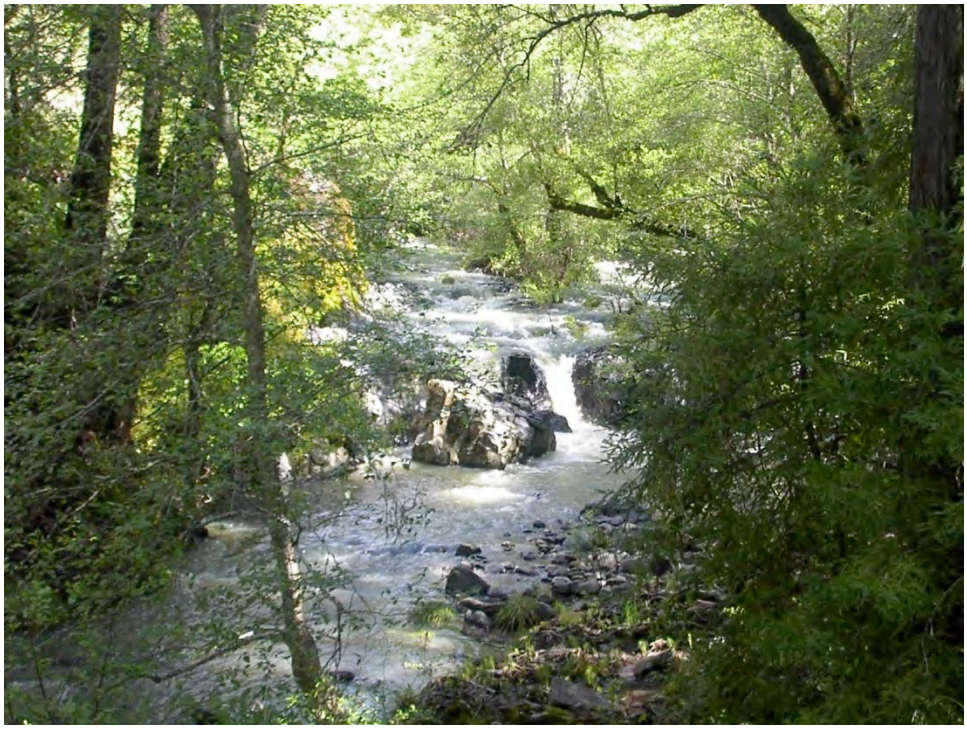
Upper Mark West Watershed Management Plan

Phase 1: Watershed Characterization and Needs Assessment



Sotoyome Resource Conservation District
8/31/2008

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Contents

Section 1. Introduction

1.1 Purpose of Upper Mark West Watershed Management Plan

The purpose of this plan is to provide tools, resources and guidance for stakeholders to protect the natural environment in the upper Mark West Creek watershed, restore and enhance altered landscapes, and to steward the land in perpetuity.

1.2 Process for Developing the Plan

The development of this plan will occur in two phases. The first phase of the plan includes general scoping, gathering existing information, and assessing needs for the second phase. During the first phase of planning, Sotoyome RCD staff has met with watershed stakeholders to learn about stakeholder needs and interests that can be addressed by the plan and to obtain information about the watershed that stakeholders have gathered. The products of the first planning phase will be: 1) A first draft of the plan that includes existing data and describes needs for second planning phase and 2) A description of the second planning phase and a budget for completing the second phase.

The second phase of the plan will include further gathering of information and development of new data sets. The Sotoyome RCD will work with subcontractors to develop studies on hydrology and geomorphology. Sotoyome RCD staff will develop data sets cataloging unpaved rural roads and large sediment sources through GIS analysis and on-the-ground investigation. The second phase will include a hydrology study emphasizing water conservation needs and opportunities in the watershed and the

implementation of a water conservation pilot project. The products of the second planning phase will be: 1) A written plan that follows the US EPA's nine elements of an effective watershed plan (see Section 1.3 for more information), 2) An interactive GIS-based system that stakeholders can access via the internet to learn about best management practices tailored to the unique combinations of biotic and abiotic factors present at a parcel scale and 3) a completed water conservation pilot project and associated brochure/manual outlining the project implementation process.

Recommendations for information that will be gathered during the second phase of planning are italicized in this document.

Stakeholder involvement will be key throughout the planning process. Stakeholders will provide guidance on the scope of the plan, contribute information to the written plan, and will review planning documents to provide feedback.

1.3 Organization of the Plan

The organization of this plan is based upon the US Environmental Protection Agency's nine elements of an effective watershed management plan, as described in the "Handbook for Developing Watershed Plans to Restore and Protect Our Waters" (2005). The following are descriptions of the nine elements, and the sections of this plan that address each one:

a) An identification of causes of impairment and pollutant sources. *Section 2, Section 3*
b) An estimate of load reductions expected from management measures. *Section 4*
c) A description of the nonpoint source management measures that will be implemented to achieve load reductions. *Section 5, Section 7*
d) An estimate of the amounts of technical and financial assistance needed to implement those management measures. *Section 7*
e) An information and education component used to enhance public understanding of the project and to encourage their early and continued participation in selecting, designing, and implementing nonpoint source management measures. *Section 6*
f) A schedule for implementing nonpoint source management measures identified in the plan. *Section 7*
g) A description of interim measurable milestones for project implementation efforts. *Section 8*
h) A set of criteria that can be used to determine whether load reductions are being achieved over time and substantial progress is being made toward attaining water quality standards. *Section 8*
i) A monitoring component to evaluate the effectiveness of implementation efforts over time. *Section 8*

1.4 Watershed Goals

The following goals were developed to reflect both the needs of the watershed's ecosystems and the priorities of stakeholders. The table below links watershed goals with indicators that demonstrate whether or not the goals are being attained, potential sources of impact that could be altered to attain the goals, and management objectives to help achieve this.

Table 1.1 Watershed goals and associated indicators, potential sources of impact, and management objectives for the Upper Mark West watershed

Goal	Indicator	Potential Source of Impact	Management Objective
Meet water quality standards for sediment/siltation	Turbidity; Total Suspended Solids	Destabilized streambanks; removal of riparian vegetation; modified drainage pathways; gully erosion; rural roads	Stabilize and revegetate stream corridors; mitigate erosion from gullies and rural roads; investigate and treat significant sediment sources
Support aquatic life and restore aquatic habitat	Dissolved Oxygen; Temperature; Turbidity; Streambed Composition; Benthic Macroinvertebrates; Riparian Vegetation; Instream Habitat Structure; Fish Passage	High turbidity levels and aggradation of stream channels raises water temperature; sediment loads alter streambed composition; removal of riparian vegetation; fish passage barriers	Stabilize and revegetate stream corridors; mitigate erosion from gullies and rural roads; conduct stream habitat typing; remove fish passage barriers; and increase instream habitat structure and complexity.
Assess, protect & enhance wetland habitat	Extent & condition of wetland plant communities; wetland functional assessments; habitat connectivity; bird species diversity and richness	Streambank and upland erosion	Map and assess wetland functions and conditions; improve agricultural management practices in sensitive areas; identify areas for conservation easements or restoration
Promote native biodiversity in upland habitats	Extent and condition of native plant communities	Invasive species	
Restore and protect forest health	Levels of Sudden Oak Death infection; frequency and magnitude of forest fires	Spread of Sudden Oak Death pathogen; modification of forest structure and composition	
Improve water conservation		Over-use of water for agricultural and residential purposes	Perform a comprehensive hydrology study; promote best management practices for water conservation and audits of water use, implement a water conservation pilot/demonstration project

1.5 Stakeholder Groups & Previous Water Quality Efforts

Consensus and collective action in the Upper Mark West Watershed (also historically known as "Alpine Valley") are rooted in the community's construction of the Alpine School in 1868. In 1940's the community built Alpine Hall, initially for a place to vote, hold social gathering and as a place for the graduation ceremonies. The one-room, 1st – 8th grade school was then, and remains today, the Community's gathering place.

The Alpine Club, a "social benefit" organization for the residents of the upper watershed was formed in the 1940's, and did work such as creek cleanups in additional to its social function. Today the Alpine Club has over 120 member families.

The Friends of the Mark West Watershed (FMWW) formed in 2001 as the environmental advocacy arm of the Alpine Club. The FMWW first challenged a proposal to subdivide and develop estate homes on 1300-acre Saddle Mountain Ranch. Containing the headwaters of both Alpine and Weeks Creeks, important Mark West tributaries, and arrayed with a mosaic of diverse habitats, Saddle Mountain is home to reproducing steelhead and Coho and an especially diverse cast of song birds, raptors and wildlife. At the end of the day, the Friends promoted a win-win solution partnering with the Sonoma County Agricultural Preservation and Open Space District, the Coastal Conservancy and others in the public acquisition of the property. Open Space and RCD staff, along with the former owners of Saddle Mountain, were the guests of honor at the FMWW Annual Harvest Moon Dinner Dance in October of 2006 celebrating Saddle Mountain as forever wild.

The FMWW is active in the watershed community with ongoing partnership projects that include:

- With the Sotoyome Resource Conservation District and the Department of Fish and Game, a $600,000 private road sediment reduction project involving more than 70 different land owners. RCD and FMWW received Environmental Achievement Awards from Congressman Mike Thompson for the project.
- With the Sonoma County Agricultural Preservation and Open Space District, established and operate the Saddle Mountain "trail-watchers" volunteers program. Trail watchers regularly hike the mountain, report what they see and work closely with Open Space as interim stewards of this valuable resource.
- With the Rincon Valley Fire Department, hosted Urban/Wildlands Interface Fire Response training drills for more than 50 engine companies on private properties in the watershed.
- In September 2007 FMWW, Jim & Betty Doerksen and Monan's Rill Institute hosted UC Extension Forest Stewardship Workshop at Monan's Rill community hub.
- With Sonoma County Public Works and Waste Management Company, conduct semi-annual creek cleanup events.
- With the Sotoyome RCD, and trained Creek Keepers, established and maintain upper Mark West Creek water monitoring programs.

- With its Campaign Committee, raised and donated $5,500 to the Measure F campaign, walked precincts and manned the telephone bank in support of reauthorizing the Agricultural Preservation and Open Space District.
- Host an annual 'Hike & Hoot' event where naturalists, geologists and birders share their knowledge in hands on hiking and exploration of the watershed. This is done in partnership with Monan's Rill Association, an intentional community of eleven families that also donate their community hall for the Hike and Hoot event.
- With community volunteers and professional equipment owned by FMWW, hosts an annual event to eradicate invasive species such as scotch broom on private and public land; improve and preserve the riparian corridors and replant native species.
- Publish an annual newsletter, host and maintain markwestwatershed.org to assist in open communication, education and stewardship efforts.
- FMWW is available to residents for assistance in watershed restoration preservation projects. Over the last five years in response to requests for assistance, watershed volunteers have assisted in large animal relocation away from the waterway, constructed manure holding pens, improved drainage systems, installed waddles and hay bales to prevent erosion and run off into the creek,. FMWW regularly advises residents as to best management practices in the application of 'fish friendly farming.'

Section 2. Inventory of the Watershed

2.1 Introduction

Over the years, the Upper Mark West watershed has repeatedly been recognized as an area with exceptional natural resources, where opportunities for conservation are abundant and valuable.

In 1973, a group of students from Sonoma State University published a study titled "The Preservation of Mark West Creek." The study identified Upper Mark West as the most natural, pristine watershed draining to the Laguna de Santa Rosa.

The 1979 Franz Valley Specific Plan notes the unique value of wildlife and fishery habitat in the Mark West watershed and surrounding areas. The Specific Plan designates a large portion of the watershed as resource conservation areas, where residential uses and other types of development should not be permitted, as they would preclude the "best use of the land." The plan specifies that the guiding principle for land use in the area should be conservation, enhancement, and timely production of the area's resources. Finally, the plan cites preservation of soil, water, biological communities, and general tranquility in this area as an important mitigation for urban growth in other areas of the county.

In 2008, the Upper Mark West watershed was designated by the Association of Bay Area Governments as a Priority Conservation Area. This designation indicates that the area is one of regional significance that provides important natural resources, ecological values and ecosystem functions. The designation also indicates an urgent need for protection.

2.2 Geographic Description and Context

The Mark West watershed drains approximately 40 square miles of land, and includes approximately 27 miles of blue line stream. The watershed is located in Sonoma County, east of the cities of Santa Rosa and Windsor (Figure 2.1). Mark West Creek joins the Laguna de Santa Rosa about five miles upstream of the Laguna's confluence with the Russian River.

The Upper Mark West watershed includes the upper reaches of Mark West Creek, as well as Humbug, Mill, Porter, Van Buren, and Weeks Creeks, and many smaller tributaries.

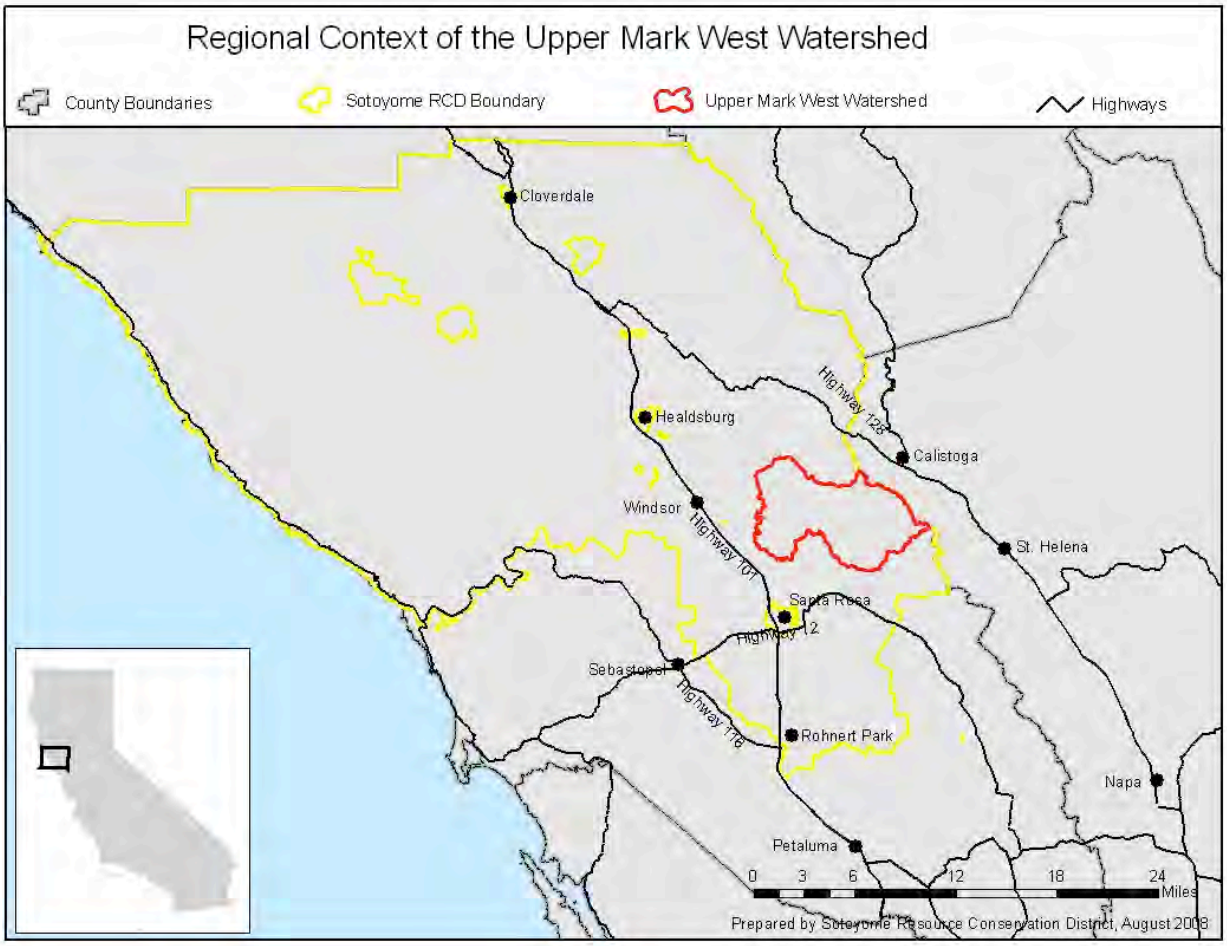

Figure 2.2 Regional Context of the Upper Mark West watershed

2.3 Demographics & Economics

The Friends of Mark West Watershed are currently developing a document that describes the watershed's community. This document will be completed by the end of Phase 2, and will be included in the final plan.

2.4 Land Uses – Current and Historic

During the late 19th and early 20th centuries, land uses in the Upper Mark West watershed were largely focused around ranching and timber harvest. These land uses are still in place today, though to a lesser

degree. In the 1960's, lands in the watershed were subdivided, and rural residential development increased. Consistent with trends throughout the county, vineyard development also increased over the latter part of the 20th century. Today's land use patterns include high occurrence of forest and chaparral, grassland/pasture, and rural residential. Vacant residential land, vineyards, orchards, and other miscellaneous land uses are also present (
Table **2.1**, Figure 2.3).

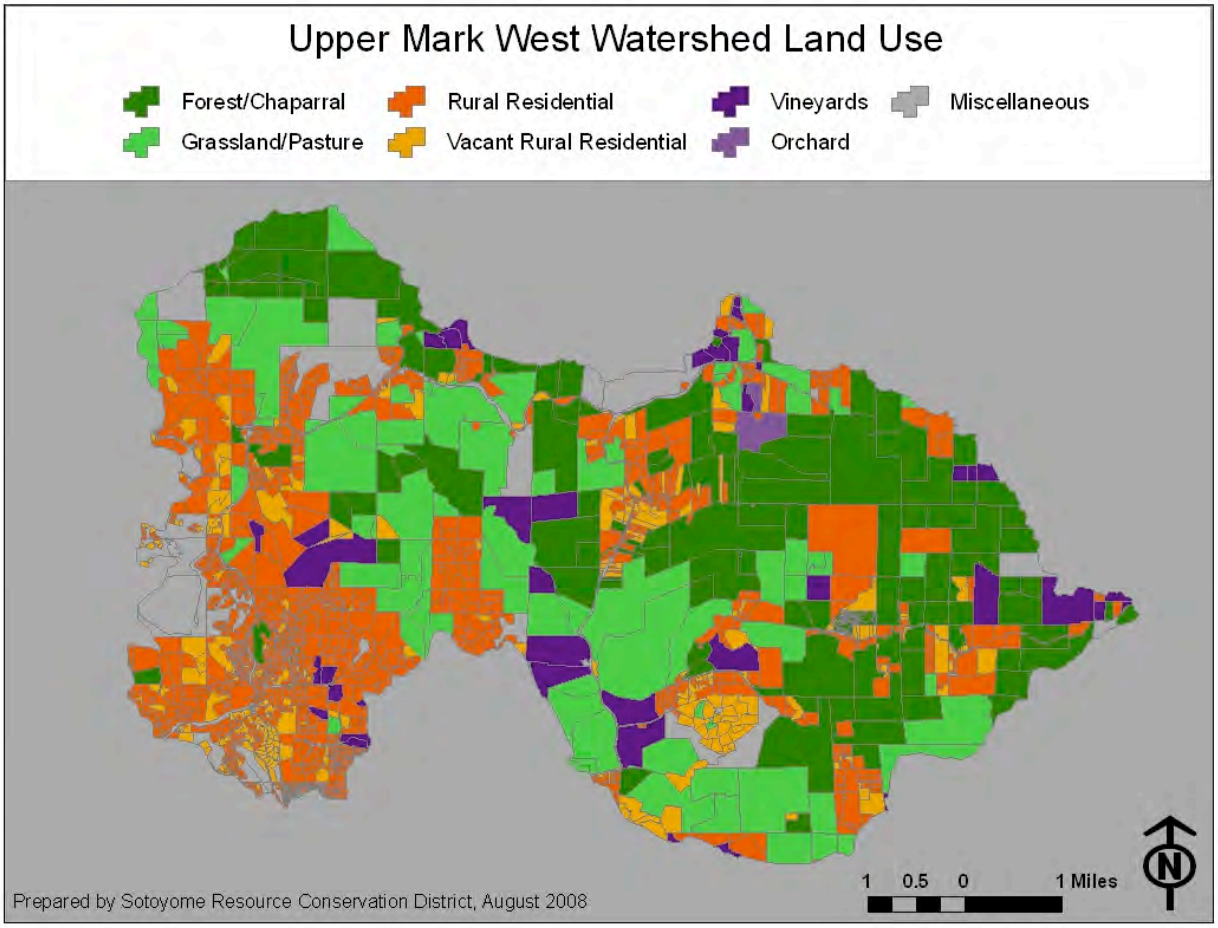

Figure 2.3 Land use in the Upper Mark West watershed

Table 2.1 Current land uses, derived from County Assessor's records.

Land Use Category	Total Acres	Percent
Forest/Chaparral	8924	28.5%
Grassland/Pasture	7988	25.5%
Rural Residential	7415	23.7%
Miscellaneous (Government, Recreation, Right-of-way, etc.)	2866	9.2%
Vacant Rural Residential	2079	6.6%
Vineyards	1872	6.0%
Orchard (Non-irrigated)	129	0.4%

Management in forested environments can have both positive and negative implications for the natural resources of a watershed. Clear-cutting, heavy road use and skidding of timber can lead to wildlife habitat loss, increased runoff, soil erosion, nutrient leaching and other issues. On the other hand, selective harvesting can benefit forest health by decreasing fuel load and reducing crowding for remaining timber. Even on lands where modern harvest practices are used, historic logging roads and skid trails can continue to contribute sediment to streams if not properly maintained or decommissioned.

Grazing of rangeland is another land use practice that can be of harm or benefit to natural resources, depending upon the intensity and methods used. Well-managed grazing can reduce the occurrence of invasive plant species and increase soil health. Over-grazing, however, can lead to destruction of wildlife habitat, soil erosion and increased runoff due to soil compaction. Livestock access to streams is another aspect of grazing that can have negative impacts on natural resources. Unless properly controlled, livestock access to streams can cause bank erosion and release of pathogens and excessive nutrients into the stream.

Residential land use can have a wide variety of effects on watershed health. The increase in impervious surfaces associated with residential land use can cause major alterations to the hydrograph, with increased peak flows and decreased base flows. Roads building associated with rural residences can also lead to erosion unless roads are properly designed and maintained. Residential water use can create a strain on surface and groundwater resources. Septic systems, if not properly placed or managed, can discharge pathogens and nutrients into streams. Additional pollutants, nutrients, pesticides, etc. are also potential products of rural residential land uses such as pest control and landscaping.

Other agricultural land uses, such as vineyards and orchards, can negatively impact natural systems when not properly managed. Increased runoff, erosion, decreased soil quality; nutrient and toxin discharges from fertilizers and pesticides, and over-use of groundwater and surface water resources are all possible impacts.

2.5 Cultural Resources

The Upper Mark West watershed is rich in historic cultural resources. The watershed was once home to the Wappo people, who lived in villages mostly near streams, and subsisted as hunter gatherers. Wappo territory was bordered by the Coast Miwok and Pomo peoples. Because of their location, the Wappo had access to both obsidian and shells, which were very valuable trade commodities. Their extensive processing of these materials into trade goods left behind many artifacts in the watershed.

The Wappo people were heavily impacted by Mexican colonization, the Gold Rush, and the influx of settlers following the passage of the Homestead Act. By the 190 census, their population had declined from an estimated 1,000 in 1770 to less than 100.

The Pepperwood Preserve is currently conducting an extensive cultural resources study which will inform further development of this section during Phase 2 of the planning process.

2.6 Geology and Topography

The Upper Mark West watershed is mountainous, with elevations ranging from 150 feet to 2400 feet. According to a recent study USGS study of the Mark West quadrangle: "The Mark West Springs quadrangle is located in the northern California Coast Ranges north of San Francisco Bay (fig 1, sheet 1). It is underlain by Mesozoic rocks of the Franciscan Complex, the Coast Range ophiolite, and the Great Valley sequence, considered here to be the pre-Tertiary basement of the northern Coast Ranges. These rocks are overlain by a complexly interstratified and mildly to moderately deformed sequence of Pleistocene to late Miocene marine and non marine sedimentary and largely sub aerial volcanic rocks. These rocks and unconformably overlying, less-deformed Holocene and Pleistocene strata are cut by the active right-lateral Healdsburg and Maacama Fault Zones." (USGS, 2004).

"The geology of the watershed is composed of the Coastal Belt Franciscan Complex, Glen Ellen Formation, and Sonoma volcanics. The Coastal Belt Franciscan Complex consists of undifferentiated and erodible mélange, with large blocks of varying lithology. These blocks form much of the rolling hill topography in the project area. The Glen Ellen Formation is highly erodible due to the unconsolidated nature of the fluvial and lacustrine sediments comprising it." (PWA, 2008).

Additional information on the geology and topography will be gathered during phase 2 of the planning process.

2.7 Soils

The Natural Resources Conservation Soil Survey of Sonoma County (1972) identifies the following soil series in the Upper Mark West watershed:

> Alluvial land, sandy (AdA) consists of sandy and gravelly deposits along streams. Stratification is variable, and recent over washes tend to change the texture of the surface layer form time to time. Limited distribution along Upper Mark West and Van Buren creeks.
>
> Alluvial land, clayey (AeA) consists of nearly level clay loams to silty clays underlain by stratified sand and gravel lenses at a depth of 20 to 40 inches. Limited distribution along Porter Creek.
>
> The Boomer series (BoE-G) consists of well-drained loams that have a clay loam subsoil. These soils are underlain, at a depth of 30 to 60 inches, by greenstone and metamorphosed rocks. Moderate distribution in the western part of the watershed, along Upper Mark West, Van Buren and Weeks Creeks, with slopes ranging from 15 to 75 percent.
>
> Clear Lake clay (CeB) is a clay that formed under poorly drained conditions. This soil is underlain by alluvium from basic and sedimentary rock. Limited distribution on Mark West Creek at the bottom of the watershed, with slopes ranging from 2 to 5 percent.
>
> The Felta Series (FaD-G) consists of well-drained very gravelly loams that have a very gravelly clay loam subsoil. These soils formed from material from volcanic tuffs mixed with uplifted river sediment and metamorphosed basic rock. Distributed widely in the western part of the watershed, with few isolated patches in the eastern part. Slopes range from 5 to 75 percent.

The Forward series (FoE-G, FrG) consists of well-drained gravelly loams that have a gravelly sandy clay loam subsoil. At a depth of 20 to 40 inches these soils are underlain by rhyolite rock and soft rhyolitic tuff. Moderate distribution in the northern part of the watershed along Porter Creek, with one isolated patch lower on Mark West Creek. Slopes range from 9 to 75 percent.

The Goulding series (GgD-G, GlD-G) consists of well-drained clay loams. These soils are underlain at a depth of 12 to 24 inches by metamorphosed basic igneous and weathered andesitic basalt of old volcanic formations. Widely distributed throughout the watershed, with slopes ranging from 5 to 75 percent.

Guenoc gravelly silt loam (GrE) is a well-drained gravelly silt loam that has a clay subsoil. At a depth of 20 to 40 inches, it is underlain by andesidic basalt. Limited distribution in the southwestern part of the watershed, with slopes ranging from 5 to 30 percent.

Haire clay loam (HcC) is a moderately well-drained loam that has a clay subsoil, and is underlain by old terrace-alluvium from mixed sedimentary and basic rock sources. Limited distribution along Mill and Porter creeks with slopes ranging from 0 to 9 percent.

The Henneke series (HgE-G2) consists of excessively drained gravelly loams that have a very gravelly clay subsoil. These soils are underlain, at a depth of 10 to 20 inches, by serpentine bedrock. Wide distribution in the eastern part of the watershed, with slopes ranging from 5 to 75 percent.

The Huse series (HyG) consists of well-drained stony clay loams that have a silty clay loam subsoil. At a depth of 12 to 25 inches that are underlain by strongly weathered serpentine and peridotite. Limited distribution in the northwest part of the watershed, with slopes ranging from 30 to 75 percent.

Kidd gravelly loam (KdF) is a somewhat excessively drained gravelly loam. It is underlain, at a depth of 5 to 20 inches, by rhyolitic rock and rhyolitic tuff. Limited distribution in the eastern part of the watershed, with slopes ranging from 9 to 50 percent.

The Laniger series (LaC-F) consists of well-drained loams. The soils are underlain, at a depth of 18 to 45 inches, by weathered rhyolite and rhyolitic tuff. Widely distributed, mostly in the northern part of the watershed, with slopes ranging from 5 to 50 percent.

Los Gatos loam (LmG) is a well-drained loam underlain, at a depth of 24 to 48 inches, by weathered sandstone and shale. One patch in the western part of the watershed, with slopes from 30 to 75 percent.

Maymen gravelly sandy loam (McF) is a well-drained gravelly sandy loam underlain, at a depth of 10 to 20 inches, by sandstone and shale bedrock. One small patch along the eastern edge of the watershed, with slopes from 30 to 50 percent.

The Montara series (MoE,G) consists of well-drained cobbly clay loams. These soils are underlain, at a depth of 8 to 20 inches, by weathered serpentine or serpentine rock. Limited distribution in the southeast part of the watershed.

The Raynor series (RaD-E, ReE) consists of well-drained clays underlain, at a depth of 20 to 60 inches, by volcanic and andesitic rocks. One patch near the northern edge and one patch at the southern edge of the watershed with slopes ranging from 0 to 30 percent.

The Redwood Hill series (RhE, RlG) is a moderately well-drained clay loam that has a predominantly clay subsoil. It is underlain, at 30 to 60 inches, by mixed greenstone and andesitic basalt rock. Moderate distribution in the western part of the watershed, with slopes ranging from 15 to 75 percent.

Riverwash (RnA) consists of very recent depositions of gravel, sand and silt alluvium along major streams and their tributaries. Gravel bars make up the majority of these areas. Moderate distribution along Mark West Creek and some occurrence along Humbug Creek.

Rock Land (RoG) consists of stony steep slopes and ridges that generally are in rough mountainous areas where there is little soil material. Moderate distribution, mostly along the upper reaches of streams and toward the edges of the watershed.

The Sobrante series (ShE-F) consists of well-drained loams that have a clay loam subsoil. They are underlain, at a depth of 20 to 40 inches, by andesitic basalt. Moderate distribution in the eastern part of the watershed, with slopes ranging from 15 to 50 percent.

The Spreckels series (SkC-F) consists of well-drained loams that have a clay subsoil. They are underlain, at a depth of 22 to 60 inches, by volcanic tuffs mixed with uplifted river sediment and weathered, basic igneous rock. Widely distributed through the watershed, with slopes ranging from 2 to 50 percent.

Suther Loam (StE) is a moderately well-drained loam with a gravelly clay subsoil. It is underlain at a depth of 18 to 40 inches by sandstone. One small patch in the northwestern corner of the watershed, with slopes from 15 to 30 percent.

The Toomes series (ToE,G) consists of well-drained loams underlain, at a depth of 5 to 20 inches, by shattered and weathered andesitic basalt and volcanic breccia. Moderate distribution, mostly throughout the central part of the watershed, with slopes ranging from 2 to 75 percent.

The Wright series (W) consists of somewhat poorly drained and moderately drained loams that have a clay subsoil. They are underlain by old valley plain alluvium of mixed origin such as volcanic and marine sediment. Limited distribution throughout the watershed, with slopes ranging from 0 to 9 percent.

The Yolo series (YnA, YoB, YsA) consists of well-drained loams underlain by recent alluvium from sandstone and shale. These soils are on alluvial fans and flood plains. Limited distribution throughout the watershed, with slopes ranging from 0 to 9 percent.

The Yorkville series (YuE-F) consists of moderately, well-drained clay loams that have a clay subsoil. They formed in material weathered from glaucophane-schist, serpentinized igneous rocks, and metamorphosed greywacke that are at a depth of 24 to 60 inches. Moderate distribution in the northeast area of the watershed, with some patches sin the southeast. Slopes range from 5 to 50 percent.

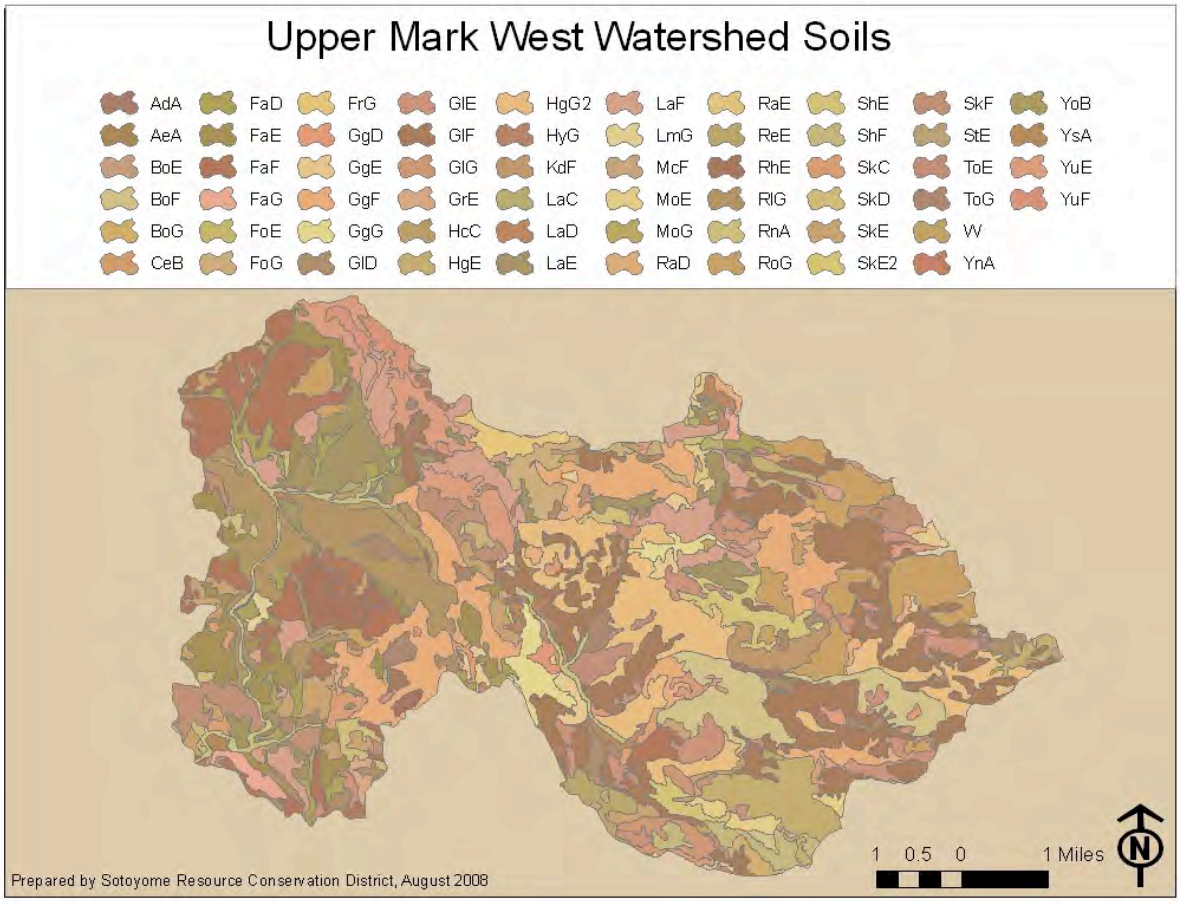

Figure 2.4 Soils of the Upper Mark West watershed

There is a need to do further research on these soil surveys, to find out if there are more detailed notes available from the surveyors.

2.8 Vegetation

Vegetation in the Upper Mark West watershed consists mostly of meadows and forested areas. Meadows are composed of a mixture of native and non-native grasses and herbs such as *Avena* spp. (oat grass), *Festuca* spp. (fescue), *Elymus* spp. (wild rye), and *Lolium* spp. (wild rye). The forest canopy

consists of *Pseudotsuga menziesii* (Douglas-fir) and *Lithocarpus densiflorus* (tan-oak). This canopy shelters an understory of *Polystichum munitum* (sword fern), *Toxicodendron diversilobum* (poison-oak), and *Corylus cornuta* (hazelnut). Transition areas between meadows and forests generally include the shrubs *Baccharis pilularis* (coyote brush), *Ceanothus cuneatus* (buck brush), and *Rubus discolor* (Himalayan blackberry), while riparian zones generally support *Sequoia sempervirens* (redwood) and *Acer macrophyllum* (bigleaf maple) with occasional *Umbellularia californica* (bay laurel).

A study of historic vegetation patterns and change in vegetation in time is needed to characterize vegetative patterns in the watershed and inform vegetation management.

2.9 Precipitation and Climate

Precipitation in the Upper Mark West watershed consists mainly of rainfall, with infrequent hail and very infrequent snow. Precipitation varies throughout the watershed due to diverse topography and elevations. On average, 95% of annual precipitation falls in October through April, with only 5% falling in May through September. Average annual precipitation ranges from 37 inches to 51 inches. Precipitation is lower in the western area of the watershed, and higher in the more mountainous eastern part of the watershed. The precipitation map (Figure 2.5) is based upon the PRISM (Parameter-elevation Regressions on Independent Slopes Model) mapping system, developed at Oregon State University. This model predicts precipitation at any location by extrapolating from known data points. Output from this model was compared with actual precipitation data from two different locations in the watershed to determine how accurate the model is in this area. In general, the model yields data that slightly overestimates precipitation in heavy rainfall months, and slightly underestimates precipitation in light rainfall months. On an annual basis, the model appears to give good estimates of precipitation in the watershed.

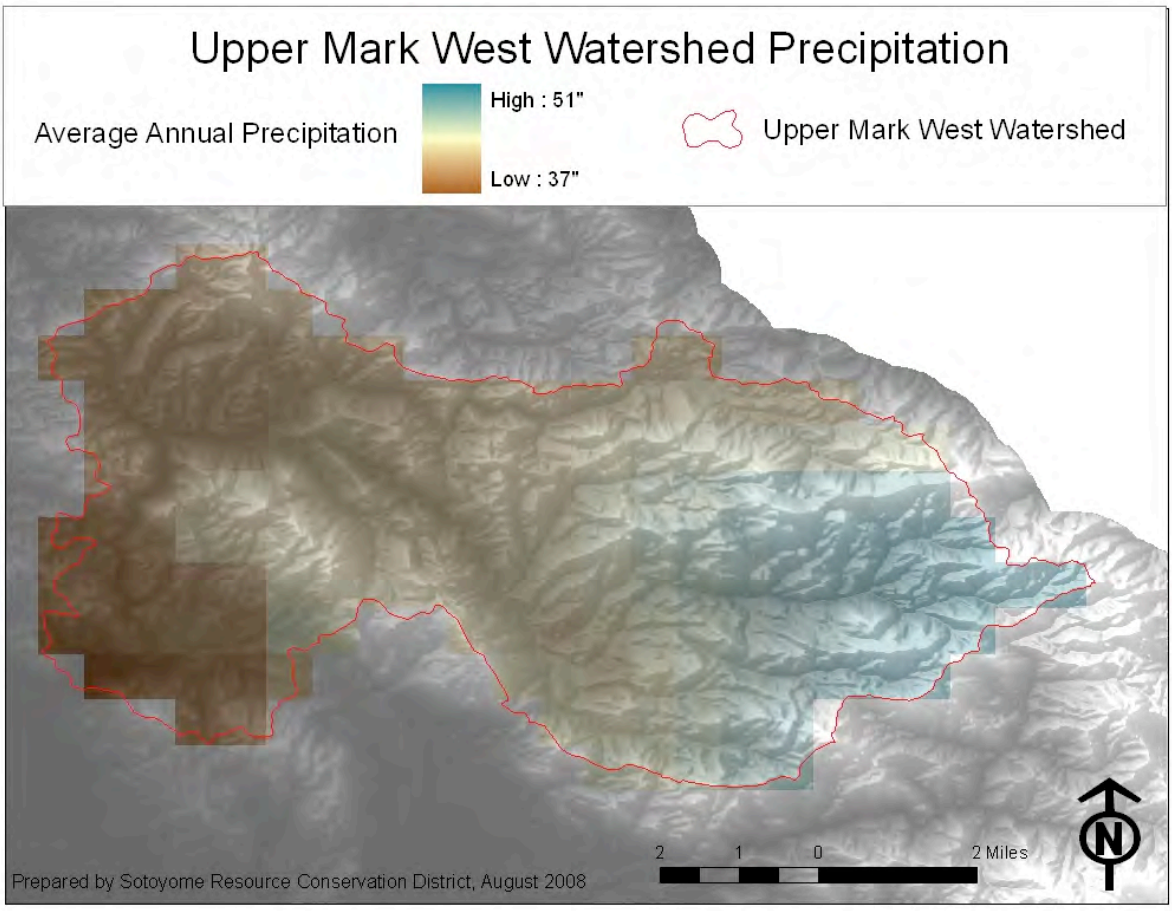

Figure 2.5 Precipitation in the Upper Mark West watershed

2.10 Surface Water Resources.

Because of the area's Mediterranean climate, with a dry season from April to November, summer stream flows are largely comprised of baseflow, or the contribution of groundwater to surface water systems. An increase of water demand during low flow periods can result, as it has in upper Mark West Creek, in surface flow becoming intermittent in relation to extraction of both surface and groundwater. In addition, increased water use results in less water volume available to dilute the concentration of pollutants or attenuate the high summer temperatures, both of which drastically affect the quality and availability of aquatic habitat.

In the Mark West watershed, the volcanic geology in the upper watershed affects water temperatures by seeping cold groundwater into the surface water throughout the summer months.

Very little stream flow data has been collected on upper Mark West Creek, and even less so on its tributaries.

The United States Geologic Survey collected flow data from a gauging station at Mark West Springs from 1958-1962. There are also flow gages lower in the Mark West Creek system at "Mark West Creek near Windsor" and "Mark West Creek near Mirabel Heights". Unfortunately, both of these stations are too distant and removed from the upper Mark West Creek watershed, as well as subject to the different urbanized runoff and irrigation influences, to make them informative about the relative conditions upstream.

The Community Clean Water Institute (CCWI) has received funding to monitor flow at five sites on Mark West Creek from March to November 2008. Flow monitoring is being conducted weekly with a hand held flow meter and several staff plates have been established to continuously record stage data. They plan to continue this monitoring in 2009.

Volunteers working with the Sotoyome RCD's Monitoring and Assessment Program have collected stream flow data on Mark West Creek at the Tarwater Road crossing since 2002. The stream flow monitoring has only been conducted during the winter to capture peak flows rather than summer low flow conditions. A goal of the Sotoyome RCD program is to expand the monitoring activities to include continuous flow monitoring stations in the upper Mark West Creek watershed.

A study of hydrology in the Upper Mark West Watershed is needed to understand the complexities of this system. Phase 2 of this planning process will include consultation with a hydrologist for the purposes of designing and conducting a hydrologic study of the watershed.

Phase 2 of the planning process will also include comparisons of actual flow with expected flow, using NASA's Soil and Water Assessment Tool. Analyses will include expected flow based on vegetation types and land use.

2.11 Groundwater Resources

The Franz Valley Specific Plan (1979) classifies the Upper Mark West watershed as an area of marginal water availability, and requires proof of water to build in some areas of the watershed.

In 2000, the Sonoma County Permit and Resource Management Department hired Kleinfelder and Associates to prepare a pilot study of groundwater resources in several water-scarce areas of the county. One of these areas was within the middle Mark West watershed, bounded on the southwest corner by Mark West Springs Road 1 ¼ miles North of Highway 101, on the northwest corner by the intersection of Mark West Springs Road and Leslie Road, on the northeast corner near the intersection of Foothill Ranch Road and Wallace Road, and on the southeast corner at the southeastern edge of the Fountaingrove Golf Course. The researchers found that availability of water in the aquifers of this area, composed primarily of fractured Sonoma Volcanics, is unpredictable. The study shows that depth to water in new wells increased by around 100% from the 1940s to the 1990s. There is a marked difference, however between this increase in depth to water and the 2000% increase in residential development over the same period. The researchers hypothesize that the effects of increased residential water demand in this area have been buffered by groundwater recharge. However, no evidence of water availability problems within the study area was found.

A study of groundwater resources in the Upper Mark West watershed is needed in order to assess water availability and the connection of groundwater to surface flow.

2.12 Threatened and Endangered Species

The Federal Endangered Species Act of 1973 (ESA) authorizes the listing of species as threatened or endangered and provides protection for listed species through laws that limit taking of these species and allow acquisition of land and disbursement of funds for conservation of listed species' habitats. Species eligible for listing under the ESA exhibit the following criteria: 1) Habitat is under threat of modification or destruction; 2) Species is over utilized for commercial, recreational, scientific, or educational purposes; 3) Species is subject to extreme disease or predation; 4) Existing regulatory mechanisms are inadequate to protect the species; or 5) The species continued existence is threatened by other natural or manmade factors.

The California Endangered Species Act (CESA) also allows listing of species and protection through limits of takes on those species. Species can be listed under either or both of the ESA and CESA, and can have different status on each list. Additionally, the California Department of Fish and Game (CDFG) has the authority to list Species of Special Concern (SSC). These species are not listed under the ESA or the CESA, but are either declining at a rate that could result in listing, or have historically occurred in low numbers and are known to have current threats to their existence. SSC listing criteria are similar to ESA criteria, and include small, isolated populations, marked population declines, habitat decline, conversion of land adjacent to limited and specialized habitat. Other criteria include prevalence on historic land, and limited records of recent presence in the state.

The California Native Plant Society (CNPS) maintains lists of plants to categorize degrees of concern for the survival of these species. These lists include but are not limited to plants that are listed under the ESA and CESA. List 1A consists of plants presumed to be extinct in California. List 1B includes plants that are rare, threatened or endangered in California and elsewhere. List 2 consists of plants that are rare, threatened or endangered in California, but more common elsewhere. It is mandatory that species on lists 1A, 1B and 2 be considered during environmental impact analyses prepared in accordance with the California Environmental Quality Act. List 3 is a review list of plants that CNPS wishes to learn more about before categorizing. List 4 is a watch list of plants that have limited distribution which cannot be considered rare, but whose status should be monitored regularly.

The Upper Mark West Watershed provides habitat for many species that are listed as threatened, endangered, species of special concern, and species listed on CNPS lists. A California Native Diversity Database (CNDDB) search of the Mark West Springs, Calistoga, Santa Rosa and Kenwood USGS 7.5m quadrangles produced the following lists of endangered animal (Table 2.2) and plant (Table 2.3) species. These lists were further developed based on observations of residents and land managers in the Upper Mark West watershed.

Table 2.2 Animal species listed as threatened, endangered, and species of special concern in the Upper Mark West area.

Scientific Name	Common Name	Federal Status	California Status	DFG Status
Accipiter cooperi	Coopers Hawk	None	None	Special Concern
Accipiter gentiles	Northern Goshawk	None	None	Special Concern
Accipiter striatus	Sharp-shinned Hawk	None	None	Special Concern
Actinemys marmorata marmorata	Northwestern Pond Turtle	None	None	Special Concern
Antrozous pallidus	Pallid Bat	None	None	Special Concern
Aquila chrysaetos	Golden Eagle	None	None	Special Concern
Athene cunicularia	Burrowing Owl	None	None	Special Concern
Cirus cyaneus	Northern Harrier	None	None	Special Concern
Clemmys marmorata	Western Pond Turtle	None	None	Special Concern
Empidonax traillii	Willow Flycatcher	Endangered	Endangered	None
Falco columbarius	Merlin	None	None	Special Concern
Falco mexicanus	Prairie Falcon	None	None	Special Concern
Falco peregrinus anatum	American peregrine falcon	Delisted	Endangered	None
Lavinia symmetricus navarroensis	Navarro roach	None	None	Special Concern
Oncorhynchus kisutch	Coho Salmon - Central California Coast ESU	Endangered	Threatened	None
Oncorhynchus mykiss irideus	Steelhead - Central California Coast ESU	Threatened	None	None
Rana boylii	Foothill Yellow-legged Frog	None	None	Special Concern
Rana draytonii	California red-legged frog	Threatened	None	Special Concern

Table 2.3 Plant species listed as threatened or endangered, or included in the CNPS Inventory of Rare and Endangered Plants (2001).

Scientific Name	Common Name	Federal Status	California Status	CNPS Status
Allium peninsulare var. franciscanum	Franciscan onion	None	None	1B
Alopecurus aequalis var. sonomensis	Sonoma alopecurus	Endangered	None	1B
Amorpha californica var. napensis	Napa false indigo	None	None	1B
Anomobryum julaceum	slender silver moss	None	None	2
Arctostaphylos canescens ssp. sonomensis	Sonoma canescent manzanita	None	None	1B
Arctostaphylos stanfordiana ssp. decumbens	Rincon Ridge manzanita	None	None	1B
Astragalus claranus	Clara Hunt's milk-vetch	Endangered	Threatened	1B
Balsamorhiza macrolepis var. macrolepis	big-scale balsamroot	None	None	1B
Blennosperma bakeri	Sonoma sunshine	Endangered	Endangered	1B
Brodiaea californica var. leptandra	narrow-anthered California brodiaea	None	None	1B

Calystegia collina ssp. oxyphylla	Mt. Saint Helena morning-glory	None	None	4
Carex albida	Sonoma white sedge	Endangered	Endangered	1B
Ceanothus confusus	Rincon Ridge ceanothus	None	None	1B
Ceanothus divergens	Calistoga ceanothus	None	None	1B
Ceanothus purpureus	holly-leaved ceanothus	None	None	1B
Ceanothus sonomensis	Sonoma ceanothus	None	None	1B
Centromadia parryi ssp. parryi	pappose tarplant	None	None	1B
Downingia pusilla	dwarf downingia	None	None	2
Eryngium constancei	Loch Lomond button-celery	Endangered	Endangered	1B
Fritillaria liliacea	fragrant fritillary	None	None	1B
Lasthenia burkei	Burke's goldfields	Endangered	Endangered	1B
Layia septentrionalis	Colusa layia	None	None	1B
Leptosiphon jepsonii	Jepson's leptosiphon	None	None	1B
Limnanthes vinculans	Sebastopol meadowfoam	Endangered	Endangered	1B
Lupinus sericatus	Cobb Mountain lupine	None	None	1B
Microseris paludosa	marsh microseris	None	None	1B
Navarretia leucocephala ssp. bakeri	Baker's navarretia	None	None	1B
Navarretia leucocephala ssp. plieantha	many-flowered navarretia	Endangered	Endangered	1B
Penstemon newberryi var. sonomensis	Sonoma beardtongue	None	None	1B
Plagiobothrys strictus	Calistoga popcorn-flower	Endangered	Threatened	1B
Poa napensis	Napa blue grass	Endangered	Endangered	1B
Sidalcea hickmanii ssp. viridis	Marin checkerbloom	None	None	1B
Sidalcea oregana ssp. valida	Kenwood Marsh checkerbloom	Endangered	Endangered	1B
Trifolium amoenum	two-fork clover	Endangered	None	1B
Trifolium depauperatum var. hydrophilum	saline clover	None	None	1B
Viburnum ellipticum	oval-leaved viburnum	None	None	2

2.13 Salmonid Populations and Habitat

Stream surveys conducted by the California Department of Fish and Game (DFG) indicate that Coho Salmon (*Oncorhynchus kisutch*) are present in Upper Mark West Creek, and steelhead (*Oncorhynchus mykiss*) are present in Upper Mark West Creek and its tributaries. Though DFG's most recent survey of Mark West Creek did not include a biological inventory, the report does include information on historic surveys, showing that both Coho and steelhead were found up to the most recent DFG biological inventory in 1970. Additionally, during the implementation of an instream habitat enhancement structure project in 2001, DFG staff observed Coho salmon in Mark West Creek (Derek Acomb, Personal Communication, 12/01). DFG also reports that, through 1983, hatchery steelhead were transferred into Mark West Creek. A stream survey of Porter Creek completed in the same year also includes historic

survey information indicating that juvenile steelhead were present from the mouth to the headwaters of Porter Creek in 1974. In a 1997 habitat inventory of tributaries to Mark West Creek, DFG staff noted steelhead in Mill Creek and Van Buren Creek.

The Sonoma County Water Agency, as part of the" Russian River Basin Steelhead and Coho Salmon Monitoring Program Pilot Study", conducted elecrofishing on Mark West Creek from 1999 to 2001. Four selected sampling reaches of Mark West Creek were electrofished, the reaches extended from the Mark West/Laguna de Santa Rosa confluence to the headwaters near Diamond Mountain. The study concentrated on population estimates, observed fish densities and species (particularly steelhead) composition percentages. Mark West Creek was selected as part of this study, in part due to the historical presence of Coho salmon (SCWA, 2002).

The study reach that extended from Mark West Springs to just downstream of the St. Helena Road crossing had a species composition of Sculpin (52%), California Roach (33%), Steelhead (12%) and Lamprey Ammocoete (3%). The study reach, which extended from just downstream of the St. Helena Road crossing to the headwaters of Mark West Creek had a population of 100% steelhead.

From 1993 to 2002 fish surveys were conducted on Mark West Creek as part of larger study examining the potential effects of reclaimed water discharged to Santa Rosa Creek by the Santa Rosa Subregional Reclamation System by Merritt-Smith Consulting. The index zone of upper Mark West Creek monitored through this study extended from Alpine Road upstream to St. Helena Road. Embeddedness was noted to be similar to that in the middle reach of Mark West Creek, which was characterized as "higher than would be expected in a pristine stream".

Fyke net studies conducted in Mark West Creek in 1991-1995 in part to evaluate of the juvenile steelhead populations in the nursery areas in the upstream reach of Mark West Creek, as well as the upper reaches of Santa Rosa, Maacama and Green Valley Creeks, indicated that conditions in the upstream habitat had a profound effect on juvenile population size and the number of smolts making their way to sea (Merritt-Smith Consulting, 2003).

The study also addressed stream flow as it relates to fish habitat, "The stream in this reach is greatly influenced by agricultural water diversions further upstream. When the stream is flowing in this reach, it provides structurally complete habitat for juvenile salmonids, including a rocky streambed, diverse riffles, pools, and glides, dense riparian cover, rootwads, cutbanks, and downed trees. However in late spring and summer, dewatering by upstream water users causes the stream to become intermittent, and the surviving fish are concentrated in a few isolated pools. According to some local residents, this has happened every summer in recent years, and is often manifested at the Alpine Road crossing as stream flowing one day, then completely dry for several days, then flowing again as water users adjust their diversions throughout the dry season. Undoubtedly, many fish are stranded in parts of the stream as it goes dry and are either asphyxiated or become easy prey for wading birds and other predators. Drying also kills most of the aquatic invertebrates needed for food by juvenile salmonids, so that each time the stream is finally re-wetted in the fall, fish food is probably in short supply for several more months until invertebrate populations increase again. (Merritt-Smith Consulting, 2003)"

DFG stream surveys identify inadequate canopy, erosion and inadequate large woody debris as limiting factors for salmonid populations in Mark West Creek and its tributaries. In addition, fish passage and inadequate spawning gravels are identified as problems in the tributaries.

In 2004, DFG released its "Recovery Strategy for California Coho Salmon," including recommendations to facilitate Coho recovery in hydrologic subareas (HSAs) throughout the North and Central coasts of California. The following tasks were determined for the Mark West HSA:

- Reduce habitat fragmentation and implement riparian improvements through land-use planning and use of conservation easements from willing landowners.
- Develop plans to improve instream habitat conditions.
- Assess, prioritize, and develop plans to treat sources of excess sediment.

2.14 Wildlife

Residents and land managers have observed a wide variety of wildlife in the area. The following is a list of wildlife that occur in the Upper Mark West Watershed, based on anecdotal evidence:

Table 2.4 Wildlife observed in the Upper Mark West watershed

Scientific Name	Common Name
Mammals	
Antrozous pallidus pacificus	Pallid bat
Bassariscus astutus raptor	Ring tailed cat
Cam's latrans ochropus	Coyote
Eptesicus fuscus bernardinus	Big brown bat
Erethizon dorsatum	Porcupine
Lepus californicus californicus Sylvilagus sp.	Black-tailed jack rabbit Rabbit
Lontra canadensis pacifica	River otter
Lynx rufus californicus	Bobcat
Mephitis mephitis occidentalis	Striped skunk
Micro tus californicus eximus	California meadow mouse
Mustela frenata	Long-tailed weasel
Mustela vison aestuarina	Mink
Myotis californicus caurinus	California myotis
Myotis thysanodes	Fringed myotis
Neotoma fuscipes fuscipes	Dusky-footed wood rat
Odocoileus hem/onus columbianus	Black-tailed deer
Peromyscus boylii	Brush mouse
Peromyscus maniculatus gambelii	Deer mouse
Peromyscus truei gilbert	Pinyon mouse
Procyon lotor psora	Raccoon
Puma con color californica	Mountain lion
Reithrodontomys megafotis longicaudis	Western harvest mouse
Sciurus griseus griseus	Western gray squirrel

Sorex trowbridgii montereyensis	Trowbridge's shrew
Sorex vagrans sonomae Scapanus or Neurotrichus	Vagrant shrew Mole
Spermophilus sp.	Ground squirrel
Sus scrofa	Wild boar/feral pig
Tamias sp.	Chipmunk
Thomomys bottae bottae	Botta's pocket gopher
Urocyon cinereoargenteus townsendii	Gray fox
Ursus americanus	Black bear
Birds	
Accipiter cooperii	Cooper's Hawk
Accipiter gentiles	Northern Goshawk
Accipiter striatus	Sharp-shinned Hawk
Aegolius acadicus	Northern Saw-whet Owl
Aeronautes saxatalis	White-throated Swift
Agelaius phoeniceus	Red-winged Blackbird
Aimophila ruficeps	Rufous-crowned Sparrow
Aix sponsa	Wood Duck
Ammodramus savannarum	Grasshopper Sparrow
Anas platyrhynchos	Mallard
Anthus rubescens	American Pipit
Aphelocoma californica	Western Scrub-Jay
Aquila chrysaetos	Golden Eagle
Ardea herodias	Great Blue Heron
Athene cunicularia	Burrowing Owl
Aythya valisineria	Canvasback
Baeolophus inornatus	Oak Titmouse
Bombycilla cedrorum	Cedar Waxwing
Branta Canadensis	Canada Goose
Bubo virginianus	Great Horned Owl
Buteo jamaicensis	Red-tailed Hawk
Buteo lineatus	Red-shouldered Hawk
Butorides virescens	Green Heron
Callipepla californica	California Quail
Calypte anna	Anna's Hummingbird
Carduelis lawrencei	Lawrence's Goldfinch
Carduelis pinus	Pine Siskin
Carduelis psaltria	Lesser Goldfinch
Carduelis tristis	American Goldfinch
Carpodacus mexicanus	House Finch
Carpodacus purpureus	Purple Finch
Cathartes aura	Turkey Vulture

Catharus guttatus	Hermit Thrush
Catharus ustulatus	Swainson's Thrush
Certhia americana	Brown Creeper
Ceryle alcyon	Belted Kingfisher
Chaetura vauxi	Vaux's Swift
Chamaea fasciata	Wrentit
Charadrius vociferous	Killdeer
Chondestes grammacus	Lark Sparrow
Chordeiles minor	Common Nighthawk
Circus cyaneus	Northern Harrier
Colaptes auratus	Northern Flicker
Columba livia	Rock Pigeon
Contopus cooperi	Olive-sided Flycatcher
Contopus sordidulus	Western Wood-Pewee
Corvus brachyrhynchos	American Crow
Corvus corax	Common Raven
Cyanocitta stelleri	Steller's Jay
Dendroica coronata	Yellow-rumped Warbler
Dendroica nigrescens	Black-throated Gray Warbler
Dendroica occidentalis	Hermit Warbler
Dendroica petechia	Yellow Warbler
Dendroica townsendi	Townsend's Warbler
Dryocopus pileatus	Pileated Woodpecker
Elanus leucurus	White-tailed Kite
Empidonax difficilis	Pacific-slope Flycatcher
Empidonax traillii	Willow Flycatcher
Eremophila alpestris	Horned Lark
Euphagus cyanocephalus	Brewer's Blackbird
Falco columbarius	Merlin
Falco mexicanus	Prairie Falcon
Falco peregrinus	Peregrine Falcon
Falco sparverius	American Kestrel
Fulica americana	American Coot
Gallinago gallinago	Wilson’s Snipe
Glaucidium gnoma	Northern Pygmy-Owl
Hirundo rustica	Barn Swallow
Icterus bullockii	Bullock's Oriole
Ixoreus naevius	Varied Thrush
Lanius ludovicianus	Loggerhead Shrike
Loxia curvirostra	Red Crossbill
Megascops kennicottii	Western Screech-Owl

Melanerpes formicivorus	Acorn Woodpecker
Melanerpes lewis	Lewis's Woodpecker
Meleagris gallopavo	Wild Turkey
Melospiza melodia	Song Sparrow
Mimus polyglottos	Northern Mockingbird
Molothrus ater	Brown-headed Cowbird
Myiarchus cinerascens	Ash-throated Flycatcher
Oreortyx pictus	Mountain Quail
Oxyura jamaicensis	Ruddy Duck
Pandion haliaetus	Osprey
Passer domesticus	House Sparrow
Passerella iliaca	Fox Sparrow
Passerina amoena	Lazuli Bunting
Patagioenas fasciata	Band-tailed Pigeon
Pelecanus erythrorhynchos	American White Pelican
Petrochelidon pyrrhonota	Cliff Swallow
Phalacrocorax auritus	Double-crested Cormorant
Phalaenoptilus nuttallii	Common Poorwill
Phasianus colchicus	Ring-necked Pheasant
Pheucticus melanocephalus	Black-headed Grosbeak
Picoides nuttallii	Nuttall's Woodpecker
Picoides pubescens	Downy Woodpecker
Picoides villosus	Hairy Woodpecker
Pipilo maculates	Spotted Towhee
Piranga ludoviciana	Western Tanager
Podilymbus podiceps	Pied-billed Grebe
Poecile rufescens	Chestnut-backed Chickadee
Polioptila caerulea	Blue-gray Gnatcatcher
Pooecetes gramineus	Vesper Sparrow
Psaltriparus minimus	Bushtit
Regulus calendula	Ruby-crowned Kinglet
Regulus satrapa	Golden-crowned Kinglet
Sayornis nigricans	Black Phoebe
Sayornis saya	Say's Phoebe
Selasphorus rufus	Rufous Hummingbird
Selasphorus sasin	Allen's Hummingbird
Sialia mexicana	Western Bluebird
Sitta canadensi	Red-breasted Nuthatch
Sitta carolinensis	White-breasted Nuthatch
Sitta pygmaea	Pygmy Nuthatch
Sphyrapicus varius	Yellow-bellied Sapsucker

Spizella atrogularis	Black-chinned Sparrow
Spizella passerine	Chipping Sparrow
Spizella pusilla	Field Sparrow
Stelgidopteryx serripennis	Northern Rough-winged Swallow
Sterna caspia	Caspian Tern
Sturnella neglecta	Western Meadowlark
Sturnus vulgaris	European Starling
Tachycineta bicolor	Tree Swallow
Tachycineta thalassina	Violet-green Swallow
Thryomanes bewickii	Bewick's Wren
Toxostoma redivivum	California Thrasher
Troglodytes aedon	House Wren
Troglodytes troglodytes	Winter Wren
Turdus migratorius	American Robin
Tyrannus verticalis	Western Kingbird
Tyto alba	Barn Owl
Vermivora celata	Orange-crowned Warbler
Vireo cassinii	Cassin's Vireo
Vireo gilvus	Warbling Vireo
Vireo huttoni	Hutton's Vireo
Wilsonia pusilla	Wilson's Warbler
Zenaida macroura	Mourning Dove
Zonotrichia atricapilla	Golden-crowned Sparrow
Zonotrichia leucophrys	White-crowned Sparrow
Reptiles & Amphibians	
Aneides flavipuntatus	Black salamander
Aneides lugubris	Arboreal salamander
Batrachoseps attenuatus	California slender salamander
Bufo boreas	Western toad
Charina bottae	Rubber boa
Clemmys marmorata	Western pond turtle
Coluber constrictor	Racer
Contia tenuis	Sharp-tailed snake
Crotalus viridis	Northern pacific rattlesnake
Diadophis punctatus	Ringneck snake
Dicamptodon ensatus	Pacific giant salamander
Ensatina escholtzi	Ensatina
Eumeces skiltonianus	Western skink
Gerrhonotus coeruleus	Northern alligator lizard
Gerrhonotus multicarinatus	Southern alligator lizard
Hyla regilla	Pacific tree frog

Hypsiglena torquata	Night snake
Lampropeltis getulus	Common kingsnake
Lampropeltis zonata	California mountain kingsnake
Pituophis melanoleucus	Gopher snake
Rana boylei	Yellow-legged frog
Rana catesbeiana	Bullfrog
Sceloporus occidentalis	Western fence lizard
Taricha granulosa	Rough-skinned newt
Taricha rivularis	Red-bellied newt
Taricha torosa	California newt
Thamnophis atratus	Western aquatic garter snake
Thamnophis elegans	Western terrestrial garter snake
Thamnophis sirtalis infernalis	California red-sided garter snake

2.15 Recreation

The Upper Mark West watershed includes small portions of Shiloh Ranch Regional Park and Bothe Napa Valley State Park. Shiloh Ranch Regional Park is owned by the County of Sonoma, and is open to the public, with access from Faught Road in Windsor. Both Napa Valley State Park is owned by the State of California, and can be accessed by the public from Highway 128 in Napa County. The watershed also includes all or significant portions of the Pepperwood Preserve, Cresta Ranch and the Saddle Mountain Preserve, as well as a number of private lands with conservation easements through the Sonoma County Agricultural Preservation and Open Space District and the Sonoma Land Trust, such as McCullough Ranch and Nefertierra. Though not open to the public on a normal basis, these lands are open for recreation through programs of the Pepperwood Foundation and Sonoma County Agricultural Preservation and Open Space District/Landpaths, respectively. Privately owned recreational lands include Safari West, a wildlife preserve showcasing African animals, and the Mayacamas Golf Club.

Section 3. Water Quality

3.1 Overview of Water Quality

Water quality refers to the physical, chemical and biological characteristics of water. Water quality information can be used to assess the safety of surface water for a variety of beneficial uses ranging from drinking water, contact recreation, and aquatic wildlife habitat requirements. Water quality is often framed in context of measureable concentrations of contaminants (See Section 3.2 for more information on beneficial uses).

Water quality is determined and affected by a complex web of chemical, physical and biological processes. A wide range of human activities can affect water quality in ways that aren't always obviously related. Temperature, for example, affects water chemistry and the functions of aquatic organisms. It has influences on the amount of oxygen that can be dissolved in water, the rate of photosynthesis by

algae and other aquatic plants, the metabolic rates of organisms, and the sensitivity of organisms to toxic wastes, parasites and diseases, and timing of reproduction, migration, and aestivation of aquatic organisms.

The impacts to water quality from human activities in the surrounding watershed depend on the type of activity, its timing, location, duration and intensity. Each type of activity affects the watershed and contributes a set of pollutants to the stream system. The concentration of pollutants varies by season, by day, and sometimes from hour to hour. This can make it difficult to measure water quality and critical to build a data record over time to assess how different conditions affect water quality.

Most water quality monitoring is conducted via grab sample and subsequent chemical analysis. Grab sampling takes a snapshot of the water quality conditions occurring at that particular spot at that particular time. Water quality sampling can be designed to take a number of instantaneous samples over time to examine trends in water quality, decline or improvement, and potentially catch a pollution event when it occurs.

Water quality is only one piece of the puzzle of evaluating stream health. Many things can influence the health of a creek and its ability to sustain sensitive species (Table 3.1).

Table 3.1 Partial list of habitat characteristics and their function in maintaining sensitive aquatic species, such as the highlighted anadromous salmonids. Adapted from National Marine Fisheries Service, 2007.

Habitat	Characteristic	Function
Water quality	Temperature, dissolved oxygen, conductivity, chemical pollution	• Mortality • Growth • Toxicity/sub-lethal effects
Water quantity	Low flow, high velocity	• Morality • Competition • Predation • Interactions with water quality (i.e. dilution)
Substrate quality	Sedimentation, substrate size	• Spawning • Incubation • Macroinvertebrate production
Geomorphology (i.e. pools and riffles)	Cover material (e.g. large woody debris, boulders), depth, gradient	• Flow refugia • Shelter from predators • Sediment traps and substrate sorting • Nutrient reservoirs • Macroinvertebrate production • Spawning • Oxygenation
Riparian corridor, extent and health	Canopy, vegetation type, vegetation amount	• Water temperature (shade) • Nutrient sources (invertebrate production • Source of large woody debris • Physical buffer and filter for sediment and chemical pollution from surrounding uplands

It is important to note that water quality analysis only provides information about the constituents analyzed for; it can only answer the questions that are asked. Due to the procedural difficulty (transport, holding times, etc.) and the expense of many analytical procedures, most water quality monitoring programs analyze for a few common chemical and physical parameters such as Temperature, pH, Dissolved Oxygen, Conductivity and concentrations of common pollutants of concern such as nutrients, pesticides, metals, oil and grease, etc.

3.2 Beneficial Uses for Surface Water

Beneficial uses describe existing and potential uses of water within a waterbody. The State and Regional water boards are responsible for designating and protecting these beneficial uses in all waters of the state. The Water Quality Control Plan for the North Coast Region (Basin Plan) designates the following existing beneficial uses for the Mark West Hydrologic Subarea:

Municipal and Domestic Supply (MUN) Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

Agricultural Supply (AGR) Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Industrial Service Supply (IND) Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.

Groundwater Recharge (GWR) Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.

Freshwater Replenishment (FRSH) Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity).

Navigation (NAV) Uses of water for shipping, travel, or other transportation by private, military or commercial vessels.

Water Contact Recreation (REC-1) Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white-water activities, fishing, or use of natural hot springs.

Non-Contact Water Recreation (REC-2) Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing (COMM) Uses of water for commercial, recreational (sport) collection of fish, shellfish, or other aquatic organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Warm Freshwater Habitat (WARM) Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Cold Freshwater Habitat (COLD) Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

Wildlife Habitat (WILD) Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Rare, Threatened, or Endangered Species (RARE) Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

Migration of Aquatic Organisms (MIGR) Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

Spawning, Reproduction, and/or Early Development (SPWN) Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Potential beneficial uses may be designated for a number of reasons, including if that beneficial use existed prior to 1975 but does not currently exist, if there are plans to develop such a use, if existing water quality conditions do not support that use but could reasonably be improved to attain that use, or if there is insufficient information to show that the uses exists, but there is potential for the use to exist. The Basin Plan also designates the following potential beneficial uses for the Mark West Hydrologic Subarea:

Industrial Process Supply (PRO) Uses of water for industrial activities that depend primarily on water quality.

Hydropower Generation (POW) Uses of water for hydropower generation.

Aquaculture (AQUA) Uses of water for aquaculture or mariculture operations including, but not limited to, propagation, cultivation, maintenance, or harvesting of aquatic plants and animals for human consumption or bait purposes.

Shellfish Harvesting (SHELL) Uses of water that support habitats suitable for the collection of filterfeeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.

3.3 Water Quality Issues and Potential Pollutant Sources

Identifying that a pollutant is present in a stream is the first step to identifying the source of the pollutant and the potential for stemming its input. The main mechanism for pollutants entering Mark West Creek and its tributaries is through Non-point source (NPS) inputs. NPS inputs are pollutants that

arise from a number of places throughout a watershed. The insidious nature of nonpoint pollution is that the individual pollutant contributions may be small, but their combined effects can be significant. Despite the widespread concern over toxic substances in our streams, the leading pollution concerns in the upper Mark West Creek watershed are sediment and increasing water temperatures. The cumulative effects of excessive amounts of these naturally occurring substances/conditions are exacerbated by the reduction in stream flows.

3.4 Water Quality Data

Water quality monitoring in the Upper Mark West watershed has been intermittent in nature.

A habitat inventory on Weeks Creek was conducted by Sonoma County Water Agency (SCWA) staff in cooperation with and supervision and data analysis by California Department of Fish and Game (DFG). The single day inventory conducted on July 31, 1997, consisted of SCWA staff walking the section of Weeks Creek to which they had access and recording a variety of habitat related information. The only water quality data collected was air and instantaneous water temperature. While air temperatures ranged from 75 to 82°F, water temperatures measured 60°F. No flow measurements were taken.

Van Buren Creek was inventoried from August 5 to 7, 1997. The only water quality data collected was air and instantaneous water temperature. While air temperatures ranged from 76 to 88°F, water temperatures ranged from 62 to 70°F. No flow measurements were taken.

A community volunteer working with the Community Clean Water Institute has been monitoring Mark West Creek just downstream of the confluence with Van Buren Creek since 2004. No data summary reports for this monitoring station are currently available.

The Sotoyome Resource Conservation District has been collecting monitoring data on upper Mark West Creek since 1999. The main data collection site, the study reach, is located upstream of the St. Helena Road crossing, upstream of the Preserve. This ongoing monitoring program has successfully collected a variety of monitoring data, consisting of physical, chemical and biological parameters, creating a data record that can be monitored over time to track changes in habitat conditions in the context of land use changes. This program has engaged the community, both as volunteers and participants in improving water quality and habitat conditions in Mark West Creek and its tributaries through the design and implementation of habitat enhancement and sediment reduction projects.

Because environmental conditions vary annually, an accurate depiction of stream temperature requires data collection over multiple years.

Another monitoring strategy is bioassessment or employing the biotic creatures living in the stream to assess the water quality conditions and overall stream health. By looking at and analyzing the type, number, distribution, age and size of aquatic macroinvertebrates, algae, fish, and other biota, one can infer a wide range of information about the quality of water and habitat over time. The mere presence or absence of certain common sensitive species can indicate both the quality of the water and the ability of that stream to support other sensitive species.

As part of the "Russian River Index of Biological Integrity (RRIBI) for First to Third Order Tributary Streams" study conducted by the California Department of Fish and Game, benthic macroinvertebrate sampling was conducted on four reaches of Mark West Creek in 1995 and two reaches in 1996. The Mark West Creek specific results are not published in this report. These results may be available to serve as baseline conditions to which future sampling efforts can be compared.

The Sotoyome RCD conducted benthic macroinvertebrate sampling on the monitoring study reach upstream of the St. Helena Road crossing in 2006. The upper Mark West Creek site showed the highest overall IBI score among the four creeks sampled, suggesting relatively high quality habitat and a cobble dominated heterogeneous substate. The relatively high number of BMIs in the shredder functional feeding group suggested an intact riparian zone (SRCD, 2007).

Section 4. Sediment Budget and Load Reductions

4.1 Analysis of Current Sediment Loading

Erosion of rural roads is known to be one of the most significant contributors of sediment to streams in this area. Pacific Watershed Associates (PWA) has completed three sediment source assessments in the Upper Mark West watershed. These assessments focused on rural roads, including Tarwater Road, Mattei Road, the Monan's Rill complex of roads, Lone Pine Road, Cleland Road, Erland Road, Phillips Road, and the roads of Pepperwood Preserve. These assessments included approximately 25 miles of unpaved roads, representing approximately 31% of the unpaved roads in the watershed. In addition to the maintained unpaved roads in the watershed, there are many miles of uninventoried driveways, access roads, skid roads and abandoned roads that have the potential to deliver sediment to streams as well.

The most common erosion problems found by PWA in the watershed were: 1) erosion at or associated with stream crossings (from several possible causes); 2) gully erosion on hillslopes below ditch relief culverts; and 3) road surface and ditch erosion. PWA found that potential erosion from these and other miscellaneous causes along the 25 miles of road surveyed would yield approximately 30,000 cubic yards of sediment to streams.

A comprehensive inventory of unmaintained roads in the watershed is needed to more accurately describe road-related erosion. Additionally, non-road related sediment sources need to be inventoried to assess their contribution to sediment loads, and to plan for future control of these sources.

A comprehensive inventory of the unpaved roads and trails that run through the Saddle Mountain Preserve (SMP) is currently being conducted by Pacific Watershed Associates as part of the SMP planning and resource inventory effort.

In addition, suspended sediment and flow data is needed to determine instream loads and compare these with identified upslope sediment yields.

4.2 Target Load Reductions

Additional knowledge about the sediment regime and current sources is needed in order to develop target load reductions. This will be accomplished during Phase 2 of the planning process.

Section 5. Recommended Land Management Practices

The Upper Mark West Watershed has many knowledgeable and motivated landowners. Outreach to these landowners has made it clear that the need is not for general, watershed-wide best management practices, but rather for an information system where landowners can find best management practices tailored to the specific conditions present at a parcel scale. Phase 2 of the planning process will include the development of an online, map-based interactive system for this purpose.

Phase 2 will also include consultation with a water conservation specialist to develop water conservation best management practices that will be suited to the Upper Mark West watershed, its water-poor environment, and the land use practices present there.

Section 6. Education and Community Outreach

Community outreach is an important part of this planning process. Through outreach to the Friends of Mark West Watershed and the Alpine Club, stakeholders have provided input on the scope of this plan, and have provided data and anecdotal information to contribute to the characterization of the watershed.

Continuing outreach to interested stakeholders will be an important part of Phase 2 as well. Sotoyome RCD staff will continue to meet with the above mentioned stakeholder groups, and will look for other opportunities to reach other stakeholders as well.

Upon completion of the plan and the interactive system, Sotoyome RCD staff will hold workshops to introduce stakeholders to the finished products. A key component of this educational effort will be to show landowners how to get the most out of the interactive system.

Section 7. Action Plan to Improve Natural Resources Sustainability

The following actions have been identified to reach the goals identified in this plan. Some of these actions may occur during Phase 2 of the planning process, while others will occur after the plan has been completed. Additional actions will be identified during Phase 2, as stewardship needs are more clearly identified.

7.1 Meet water quality standards for sediment/siltation

Action 1: Complete rural roads assessments for remaining roads in watershed.

Project Steps:

1. Conduct outreach to enlist additional landowners in rural roads assessments

2. Seek funding to complete roads assessments
3. Contract with Pacific Watershed Associates (PWA) to complete assessments

Responsible Parties: Sotoyome RCD, Cooperating Landowners

Timelines: *To be determined during phase 2*

Budgets: Roads assessments by PWA currently cost roughly $1,900 per mile of road. Based on current estimates of unpaved road length in the watershed, an assessment of all roads that have not yet been assessed would cost upwards of $100,000. This number could be increased due to the existence of roads that have not been identified. Additionally, Sotoyome RCD would incur costs for landowner outreach and coordination.

Action 2: Complete high and medium priority improvements on all rural roads in the watershed, as specified in assessment reports.

Project Steps:

1. Complete roads assessments, as stated in Action 1.
2. Seek funding to implement high and medium priority improvements, as identified by PWA
3. Contract with PWA to complete roads improvements

Responsible Parties: Sotoyome RCD, Cooperating Landowners

Timelines: *To be determined during phase 2*

Budgets: Costs for road improvements will depend entirely on the number, type, and severity of the sediment sources identified. For example, treatment of high and medium priority sites on around 2 miles of Erland Road is estimated to cost approximately $89,000, while the treatment of high and medium priority sites along around 10 miles of roads on the Pepperwood Preserve is estimated to cost approximately $186,000.

Action 3: Identify and address other large-scale sediment sources in the watershed

Project Steps: *To be determined during phase 2*

Responsible Parties: *To be determined during phase 2*

Timelines: *To be determined during phase 2*

Budgets: *To be determined during phase 2*

7.2 Support designated uses for aquatic life

Actions to be determined during phase 2.

7.3 Restore aquatic habitat

Actions to be determined during phase 2.

7.4 Assess, protect & enhance riparian and wetland habitat

Actions to be determined during phase 2.

7.5 Promote native biodiversity in upland habitats

Action 1: Complete phytolith study of the watershed to determine composition and extent of pre-settlement plant communities.

Project Steps: *To be determined during phase 2*

Responsible Parties: *To be determined during phase 2*

Timelines: *To be determined during phase 2*

Budgets: *To be determined during phase 2*

7.6 Restore and protect forest health

Actions to be determined during phase 2.

7.7 Improve water conservation

Action 1: Complete water conservation pilot project to demonstrate potential water conservation solutions for the area.

Project Steps: *To be determined during phase 2*

Responsible Parties: Sotoyome Resource Conservation District, Cooperating Landowner(s)

Timelines: During Phase 2 of the planning process

Budgets: $10,000

Action 2: Complete a study of groundwater resources in the Upper Mark West watershed.

Project Steps: *To be determined during phase 2*

Responsible Parties: Friends of Mark West Watershed

Timelines: *To be determined during phase 2*

Budgets: *To be determined during phase 2*

Section 8. Follow-up Monitoring & Indicators

8.1 Monitoring Plan

A monitoring plan will be developed as part of Phase 2, when specific actions and corresponding load reductions have been determined. This monitoring plan will be developed in close cooperation with stakeholders who will take part in ongoing monitoring efforts.

8.2 Indicators

As outlined in Section 1.4, indicators for monitoring have been identified to correspond with each watershed goal. Table 8.1 summarizes the indicators for each watershed goal.

Table 8.1Watershed goals and corresponding indicators for the Upper Mark West watershed

Goal	Indicators
Meet water quality standards for sediment/siltation	Turbidity; Total Suspended Solids
Support aquatic life and restore aquatic habitat	Dissolved Oxygen; Temperature; Turbidity; Streambed Composition; Benthic Macroinvertebrates; Riparian Vegetation; Instream Habitat Structure; Fish Passage
Assess, protect & enhance wetland habitat	Extent & condition of wetland plant communities; wetland functional assessments; habitat connectivity; bird species diversity and richness
Promote native biodiversity in upland habitats	Extent and condition of native plant communities
Restore and protect forest health	Levels of Sudden Oak Death infection; frequency and magnitude of forest fires
Improve water conservation	Stream flow volumes, particularly in late summer months