October 24, 2008

Pilarcitos Integrated Watershed Management Plan

Prepared for

San Mateo County Resource Conservation District &
California State Water Resources Control Board

Prepared by

Philip Williams & Associates, Ltd.

with Sound Watershed Consulting, H.T. Harvey & Associates,

D.W. Alley & Associates, Jerry Smith, PhD, and Weber-Hayes & Associates

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1. EXECUTIVE SUMMARY

The Pilarcitos watershed (Figure 1) is a significant area of ecological, cultural and economic diversity. It is a source of clean drinking water for residents of the central coast and San Francisco Bay Area and supports several natural-resource based economies – including agriculture and recreational tourism. The watershed is also experiencing increased competition for water between agricultural, domestic, recreational, commercial and environmental uses.

Public and private stakeholders in the watershed have been working together intermittently since the mid-1990s. In 2005, a group consisting of over 20 local and regional agencies and advocacy groups gathered with nearly 200 members of the community at a water summit to discuss watershed-based approaches for balancing the beneficial uses of water in Pilarcitos Creek. The Coastside County Water District (CCWD), San Francisco Public Utilities Commission (SFPUC), Sewer Authority Mid-Coastside (SAM) and National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS) echoed comments from the San Mateo County Board of Supervisors that continued dialogue is necessary between local stakeholders and the public to achieve balanced solutions including the use of recycled water.

Following on the 2005 Water Summit, the SFPUC collaborated with CCWD, SAM, and the San Mateo Resource Conservation District (RCD) to secure a grant from the San Francisco Regional Water Quality Control Board (RWQCB) to develop an Integrated Watershed Management Plan (IWMP). Part of the IWMP process includes the formation of the Pilarcitos Creek Restoration Workgroup (Workgroup), which aims to implement restoration and management actions in the Pilarcitos watershed. The Workgroup consists of the aforementioned organizations and agencies as well as members of the Pilarcitos Creek Advisory Committee (PCAC) and other stakeholders. The RCD is acting as the contact manager and convener of the Workgroup meetings.

The purpose of the IWMP is to promote balanced solutions to effectively manage the Pilarcitos Creek watershed that satisfy environmental, public health, domestic water supply, and economic interests. It will achieve this purpose by prioritizing restoration projects that individually or collectively help to achieve six key goals, described in Section 3 and summarized here:

1. *Protect and recover Steelhead trout and other native aquatic and riparian species*
2. *Enhance streamflows while maintaining yield*
3. *Manage stream channel corridors to reduce erosion, sedimentation and flood risks*

4. *Increase native riparian vegetation*

5. *Maintain good water quality conditions*

6. *Promote community and stakeholder collaboration*

These goals were developed to address several key watershed management issues that were identified following a review of information about the existing state of the watershed (Appendix A). The key watershed management issues include the following:

- Instream flows to support aquatic resources during critical summer and fall periods.
- Other ecosystem factors, including fish passage, instream habitat, watershed erosion, channel maintenance, riparian vegetation, exotic invasive species, and the spring estuary/summer lagoon.
- Social issues, including community engagement, landowner concerns, beach quality, and landfill issues.

The Pilarcitos IWMP identifies four improvement projects, five feasibility projects, three planning projects and seven additional assessment projects. An objective project-evaluation process was used to integrate project priorities using both scientific and management criteria to arrive at a ranking of projects. This methodology is described in Section 5.1. Project rankings were determined through a facilitated process between the consulting team responsible for this report and stakeholders identified in the Memorandum of Understanding (MOU) (Appendix B).

Implementation of the IWMP will continue through the Workgroup. The key factors affecting the IWMP Implementation Strategy are outlined in Section 5.1.2. Lead agency responsibilities, milestones, and funding sources are identified for each proposed project in Section 5.

Acknowledgements

This document is the product of the hard work of many stakeholders in the watershed. In addition to the many community members who attended public meetings to develop the Pilarcitos IWMP, we would like thank the following people for their contributions.

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2. INTRODUCTION AND PLANNING APPROACH

The Pilarcitos watershed (Figure 1) is a significant area of ecological, cultural and economic diversity. While it is located near one of the most heavily populated areas of California, it remains relatively undeveloped, and large portions of the watershed retain many of the natural features that existed prior to European settlement of the watershed.. The Pilarcitos watershed is a source of clean drinking water for residents of the central coast and San Francisco Bay Area and remains rich in native plant and animal species. The watershed supports several natural resource-based economies – including agriculture and recreational tourism. Pilarcitos Creek is also identified as critical habitat for the recovery of steelhead trout, federally listed as threatened.

Pilarcitos Creek originates on the eastern side of Montara Mountain and flows about 12 miles to the Pacific Ocean near the City of Half Moon Bay in California (Figure 1). It is the principal watercourse draining a coastal watershed of approximately 17,900 acres (about 28 square miles) in San Mateo County. The watershed encompasses seven subwatersheds containing the following smaller tributaries: Nuff Creek, Corinda Los Trancos Creek, Apanolio Creek, Albert Canyon, Madonna Creek, Mills Creek, and Arroyo Leon. Pilarcitos Creek can be divided into three broad reaches: Upper Pilarcitos, above the confluence with the seven tributaries; Middle Pilarcitos, primarily confined to an agricultural and residential floodplain valley; and Lower Pilarcitos, which flows through the City of Half Moon Bay to the Pacific Coast.

The creek originates on land owned by the SFPUC, then passes through CCWD land, then private, residential, and agricultural lands and then lands owned by other public entities including the City of Half Moon Bay, State Parks, and SAM before draining into the Pacific.

2.1 BACKGROUND

Public and private stakeholders in the watershed have been working together intermittently since the mid-1990s as part of the Pilarcitos Creek Watershed Restoration Project funded by the California Department of Fish and Game (CDFG) and the RWQCB. The PCAC was formed to advise the CDFG and RWQCB with the Restoration Project which resulted in the Pilarcitos Creek Restoration Plan (Restoration Plan) (PWA, 1996). The 1996 Restoration Plan identified numerous opportunities for restoration in the watershed. In 1999, the RCD became responsible for implementing the Restoration Plan. The PCAC continued in its role as advisor and stakeholder advocate of issues concerning Pilarcitos Creek.

Numerous projects recommended in the Restoration Plan were implemented in the watershed (Appendix A – Section 7). Fish passage barriers were removed in the Apanolio, Arroyo Leon, and Mills Creek watersheds. As part of continued support, SFPUC performed numerous habitat surveys and monitoring efforts in the Upper Pilarcitos watershed and, in 2007, performed experimental flow releases below Stone Dam to assess the feasibility of improving streamflow in Lower Pilarcitos.

Recognizing the need for continued effort in the watershed, a group consisting of over 20 local and regional agencies and advocacy groups gathered with nearly 200 members of the community at a 2005 Water Summit to discuss watershed-based approaches for balancing the beneficial uses of water in Pilarcitos Creek. The RCD, PCAC, CCWD, SFPUC, SAM and NMFS echoed comments from the San Mateo County Board of Supervisors that continued dialogue is necessary between local stakeholders and the public to achieve balanced solutions including the use of recycled water. The discussion included a series of presentations that outlined a vision for the watershed, characterized its existing condition, described recycled water approaches, and updated the community on actions taken to date.

In November 2005, voters in Half Moon Bay, CA overwhelmingly approved Measure P, with more than 84 percent of the vote in favor of the measure, which asked:

"Do you want the City of Half Moon Bay to support the development of recycled water through its participation in the Sewer Authority Mid-Coastside Joint Powers Authority for use by consenting farmers and large-scale water users such as golf courses and nurseries as a potential alternative to water these users currently draw from Half Moon Bay creeks?"

2.2 CURRENT IWMP PROCESS

Following on the 2005 Water Summit, the SFPUC collaborated with CCWD, SAM, and the RCD to secure a grant from the RWQCB to develop an Integrated Watershed Management Plan (IWMP). Part of the IWMP process includes the formation of the Pilarcitos Creek Restoration Workgroup (Workgroup), which aims to implement restoration and management actions in the Pilarcitos watershed. The Workgroup consists of the aforementioned organizations and agencies as well as members of the PCAC and other stakeholders. The RCD is acting as the contact manager and convener of the Workgroup meetings.

The purpose of the IWMP is to promote balanced solutions to effectively manage the Pilarcitos Creek watershed that satisfy environmental, public health, domestic water supply, and economic interests. This plan updates the 1996 Pilarcitos Creek Restoration Plan, broadens and formalizes the participants in the development of the IWMP by creating the new Pilarcitos Creek Restoration

Workgroup, and addresses the federal listing of the Steelhead as a threatened species (1996) while incorporating current and future water supply issues and important economic issues.

The watershed will face several challenges in the next few decades. Housing demands in the San Francisco Bay Area will likely cause increased development pressures in the watershed. Dams, diversions, and indirect impacts from various land-use activities have combined to reduce fish and wildlife habitat, degrade stream channels, block access to steelhead spawning, and increase exotic species invasions. The watershed is also experiencing increased competition for water between agricultural, domestic, recreational, commercial and environmental uses.

The IWMP was developed by a consultant team with the oversight of the Pilarcitos Workgroup, consisting of representatives from over 19 or more partnering entities, including local, state and federal agencies and local community and advocacy groups. The Workgroup is guided by a Memorandum of Understanding (MOU) (see Appendix B), and has developed input from all affected stakeholders in the process, including local utilities, the agricultural community, public and private landowners, state and federal regulatory agencies, advocacy groups, local residents, and elected officials.

The success of any planning process hinges upon balancing the issues and concerns of the stakeholders. The Pilarcitos watershed is a relatively small watershed with a diverse set of uses. Many of the building blocks for achieving watershed improvements are in place, and there is broad agreement that additional work can be beneficial.

However, there are many uncertainties about specific ecological processes and the effect of watershed management practices on those processes. To date, incomplete scientific data and inconsistent monitoring practices limit knowledge of the cumulative effects of land-use practices on the desired functions and conditions in the watershed. The IWMP documents the understanding of existing watershed conditions, and identifies data gaps that currently exist.

Based on an analysis of the existing condition of the watershed and public input, the Workgroup established a set of goals and objectives for the IWMP (Section 3). This document summarizes key information from the Watershed Assessment Summary in Appendix A (Section 4) and recommends a set of projects that will help to achieve the goals and objectives developed by the Workgroup (Section 5). The set of projects includes specific improvement projects, feasibility studies, planning programs, and additional assessment projects that will help close data gaps. It also includes a description of the process used for evaluating and prioritizing key projects (Section 5.1), and discusses a strategy to implement identified projects (Section 6).

3. PLAN GOALS AND OBJECTIVES

The purpose of the IWMP is to promote balanced solutions to effectively manage the Pilarcitos Creek watershed that satisfy environmental, public health, domestic water supply, and economic interests. The Pilarcitos IWMP establishes a set of goals that define broad types of actions that will combine to manage and restore the Pilarcitos watershed. For each goal, a series of objectives offers more specific guidance about how each goal will be achieved. The goals and objectives reflect agreement by the Workgroup achieved through an ongoing dialogue and public input. Together, the goals and objectives provide a foundation for the Implementation Strategy and Plan.

Goal 1. Protect and recover federally-listed steelhead trout and other native species that depend on aquatic and riparian environments by providing habitat sufficient for sustainable population levels.

Objective 1A: Where practical, remove or modify any significant (population-limiting) barriers to steelhead access to fair or better spawning or rearing habitat.

Objective 1B: Provide an abundance of rearing habitats by supplementing existing rearing habitat with additional restored and managed habitat features.

Objective 1C: Implement water conservation measures as well as active and passive riparian habitat restoration programs to support a robust riparian corridor dominated by locally-native riparian plant species.

Objective 1D: Increase existing summer and fall streamflow to Pilarcitos Creek and its estuary to maintain sustainable populations of native species that depend on aquatic and riparian environments.

Objective 1E: Provide guidelines for incorporating large wood (e.g., logs, stumps, and root wads) in streams while balancing benefits with streambank erosion and flooding hazards.

Objective 1F: Control non-native predators of California red-legged frog (i.e., bullfrogs) via managing hydroperiods and implementing active predator eradication programs in locations where this is feasible (i.e., off-channel ponds).

Goal 2. Develop cost-effective, stakeholder-supported alternative water supply and water recycling projects to enhance streamflow while maintaining yield for users.

Objective 2A: Manage flows to improve aquatic habitat and to improve conditions that support native, riparian habitat (e.g., willow/alder-dominated riparian habitat, instream wetlands).

Objective 2B: Improve efficiency and operations in existing water storage and delivery systems.

Objective 2C: Implement recycled water projects to reduce demand for Pilarcitos Creek streamflows.

Objective 2D: Control the expansion and begin to reduce the extent of riparian eucalyptus to reduce summer water loss.

Objective 2E: Implement Objective 1D above.

Goal 3. Restore or manage stream channels and their floodplains to resist erosion and sedimentation and to minimize flood risks.

Objective 3A: Integrate ecologic value into channel treatment designs that accommodate natural geomorphic processes.

Objective 3B: Implement best management practices to limit erosion along channels and on hillslopes in the short and long-term, with vegetative cover or other surface erosion-control measures.

Objective 3C: Re-establish native riparian vegetation on bare streambanks to increase stability and function and to improve the aesthetic and habitat quality of the riparian corridor.

Objective 3D: Implement best management practices and projects to reduce total sediment delivery from both human land use sources and natural background levels.

Goal 4. Increase native vegetation with prioritized attention to special-status plant species, while removing exotic and invasive plant species.

Objective 4A: Improve degraded habitat to increase the spatial extent, distribution, and amount of native riparian forest, freshwater wetlands, and off-channel ponds/wetlands and support native species populations and biodiversity.

Objective 4B: Remove invasive non-native plant species from the riparian corridors of the watershed. See Objective 2D above.

Objective 4C: Implement Objective 1D above.

Goal 5. Implement activities to maintain good water quality conditions for both human and biotic uses.

Objective 5A: Control or mitigate pollution at the source prior to delivery to the stream network.

Objective 5B: Maintain water quality at the highest practical level, exceeding all regulatory standards.

Objective 5C: Develop monitoring program or acquire baseline and monitoring data.

Objective 5D: Implement Objective 2B: above.

Objective 5E: Implement Objective 2D: above.

Objective 5F: Implement Objective 1D: above.

Goal 6. Encourage and facilitate extensive community and stakeholder collaboration in watershed management.

Objective 6A: Develop and make available essential data to inform watershed management practices and decisions.

Objective 6B: Increase community awareness of watershed processes and habitat through such means as newsletters and riparian and agricultural landowner outreach and educational workshops.

Objective 6C: Provide informational resources for interested organizations and teachers and a framework for student and volunteer engagement in watershed management

activities.

Objective 6D: Develop a long-term monitoring and reporting program to evaluate the success of the restoration projects and to adjust treatments based on the monitoring results.

4. WATERSHED ASSESSMENT SUMMARY

The conditions within the Pilarcitos watershed form the basis for the projects listed in the IWMP. The following section outlines some of the more essential information regarding existing conditions and impacts, including strategies for addressing them, and provides a framework for collaboration with stakeholders within the watershed. This section summarizes information that is discussed in considerable detail in the Watershed Assessment Update (Appendix A).

4.1 ECOSYSTEM FUNCTIONS AND PROCESSES

One of the primary requirements of integrated watershed management planning is the need to protect key ecosystem functions and processes. An integrated approach to watershed restoration involves focusing on the entire ecosystem and the functions and processes necessary to sustain it. This contrasts with other narrowly focused approaches that concentrate on one habitat or species or concern (e.g. water quality). Many of the natural functions within the watershed help to support key watershed beneficial uses. For example, wetlands help to improve water quality. Stable channels help to reduce flood losses to agricultural entities and streamside residents, as well as protect capital infrastructure like roads, bridges, buildings, etc. By supporting these natural functions, the cost of repairs and maintenance of the infrastructure can be reduced.

There are also public resources that must be maintained for the benefit of the entire community. The broader community places high aesthetic values on riparian areas, streamside corridors and public beaches. A clean water supply is also a very important public need. All of these functions can be sustained with attention to these key ecosystem processes.

4.1.1 Fish Passage and Instream Habitat

Culverts are potentially important barriers to adult steelhead migrating upstream. Even when originally constructed at channel grade level, down cutting frequently occurs at the downstream ends of culverts, especially in sandy-bedded streams like those within the Pilarcitos Creek watershed. This produces “perched” culverts. A private culvert on Arroyo Leon and an historical bridge on Mills Creek were modified in 1997-1998 for adult passage following recommendations by PWA (1996).

However, the (vortex) boulder weirs used to remediate the culverts were also subject to channel down-cutting and still posed difficulties to steelhead passage in 2007 (Alley 2007b, Alley 2007c). A private culvert (barrier 3) on Apanolio Creek was modified in 2007 for fish passage with

boulder weirs that may be subject to down-cutting in the future. A partial barrier to adult steelhead movement exists at Highway 92 on Pilarcitos Creek.
Fish passage barriers can block or impede upstream access for adult steelhead, preventing seeding of upstream habitats. In response to density induced competition, juvenile steelhead generally disperse downstream in late spring and summer and saturate downstream habitats, including reaches where spawning conditions are poor. However, in some cases, barriers can also have effects by blocking juvenile fish from upstream movements. These movements are probably only ecologically significant (limiting to steelhead smolt production) where lower reaches become too warm for rearing or where fish move upstream to or from winter high flow refuges. Even when lower reaches dry up, it appears that fish generally concentrate in deep pools (which also later dry up), rather than move upstream. The apparently low relative significance of juvenile movement in many cases is an important issue, since providing passage for large, high-jumping adults can often be accomplished relatively easily and cheaply compared to providing passage for juvenile fish.

There is broad support for improving conditions for resident steelhead and native fish. Steelhead access to large portions of the watershed is blocked or impeded by manufactured barriers, such as dams or culverts. Some of these improvements require addressing regulatory issues that may accompany restoration or enhancement efforts. Instream flow conditions and some land use practices may also need to be addressed to support habitat improvements. While some fish passage and habitat improvement opportunities are known, existing data gaps must be filled to develop more insight into the limiting factors for steelhead in the watershed.

The Watershed Assessment Update (Appendix A) summarizes the habitat ratings for Pilarcitos stream reaches. On the Pilarcitos main stem, stream habitat quality and fish abundance generally increased upstream. Twelve of 17 spawning habitat reach ratings within the watershed were poor, and only three were rated as fair. However, with additional investigations of four upstream reaches, spawning on upper Pilarcitos Creek, upper Arroyo Leon and Albert Canyon are rated as fair or better. In 1996 rearing habitat was rated "fair-good" in only three reaches out of 17, but three additional reaches investigated since are rated as fair-good or better. The pond above the second barrier in Apanolio Creek and the two ponds on Arroyo Leon provided, and still potentially could provide, the only “good” or better rearing habitat for juvenile steelhead.

4.1.2 Instream Flows

Flows in Pilarcitos Creek and its tributaries follow an annual pattern consistent with Mediterranean rainfall-dominated runoff patterns. The median annual hydrograph typically peaks in February and March near 20 cubic feet per second (cfs). Flows are typically below two cfs from June through mid-November. The rising and falling limbs of the annual hydrograph typically take 40-60 days each.

Streamflows below Stone Dam rarely exceed five cfs and typically do so only during extreme flow years. The duration of peak flows is short, usually only a few weeks each year. The majority of flows below Stone Dam are well below one cfs. However, since the channel is relatively small here, a discharge of one cfs is equivalent to a flow depth of about 0.31 feet.

In general, flows in Middle and Lower Pilarcitos Creek are predominantly provided by the subwatersheds of Middle Pilarcitos, Arroyo Leon, and Apanolio. Streamflow in the lower watershed is affected by diversions, dams, and domestic and irrigation wells. It also is influenced by water supply infrastructure management practices, land-use practices, allocation of water rights, and the need to maintain important ecosystem functions and processes. The following sections briefly describe some of these key issues.

4.1.3 Watershed Erosion and Sedimentation

Erosion and impairments to natural hydrologic functions from various land use practices (e.g., diverted runoff, increased impermeability, road grading) is a common issue in many watersheds, and the Pilarcitos is no exception. Soil types within portions of the watershed are especially prone to erosion when disturbed. Sources of erosion are typically associated with agriculture, roads, trails and streamside encroachment. Cost-effective Best Management Practices (BMPs) can often address erosion and sedimentation. Data from existing studies indicates that the two primary sources of sediment in the Pilarcitos Watershed are from Apanolio Creek and Upper Pilarcitos Creek below Stone Dam. This is generally consistent with measures of the watershed geomorphology that also show that the highest rates of erosion come from these sub-basins.

The 1996 Restoration Plan stated that approximately 400 acres of floodplain and hillslope are cultivated for agriculture within the Pilarcitos Creek watershed (PWA, 1996). Topsoil eroded from the farmed area by sheet erosion is carried toward creeks, and in areas with no riparian buffer, the sediment contribution from agriculture may be high. Agricultural runoff contributes to sedimentation in Apanolio Creek (Balance 2003b). Aerial photographs reveal that much of the floodplain in Middle Pilarcitos is used for agricultural purposes.

Roads are a particular opportunity within the watershed. Road erosion has been cited by several of the residents within the watershed as being at least partly responsible for flood-related damage. Road maintenance issues were also noted during the tour of the upper watershed. Improved road design and maintenance practices can improve hydrologic conditions, limit sediment delivery to the stream environment, and prevent road failures.

4.1.4 Channel Maintenance

A review of current and historic aerial photographs suggests that few large-scale channel planform changes have occurred over the last six decades. Planform changes typically occur in response to deposition of coarse sediment or accumulations of large woody debris, both of which are limited in the watershed. Coarse sediment and woody debris also provide important habitat structure, and the lack of structure may be a limiting factor in habitat creation within the watershed.

Grazing, agriculture and, more recently, urbanization, have changed the relationship between rainfall and the resulting runoff that enters streams and rivers. As a watershed becomes more intensively developed, a greater proportion of rainfall appears as runoff (as opposed to infiltrating into the soil or being trapped by vegetation), resulting in more frequent runoff events with greater volume and higher peak flows. These flow regime changes disturb the channel equilibrium and often cause erosion of the bed and banks. This process is generally known as hydromodification.

Impacts from hydromodification likely are greatest in Lower Pilarcitos and Corinda Los Trancos. Increasing residential development in Half Moon Bay increases the impervious surface in Lower Pilarcitos increasing the amount of runoff. Lower Pilarcitos is particularly susceptible to impacts from hydromodification because the channel substrate is predominantly sand. The BFI landfill covers a majority of the Corinda Los Trancos watershed ultimately reducing infiltration and therefore summer flows. However, as noted above, the reduction in sediment in Corinda Los Trancos is subject to retention structures, which can fail. The Pilarcitos Quarry also increases runoff in the Nuff Creek watershed.

Another factor that may contribute to sediment is the degree of channel bed instability throughout the watershed. Channels throughout the watershed are incised, possibly due to long-term land-use impacts that have altered flow patterns, contributing to higher peak flows. Streamside riparian management may also play a role in reducing bed stability within the watershed.

The IWMP addresses strategies for improving the natural channel response functions in ways that can coexist with other land-use needs. Channels are maintained by natural flow conditions that present a certain frequency of relatively high flow events that can mobilize and sort sediment. With a change in the natural balance of flooding, channels can become unstable over time. While specific data is lacking, informal evidence in the Pilarcitos Watershed suggests that the channels on the main stem and several of the larger tributaries may be incised (cut deeper and narrower) relative to their natural condition. Encroachment of land uses on channel banks, and the conversion of floodplains into human infrastructure may also affect the channel condition.

4.1.5 Riparian Vegetation and Habitat

Riparian communities have a strong influence on the geomorphic and habitat functions of the stream environment. The riparian canopy affects stream temperatures and aquatic plant growth. Instream wood that naturally accumulates in the channel can support channel functions and can greatly benefit fish spawning and rearing habitat by creating habitat complexity. A functional riparian community often requires exposure to natural disturbances that create new surfaces for the germination of native species and limited competition from exotic invasive species. In the absence of these processes, riparian canopy species die without being replaced by younger generations.

Riparian vegetation in the Pilarcitos varies between the upper and lower portions of the watershed. Arroyo willow (*Salix lasiolepis*) and red alder (*Alnus rubra*) are the dominant trees in the riparian corridors of the watershed. However, the upper watershed also includes a few additional closely associated habitats along the riparian corridor; these include the coastal scrub, chaparral, and Douglas fir forest. The riparian plant communities in the watershed have previously been classified by various sources within different parts of the watershed (PWA 1996, EDAW 2002). Riparian areas in the lower watershed have been classified into five categories according to the dominant tree species: Willow Riparian Forest, Willow-Alder Riparian Forest, Willow-Mixed Riparian Forest, Eucalyptus-Alder Riparian Forest, or Eucalyptus Grove (PWA, 1996).

4.1.6 Control of Exotic and Invasive Vegetation

Invasive non-native species are present in all seven tributaries of Lower Pilarcitos, frequently occurring with high percent cover (PWA, 1996). Blue gum eucalyptus and Cape ivy appear to be the most pervasive and cover the greatest surface area. Additional invasive species that occur in the watershed include poison hemlock, bristly ox-tongue (*Picris echioides*), black mustard (*Hirschfeldia incana*), Italian thistle (*Carduus pycnocephalus*), milk thistle (*Silybum marianum*), periwinkle (*Vinca major*), garden nasturtium (*Tropaeolum majus*), pampas grass and jubata grass (*Cortaderia spp.*), French broom (*Genista monspessulana*), and small-leaf spiderwort (*Tradescantia fluminensis*). The most highly invaded areas appear to be along lower Nuff Creek near the confluence with Pilarcitos Creek, Mills Creek, and the lower reaches of Pilarcitos Creek. Detailed information about the amount and location of invasive species are not available for the upper watershed.

These species can present challenges for both ecosystem functions and desired land uses. When exotic plant species replace native plant communities, they severely alter or destroy critical linkages, both physical and biological, that maintain ecological function. Exotic plant invasion reduces complexity and biodiversity in the system and alters essential processes with which the

ecosystem has evolved. Exotic species prevent recruitment of native vegetation. Invasive species are often "weedy" species that can infiltrate agricultural fields, increase fire risk, and harm native species habitat requirements. Exotic and invasive vegetation is rapidly becoming the greatest threat to ecosystem function in the watershed. Control of exotic species can be resource intensive and usually requires a commitment of money and resources over a sustained period.

4.1.7 Lagoon Habitat

Lagoons/estuaries provide important spring and summer rearing habitat and saltwater transition habitat for smolting steelhead (juvenile steelhead migrating to the ocean) in many coastal watersheds (Smith 1990; Bond 2006). For Pilarcitos Creek, the lack of summer stream flow to the mouth prevents the development of a lagoon in all but the wettest years. Even in systems where summer water is available, the beach configuration and sandbar dynamics are major factors in the quality of a lagoon for steelhead rearing in spring and summer. Lagoons support salt-water acclimation, which improves smolt survival upon ocean entry (Smith 1990). Sandbar dynamics are also a factor in lagoon ecology, with early summer sandbar formation damming up inflow and producing productive, mixed, (but often relatively warm) freshwater lagoons (Smith 1990, Bond 2006). Not only does Pilarcitos Creek normally lack a summer lagoon, due to lack of inflows, it does not provide a spring feeding or salt water transition habitat for smolts because of a lack of residual depth when the sandbar is not in place; small smolts produced in upstream portions of the watershed probably have minimal transition habitat and low ocean survival (Bond 2006).

There is interest in restoring functional estuary conditions in the historic lagoon location. This idea has a number of technical challenges. Sufficient inflows in excess of seepage through the sandbar are necessary to maintain adequate habitat depth in the lagoon during the summer and fall. Potential structural improvements to support a more functional lagoon are constrained by physical limitations at the site and the risk of harming the timing and success of smolt (juvenile steelhead migrating to the ocean) migration. A restored lagoon may also need to address high rates of predation, warm water temperatures, and water quality issues. There must also be sufficient lagoon inflow to sustain a freshwater environment in the lagoon. Otherwise, a saltwater lens will develop on the lagoon bottom and water temperatures may become too warm for steelhead. Overcoming these issues will require a more focused analysis.

4.2 WATER MANAGEMENT

One of the most important limiting factors for both fish habitat and possibly for water quality in the Pilarcitos watershed is management of summer instream flows, which typically has been low under historical conditions. Low flows limit fish migration, reduce available rearing habitat, and might retain pollutants in the stream environment. Many of the other opportunities for

improvement in the Pilarcitos watershed hinge upon the ability to improve summer and fall instream flows in the lower watershed.

4.2.1 Instream Flow Improvement Opportunities

The Restoration Plan concluded that the most limiting factor to steelhead population was low streamflow resulting from water diversion, which hinders adult spawning migration, smolt out-migration, and juvenile rearing conditions. Although the fishery assessments reported in the Restoration Plan were performed in a wet year (1995), summer stream flows were still low enough to limit steelhead abundance throughout the watershed.

Summertime instream flow conditions in Lower Pilarcitos (Figure 1) have been significantly lower than other creeks along the central coast. Retention of water at Pilarcitos Lake and its diversion at Stone Dam eliminated a significant portion of the contributing watershed area. Base flows from tributary basins have been insufficient to compensate for the lack of water from Upper Pilarcitos. Prior to 1997, it was not uncommon for Pilarcitos Creek at Half Moon Bay to be dry for 30 or more days each year. After 1998, a minimum flow level has been maintained throughout the year, although the volume of flow in summer has remained low.

The 2007 summer flows in Lower Pilarcitos, as measured at Half Moon Bay by the USGS, generally have exceeded the 80th percentile of historic summer flows for this station over its 40 years of record. This trend occurred despite the otherwise dry conditions along most of the other coastal streams. The source of this additional water can be traced back to releases below Stone Dam, which are two to four times higher in 2007 than they have been over the last 10 years (the period of record below Stone Dam). The improved 2007 flow conditions, as well as improved lagoon conditions, offer a perspective for opportunities to improve instream flows.

4.2.2 Water Supply Infrastructure

The SFPUC operates reservoir facilities in the upper Pilarcitos watershed. The facilities include Pilarcitos Reservoir, Stone Dam, water conveyance pipelines and tunnels, various buildings and roads. The SFPUC owns the land comprising the upper watershed of Pilarcitos Creek and the stream corridor from Stone Dam Reservoir extending downstream approximately one mile. SFPUC controls access to these lands to protect water quality and has managed the upper watershed for a number of environmental benefits. EOA (1990) indicated that SFPUC diversions capture 28 percent of the total watershed runoff, the largest amount among existing water users.

The CCWD serves the City of Half Moon Bay and a part of the unincorporated area of San Mateo County including Miramar, Princeton by the Sea and El Granada. The District's service territory encompasses approximately 14 square miles and serves nearly 18,000 people. CCWD has three

water supply sources that affect Pilarcitos watershed: Pilarcitos Lake or Reservoir, Crystal Springs Reservoir, and the Pilarcitos Well Field. Supplies from Pilarcitos and Crystal Springs Reservoirs are provided by SFPUC. CCWD also operates a supply reservoir outside the Pilarcitos watershed. The entire system consists of two water treatment plants, 17 miles of transmission pipeline, 83 miles of distribution pipeline, several water storage tanks, and other equipment. The average annual yield from these four sources is about 2800 acre-feet. Approximately 1,800 acre-feet of water is supplied from the SFPUC sources and the remaining water is supplied locally.

Domestic and agricultural users throughout the watershed hold additional water rights. The amount of permitted appropriative diversions in the watershed total about 878 acre-feet per year. Most appropriative users are prohibited by conditions in their permit or licenses from diverting water during the summer. The amount of riparian diversion and pre-1914 appropriative diversions are reported in statements filed with the SWRCB as 2,296 acre-feet per year. The existing water supply infrastructure depends in part on antiquated delivery systems that were designed and constructed, in some cases, in the nineteenth century. Water is routinely transferred out of the basin and stored in Crystal Springs Reservoir.

4.2.3 Gray Water Sources and Uses

Gray water is non-industrial wastewater that has not been exposed to toilet waste. It is generated from domestic activities such as washing dishes, laundry and bathing. Gray water also can be runoff from certain light industrial or agricultural uses that do not introduce significant pollutants (e.g., heavy metals, toxins, fecal waste, etc). By contrast, “black water” typically contains larger amounts of chemical and biological contaminants (from feces or toxic chemicals). Gray water gets its name from its cloudy appearance.

Gray water can provide an opportunity to improve the availability of water supply in areas like the Pilarcitos watershed where freshwater supplies exceed available demand. It can be particularly useful for commercial irrigation, domestic sewage (e.g., flushing toilets), or industrial cooling applications. Such treatments usually require modest treatments to address public health and aesthetic concerns.

Existing water use regulations in many jurisdictions preclude the use of gray water, often treating it as sewage. Many of the regulations preventing the use of gray water are based on public health issues. However, with water conservation becoming increasingly important in the Pilarcitos watershed, it may be appropriate for the community to evaluate the actual risks and potential benefits. Recently, an increasing number of regulatory jurisdictions are coming to accept that the microbiological risks of gray water reuse at the individual domestic level can be insignificant, if well managed. Recent regulatory and law changes in Montana, and overseas in Germany and

Australia, offer some insight into approaches that can be used to address risks while improving water supply.

4.2.4 Recycled Water

The community strongly supports recycling water as a means to increase water supplies. Existing feasibility studies have identified that recycled water could cost-effectively support the Ocean Colony Golf Courses and agricultural uses.

To develop a recycled water capacity that meets water quality requirements, SAM must upgrade its Wastewater Treatment Plant from secondary treatment to tertiary treatment. Disinfected tertiary treatment requires coagulation/flocculation, filtration, and higher levels of disinfection by either ultraviolet radiation or chlorination. The existing treatment facilities have sufficient space to accommodate additional needed processes.

4.2.5 Water Quality

Water quality is essential to maintaining public health and often is considered a good indicator of the health of riparian habitats. Riparian habitats with native vegetation and dynamically stable stream channels have clean water in which species such as steelhead trout and the California red-legged frog (CRLF) can thrive. Pollutants degrade water quality and associated habitats for endangered and special status species. Thus, water quality for multiple beneficial uses is measured or monitored by tracking the presence of contaminants as well as physical and chemical properties of the water such as temperature and turbidity.

Extensive water quality monitoring in the Pilarcitos Creek watershed resulted in large part from concerns about degraded conditions at Venice Beach, where Pilarcitos Creek enters Half Moon Bay. A detailed investigation of water quality in the Pilarcitos Creek was initiated by the San Mateo County Public Health and Environmental Protection Division (SMCPHEPD) to determine the cause of the conditions at Venice Beach. Both the SMCPHEPD data, and those collected by the Monterey Bay Sanctuary Citizen Watershed Monitoring Network (Network), a consortium of 20 volunteer monitoring groups on the Central Coast, show consistently high fecal coliform counts compared to other coastal streams (Appendix A). The Network data also indicate that trace metals, nitrates, and suspended sediment concentrations were elevated periodically over the period from 2003 to 2006.

4.3 WATERSHED MANAGEMENT ISSUES

Human uses within the watershed are also an important consideration for the IWMP. Sustainable watershed management requires that land use and management practices are consistent with economic needs as well as ecological functions. This section briefly outlines some of these issues.

4.3.1 Community Engagement

Community engagement and support are essential ingredients to success in implementing the management plan. While the Pilarcitos Creek Restoration Workgroup offers an excellent opportunity to involve key stakeholders, there is interest in involving the community at large in ways that can be productive and effective. Greater community involvement will help generate additional support for the various projects recommended in the IWMP. Broad public support can provide additional motivation for policy-makers and funding sources to help achieve watershed management goals.

4.3.2 Beach Quality

The beaches near the Pilarcitos mouth have been documented as having some of the poorest water quality on the central California coast. Beach conditions reflect cumulative water quality conditions from Pilarcitos Creek as well as offshore water quality. Beach water quality can serve as an important indicator of an ecologically sustainable watershed and Steelhead habitat conditions. It also reflects the economic value of Venice Beach and risks to public health, and as such, beach water quality is an important component in the IWMP.

Sources of the poor water quality have not been identified, and are generally difficult to isolate in a large complex watershed. Some public perceptions point to large bird populations, insufficient streamflows, insufficient sewage treatment, and urban runoff from the city of Half Moon Bay. The IWMP and its implemented projects will address poor beach water quality, by improving upstream water quality. Whether or not there will be additional sources of contaminants outside of the watershed context that continue to impair the water quality at the beach remains unclear. These additional sources may or may not be appropriate or feasible to address within the context of the IWMP. Certainly, any identified possible sources of contamination to the watershed at large, such as those identified by the SMCPHEPD, can be addressed.

4.3.3 Landowner Concerns

Private landowner concerns vary widely. Many commercial and residential landowners have water rights in the Pilarcitos watershed, and there is concern over the future of those rights. Landowners are also concerned with upstream land management practices that may affect their

land holdings, particularly as a result of potential flood damage risks. Landowners are also concerned about the increasing problems associated with invasive weeds.

4.3.4 Landfill Issues

There continues to be concern about the effect of the landfill on watershed resources. The large population of birds associated with the landfill may affect water quality. There is also concern about the long-term contamination of groundwater and surface water supplies downstream of the landfill.

5. IDENTIFIED PRIORITY PROJECTS

This section describes projects identified by the Workgroup that address the issues described in Section 4, the Watershed Assessment Update (Appendix A), and data gaps identified by the consultant team. The Workgroup thoroughly reviewed and supports the project list included in this section. This list of proposed projects describes a series of planned activities that will benefit the watershed and help achieve the goals and objectives described in Section 3. Five broad categories of projects are presented here, the top four of which comprise priority projects:

1. **Improvement Projects** – These projects will directly achieve plan goals and objectives. Improvement projects can include restoration, enhancement, site acquisition projects and specific management action projects.
2. **Feasibility Studies** – These studies will support specific watershed improvements, but require additional scientific or engineering analysis before a specific project plan can be developed.
3. **Planning Project**s – These projects will aid overall management of the Pilarcitos watershed, but are not necessarily associated with a specific project. They may require general regulatory review, planning, and stakeholder collaboration projects.
4. **Assessment Projects** – These additional studies, data collection and monitoring projects are necessary to develop specific improvement projects, to guide watershed management and planning activities, or to support adaptive management efforts. They build on the work developed in the Watershed Assessment Update (Appendix A), and focus additional efforts toward priority issues and uncertainties.
5. **Other Projects Considered But Not Developed** – These projects were initially identified and prioritized by the Workgroup, but were subsequently deferred for a variety of reasons. The Workgroup generally recognizes the value that these projects offer, and reserves the opportunity to reconsider these projects in the future as resources permit.

5.1 PROJECT EVALUATION AND IMPLEMENTATION

5.1.1 Project Evaluation

The Workgroup compared proposed projects against a series of criteria. Objective criteria were carefully selected to ensure that projects most likely to achieve IWMP goals and objectives would

rank higher than those with less potential benefit. Workgroup members and the Consultant Team were surveyed to rank projects using the following criteria:

- **Estimated Benefit Versus Cost** – The project's approximate value relative to cost based on the perceptions of the Workgroup.
- **Certainty of Benefits** – A best professional judgment of the likelihood that project benefits will be achieved as a result of the project. In most cases, project benefits depend upon design factors that are beyond the scope of this project to evaluate fully.
- **Stakeholder Support** – The level of support for the project by the stakeholders.
- **Project Synergies** – The degree to which the project creates disproportionately larger benefits when combined with other projects or due to its location at a strategically important site within the watershed. This category can also include cumulative effects benefits.
- **Goals and Objectives** – How many objectives could be addressed by each project (Section 3).
- **Key Watershed Management Issues** – The score describes the number of key watershed management issues that will be addressed by the project (described in Section 4).

In addition to the objective criteria, Workgroup members and the consultant team subjectively scored projects, rating from A (high) to E (low). Combining objective and subjective scores, projects were classified into four tiers. Tier 1 projects received the highest priority ratings and Tier 4 projects received the lowest. The Workgroup reviewed project scoring during a facilitated workshop to validate the appropriate scoring of the projects and made slight modifications based on the group discussion. The results are provided in the table below.

Table 1. Project Ranking Tiers from Highest Priority (1) to Lowest Priority(4)

		RANKING TIER
5.2	**IMPROVEMENT PROJECT SUMMARIES**	
5.2.1	Recycled Water Project	1
5.2.2	Pilarcitos Reservoir and Stone Dam Operational Flexibility Improvement Project	1
5.2.3	Equestrian Bridge	4
5.2.4	Fish Passage Improvement Project	4
5.3	**FEASIBILITY STUDY SUMMARIES**	
5.3.1	Pilarcitos Lagoon Habitat Enhancement Opportunity Study	1
5.3.2	Pilarcitos Creek Watershed Protection Easement Program Feasibility Study	1
5.3.3	Recycled Off-channel Water Storage Feasibility Study	1
5.3.4	Diverted Off-channel Water Storage Feasibility Study	2
5.3.5	Arroyo Leon Pond Sites Conceptual Rehabilitation Restoration Alternatives Study	3
5.4	**PLANNING PROJECT SUMMARIES**	
5.4.1	Watershed Monitoring Program	1
5.4.2	Eucalyptus Control and Removal Planning	3
5.4.3	Stream Habitat Restoration and Enhancement Opportunity Program	3
5.5	**ASSESSMENT PROJECT SUMMARIES**	
5.5.1	Water Budget Development Project	1
5.5.2	Road Assessment Project	1
5.5.3	Geomorphic Channel Assessment	2
5.5.4	Riparian Habitat Restoration and Invasive Plant Eradication Assessment	2
5.5.5	Systematic Watershed-Scale Fish Habitat Assessment Project	3
5.5.6	Assess Habitat Management and Restoration Opportunities for Sensitive Wetland Species	3
5.5.7	Preliminary Arroyo Leon Fish Habitat Assessment	1
5.6	**OTHER PROJECTS CONSIDERED BUT NOT DEVELOPED**	
5.6.1	Water Conservation Program	1
5.6.2	Lower Pilarcitos Streamflow Improvements	1
5.6.3	Tertiary Water Groundwater Recharge	1
5.6.4	Riparian Setback Management Planning	1
5.6.5	Stormwater Impacts Analysis	2
5.6.6	Non-Point Source Pollution Reduction Project	2
5.6.7	Gray Water Utilization Study	3
5.6.8	Stream Restoration and Maintenance Support	3
5.6.9	Fish Habitat Enhancement	3
5.6.10	Watershed-Scale Sensitive Plants and Habitats Assessment	4
5.6.11	Beach Water Quality Sanitary Survey	4

5.1.2 Implementation Strategy

The implementation of the IWMP will continue to be driven by the Pilarcitos Restoration Workgroup and the collaboration among IWMP stakeholders. This section describes the plan to ensure that projects identified in the IWMP will be realized to achieve the goals of the IWMP.

5.1.2.1 Continuation of the Workgroup

Workgroup meetings will be held twice a year at publicly noticed meetings of Workgroup member agencies. The IWMP will be updated every year in order to adjust the plan as needed and to identify specific upcoming tasks and projects. New projects or project descriptions for Phase II projects will be developed in coordination with these meetings, or on an ad-hoc basis as specific opportunities arise. The implementation plan will also be updated annually to reprioritize and update activities that have occurred throughout the year in the watershed. Additional public workshops will be conducted as necessary with project sponsors holding public workshops on their projects as needed. An annual report or newsletter will be prepared and distributed which will highlight the IWMP's progress on meeting its milestones.

5.1.2.2 Lead Agency Responsibilities

Lead agencies will be responsible for developing assigned projects. Development may include obtaining necessary funds, administering contracts, supervising project development, leading collaboration efforts, and communicating with relevant partners and stakeholders. Lead agencies are encouraged to coordinate with collaborators in the development of each project. Lead agencies will also be responsible for reporting on project development and progress, modifying or amending project descriptions, and coordinating among key stakeholders. Lead agency assignments may change as the plan is implemented.

5.1.2.3 Project and Implementation Funding Sources

Lead agencies will be responsible for seeking funding for individual projects. Project funding can be obtained from a wide array of grant resources or direct agency funding. Specific grants or other funding opportunities will be shared among the workgroup members and other stakeholders as opportunities arise. Because of the need to rely on external funding and grant opportunities, project priorities may shift as resources or opportunities become available.

On-going funding or in-kind support requirements for IWMP management, oversight and implementation will be identified by the Workgroup in the early months following adoption of this plan. Such implementation funding and support will provide resources to develop grants,

coordinate among stakeholders, hire contractors and consultants, facilitate issues among workgroup members, develop requests for proposals, develop information resources, and coordinate data. It can also provide staff resources for the workgroup to accomplish tasks that are identified in workgroup meetings. Implementation resources will be particularly important as Phase II project descriptions are developed.

5.1.2.4 Monitoring Plan

Implementation progress monitoring will be addressed under the Watershed Monitoring Program, a Tier 1 project identified by the workgroup. In addition to monitoring the implementation of the IWMP, the Monitoring Program will include effectiveness monitoring, status and trend monitoring, validation monitoring, and resource objectives and performance measures. The program will also establish an adaptive management framework that will help guide management decisions and provide feedback to the workgroup for future decision support. More information is given in the Watershed Monitoring Program description, Section 5.4.1.

5.1.2.5 Timeline and Project Milestones

Measurable milestones for implementation of projects and programs are included in individual project descriptions below. Implementation of the full set of recommendations will address the goals and objectives of the Pilarcitos Restoration Workgroup and the public described in Section 3. The long-term planning horizon of the IWMP supports an adaptive management approach that allows the flexibility to respond to new information, opportunities, and constraints as they arise in order to achieve the desired results that are described in the goals and objectives. A timeline for implementation of individual projects is shown in Table 2.

Table 2. Implementation Plan Timeline

			Project Extent		
			Short-Term	Long-Term	
5.2	**IMPROVEMENT PROJECT SUMMARIES**		*within two years*	*within five years*	*Ongoing*
	5.2.1	Recycled Water Project	■	■	
	5.2.2	Pilarcitos Reservoir and Stone Dam Operational Flexibility Improvement Project	■	■	
	5.2.3	Equestrian Bridge	■	■	
	5.2.4	Fish Passage Improvement Project	■		■
5.3	**FEASIBILITY STUDY SUMMARIES**				
	5.3.1	Pilarcitos Lagoon Habitat Enhancement Opportunity Study	■		
	5.3.2	Pilarcitos Creek Watershed Protection Easement Program Feasibility Study	■		
	5.3.3	Recycled Off-channel Water Storage Feasibility Study	■	■	
	5.3.4	Diverted Off-channel Water Storage Feasibility Study	■	■	
	5.3.5	Arroyo Leon Pond Sites Conceptual Rehabilitation Restoration Alternatives Study	■	■	
5.4	**PLANNING PROJECT SUMMARIES**				
	5.4.1	Watershed Monitoring Program	■		■
	5.4.2	Eucalyptus Control and Removal Planning		■	
	5.4.3	Stream Habitat Restoration and Enhancement Opportunity Program	■	■	
5.5	**ASSESSMENT PROJECT SUMMARIES**				
	5.5.1	Water Budget Development Project	■		
	5.5.2	Road Assessment Project		■	
	5.5.3	Geomorphic Channel Assessment	■	■	
	5.5.4	Riparian Habitat Restoration and Invasive Plant Eradication Assessment	■		■
	5.5.5	Systematic Watershed-Scale Fish Habitat Assessment Project	■		■
	5.5.6	Assess Habitat Management and Restoration Opportunities for Sensitive Wetland Species		■	
	5.5.7	Preliminary Arroyo Leon Fish Habitat Assessment	■		

5.2 IMPROVEMENT PROJECT SUMMARIES

5.2.1 Recycled Water Project

Priority Ranking: Tier 1
Water Body: Pilarcitos Watershed

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
Sewer Authority Mid-Coastside John F. Foley III, Manager 1000 N. Cabrillo Highway Half Moon Bay, CA 94019 (650) 726-0124 (650) 726-7833 Fax jack@samcleanswater.org and Coastside County Water District David R. Dickson, General Manager 766 Main Street Half Moon Bay, CA 94019 (650) 726-4405 (650) 726-5245 Fax ddickson@coastsidewater.org	▪ San Mateo County Resource Conservation District ▪ Farm Bureau ▪ City of Half Moon Bay ▪ POST ▪ Surfrider ▪ SFPUC	Cold freshwater habitat, fish migration, preservation of rare and endangered species, water supply	$5,000,000 to $15,000,000

5.2.1.1 Project Summary

The objective of this project is to increase the available instream water supply by reducing water demand. This project will develop a recycled water program by a) developing tertiary water treatment capacity and b) negotiating agreements with specific customers. Primary users for recycled water include golf courses and various agricultural users within the service area. This project assumes that reduced pumping withdrawals by primary recycled water users will increase water availability for Pilarcitos Creek. This project has received broad public support as indicated by overwhelming approval of a recycled water advisory ballot initiative in November 2005.

5.2.1.2 Project Rationale

Recycled water is treated wastewater that has been adequately oxidized, coagulated, filtered, and disinfected. Proposed uses of the tertiary-treated recycled water include turf grass irrigation (golf courses, parks, etc), agricultural irrigation (crops, cut flowers, nurseries, etc), and possibly stream flow augmentation. This Recycled Water Project assumes that reduced pumping withdrawals by primary recycled water users will increase water availability for Pilarcitos Creek, although direct evidence to this effect has not been developed to date.

5.2.1.3 Project Scope

This project would develop a recycled water customer base, secure commitments and permits, design and construct a treatment facility to produce recycled water and operate the treatment facility. Transmission and/or distribution pipelines to deliver recycled water to the customers will be provided by either by CCWD or specific users.

A study will be conducted to examine developing recycled water facilities to meet California Title 22 tertiary treatment, unrestricted use requirements. The study focuses on identifying potential recycled water users and the treatment process improvements required to meet Title 22 tertiary treatment standards for unrestricted use for a dry-weather flow of 1.65 million gallons per day (mgd) and peak wet-weather flow of 15 mgd. The project will also overview financing alternatives.

The project must comply with the Inland Surface Water, Enclosed Bays and Estuaries Plan (including the State Implementation Plan and California and National Toxics Rule) and the San Francisco Bay Basin Plan. Minimum standards include limits for salt, toxicity, dissolved oxygen, temperature, ammonia, metals and pesticides. In addition, various permits and/or permit revisions would be required to implement this project, as follows:

- A revision to the existing National Pollutant Discharge Elimination System (NPDES) discharge permit would be required because a new discharge location would be added, namely a reuse site. The NPDES permit would also need modifications because the added level of treatment due to water reuse would now need to be approved by the California Department of Public Health.
- A California Coastal Commission Permit is required anytime an agency or person is proposing development within the coastal zone.
- A new NPDES discharge permit would be required if the SAM WWTP selects to change from an ocean discharge to a surface water discharge.

- The Recycled Water Project will require environmental review under the California Environmental Quality Act (CEQA).

SAM is considering two sizing options for the Recycled Water Facility:

Option 1 Year Round Reuse and Winter Ocean Discharge

In this option, all of the current dry-weather flow, 1.65 million gallons per day (mgd), would be treated to Title 22 tertiary unrestricted reuse standards year round. In the summer, the recycled water can be used for irrigation of golf courses and agriculture and in the winter, growers would store the water for their use as needed. Only summer diurnal storage will be provided at SAM's WWTP. Because summer diurnal flow variations include peaks of approximately 3.0 mgd and minimal hourly flows of 0.2 mgd during dry weather, storage would be needed after secondary treatment to equalize high and low flows to a constant feed rate of 1.65 mgd to the tertiary treatment facilities. A consistent flow also helps to optimize the tertiary processes. Because both secondary clarifiers are not needed during dry weather, existing Secondary Clarifier No. 1 can be used as an equalization basin. The clarifier has a volume of 600,000 gallons. It is envisioned that the clarified effluent line exiting Secondary Clarifier No. 1 would be converted to both accept flow and act as equalization storage (in summer months) and discharge flow and act as a clarifier (in winter months). A gate and other revisions would need to be added at the current clarified effluent line discharge to accommodate the seasonal change in basin function. Where pipes from the secondary clarifiers currently join to feed the chlorine contact tank, a diversion structure and secondary effluent pump station would be built to direct flow from the equalization basin to the tertiary facilities. It is also envisioned that the gate located in the aeration-basin splitter box that controls flow to Secondary Clarifier No. 1 would have to be motorized. This would allow the gate to be closed in the summer season and open, as needed, in the winter season.

The produced tertiary water quality should be sufficient to discharge directly to users, irrigation wells, or Pilarcitos Creek, if ultraviolet (UV) radiation is used for disinfection. If chlorine were used for disinfection, the water quality would only be sufficient to discharge to the irrigation wells or users, due to disinfection byproducts associated with chlorine. Aeration Basin No. 4 would be converted to store recycled water produced but not immediately utilized to meet peak demands. A recycled water pump station would be built into the southern end of Aeration Basin No. 4 to pump the recycled water off site. In the winter months when flow is greater than 1.65 mgd, the secondary effluent would be discharged to the ocean as is currently permitted, with 1.65 mgd receiving tertiary treatment for distribution to end users.

Option 2 Seasonal Irrigation and Year Round Stream Flow Augmentation

Under this option, all of the dry-weather and wet-weather flow would be treated to Title 22 tertiary standards and used for irrigation or Pilarcitos Creek augmentation. UV treatment is mandatory for this option. The tertiary facilities would be sized for 3.0 mgd to treat the average wet season flow. Two large storage tanks would be installed to hold flow in excess of 3.0 mgd until it could be treated. These tanks would hold about 7.0 million gallons (MG) to accommodate a 10-year storm event. As in Option 1, in the dry season, one of the secondary clarifiers would be used as an equalization basin to optimize the tertiary processes by providing a steady flow. In the wet season, both secondary clarifiers would be used for treatment. Flow would be directed to the tertiary facilities from two locations:

1. A diversion structure/pump station built where pipes from the secondary clarifiers currently join to feed the chlorine contact basin. The diversion structure and pump station would allow the chlorination step to be omitted in the dry season, when the tertiary facilities can handle the maximum flow and storage would not be needed.

2. The 3.5-million-gallon holding tanks. Since the storage tanks may hold water for longer than several days, the flow to be stored would need to be chlorinated. Option 2 requires a 15-mgd pump station be built in the chlorine contact basin to pump to the holding tanks. Another pump station, sized at three mgd, would be needed to lift water from the storage tanks to the tertiary facilities as the water level in the tank would often fall below the 25-foot height of the tertiary facilities.

As in Option 1, revisions to seasonally convert Secondary Clarifier No. 1 would be required for Option 2. In addition, as in Option 1, recycled water produced but not immediately utilized would be stored in the existing Aeration Basin No. 4.

A recycled water pump station will be required to convey recycled water from the recycled water storage basin (converted Aeration Basin No. 4) to the customers. In these options, it is assumed that recycled water will be pumped to the well field, across Pilarcitos Creek that is currently used by the golf courses. The pump station can be located in the southern corner of the recycled water storage basin.

Implementation Schedule

For the long-term schedule, pilot testing of filtration systems is estimated to take about six months and design/bid/award is estimated to take about 12 months. Construction is estimated to take approximately 12 months. While there may be unforeseen issues that may arise than can delay the project, it will likely take two years to complete project permitting, public outreach, and

comment periods, although some permitting can be done concurrently with the design. In approximately three years, the SAM WWTP could be producing recycled water that meets Title 22 unrestricted use requirements.

Additional Implementation Issues

Administrative and financial details are essential for this recycling project. Financing and funding of the project will be considered in revenue programs, grants, and loans. The added administrative implementation details include:

- Negotiate and prepare reuse agreements with customers.
- Prepare Engineering Report for the Permit Application with the California Public Health Department.
- Develop customer rules and ordinances.
- Conduct cross connections tests and certification.
- Extensive public outreach.

5.2.1.4 Project Benefits

The project will meet California Title 22 tertiary treatment, unrestricted use, requirements, and may therefore provide water suitable to a number of uses. The project may increase the net usable supply of water to users within the Pilarcitos watershed. While it is not clear specifically how the recycled water project can directly benefit salmonid habitat in Pilarcitos Creek, the Workgroup believes that the increased supply will reduce pressure on direct water supplies from Pilarcitos Creek, and thus it will yield substantial indirect benefits to the watershed. Recycled water supplies also increase availability of water to these users during periods of drought, thus providing supply reliability. Recent feasibility studies (Carollo 2005, 2002) indicate that a supply of recycled water is safe and feasible.

5.2.1.5 Project Milestones

Obtain funding ♦ Contract for design development ♦ Develop alternatives ♦ Conceptual design ♦ Final design ♦ Permitting ♦ Bid solicitation ♦ Construction ♦ Monitoring

5.2.2 Pilarcitos Reservoir and Stone Dam Operational Flexibility Improvement Project

Priority Ranking: Tier 1
Water Body: Pilarcitos Creek middle reach

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
San Francisco Public Utilities Commission Jim Salerno 1657 Rollins Rd Burlingame, CA 94010 (650) 652-3125 jsalerno@sfwater.org	▪ CCWD ▪ San Mateo County Resource Conservation District	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, and wildlife habitat	n/a

5.2.2.1 Project Summary

This project will provide spring and summer/fall flows below Stone Dam to improve adult steelhead passage and summer rearing of juvenile steelhead in the two miles between Stone Dam and the CCWD well field.

5.2.2.2 Project Rationale

The project will modify the water right to allow the recovery of all or a portion of the dry-season bypass flows at the CCWD well field for water supply purposes. It will evaluate and design infrastructure improvements that can support flow management and will provide operational guidelines that direct flow releases and support water supply management objectives.

This project will evaluate opportunities for accessing dead storage in Pilarcitos Reservoir that could be used to improve overall water supply conditions for fisheries and other uses. Dead storage is the volume of water that exists within Pilarcitos Reservoir below the water supply intake structures. Key factors that need to be considered include the water quality in low limnological horizons within the lake, the cost and feasibility of structural improvements, and the potential benefits to instream flows and/or general water availability.

5.2.2.3 Project Scope

The purpose of the project is to improve operational flexibility of water system infrastructure in the Pilarcitos Creek watershed to deliver water to CCWD and maintain good environmental conditions in the reservoir and below Pilarcitos and Stone Dams. The project features include:

1. A low-head pump that will allow water from the reservoir to be pumped over the spillway and flow down Pilarcitos Creek to Stone Dam, where it can be diverted to CCWD and flow over Stone Dam to support native fishes;
2. An aeration system for the reservoir that will avoid anoxic conditions and maintain good water quality conditions; and
3. Improvements to the spillway flashboards at Stone Dam that will allow for their safe operation and minimize maintenance. This improved operational flexibility will allow water to be pumped from the reservoir for release into upper Pilarcitos Creek after the water level has dropped below the spillway (but only until the reservoir level reaches a minimum pool volume/depth, as conditions allow).

The intent is to allow more water to flow down Pilarcitos Creek to Stone Dam, where some will be diverted to CCWD and some will continue downstream below Stone Dam to support native fishes. Absent these improvements, in dry years when water in the reservoir drops below the spillway, Pilarcitos Creek below Pilarcitos Dam and Stone Dam will not receive water from the reservoir.

SFPUC will engage in technical analyses and appropriate permitting activities to implement this project scope.

5.2.2.4 Project Benefits

Low summertime instream flows have been identified as one of the critical limiting factors affecting fish habitat in lower Pilarcitos Creek. The project will improve adult steelhead passage and summer rearing for juvenile steelhead in a reach with relatively good stream substrate conditions and that historically has had low-flows or becomes intermittent in summer. The enhanced steelhead summer rearing habitat from this project below Stone Dam will mitigate loss of steelhead habitat above Stone Dam. Access to what is presently dead storage in Lake Pilarcitos could provide a significant stored water resource in support of higher summertime instream flows in Pilarcitos Creek below Stone Dam.

5.2.2.5 Project Milestones

The Pilarcitos Creek Operational Flexibility Improvement Project will be designed, funded and implemented in its entirety by the SFPUC. The SFPUC intends to finalize plans during the next few months, and to complete the project by October 2009. Stream flow monitoring data, currently available at the USGS gage below Stone Dam, will be used to evaluate project implementation.

5.2.3 Equestrian Bridge

Priority Ranking: Tier 4
Water Body: Lower Pilarcitos Creek

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
California State Parks Joanne Kerbavaz 95 Kelly Ave. Half Moon Bay, CA 94019 (650) 726-8805 jkerb@parks.ca.gov	▪ San Mateo County Resource Conservation District	Fish migration, preservation of rare and endangered species, fish spawning, and wildlife habitat	$400,000 to $700,000

5.2.3.1 Project Summary

The project will install an equestrian bridge where an existing horse trail passes through Pilarcitos Creek, just upstream of the beach.

5.2.3.2 Project Rationale

The existing horse trail allows horses to cross the creek and surrounding riparian area. Horse traffic can cause erosion of the stream bank and bed, which could add sediment to the stream. Horse manure and urine deposited directly in the creek has the potential to affect water quality.

5.2.3.3 Project Scope

The project will develop a design for an equestrian bridge and fund permitting, environmental review, construction, and maintenance of an equestrian bridge. If necessary, the project will include the relocation of the existing trail to a more appropriate location for the river crossing.

5.2.3.4 Project Benefits

The project will reduce impacts from animal traffic on the creek banks and bed, and will reduce the direct input of animal waste.

5.2.3.5 Project Milestones

Obtain funding ♦ Develop design alternatives ♦ Select design ♦ Permitting ♦ Construction bid solicitation ♦ Construction

5.2.4 Fish Passage Improvement Project

Priority Ranking: Tier 4
Water Body: Arroyo Leon, Mills Creek, Apanoilo Creek,

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
San Mateo County Resource Conservation District Kellyx Nelson 625 Miramontes Street, #103 Half Moon Bay, CA 94019 (650) 712-7765 kellyx@sanmateorcd.org	▪ NOAA Fisheries ▪ CA Department of Fish and Game	Fish migration, preservation of rare and endangered species, fish spawning, and wildlife habitat	TBD

5.2.4.1 Project Summary

This project will continue to evaluate opportunities to improve fish passage throughout the watershed. There are currently six known fish passage barriers within the watershed. In some cases, past efforts at mitigating fish passage have met limited success. In other cases, the benefits of improving passage may not warrant the cost.

Restoring fish passage at these sites will require a comprehensive site analysis, including a geomorphic, hydraulic, and hydrologic assessment based on calculations of critical thresholds. The site assessments should include site surveys to develop quantitative information necessary to support critical entrainment threshold calculations. A site drawing or diagram should be developed to support a site engineering assessment for each site. Each project assessment should lead to a recommended treatment option and cost estimate, and each project will require permitting and construction considerations.

The sites identified below will be evaluated as funding, landowner support, and available resources permit. The locations of these projects can be found in Figure 2 and Figure 3, which also show the assessed steelhead spawning and rearing habitats respectively. Habitats in these areas were characterized in the Pilarcitos Watershed Assessment Update (Appendix A).

5.2.4.2 Lower Arroyo Leon Creek Upstream of Mills Creek

This site requires reconstruction of the lower vortex weir on Arroyo Leon just upstream from the Mills Creek confluence by replacing dislodged boulders and constructing a more stable grade control structure downstream of the driveway weir and above the downstream bend. Design modifications may include weir packing or other methods to stabilize existing boulders. The design will address channel incision and establish slope protection along the right (north) bank

upstream of the weir. The design should also identify culvert and riparian vegetation improvements to stabilize current hillslope failure and stream sedimentation. Hillslope toe protections may also be necessary at the outside of the sharp bend immediately upstream of the driveway bridge.

Project Rationale

This site was evaluated by Alley (2007b), and is discussed in the Watershed Assessment Update (Appendix A). Improving fish passage will improve and maintain fish access to the upper portion of Arroyo Leon over a wider range of storm flows and prevent further erosion and sedimentation of the creek. Figures 2 and 3 characterize spawning and rearing habitat upstream of the site. Spawning habitat upstream of this barrier has been rated as "Poor to Fair" to Higgins Road. Rearing habitat upstream of the barrier to Higgins Road has been rated "Fair." Spawning and Rearing habitat upstream of Higgins Road has been rated "Fair," but limited data exists here.

5.2.4.3 Mills Creek at the Historic Bridge

Alley (2007b) evaluated a drop structure at a perched historic bridge on Mills Creek that had previously been identified as a barrier (PWA, 1996). PWA performed a brief engineering and geomorphic evaluation at the site on January 29, 2008. Both of these evaluations are described in more detail in the Watershed Assessment Update (Appendix A).

The bridge has provided grade control for the upper reaches of Mill Creek, stabilizing it at a slope of roughly one percent. The step structures are providing a fair amount of heterogeneity in the channel between weirs 4 through 2, where the drop heights are roughly 1 to 1.5 ft. There are jump barriers to adult steelhead at weirs 6, 5, 4 and 1. Fish passage through the culvert under the historic bridge also is extremely difficult and probably limited to a narrow range of high flows.

Project Rationale

Alley (2007b) made recommendations that could provide near-term fish passage. Grout may not be a viable alternative with such short step spacing due to extreme hydraulic forces on downstream steps at high flows. Several dislodged grouted-boulder specimens were observed downstream of the project area, demonstrating that this approach may not be effective. A comprehensive hydrologic and hydraulic analysis should be undertaken to determine adequate fish passage remedies relative to site constraints. Possible solutions to remediate the conditions at the historical bridge site might include:

- Fill pools with large material to create a "roughened channel." This may not be supported by permitting agencies and design depths and velocities for fish passage flows may not be able to be met.
- Raise height of step 5. Fill in pool below step 5 and construct a short riffle of tightly interlocked material. Construct a riffle below step 1 using large boulders with a wide gradation of gravel and angular rock.
- Build additional weir(s) downstream of weir 6 to lessen overall relief. Repair existing weir crests with a minimum of one-ton rock.
- Remove weirs 5, 4, and 2 and redistribute steps further downstream to increase step spacing.

Modification of this project will provide adult steelhead passage past the historic bridge to at least one mile of spawning and rearing habitat upstream. An onsite biological assessment (Alley 2007b) judged it biologically unnecessary to make the site passable to juvenile steelhead. As shown in Figure 2, spawning habitat upstream of this barrier has been rated "Fair" and "Poor-Fair." Rearing habitat, shown in Figure 3, has been rated as "Fair" and "Poor-Fair."

5.2.4.4 Barrier 2 on Apanolio Creek

This site contains a passage barrier immediately downstream of a dam on Apanolio Creek that limits adult steelhead access to the entrance of an inclined culvert through the dam. Modifying the culvert for adult steelhead passage at this dam can allow steelhead to spawn upstream of the dam and use the pond for juvenile summer rearing, assuming that downstream barriers are also addressed.

In addition to the engineering assessment for this site, this project may also benefit by developing guidelines for operation of the impoundment to support upstream adult steelhead passage, downstream smolt passage and juvenile steelhead rearing within the pond.

Project Rationale

If downstream barriers are also improved, modifying the culvert for adult steelhead passage at this site can support improved steelhead access to spawning upstream of the dam and improved juvenile summer rearing in the pond. Juveniles reared in this pond can be expected to reach smolt size their first year and in might significantly exceed the numbers of fish produced in the remainder of Apanolio Creek. Beneficial operation of the Apanolio Pond for steelhead rearing could help mitigate the loss of valuable Pilarcitos lagoon habitat. As shown in Figures 2 and 3, Habitat at this reach of Apanoilo Creek has been rated as "Poor-Fair" for spawning and "Good"

for rearing. If the pond does not continue to operate in the future, rearing habitat would most likely be classified as "Fair."

5.2.4.5 Apanolio Flashboard Dam and Apron Removal, Downstream of the BFI Property Line

This site includes an existing flashboard dam and apron and an unstable (incising) channel grade. Channel downcutting below the concrete apron at an unused flashboard dam has produced a nearly impassable barrier to migrating adult steelhead (Alley 2007a). The apron should be removed to prevent further downcutting, and the channel grade should be stabilized.

Project Rationale

This project would remove a fish passage barrier, reduce sediment production from further downcutting, and improve downstream habitat if the pond continues to operate. If the downstream Barrier 1 were modified, this project would allow steelhead access to an additional one mile of potential steelhead habitat of relatively low quality before encountering the first of four barriers on BFI Property (Alley 2007a). As shown in Figures 2 and 3, spawning habitat has been rated as "Fair" upstream of this site, and rearing habitat has been rated as "Poor".

5.2.4.6 Barrier 3 on Apanolio Creek

The recently installed boulder weirs at Barrier 3 on Apanolio Creek may require maintenance based upon the observations of boulder transport at similar structures on Arroyo Leon and Mills Creek in 2007 (Alley 2007b).

Project Rationale

Observations of channel widths upstream suggest that the reconstructed channel is likely to widen after storm flows to more than five feet. Modifications might include approaches to stabilize the existing boulder weirs, with particular attention to the stability of the weir boulders and boulders keyed into the streambanks. The weirs should be re-evaluated after large peak flows (e.g., approximately bankfull stage) to assess upstream fish passage opportunities, particularly at the lowermost weir.

Maintenance of the recently installed weirs will ensure steelhead passage past the new bridge after downstream barriers have been removed. A relatively short stretch of stream is made available by this project because the flashboard dam apron upstream (see 5.2.8) has become a substantial passage barrier due to downcutting below the apron in the last 10 years. As shown in Figures 2 and 3, spawning habitat has been rated as "Poor-Fair" immediately upstream of this site, and rearing habitat has been rated as "Fair."

5.2.4.7 Barrier 1 on Lower Apanolio Creek

This project would re-evaluate existing fish-passage improvement designs for the first barrier on Apanolio Creek given the failure of similar implemented designs on Mills Creek and Arroyo Leon (Alley 2007b).

Project Rationale

Designs have been completed for boulder weir passage at the first barrier on Apanolio Creek to provide passage past a diversion structure. Design modifications should consider methods of stabilizing existing boulders.

Passage at this barrier will likely allow steelhead access upstream to near the BFI property line in wetter years, including potentially rearing juvenile steelhead in the Apanolio Pond (Barrier 2). Much of the benefit depends upon operating the Apanolio Pond for steelhead rearing, as the amount and quality of accessible stream habitat is low. In general, the recommendations for Apanolio Creek barrier modifications in PWA (1996) were based on the potentially high rearing potential in the pond and on the expectation that habitat on BFI property was accessible and of relatively good quality. Assessment in 2007 (Alley 2007b), however, found relatively poor habitat and significant barrier problems just downstream of BFI property and on the BFI property. As shown in Figures 2 and 3, spawning habitat has been rated as "Poor" immediately upstream of this site, and rearing habitat has been rated as "Fair."

5.2.4.8 Project Milestones

Obtain funding ♦ Contract for design development ♦ Develop alternatives ♦ Conceptual design ♦ Final design ♦ Permitting ♦ Bid solicitation ♦ Construction ♦ Monitoring

5.3 FEASIBILITY STUDY SUMMARIES

5.3.1 Pilarcitos Lagoon Habitat Enhancement Opportunity Study

Priority Ranking: Tier 1
Water Body: The Pilarcitos Creek Watershed, Apanolio Creek, Pilarcitos Creek, Pacific Ocean

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
San Mateo County Resource Conservation District Kellyx Nelson 625 Miramontes Street, #103 Half Moon Bay, CA 94019 (650) 712-7765 kellyx@sanmateorcd.org	▪ NOAA Fisheries ▪ CA Department of Fish and Game ▪ California State Parks	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, and wildlife habitat	$150,000 to $250,000

5.3.1.1 Project Summary

This project will address two goals: 1) evaluate the controlling factors affecting the morphology and habitat of the Pilarcitos Lagoon and 2) explore the potential for improving adult and smolt fish passage and enhancing habitat conditions at the lagoon. While the primary focus will be on fish species of special concern (steelhead and tidewater goby), the analysis will also consider the potential to benefit or affect other species and communities, particularly other species of concern (e.g., red-legged frog, western snowy plover).

5.3.1.2 Project Rationale

Lagoons/estuaries provide important spring and summer rearing habitat and saltwater transition habitat for smolting steelhead (juvenile steelhead migrating to the ocean) in many coastal watersheds. For Pilarcitos Creek, the lack of summer stream flow to the mouth prevents the development of a lagoon in all but the wettest years, limiting fish passage as well as habitat. Another constraint on fish passage results from the movement of the outlet of the creek. Migration of the mouth can create a long reach with very shallow flow, directly limiting passage and facilitating fish predation by birds. Even in systems where summer water is available, the beach configuration and sandbar dynamics are major factors in the quality of a lagoon for steelhead rearing in spring and summer. Lagoons support salt-water acclimation, which improves smolt survival upon ocean entry. Sandbar dynamics are also a factor in lagoon ecology, with early summer sandbar formation damming up inflow and producing productive, mixed, (but often relatively warm) freshwater lagoons. Not only does Pilarcitos Creek normally lack a summer

lagoon, due to lack of inflows, but it also does not provide a spring feeding or salt water transition habitat for smolts because of a lack of residual depth when the sandbar is not in place. Small smolts produced in upstream portions of the watershed probably have minimal transition habitat and low ocean survival.

There is significant interest in restoring functional estuary conditions in the historic lagoon location. This idea has a number of technical challenges. Sufficient inflows in excess of seepage through the sandbar are necessary to maintain adequate habitat depth in the lagoon during the summer and fall. Potential structural improvements to support a more functional lagoon are constrained by physical limitations at the site and the risk of harming the timing and success of smolt migration. A restored lagoon may also need to address predation concerns, warm water temperatures, and other water quality issues. There must be sufficient lagoon inflow to sustain a freshwater environment in the lagoon. Otherwise, the saltwater lens that typically develops on the lagoon bottom will limit rearing habitat for steelhead in the lagoon. Identifying a feasible approach to overcome these challenges requires a focused analysis of opportunities and constraints.

Investigation of the potential opportunities and constraints for restoring or creating a functional lagoon at the mouth of Pilarcitos creek is both essential and timely. Commitments are currently being made by the San Francisco Public Utilities Commission for enhanced flows below Stone Dam. Other opportunities to enhance flows in Pilarcitos Creek are also being explored. The lagoon-enhancement opportunity project is closely linked to associated restoration efforts within the watershed being pursued under the umbrella of the Pilarcitos Integrated Watershed Management Plan.

5.3.1.3 Project Scope

The investigation will contain four primary components:

1. Developing an understanding of historic lagoon and coastal conditions and evolution to help identify key factors controlling lagoon form and function;
2. Evaluating current conditions and seasonal cycles of lagoon functioning at Pilarcitos and in comparison to other central coast watersheds, including terrestrial and aquatic species habitat utilization investigation and assessment;
3. Identifying opportunities and constraints for lagoon habitat enhancement, as well as management and regulatory considerations; and
4. Formulating draft conceptual enhancement alternatives and assessing their potential habitat benefits and other anticipated resource and habitat responses.

The first project task will identify the historical (pre-development) characteristics of the lagoon in terms of physical form, habitat conditions (to the extent possible), and land use patterns including physical, biological, and chemical components. The context for existing conditions will be informed by a historical reconstruction using available aerial photographs, surveys, maps, and historical accounts. These resources will guide geomorphic and ecological interpretations of those seasonal processes and key events that have influenced the changing dynamic condition of the lagoon over time. Factors that will be considered will include local land-use, nearshore littoral cell dynamics, coastal and fluvial geomorphic processes, ecological successional dynamics, local groundwater conditions, and seasonal and annual surface water conditions. Through spatial analyses of historic maps and air photos and supplemented with historic accounts and literature review, this task will develop a historical timeline of changes in the watershed and littoral cell.

The second project task will be to evaluate the seasonality of the physical coastal and watershed processes that presently influence the lagoon including the cycles in beach dynamics, tidal prism, stream flow and temperature and salinity changes. This evaluation will lead to a better understanding of the processes that regulate the opening and closing of the bar-built estuary and control the habitat quality at different times of the year. For example, at least an approximate understanding of the following elements may be necessary to assess the feasibility of lagoon habitat enhancement: location and size (area) of the estuary/lagoon; available seasonal freshwater inflows; interaction of lagoon water supply with groundwater; freshwater inflows; ocean conditions; and tide ranges needed for lagoon breaching; littoral cell sediment dynamics, including sand supply and transport for bar formation; and sediment supply from the watershed that is delivered to the mouth. Pilarcitos Lagoon is a bar-built estuary that is similar to other Central Coast estuaries (e.g., Pescadero, Waddell, and Scotts Creeks). Studies of similar systems may provide insight into opportunities and constraints at Pilarcitos Lagoon or approaches to defining them.

Based on the first two tasks leading to an understanding of the various processes involved in regulating the breaching of the lagoon, the third project task will develop description of project opportunities and constraints. Study investigators will develop a conceptual model linking observed evolution of the lagoon from historic to present day conditions to known or hypothesized changes in habitat conditions. This conceptual model of lagoon evolution will then be used to help identify opportunities and constraints for habitat enhancement within the present day and potential future system conditions. Analyses of coastal and watershed processes, obstructions, and material fluxes are required to understand whether a factor may pose a major constraint on the feasibility of habitat enhancement. This task will also identify key management and regulatory concerns of the stakeholders, including the landowner, California State Parks, and resource management agencies.

The fourth project task will use the information generated in the first three tasks to develop broad lagoon-habitat enhancement alternatives. Each alternative will be described in terms of habitat benefits, relative costs, pros/cons, and project uncertainties.

Deliverable: A report that will provide a basis for developing a technically-sound lagoon ecosystem function enhancement project in a subsequent phase.

5.3.1.4 Project Benefits

This project will provide the basis for determining what, if any, lagoon fish passage and habitat enhancement approaches have the potential to provide significant benefits for fish or other species of concern and should therefore be considered for future development as a watershed enhancement project.

5.3.1.5 Project Milestones

Obtain funding agreement ♦ Bid solicitation ♦ Contractor selection ♦ Develop TAC ♦ Draft report ♦ Final report

5.3.2 Pilarcitos Creek Watershed Protection Easement Program Feasibility Study

Priority Ranking: Tier 1
Water Body: The Pilarcitos Creek Watershed

Implementation Leads	Collaborators	Beneficial Uses	Estimated Cost
POST Paul Ringgold 222 High Street Palo Alto, CA 94301 (650) 854-7696 pringgold@openspacetrust.org and Farm Bureau Tim Frahm 315 Magnolia Half Moon Bay, CA 94019 (650) 560-0232 timfrahm@hotmail.com	▪ RCD ▪ CCWD ▪ SFPUC	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	$25,000 to $40,000

5.3.2.1 Project Summary

A Watershed Protection Easement Program will provide opportunities for sustained landscape management benefits while providing willing landowners appropriate compensation for applying resource conservation protections along their lands.

5.3.2.2 Project Rationale

This project would explore the feasibility of developing, expanding or applying a conservation easement program within the Pilarcitos Creek Watershed. It would evaluate any existing easement projects within the watershed and study examples of comparable programs featuring typical projects that demonstrate potential for restoring riparian habitat on private land along steelhead bearing streams. It would investigate current San Mateo County Ordinances and Local Coastal Program stipulations designed to protect riparian habitat, identify any potential barriers to implementation of these regulations, and locate sites where the riparian corridor has been adequately protected through these measures.

5.3.2.3 Project Scope

This Feasibility Study would explore opportunities for the development and implementation of a voluntary Watershed Protection Easement Program within the Pilarcitos Creek Watershed. For

the purposes of this feasibility study, Watershed Protection Easements may include flood-way, riparian or conservation easements within the riparian channel or in associated upland landscapes within the watershed. This feasibility study would:

1. Provide examples (as background) of comparable programs featuring typical projects that demonstrate potential for restoring riparian habitat on private or public land along streams that support populations of steelhead and other sensitive species.

2. Provide examples of floodway, riparian or conservation easement language used in other models.

3. Detail current sources and feasibility of funding watershed protection easements.

4. Detail current San Mateo County and City of Half Moon Bay ordinances and Local Coastal Program stipulations designed to protect riparian habitat.

5. Identify existing Watershed Easement Protection projects within the watershed, including mapping of the following:
    a. Existing patterns of private and public ownership within the watershed and
    b. Existing floodway, riparian or conservation easements within the watershed.

6. Based on existing protections (4 and 5 above), make a "determination of need" (i.e., would Pilarcitos Creek Watershed benefit from a Watershed Protection Easement Program?). If the program is determined to be needed, then continue to the next step.

7. Develop a method of identifying priority reaches of the watershed to assist in the development of a resource-based strategy for easement negotiation and acquisition. Inputs to this process would include:
    a. GIS mapping layers, including
        i. Private/Public ownership (5-a)
        ii. Existing easements (5-b)
    b. Comparison of sinuosity from the 1950's with conditions today
    c. Reaches of stream identified as high, fair or low value for rearing and spawning for steelhead
    d. When available, reaches of stream identified for other resource values (such as other riparian wildlife and water quality)

e. Level of threat to flood-way or inundation from Pilarcitos Lake and Stone Dam breach reports.

8. Based on the existing protections (4, 5-a, 5-b) and the GIS mapping layers, the Study would determine:
   a. Gaps in protection (either location gaps or resource gaps) and
   b. Priority resource reaches that are "unprotected" or "under protected."

5.3.2.4 Project Benefits

A conservation easement program can provide opportunities for sustained landscape management benefits while providing landowners appropriate compensation for applying conservation protections along their lands.

5.3.2.5 Project Milestones

Identify sources of funding for consultant (POST to provide in-kind support in the form of information and mapping layers described in Project Scope Items #5 and 7) ♦ Issue RFP ♦ Contract for feasibility study ♦ Review assessment of existing protections to make "determination of need" ♦ If "determination of need" deems program necessary/useful, develop method for identification, prioritization and funding sources for easement projects ♦ Issue final report and recommendations

5.3.3 Recycled Off-channel Water Storage Feasibility Study

Priority Ranking: Tier 1
Water Body: The Pilarcitos Creek Watershed

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
Farm Bureau Tim Frahm 315 Magnolia Half Moon Bay, CA 94019 (650) 560-0232 timfrahm@hotmail.com	▪ Sewer Authority Mid-Coastside ▪ CCWD ▪ POST ▪ RCD	Water supply, agricultural uses, cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	$TBD

5.3.3.1 Project Summary

This feasibility study would explore opportunities for funding, permitting and constructing, managing and maintaining off-channel impoundments within the Pilarcitos Creek Watershed when the source of the stored water comes from treated wastewater from the Sewer Authority Mid-Coastside (SAM) Recycled Water Project.

5.3.3.2 Project Rationale

Availability of off-channel water impoundments can help farmers reduce their reliance on direct summer stream diversions for irrigation in order to increase dry season stream flows for the benefit of instream habitat for fish and other species.

Recycled water will be generated year round by the SAM Recycled Water Project but the primary irrigation demand for the water is limited to the summer/fall months. In order to maximize the use of the recycled water, storage ponds would be constructed to impound recycled water produced during the winter months (low demand months) for use during the high demand months.

5.3.3.3 Project Scope

The feasibility study is intended to identify permitting pathways, estimated costs of permitting and construction, and available sources of funding for construction of the ponds and the infrastructure needed to transport the treated water from the SAM facility to the storage ponds.

This feasibility study will accomplish the following:

1. Provide examples of comparable projects elsewhere in the state of California, along with assessments of what did and did not work.
2. In coordination with any other past or current water supply and demand studies in the Pilarcitos Watershed, provide a determination of need and or interest.
3. Identify opportunities for pond locations in the Pilarcitos Watershed. Issues to consider include proximity to demand and feasibility of delivery infrastructure.
4. Investigate current sources and feasibility of funding.
5. Investigate current regulatory authorities that can be used to facilitate the creation of an off-channel storage project or authorities which may prevent such a project (including water rights, water quality, Recycled Water Treatment Regulations California Code of Regulations (Title 22), species considerations (DFG, USFWS), local and regional land use regulations (City of Half Moon Bay and County of San Mateo zoning, General Plan and Local Coastal Plans).

5.3.3.4 Project Benefits

Improved water storage can provide opportunities for sustained landscape management benefits by providing landowners with water supply options that are not limited by seasonal flow conditions.

Identify sources of funding for project ♦ Issue RFP if not conducted by project leads ♦ Contract for and or conduct feasibility study ♦ Discuss outcome of initial investigations with Project Leads and Project Collaborators and solicit input ♦ Discuss outcome of initial investigations with Work group and solicit input ♦ Issue final report and recommendations

5.3.4 Diverted Off-channel Water Storage Feasibility Study

Priority Ranking: Tier 2
Water Body: The Pilarcitos Creek Watershed

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
POST Paul Ringgold 222 High Street Palo Alto, CA 94301 (650) 854-7696 pringgold@openspacetrust.org and Farm Bureau Tim Frahm 315 Magnolia Half Moon Bay, CA 94019 (650) 560-0232 timfrahm@hotmail.com	▪ RCD ▪ CCWD	Water supply, agricultural uses, cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	approx. $50,000 (rough estimate)

5.3.4.1 Project Summary

This feasibility study would explore opportunities for the funding, permitting and constructing, managing and maintaining off-channel impoundments within the Pilarcitos Creek Watershed when the source of the stored water comes from diverting "natural sources," including overland run-off, groundwater extraction and or winter diversion of streamflow from the main stem of Pilarcitos Creek or from tributaries of Pilarcitos Creek. The feasibility study is intended to identify permitting pathways, estimated costs of permitting and construction, and available sources of funding for a pilot project or projects in the Pilarcitos Creek Watershed.

5.3.4.2 Project Rationale

Availability of off-channel water impoundments can help farmers reduce their reliance on direct summer stream diversions for irrigation in order to increase dry season stream flows for the benefit of instream habitat for fish and other species.

These projects are expected to benefit both fish (and other sensitive species) and farmers, as well as to help resource agencies meet their species and habitat protection goals. The projects would benefit steelhead populations by increasing streamflows during critical, dry summer months (increased summer flows would result from reduced summer demand from the creek or from groundwater). Farmers would benefit from both a more reliable irrigation supply and increased

regulatory certainty about their diversions. The regulatory agencies would benefit by achieving their species and habitat protection objective of reducing stream diversion during the summer low-flow months without having to take costly, and often protracted, regulatory enforcement action.

5.3.4.3 Project Scope

The project will explore three types of storage ponds, with the intention of establishing a template for permitting, construction, management and evaluation that can be used by landowners to effectively permit and design storage facilities.

A. Hill Ponds/Stock Ponds that fill with winter runoff (less than 10 ac-ft)

B. Irrigation Ponds that fill with winter runoff (up to 49 ac-ft)

C. Irrigation Ponds that fill with winter stream diversions from Pilarcitos Creek main stem or tributaries.

This feasibility study would include the following:

1. Provide a synthesis of the efforts to date that have been made by local landowners, Farm Bureau, Resource Conservation District, agencies, and other key partners such as the State Coastal Conservancy, Sustainable Conservation and Trout Unlimited on pursuing pilot projects in San Mateo county.
2. Provide examples of comparable projects elsewhere in the state of California, along with assessments of what did and did not work.
3. Identify opportunities for a pilot project(s) in the Pilarcitos Watershed.
4. Investigate current sources and feasibility of funding off-channel storage projects.
5. Investigate current regulatory authorities that can be used to facilitate the creation of an off-channel storage project.
6. In coordination with any other past or current water supply and demand studies in the Pilarcitos Watershed, provide a determination of need for additional off-channel storage.

5.3.4.4 Project Benefits

Improved water storage can provide opportunities for sustained landscape management benefits by providing landowners with water supply options that are not limited by seasonal flow conditions.

5.3.4.5 Project Milestones

Identify sources of funding for consultant ♦ Issue RFP ♦ Contract for feasibility study ♦ Discuss outcome of initial investigations with Pilarcitos IWMP work group and solicit input regarding Pilarcitos watershed pilot project opportunities ♦ Issue final report and recommendations

5.3.5 Arroyo Leon Pond Sites Conceptual Rehabilitation Restoration Alternatives Study

Priority Ranking: Tier 3
Water Body: Arroyo Leon Creek

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
San Mateo County Resource Conservation District Kellyx Nelson 625 Miramontes Street, #103 Half Moon Bay, CA 94019 (650)712-7765 kellyx@sanmateorcd.org and POST Paul Ringgold 222 High Street Palo Alto, CA 94301 (650) 854-7696 pringgold@openspacetrust.org	▪ NOAA Fisheries ▪ CA Department of Fish and Game	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, and wildlife habitat	$45,000 to $120,000

5.3.5.1 Project Summary

This project will identify habitat improvement alternatives that will integrate with dynamic ecological and geomorphic processes to restore a productive natural channel environment along the reach of Arroyo Leon near where the ponds historically operated. The primary focus will be to restore summer rearing habitat for steelhead while retaining fish passage for both adults and juveniles. Secondary goals include the maintenance of quality riparian habitat and enhancing California red-legged frog (CRLF) habitat.

5.3.5.2 Project Rationale

The former instream pond system on Arroyo Leon Creek has been shown to provide summer rearing habitat supporting high densities of large, fast growing juvenile steelhead. The operation of these ponds was stopped after 2001 by NOAA Fisheries and CDFG in response to concerns regarding fish passage and requirements under the Endangered Species Act. This project would rehabilitate the stream along the reach where the ponds formerly operated. The project would: 1) improve summer rearing habitat for juvenile steelhead, and 2) provide downstream passage for steelhead smolts. The project could also identify the feasibility of off-channel water-storage (see Section 5.3.4) to provide summer water supply for irrigated cropland in a manner that does not

affect steelhead. Secondary goals would include riparian habitat restoration and California red-legged frog (CRLF) habitat improvements.

Summer rearing habitat for juvenile steelhead is limiting production of smolts in the Pilarcitos watershed, due to poor habitat conditions that reduce overwinter survival of young-of-year and yearling fish and limit their size throughout the watershed. The lack of good feeding conditions in the lower reaches and lagoon for out-migrating fish in spring, and the lack of a saltwater adjustment zone in the estuary, mean that the small smolts produced in most of the watershed have a low probability of returning as adults (Bond 2006).

Improved instream habitat on Arroyo Leon Creek could provide summer rearing habitat to "support older, larger juvenile steelhead. The site is currently responding to the abandonment of pond operations in the form of vegetative encroachment, localized bed and bank erosion, and localized channel avulsions. The abandoned dam structures continue to influence geomorphic processes affecting fish passage conditions, erosion, deposition, and storm hydrology.

A detailed site assessment will help establish the risks and opportunities associated with the existing channel configuration, abandoned dam structures, and riparian vegetation successional trends.

5.3.5.3 Project Scope

A conceptual rehabilitation restoration alternatives study would include a detailed site assessment to evaluate the existing and trending conditions for the reach formerly affected by pond operations, including the area immediately downstream of the lower dam structures, and immediately upstream of the uppermost impoundment zone.

The assessment should include the following:

Geomorphic Assessment – By evaluating hillslope and stream sediment conditions, the existing erosion potential, sediment transportation capacity and the recovery trends expressed in the existing channel, the project will be able to establish risks and opportunities for recovery of rearing habitat, fish passage, and spawning conditions. For example, preliminary site review suggests that potential risks include channel incision, remobilization of fines from dam operation, and/or channel simplification. The geomorphic assessment will identify opportunities to restore eco-geomorphic functions that support steelhead habitat and improve channel dynamics (including both lateral and vertical stability).

Riparian Condition Assessment – As part of the field surveys, stand-level riparian mapping can help to identify where riparian vegetation influences instream habitat by affecting canopy, wood

supply, erosion controls, litter contributions, etc. It will further evaluate the existing stand density, species composition, and growth habits to project vegetative successional trends over the next one to three decades. Using this information, the project will identify opportunities to align stream and riparian restoration objectives.

Habitat Assessment – By evaluating the habitat quality, availability, distribution and potential in a systematic and objective manner throughout the reach, the project will establish a useful baseline and establish the potential habitat and fish production capacity for various restoration alternatives.

These assessments will be used to identify restoration alternatives and establish the technical criteria for establishing project feasibility and potential benefits. The project approach should consider varied approaches to restoration and/or enhancement that might include experimenting with modifying existing structures to achieve low-cost, but effective habitat improvements. Alternatives that integrate or modify existing dam structures in support of improving habitat may be considered. Such alternatives should improve steelhead rearing habitat and provide fish passage without requiring regular operations or maintenance. Other approaches might include phased restoration targeted to transition site conditions in support of geomorphic constraints, or modest enhancement actions targeted to work in collaboration with natural channel evolution.

A first project task will identify the existing and projected near-term characteristics of the stream in terms of driving eco-geomorphic processes, instream habitat conditions, and riparian conditions. The existing conditions will be documented by developing maps, photos, descriptions and an inventory of existing habitats.

A second task will develop geomorphic and ecological interpretations of active geomorphic and ecological processes that have influenced the changing dynamic condition of the stream over time. Study investigators will develop a conceptual understanding of the evolution of the stream following cessation of pond operations in 2002 to present day conditions and will extend that understanding to project stream conditions that are likely to develop over the next 5-30 years based on fundamental geomorphic principles and ecological successional pathways. Such factors will require an integrated understanding of the site hydrology, geomorphology, riparian ecology, existing instream structures and fish habitat requirements. Using these interpretations, the project will identify opportunities and constraints for improving instream habitat.

A third task will integrate the results from the first two tasks to identify potential restoration alternatives, including an assessment of the risks and potential benefits for each alternative sufficient to select appropriate preferred alternatives.

Deliverable: A report that outlines conceptual alternatives for developing technically sound stream rehabilitation. The report should include conceptual drawings, existing condition maps, data summaries, a descriptive narrative, and listed benefits/constraints for each alternative. The design, permitting and engineering of the selected alternative will be conducted under a separate project.

5.3.5.4 Project Benefits

Summer rearing habitat for juvenile steelhead is limiting production of smolts in the Pilarcitos watershed, in particular due to poor habitat conditions that reduce overwinter survival of young of year and yearling fish and limit their size throughout the watershed. In addition, the lack of good feeding conditions in the lower reaches and lagoon for out-migrating fish in spring, and the lack of a saltwater adjustment zone in the estuary, means that the small smolts produced in most of the watershed have low probability of returning as adults (Bond 2006).

This project will evaluate the potential to rehabilitate the channel to improve habitat conditions and encourage the recovery of the site from impacts associated with operations of the ponds. Rehabilitation of the Arroyo Leon pond sites would also enhance habitat for the California red-legged frog and restore riparian habitat in the reach. California red-legged frogs were observed at these ponds during previous fish surveys (Smith, 2007; Smith 2002).

5.3.5.5 Project Milestones

Obtain funding ♦ Bid solicitation ♦ Contractor selection ♦ Develop TAC ♦ Draft report ♦ Final report

5.4 PLANNING PROJECT SUMMARIES

5.4.1 Watershed Monitoring Program

Priority Ranking: Tier 1
Water Body: The Pilarcitos Creek Watershed, Apanolio Creek, Pilarcitos Creek, Pacific Ocean

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
San Mateo County Resource Conservation District Kellyx Nelson 625 Miramontes Street, #103 Half Moon Bay, CA 94019 (650) 712-7765 kellyx@sanmateorcd.org	▪ CCWD ▪ POST ▪ Surfrider ▪ SFPUC ▪ NOAA Fisheries ▪ CA Department of Fish and Game ▪ California State Parks	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, and wildlife habitat	$15,000 to $30,000

5.4.1.1 Project Summary

This program project would establish a detailed watershed monitoring plan, including a funding mechanism and support for routine watershed monitoring. The watershed monitoring plan will develop and maintain essential information that tracks key resources in the watershed, including stream flows, water quality, endangered species, and riparian community dynamics. The plan and associated program would provide a long-term source of management information that would help guide continued Workgroup activities and projects. The Watershed Monitoring Program would establish a cost-efficient, systematic data collection strategy that would address ongoing watershed management concerns. The program will also establish a rigorous adaptive management framework to guide management decisions and provide feedback on existing actions. The Watershed Monitoring Program would also assist in coordinating stakeholder collaboration to address key impacts identified by the monitoring practices.

5.4.1.2 Project Rationale

A Watershed Monitoring Program would establish a cost-efficient, systematic data collection strategy that would address ongoing watershed management concerns. An integrated monitoring and adaptive management framework will provide an ongoing scientific basis for management with the Pilarcitos watershed, and will help identify when various monitoring types should be applied. The program would also establish a rigorous adaptive management framework to guide management decisions and provide feedback on existing actions. The Watershed Monitoring Program would also assist in coordinating stakeholder collaboration to address key impacts

identified by the monitoring practices. A Monitoring Program can also provide key metrics that will be helpful toward long-term IWMP implementation.

5.4.1.3 Project Scope

Implementation of the full set of recommendations will address the goals and objectives of the Pilarcitos Restoration Workgroup and the public described in Section 3. The long-term planning horizon of the IWMP generally supports an adaptive management approach that allows the flexibility to respond to new information, opportunities, and constraints as they arise in order to achieve the desired results that are described in the goals and objectives. Adaptive management will be incorporated through informal communication within workgroup members as projects are implemented and monitored. The purpose of the monitoring and adaptive management program will be to:

- Assist in the development of adaptive management approaches for each project
- Fill critical data gaps that inform watershed management practices and decisions
- Establish and fund monitoring and adaptive management systems that measure the success of specific watershed management strategies and guide appropriate responses
- Establish systems and processes for sharing data and information
- Establish a regulatory process that reduces the administrative burden associated with beneficial IWMP projects

The program will utilize several components, including:

Implementation Monitoring - measures the extent that project design and intent are met by project implementation. It usually is conducted shortly after a project is completed, and is guided by the specific design documents developed for the project. For example, if the project design calls for enhancement of 3 instream pools, then the implementation monitoring action verifies that 3 pools were indeed made deeper with more escape cover than the pre-existing habitat.

Effectiveness Monitoring - is a more comprehensive monitoring approach that evaluates how well the implemented action achieves the desired results. It usually requires prolonged period of monitoring and tracking over time. For example, if the basis for the project design was that additional pools would improve rearing habitat and produce a higher population of smolts, then the effectiveness monitoring protocols would measure densities of smolt-sized juvenile steelhead in the newly enhanced pools in relation to densities in this stream segment prior to pool

enhancement and in comparison to other pools in the vicinity at the time the newly enhanced pools are sampled.

Status & Trend Monitoring – measures and tracks the changes in conditions over time, usually using periodic sampling protocols. Status and trend information tracks overall watershed conditions and actions to evaluate the extent that overall watershed management actions affect aquatic resources (e.g. fish, water quality, etc). Examples could include annual surveys of steelhead below Stone Dam (autumn survey) focusing on young fish, routine water quality sampling, returning adults, etc.

Validation Monitoring - involves testing specific working hypotheses that guide land management. A well-designed monitoring program will integrate data collection protocols between effectiveness and validation monitoring and will use validation monitoring to continuously refine performance measures and resources objectives.

Resource Objectives & Performance Measures - specific and quantifiable targets that can be used to guide management. When resource objectives are met, then overall watershed management with respect to that resource is considered to be in good shape. An example of a resource objective is an average annual smolt production of X. Performance measures are cost-effective ways to measure resource objectives. Using the example from above, it may not be cost effective to measure every outmigrating smolt. However, a sample protocol (or proxy variable) that is related to the number of smolts (but easier to measure) might be a more effective monitoring metric (e.g., numbers of redds).

A Watershed Monitoring Plan should be developed collaboratively with Workgroup participants. The Monitoring Program should help to inform management of the watershed by developing and maintaining relevant watershed information and data. The basis for the Monitoring Program can be developed around a series of Key Management Questions, especially those questions that have been historically difficult to answer during Integrated Watershed Management Planning projects. Examples of Key Questions might include:

- How much appropriated water is utilized under various seasonal conditions?
- What is the relationship between fish habitat and fish populations/abundance?
- Where are significant sources of non-point source pollutants?
- Where are the gaining and losing reaches and what is the net exchange between surface and ground water?
- How effective are erosion control treatments in reducing sediment delivered to streams?
- What are the long-term trends in fish populations and abundance?

- Are fish populations responding to restoration efforts?
- What are the status and trends of fish populations in the watershed?

5.4.1.4 Project Benefits

This program would support landowners and agencies by providing them with improved knowledge and resources to guide watershed management. The program would complement and contribute to many of the additional assessment projects (Section 5.5), and would be a resource to help guide additional data collection efforts within the watershed. It would also act as a repository for data and reports compiled within the watershed, which will support more effective long-term watershed management.

5.4.1.5 Project Milestones

Obtain funding/resources ♦ Report synthesizing current monitoring data and identifying gaps ♦ Develop reporting structure to share data ♦ Develop program to fill data gaps ♦ Implement complete monitoring program

5.4.2 Eucalyptus Control and Removal Planning Priority Ranking: Tier 3 Water Body: The Pilarcitos Creek Watershed, Apanolio Creek, Pilarcitos Creek, Pacific Ocean			
Implementation Lead San Mateo County Resource Conservation District Kellyx Nelson 625 Miramontes Street, #103 Half Moon Bay, CA 94019 (650) 712-7765 kellyx@sanmateorcd.org	**Collaborators** ▪ CCWD ▪ POST ▪ California State Parks ▪ San Mateo County ▪ SFPUC	**Beneficial Uses** Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, and wildlife habitat	**Estimated Cost** To Be Determined

5.4.2.1 Project Summary

This project will coordinate among regulating agencies to establish protocols in support of weed species removal from riparian zones and uplands by willing landowners. The project will identify regulatory and permitting guidelines, appropriate removal methods, and perhaps incentive programs, for removal and control of eucalyptus.

5.4.2.2 Project Rationale

Eucalyptus is an invasive species that is highly aggressive at displacing native riparian vegetation. It also presents a significant increase in fire risk that increasing the risk of significant sedimentation associated with wildfire. Existing regulatory requirements often do not support Eucalyptus removal or management. This project will work with agencies to establish protocols for effective control and removal where Eucalyptus poses risks to watershed resources.

5.4.2.3 Project Scope

This project will include the following tasks:

1. Identify the extent of eucalyptus and the consequences of removing stands from an ecological and hydrological perspective;

2. Review existing literature about Eucalyptus control and removal, with a focus toward a) identifying science-based arguments in favor of more effective Eucalyptus control,

and b) identifying strategies that can address regulatory concerns (e.g., loss of bird habitat, aesthetic concerns, removal of large trees); and

3. Facilitate collaborative dialogue with relevant regulatory agencies to identify alternatives that can meet the goals of all stakeholders.

5.4.2.4 Project Benefits

Eucalyptus removal will improve native riparian and upland habitat quality and quantity, increase native riparian habitat understory diversity, improve riparian habitat for native riparian obligate (often rare) bird species, improve soil conditions by increasing permeability and decreasing runoff and erosion, reduce fire risk, and increase inputs of high quality leaf litter into the aquatic food chain. This project will support landowners seeking more proactive controls against Eucalyptus proliferation by providing a pathway for addressing existing regulatory constraints. It will also identify and potentially provide resources for the removal of Eucalyptus trees and restoration of native vegetation.

5.4.2.5 Project Milestones

Obtain Funding ♦ Map of impacted areas/ Eucalyptus survey ♦ Identify regulatory and permitting guidelines ♦ Develop summary of policies ♦ Meetings with regulators ♦ Recommendations for addressing regulatory constraints

5.4.3 Stream Habitat Restoration and Enhancement Opportunity Program Priority Ranking: Tier 3 Water Body: The Pilarcitos Creek Watershed			
Implementation Lead California Department of Fish and Game George Neillands P.O. Box 47 Yountville, CA 94599 (707) 944-5525 gneillands@dfg.ca.gov	**Collaborators** ▪ RCD	**Beneficial Uses** Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, and wildlife habitat	**Estimated Cost** n/a

5.4.3.1 Project Summary

This goal of this program is to develop collaborative efforts with willing landowners to implement instream restoration and enhancements for the benefit of fish and other aquatic organisms. Specific opportunities might include habitat structural improvements, large woody debris placement, passable grade control structures, etc. Specific attention might be given to rearing habitat improvements or enhancements, or instream enhancement projects that increase the storage and sorting of spawning gravels in reaches that can supply competent gravel. Additional projects could evaluate upstream reaches on Mills, Arroyo Leon and upper Pilarcitos for possible spawning gravel retention initiatives.

5.4.3.2 Project Rationale

One of the primary goals of the IWMP is to improve conditions for endangered Steelhead throughout the watershed. However, the information available at the time of the Watershed Assessment Update was limited, and therefore the assessment of existing fish habitat conditions was unable to identify a comprehensive set of potential improvement projects. Over time, this program will develop restoration and enhancement opportunities with willing landowners throughout the watershed that are based on sound scientific assessments.

5.4.3.3 Project Scope

Building on the information provided in the Watershed Assessment Update, and additional information developed by other projects and programs identified within this IWMP, program

managers will identify specific opportunities that could include habitat structural improvements, large woody debris placement, passable grade control structures, etc. Specific attention should be given to rearing habitat enhancements and instream enhancement projects that increase the storage and sorting of spawning gravels in reaches that can supply competent gravel. Program managers and investigators should evaluate all steelhead habitat reaches throughout the watershed, with an initial focus on evaluating upstream reaches on Mills, Arroyo Leon, middle Pilarcitos and upper Pilarcitos.

5.4.3.4 Project Benefits

This program would increase fish habitat throughout the watershed by leveraging resources available to willing landowners with guidance from expert staff. Under current conditions, rearing habitat is generally limiting overall fish production.

5.4.3.5 Project Milestones

Obtain Funding ♦ Develop TAC ♦ Develop Alternatives ♦ Seek Landowner Collaboration ♦ Conceptual Designs ♦ Seek Proposal/Funding for individual projects ♦ Final Design ♦ Permitting ♦ Bid Solicitation ♦ Construction ♦ Monitoring Effectiveness

5.5 ASSESSMENT PROJECT SUMMARIES

5.5.1 Water Budget Development Project

Priority Ranking: Tier 1
Water Body: The Pilarcitos Creek Watershed

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
San Mateo County Resource Conservation District Kellyx Nelson 625 Miramontes Street, #103 Half Moon Bay, CA 94019 (650) 712-7765 kellyx@sanmateorcd.org	▪ CCWD ▪ SFPUC ▪ PCAC	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	$30,000 to $145,000

5.5.1.1 Project Summary

This project will refine the water budget information developed in the Watershed Assessment Update by addressing a number of large data gaps that add significant uncertainty to the existing water budget.

5.5.1.2 Project Rationale

One of the key limiting factors in identifying and evaluating water supply improvements is considerable uncertainty about the water budget for the Pilarcitos Watershed. A detailed water balance accounts for all the sources and uses of water and typically addresses its availability throughout the watershed for wet, normal and dry years. Several of the components for such an understanding are missing.

5.5.1.3 Project Scope

Components of a detailed water balance include (in approximate order of priority):

1. *Estimates of Diversions from Pilarcitos Reservoir to SFPUC* – A detailed accounting of water diversions from Pilarcitos Reservoir to other facilities operated by SFPUC (e.g., Crystal Springs Reservoir) is not available. This fundamental data will help

identify strategies for more efficient water transfers and maintenance of instream flows for Pilarcitos Creek.

2. *Review Existing Gage Data* – Previous monitoring studies for several of the subwatersheds collected streamflow data at 15-minute intervals. However, the published reports only provide summary results that limit our ability to evaluate more detailed subwatershed response patterns. Compiling and integrating this data into a watershed-scale hydrologic analysis could help inform the rainfall-runoff transformation and baseflow conditions for these tributaries, which could help establish operational strategies for managing flow releases below Pilarcitos Lake and Stone Dam.

3. *Surface Water Hydrologic Model* - Detailed hydrologic measurement or modeling of subwatersheds will improve our understanding of annual flows, storm response, and baseflow conditions, especially if this model can be calibrated to existing flow information. A model will allow analysis of various different test scenarios to help identify the potential benefits and impacts associated with various strategies.

4. *Integrate Surface/Subsurface Models* – Understanding the interaction between stream conditions and subsurface withdrawals will help establish sustainable limits to groundwater use, improved management strategies for groundwater pumping given instream flow effects and can help improve groundwater storage and conjunctive use strategies.

5. *Estimates of Private Diversions* - Improved estimates of actual (versus permitted) water rights diversions will help to estimate the losses (reductions) associated with diversions as opposed to all other loss mechanisms. In addition to evaluating permitted water rights, an estimate of private well usage in the watershed on a monthly and annual basis would augment the water balance and help to determine the cumulative level of impact from private well usage.

6. *Perennial Flow Distribution for Dry Years* – Determine spatial extent of perennial flow distribution in dry years to help constrain estimates for the water balance associated with private users (for which current data is unavailable) and to help develop an understanding of available fish rearing habitat.

7. *Open Estuary Days* – One of the limiting factors for the lagoon project is the ability to maintain an open estuary where fish can migrate to and from the ocean at appropriate times in the steelhead life-cycle. Data to help evaluate the volume of water necessary to support an open estuary can include the USGS Gage at Half Moon Bay and sampling estuary groundwater variables (hydraulic conductivity, infiltration, hydraulic gradient, etc). Other approaches may include systematically collected time-lapse photography or visual observations. This component of the water budget

may be completed as part of the Pilarcitos Lagoon Habitat Enhancement Opportunity Study.

The specific project scope for these tasks will be developed as this project proceeds. It is likely that this project will be phased as resources become available, and as information needs to support other projects become apparent. Project scope may include evaluating existing data at a higher level of resolution than occurred during the Watershed Assessment Update (Appendix A), collecting new field data, modeling, evaluating proxy data, etc.

5.5.1.4 Project Benefits

A detailed water budget allows managers and stakeholders to quantify and identify the sources and uses of water throughout the watershed. It will provide objective, numerical data to guide selection of project priorities, identify potential problem areas, and forecast response to various proposed projects. A well-maintained water budget will also allow water supply agencies to better coordinate responses to demand needs and will support the development of improved monitoring and adaptive management tools.

5.5.1.5 Project Milestones

Establish technical review committee of collaborators ♦ Obtain funding ♦ Selection consultants ♦ Complete literature and data review ♦ Select models that will be used for estimates and assessments ♦ Generate reports on yield and diversions ♦ Complete updated water budget with new information that allows managers and stakeholders to quantify and identify the sources and uses of water throughout the watershed ♦ Develop and refine project scope iteratively as data are collected

5.5.2 Road Assessment Project

Priority Ranking: Tier 1
Water Body: The Pilarcitos Creek Watershed

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
San Mateo County Resource Conservation District Kellyx Nelson 625 Miramontes Street, #103 Half Moon Bay, CA 94019 (650) 712-7765 kellyx@sanmateorcd.org	▪ NRCS ▪ CCWD ▪ POST ▪ San Mateo County ▪ California State Parks ▪ SFPUC	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	$20,000 to $45,000

5.5.2.1 Project Summary

This project will develop a prioritized list of road improvement opportunities throughout the watershed that can reduce sedimentation or hydrologic impacts to existing quality stream habitat reaches. The road assessment will map and classify existing roads, assess and rate existing watershed impacts, identify maintenance needs and recommend site treatments using Best Management Practices.

A systematic road assessment project will evaluate and prioritize locations of significant hydrologic impacts, sediment sources, and sediment delivery and impact to the channel network. The road assessment will map and classify existing roads, assess and rate level of watershed impacts, identify maintenance needs and recommend Best Management Practices. This effort will build on existing studies by SFPUC, California State Parks, POST, and others, by integrating and synthesizing the information for a complete watershed-scale understanding of the impacts from roads on fish habitat, erosion risk and water quality. The assessment will focus on dirt roads, private roads, local roads and county roads.

5.5.2.2 Project Rationale

Roads have been widely implicated as significant sources of sediment and hydrologic impacts in watersheds throughout the western United States. Existing information for the Pilarcitos watershed, including both formal reports and informal knowledge from those familiar with the watershed, has identified road impacts in several portions of the watershed. However, a number of significant information gaps exist about the location and overall impact from potential sources.

This project will establish the extent that road erosion problems are significant sources of water quality impairments and instream habitat degradation.

A systematic road assessment project will evaluate and prioritize locations of significant hydrologic impacts, sediment sources, and sediment delivery and impact to the channel network. This effort will build on existing studies by SFPUC, California State Parks, Peninsula Open Space Trust, and others, by integrating and synthesizing the information for a complete watershed-scale understanding of the impacts from roads on fish habitat, erosion risk and water quality. The assessment will focus on dirt roads, private roads, local roads and county roads that contribute to existing high-quality habitat.

5.5.2.3 Project Scope

1. **Compile and Review Existing Information** –Information will be reviewed from known existing sources. Information will be compiled into a GIS system so spatial and inventory information may be compiled and/or collected. Aerial photos, GIS information, and discussions with key stakeholders will be evaluated to prioritize field efforts, with priorities going toward 1) known problem sites, 2) road segments contributing to high-quality habitat reaches, 3) a sample of prior treated sites (to evaluate treatment effectiveness) and 4) other unsurveyed road segments. Known existing information sources include:
    a. Existing aerial photographs and maps
    b. Existing GIS inventory layers
    c. *Sediment-Transport Reconnaissance of the Pilarcitos Creek Watershed, San Mateo County, California – Water Year 2000* (Balance Hydrologics 2001)
    d. *Catalog of Active Sediment Sources and Control Opportunities, Apanolio Creek, Half Moon Bay, San Mateo County, California* (Balance Hydrologics 2003)
2. **Field inventory** – Prioritized sites will be sampled in the field. Roads will be driven by a geomorphologist, soil scientist, road engineer or others with expertise in road erosion processes and treatment strategies. These experts will identify problem source areas that have the potential to deliver to the stream network. Information for problem sites will be collected, and should include:
    a. GPS coordinates of key features (gullies, failing culverts, etc)
    b. A narrative and quantitative description of the problem
    c. Associated impacts to watershed resources (e.g., water quality, fisheries, etc)

d. Characteristics of sediment sources (typical grain size, volumes, etc)

e. Recommendations for site treatments

f. Cost estimates for repairs

3. **Reporting** – The project deliverable will include a detailed report that documents the results of the prior tasks and makes recommendations for prioritized treatments. Treatment recommendations will include an inventory of erosion control projects and the estimated magnitude and spatial extent of impacts from each site.

5.5.2.4 Project Benefits

The road inventory and assessment will identify and prioritize sources of sediment and significant hydrologic impacts associated with roads. Roads are typically one of the largest sources of fine sediment pollution. Erosion from cut-slopes and bare road surfaces is easily routed to the road drainage system, which is often connected to the stream environment during large storms. Road drainage systems can destabilize roads fill-slopes causing landslides. Hydrologic effects from road can also have significant impacts to both peak flows and baseflows. Several anecdotal citations and consulting team observations of road problems were noted during the watershed-assessment update process.

5.5.2.5 Project Milestones

Select methodologies for inventory protocols and special assessments ♦ Train field staff or hire consultants ♦ Develop database ♦ Obtain landowner access permission ♦ Conduct filed inventory ♦ Complete database of findings ♦ Develop prioritized implementation plan for remediation.

5.5.3 Geomorphic Channel Assessment

Priority Ranking: Tier 2
Water Body: The Pilarcitos Creek Watershed

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
California Department of Fish and Game George Neillands P.O. Box 47 Yountville, CA 94599 (707) 944-5525 gneillands@dfg.ca.gov and NOAA Fisheries Patrick Rutten 777 Sonoma Ave. Rm. 325 Santa Rosa, CA 95404 (707) 575-6059 patrick.rutten@noaa.gov	▪ RCD ▪ NRCS ▪ SFPUC	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	$40,000 to $72,000

5.5.3.1 Project Summary

This project will conduct a geomorphic survey of selected stream reaches and hillslope sediment sources to establish baseline conditions in support of erosion control projects, stream habitat improvements, channel incision risk assessment, streamside-vegetation improvement opportunities, sediment source inventories, and existing infrastructure impacts. The project will build on data developed in Appendix A (Watershed Assessment Update) to identify field sites for assessment.

5.5.3.2 Project Rationale

A systematic inventory of riparian and channel bank conditions has never been completed for the Pilarcitos watershed. The lack of geomorphic data was a significant limiting constraint in identifying stream enhancement or restoration opportunities and priorities for this IWMP. Although these issues are known to occur, the extent of existing channel incision, bank erosion, and riparian conditions are mostly unknown throughout most of the watershed.

Most of the existing fish habitat assessment is based on the stream conditions at the time of the assessment. A geomorphic survey will identify the potential for improved fish habitat conditions

based on ecological and geomorphic processes that create and maintain habitat features. For example, erosion control projects can reduce the level of fine sediment in the creek through source control, onsite treatment and/or mitigation, improving downstream habitat conditions.

5.5.3.3 Project Scope

A geomorphic channel assessment would build on the watershed-scale assessment provided in Appendix A (Watershed Assessment Update) by collecting and evaluating field data throughout the watershed. A representative stratified sampling protocol will be developed, using stream reach priorities as stratified units, and either complete reach-scale inventories or randomly sampled sub-reaches. Reach-scale inventories will include measures of key geomorphic and habitat features, including (but not limited to) channel dimensions (width, depth, slope), substrate conditions, pool frequency and characteristics, erosion inventory, woody debris inventory, stand-level riparian mapping, etc.

The objective of these data is to provide a systematic array of data that can be used to:

Prioritize habitat improvement opportunities – By evaluating the habitat quality, availability and potential in a systematic and objective manner throughout the watershed. It will also provide the data to evaluate the relative benefit of various opportunities across the watershed.

Erosion Control Inventory – By evaluating hillslope and stream sediment sources, the project will establish a prioritized inventory of sediment control sites that will reduce sediment delivery to streams and aquatic habitats.

Channel Risk Assessment – By evaluating existing geomorphic channel conditions, the project will identify risks and opportunities to restore geomorphic channel conditions from degraded bed and bank conditions, hydraulic effects, channel incision, existing infrastructure impacts, etc. The project will be able to identify opportunities to restore eco-geomorphic functions that support steelhead habitat and improve channel stability (both lateral and vertical stability).

Riparian Condition Assessment – As part of the field surveys, stand-level riparian mapping can help to identify where riparian vegetation influences instream habitat by affecting canopy, wood supply, erosion controls, litter contributions, etc. The project will identify opportunities to align stream and riparian restoration opportunities.

Monitoring – The data from this project will provide objective and systematically collected data that can form the basis for watershed-scale monitoring and adaptive management.

Priorities should include the mainstem Pilarcitos Creek below Stone Dam, Arroyo Leon Creek, Mills Creek, Apanolio Creek and targeted tributaries.

5.5.3.4 Project Benefits

A systematic inventory of stream reaches will provide the technical basis to identify and manage watershed impacts, establish project priorities, and evaluate cumulative watershed effects. The assessment will be used to help identify the cost, benefits and level of effort necessary to meet IWMP objectives at specific project locations throughout the watershed. It will establish an inventory of stream restoration or enhancement opportunities and erosion control projects that can provide habitat or mitigate observed degradation (e.g., erosion, channel incision, and habitat simplification).

Erosion control projects can reduce the amount of fine sediment delivered to the stream, provide improved habitat for aquatic and terrestrial species, and have a number of other potential benefits, depending upon the specific site conditions. Existing information regarding potential project sites is incomplete and largely anecdotal. A systematic inventory and assessment will support a more efficient and effective resource for identifying specific project sites and priorities.

5.5.3.5 Project Milestones

Obtain Funding ♦ Develop TAC ♦ Bid Solicitation ♦ Contractor Selection ♦ Landowner Access ♦ Conduct Field Assessment ♦ Draft Report ♦ Final Report

5.5.4 Riparian Habitat Restoration and Invasive Plant Eradication Assessment

Priority Ranking: Tier 2
Water Body: The Pilarcitos Creek Watershed

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
San Mateo County Resource Conservation District Kellyx Nelson 625 Miramontes Street, #103 Half Moon Bay, CA 94019 (650) 712-7765 kellyx@sanmateorcd.org	▪ MROSD ▪ SFPUC	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	$45,000 to $55,000

5.5.4.1 Project Summary

This project will fill existing data gaps regarding the distribution of native and invasive riparian habitats and species, and will identify and prioritize riparian habitat restoration and invasive plant eradication opportunities and projects.

This project is the first step toward identifying and prioritizing riparian habitat restoration actions within the watershed. As such, this project will first fill existing data gaps regarding the distribution of native and invasive riparian habitats and species. It will then identify and prioritize riparian habitat restoration and invasive plant eradication opportunities/projects. To fill existing data gaps, this project will survey riparian habitat and invasive plants streamside corridors of the headwater region in Apanolio Creek, Corinda Los Trancos Creek, Nuff Creek, Madonna Creek, Mills Creek, and Arroyo Leon Creek. The project will characterize the riparian plant community, estimate riparian corridor widths, and map invasive plant species to a similar level of detail presented in the Pilarcitos Creek Restoration Plan (PWA, 1996). Methods would be similar to those used for the 1996 plan, namely color aerial photography interpretation (using National Agricultural Aerial Program imagery; see http://datagateway.nrcs.usda.gov/GatewayHome.html) and some field surveys. The project will include assessing the historical condition/width of the riparian corridor from examination of historical aerial imagery to aid in the development of restoration goals. The products of this project would include the identification of property ownership and prioritization of specific riparian restoration opportunities.

Such opportunities could generally include:

- Restore ecosystem processes that support the life-cycle requirements for native canopy species like willow and alder
- Identify setback distances that support stable bank and riparian conditions
- Establish and fund a sustained program to manage exotic invasive species removal and native species establishment
- Remove eucalyptus from riparian areas and replace with native canopy species (e.g., willow, alder, etc)

This project would also prepare a user-friendly brochure for landowners on the impacts, eradication methods, and permitting requirements for the various riparian, invasive plants in the watershed.

5.5.4.2 Project Rationale

The riparian assessment contained in the Watershed Assessment Update (Appendix A) was limited to preliminary, large-scale observations based on aerial photography and very limited field observations. A systematic evaluation of riparian conditions, perhaps in coordination/collaboration with geomorphic or fish habitat surveys, would significantly improve the resolution of information available for riparian communities in the Pilarcitos watershed.

5.5.4.3 Project Scope

To fill existing data gaps, this project will survey riparian habitat and invasive plants streamside corridors of the headwater region in Apanolio Creek, Corinda Los Trancos Creek, Nuff Creek, Madonna Creek, Mills Creek, and Arroyo Leon Creek. The project will characterize the riparian plant community, estimate riparian corridor widths, and map invasive plant species to a similar level of detail presented in the Pilarcitos Creek Restoration Plan (PWA, 1996). Methods would be similar to those used for the 1996 plan, namely color aerial photography interpretation (using NAIP 2005 imagery; see http://datagateway.nrcs.usda.gov/GatewayHome.html) and some field surveys. The project will include assessing the historical condition/width of the riparian corridor from examination of historical aerial imagery to aid in the development of restoration goals. The products of this project would include the identification of property ownership and prioritization of specific riparian restoration opportunities.
Such opportunities could generally include:

- Restore ecosystem processes that support the life-cycle requirements for native canopy species like willow and alder;
- Identify setback distances that support stable bank and riparian conditions;

- Establish and fund a sustained program to manage exotic invasive species removal and native species establishment; and
- Remove eucalyptus from riparian areas and replace with native canopy species (e.g., willow, alder, etc).

This project would also prepare a user-friendly brochure for landowners on the impacts, eradication methods, and permitting requirements for the various riparian, invasive plants in the watershed.

5.5.4.4 Project Benefits

The project would provide a relatively complete baseline of information to assess and prioritize riparian habitat restoration opportunities in the watershed. These reaches were not covered in the Pilarcitos Creek Restoration Plan (PWA, 1996). The surveys will provide important information about the status of riparian conditions in the identified sub-watersheds, and will identify and prioritize specific riparian habitat restoration opportunities. It will identify specific riparian restoration/invasive plant eradication projects. Information about the historical condition of riparian forest would be used to develop restoration goals for riparian areas in the watershed.

5.5.4.5 Project Milestones

Funding/ partner resources ♦ Map survey of invasives ♦ Develop brochure ♦ Develop program to manage invasive species

5.5.5 Systematic Watershed-Scale Fish Habitat Assessment Project Priority Ranking: Tier 3 Water Body: The Pilarcitos Creek Watershed			
Implementation Lead California Department of Fish and Game George Neillands P.O. Box 47 Yountville, CA 94599 (707) 944-5525 gneillands@dfg.ca.gov	**Collaborators** ▪ RCD	**Beneficial Uses** Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	**Estimated Cost** $60,000 to $75,000

5.5.5.1 Project Summary

This project will develop a more systematic habitat and fisheries evaluations throughout the watershed to address variations in flow conditions associated with the existing data and the wide period between evaluations for various stream segments.

5.5.5.2 Project Rationale

Much of the habitat and fisheries evaluation for the Pilarcitos Creek watershed was done in 1995, a very wet year. Subsequent evaluations were done in a variety of rainfall year types: 1996, 1999, 2000, 2001, and 2004 (average year) and 1998 (very wet/El Niño year). In addition, the 1998 El Niño storms and the storms in 2005 and 2006 could have substantially changed habitat conditions within the watershed. Components of such a systematic survey should identify limiting factors affecting overall habitat quality, and prioritize specific restoration opportunities.

5.5.5.3 Project Scope

The project scope will include the following:

- Habitat will be evaluated in approximately two-kilometer stream reaches distributed throughout the watershed.
- A representative stratified sampling protocol will be developed, using stream reach priorities as stratified units, and either complete reach-scale inventories or randomly

sampled sub-reaches. Habitat conditions within reaches throughout the watershed will be evaluated for channel and bank conditions, substrate composition, meso-habitat (pool, riffle, run) frequency, average pool depth, complexity and cover, canopy, woody debris in the channel and potential wood recruitment, etc., such as by habitat typing and evaluation in each reach. Habitat will be evaluated in two km stream reaches distributed throughout the watershed. Habitat typing data will be collected, including surface area, water depth, complexity, escape cover, substrate and embeddedness (visual estimate), percent fines (visual estimate) and tree canopy closure. Incidence of wood in the creek and streambank erosion should be documented for each segment.

- Fish densities and sizes will be evaluated in approximately two kilometer stream reaches distributed throughout the watershed in a single (average) year, especially since surveys on Apanolio Creek (Alley 2007a) and the barriers on Mills and Arroyo Leon (Alley 2007b) indicate substantial channel changes since the original surveys. Ideally, fish densities and sizes will be re-evaluated during the same year that habitat conditions are evaluated through two-stage sampling. The stream above Stone Dam should be studied because past work there was not coincidental with sampling below Stone Dam. Two-stage sampling similar to the Hankin and Reeve's (1988) methodology will be conducted in a proportion of each habitat type (10 percent for riffles and 30 percent for pools and runs) throughout each reach. Densities of juvenile steelhead and the variance of these densities will be developed as well as a full stream-reach population estimate by age class for late summer rearing steelhead. These data will be compared to fish data collected in 1995-96 for the 1996 plan and subsequent sampling in Albert Canyon and above and below Stone Dam. A report will be provided, summarizing updated quantitative steelhead densities, age/size structure and habitat use compared to earlier findings.
- The lagoon area should be observed in a general fashion. Past work has indicated that it is usually dry by late summer or even sooner and is likely to have surface water only intermittently. It is not believed to have fishery value under the present water diversion scheme on the creek. If there happens to be surface water at the lagoon during data collection at stream sites, then size, water depth and presence/absence of fish escape cover should be measured and photographs should be taken.

5.5.5.4 Project Benefits

The project would provide a relatively complete baseline of information to assess and prioritize fish-habitat restoration opportunities in the watershed. The surveys will provide important information about the status of fish habitat and population conditions in each of the identified sub-watersheds, as well as the overall watershed. It will also identify and prioritize specific restoration opportunities.

5.5.5.5 Project Milestones

Obtain Funding ♦ Bid Solicitation ♦ Contractor Selection ♦ Landowner Access ♦ Coordinate with TAC ♦ Conduct Field Assessment ♦ Annual Report ♦ Three-five year Report

5.5.6 Assess Habitat Management and Restoration Opportunities for Sensitive Wetland Species Priority Ranking: Tier 3 Water Body: The Pilarcitos Creek Watershed			
Implementation Lead California Department of Fish and Game George Neillands P.O. Box 47 Yountville, CA 94599 (707) 944-5525 gneillands@dfg.ca.gov	**Collaborators** ▪ RCD ▪ California State Parks ▪ SFPUC ▪ NRCS ▪ USFWS	**Beneficial Uses** Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	**Estimated Cost** $45,000 to $60,000

5.5.6.1 Project Summary

This project will collect the necessary information to determine habitat management/enhancement and restoration opportunities in the watershed for the California red-legged frog, San Francisco garter snake, and western pond turtle.

5.5.6.2 Project Rationale

Little is known about the distribution, condition and use of suitable habitats for California red-legged frog, San Francisco garter snake, and western pond turtle in the watershed. Such habitat enhancement and restoration would also benefit numerous other associated aquatic and wetland species in the watershed.

5.5.6.3 Project Scope

The project will conduct reconnaissance-level surveys to assess the suitability and quality of existing pond and reservoir habitats in the watershed for California red-legged frog, San Francisco garter snake, and western pond turtle. Reconnaissance-level surveys (not protocol-level surveys at this planning stage) would be conducted in suitable habitats for California red-legged frog, San Francisco garter snake, and western pond turtle, as well as for their predators and other threats to these species that might limit their distribution, within primary habitat (i.e., ponds, pools within streams, and wetlands) throughout the Pilarcitos watershed. This reconnaissance-

survey information will be synthesized to identify specific habitat management and restoration opportunities as well as population surveys throughout the watershed.

5.5.6.4 Project Benefits

The project will result in a set of specific projects for improving habitat conditions for sensitive aquatic species within the watershed and population abundance surveys for these species.

5.5.6.5 Project Milestones

Obtain Funding ♦ Bid Solicitation ♦ Contractor Selection ♦ Landowner Access ♦ Coordinate with TAC ♦ Conduct Assessment ♦ Draft Report ♦ Final Report

5.5.7 Preliminary Arroyo Leon Fish Habitat Assessment

Priority Ranking: Tier 1
Water Body: Arroyo Leon Creek

Implementation Lead	Collaborators	Beneficial Uses	Estimated Cost
California Department of Fish and Game George Neillands P.O. Box 47 Yountville, CA 94599 (707) 944-5525 gneillands@dfg.ca.gov	▪ POST ▪ RCD	Cold freshwater habitat, fish migration, preservation of rare and endangered species, fish spawning, warm freshwater habitat, riparian habitat and wildlife habitat	$15,000 to $20,000

5.5.7.1 Project Summary

This project will survey the length of Arroyo Leon upstream of the Arroyo Leon pond site to characterize the existing fish habitat, densities and conditions. This project would be superseded by the more systematic, watershed-scale assessment described in the Systematic Watershed-Scale Fish Habitat Assessment Project (Section 5.5.5).

5.5.7.2 Project Rationale

This assessment will fill the largest remaining data gap on current fish habitat within the Pilarcitos Creek watershed, and will allow comparisons to other project sites using the results in Appendix A.

5.5.7.3 Project Scope

This project would follow the methodology described in Appendix A to support comparisons with other reaches within the watershed. The survey would include approximately 2.5 miles of stream channel, and would entail walking the reach until a natural barrier to adult migration is found. Habitat typing (evaluating habitat conditions) and electrofishing to determine fish densities should be done in three selected segments/sites.

Habitat conditions within reaches throughout the watershed should be re-evaluated for channel and bank conditions, substrate composition, meso-habitat (pool, riffle, run) frequency, average pool quality, escape cover, canopy, woody debris in the channel and potential wood recruitment,

etc., such as by habitat typing and evaluation in a 0.1 mile section in each reach. Habitat should be evaluated in 12, 0.15-mile stream segments distributed throughout the watershed. Habitat typing data should be collected, including water depth, escape cover, substrate embeddedness (visual estimate), percent fines (visual estimate) and tree canopy closure. Incidence of wood in the creek and streambank erosion should be documented for each segment. Sources of large wood recruitment should be inventoried in at least one 200-foot segment of each of the 0.15-mile habitat typed segments.

5.5.7.4 Project Benefits

The extent and quality of upper Arroyo Leon habitat will be known for the first time. This will allow proper assessment of benefits of barrier projects downstream, and will provide information on the relative value of additional restoration or enhancement opportunities in the Arroyo Leon watershed.

5.5.7.5 Project Milestones

Develop Sampling Universe w/TAC ♦ Landowner Access ♦ Conduct Field Assessment ♦ Draft Report ♦ Final Report

5.6 PHASE II: DEFERRED PROJECTS

Several projects identified during the Integrated Watershed Management Planning process did not make the cut as priority projects. The following projects received support by the Workgroup for future consideration. The status of these projects reflects a variety of constraints on the Workgroup, including limited staff support, limited funding, existing coverage by other jurisdictions, or decisions to focus on other priorities. As resources become available, these projects can be considered for future implementation.

5.6.1 Water Conservation Program

PRIORITY RANKING: TIER 1

A water conservation program was recommended as another cost-effective approach toward improving water availability in the Pilarcitos watershed. A water conservation program would include education, and outreach to the public and major water users to encourage efficient water usage. It would also seek to develop tools and strategies that could be used to promote more efficient usage, and could provide funding for conservation infrastructure (e.g., cisterns).

The Workgroup concluded that water conservation programs that can support other projects are already in place with CCWD, the RCD, NRCS, Farm Bureau, and others, and that program elements described above can be considered within these existing programs.

5.6.2 Lower Pilarcitos Streamflow Improvements

PRIORITY RANKING: TIER 1

A number of ideas were discussed that could improve streamflow in the lower watershed. The Pilarcitos Reservoir and Stone Dam Operation Flexibility Improvement Project will evaluate increased summertime releases below Stone Dam. The following project ideas would help improve streamflows using other approaches. Evaluating the potential of these projects will require additional hydrologic analysis, and in many cases, these ideas have not been fully evaluated for feasibility, benefit or cost.

This planning project will identify and evaluate additional alternatives for developing improved streamflow in lower Pilarcitos Creek. The project will develop information that can be used by the Workgroup to identify additional projects.

Projects that increase summer and fall stream flows to the lower Pilarcitos Creek and its estuary/lagoon could resolve one of the primary limiting factors affecting habitat in the lower

watershed. One approach is described elsewhere (Stone Dam Flow Releases). Specific projects will be identified collaboratively within the stakeholder group, and could include projects that:

- Improve the Stone Dam gate system to develop more automated flow regulation capacity and to support more efficient flow management
- Develop efficient water transport and storage systems for more direct delivery to CCWD
- Augment instream flows with recycled water sources OR substitute recycled water for uses that currently rely on instream flows
- Evaluate the purchase of water rights for dedicated use in maintaining minimum flows to the summer lagoon
- Evaluate existing stormwater system impacts to baseflows
- Stormwater detention systems that are designed to support increased baseflows to the lower watershed
- Increased off-channel storage facilities that can store water for summer release
- Increase groundwater levels in gaining stream reaches
- Purchase water rights for dedicated use in maintaining minimum flows to the summer lagoon

The Workgroup concluded that these ideas were not sufficiently developed into a coherent project, and thus deferred them until they can be more fully developed. Several of the assessment projects will help to establish the feasibility and value of many of these ideas.

5.6.3 Tertiary Water Groundwater Recharge

PRIORITY RANKING: TIER 1

This project would develop a feasibility study to evaluate the use of recycled water to recharge groundwater supply aquifers throughout the watershed. The study would address issues associated with water quality, storage potential, associated risks, etc.

The Workgroup considered this project as possibly falling within the scope of the Recycled Water Project, and therefore deferred consideration of the project.

5.6.4 Riparian Setback Management Planning

PRIORITY RANKING: TIER 1

This proposed project would promote and/or establish land-use restrictions in riparian areas. Riparian buffers or setbacks have been a widely applied Best Management Practice that has been demonstrated to offer much benefit for fish habitat and water quality.

The Workgroup determined that this was not a function of the Integrated Watershed Management Planning process, but was instead a function of land-use regulation, and that the County maintained such jurisdiction.

5.6.5 Stormwater Impacts Analysis

PRIORITY RANKING: TIER 2

This project would evaluate the watershed for impacts associated with stormwater management. Such impacts generally result from increased peak flow runoff from urbanized areas and other land-uses. Stormwater impacts observed in other jurisdictions typically include increased channel incision, increased sedimentation, degraded water quality, reduced infiltration, diminished baseflows, etc.

The Workgroup determined that a thorough stormwater impacts assessment was the responsibility of the City of Half Moon Bay and other jurisdictions responsible for managing stormwater infrastructure.

5.6.6 Non-Point Source Pollution Reduction Project

PRIORITY RANKING: TIER 2

This project would identify and design mitigations for significant non-point sources of pollution throughout the watershed. Non-point sources include pollutants that are delivered to the stream network through normal runoff processes (i.e., they are not delivered by a pipe discharging into the creek). Such pollution sources are commonly associated with roads, agricultural fields, stormwater runoff, and large land disturbance activities (e.g., mining, forest clearing, landfills).

The Workgroup determined that a thorough non-point source assessment was beyond the scope of the Workgroup, and was generally the responsibility of the Regional Water Quality Control Board and other jurisdictions. Additionally, several of the more significant elements of this

project will be developed by priority projects already identified by the Workgroup (e.g., Road Assessment Project, Geomorphic Channel Assessment).

5.6.7 Gray Water Utilization Study

PRIORITY RANKING: TIER 3

This project would will identify opportunities and establish the feasibility of developing a gray water infrastructure within Pilarcitos watershed. The project would identify specific sources of gray water, potential users, and treatment and delivery system options. A feasibility study would identify the estimated reduction in virgin water demand that could be achieved by implementing a gray water system and the estimated cost of design, permitting and development of the required infrastructure.
A gray water infrastructure that reduces demand for virgin water can increase the availability of fresh water for instream habitat uses. It would also support greater capacity for beneficial uses of water within the Pilarcitos without increasing the need to import water from other sources.

Adding gray water infrastructure within the Pilarcitos watershed could reduce demand for virgin water supplies, potentially increasing the availability of fresh water for instream habitat uses. It could also support greater capacity for beneficial uses of water within the Pilarcitos without increasing the need to import water from other sources.

The Workgroup was unable to identify an implementation lead for this project, and thus it was deferred.

5.6.8 Stream Restoration and Maintenance Support Program

PRIORITY RANKING: TIER 3

This project would seek funding to support technical guidance, technical support and project funding for stream and watershed maintenance issues throughout the Pilarcitos watershed. It would benefit the ecological integrity of the watershed by supporting community and stakeholder collaboration in watershed management. Example projects might include establishing guidelines for consistent bank stabilization treatments that restore the dynamic equilibrium of the creek on public and private land in the Pilarcitos Creek watershed.

The Workgroup recognizes that federal cost-share programs to support payments to landowners for land improvements are generally considered win-win propositions, but the programs are shrinking or disappearing. One approach to this issue is to establish an innovative self-funding plan that attracts landowners to conservation projects as well as additional funds from other

agencies. This approach has been implemented to great success by the Missoula Conservation District, which offers a compelling case study. High demand has allowed the Missoula Conservation District to choose high quality projects while the funding is not required to be used in a single fiscal year, as is the case with many existing federal programs. Unspent funds can be rolled over into the next year. The San Mateo County RCD could implement a similar program with funds raised to provide cost-share for NRCS cooperators or others based on criteria developed by the RCD.

The Workgroup recognized the value of such a funding mechanism, but felt it extended beyond to scope of the priority IWMP projects.

5.6.9 Fish Habitat Enhancement

PRIORITY RANKING: TIER 3

This project would develop collaborative efforts with willing landowners to implement instream enhancements for the benefit of fish. Specific opportunities might include habitat structural improvements, large woody debris placement, passable grade control structures, etc. Specific attention might be given to rearing habitat improvements or enhancements, or instream enhancement projects that increase the storage and sorting of spawning gravels in reaches that can supply competent gravel. Additional projects could evaluate upstream reaches on Mills, Arroyo Leon and upper Pilarcitos for possible spawning gravel retention initiatives.

The project was not deemed sufficiently developed by the Workgroup. Many geomorphic and habitat information gaps remain that limit site selection and diagnosis of beneficial projects. The Workgroup recognizes that as additional assessment projects are completed, more specific projects will be identified.

5.6.10 Watershed-Scale Sensitive Plants and Habitats Assessment

PRIORITY RANKING: TIER 4

This project would list sensitive habitats and special-status plant species that are either known to occur or have the potential to occur within the entire Pilarcitos watershed, including areas outside of riparian areas. There are a number of sensitive habitats and special-status plant species in the watershed outside of the riparian zone that were not considered in the 1996 PWA report that have value and warrant management consideration (e.g., serpentine grassland, old-growth Douglas fir, maritime chaparral). The spatial extents of these habitats are mapped in detail for the upper watershed, but their boundaries beyond SFPUC land are not known. This project will support more specific habitat mapping projects as deemed appropriate.

The project would research the habitat requirements of special-status plant species, the site requirements for sensitive habitats, and management concerns for each element. It would conduct reconnaissance surveys of likely areas within the lower watershed and the headwater regions in Apanolio Creek, Corinda Los Trancos Creek, Nuff Creek, Madonna Creek, Mills Creek, and Arroyo Leon Creek to determine the location of sensitive habitats. The estimated cost for this project is about $10,000.

The project will research the habitat requirements of special-status plant species, the site requirements for sensitive habitats, and management concerns for each element. It will conduct reconnaissance surveys of likely areas within the lower watershed and the headwater regions in Apanolio Creek, Corinda Los Trancos Creek, Nuff Creek, Madonna Creek, Mills Creek, and Arroyo Leon Creek to determine the location of sensitive habitats.

The Workgroup determined that the focus of this project on plants and upland habitats was beyond the scope of the current focus on fish habitat, water quality, and watershed integrity.

5.6.11 Beach Water Quality Sanitary Survey

PRIORITY RANKING: TIER 4

This project would develop a Watershed Sanitary Survey for the beaches adjacent to the mouth of Pilarcitos Creek. The sanitary survey would identify pollutant sources that are responsible for the often degraded condition of the beach quality.

The Workgroup determined that existing information is available, and that the scope of this project extends beyond the boundary of the watershed.

5.7 OTHER PROJECTS CONSIDERED

Several other projects were considered by the Workgroup. Several of these were rolled into projects described above. Other project ideas were discussed briefly, but not substantially developed. Only the Arroyo Leon Pond Rehabilitation was developed with some detail, but was rejected from the plan.

5.7.1 Arroyo Leon Pond Rehabilitation

This project would have restored instream ponds on Arroyo Leon Creek to provide better summer rearing habitat for juvenile steelhead. Operation of these ponds was stopped by regulatory action after 2001 in response to concerns regarding fish passage and requirements under the Endangered

Species Act. The rehabilitation would have included construction of overflow flumes suitable for steelhead smolt passage and modification of the outlet structures on one or both Arroyo Leon Ponds (Johnson Ranch or Giusti) so that they could quickly drain prior to significant forecasted storm events. The rehabilitation process would have developed operational guidelines and/or structural improvements to minimize negative impacts while restoring functional rearing habitat. It would have also secured permits from the California Department of Fish and Game and the National Marine Fisheries Service to resume operation of the ponds in a manner that would provide steelhead rearing and would not significantly interfere with fish passage.

This project was rejected by both the California Department of Fish and Game and the National Marine Fisheries Service. There were a number of agency concerns that could not be overcome within the constraints of the site and regulatory requirements.

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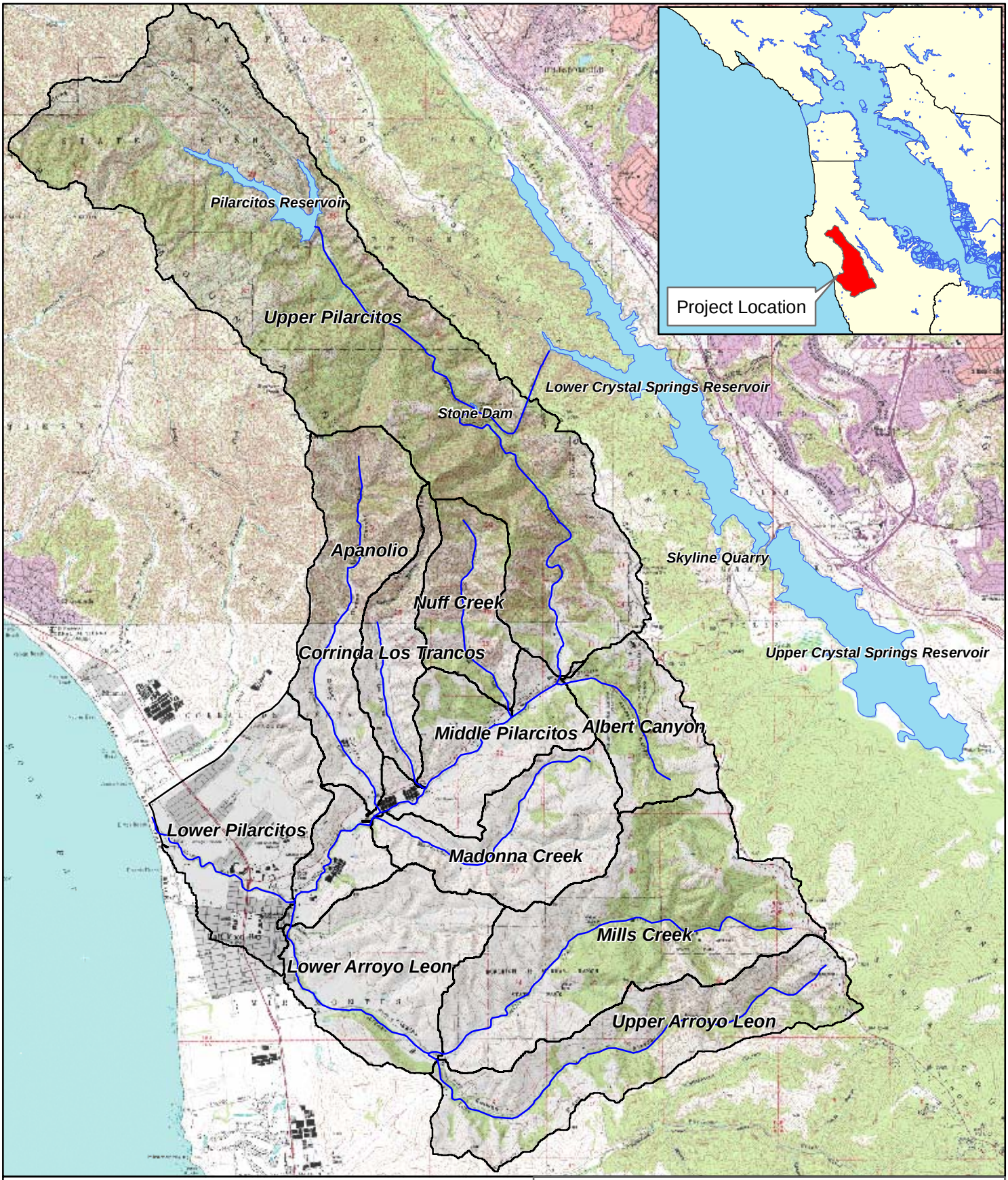
8. FIGURES



Source: USGS (DRG, DEM), SFPUC (water bodies)

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figure 1

Pilarcitos IWMP

Pilarcitos Watersheds Location Map

PWA Ref. # 1884

PWA

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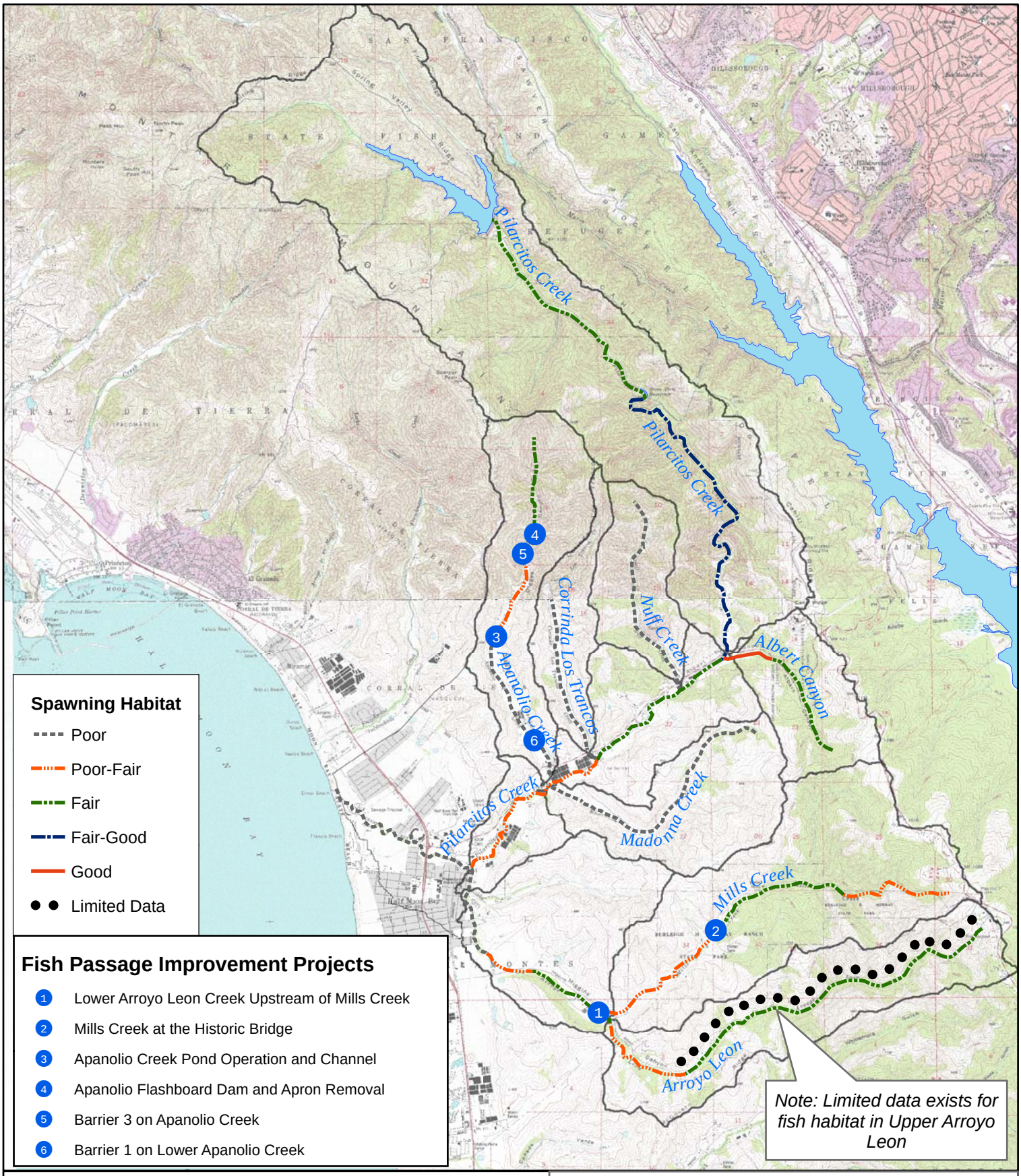

Source: USGS (DRG, DEM), SFPUC (water bodies)

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figure 2

Pilarcitos IWMP

Steelhead Rearing Habitat

PWA Ref. # 1884

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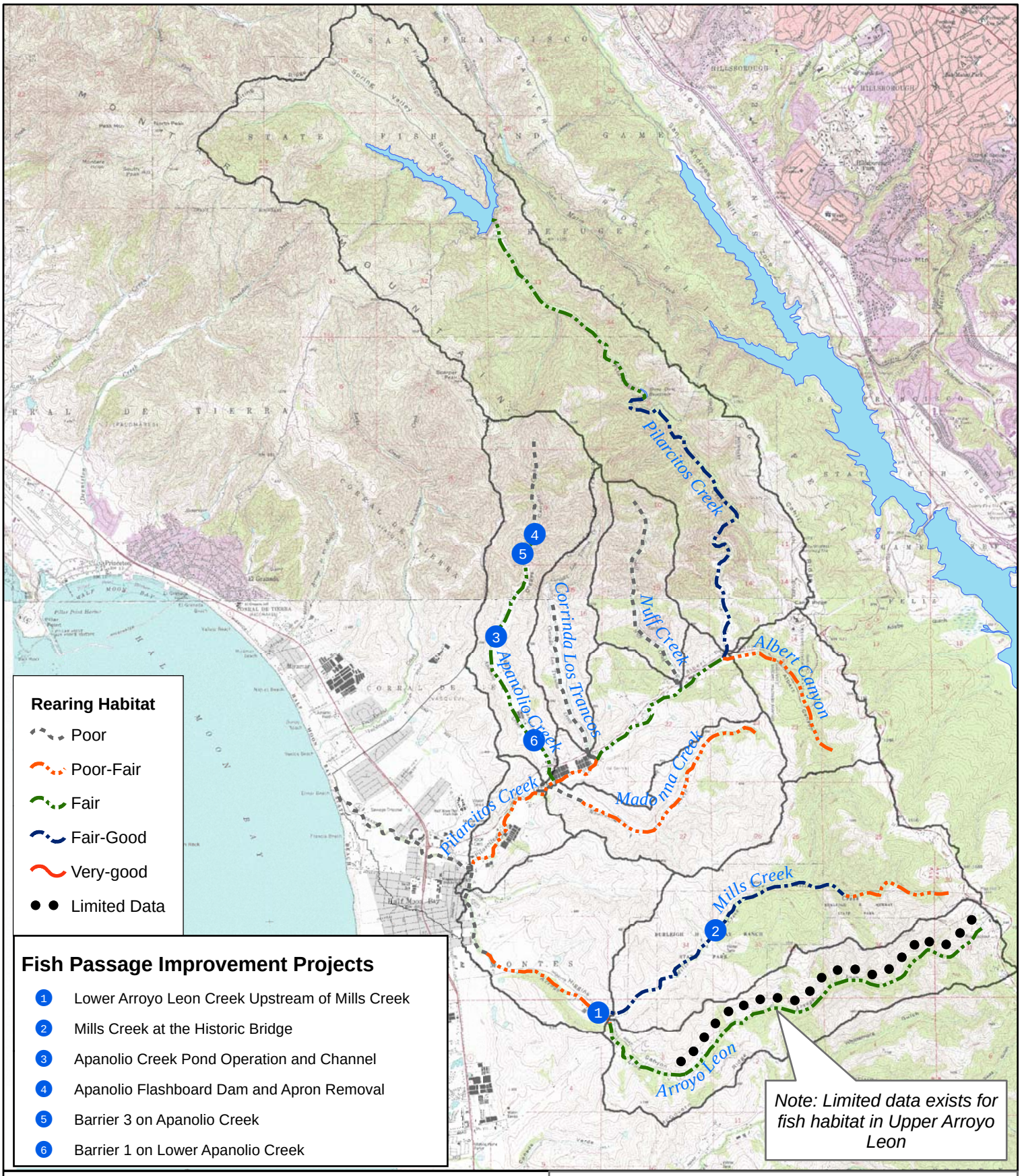

Source: USGS (DRG, DEM), SFPUC (water bodies)

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figure 3

Pilarcitos IWMP

Steelhead Rearing Habitat

PWA Ref. # 1884

PWA

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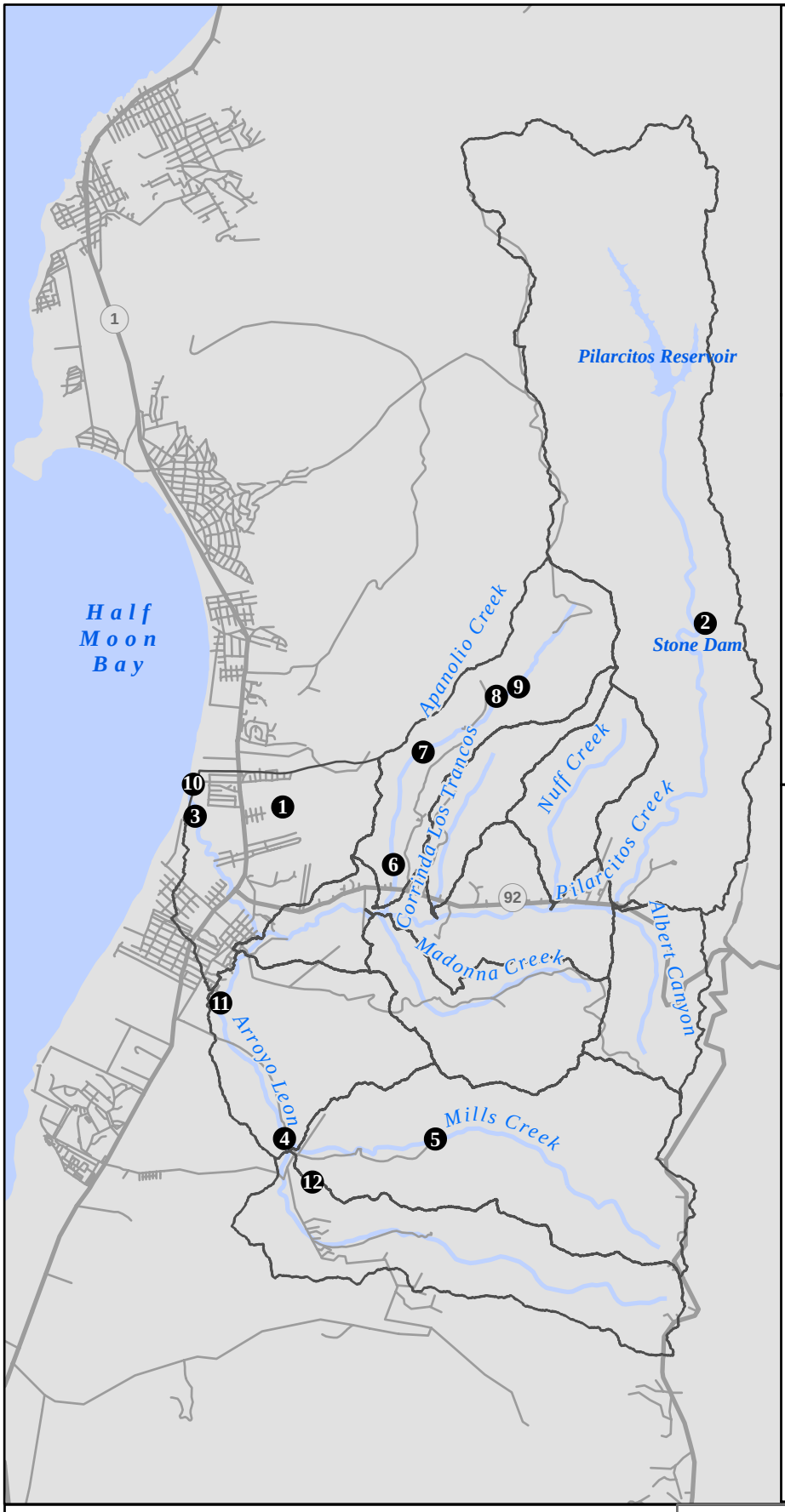

	Project Title	Section
1	Recycled Water Project	5.2.1
2	Pilarcitos Reservoir and Stone Dam Operational Flexibility Improvement Project	5.2.2
3	Equestrian Bridge	5.2.3
	Fish Passage Improvement Projects	5.2.4
- 4	Lower Arroyo Leon Creek Upstream of Mills Creek	
- 5	Mills Creek at Historic Bridge	
- 6	Barrier 1 on Lower Apanolio Creek	
- 7	Barrier 2 on Apanolio Creek	
- 8	Barrier 3 on Apanolio Creek	
- 9	Apanoilo flashboard Dam and Apron Removal	
10	Pilarcitos Lagoon Habitat Enhancement Study	5.3.1
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12	Preliminary Arroyo Leon Fish Habitat Assessment	5.5.7

Watershed-wide Projects

-	Recycled Water Project*	5.2.1
-	Pilarcitos Creek Watershed Protection Easement Program Feasibility Study	5.3.2
-	Recycled Off-Stream Water Storage Feasibility Study*	5.3.3
-	Diverted Off-Stream Water Storage Feasibility Study*	5.3.4
-	Watershed Monitoring Project	5.4.1
-	Eucalyptus Control & Removal Planning	5.4.2
-	Stream Habitat Restoration and Invasive Plant Eradication Assessment	5.4.3
-	Water Budget Development Project	5.5.1
-	Road Assessment Project	5.5.2
-	Geomorphic Channel Assessment	5.5.3
-	Riparian Habitat Restoration and Invasive Plant Eradication Assessment	5.5.4
-	Systematic Watershed-Scale Fish Habitat Assessment Project	5.5.5
-	Assess Habitat Management and Restoration Opportunities for Sensitive Wetland Species	5.5.6

* Projects marked with an asterisk may also benefit areas outside of the Pilarcitos watershed.

Source: USGS (DRG, DEM), SFPUC (water bodies)
Note: Other projects considered but not developed are not shown

0 0.5 1 2 3 Miles

figure 4

Pilarcitos IWMP
IWMP Potential Project Location Map

PWA Ref. # 1884

PWA

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Appendix A
PILARCITOS INTEGRATED WATERSHED MANAGEMENT PLAN
WATERSHED ASSESSMENT UPDATE

Appendix B
WORKGROUP MEMORANDUM OF UNDERSTANDING