Garrapata Creek Watershed Assessment and Restoration Plan

Riparian Element

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Preface

The following report was prepared for the Garrapata Creek Watershed Council as a component of the Garrapata Creek Watershed Assessment and Restoration Plan, a project funded by the California Department of Fish and Game under California Senate Bill 271. The specific DFG Grant Agreement Number is PO230475, Federal Number Grant Document 77-0571493.

The objectives of the Garrapata Creek Watershed Council include the enhancement of the steelhead fishery and associated riparian communities supported in the Joshua Creek, Wildcat Canyon and Garrapata Creek drainages. The Watershed Assessment and Restoration Plan includes an analysis of steelhead barriers (Casagrande and Smith 2004), as well as a physical analysis focused on hydrology and sedimentology (Smith, et al. 2004). The riparian element of the Watershed Assessment and Restoration Plan includes a description of the vegetation history and contemporary natural community composition in the watershed, as well as a discussion of management challenges, enhancement opportunities and data gaps.

Watershed Assessment generally involves a systems approach to analyzing physical, biotic and social features of a watershed, which is essentially a rainfall catchment area. Ultimately, the assessment process usually results in the development of an Action Plan that identifies ways to:

- Protect water resources and the physical and biological processes that influence water resources;
- Provide education and assistance to stakeholders;
- Create effective strategies for constructive measures that address problems and enhance watershed values.

Acknowledgments

The following individuals facilitated the development of the riparian element of the Garrapata Creek Watershed Assessment and deserve thanks for their field support, information exchange, and community involvement.

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1. Background Information

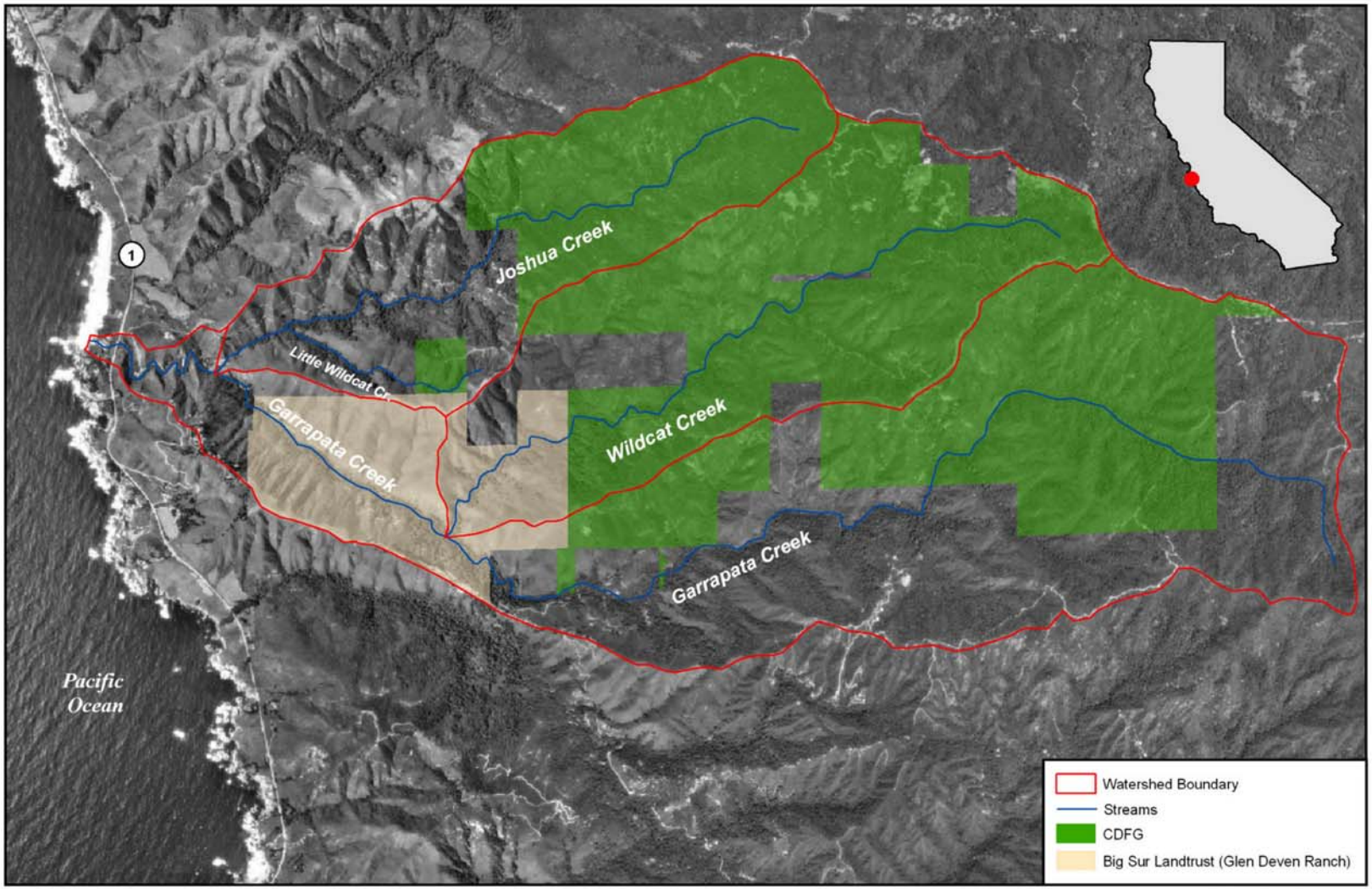
The Garrapata Creek Watershed (GCW) is a coastal drainage framed by the northern margin of the Los Padres National Forest and rugged terrain along the Pacific slope of the Santa Lucia Range. Most of the watershed is composed of faulted and fractured Cretaceous granitic rocks of the Soberanes Point Formation. Large portions of the upper watershed are in public ownership through the Los Padres National Forest and the California Department of Fish and Game. The estuary/lagoon at the mouth of Garrapata Creek occurs on privately owned property adjacent to Garrapata State Beach. The remainder of the watershed is held in an assortment of private holdings, including approximately 850-acres owned by the conservation-oriented organization The Big Sur Land Trust.

The mouth of Garrapata Creek is about 10 miles south of Carmel. Elevations in the drainage basin range up to 3445-feet on White Rock Ridge and approximately 3935-feet close to the edge of the Los Padres National Forest east of Twin Peaks. Two primary tributaries, Joshua Creek and Wildcat Canyon, contribute perennial flow to the principal Garrapata Creek and collectively these stream systems comprise a watershed of about 10.7 square miles in area.

The GCW has some limited population and distribution data for the South/Central California Coast Steelhead Ecologically Significant Unit (Steelhead ESU), however information about the character of riparian vegetation resources in the watershed is not known from the sparse literature. Field survey and watershed assessment work that was completed by Pacific Watershed Associates in March 2003 identified the reduction of erosion and sediment delivery throughout the watershed as key to the restoration and ultimate recovery of stream habitat supporting salmonids (PWA 2003). However, the focus on reducing sediment inputs to restore stream values for the fishery did not address the character, or functional health of associated riparian vegetation resources.

The following text describes riparian resources and upland natural communities in Joshua, Wildcat and Garrapata canyons. The text describes typical species composition, relative vigor and stability of riparian ecosystems and provides suggestions for enhancing vegetation values for the benefit of both the riparian corridor and associated aquatic habitat in the adjacent streams.

The Garrapata Creek Watershed and major tributary drainage basins are presented in Figure 1 (prepared by Joel Casagrande, Casagrande and Smith, 2004). The green overprint represents the combined area of the Palo Corona Ranch and Joshua Creek Ecological Reserve properties owned by the California Department of Fish and Game. The tan overprint represents the Glen Deven Ranch owned by The Big Sur Land Trust.


Joshua Creek
Little Wildcat Cr.
Garrapata Creek
Wildcat Creek
Garrapata Creek
Pacific Ocean
1
Watershed Boundary
Streams
CDFG
Big Sur Landtrust (Glen Deven Ranch)
0 0.5 1 Kilometers
0 0.5 1 Miles
N
Map Produced By: Joel Casagrande
Stream Layer: CDFG
1:100k Hydrography Version: 2003.6
Boundary Layer: GCWC
DOQ Imagery: CaSIL
Image Date: 2 May 1996
(C) CCoWS, 2004

2. Vegetation History

The Garrapata Creek Watershed (GCW) supports a rich human history that includes well over one hundred years of rural settlement and all the various attendant activities that relate to residential development and commercial exploitation. Road construction, logging, land clearing, water extraction, grazing, commercial fish rearing, and probably agriculture occurred as homesteaders made claims to land in the GCW and established their home and ranches. The vegetation history of the GCW includes significant alterations due to human activity, as well as naturally induced episodic changes resulting from wildfires and floods.

Earliest European and American settlement in the watershed no doubt pre-dates a 1895 application to operate a post office establishment – the Mungo Post Office – which was situated on the south side of Garrapata Creek about one-half mile from the coast road (Clark 1991). The Mungo Post Office may have been established to service the robust timber industry that sprang up throughout the Big Sur region at the close of the 1800's. The history of early commercial tanbark oak and redwood logging in the area is recorded in the massive remnant redwood stumps with springboard notches that occur along canyon bottoms and moist canyon slopes.

Tanbark oak trees occur as scattered elements in Redwood and Mixed Evergreen Forest, and the extraction of tanbark trees involved numerous cable networks and skid trails for livestock that helped harvest this resource. Roads, landings and haul trails were built to facilitate timbering activities. Some road networks were crudely dug excavations, while others were elaborate systems of cribbing with inlaid timbers that created roadbeds perched high above steep canyon streams.

Old Growth redwood stumps occur along most of the Joshua Creek canyon bottom, including the upper headwaters in what is now the Department of Fish and Game Joshua Creek Ecological Reserve. Stumps also occur in Wildcat Canyon and in the lower and middle reaches of Garrapata Canyon. It is possible that logging activities extended into the upper watershed of Garrapata Creek following the distribution of redwood trees along shaded and moist canyon bottoms and tanbark in the Mixed Evergreen Forest, however field inspection in the mid- and upper reaches of Garrapata Canyon proved difficult because of challenging terrain and private property considerations. Most of the contemporary Redwood Forest habitat in the Garrapata Creek Watershed is second, and perhaps even third-growth.

Figure 2 is a reproduction of a small portion of a 1909 map prepared by Monterey County Surveyor, Lou Hare. The names of property owners in Garrapata Canyon and Wildcat Canyon include the Notley brothers, who established a thriving, albeit short-lived ocean port at Palo Colorado where tanbark and redwood logs were loaded onto ships bound for tanneries and construction sites in Monterey, Santa Cruz and San Francisco.

The Parmalee name occupies a block of land around the Trout Farm that was previously owned by Isaac Newton Swetnam. According to Jeff Norman, the area around the Trout Farm was also owned at one time by O.O. Woodfin (Norman, 1992-1993). The notation on the Hare map for A. Larg is a typographical error for the name Lang (Norman, 2004). Interestingly, the Hare map does not include the major tributary of Joshua Creek, locally referred to as "Joshua's Wildcat", or "Cougar Gulch" (Norman, 1992-1993).

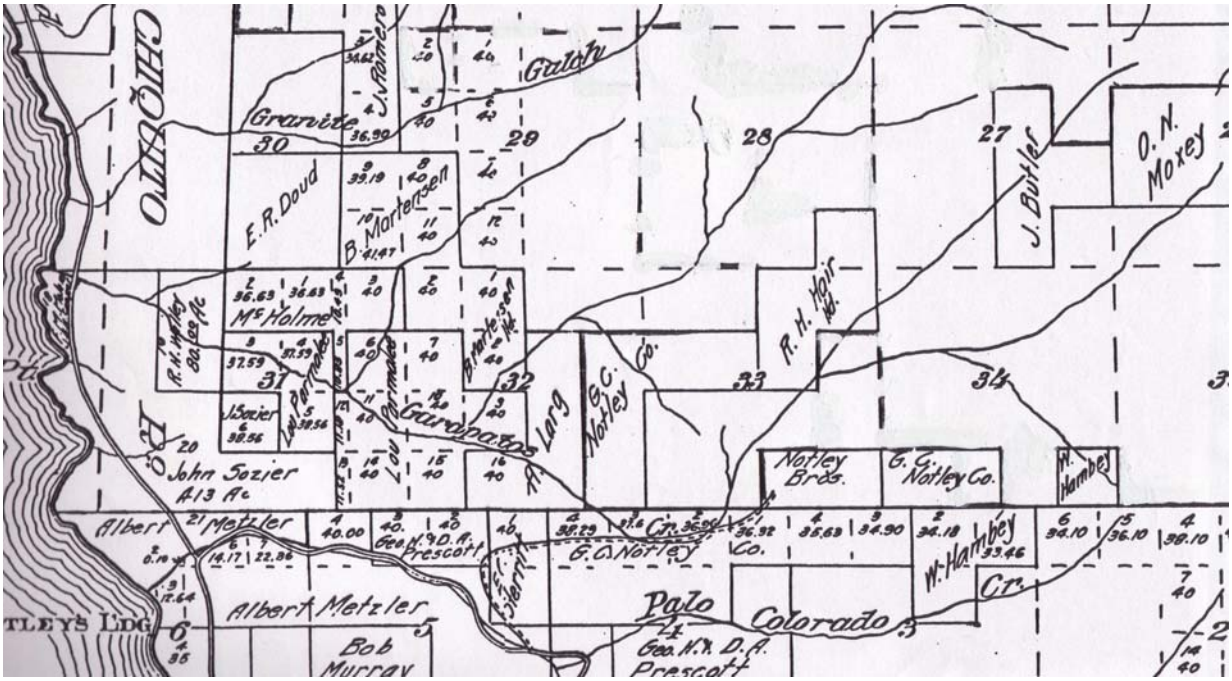


Figure 2 – 1909 map by Monterey County Surveyor Lou Hare

In neighboring Palo Colorado Canyon, road construction and logging denuded steep canyons and left stream courses clogged with sediment and woody debris for decades after loggers cleared the land and moved their timber to mills and coastal landings (Nedeff, 1992). Although historic data were not discovered that chronicle historic logging activities specific to the Garrapata Creek Watershed, there is little question that significant human alteration of the original tanbark oak and redwood canyon landscape was effected by enterprising lumberjacks in the late 1800's early 1900's.

The history of logging activities in the GCW underscores the significance of how substantially portions of the landscape had been altered in past decades. In addition to timber operations and homesteading activities, e.g., the stone hearth in lower Wildcat Canyon, commercial activities like livestock grazing and fish-rearing have occurred in scattered parts of the watershed. Cattle drives from ranches deep in Big Sur country made their way north along the coast and inevitably grazed areas of the lower GCW on their march to markets in Monterey and Salinas (Post, 2003). For more than a century, cattle have grazed on the Doud Ranch in the northern Joshua drainage and across portions of the upper Joshua watershed (Norman, 1992-1993). More recently, the ridgeline separating Garrapata Canyon from Palo Colorado Canyon (Glen Deven Ranch) has been mowed and grazed to maintain a fire break.

According to Bill Lange (Norman, 1992-1993), "Dutch" Louie, one of the earliest settlers in the Joshua drainage, operated a cheese factory in what is today the DFG Ecological Reserve. Access was over a sled route across the Doud Ranch. Mr. Louie sold his land to a man named Curtis, who eventually sold to the parents of Bill Lange, Rudolph and Martha Lange. At that time, access to the Lange Ranch was on a road that left lower Garrapata Canyon near the old Woodfin property at the

current Trout Farm. The contemporary route to the DFG Ecological Reserve was surveyed by Rudolph Lange and constructed by Frank DeAmeral in 1936.

Commercial fish-rearing has occurred in both upper Joshua Creek and lower Garrapata Canyon, where fish operations included ponds, off-channel tanks and water diversions. The Joshua Creek operation was started by Bill Lange in the early 1960's (Norman, 1992-1993). More recent changes in the landscape include the clearing of a Pacific Gas and Electric Company (PG&E) right-of-way for high tension power lines that span the upper Garrapata drainage near the boundary with the Los Padres National Forest. In addition to physical clearing of vegetation in the watershed, water extraction from the main stream canyons and from springs and bedrock wells in upland areas, may influence the species composition of phreatophytic habitat that is dependent on high soil moisture.

The contemporary landscape bears only reminders of the history of large-scale anthropogenic disturbances. Today there does not appear to be logging or large-scale grazing in the watershed, and clearing is generally limited to the PG&E right-of-way and the patchwork of rural residential home sites concentrated in the lower watershed. Vegetative indicators of past historic activities can be noted in the presence of atypical plants that have naturalized over large areas of the riparian corridor, including blue gum eucalyptus (*Eucalyptus globulus*), Monterey pine (*Pinus radiata*), Monterey cypress (*Cupressus macrocarpa*) and periwinkle (*Vinca major*). When located outside of their natural range, these species and many others are typically considered domestic plantings associated with historic home sites.

In addition to past landscape alterations brought about by human activities, the watershed has been subjected to natural episodes of change that occur with variable periodicity. The region has a fire history that begs to be documented and the watershed has experienced vegetation changes resulting from landslides and slumps. Of particular importance to riparian vegetation is the episodic disturbance brought about by flooding, which uproots vegetation, transports woody debris, veneers banks and floodplains with fresh sediment, and restarts the ecological clock for riparian processes.

Figures 3 and 4 are historical photographs depicting the mouth of Garrapata Canyon in 1912. At the time these two photographs were taken, a bridge over Garrapata Creek was situated upstream of the current Highway 1 alignment. Note the complete lack of riparian vegetation and the extent of barren cobble bars on the floodplain south (right) of the old bridge. It appears that access to the canyon bottom was provided by the road that still hugs the south canyon wall immediately downstream of the Highway 1 Bridge. Note also the steep switchbacks that descend to the canyon from the saddle above the bridge on the south side (Figure 3). There were huge floods documented along the Central Coast in 1911 and again in 1914, and it is likely that Garrapata Creek suffered substantial flooding and erosion during these episodic high flow events. Logging activities that destabililzed upstream slopes may have contributed to the massive erosion that stripped all vegetation from the banks of the creek. Compare conditions in 1912 with riparian vegetation in July 2004, as shown in Figure 12, page 18.

Figure 5 is a photograph of the newly constructed Highway 1 Bridge in the early 1930's. This image is courtesy Pat Hathaway and California Views. In this photograph, the older, metal bridge spanning the Garrapata lagoon still stands downstream of the new concrete archway. Note the sparse willow vegetation and exposed channel banks under the new bridge. Compare streamside vegetation in the 1930's with July 2004, as shown in Figure 14, page 22.

Figure 3 – Garrapata Canyon in 1912. Courtesy Jeff Norman and Kit Phillips.

Figure 4 – "Tick Creek". Courtesy Jeff Norman and Kit Phillips.

Figure 5 – The new Highway 1 Bridge over Garrapata Canyon. Riparian vegetation in this early 1930's view is very sparse, with discontinuous willow thickets found on exposed sand and gravel bars.

3. Methods

Methods used for the examination of vegetation resources in the Joshua, Wildcat and Garrapata drainage basins were descriptive in nature and not quantitative. The protocol for assessing riparian function loosely follows the "Properly Functioning Condition" analysis techniques forwarded by a consortium of federal agencies that consider hydrology, vegetation and geomorphic processes (erosion and deposition) to determine how well riparian systems are working (U.S., 1998). The Riparian Area Management Handbook (U.S., 1998) defines riparian and wetland habitat as being in proper functioning condition when adequate vegetation, landform, or large wood is present to:

- Dissipate stream energy associated with high waterflow, thereby reducing erosion and improving water quality;
- Filter sediment, capture bedload, and aid floodplain development;
- Improve flood-water retention and ground-water recharge;
- Develop diverse ponding and channel characteristics to provide habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding and other uses;
- Support greater biodiversity.

All lower reaches of Joshua Creek, Wildcat Canyon and Garrapata Creek, including the estuary/lagoon, were traversed on foot until private property access constraints and/or physical barriers were encountered. The uppermost watershed areas of all three drainages were surveyed on foot using vehicular routes on the DFG Palo Corona - Little Horse property. Field survey pursuant to this project was conducted in October of 2003, and March, July, August and November of 2004.

Figure 6 – The mouth of Garrapata Creek at the edge of the coastal lagoon. July 2004.

4. Natural Communities

The Garrapata Creek Watershed (GCW) is a classic mosaic of coastal and inland vegetation types typical of Pacific slope watersheds in central California. In a transect from the upper watershed divides to the estuary/lagoon at the mouth of Garrapata Creek, the natural communities in the GCW reflect bedrock, tectonics, soil, aspect, moisture, fire, land use and marine influences.

4.1 Uplands:

Upper watershed vegetation in Joshua, Wildcat and Garrapata canyons is remarkably similar; the vegetation is a patchwork mosaic of differing habitat types that reflect edaphic (soil) differences, fire histories and microclimate conditions. Sunny, exposed, generally south-facing slopes are mantled with chamise-dominated Chaparral, with patches of mesic Canyon Live Oak/Bay Forest tucked into the folds of narrow drainages. Floristically diverse Mixed Chaparral usually occurs on south slopes in inland areas of the watershed, particularly on higher elevation DFG lands. Most all north-facing slopes support Mixed Evergreen Forest, with a few unique groves of enormous Madrone (*Arbutus menziesii*) and Canyon live oak (*Quercus chrysolepis*) in the highest elevation areas of the Wildcat drainage. Most narrow drainage bottoms support linear Canyon Riparian communities that snake their way along increasingly steep gradients towards watershed divides.

Figure 7 – Enormous madrone in upper Wildcat Canyon. Photo by Gordon Johnson, May 2004.

As one moves towards the coast and the omnipresent marine influence of persistent coastal fog, Chaparral vegetation gives way to Northern Coastal Scrub and occasional patches of Maritime Chaparral, which is found on marine terraces in the Highway 1 corridor. Closest to the coast, the

bluffs and dunes at the mouth of Garrapata Canyon host uncommon communities noteworthy in their own right for their floristic composition and vegetative complexity.

Large tracts of Grassland ecosystems occur on the northern margin of the watershed along the northern edge of Joshua Creek. Although dominated by introduced annual species and forbs, the Joshua divide includes notably large patches of native, perennial grasses and both perennial and annual wildflower species. The eastern edge of the Wildcat Canyon drainage has a few very small, but distinctive patches of Grassland that are also notable for their composition of native, perennial species. Other areas of Grassland ecosystems in the watershed tend to be small, widely scattered, and composed primarily of introduced, annual species and weedy forbs.

As is typical of watershed vegetation, the most extensive coverage of specific natural community types occurs in the upper watershed areas, with the most restricted plant community distribution at the narrow mouth of Garrapata Creek.

4.1.1 Chamise Chaparral: On the hottest, driest slopes that are also often the poorest in terms of soil development, shrub-dominated chaparral vegetation is characterized by a predominance of chamise (*Adenostoma fasciculatum*). Occasionally, shrubby forms of canyon live oak (*Quercus chrysolepis*) and coast live oak (*Q. agrifolia*) occur with yerba santa (*Eriodictyon californicum*) and poison oak (*Toxicodendron diversilobum*). Areas with more open cover closer to the coast may include deerweed (*Lotus scoparius*), sticky monkey flower (*Mimulus aurantiacus*) and black sage (*Salvia mellifera*).

4.1.2 Mixed Chaparral: The farthest inland and highest elevation south-facing slopes in the Joshua, Wildcat and Garrapata drainages include shrub species more typical of inland chaparral communities removed from persistent marine influences. The "inland" vegetation mosaic includes Eastwood's manzanita (*Arctostaphylos glandulosa* ssp. or var. ?), bush poppy (*Dendromecon rigida*), golden fleece (*Ericameria arborescens*), toyon (*Heteromeles arbutifolia*), coffeeberry (*Rhamnus californica*), and several species of ceanothus, including warty-leaved ceanothus (*Ceanothus papillosus*) and buck brush (*C. cuneatus*). Occasionally, the endemic Santa Lucia monkey flower (*Mimulus aurantiacus* var. *bifidus*), scarlet bugler (*Penstemon centranthus*) and California buckwheat occur (*Eriogonum fasciculatum*).

4.1.3 Mixed Evergreen Forest: The forested hill slopes on north-facing aspects are generally damper and more shaded areas of the watershed. These slopes are vegetated with a variable mixture of tanbark oak (*Lithocarpus densiflora*) and California bay (*Umbellularia californica*), with scattered canyon live oak (*Quercus chrysolepis*) and madrone (*Arbutus menziesii*). Closer to the ocean, coast live oak (*Quercus agrifolia*) increases in the mix of other evergreen species. Beneath the canopy, hairy honeysuckle (*Lonicera hispidula*), coffeeberry (*Rhamnus californica*), and the endemic Santa Lucia gooseberry (*Ribes sericeum*) occur. The gooseberry is found only in moist canyons of the Santa Lucia Range and is considered rare, but not endangered by the California Native Plant Society (List 4).

Figure 8 – Mixed Chaparral vegetation and pockets of Canyon Live Oak/California Bay Woodland along PG&E maintenance road in upper Garrapata Creek Watershed. August 2004.

Figure 9 – Mixed Evergreen Forest along PG&E powerline right-of-way in upper Garrapata Creek Watershed. August 2004.

4.1.4 Canyon Live Oak/California Bay Forest and Woodland: The Canyon Live Oak/California Bay habitat is a variant of Mixed Evergreen Forest, however it usually has a more open canopy and occurs in small, discontinuous patches tucked into drainages on more xeric (dry) south-facing slopes. This habitat is dominated by Canyon live oak (*Quercus chrysolepis*) and California bay (*Umbellularia californica*). Areas with closed canopies are considered forest types, while areas of more open canopy cover qualify as woodland. Often the Oak/Bay woodland includes shrubby forms of canyon live oak that intergrade with ceanothus and other shrubs typical of both the Mixed Evergreen Forest and Mixed Chaparral.

4.1.5 Redwood Forest: This natural community is indicated by the dominant presence of coast redwood (*Sequoia sempervirens*). The Redwood Forest canopy in the Joshua, Wildcat and Garrapata drainages extends along canyon bottoms and up canyon sides where damp soils maintain these moisture-dependent trees. Coastal fog and the supplemental moisture provided by fogdrip sustain redwoods for short distances along tributary canyons with variable seasonal flow. An understory of tanbark oak (*Lithocarpus densiflora*), big-leaved maple (*Acer macrophyllum*), California bay (*Umbellularia californica*), redwood sorrel (*Oxalis oregana*), sword fern *(Polystichum munitum*), lady fern (*Athyrium filix-femina*), iris (*Iris douglasiana*), pink star-flower (*Trientalis latifolia*), vanilla grass (*Hierochloe occidentalis*) and false Soloman's seal (*Smilacina racemosa*) occurs under the redwood canopy. Deep shade often makes understory vegetation in these forests quite open, as sunlight has difficulty penetrating the thick canopy.

Although notable large old growth trees occur sporadically throughout the watershed, most of the Redwood Forest habitat in Joshua, Wildcat and Garrapata canyons is second growth forest. There may be areas where repeated logging or thinning has produced third growth conditions.

4.1.6 Grassland: Grassland ecosystems in the GCW occur on the northern margin of the Joshua Creek drainage and in small, discontinuous patches in the uppermost watershed areas of Wildcat Canyon. As mentioned in the text above, most of the Grassland in the study area is dominated by non-native, annual species, however there are large patches of native perennial grasses that speak to the biological significance of these habitats. Common native species at higher elevations include purple needle grass (*Nasella pulchra*) and western ryegrass (*Elymus glaucus*). Non-native annuals include wild oats (*Avena fatua*), rupgut brome (*Bromus diandrus*), Italian ryegrass (*Lolium mutiflorum*) and barnyard foxtail (*Hordeum leporinum*), as well as many others.

Figure 10 – Patches of Grassland vegetation in upper Wildcat Canyon Watershed.
Photograph by Gordon Johnson, May 2004.

4.1.7 Northern Coastal Scrub: This shrub-dominated habitat occurs on hill slopes that are heavily influenced by the presence of cool, moist advective fog. The sparse, brittle appearance of this evergreen habitat is characteristic of many south and west-facing slopes in the GCW. Typical dominant species in the Northern Coastal Scrub community include coast sagebrush (*Artemisia californica*), poison oak (*Toxicodendron diversilobum*), lizard-tail *(Eriophyllum staechadifolium*), coyote brush (*Baccharis pilularis*), blue blossom (*Ceanothus thyrsiflorus*), deerweed (L*otus scoparius*) and occasional western bracken fern (*Pteridium aquilinum*). Twining coast morning glory (*Calystegia macrostegia* ssp. *cyclostegia*) and wild cucumber (*Marah fabaceus*) can often be seen draped over the shrub vegetation.

Breaks in the shrub canopy and margins of disturbed areas can support California fuchsia (*Epilobium canum*), bird's-foot fern (*Pellaea mucronata*) and sparse native purple needle grass (*Nassella pulchra*). Under the thick, closed canopy of generally short shrubs (5-foot average height), yerba buena (*Satureja douglasii*) and infrequent bunches of California oat grass (*Danthonia californica*) occur along the exposed edges of the scrub community where there is less competition from other plants and more open habitat conditions.

4.1.8 Coastal Sage Scrub: This transitional natural community occurs on more gradual slopes topographically below Northern Coastal Scrub and above Coastal Bluff Scrub. Many of the typical Northern Coastal Scrub species also occur in Coastal Sage Scrub, however the Sage Scrub community is characterized by prominent bush lupine (*Lupinus arboreus*), silver bush lupine (*Lupinus albifrons* var. *albifrons*), seacliff buckwheat (*Eriogonum parvifolium*), black sage (*Salvia mellifera*), sticky monkey-flower (*Mimulus aurantiacus*), and bee plant (*Scrophularia californica*). Seacliff buckwheat is the host plant for the Federally Endangered Smith's blue butterfly.

4.1.9 Central Maritime Chaparral: Very little of this particularly interesting natural community occurs in the GCW, however the small patches of Maritime Chaparral on coastal bluffs near Highway 1 are particularly noteworthy. Maritime Chaparral habitat is characterized by groupings of endemic manzanitas, and the GCW areas of this community includes shaggy-barked manzanita (*Arctostaphylos tomentosa* ssp. *tomentosa*), Hooker's manzanita (*A. hookeri*), and the northern-most extension of the Little Sur manzanita (*A. edmundsii forma edmundsii*). In addition, salal (*Gaultheria shallon*) and seacliff buckwheat occur in scattered locations. Although detailed surveys of this plant community were not conducted as a component of the Garrapata Creek Watershed Assessment, it is anticipated that further investigation of the Central Maritime Chaparral area within the watershed will yield information on the potential distribution of rare plants and wildlife associated with this habitat.

4.1.10 Coastal Bluff Scrub: This habitat is present on the lowest slopes of the GCW on the coastal bluffs adjacent to the narrow stream mouth of Garrapata Creek. The Coastal Bluff Scrub natural community occupies steep, rocky habitat subjected to harsh winds and misting sea spray. Typical plant species in this community include bluff lettuce (*Dudleya farinosa*), sea lettuce (*D. caespitosa*), seaside daisy (*Erigeron glaucus*), seacliff buckwheat (*Eriogonum parvifolium*), lizard tail (*Eriophyllum staechadifolium*), and common beach aster (*Lessingia filaginifolia* var. *filaginifolia*. Coastal Bluff Scrub above the mouth of Garrapata Creeks includes occasional California sage (*Artemisia californica*), Hooker's evening primrose (*Oenothera elata* ssp. *hookeri*), California blackberry (*Rubus ursinus*), bee plant (*Scrophularia californica*), and ubiquitous poison oak (*Toxicodendron diversilobum*). Coastal Bluff Scrub grades into Coastal Sage Scrub and Northern Coastal Scrub habitats at upper elevations of the GCW.

4.1.11 Central Dune Scrub: This habitat is the closest terrestrial community to the active ocean shore zone. Active dunes in the tidal zone merge with areas stabilized with ice plant (*Carpobrotus chilense*), mock heather (*Ericameria ericoides*), lizardtail (*Eriophyllum staechadifolium*), and yarrow (*Achillea millefolium*). Species growing in the active dunes include sea rocket (*Cakile maritime*), beach-bur (*Ambrosia chamissonis* var. *bipinatifecta*) and a sedge species that extends from the wetted edge of the creek into sand dunes (*Carex* sp.).

4.1.12 Coastal Brackish Marsh: The mouth of Garrapata Creek empties into a coastal estuary that periodically forms a lagoon when wave action builds up a berm of sand that blocks flow out to the ocean. The mixing area of fresh and salt water has a very interesting collection of wetland plants which grade from typical riparian types into backwater emergent species and salt marsh plants that are subjected to persistent saline influences. Freshwater wetland plants like chain fern (*Woodwardia fimbriata*), arroyo willow (*Salix lasiolepis*), iris-leaved rush (*Juncus xiphioides*), common monkey flower (*Mimulus guttatus*), horsetail (*Equisetum arvense*), and small-fruited bullrush (*Scirpus microcarpus*) grade into habitats where more salt-tolerant species like silver-weed (*Potentilla anserina* ssp. *pacifica*), Baltic rush (*Juncus balticus*), California bulrush (*Scirpus californicus*) and dune sedge (*Carex* sp.) occur. Dune sedge has stabilized the margin of the sand dunes, as well as the fine terrestrial sediments deposited at the mouth of the creek.

Figure 11 – The coastal edge of the Garrapata Creek Watershed where Garrapata Creek meets ocean water in the coastal lagoon. July 2004.

4.2 Riparian:

Riparian natural communities in the Garrapata Creek Watershed run the gamut from coastal forms that are pruned and stunted by salty winds at the mouth of the mainstem, to narrow, linear habitats restricted to the seasonally damp folds of the chaparral-covered watershed divides. By definition, riparian vegetation is associated with the margins of streams and is restricted to the narrow belt of land influenced directly by stream flow. High water tables in the alluvium fringing streams in the GCW sustain riparian species, which otherwise could not survive in the seasonally arid climate of central California.

As noted by Henson and Usner in "The Natural History of Big Sur" (page 149):

> The exact character of this plant community differs from creek to creek and is dependent on several factors. The steepness and orientation of a river canyon's walls determine how much sunlight reaches the canyon floor. The makeup of the riverbed – whether it is sandy or rocky – influences what plants can take hold. The grade, shape, and width of the stream channel determines where and how fast water flows. This is especially significant during floods when many plants are torn up at the roots by high water and floodplains are cut.

The following descriptions of riparian communities provide general characteristics and note typical species in the vegetation associations found throughout the watershed. Ensuing text provides more detailed and comprehensive descriptions of habitat found along lower reaches of Garrapata Creek, Joshua Creek and Wildcat Canyon.

4.2.1 Lower Watershed Riparian: The lower reaches of the GCW support a collection of riparian habitat types that include several species of willow (*Salix*) as dominant or co-dominant taxa. Each of the following natural communities is noted individually in the DFG List of California Terrestrial Natural Communities Recognized by the California Natural Diversity Data Base (DFG, 2003). However, the lower watershed riparian habitats are being described together for this report and the reader should recognize that each association reflects slightly differing environmental conditions and cover of primary plant indicators.

The following natural communities occur along lower Garrapata Creek and the lowest portion of Joshua Creek where the mainstem canyon bottom is relatively wide and floodplain development has created appropriate habitat for riparian vegetation recruitment:

- Central Arroyo Willow
- Red willow/Arroyo willow
- Red Alder/Arroyo Willow

Each of these streamside communities includes varying proportions of arroyo willow (*Salix lasiolepis*), which occurs in pure stands, as well as with other riparian species as a co-dominant. Arroyo willow is usually a relatively small tree that can grow in very shrubby forms. Wind-borne seeds produced in early spring are designed to fall to recruitment sites veneered with fresh sediment exposed as stream levels retreat at the close of the rainy season. Arroyo willow, as all genera in the Willow Family found in central California - the Salicaceae (*Populus, Salix*) - can also propagate

vegetatively by sprouting roots from stems and twigs when woody portions of the plant are buried by alluvium or submerged in water. The ability of the stem material to reform into tissue that can sprout adventitious roots is an adaptation to the active and dynamic stream environment that will predictably be disrupted by occasional flood and sedimentation events.

Occasionally, arroyo willow will occur with red willow (*Salix laevigata*), a willow species that can attain tree heights of 15 to 40 feet, or more under favorable conditions. Leaves of the red willow are noticeably larger and more linear than those of arroyo willow and generally taper to a fine point. The leaf margins of red willow are dentate, meaning that the leaf edge is finely toothed.

Both arroyo and red willows can occur with red alder (*Alnus rubra*) in the lower GCW. Red alder is a pioneering colonizer along the banks of streams in the watershed and often the relative dates of large flow events can be determined by the even age of alder trees that occur in dense stands. Alders require constant high water tables and usually can not grow where their shallow roots fail to reach abundant moisture. Shifting stream channels, channel incision, or drops in watertable levels result in alder mortality and the presence of dead alders may provide clues to lowering groundwater or the geomorphic history at particular sites in the watershed.

Figure 12 – Red Alder/Arroyo Willow Riparian habitat near the mouth of Garrapata Canyon. July 2004.

Typical understory plants in various phases of willow/alder habitat in the lower GCW include creek dogwood (*Cornus sericea* ssp. *occidentalis*), which is also called western red dogwood, thimbleberry (*Rubus parviflorus*), California blackberry (*R. ursinus*), mugwort (*Artemisia douglasiana*), chain fern (*Woodwardia fimbriata*), shield fern (*Polystichum californicum*), wood rose (*Rosa gymnocarpa*) and wood mint (*Stachys bullata*). Occasionally, damp cobbles or fine soils adjacent to the active channel support patches of liverwort (*Conocephalum* sp.), and areas of slow moving water are choked with watercress (*Rorippa nasturtium-aquaticum*).

The lower GCW riparian habitat is composed of areas where open canopies and abundant light create dense, shrubby stands dominated by arroyo willow, however there are quite different areas where tall canopies of mature red alder and naturalized blue gum eucalyptus (*Eucalyptus globulus*), Monterey pine (*Pinus radiata*) and Monterey cypress (*Cupressus macrocarpa*) create structurally simple plant associations with understories dominated by low, tangled vines of blackberry and non-native species. The "natural communities" throughout the lower reaches of the GCW are mostly compromised by invasive species and weed-free habitat is relatively hard to find.

4.2.2 Redwood-Riparian Forest is a phase of adjacent redwood-dominated habitat restricted to the edges of perennial stream reaches of Joshua, Wildcat and Garrapata creeks. The riparian phase of the adjacent Redwood Forest occurs where canyon bottoms narrow and stream gradients increase in steepness. Shaded by dense canopies that open up ever so slightly where divided by stream courses, the Redwood-Riparian communities of the GCW include many species found in the neighboring Redwood Forest, but also include species unique to streamside habitats.

Redwood, tanbark oak, big-leaved maple and bay usually provide the overstory above redwood sorrel and widely scattered shrubs. Vegetation lining the banks of Joshua, Wildcat and Garrapata creeks tends to be discontinuous and is either confined to areas above steep banks, or floodplain terraces immediately adjacent to the active channels in each drainage. The shrub component of the Redwood-Riparian Forest can include coffeeberry, thimbleberry, sticky monkey flower, canyon gooseberry (*Ribes menziesii*), Santa Lucia gooseberry (*R. sericeum*), creambush (*Holodiscus discolor*), elk clover (*Aralia californica*) and osoberry (*Oemleria cerasiformis*).

A variety of ferns species generally grow in separated locations along stream banks, with chain fern and shield fern found with five-finger fern (*Adiantum aleuticum*), lady fern (*Athyrium felix-femina*), western bracken (*Pteridium aquilinum*), sword fern (*Polystichum munitum*), wood fern (*Dryopteris arguta*) and occasionally maidenhair fern (*Adiantum jordanii*). Common, although not ever abundant, herbaceous species include sedges (*Carex* spp.), vanilla grass (*Hierochloe occidentalis*), stinging nettle (*Urtica dioica* ssp. *holosericea*), crimson columbine (*Aquilegia formosa*), boykinia (*Boykinia elata*), and the lovely leopard lily (*Lilium pardalinum*). Western colt's foot (*Petasites palmatus*) is found growing in both coarse cobble, as well as fine sediments. Colt's foot can occur partially submerged adjacent to the active channel and also higher on floodplains above the typical bankfull stage.

4.2.3 Canyon Riparian: As one moves up in elevation above the zone where redwood dominates the canopy, canyons become increasingly narrow and v-shaped stream valleys are constrained by bedrock-controlled topography. Canyon Riparian habitat is restricted to the narrow canyon bottoms that usually support seasonal flow. This moisture-dependent habitat thins out as elevation and steepness increase throughout the watershed and the diversity of riparian or wetland obligate species lowers as the number of upland types increases. Fog and the supplemental moisture from fogdrip become negligible. Big-leaved maple (*Acer macrophyllum*), occasional sycamore (*Platanus racemosa*), poison oak and blackberry typify Canyon Riparian communities until elevations increase and mesic habitat grades into upland types of Canyon live oak/Bay or Mixed Chaparral. Often the only noticeable indicator of a Canyon Riparian habitat will be an occasional maple in an otherwise evergreen canopy.

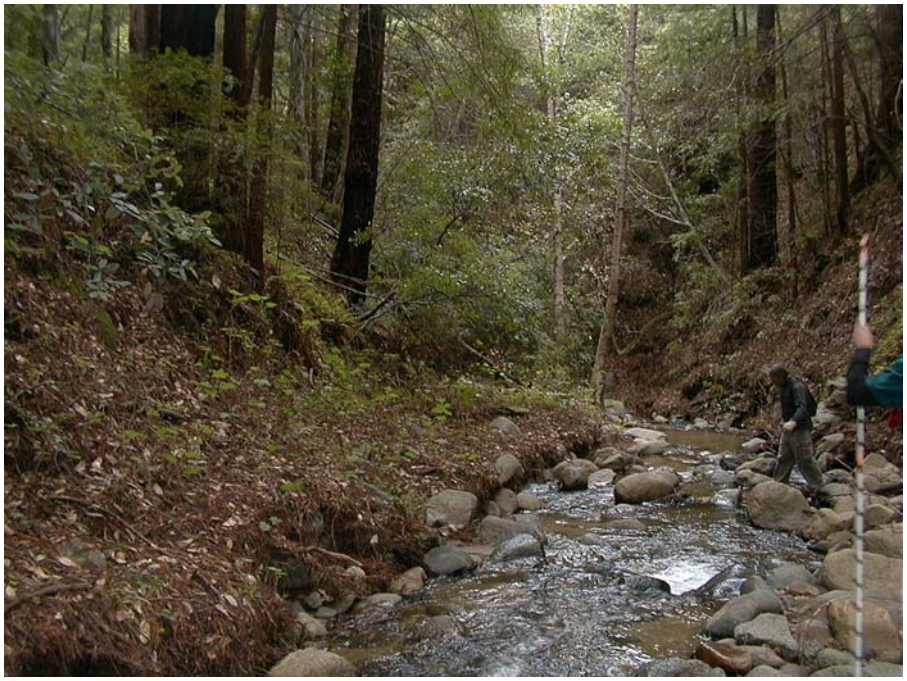


Figure 13 – Redwood Riparian habitat along middle reaches of Garrapata Creek. Note the relatively wide floodplain, which is unvegetated and covered with a thick layer of redwood duff. March 2004.

5. Garrapata Creek Watershed Assessment – Riparian Habitat Evaluation

Riparian vegetation in the Garrapata Creek Watershed is a floristically diverse collection of moisture-dependent plants in habitats that are influenced by physical aspects of the watershed and related biological processes. The following attributes are among the primary features that create different riparian conditions throughout the GCW, thereby influencing riparian function:

- character of the substrate
- quantity, quality and seasonality of soil moisture
- periodicity of disturbance
- stream profile and gradient
- width of channel and corresponding floodplain
- adjacent natural community
- presence of large woody debris
- historic land use
- contemporary human activities
- presence of non-native plant species

5.1 Garrapata Creek

Garrapata Creek is the mainstem canyon and stream in the watershed. Garrapata Creek was traversed on foot and surveyed for riparian features from the river mouth to the upstream boundary of Glen Deven Ranch, and from the Munro residence downstream to the big log jam. Streamside habitat was also observed from along the public roadway near the upstream bridge crossing on Garrapatos Road. The upper watershed was surveyed on foot from vantage points on the service road below the PG&E powerline and along the old Garrapata Ridge trail between the Garrapata mainstem and the Wildcat Canyon drainage basin.

The lower canyon area affords wide floodplain habitat and terraces with areas of deeper soil. Alluvial fill narrows in depth from it's deepest at the mouth of the canyon, to locally shallow areas in bedrock-controlled reaches upstream of the Munro residence. Although the relatively wide canyon in the lowest part of the watershed provides appropriate growing sites for well-developed riparian forest habitat, this is the area most disturbed by historic and contemporary land use activities. Early settlement in this portion of the watershed was facilitated well before the 20th century by the naturally flat topography, abundant water supply and rich bottomland soils deposited from upstream sources during high flow events. The lower Garrapata and Joshua Canyon areas also are the most threatened by modern human intrusions, including disturbance from land clearing, road building, sedimentation and the introduction of a plethora of non-native weedy plants.

The mouth of Garrapata Canyon narrows between bedrock outcrops that support the arched span of the Highway 1 bridge. Downstream of the bridge, the creek eventually mingles with brackish water in the interesting estuarine/lagoon habitat that includes a variety of freshwater and salt marsh species. The coastal edge of true riparian habitat is a small grove of arroyo willow and red alder trees that are stunted and pruned by persistent, salt-laden, on-shore winds. Near the mouth of the canyon, the unusual porcupine gooseberry (*Ribes menziesii* var. *hystrix)* occurs as a component of

the tangled arroyo willow/red alder scrub. The channel margins of the creek support typical Lower Watershed Riparian habitat with notable occurrences of western water hemlock (*Cicuta douglasii*), small-fruited bulrush (*Scirpus microcarpus*), common three-square (*Scirpus pungens*), common monkey flower (*Mimulus gutattus*), native blackberry (*Rubus ursinus*) and a variety of fern species.

Figure 14 – Garrapata Creek mouth at Highway 1. July 2004.

Upstream of the Highway 1 Bridge, the canyon opens up and supports a structurally diverse assemblage of riparian species dominated by different-aged stands of arroyo willow and red alder. The creek banks are well-vegetated with an assortment of ferns, sedges and herbaceous species typical of the Lower Watershed Riparian community. A few individual black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) are included in the riparian mix, however the increasingly prolific Cape ivy (*Delairea odorata*) has invaded this plant community and has begun its relentless stranglehold on this habitat.

In addition to Cape ivy, a host of weedy, invasive species occur in the lower watershed, including a variety of grasses; kikuyu (*Pennisetum clandestinum*), nit (*Gastridium ventricosum*), veldt (*Ehrharta erecta*), rattlesnake (*Briza maxima*), rabbitfoot (*Polypogon monspeliensis*), maritime

beard (*P. maritimus*) and rupgut brome (*Bromus diandrus*). Numerous large, old Monterey cypress, Monterey pine and blue gum eucalyptus have subsumed the biological role of tall, native riparian trees in much of the lower watershed, although mature alders and red willows still persist.

Black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) is noticeably absent as a primary riparian species in the lower watershed of the Garrapata and Joshua Creek drainages. Black cottonwood is a floodplain tree that occurs abundantly along the margins of the Carmel, Big Sur and Little Sur rivers, however it occurs only occasionally in the lower GCW. The species propagates readily as sprouting root clones, as well as by seedling establishment on fine sediments. Recruitment for black cottonwood can occur both vegetatively, and by seeding as long as alluvium is kept damp along stream margins. The largest stand of black cottonwood in the GCW is found around the south-easterly side of the artificial pond on the Glen Deven Ranch, where the requisite soil and moisture conditions occur. Another smaller stand occurs near the Weston residences. The absence of black cottonwood as an important component of the riparian forest in this coastal watershed is unusual, as it is more common in other, similarly sized coastal streams in the Big Sur region.

Western sycamore (*Platanus racemosa*) is also uncommon in the lower GCW. Three trees were observed in the canyon bottom along the downstream reaches of Garrapata Creek: one individual approximately 958-feet upstream of the river mouth, and two in the downstream reaches of Glen Deven Ranch (linear measurement courtesy of Joel Casagrande). The trees are on flat terrace areas in the canyon bottom where infrequent high flow events occur to saturate soils and deposit new sediment. It is likely that the relict trees in Glen Deven reflect floodplain conditions that have not been repeated along Garrapata Creek in some time, as no young sycamore seedlings were observed during the field work for this study. Perhaps the sycamores were established during a rare flow event with just the right set of soil and moisture conditions that encouraged seedling survival.

Whatever the history of sycamore recruitment along lower Garrapata Creek, these three individual trees, and others that may have been missed during the course of the watershed assessment, are quite unique. Care should be taken to maintain the viability of the larger tree on Glen Deven Ranch by continuing to remove lianas of Cape ivy that threaten to overcome this mature individual. Maintaining a viable seed source, i.e., maintaining the vigor of sycamores in the canyon, will insure that future recruitment can occur if appropriate conditions are provided.

The streambanks in lower Garrapata Canyon are generally well-vegetated and stable, with a few marked exceptions. Portions of the low flow channel approximately 860-feet upstream of the river mouth are lined with stands of even-aged alders that appear to have died as a result of 2 to 3-feet of recent incision in the floodplain. It is possible that these trees were established after the 1998 El Niño high flow event and that they perished when their shallow roots were dewatered as the stream incised through recent deposits. Streambanks in this reach are not well-vegetated and could be prone to destabilization in high flows.

Streambanks devoid of vegetation allow streamflow to accelerate, pick up loose sediment, and potentially undermine the stability of *in-situ*, as well as downstream riparian habitat areas. Sites where vehicular roads cross the stream, as well as sidecast material and sediment generated by natural landslides or drainage off unpaved roads, provide sediment influxes that exacerbate already high levels of both suspended load and bed load. Large cleared areas centered at approximately 1720-feet upstream of the river mouth do not provide understory vegetation or plants to trap sediment and stabilize stream banks. This particular site (Figure 15) is a non-functional riparian

area because it lacks understory, has extensive areas of exposed bare ground (300 feet of bank), and can not provide vegetation or large woody debris that will moderate streamflow and potential future degradation. Despite it's geomorphic position on a point bar of the channel, and despite a discontinuous line of alders situated at the top of the bank, the lack of protective ground cover will promote the erosive capacity of the stream through this reach and increase sediment loads.

Figure 15 – Cleared area along lower Garrapata Creek. Lack of riparian vegetation increases erosion hazard. July 2004.

Disturbed areas of the riparian forest "invite" the invasion of weedy species, most of all Cape ivy, but also eucalyptus, Monterey pine and other aggressive pioneers. Cape ivy prefers well-lit sunny locations, although it can colonize deep in the shaded forest as well. Genista (*Genista monspessulana*) is the primary invader in adjacent, more open terrace habitat. Genista is increasingly a threat to roadsides and grassy, previously disturbed terrace areas along Garrapata Creek.

Non-native weeds, and species native to California but not native to the Garrapata Watershed, proliferate in disturbed soils where sunlight is readily available. Genista, black acacia (*Acacia melanopsis*), poison hemlock (*Conium maculatum*), foxglove (*Digitalis purpurea*), English ivy (*Hedera helix*) and periwinkle (*Vinca major*) occur in patches of varying density throughout the lower watershed. Of special concern is the increasing presence of sticky eupatorium (*Ageratina millefolium*), a noxious weed that may have poisonous sap. The presence of these weedy species speaks to the long history of human occupation and disturbance in the GCW, however these plants continue to increase in density and cover, thereby threatening the integrity of the native natural communities in the watershed.

In addition to Cape ivy and sticky eupatorium being very serious threats to the integrity of the riparian community in lower Garrapata Creek, the large stands of Monterey pine, cypress and eucalyptus create habitat conditions that do not favor the recruitment of native species. These tree species were likely introduced at various stages in the settlement of Garrapata Canyon and now tower above the surrounding stream corridor. Mixed stands of huge eucalyptus and Monterey pine extend from the area near the Trout Farm to beyond the pond at Glen Deven Ranch. Seedling pines and eucalyptus continue to proliferate in reaches of the canyon where wide terraces are crossed with overflow channels that carry flow only during the highest stages. In one area of lower Glen Deven Ranch, several braided channel areas of the floodplain include mid-stream bars that are approximately 10-feet above the active channel. Eucalyptus provides the overstory in this region, with occasional red alder and pine. The understory of wood mint, blackberry and chain fern in these areas is being overcome by Cape ivy, yet seedling pines and eucalyptus have managed to survive despite the ivy and very shaded conditions.

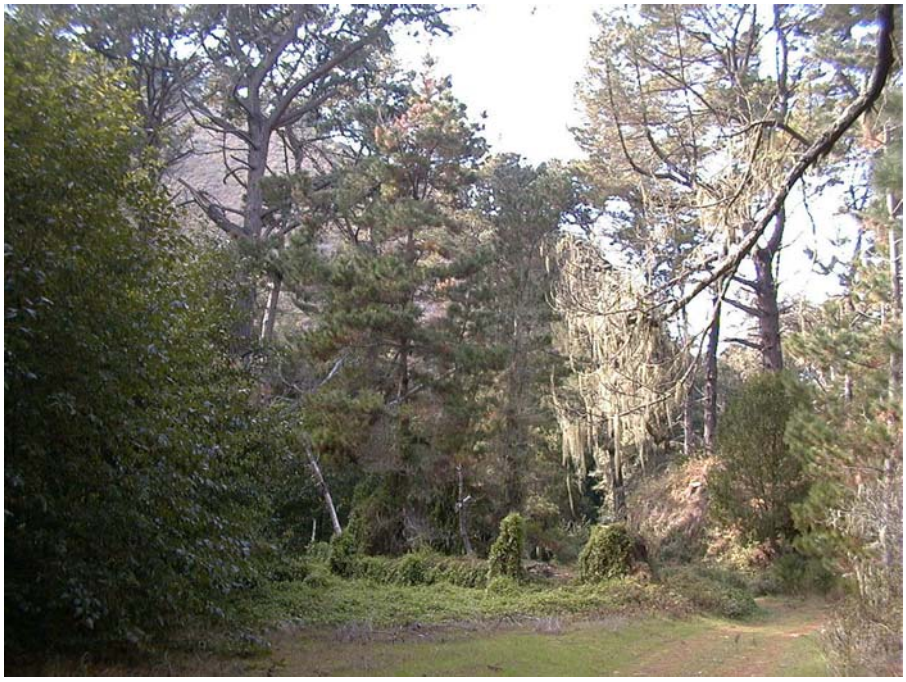


Figure 16 – Monterey pine, blue gum eucalyptus and Cape ivy dominate the riparian corridor in this reach of Garrapata Canyon. November 2004.

Floodplain riparian habitat along the creek fronting the pond on the Glen Deven Ranch, and in several reaches upstream of the pond, is constrained by the proximity of the vehicular roadway. The road is not necessarily a destabilizing factor, however several reaches of the stream abut the road and have banks oversteepened by the proximity of the elevated roadbed. Past maintenance practices that sidecast material into the stream channel appear to have ceased, however the erosive work of the active channel against sections of the roadbed may destabilize portions of the streambank in future high flow events.

The stream in the area adjacent to the Glen Deven pond has been constrained by the berm and roadway that creates the northern flank of the pond. Slopes above the pond are prone to spring activity, saturated soils, and landsliding, as this area occurs in the trace of the Garrapata Fault zone. The pond area is biologically valuable as open water habitat, however the stream corridor and floodplain in this reach are functionally at risk because of the dense eucalyptus-dominated habitat that precludes the establishment of native species. Recovery of native riparian forest vegetation in this portion of the watershed will be difficult because of the extent of Cape ivy, eucalyptus and pine invasion.

Figure 17 – Roadway in mid-Garrapata Canyon constrains the active channel of the creek. English ivy veneers the embankment. November 2004.

As the canyon narrows in an upstream direction, Redwood-Riparian Forest predominates with an open understory below the tall, nearly closed canopy. The canyon topography steepens immediately adjacent to the channel, which has only limited opportunity for floodplain development. Many reaches are entirely bedrock-controlled and streamside vegetation is confined to widely scattered growing sites on adjacent canyon walls. Where the channel widens, discontinuous floodplain areas tend to be sparsely vegetated with grasses and herbaceous plants that quickly loose root stability when inundated with higher flows.

Channel bank stability in the middle reaches of the GCW is generally good, with little evidence of active erosion despite the lack of abundant riparian vegetation. Certainly there are occasional point sources of bank failure in the narrow sections of the Garrapata drainage, however the Redwood-Riparian habitat in this region appears to provide adequate bank stability for the stream.

Sudden Oak Death (caused by the pathogen *Phytophthora ramorum*) has resulted in astonishing mortality of tanbark oak trees throughout various natural communities in the GCW. Where

Redwood-Riparian habitat occurs, dead wood and fallen snags have increased debris on the forest floor and in the stream channel, however tanbark tends to decompose quickly. Although tanbark debris entering the stream system will accumulate, it should not persist for long periods of time.

Redwood snags and remnant logs that enter the system can, and have, created significant barriers to fish migration. Overall, large and small woody debris in the channel appears not to destabilize adjacent banks in most cases, despite being potentially significant barriers to fish movement. Woody debris contributes to diverse channel forms and can generate structure and habitat that benefits both steelhead and other aquatic organisms. Aggrading conditions behind debris jams create conditions at the toe of the bank where riparian plants must adapt to new and changing bank features. These conditions tend not to promote riparian vegetation development until an equilibrium elevation is reached for sediment behind the.

Concluding Remarks: In general, lower Garrapata Canyon is characterized by a relatively stable and well-vegetated stream channel, with streamside plants developing root masses capable of withstanding relatively high flows. Vegetation occurs on the channel margin and on the adjacent terraces to trap sediment during high flow events. In the lowest portion of the canyon, the wide floodplain has been overtaken by a predominance of non-native trees and weedy herbaceous species. Natural riparian recruitment has been compromised by weedy species that compete with natives for available establishment sites. The tall, dense canopy, and the terpene-rich duff produced by eucalyptus, creates very poor growing conditions for native riparian species. After disturbances associated with high flows, native riparian vegetation will have less and less opportunity for recovery and maintenance as long as the non-native trees dominate. Combined with the increasing threat from Cape ivy, the riparian corridor throughout portions of the lower Garrapata Creek area is functionally at risk.

5.2 Joshua Creek:

Joshua Creek is the northerly and first of two (moving upstream) major streams tributary to Garrapata Creek in the Garrapata Creek Watershed. The Joshua Creek drainage basin is approximately 2.1 square miles in area. Joshua Creek was surveyed for riparian features from the creek mouth at the confluence at Garrapata Creek, to the upstream limit of steelhead anadromy at a 50-foot waterfall. Upper watershed habitat was also observed from vantage points along the vehicular ridge road in the Palo Corona Ranch. Previous field work was conducted in 1992 and 2002 by the author in the DFG Joshua Creek Ecological Reserve.

The uppermost reaches of the Joshua drainage basin are densely vegetated with Mixed Chaparral and Mixed Evergreen Forest, however Redwood Forest and associated Redwood-Riparian habitat occur well upstream of the old Lange residence along the bottom of the damp, shaded canyon.

Joshua Creek is shown on the USGS Mt. Carmel and Soberanes Point 7.5' quadrangles as a perennial stream downstream of a small weir structure that historically impounded flow on the old Lange homestead. This old dam and other water diversion structures a short distance downstream, once supplied a small hatchery and fish-rearing establishment operated by Bill Lange in the 1960's.

The lower reaches of Joshua Creek downstream of the waterfall support typical Redwood-Riparian habitat with vegetation characteristic of this natural community. Unfortunately, light gaps and areas where slope failure along the stream channel have occurred also produce disturbances being actively colonized by insidious Cape ivy. Figure 18 is a growing slope failure that resulted from an unstable streambank being undercut at the site of a massive tree-fall.

Figure 18 – Cape ivy has invaded the light gap created in the canopy by slope failure and tree-fall along Joshua Creek. November 2004.

In the lower canyon downstream of the waterfall, streamside vegetation is generally sparse and often discontinuous, as is typical of Redwood-Riparian habitat. Chain, wood, lady, shield, sword and five-fingered ferns occur with thimbleberry and occasional Santa Lucia gooseberry in the riparian corridor. Vanilla grass, columbine and boykinia occur under the canopy of sporadic big-leaved maple, redwood and bay. The margins of the generally narrow channel tend to be sparsely vegetated, with occasional wider floodplain areas notable for their dense cover. Sticky eupatorium occurs in isolated patches in lower Joshua Creek, and numerous non-native species are found in the lowest reaches of the stream near historic homesteads.

As noted by Smith, et al. (2004) and Casagrande and Smith (2004), the Joshua Creek drainage carries a heavy sediment load. Loose sediment entering the stream corridor and deposited on adjacent narrow floodplains creates good recruitment sites for riparian species and in typical situations, the vegetation established on sandy bars and banks stabilizes loose sediment. In several areas along Joshua Creek, sediment is deposited too frequently, or reworked too often along stream margins and on floodplains to allow attendant riparian species to attain full maturity. Immature vegetation is easily uprooted and thus fails to provide the sediment-binding and trapping features that could potentially reduce the downstream transport of material.

Figure 19 – A wide area of floodplain along Joshua Creek. This site has been relatively stable long enough for chain fern and sedge to mature. November 2004.

5.3 Wildcat Canyon:

Wildcat Canyon is the southerly and second of two (moving upstream) major streams tributary to Garrapata Creek in the Garrapata Creek Watershed. The drainage basin is approximately 2.9 square miles in area. Wildcat Canyon was surveyed for riparian vegetation from the creek mouth at the confluence at Garrapata Creek, to the upstream limit of steelhead anadromy at a series of bedrock waterfall cascades that create a 30-foot barrier to fish migration. Upper watershed habitat was observed from vantage points along the vehicular ridge road in the Palo Corona Ranch. Previous field work was conducted in 2002 and 2003 by the author along one of the decommissioned roads in south fork of the upper Wildcat Canyon drainage.

The uppermost reaches of the rugged Wildcat Canyon drainage basin are densely vegetated with Mixed Chaparral and Mixed Evergreen Forest. Redwood Forest and associated Redwood-Riparian habitat occur along the lower creek and well upstream of the limit of anadromy. Wildcat Canyon is depicted as a seasonal stream on the USGS Soberanes Point 7.5' quadrangle, however in recent times the creek has been observed to be perennial in the lower reaches.

Lower Wildcat Canyon supports a low-gradient channel with occasional bedrock control. Typically, there is an entrenched channel in areas of shallow alluvium, with narrow floodplain and terrace areas that lack riparian cover. An abandoned homestead occurs near the waterfall cascade and it appears that the redwood mantle of the stone hearth is at the current level of the cobble bar.

If this is the case, then the original grade where the old cabin was constructed was much lower and coarse sediment has accumulated to a depth of several feet since the structure was built.

Figure 20 – Coarse sediment up to mantle of hearth at Wildcat homestead. November 2004.

In the early 1990's, the upper watershed of Wildcat Canyon was severely disturbed by unpermitted road grading that generated massive quantities of unstabilized sediment (Williams and Kondolf, 1991). During the summer of 1991, John Williams, Graham Matthews and Matt Kondolf, along with Bill Weaver and Danny Hagens of Pacific Watershed Associates, inventoried sediment sources and estimated sediment volume stored within the channel of several forks of Wildcat Canyon. In their report, the authors noted that significant amounts of sediment were poised to enter the channel. They estimated that sediment slugs would move through the system in varying amounts depending on rainfall quantities over the next three decades. With the restoration that ensued to decommission the illegal roads, the authors estimated that the probable recovery period would be one or two decades and that most of the loose sediment generated by road building would be transported out of both Wildcat and Garrapata creeks over that time.

Riparian vegetation along lower Wildcat Canyon reflects the deep shade and meager establishment sites typical of narrow channels in Redwood-Riparian habitat. The most floristically diverse riparian patch is also the widest location in the lower canyon where the old homestead occurs. The coarse cobble at this site supports western coltsfoot (*Petasites palmatus*), blackberry (*Rubus ursinus*), mugwort (*Artemisia douglasiana*), elk clover (*Aralia californica*), leopard lily (*Lilium pardalinum*), thimbleberry (*R. parviflora*) and a variety of ferns. A few large red alder occur over the open understory, where unfortunately a small patch of Cape ivy has recently become established.

Figure 21 – Lower Wildcat Canyon watershed looking north
from Rocky Ridge. July 2003.

6. Special Status Species and Habitats of Special Interest

1. South/Central California Coast Steelhead Ecologically Significant Unit (*Oncorhynchus mykiss*): Federally Threatened. Confirmed in Garrapata Creek and Joshua Creek, and likely found in lower Wildcat Canyon.

2. Smith's blue butterfly (*Euphilotes enoptes smithi*): Federally Endangered. Requires host plant seacliff buckwheat (*Eriogonum parvifolium*), which is found in all coastal habitats near the Highway 1 corridor at Garrapata Creek.

3. California red-legged frog (*Rana aurora draytonii*): Federally Threatened. The presence of the California red-legged frog has been confirmed along lower Garrapata Creek by Ken Ekelund, who observed an adult in February 2003 (Ekelund 2004). The frog was resting in standing water along the roadway fronting Garrapata Creek in the Glen Deven Ranch. The puddle originated as runoff from a spring on the southern side of the road upstream of the vehicular creek crossing. Although foothill yellow-legged frog (*Rana boylii*) has not been documented in the watershed, this uncommon species of frog could be found in the upper reaches of Garrapata, Wildcat and Joshua Creeks. Foothill yellow-legged frog occurs in association with higher gradient, shady streamside habitats that are found in the upper watershed.

4. Several avian species are considered indicators of good-quality riparian habitat. It is recommended that avian surveys be conducted on the watershed to document bird species and note the presence/absence of riparian obligates like yellow warbler (*Dendroica petechia brewsteri*) and willow flycatcher (*Empidonax trailii*). Trends in avian diversity and population size can offer insight into the quality of riparian habitat over time.

5. Springs and seeps provide off-channel riparian or wetland conditions that offer valuable wildlife habitat benefits. Bedrock springs also potentially contribute to stream flow. Numerous bedrock spring sites occur within the Garrapata Creek Watershed.

7. General Conclusions

In general, the Garrapata Creek Watershed and most reaches of Garrapata Creek, Wildcat Canyon and Joshua Creek have good quality riparian habitat in "Properly Functioning Condition" (U.S., BLM 1998). There is adequate cover to protect banks and dissipate stream energy during high flows, as well as to provide habitat for terrestrial and aquatic species. Of concern is the predominance of weedy species in the immediate riparian corridor, particularly in the lower Garrapata and Joshua drainages. Also of concern is the relatively high sediment load carried by Joshua Creek, which tends to cause stream flows to destabilize immature riparian vegetation on continuously active bars and floodplains. When given a chance to mature, riparian vegetation will capture sediment and promote floodplain development.

The presence and cover of several weedy species is problematic in the lower watershed. Weeds may control recruitment sites and perpetuate a non-native riparian environment. In addition, food webs in river systems can be damaged for native aquatic organisms when weedy cover takes hold. Linked energy flows between riparian vegetation and the production of detritus and invertebrate food resources for salmonids can be disrupted by changes in associated riparian vegetation (Power and Dietrich, 2002). Research described in the literature confirms that red alder in particular, provides abundant invertebrate and detritus input to streams, thus supporting fish biomass in a manner that can not be provided by non-native riparian vegetation (Wipfli, 2004). The dominance of floodplain areas by eucalyptus, Monterey pine and cypress could lead to decreased habitat values for steelhead trout and a variety of riparian obligate species.

In the Garrapata Creek Watershed, the biologically limiting factor for riparian vegetation appears to be a combination of weed dominance and/or human activities (clearing, dumping of trash, road maintenance). Despite the concern for high sediment loads in the Joshua drainage, sediment issues in most other portions of the watershed are not critical limiting factors for riparian vegetation. In fact, the deposition of sediment can enhance recruitment.

The presence of large wood is generally a beneficial element in the riparian corridor. Diverse structure provides instream habitat value. Although the large logjams that restrict fish passage in Garrapata Creek are a limiting feature for steelhead, the barriers have trapped a significant amount of load and reduced downstream sediment accumulation in pools and areas of slower water flow. The stream has adjusted to a new toe of bank created by accumulated sediment behind the logjams and riparian vegetation growth on these adjusted topopgraphic features has promoted bank stability upstream.

In several areas of the watershed, the potential width of the riparian zone – edge of bank through floodplain or zone of stream influence – is constricted by homesites, roads, artificial ponds, and areas of cleared land. Floodplain constrictions limit water movement during high flow events and often lead to concentrated flow areas where bank erosion is facilitated.

Overall, upper portions of the Garrapata Creek Watershed appear stable. Upland vegetation is largely intact and there are few intrusions that could potentially impact riparian vegetation. The effects of periodic wildfire in the entire watershed may be exacerbated by the increase in fuels caused by Sudden Oak Death.

8. Management Issues and Riparian Habitat Enhancement Opportunities

The fundamental objectives of Watershed Management programs generally reflect the following over-arching goals:

- Protect physical and biological processes.
- Provide education to community.
- Create strategies and partnerships to achieve first 2 goals.

Regarding riparian habitat and upland natural communities in the Garrapata Creek Watershed, most physical and biological processes remain intact. Upper watershed areas of Garrapata Creek, Joshua Creek and Wildcat Canyon are largely untrammeled today and will continue to persist in conserved status through public ownership.

There are a few, specific locations where riparian habitat in the lower drainages is non-functional, or functionally at risk, however these situations do not characterize the majority of the watershed. Through the work of the Garrapata Creek Watershed Council, there are numerous opportunities to provide education to the community via strategies and partnerships that will assist with achieving habitat and outreach goals.

For riparian vegetation, proactive change would be most beneficial in the lower watershed. Types of riparian enhancement projects range from massive in scope, to very small, site-specific efforts. Riparian community function would be improved by removing non-native trees to enhance floodplain habitat values - the elimination of eucalyptus, Monterey pine and Monterey cypress from the lower Garrapata Watershed should be encouraged. Riparian community function could be dramatically enhanced from the Glen Deven Ranch downstream to the mouth of the canyon (including the lower Joshua area), although the effort to accomplish the changes required would be significant and would result in localized short-term habitat disruption. These invasive species will increase in cover and density through time and should be controlled to the extent feasible. As the non-native component of the Lower Watershed Riparian habitat increases, riparian function will decrease and eventually come close to failure. As red alder is replaced by non-native vegetation, the input of beneficial detritus and invertebrates used by steelhead will diminish and aquatic habitat will degrade.

The same recommendation for elimination and control applies to the increasingly pervasive Cape ivy, which likely can not be completely removed from the watershed without the introduction of biological control agents. Cape ivy would be extremely difficult to eliminate from the watershed, yet it's spread can be controlled, or at least slowed by manual and chemical agents. Even small advances in restoring native habitat by removing Cape ivy can result in significant benefits to wildlife and plant resources.

Pragmatic efforts to restore riparian function include relatively small projects involving revegetation of eroding banks, restoring cleared areas, and moving livestock outside the riparian corridor. Limiting the spread of invasive weeds like vinca, veldt grass, pampas grass (*Cortaderia jubata*) and sticky eupatorium helps to maintain the character and function of native ecosystems and will benefit native wildlife species.

To protect physical and biological processes in the watershed, the community can promote the following activities:

■ **Minimize water extraction from the watershed**. Identify water sources and monitor extraction. Promote off-channel spring development so that instream flow is not compromised by direct diversion. Encourage use of drought-tolerant landscaping.
■ **Reduce weed cover in the floodplain and throughout the watershed**. Weed eradication will enhance native riparian vegetation by producing recruitment sites for native species and maintaining food webs for salmonids.
■ **Reduce sediment loads**. Evaluate function of stream crossings, impermeable surfaces, culverts, and drainage off roads, and remediate as needed.
■ **Promote bank vegetation integrity**. Control riparian vegetation impacts that result from recreational activities and road crossings. Revegetate barren areas with native species and control weedy plants. Move livestock outside of the floodplain.
■ **Assess need and identify biologically appropriate techniques for fuels reduction around residential sites**. Provide information to the community in accordance with ecologically sensitive methods for clearing vegetation that maintain function of surrounding natural habitats and do not accelerate erosion of soil.
■ **Develop educational outreach tools**. Share brochures, planting guides, riparian corridor enhancement, fire clearing and weed information material with residents in the watershed. Conduct community weed control campaigns. Share results of hydrologic monitoring and sediment sampling, and keep residents informed about general watershed and stream conditions.
■ **Encourage removal and appropriate disposal of trash**, both in the riparian corridor and around private residences. Facilitate disposal of weed biomass to remove undesirable vegetative material from the watershed.
■ **Maintain existing roads, homesites and cleared areas in the riparian zone in a manner that reduces potential erosion and does not encroach into the artificially narrowed floodplain**. Narrow floodplain areas should be monitored for signs of incipient erosion and proactive measures taken to prevent bank failure.

<u>Prioritize action based on the need, magnitude and feasibility of the project. What can be done first without permits or lots of capital?</u>

1. Control the spread of Cape ivy, eucalyptus, Monterey pine, vinca, pampas grass, sticky eupatorium and other invasive weeds, particularly in areas that support willow and alder vegetation. Provide disposal options to remove weed biomass.
2. Identify areas where streambanks are barren or potentially unstable, and revegetate with native species.
3. Clean up trash and provide disposal options.
4. Develop information outreach campaign.
5. Assess feasibility of grant opportunities for larger-scale floodplain restoration that includes eucalyptus, pine and cypress removal.
6. Develop a strategy and action plan to assess need for action/restoration after high flows have caused erosion or bank failure.
7. Identify grant opportunities and conduct avian monitoring, both baseline and follow-up.

8. Identify opportunities to enhance habitat for California red-legged frog. Remove bullfrogs from pond habitats.

Figure 22 – Downstream of Garrapatos Road bridge over Garrapata Creek. The barren right bank has been protected by jute netting and is ready for revegetation with native riparian plants. October 2003.

9. Data Gaps

Topics or issues for further exploration:

- Establish permanent monitoring stations – collect info on baseline riparian conditions and revisit periodically.
- Establish cross section monitoring stations – data base to compare with future conditions.
- Estimate a water budget - input of water from upslope sources/springs, surface runoff.
- Assess specific condition of riparian vegetation in vicinity of large wells.
- Document annual water extraction from wells and instream diversions.
- Evaluate instream cover and aquatic habitat values.
- Document macroinvertebrate species and monitor periodically (indicators of water qual.)
- Document avian species and monitor periodically (can be indicators of riparian condition).
- Inventory for California red-legged frog, tiger salamander, Smith's blue butterfly, foothill yellow-legged frog.
- Accurately map vegetation types in watershed (Monterey County maps too general).
- Inventory lagoon parameters and assess value for juvenile steelhead.
- Continue riparian assessment in upper watershed currently inaccessible due to terrain and private property issues.
- Research historic land use, logging, settlement, fire history, history of the Trout Farm.

Figure 23 – The Garrapata Creek Lagoon provides valuable rearing habitat for Federally Threatened steelhead. July 2004.

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