings of naturally occurring and successful species within these areas such as yerba santa (*Eriodictyon californicum*), gum plant (*Grindelia robusta*) and buckwheat (*Eriogonum* sp.). The plantings within this area include native bunchgrasses (primarily deer grass [*Muhlenbergia rigens*]), Juncus (*Juncus* sp.), blue oak (*Quercus douglasii*) and valley oak (*Q. lobata*) seedlings, Mexican elderberry, California poppy (*Eschscholzia californica*), and Penstemon (*Penstemon* sp.). The mounding of rocks around the planted vegetation gives an appearance of a horticultural landscape (see figure 6). Restoration activities should be ecologically appropriate and should facilitate the natural processes (such as fire and flooding), which support the existence of vegetation communities within the preserve.

Figure 6. Mounding of rocks around plantings in annual grasslands.

Some plant selections used in restoration plantings are from unspecified origins. In some cases, the stock utilized may not be appropriate to the BCEP or the Sacramento Valley region. Restoration plantings should be comprised of species and their ecotypes appropriate to the Butte Creek watershed or found within relatively short distance of the BCEP. Native seed sources located onsite should be identified and seeds should be collected and increased for restoration. The onsite greenhouse could be used to propagate some of these; however, for larger projects, the Natural Resource Conservation Service's Plant Material Center in Lockeford could be utilized to grow plants for restoration.

A significant missing component from the management of the BCEP is to define objective restoration criterion and monitoring protocols. . It is highly recommended that restoration criterion be established prior to any further plantings. Similarly, appropriate monitoring protocols should be developed and implemented for future projects. Numerous examples of monitoring program designs are available; Elzinga *et al*. 1998, Morrison 2002 and Atkinson *et al*. 2004 provide some useful approaches. If funding for monitoring is a concern, it is possible to develop citizen participation monitoring, which could be implemented by visiting K-12 or even undergraduate or graduate students at little or no cost and could bolster community involvement and ownership of the preserve and Butte Creek. Employees and volunteers may require more guidance and oversight in order to be able to successfully implement the developed plans. As stated previously, whatever is decided, it is critical to ensure the plans for restoration include measurable achievable criteria. Fixed long-term monitoring points and plots should be established throughout the preserve to ensure management objectives are being met.

There is an abundance of woody debris jams within the riparian forest. While woody debris serves as important habitat for many species, the accumulation of woody debris poses a fire threat to the riparian forest and adjacent habitats. In some locations, the woody debris jams occupy over 0.025 acre (100 meters^2) and are approximately 3.3 feet (1 meter) deep. Intermixed with these debris piles are trash and other anthropogenic articles. A quantification of downed and woody debris should be completed to determine the fuel load throughout the preserve. Where abundant fuels are located, they should be reduced or fragmented to minimize the threat of fire spread. Prescribed fire may reduce woody debris and facilitate the movement of such debris during high flow events. This debris could serve several purposes for the preserve: relocated woody debris may provide habitat for organisms including fish and invertebrates; energy dissipators for streambank protection; or refugial habitat for upland species.

Wildlife:
It is apparent that the primary species of interest at the BCEP are the salmonids. Throughout the watershed there are major efforts to ensure the enhancement and survival of these fisheries resources. It is not clear what actions have been taken to improve habitat conditions for anadromous fish at the preserve. However, as mentioned previously in the soils and vegetation sections of this document, there are problematic areas where factors such as erosion and lack of shaded habitat may limit the potential for conservation and management in the vicinity of the preserve. Actions discussed previously should assist in achieving conservation and management objectives for these species. Additionally, habitat and population monitoring could aid in assessing the habitat utilization within the BCER. Numerous documents discuss the importance of Butte Creek as a salmonid bearing stream and outline management and monitoring guidance (*e.g.,* Service 2001 and the Honey Run Unit Monitoring Plan [author and date unknown]).

The conservation and management for other rare, threatened or endangered species and their habitats at the BCEP is also of importance. Federal and state recovery plans for such species are a good source of information to identify what management actions may be taken to promote the recovery of such species. In many cases, the conservation of these species will aid in the sustainability of habitat and populations of more common species. Examples of recovery actions for two threatened species, which occur at the preserve, are provided below. It is suggested that recovery plans or conservation strategies for other species, which could occur at the preserve, be reviewed and incorporated as appropriate into future management actions. Additionally, inclusion of recovery actions into future projects can be used to acquire funding and ease regulatory review of such projects.

Several plantings of the valley elderberry longhorn beetle’s host plant, Mexican elderberry, have been completed in association with previous mitigation and restoration projects. The Service (1984) outlines recovery implementation tasks for this species. Highlights of these tasks are as follows:

- Assess the impacts of management activities on the species and its host plant (task 33.4)
- Research restoration and enhancement techniques and conduct short- and long-term monitoring (task 34)
- Monitor the status of the species and outcomes of management actions (task 35)
- Develop and implement a management plan (task 53)

The bald eagle is another threatened species that occasionally utilizes the preserve and could benefit from management activities at the preserve. Maintenance of habitat and populations of fisheries resources will indirectly benefit the bald eagle. The diversification of age class and structure of the upland and riparian forest as previously suggested would facilitate the sustainable existence of suitable nest and roost trees as well as encourage a diversity of other wildlife upon which the bald eagle might prey. The Service (1986) has not specifically identified Butte Creek as an important area for the species recovery. However, it is known that bald eagles do utilize Butte Creek, and thus could benefit from some directed management actions. Some of the general recovery tasks identified for the Sacramento Valley and foothill region include the following:

- Integrate habitat guidelines into planning and implementation documents (task 1.23)
- Manage fisheries and other prey populations and their habitats (including forest management and restoration) to provide adequate food for eagles (tasks 1.3, 1.312, 1.321, and 1.322)
- Limit human activity in areas utilized frequently by eagles (task 1.33)
- Develop interpretive outreach materials to educate the public of the species (task 3.1)

Obviously, many of the existing objectives of the preserve are supportive of the conservation and management of these and other species. However, it is important to ensure that efforts are made to aid in management of these species where appropriate.

In some areas of the preserve the existence of seasonally inundated depressions exist, but function in a limited capacity as wetlands. Few of these areas currently provide habitat value for wildlife. In locations where topsoils are not available, Teichert has developed ponds or other impoundments that support wildlife use. Scouring or excavating depressions to make groundwater seasonally or permanently available can create such features. Even existing natural features such as areas adjacent to the overflow channel could be enhanced to mimic oxbow type habitats as offstream water features. Thus, these areas could be enhanced. It is recommended that future restoration plans evaluate the construction or enhancement of these features into seasonal or permanent wetlands. Similarly, the enhancement of the riparian corridor through accumulation of sediments and organic material coupled with natural recruitment or restoration of vegetation mentioned previously can also be beneficial to development of wildlife habitat including the improvement of instream habitat for aquatic species.

Due to the lack of extensive stands of mature and senescent trees, there is also a lack of suitable nesting and roosting cavities. Construction of nest boxes and roost boxes suitable for a variety of birds and bats would greatly benefit such species. Nest boxes of various sizes (*e.g.,* for oak tit mice [*Baeolophus inornatus*] and barn owls [*Tyto alba*]) would not only provide increased nesting opportunities for such species, but the construction and monitoring of nest boxes would be a potential education and outreach or research activity at the preserve.

During one visit to the preserve, mountain lion (*Felis concolor*) scat and tracks were located between areas AGS1 and AGS2 identified in figure 3. Also, within AGS1 an older pile of black bear scat (*Ursus americanus*) was observed. The mountain lion scat contained deer fur, dewclaws and manzanita (*Arctostaphylos* sp.) berries. The bear scat also contained manzanita. The preserve supports a small population of manzanita. The fruits of manzanitas and other fruiting shrubs are an important food source for many wildlife. Future planting schemes should include a diversity of fruiting shrubs and vines. During this same visit, a covey California quail (*Callipepla californica*) was observed utilizing a brush pile within AGS2. Brush piles provide important cover from predators, and many organisms will utilize them. The creation of brush piles among grasslands can serve as an important habitat element. Materials collected during fuels reduction as described previously can be used to create these piles.

Mitigation:
The concept of utilizing the BCEP as a mitigation bank is a novel approach to procure funding for restoration and management in perpetuity. However, there are several considerations that should be made in order for mitigation to contribute to regional conservation efforts. Specifically, there needs to be a plan along with the delineation of areas where credits will be sold via the development of a credit method. The delineation and establishing of credits will ensure that issuance of duplicative credits for the same area of land does not occur. Additionally, there are concerns for a net-loss of habitats and ecosystem services. Dale and Gerlak (2007) found that many wetland mitigation projects did not provide sufficient compensation for the area lost. Howald (1996) provides an analysis of translocation and mitigation. While this analysis is based on a case study of vernal pools, the same issues apply to other ecosystems. Without a clear restoration/mitigation design, implementation schedule, monitoring plan and management in perpetuity many restoration or mitigation efforts will not succeed. In the case of maintaining a no-net-loss of wetlands or other ecosystem components, a rigorous level of analysis is critical to ensure basic criteria are met. As Brown and Lant (1999) found in their review of wetland mitigation banks, the no-net-loss of wetlands is often not achieved due to a variety of problems including failure to provide ecosystem functions after a given period of time. Furthermore, translocation as a mitigation strategy alone may not achieve the no-net-loss of resources (Howald 1996). With respect to the proposed mitigation for the Route 70 Freeway Upgrade Project, the proposal includes restoration and monitoring criterion which appear sufficiently developed to ensure attainment of mitigation objectives (see Begley 2006).

Outreach, Education and Research:
Holtgrieve *et al*. (2000) discusses issues related to use by the public and for educational purposes. It is unclear what items from this plan have been implemented. K-12 student visits to the BCEP are a regular occurrence as are visitations by classes from CSU Chico and Butte College. Stemen (pers. comm. 2006) stated that students and other volunteers regularly participate in restoration plantings. However, there are no restoration criterion identified and follow-up monitoring of such plantings is lacking. Development of comprehensive restoration and monitoring plans would greatly improve the evaluation of such efforts, and would likely lead to the improvement of planting success based on adaptive management strategies that could be implemented.

Presumably, research projects are also occurring at the BCEP. No information was obtained to suggest the direction of any such projects.

Other:
A variety of additional management actions are outlined in Holtgrieve *et al*. (2000). Some of these include: the need for perimeter signage to inform visitors of the preserve boundaries; and monitoring of access to the preserve, which is currently lax. Holtgrieve *et al*. (2000) and other sources indicate that access to the preserve would be limited, and records of visitors would be maintained. Access is currently unrestricted, and it is unclear what records of visitors are maintained. The major concern about unrestricted visitation is the disturbance of wildlife and potential for off-trail use. The current practices should be reevaluated to ensure they are supportive of the management objectives for the preserve.

In a related issue to access, the entry and parking area near the preserve gate needs improvement. Specifically, the area should be recontoured to reduce the difference between the road grade and parking area. The parking area should be widened to enable vehicle turn around. There should also be sufficient room to accommodate visitor parking and emergency vehicle access to the gate. Within this area, the wire fence needs maintenance. Several posts are bent and the wire strands are not taut. Loose fencing could pose a risk for wildlife entanglement.

The suppression of fire (both prescribed and wildland) on the preserve is something to consider. Since hydrants are not located throughout the preserve, it is important to ensure that existing water storage features are fitted with hydrant outlets.

Lastly, due to the significance of the preserve to watershed conservation and management it should be a priority to support watershed-wide efforts such as the watershed management strategy. Successful conservation and management at the preserve has little regional impact if there is not a coordinated effort within the watershed.

Literature Cited

Atkinson, A.J. P.C. Trenham, R.N. Fisher, S.A. Hathaway, B.S. Johnson, S.G. Torres, and Y.C. More. 2004. Designing monitoring programs in an adaptive management context for regional multiple species conservation plans. U.S. Geological Survey Technical Report. USGS Western Ecological Research Center, Sacramento, CA

Begley, E. 2006. *Mitigation for Impacts to Seasonal Forested Wetlands: Supplement to the June 2005 Riparian Wetlands Mitigation and Monitoring Proposal*.

Brown, P.H. and C.L. Lant. 1999. *The Effect of Wetland Mitigation Banking on the Achievement of No-Net-Loss*. Environmental Management 23(3): 333-345

Butte Creek Watershed Conservancy. 1998. Butte Creek Watershed Project Draft Existing Conditions Report. Chico, CA

------- 2000. *Watershed Management Strategy*. Chico. CA

Dale, L. and A.K. Gerlak. 2007. It's All in the Numbers: Acreage Tallies and Environmental Program Evaluation. Environmental Management 39: 246-260

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. *Measuring and Monitoring Plant Populations*. U.S. Department of Interior, Bureau of Land Management. Denver, Colorado.

Holtgrieve, D., L. Lukes, R. Haiman, K. Lundberg, A. Harthorn, J. Du, B. Vieg, and M. Quinn. 2000. *Butte Creek Ecological Preserve Honey Run Unit Management Plan*. California State University Chico. Chico, CA

Howald, A. 1996. *Translocation As a Mitigation Strategy: Lessons from California*. In D.A. Falk, C.I. Millar, and M. Olwell *eds*. *Restoring Diversity: Strategies for Reintroduction of Endangered Plants*. Island Press. Washington, D.C.

Mayer, K.E. and W.F. Laudenslayer. 1988. *A Guide to Wildlife Habitats of California*. California Department of Forestry and Fire. Sacramento, CA

Merz, J.E. and P.B. Moyle. 2006. *Salmon, Wildlife, and Wine: Marine-Derived Nutrients in Human-Dominated Ecosystems of Central California*. Ecological Applications 16(3): 999-1009

Morrison, M.L. 2002. Wildlife Restoration: Techniques for Habitat Analysis and Animal Monitoring. Island Press. Washington, D.C.

Natural Resource Conservation Service. 2006. Soil Survey of Butte Area, Parts of Butte and Plumas Counties. Natural Resource Conservation Service, Davis, California

Schwein, J.R. 2001a. *Butte Creek Ecological Reserve Canyon Unit Draft Management Plan*. California State University, Chico. Chico, CA

------ 2001b. *Butte Creek Ecological Reserve: Canyon Unit Management Plan*. A Masters Project. California State University, Chico. Chico, CA

Stemen, M., C. Collison, and J. Gallaway. 2005. *Draft Riparian Wetlands Mitigation and Monitoring Proposal: Caltrans Route 70 Freeway Upgrade Project Yuba and Sutter Counties, California*. California State University, Chico. Chico, CA

Unknown. circa 2001. *Honey Run Unit Monitoring Plan*. Chico, CA

U.S. Fish and Wildlife Service. 1984. Valley Elderberry Longhorn Beetle Recovery Plan. U.S. Fish and Wildlife Service. Portland, OR

------ 1986. Recovery Plan for the Pacific Bald Eagle. U.S. Fish and Wildlife Service. Portland, OR

------ 2001. *Final Restoration Plan for the Anadromous Fish Restoration Program: A Plan to Increase Natural Production of Anadromous Fish in the Central Valley*. Sacramento, CA

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Aerial Imagery

Google, Inc. 2007. Google Earth Professional Edition. Mountain View, CA

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Example Management Decision Matrix				
Management Action/Need	**Spatial Extent** 0 = non-existent or unknown 1 = localized 2 = several isolated locations 3 = Extensive	**Urgency** 0 = lack of action does not result in adverse impacts preserve 1 = Moderate adverse impacts if neglected 2 = Severe adverse impacts if neglected	**Ability to Manage** 0 = Low 1= Moderate 2= High	**Total** Highest score is the highest priority task.
General Items				
Revise and update existing management plans (include short- and long-term management actions	3	2	2	**7**
Implement actions outlined in management plans	3	2	2	**7**
Design monitoring protocol with flexibility for adaptive management	3	1	2	**6**
Implement monitoring and adaptive management	3	1	2	**6**
Specific Management Actions				
Develop soil restoration test plots and assess methods suitable to restore degraded soils at preserve	1	1	2	**4**
Conduct feasibility study for development of additional permanent or seasonal wetlands	1	0	2	**3**
If applicable, create or enhance wetlands and monitor their status	1	0	2	**3**
Install peizometers to monitor ground water availability	2	1	2	**5**
Eradicate/manage	3	2	2	**7**

invasive vegetation				
Eradicate/manage invasive wildlife	0	1	2	3
Restore and adaptively manage riparian vegetation	2	0 System is dynamic and functional	2	4
Restore and adaptively manage upland vegetation	2	1 Provides minimal buffering/filtration	2	5
Install, monitor and maintain bird and bat boxes	1	0	2	3
Facilitate the enhancement of the overflow channel by using methods to encourage native plant establishment	1	2	1	4
Assess sediment input rates	1	0	2	3
Fuels reduction / removal of woody debris	2	2	2	6
Identify actions from species recovery or management plans to implement at the preserve	3	0	2	5
Establish a credit method for mitigation banking	2	1	2	5
Become a certified mitigation bank	2	0	2	4

Management Implementation Plan				
Task	**Priority (from decision matrix)**	**Time to Completion**	**Cost**	**Status**
Revise and update existing management plans (include short- and long-term management actions				
Implement actions outlined in management plans				
Design monitoring protocol with flexibility for adaptive management				
Implement monitoring and adaptive management				
Specific management actions				
Develop soil restoration test plots and assess methods suitable to restore degraded soils at preserve				
Conduct feasibility study for development of additional permanent or seasonal wetlands				
If applicable, create or enhance wetlands and monitor their status				
Install peizometers to monitor ground water availability				
Eradicate/manage invasive vegetation				
Eradicate/manage invasive wildlife				
Restore and adaptively manage riparian vegetation				
Restore and adaptively manage upland vegetation				
Install, monitor and maintain bird and bat boxes				
Facilitate the enhancement of the				

overflow channel by using methods to encourage native plant establishment				
Assess sediment input rates				
Fuels reduction / removal of woody debris				