Title

Early post-restoration re-vegetation performance and critical social and institutional factors in a landowner-involved restoration project on lower Wooden Valley Creek, Napa County, CA

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Abstract:

The restoration of a one-mile stretch of the lower Wooden Valley Creek on the cattle ranch owned by the McQueeny family in Napa County, California addressed denuded stream banks lacking native riparian vegetation and canopy cover that have resulted in salmonid habitat degradation and species decline (Marcus and CSPA, 2004). A primary concern of the McQueeny restoration demonstration project is the impact of high summertime stream temperatures on steelhead trout (*Oncorhynchus mykiss*), and the threat of continued bank incision in close proximity to the McQueeny home (Marcus and CSPA, 2004; Marcus, October 18, 2010; McQueeny, November 2, 2010 and November 20, 2010). Existing studies of the McQueeny property, Wooden Valley Creek, and larger Suisun Creek watershed restoration describe restoration baselines, restoration processes, and intended goals and outcomes (Circuit Rider Productions, 2007; Jackson, 2007; Purcell and Cover, 2007; Marcus and CSPA, 2004). Our research aims to fill a gap in the connection between the abundance of research, design, process, and outcome data (quantitative) and rancher/landowner implementation data (qualitative).

Restoration literature in general calls for participatory, collaborative processes, and adaptive management (Beechie et. al, 2010; Downs et. al, 2002; Kondolf, 1998; Kondolf et. al, 1995; Palmer et. al, 2005; Wohl et. al, 2005). Nevertheless, we argue that this restoration project is an example of how restoration planning, and especially post-project monitoring, may not include specific indicators or means for evaluating how landowners/stakeholders facilitate or impact restoration success. We investigate not only re-vegetation interim achievements, but also how this landowner-involved restoration process is impacted by landowner decision-making and by largely undocumented adaptive maintenance activities independently carried out by the landowner. Evidence suggests that these factors are critical to the potential success or failure of the project in restoring riparian vegetation, improving bank stability, and ultimately enhancing stream conditions for steelhead trout (*O.mykiss).*

Introduction and Purpose:

A recent (2009-2010) re-vegetation project along a one-mile stretch of the lower Wooden Valley Creek, which is in the Suisun Creek Watershed in Napa and Sonoma County, focused on restoring habitat and passage conditions for steelhead trout (*Oncorhynchus mykiss*), which is federally-listed as a threatened species (Circuit Rider Productions, 2007; Jackson, 2007; Purcell and Cover, 2007; Marcus and CSPA, 2004). The lower Wooden Valley Creek is a tributary to Suisun Creek, and flows southward through Napa and Sonoma county (*Appendices 7 and 14).* Our evaluation focuses on one component of the re-vegetation project, within the larger Suisun Creek watershed enhancement project currently underway (*Appendices 1, 4-6, and 14).* For the purposes of our research, we investigate re-vegetation efforts focused within a swath of private property historically used for cattle ranching by Napa landowner Dan McQueeny (*Appendices 1-3*).

There are extensive studies of the McQueeny property, Wooden Valley Creek, and larger Suisun Creek watershed that describe in-depth restoration motivators, baseline data, restoration process, and intended goals and outcomes (Circuit Rider Productions, 2007; Jackson, 2007; Purcell and Cover, 2007; Marcus and CSPA, 2004). We aim to fill a gap in the connection between the abundance of research, design, process, and outcome data (largely quantitative) and rancher/landowner implementation data (largely qualitative) (*Appendix 17*).

Restoration literature calls for participatory, collaborative processes, and for adaptive management (Beechie et. al, 2010; Downs et. al, 2002; Kondolf, 1998; Kondolf et. al, 1995; Palmer et. al, 2005; Wohl et. al, 2005), but we argue that this demonstration restoration project is an example of how restoration planning and post-project monitoring may not include specific indicators or means for evaluating how landowners/stakeholders facilitate or impact restoration success. We investigate not only the environmental outcomes (re-vegetation interim achievements), but also how this uniquely landowner-involved restoration process is impacted by landowner participation and decision-making, and largely undocumented adaptive maintenance activities carried out by the landowner independent of the organizations or agencies facilitation of the restoration project.

Background:

The Suisun Creek Watershed Enhancement Project was funded through the CALFED Watershed Program (under the CALFED Bay Delta Program) (Marcus and CSPA, 2004). Sponsor/facilitating organizations included two nonprofit environmental advocacy organizations working on California fisheries habitat rehabilitation: Fish Friendly Farming (FFF) and the California Sportfishing Protection Alliance (CSPA). With the cooperation of Napa County landowner and cattle rancher Dan McQueeny, FFF and CSPA implemented a demonstration restoration project to improve habitat and passage conditions for federally listed steelhead trout (*O. mykiss*) in a section of the lower Wooden Valley Creek (Marcus and CSPA, 2004).[1] Sponsors FFF and CSPA hired contractor Circuit Rider Productions Inc. to plant native vegetation along the stream corridor within the McQueeny property in the spring of 2010 (Circuit Rider Productions Inc., 2007; Marcus and CSPA, 2004; *Appendices 1-3*). Mr. McQueeny has been involved in the planning stages of the project since 2007 and signed a contract with sponsor organizations to participate in the project, receive partial funding, and independently maintain the project on his property for three years following the vegetative planting (McQueeny, November 20, 2010). FFF is responsible for ongoing formal monitoring activities, which include

[1] The McQueeny project is somewhat unique in that it is one of the few dedicated cattle ranching operations in vineyard-dominated Napa/Sonoma counties. Cattle ranching is more destructive to riparian vegetation than vineyard operations, and the McQueeny property was a creek segment with least riparian cover and canopy relative to neighboring properties along Wooden Valley Creek (Marcus and CSPA, 2004).

semi-regular site visits (approximately 3 times per year) by a FFF staff person during which the staff person takes photo-documentation at select photo-monitoring points along the stream corridor within the McQueeny property, and stream condition data at stream monitoring points along the larger lower Wooden Valley Creek (Circuit Rider Productions Inc., 2007; Marcus, October 18, 2010; McQueeny, November 20, 2010; *Appendix 2*).

The McQueeny restoration project site and Wooden Valley Creek (and larger Suisun Creek Watershed) benefit from a substantial body of research including a watershed enhancement plan (Marcus and CSPA, 2004), a channel investigation (topographic, cross-sections, bed material analysis, permeability analysis) (Jackson, 2007), a Biological and Habitat Condition Evaluation (benthic macroinvertebrate indicators) (Purcell et. al, 2007), a Riparian Habitat Enhancement Plan (native vegetation planting and non-native vegetation removal) (Circuit Rider Productions Inc., 2007), and stream temperature surveys (Marcus, November 24, 2010). *See* "Habitat Evaluations and Planning Documents" from 2007 in Table 1 below.

This information provides a comprehensive and detailed analysis of restoration motivation, planning, and processes, and we summarize this information where relevant throughout this study and in appendices. *Appendices 1-16* include maps and figures from this collection of studies. We do not duplicate information provided in these recent studies.

Table 1: McQueeny Property (Wooden Valley Creek, Suisun Creek Watershed) Restoration Timeline

Year	Restoration Activity
2004	Final Suisun Creek Watershed Assessment and Enhancement Plan. FFF and CSPA.
2007	Habitat Evaluations and Planning Documents: *Channel Investigations of Suisun Creek and Wooden Valley Creek Based on Data Gathered from 2001 through 2006*. Jackson, Dennis. Prepared for: Laurel Marcus & Associates; *Evaluation of Biological and Habitat Conditions in the Suisun Creek Watershed (Napa/Solano Co.)*. UC Berkeley; *McQueeny Property - South Suisun Creek Watershed Program, Riparian Habitat Enhancement Plan*. Circuit Rider Productions Inc.;
2009	Mr. McQueeny installs electric cattle fencing to create new limited and controlled cattle access to creek; Circuit Rider Productions, FFF, and CSPA install irrigation system (above-ground pipe and drip system supplied by private groundwater well).
2010	(Spring) Beginning of McQueeny contract; Circuit Rider Productions plants native vegetation along 16 riparian planting zones on the McQueeny Property; Mr. McQueeny begins herbicide eradication of non-natives along riparian zones.
2010-2013	(Ongoing) Mr. McQueeny monitoring/maintenance: maintaining timed (2x/week) irrigation system throughout 16 zones; re-planting plants that do not survive or are uprooted by wild pigs; training cattle in new fencing and plot rotation schedule; and spraying invasive plants with herbicide. FFF photo-monitoring 4x/year.
2013	End of McQueeny contract. Mr. McQueeny to potentially continue restoration activities on his own.

The lower Wooden Valley Creek (and Suisun Creek Watershed):

Suisun watershed is dominated by rural land use, largely composed of undisturbed land and private agricultural land used for livestock grazing, viniculture, orchards and row crops (Marcus and CSPA, 2004). Unlike a majority of urban creeks and watersheds located within the Bay Area, the rural nature of the Suisun watershed creates ideal conditions required for sustaining healthy aquatic and riparian habitats that may be utilized by steelhead trout (*O.mykiss)* (Marcus and CSPA, 2004).

Wooden Valley Creek flows approximately 7 miles from its origin, which is located 1.5 miles north of Wooden Valley, before its confluence with Suisun Creek (*Appendices 4-6*). Wooden Valley Creek drains a 14 square mile sub-basin, which varies characteristically from a set of steep, first order riffles, step pools and headwater creeks, to an unconfined alluvial channel in the lower Wooden Valley (Jackson, 2007; Marcus and CSPA, 2004). The lower alluvial channel then transitions to a low slope, bedrock gorge, and an unconfined channel (Jackson, 2007; Marcus and CSPA, 2004; *Appendices7-10*). Under natural conditions, the unconfined alluvial channel typically supports well-established riparian cover and salmonid spawning and rearing habitats (Marcus and CSPA, 2004). Current habitat characteristics, combined with year-round flow, support the hypothesis that the main Wooden Valley Creek channel can support critical spawning and rearing habitat for salmonids (Marcus and CSPA, 2004).

Over the past 50 years the riparian corridor of the lower Wooden Valley Creek has degraded, due to increased floodplain development for agricultural and residential use (Marcus and CSPA, 2004). Such actions have confined floodwaters into the Lower Wooden Valley, which has significantly reduced overbank flow and floodplain inundation capacity (Marcus and CSPA, 2004). The riparian corridor averages 172 feet of lateral cover in Wooden Valley (Marcus and CSPA, 2004). Currently, canopy cover is fragmented and narrow, or non-existent in the lower Wooden Valley Creek, which contributes to high summer water temperatures (Marcus and CSPA, 2004). Understory invaders, such as Himalayan blackberry, blue periwinkle and Harding grass are widespread along both Suisun and Wooden Valley creeks and their tributaries, and can out-compete native flora (Marcus and CSPA, 2004). In response, FFF and CSPA proposed native re-vegetation projects (combined with non-native eradication) to mitigate the degraded riparian cover, establish more stable banks to address erosion (Marcus and CSPA, 2004).

McQueeny Property: Native Re-vegetation and Non-Native Eradication:

The McQueeny restoration project addressed salmonid declines and habitat degradation, by prioritizing the restoration of denuded stream banks lacking native riparian vegetation and canopy cover, in an effort to mitigate high summertime stream temperatures and increase habitat complexity (Marcus, October 18, 2010; Marcus and CSPA, 2004).

Dan McQueeny owns 1.25 miles of the Lower-Wooden Valley Creek, and is a 5th generation cattle rancher on this property (Circuit Rider Productions Inc., 2007; McQueeny, November 2, 2010 and November 20, 2010). The Lower-Wooden Valley Creek is a seasonal creek, which has high flows in the winter and low or no flows in the summer months (McQueeny, November 2, 2010 and November 20, 2010). The seasonality of the creek makes the riverbed and banks more easily accessible by cattle and consequently more susceptible to cattle induced degradation (McQueeny, November 20, 2010). McQueeny lightly grazes the riparian areas of his property, and has used electric fencing to exclude grazing from specific portions of the creek for multiple purposes, including 1) facilitating re-growth of newly planted riparian vegetation, and 2) encouraging riparian growth along the banks closest to his home in order to prevent them from continuing to erode during high flow events (McQueeny, November 20, 2010). Cattle ranching has reduced natural riparian cover of the lower Wooden Valley Creek and increased the prevalence of non-native vegetation (Himalayan blackberry - *Rubus discolor*) (Marcus and CSPA, 2004). In-stream vegetation is noticeably denser within a reach outside McQueeny's home that has been entirely excluded from grazing over the past three years (*Appendix 19, Images 15-16*).

The loss of native riparian vegetative cover results in increased summertime stream temperatures (Marcus and CSPA, 2004), which according to studies conducted and contracted by FFF, can be mitigated by excluding cattle from the riparian corridor, re-establishing native plant communities in locations that reflected each species' relationship to the bankfull channel in a natural system, and eradicating invasive non-natives that prevent establishment of cover-providing natives (Jackson, 2007; Purcell and Cover, 2007; Marcus and CSPA, 2004). In the spring of 2010, native plants were re-planted along the stream banks of a one-mile segment of the Lower Wooden Valley Creek on the McQueeny property (*Appendices 1-3*), which included: Oregon Ash

(*Fraxinus latifolia*), coast live oak (*Quercus agrifolia),* valley oak *(Quercus lobata),* and California bay laurel *(Umbellularia californica)* (Circuit Rider Productions, Inc., 2007). The restoration contract also stipulated that McQueeny manually remove, as well as use approved chemical herbicides to eradicate non-natives from his property (Circuit Rider Productions, Inc., 2007). Intended results include a long term increase in riparian cover, which will mitigate increased summertime stream temperatures by providing shade and enhance spawning habitat and passage, by improving bank stability (Marcus and CSPA, 2004).

Questions:

We aim to investigate not only the environmental outcomes (re-vegetation interim achievements), but also how this uniquely landowner-involved restoration is impacted by landowner participation; to do this, we ask the following larger questions:

1) What is the current interim status of riparian vegetation, canopy cover, and related habitat quality improvements? How is information on progress collected, and how often? To what degree is there landowner involvement in information collection and post restoration monitoring?

2) What has the demonstration project landowner/cattle rancher contributed to the collection of vegetative, hydrologic, ecologic, or geomorphic information thus far, if any? What is the rancher's continued involvement/maintenance role? What resources does the landowner have at his disposal to properly execute restoration responsibilities?

3) In the relationship between the implementing groups/agencies, contractors, the landowner, and environmental restoration factors (planted and eradicated species, cattle fencing) what are the contributors to project success and/or challenges?

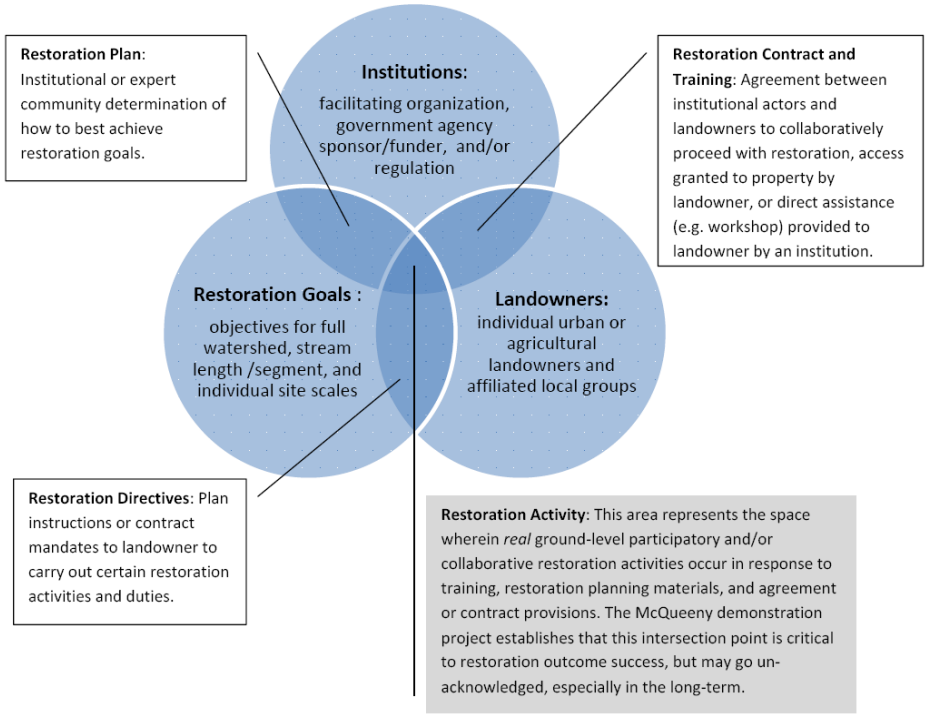

Figure 1: Concept map of the intersection between different agents in restoration activities.

We researched these questions through a combined evaluation of planning documents, interviews with Laurel Marcus of FFF and landowner Dan McQueeny, restoration site evaluation, and critical interpretation of summary evidence provided in *Appendices 17 and 18*. We synthesize and describe these finding in the *Results and Discussion* section below.

Methods and Approach:

Due to extensive existing baseline studies (Marcus, 2004; Jackson, 2006; Purcell and Matthews, 2007; Circuit Rider Productions, 2007), our original research focuses on 1) interim re-vegetation success, 2) landowner involvement in restoration processes and outcomes, and 3) the connections between interim success and landowner involvement. Our research evaluates interim re-vegetation success in a documentary format (*Appendix 18*), which supplements and frames a social/institutional discussion of interim restoration outcomes (*Appendix 17*).

We conducted:

1) A post-baseline survey of native re-vegetation success along a single 500-foot-long zone within the larger one-mile-long McQueeny property restoration along the Lower-Wooden Valley Creek (a planting "zone" delineated by Circuit Rider Productions in their plan: *Appendices 1 and 3*), and

2) A socially focused analysis of landowner involvement/participation through stakeholder (Laurel Marcus of FFF, and landowner Dan McQueeny) interviews to investigating landowner participation in the planning, design, maintenance and monitoring of the restoration project. Information from those interviews supplements project documentation, and is cited throughout this paper (e.g. Marcus, October 18, 2010; McQueeny, November 2, 2010; McQueeny, November 20, 2010).

This restoration project, due to high-level landowner involvement, presented an opportunity to evaluate social factors as they contribute to project successes and challenges.

We evaluate interim successes based on: a) re-vegetation survival thus far (*Appendix 18*), b) invasive, non-native eradication success (*Appendix 17*), and c) landowner involvement, input, and perspective on restoration progress and interim successes and challenges (*Appendix 17*). Our ability to conduct a more complete stream habitat evaluation was limited due to duration of restoration at the time of our study, and season during which this evaluation occurred.[2] We made our evaluation within the space of an individual stream corridor

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[2] Limitations to this study included:

1) This is a discreet three-year project, currently less than a third complete. Pre-planning began in 2007 (initial studies), and the landowner became actively involved in 2007-2008 (meetings and consultations), which resulted in the re-vegetative planting not taking place until early spring, 2010. Because this is an ongoing project, overall, long-term successes cannot be observed for this restoration at the time of this study.

2) Baseline evaluations, or measured factors of significance, for stream habitat pertain predominantly to summer conditions; the Wooden Valley Creek is a perennial stream that runs dry in the summer, and restored riparian vegetation and canopy cover serve to decrease stream temperatures during warm periods. Existing stream assessments at this site include original baseline studies and ongoing monitoring of: stream temperature, PH, dissolved oxygen, ammonia, nitrate, and phosphate; certain habitat quality indicators such as pebble count and embeddedness; and a bio-assessment of benthic macroinvertibrate indicators. We did not address these factors in our analysis, due to the recent nature of previous analysis, as well as seasonal limitations. Our study was conducted in the late fall, 2010 during which time the stream was dry and no data specific to stream conditions was collected.

"zone" within the one-mile restored stream segment on the McQueeny property; we chose to survey zone 14, a representative 500-foot planting, eradication, and cattle-excluded section (Circuit Rider Productions Inc., 2007). We selected this zone due to McQueeny's recommendation, and because this was a more denuded section of his property with the least canopy cover, which potentially stands to benefit most from restoration (Circuit Rider Productions Inc., 2007; McQueeny, November 20, 2010).

For this study, we evaluated existing planning documents and studies, conducted interviews with project-involved persons, and visited the site and collected original data about the progress and status of the restoration demonstration project. Sources included:

1. Suisun Creek Watershed (umbrella) enhancement plan (Marcus and CSPA, 2004), FFF-contracted a channel investigation including topographic, cross-section, bed material, and permeability analyses (Jackson, 2007), a FFF-contracted Biological and Habitat Condition Evaluation using benthic macroinvertebrate – BMI – indicators (Purcell and Cover, 2007), a Riparian Habitat Enhancement Plan outlining native vegetation planting and non-native vegetation removal (Circuit Rider Productions Inc., 2007), and stream temperature surveys (Marcus, November 24, 2010).
2. Email and telephone correspondence/interview with Laurel Marcus, executive director of FFF: main facilitator of the larger Suisun Creek watershed enhancement project and McQueeny demonstration re-vegetation project (Marcus, October 18, 2010 and November 24, 2010).
3. Telephone interview, one demonstration site visit and vegetation survey, and in-person interview with landowner and cattle rancher Dan McQueeny (McQueeny, November 2, 2010 and November 20, 2010).

Habitat and vegetation assessment:

1) We documented re-vegetation of native plants (a total of 22 plants planted in 20 planting "plots") in zone 14 along Lower Wooden Valley Creek by evaluating and recording (*Appendix 18*):
    a. Vegetation species (identified and catalogued)
    b. Status of sapling health (identified generally as alive or dead)
    c. Plant elevation (feet above sea level) and GPS location (degrees north and west) using a Garmin GPSMAP® 60.
    d. Overstory canopy density using a spherical densitometer
    e. Photographs of each plant from several angles and distances, including documentation of installed irrigation system, using a Cannon 60D digital camera.

2) Eradication (zone 14): we photo-documented presence of Himalayan blackberry within the restoration zone (*Appendix 19, Images 5-9, and 12*).[3]

Social and Institutional Assessment:

This assessment was made considering dominant social and institutional factors involved in the planning, execution, and ongoing maintenance of the demonstration project.

We approached our analysis with the perspective that:

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[3] We had originally intended to individually document the blackberry plants (as we did with the natives), but the blackberry was pervasive throughout the zone, with large multi-plant patches (although not within 15 feet of any planted seedling) (McQueeny, November 20, 2010). It was especially abundant on the bank opposite zone 14 bank (*Appendix 19, Images 8 and 9*), a segment represented by the area just south of and including zone 13 (zone 13 from Circuit Rider Productions Inc., 2007; *Appendix 1*).

1. Landowner cooperation in restoration projects is a complicating factor (positive and negative with regard to project success).[4]

2. Landowner cooperation is important because landowners are often best situated to provide ongoing maintenance and monitoring (Marcus and CSPA, 2004). However, it is prudent to note that landowner maintenance and monitoring might not be consistent with what an official, published plan references, or that facilitating organizations can account for in terms of funding and staff.

3. A landowner's restoration 'knowledge' may not be formal, scientific knowledge, but instead learned processes/habits; word-of-mouth information from neighbors or local information-disseminating groups (farm bureaus, government agencies, or environmental nonprofits); or family history (Wilson et. al, 2003). Alternate forms of knowledge on restoration activities may not be present in formal restoration records, but nevertheless these alternately learned processes/habits impact the restoration process and outcomes because they inform landowner maintenance actions (McQueeny, November 20, 2010; *Appendix 17*).

We evaluated the combined: individual landowner social role, facilitating organization institutional role, and real interim restoration outcomes (*Appendix 17*) by pairing together:

a) Assessment of planning document restoration objectives and goals

b) Interim material restoration success, e.g. plant survival (as observed in *Appendix 18*)

c) How the landowner role intersects with plan objectives and a real interim outcomes

d) How planning documents and/or the facilitating organization accounts for the connection between landowner involvement, and material outcomes.

Results and Discussion

Here, we discuss outcomes of the evaluation process described above, and present this information in full in *Appendices 17-19*. We will discuss key factors of evaluated restoration objectives and outcomes, using the information synthesized in *Appendices 17 and 18,* and the intersection of the primary planning documents and during- and post- project monitoring (Circuit Rider Productions Inc., 2007; Marcus and CSPA, 2004) with landowner participation (Marcus October 18, 2010; McQueeny, November 2, 2010 and November 20, 2010) through the discussion of the following major factors:

1) Native Re-vegetation and Non-Native Eradication Activities
2) "Participation" of Landowner: Planning Document vs. Evaluation
3) Monitoring and evaluation of 1) and 2) above, inasmuch as they intersect

<u>1) Native Re-vegetation and Non-Native Eradication Activities</u>

In the spring of 2010, native plants were re-planted along the stream bank of zone 14 of the McQueeny site (*Appendices 1 and 2*) which included: Oregon Ash (*Fraxinus latifolia*), coast live oak (*Quercus agrifolia),* valley oak *(Quercus lobata),* and California bay laurel *(Umbellularia californica)* (Circuit Rider Productions Inc., 2007).

[4] For example, a difficulty in landowner participation in restoration is exemplified by this statement from the *Final Suisun Creek Watershed Assessment and Enhancement Plan* "It would be too labor-intensive and difficult to acquire landowner access to monitor changes in the composition and form of the entire length of each of the two creeks frequently" (Marcus and CSPA, 2004. p. 7). Some landowners are simply unwilling to grant access to their property for evaluation or restoration activities. Alternately, the same plan mentions that, "Since the majority of land management decisions are made by local landowners then cooperation with the land manager is the most effective way to improve the conditions in the watershed and creeks" (Marcus and CSPA, 2004. p.129).

Natives:

Native plants play a critical role in bank stabilization, and provide shade along the stream corridor, helping to maintain natural and complex aquatic conditions that support salmonid populations (Marcus and CSPA, 2004). Non-native vegetation, such as Himalayan blackberry *(Rubus discolor)*, have colonized the degraded riparian landscape, due to the effects of intensive grazing practices, which led to the reduction of native flora and the proliferation of more hearty, non-native flora (Marcus and CSPA, 2004). This can be seen in the abundance of Himalayan blackberry throughout the McQueeny property (*Appendices 1 and 19, Images 5-9 and 12*). Non-natives out-compete native riparian plants because riparian ecosystems are adapted to periods of flooding and desiccation, but weedy invasives are adapted to thrive in such disturbed ecosystems (Marcus and CSPA, 2004). Himalayan blackberry does not maintain stable banks, provide shade or habitat for native wildlife as effectively as native vegetation, such as the native valley oak and Oregon ash (Marcus and CSPA, 2004). Additionally, native trees planted along the stream bank have deeper and more complex root systems that stabilize stream banks and provide shade to stream corridors (Marcus and CSPA, 2004). Lacking native stream bank vegetation was present along zone 14 of the McQueeny site, where there was no canopy cover for over 60% of the 500-foot stream bank segment, and less than 30% cover for approximately 90% of the segment (*Appendix 18*).

Of the twenty native plantings along the east bank of the stream corridor just north of McQueeny's home, represented by zone 14 (*Appendix 1*), seven were California bay laurel (4 alive, 3 dead, concentrated at the southern end of the zone where most existing canopy cover was present), five were valley oak (all alive), five coast live oak (all alive, two planted in the same plot segment and housed within the same protective hardware as two Oregon ash plants[5]), four Oregon ash (all alive, two planted dually with coast live oak plants – *see footnote 4*), and 1 unknown (alive) plant species (*Appendix 18*). All plants had intact and functioning weed mats, protective insect shields in the form of metal mesh pockets (about half of which were open or torn, either by plant growth or through external disturbance), targeted drip irrigation, and were established in an approximate clearing of a 3 foot radius or more wherein there was generally no other significant plant cover (*Appendix 18*). Most saplings measured between 9" and 12" in height (within the metal mesh pocket measuring between 9"-15" in height, see *Appendix 19, Image 10*), but several were already outgrowing the mesh pockets and had pushed through openings on the tops or sides of the pocket casing (*Appendix 18*). While cattle appeared to be successfully excluded from zone 14 by the installed electric fencing (described below, and see *Appendices 17 and 19, Images 11, 12, and 15-17*), McQueeny mentioned that wild pigs, which are abundant in the area, would regularly enter the property and uproot the native plants (*Appendices 19, Images 1 and 2*), and that there was little he could do to control this type of disturbance (McQueeny, November 20, 2010).

The re-planted California bay laurels that had died (*Appendix 18*) were not uprooted nor did there to appear to be a cause of failure due to cattle infringement or protective hardware failure; McQueeny did not know the reason for their failure, but noted that some of the plants had not survived, particularly California buckeye (not present on zone 14, but present along other zones), and that he would shortly be purchasing replacement natives (McQueeny, November 20, 2010). McQueeny did not specify whether he would be replacing the natives with the same species initially planted by the contractor (McQueeny, November 20, 2010).

McQueeny is also responsible for the maintenance and monitoring of the drip irrigation system, and planting shelter structures (Circuit Rider Productions, 3; Marcus, October 18, 2010; McQueeny, November 20, 2010). Irrigation infrastructure costs were covered by restoration funds (from the CALFED Watershed

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[5] The twenty overall plantings represent twenty planting *plots*, which include plants, protective hardware, and dedicated drip-irrigation supply; two of the plots contained dual plantings of Oregon ash and coast live oak within the same protective hardware and irrigation supply unit. Therefore, individual plants in fact total twenty-two. We do not know the reason for the dual planting in these two plots.

Program/Bay Delta Program), except for some minimal, and according to McQueeny – insignificant - additional hardware costs that he covered himself (Marcus and CSPA, 2004; McQueeny, November 2, 2010 and November 20, 2010). According to McQueeny irrigation maintenance is also minimal, as irrigation is automated and timed 2x/week (McQueeny, November 2, 2010 and November 20, 2010). Nevertheless, McQueeny stated that due to the fact that irrigation is a single plastic pipe extending the entire length of the one-mile restoration through all 16 restoration zones[6], a breech or break in any part of the irrigation system would compromise all zones, and therefore he should remain diligent in monitoring (McQueeny, November 20, 2010). Due to time-constraints of his regular range management duties, and the large time-investment that would be required to regularly inspect the entire pipeline and all drip points regularly, there stands a potential avenue for full zone or multi-zone sapling failure come dry summer months due to possible irrigation pipe blockages or breaks that might not be evident until sapling failure serves as an irrigation problem indicator. Nevertheless, at the time of our inspection, both irrigation and protective hardware were in place and functioning for all saplings in zone 14 (*Appendix 18*).

Cattle exclusion through fencing:

The planted natives were spaced evenly along a 500-foot north-south running stretch of the lower Wooden Valley Creek, which was historically open to cattle ranging (Circuit Rider Productions Inc., 2007; Marcus, October 18, 2010; McQueeny, November 20, 2010). Cattle are now excluded from the area through the use of electric fencing installed and maintained by McQueeny, at his own cost (McQueeny, November 2, 2010 and November 20, 2010). The cattle fencing represented not only an infrastructure input, but also a time and labor input on the part of McQueeny in terms of range management strategies (*Appendix 17*). New fencing required not only installation (costs in terms of money and time[7]), but McQueeny also devised a new rotational schedule for his cattle, to accompany the new fencing scheme, throughout his property to provide for restoration activities (McQueeny, November 20, 2010). The new cattle rotation scheme required that McQueeny re-train cattle (which is especially difficult with young cattle who may be able to bypass the electric fencing until they reach a certain size) to respond properly to fence; and must continually repair and re-align the fence according to natural environmental disturbances (weather/animal) (McQueeny, November 20, 2010; *Appendix 19, Image 11*). Despite the high maintenance and monitoring requirements that this fencing process requires of McQueeny, the established fencing appears to adequately coral his cattle off of protected stream bank and bed areas, and plant survival supports the conclusion that his fencing installation and new rotation scheme serve the interests of native planting success (at least along the evaluated zone 14) (McQueeny, November 20, 2010; *Appendix 18*). McQueeny feels confident that reduced grazing use of the riparian corridor is sufficient to maintain a healthy habitat for the saplings' ongoing survival (McQueeny, November 20, 2010). Based on the current survivorship of the saplings observed in zone 14, our data (*Appendix 18*) suggests that his speculation is accurate.

Non-Natives:

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[6] The original irrigation plan, designed with McQueeny's input and suggestions, included three water storage tanks spaced throughout the property, which were to be supplied by piped well water. Stored water from the tanks would then supply nearby restoration zones along the stream banks through a network of PVC pipes. Ultimately, there was not enough pressure in the plastic piping stemming from the tanks to adequately provide regular drip irrigation to the plants, and therefore Circuit Rider Productions (contractor) installed a single plastic pipeline fed by well water and running the entire length of the one-mile restoration site. The tanks are currently empty, but McQueeny intends to independently set up a system wherein they will be filled with well water to serve as a reservoir for supplying drinking water troughs to his cattle, partially as means of keeping cattle away from the stream banks. (McQueeny, November 20, 2010).

[7] McQueeny did not see the costs as prohibitive, although electric fencing is $.05 more per foot than traditional fencing (approximately $0.17/foot for electric vs. $0.12/foot for traditional fencing), and requires more maintenance and upkeep (McQueeny, November 20, 2010).

Along zone 14 and throughout the larger one-mile McQueeny site segment of the lower Wooden Valley creek, Himalayan blackberry was pervasive despite active eradication activities by McQueeny according to contract stipulations (Circuit Rider Productions Inc., 2007; *Appendices 1, 3, and 19, Images 5-9, and 12*). The restoration contract stipulated that McQueeny use approved chemical herbicides to remove non-natives from his property, and McQueeny has utilized Monsanto's Aquamaster herbicide to eradicate the Himalayan blackberry on his property (Circuit Rider Productions Inc., 2007; *Appendix 3*). Aquamaster is an herbicide that has proven to be fairly effective at killing non-native weeds (Circuit Rider Productions Inc., 2007; Monsanto, 2010). Physical removal was also recommended[8], but was not being executed by McQueeny at the time of this study (Circuit Rider Productions Inc., 2007; McQueeny, November 20, 2010). Between Spring and Fall, 2010, McQueeny had applied 4 rounds of herbicide spraying to blackberry plants within multiple restoration zones on his property, which thus far partially eradicated specific plants where applied, but had not contributed to a substantial overall removal according to McQueeny (McQueeny, November 20, 2010) and as made evident by inspection of zone 14 and adjoining property segments where blackberry was abundant (*Appendix 19, Images 5-9 and 12*). McQueeny had not yet attempted manual removal techniques due primarily to time constraints (manual removal by an individual is time-intensive); he was also attempting to evaluate the success of herbicide removal alone (McQueeny, November 20, 2010). While herbicides have thus far removed some of the Himalayan blackberry, McQueeny found that there was an abundant new outcropping following his initial herbicide applications, which occurred mostly in the dry stream bed and non-planted banks; blackberries were not encroaching on native plant seedlings at the time of our evaluation (McQueeny, November 20, 2010; *Appendix 19, Images 5-9 and 12).* McQueeny speculated that new abundant blackberry outcroppings following commencement of restoration activities could be caused by 1) lack of cattle-trampling of blackberry plants due to new fenced-off stream corridor from which cattle were excluded, 2) robust root structures, and 3) seeds carried from upstream during flow events and deposited on his property, which were then able to germinate and thrive in the absence of both cattle trampling and intra-specific competition (McQueeny, November 20, 2010; *Appendix 17*).

2) "Participation" of Landowner: Planning Document vs. Evaluation

Private property access issues and limited funds for large-scale watershed restoration may in some cases, such as throughout the Suisun Creek watershed restoration, necessitate voluntary landowner participation (Marcus and CSPA, 2004). The Suisun Creek watershed, with its decentralized 'demonstration project' components,, provides an example of a restoration effort within which sponsor organizations (and government funding institutions) must release and distribute restoration management and monitoring duties to individual landowners. The specific evidence of this is provided in our description of the re-vegetation activities evaluated in the previous section, and in more detail in *Appendix 17*. In planning documents, the participatory and collaborative restoration process, involving high-levels of landowner guidance and even leadership on restoration activities, is described more generally in the guiding planning document – the *Final Suisun Creek Watershed Assessment and Enhancement Plan* (Marcus and CSPA, 2004), and most specifically in the planting contractors' *Riparian Habitat Enhancement Plan* (Circuit Rider Productions, 2007).

Planning documents make specific reference to participation (that we argue below are not addressed in actual during- and post-project monitoring) that serve as broad guidelines for the leadership granted to the individual landowners, such as McQueeny, involved in demonstration restoration components of the larger Suisun Creek watershed restoration:

[8] According to "The Weedworkers' Handbook" (The Watershed Project, and California Invasive Plant Council, 2004), http://ucce.ucdavis.edu/files/filelibrary/5319/18601.pdf. (Circuit Rider Productions Inc., 2007).

Table 2: Examples of explicit references concerning the critical nature of landowner participation and collaboration in Suisun Creek watershed restoration from the *Final Suisun Creek Watershed Assessment and Enhancement Plan* (Marcus and CSPA, 2004).

"This process is termed adaptive management and requires both an array of scientific monitoring at long-term stations and community and landowner involvement to implement the program. The approach to implementation of improvements must be through cooperative relationships with landowners in the watershed. Since the majority of land management decisions are made by local landowners then cooperation with the land manager is the most effective way to improve the conditions in the watershed and creeks." (p.viii)
"The landowners of these areas need to support re-vegetation and the projects would need to be designed to take into account the landowner's needs as well as the practical aspects of native plant re-vegetation." (p.viii, 129)
"Many landowners are interested in having demonstration projects completed on their riparian corridor to remove invasive plants and replant with natives. In some locations, these projects would increase native riparian tree cover and thus reduce water temperatures. Several sites were selected encompassing up to 12 acres on both Suisun and Wooden Valley Creeks for demonstration projects. As part of the demonstration projects, workshops for local landowners should be held to explain eradication methods and re-vegetation projects." (p. ix)
Since the majority of land management decisions are made by local landowners then cooperation with the land manager is the most effective way to improve the conditions in the watershed and creeks. (p.129)
Once several eradication concepts have been developed, the landowners on the [Suisun] creek need to be involved and have input. It will be critical to work closely with landowners to eradicate this plant [giant reed (*Arundo donax)]* and continue follow-up activities. (p.131)
Eradication of these species requires long-term maintenance and follow-through by the owner. All treatments would be completed with workshops of local landowners to demonstrate the appropriate use of herbicide and how to avoid overspray and loss of native plants…the agricultural community has a vested interest in learning about control and removal of the invasive plants and how to re-vegetate, care for native plants, as well as how to obtain permits and financial and technical assistance. (p.133)
The demonstration projects will build the knowledge base in the local community to address this problem effectively and develop additional projects for the watershed program with other landowners. (p.133)

Of the five "tasks" within the "scope" of the above plan, one is explicitly dedicated to "Community and Landowner Involvement," and an additional two tasks necessitate a high level of interaction and reliance on landowners according to the descriptions of activities involved (Marcus and CSPA, 2004. p.5). These include Task 1 "Gather existing sources of Information" and Task 5 "Evaluate Monitoring and Survey Information, Identify Enhancement Need and Prepare Enhancement Plan" (Marcus and CSPA, 2004. p.5). Two of the five larger restoration "goals" also reference landowner participation. Those goals include: "Provide a process to directly involve landowners, elected officials, environmental groups, government agencies, and local community interests in the enhancement of the Suisun Creek watershed," and "Respect private property rights by requesting access in writing for studies and by working with willing landowners on project implementation" (Marcus, 2004. p.6).

More specifically, the McQueeny demonstration site re-vegetation plan, designed by contractor Circuit Rider Productions, provides the following more specific landowner-involved activities:

Table 3: Re-vegetation duties reliant on landowner participation made in the *Riparian Habitat Enhancement Plan* (Circuit Rider Productions, Inc., 2007. p.3). Also, see *Appendix 3*.

"A temporary fence shall be installed by the property owner to exclude livestock from the revegetation planting zones..."
"The property owner will be responsible for maintaining the plants."
"Weeds shall be removed [by the landowner] around each plant for a period of three years - twice in the spring and once in the fall."
"Himalayan blackberry, an invasive plant, should be removed [by the landowner] from the riparian zone." [This statement is followed by guidelines to the landowner for "physical as well as chemical control methods."]

These examples are indicative of the large degree to which the facilitating organizations and the contractor explicitly understand, respect, and rely upon a high-level of landowner participation to successfully carry out restoration activities.

We found through interviews with Laurel Marcus of FFF and landowner Dan McQueeny that the participatory elements of the restoration, insomuch as it can be shown by the McQueeny demonstration project, largely follow the objectives and goals stated in the planning documents. Workshops meant to inform and educate landowners on restoration activities, benefits, and responsibilities were provided to landowners within the watershed region as described in the *Final Suisun Creek Watershed Assessment and Enhancement Plan* (Marcus and CSPA, 2004) according to Marcus and McQueeny (Marcus, October 18, 2010; McQueeny, November 2, 2010 and November 20, 2010). McQueeny is currently carrying out the responsibilities outlined by contractor Circuit Rider Productions in the *Riparian Habitat Enhancement Plan* (Circuit Rider Productions, 2007; *Appendix 17*).

<u>3) Monitoring and evaluation of the restoration impacts present in the intersection of 1) re-vegetation and 2) landowner participation</u>

While adequate attention is paid to the measures and outcomes of the larger overall restoration (re-vegetation success as described above in *Results and Discussion* section 1, the design of the during and post-project monitoring program (Circuit Rider Productions, 2007; Jackson, 2007; Marcus and CSPA, 2004; *Appendix 2* – photo-monitoring plan) associated with this restoration may not adequately acknowledge the decentralized, informal nature of how restoration projects are carried out on the ground. In the case of the McQueeny project, our evaluation determines that re-vegetation restoration activities appear to be defined by a predominantly unobserved and undocumented set of maintenance and upkeep activities independently determined by McQueeny (*Appendix 17*).

This is not to say that restoration has not thus far been successful – our evaluation shows the opposite, that restoration is in fact proceeding well, and that planted seedlings are successful overall despite some problems with eradication (*Appendices 18 and 19*). Yet, we argue that the evaluation and monitoring activities described in planning documents may not be capturing important contributors and factors that largely influence re-vegetation success, and non-native eradication challenges. Knowledge of these contributors would likely support restoration learning processes that are otherwise highly valued by the restoration community (*such as described in* Beechie et. al, 2010; Downs et. al, 2002; Kondolf, 1998; Kondolf et. al, 1995; Palmer et. al, 2005; Wohl et. al, 2005), and in adaptive management needs mentioned in the *Suisun Creek Watershed Assessment and Enhancement Plan* (Marcs and CSPA, 2004) - see Table 2 above.

The critical role of landowners in the restoration of Wooden Valley Creek and the larger Suisun Creek watershed is stated explicitly and also implied throughout restoration planning materials, and yet there appears to be no measures for analyzing the role or impact of landowner participation in this project, other than through an assumption that contract duties are carried out as written by the landowner. We do not find this assumption to hold based on our interview with Dan McQueeny and simultaneous survey of his land, due to the natural changing demands of the restoration process that require adaptive forms of landowner participation and decision-making in fulfilling contract requirements (*Appendix 17*). For all activities, re-vegetation photo-documentation and McQueeny site visits by FFF staff (to specific monitoring locations) approximately four times per year, are the monitoring activities currently taking place (McQueeny, November 20, 2010; *Appendix 2*). McQueeny states that he has had little contact with FFF staff since installation of the project, and is left to independently carry out his contracted duties. Again, this is not to say this is not a sufficient process, and is likely a best and most cost-effective process. We argue that this process may not in fact document the true nature of the restoration process, and existing monitoring activities might ultimately neglect or construe true contributors to success or failure in landowner-involved restorations. Some examples that reference above-stated re-vegetation outcomes and participatory elements that are outlined in planning documents, but for which there appear to be no adequate mechanisms for during- or post-project monitoring include[9]:

1) Native plantings and hardware installation: Maintenance to plants, including hardware upkeep or replacement, is McQueeny's responsibility. Photo-documentation may not capture explanations for certain disturbed or changed hardware installations (such as through uprooting by wild pigs). Some of the observed plants were overgrowing their hardware, and adjustments to that hardware would need to be made by McQueeny - who may not have the time or resources to attend to all plants within the restoration.

2) Irrigation installation: Because the installed irrigation infrastructure does not use the storage tanks that were originally installed on his property (*see footnote 5*), McQueeny plans to re-use these to create drinking troughs for the cattle on his property as alternatives to their needing to access the stream corridor in search of water. This process will go undocumented because record of McQueeny's role in irrigation/water supply management only goes so far as to document whether or not seedlings are receiving adequate water, not the larger picture of range management and how that coincides with irrigation of the restoration plants.

3) Cattle Fencing: The fencing is a critical component of the restoration success, as keeping cattle from the new native vegetation is key to restoring riparian cover. This is one of McQueeny's most important management roles, and the most labor intensive for him, as it involves devising an entirely new range management system, and re-training his cattle herd. There is no monitoring or accounting for the success and efforts of his work other than through impacts it will have on plant survival - as plant survival is the only formally documented outcome measure. Negative outcomes might potentially be linked to fencing failure, and success certainly depends on it, but the exact cause and nature of those outcomes would likely not be recorded as such, other than being attributed generally to the presence of cattle fencing – not the specific practice of fence installation or range management involved.

4) Non-native Eradication: This is another important responsibility critical to success of the project, for which there appears to be little active communication between FFF and McQueeny. It appears McQueeny is simply expected to eradicate non-native vegetation using recommended methods, to be evaluated semi-annually through photo-documentation. Eradication appears to be successful to the effect

[9] See *Appendix 17* for a complete description of landowner roles in executing the restoration/contract activities, and noted undocumented landowner roles in defining success of restoration outcomes.

of keeping Himalayan blackberry away from new native seedlings, but the Himalayan blackberry are otherwise persistent throughout the stream corridor. McQueeny has several explanations about why this is occurring (root structures, re-seeding from upstream, and even suggests they might be growing more abundant due to lack of cattle trampling). These inputs are not recorded or considered in management or monitoring as far as can be observed. McQueeny has plans for how he might alternately address the eradication problem following the close of his contract, at which point he plans to rotate his goats around riparian parcels to trim the vegetation (the goats will eat and/or likely trample blackberry, and will not harm the planted natives as they will have reached a necessary level of maturity at that point so as to not be damaged). This longer-term management will likely go unrecognized, although it stands to potentially influence the long-term, post-contract success of the project.

We find that these are significant in that they represent adaptations to restoration strategies (especially McQueeny's future plans for installation of drinking water troughs and plan to use goats to ultimately control blackberry growth) that if documented, might suggest alternative practices in other sites that could further lend to restoration successes, but where undocumented will not be accounted for, especially in terms of post-contract (post-2013) long-term successes.

Conclusions

In this analysis, we asked what interim "success" of the McQueeny restoration demonstration project constitutes in terms of 1) interim re-vegetation, 2) landowner participation, and 3) the effectiveness of the (stated) during- and post- project monitoring process in evaluating the connection between (1) re-vegetation success (2) and landowner involvement. Evaluation of re-vegetation success combined with interviews with Dan McQueeny and Laurel Marcus of FFF demonstrates that (1) and (2) are inextricably linked, and we find that landowner participation in the restoration processes is under-evaluated relative to the attention granted to other measures of restoration outcomes such as quantitative geomorphic or ecological components (Jackson, 2007; Purcell and Cover, 2007) and qualitative habitat assessments (Marcus and CSPA, 2004). The material impacts of 'social' factors on interim restoration outcomes (*not* success in terms of potential social engagement 'values' – but *measurable success of the physical restoration*), due to evidence from this study (*Appendices 17-19*), suggest that there might be benefits to be had in more explicitly analyzing landowner/stakeholder roles while defining best practices in monitoring, evaluation, and adaptive management of small stream restoration projects. Current efforts in stream restoration emphasize the importance of post-project monitoring for restoration community learning processes (Beechie et. al, 2010; Downs et. al, 2002; Kondolf, 1998; Kondolf et. al, 1995; Palmer et. al, 2005; Wohl et. al, 2005). In small projects where landowners are implicitly or explicitly tasked with long-term maintenance and monitoring, more consideration of the role played by landowners may provide valuable inputs to restoration knowledge and especially long-term sustainability of projects.

Larger Considerations

With regard to the Suisun Creek watershed and lower Wood Valley Creek restoration components, it is important to consider the unique characteristics of the land managers[10] within the watershed, if one hopes to

[10] We must note that the McQueeny site is a unique case study: McQueeny is not only one of a few cattle ranchers within the Napa and Sonoma Counties region chiefly dedicated to viniculture, but he and his wife are long-standing active community members (McQueeny is active in his local Farm Bureau) and willing to engage environmental causes (McQueeny, November 20, 2010). McQueeny explained that a majority of land managers in the region have established methods and habits of land management, and are not easily swayed to modify their tendencies, which is a documented and common characteristic among American farmers (McQueeny, November 20, 2010; Wilson et al. 2003). Unlike most other ranchers in the Suisun Creek watershed, McQueeny felt that it was his duty to modify his management practices with that hopes that through a decrease in grazing intensity and the implementation of restoration efforts, his land may

effectively work with the local community and stakeholders to mitigate environmental degradation, promote best management practices that support habitat restoration efforts, and to promote environmentally conscious stewardship practices within the local community, by showing that they are financially sustainable[11] and beneficial to the integrity and productivity of the common landscape. Suisun Creek watershed planners clearly understand this as evidenced by language in the available planning documents (See Tables 2 and 3 above), but evaluation criteria does not adequately document its acknowledged importance.

Farmers have highly ritualized land use practices, and therefore conscious deviations from historical norms and practices are not prevalent within American farming culture and may represent a critical hurdle for future restoration endeavors (Wilson et. al, 2003). Due to divergent community land-use values (e.g. a rural Napa County vs. a more urban neighboring Marin County), it is prudent to understand the coupled social-environmental dynamics of a specific community or region when considering restoration activities and the nature of landowner involvement. This is clearly being done in a broad sense within this (Suisun Creek Watershed restoration as described in Marcus and CSPA, 2004) and other restoration sites. Incorporating information about landowner decision-making practices into restoration evaluations might not be an unreasonable goal, as social factors certainly stand to materially influence watershed-scale restoration success in any location where private landowners determine access to land and waterways.

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be restored to a more healthy and productive state (McQueeny, November 20, 2010). In addition, McQueeny believes that by proactively participating in stream restoration endeavors, he will be better prepared for the possibility of increased land use regulations (such as through Endangered Species Act – mandated activities) that address the decline and sensitivity of salmonids and their critical habitats (McQueeny, November 20, 2010).

[11] For many ranchers and farmers, money is often an issue. For them, making it through the year is not an academic or best management exercise but a real life battle (Wilson et al. 2003). McQueeny's wife not only works off-farm to support their family, but McQueeny's son does as well (McQueeny, November 20, 2010). McQueeny noted that he spent some of his own money maintaining the project, which has put some pressure on him financially, but his motivation to mitigate the damage to his land remains a priority – and ultimately the restoration, especially with respect to bank stabilization near his home and potentially avoiding future regulatory mandates that might come with no financial support, stand to materially benefit him and his family in the long-term (McQueeny, November 20, 2010).

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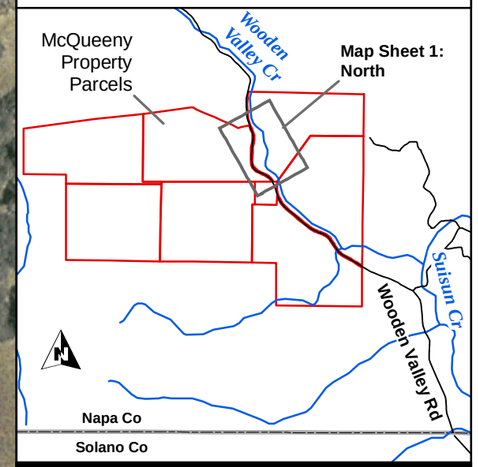
APPENDICES

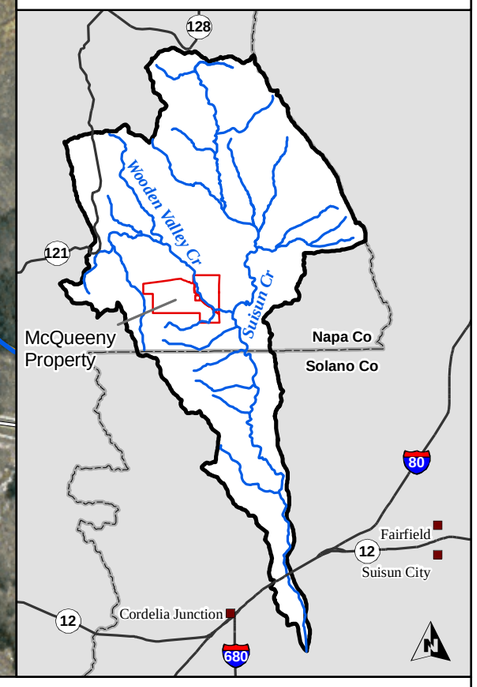
Appendix 1

Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Wooden Valley Cr
Wooden Valley Rd

STREET DETAIL LOCATION MAP



SUISUN CREEK BASIN LOCATION MAP



N

0 100 200
Feet

- Himalayan blackberry
- Planting Locations
- Parcel Boundaries

DATA SOURCES: Laurel Marcus & Associates, County of Napa GIS, California Spatial Information Library, DigitalGlobe

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DRAWN:	Elizabeth Lotz			
SCALE:	see above			
DATE:	06/06/07			
FILE:	McQueeny_North_Map_sh1			

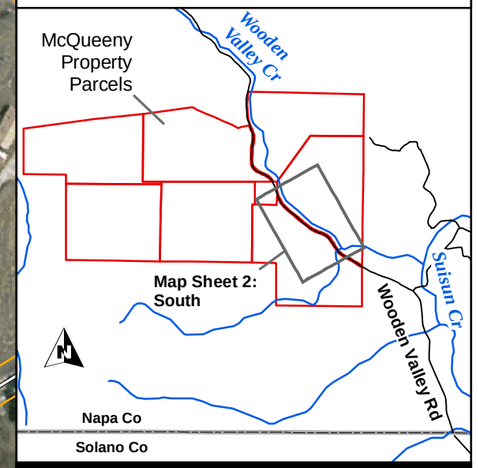
CALFED Watershed Program
Implementation Project
Sponsors: Laurel Marcus & Associates,
California Sportfishing Protection Alliance

McQueeny Property - North
Suisun Creek Watershed Program
Riparian Habitat Enhancement Plan
Wooden Valley Creek, Napa County, California

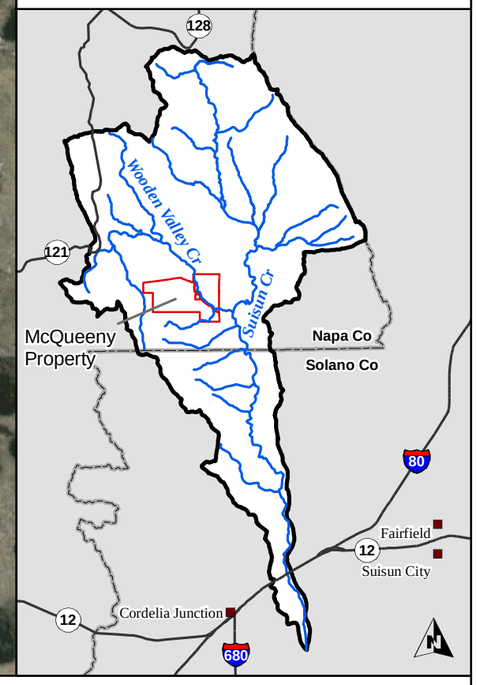
SHEET NO. 1 OF 4 SHEETS

Zone 16
Zone 15
Zone 14
Zone 13
Zone 12
Zone 11
Zone 10
Zone 9
Zone 8
Wooden Valley Cr
Wooden Valley Rd

STREET DETAIL LOCATION MAP



SUISUN CREEK BASIN LOCATION MAP



0 100 200
Feet

- Himalayan blackberry
- Planting Locations
- Parcel Boundaries

DATA SOURCES: Laurel Marcus & Associates, County of Napa GIS, California Spatial Information Library, DigitalGlobe

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		REVISIONS	DATE	BY
DESIGN:	Rob Evans			
DRAWN:	Elizabeth Lotz			
SCALE:	see above			
DATE:	06/06/07			
FILE:	McQueeny_South_Map_sh2			

CALFED Watershed Program Implementation Project

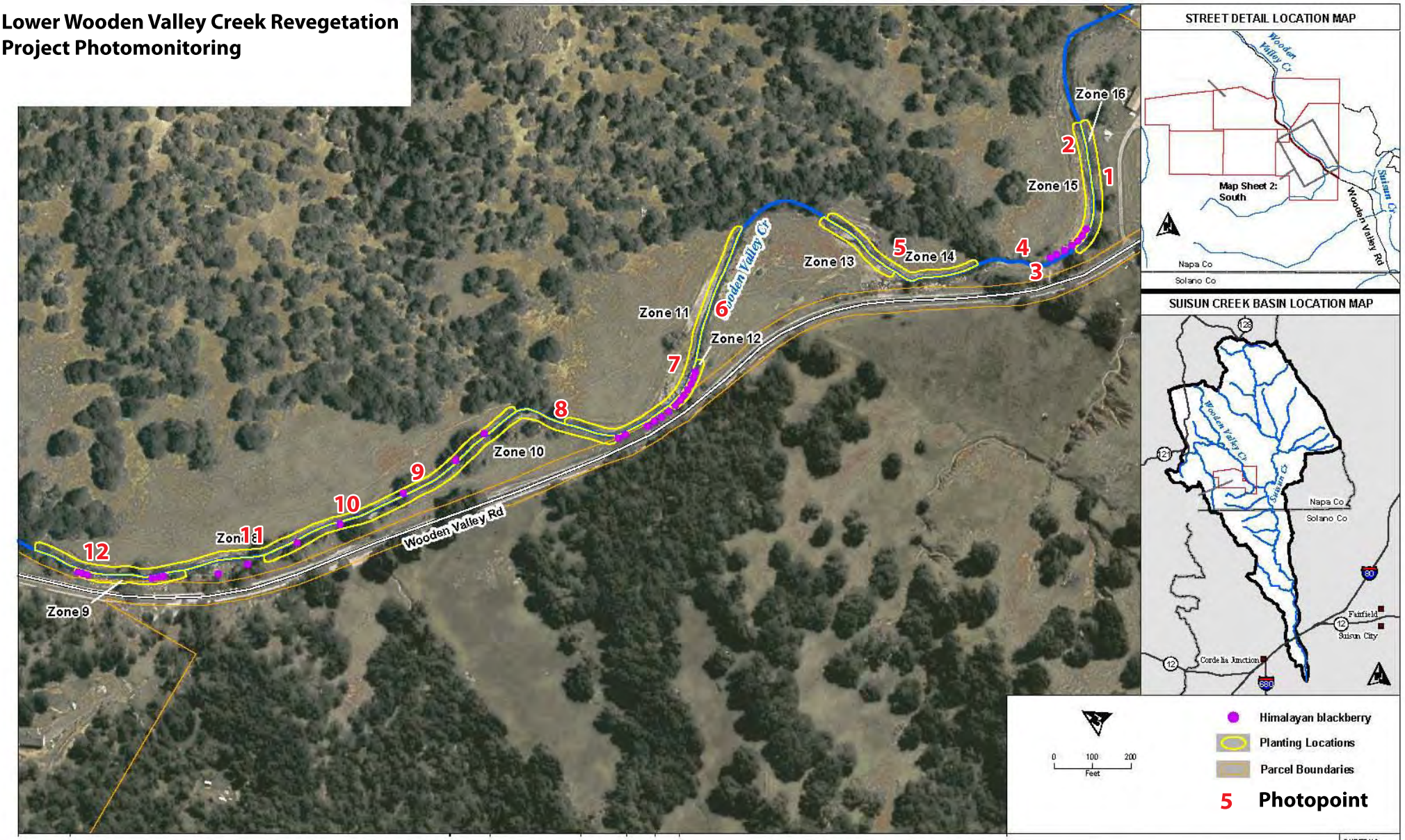
Sponsors: Laurel Marcus & Associates, California Sportfishing Protection Alliance

McQueeny Property - South
Suisun Creek Watershed Program
Riparian Habitat Enhancement Plan
Wooden Valley Creek, Napa County, California

SHEET NO. 2 OF 4 SHEETS

Appendix 2

Lower Wooden Valley Creek Revegetation Project Photomonitoring



Suisun Creek Watershed Program
Riparian Habitat Enhancement Plan
Wooden Valley Creek, Napa County, California

SHEET NO. 2 OF 4 SHEETS

PLANTING NOTES:

1. The Riparian Habitat Enhancement Plan is designed to enhance the riparian zone on the property given current hydrologic conditions and land use. Selected plants are intended to create a riparian corridor of ecologically appropriate native plants along the upper bank and floodplain to provide canopy cover and wildlife habitat. It should be noted that the proposed work may not prevent bank erosion or failure, and CRP shall not be held liable in the event that erosion occurs in the future.
2. Planting shall be installed in the winter months, once rainfall has moistened the soil to a depth of 10 inches or greater. Planting shall be completed by March.
3. Planting technique shall be predominantly liner-sized seedlings (see Planting Details) propagated from seeds and cuttings collected within the Napa River watershed, as close as possible to the revegetation site. Plants will be installed with protective hardware and weed mats that are appropriate to the site conditions.
4. Circuit Rider Productions, Inc., or sub-contractors supervised by qualified restoration ecologists, will install the planting.
5. No individual plant locations are shown. The final design will be developed in the field by a professional qualified in ecological restoration. Each planting spot shall be marked in the field with a color coded (to species) surveyor flag. Flags shall remain at each planting spot after plant installation.
6. A temporary fence shall be installed by the property owner to exclude livestock from the revegetation planting zones, which are from center of channel to approximately 15 feet out from the top of bank. The fence should remain in place until installed plants become established.
7. The property owner will be responsible for maintaining the plants. To ensure survival, plants will require frequent irrigation during the first dry season after planting. Irrigation should begin in April and continue into October. Approximately one to two gallons of water shall be applied directly to the plant during each irrigation visit. Watering interval shall be 7 to 10 days depending on weather conditions.
8. Weeds shall be removed around each plant for a period of three years - twice in the spring and once in the fall.
9. Himalayan blackberry, an invasive plant, should be removed from the riparian zone. Physical, as well as chemical control methods are outlined in "*The Weedworkers' Handbook"* (The Watershed Project, and California Invasive Plant Council, 2004), which can be found online at: http://ucce.ucdavis.edu/files/filelibrary/5319/18601.pdf.

   Care shall be taken to avoid damage to native plants during the removal process. There are several non-toxic methods such as tarps and/or hand removal techniques that may be used. If the placement of tarps is used to control invasive plants in the riparian zone, they should be installed in the spring and removed in mid to late October, prior to high flows. Tarps generally need to be left in place for at least five months for the method to be effective.

   If herbicide is used, a method that prevents drift onto native vegetation and/or surface water shall be utilized. Consultation with the Napa County Agricultural Commissioner's office is advised, and depending on the herbicide used, may be required by law. Follow-up treatment for all methods of invasive plant eradication may be necessary in subsequent years.

REVEGETATION PLANT LIST - McQUEENY PROPERTY																				
Scientific Name	**Common Name**	**Number of Plant Locations by Zone**																**Container Size**	**Spacing (F.O.C.)**
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**TOTAL**		
SHRUBS																				
Sambucus mexicana	blue elderberry	0	0	0	3	0	0	8	0	0	8	0	0	0	0	0	0	**19**	dee pot	5-10'
TREES																				
Acer macrophyllum	big-leaf maple	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	**4**	supercell	8-12'
Aesculus californica	California buckeye	0	0	0	0	0	0	7	0	0	10	5	0	0	0	0	0	**22**	tree pot	8-12'
Alnus rhombifolia	white alder	3	5	0	0	0	0	0	20	0	0	5	0	0	0	0	0	**33**	supercell	8-12'
Fraxinus latifolia	Oregon ash	0	0	0	0	0	0	0	5	0	0	0	0	0	5	15	0	**25**	supercell	8-12'
Quercus agrifolia	coast live oak	17	3	5	2	10	10	4	25	0	13	15	0	3	5	5	10	**127**	D-16	8-12'
Quercus douglasii	blue oak	8	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	**13**	D-16	8-12'
Quercus lobata	valley oak	8	3	4	3	10	10	3	35	0	5	25	0	4	5	10	7	**132**	D-16	8-12'
Umbellularia californica	California bay-laurel	8	0	2	2	6	5	10	10	0	15	10	0	0	5	5	5	**83**	supercell	8-12'
DORMANT CUTTINGS																				
Salix sp.	willow	20	5	0	5	0	25	20	90	40*	0	0	20*	0	0	0	50	**275**	cutting	4-10'
TOTAL:		**64**	**16**	**11**	**15**	**26**	**55**	**52**	**189**	**40**	**51**	**60**	**20**	**7**	**20**	**35**	**72**	**733**		

* = pole cutting

CIRCUIT RIDER PRODUCTIONS, INC.
ECOLOGICAL RESTORATION SERVICES ■ HUMAN SERVICE PROGRAMS
9619 Old Redwood Highway
Windsor, CA 95492
voice 707.838.6641 fax 707.838.4503

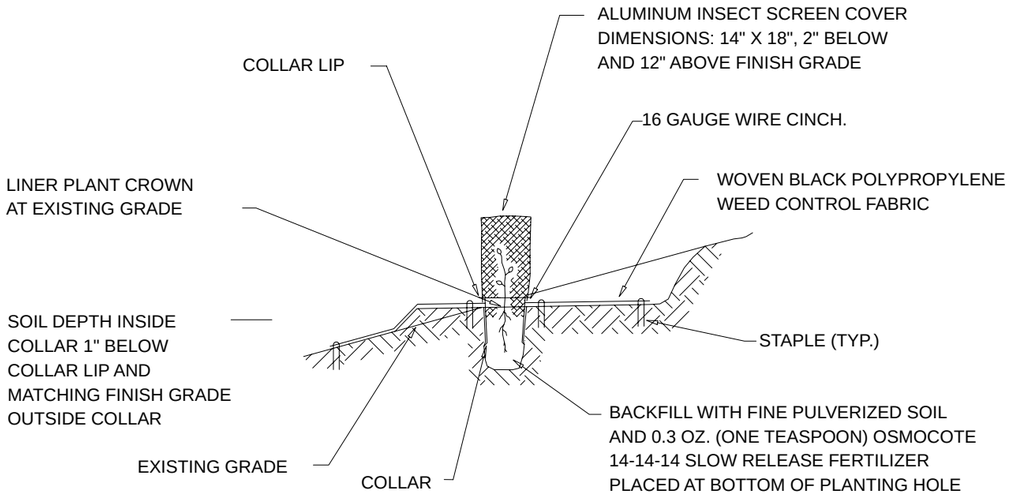
DRAFT

		REVISIONS	DATE	BY
DESIGN:	Rob Evans			
DRAWN:	Elizabeth Lotz			
SCALE:	see above			
DATE:	06/06/07			
FILE:	McQueeny_Notes_sh3			

CALFED Watershed Program
Implementation Project
Sponsors: Laurel Marcus & Associates,
California Sportfishing Protection Alliance

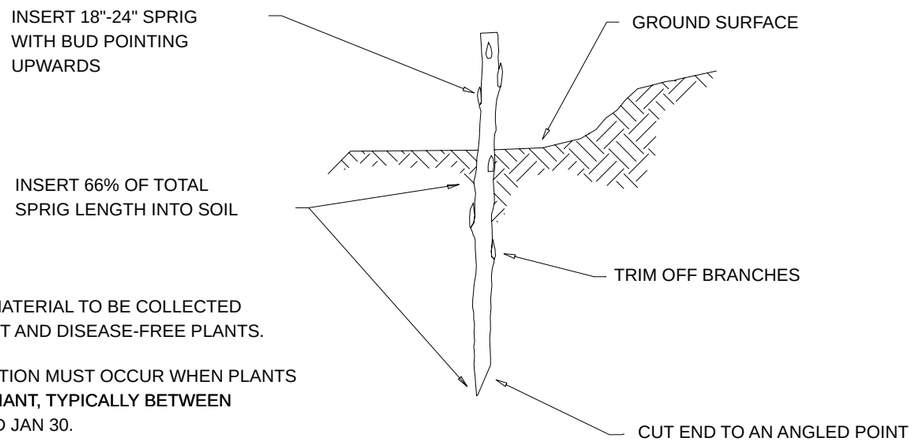
McQueeny Property
Suisun Creek Watershed Program
Riparian Habitat Enhancement Plan
Wooden Valley Creek, Napa County, California

SHEET NO. 3 OF 4 SHEETS



LINER PLANTING DETAIL

NOT TO SCALE



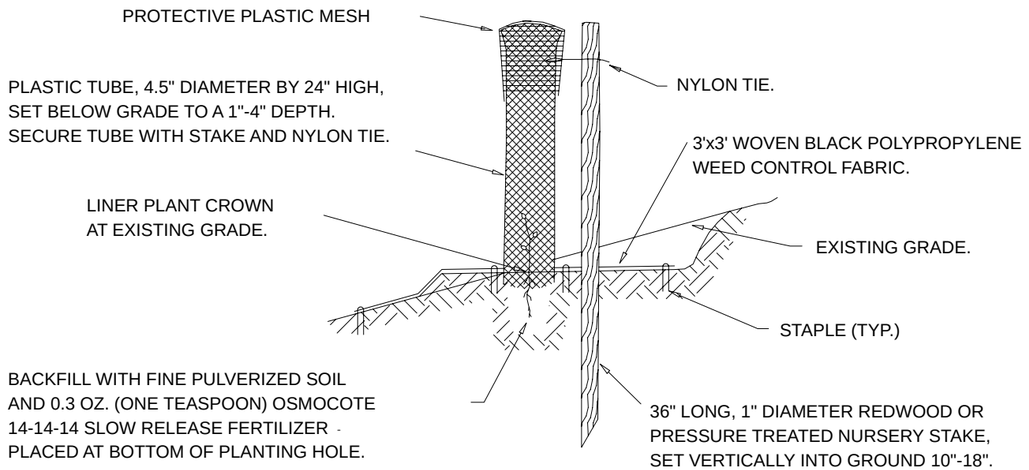
1. SPRIG MATERIAL TO BE COLLECTED FROM PEST AND DISEASE-FREE PLANTS.

2. COLLECTION MUST OCCUR WHEN PLANTS ARE DORMANT, TYPICALLY BETWEEN DEC. 1 AND JAN 30.

3. ALL WILLOW MATERIAL SHOULD BE COLLECTED WITHIN THE WATERSHED AS CLOSE TO THE PROJECT SITE AS POSSIBLE, AND KEPT MOIST DURING COLLECTION AND TRANSPORT.

DORMANT WILLOW SPRIG INSTALLATION

NOT TO SCALE



TREE SHELTER PLANTING DETAIL

NOT TO SCALE

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ECOLOGICAL RESTORATION SERVICES ■ HUMAN SERVICE PROGRAMS
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Windsor, CA 95492
voice 707.838.6641 fax 707.838.4503

DRAFT

		REVISIONS	DATE	BY
DESIGN:	Rob Evans			
DRAWN:	Elizabeth Lotz			
SCALE:	see above			
DATE:	06/06/07			
FILE:	McQueeny_Details_sh4.mxd			

CALFED Watershed Program
Implementation Project
Sponsors: Laurel Marcus & Associates,
California Sportfishing Protection Alliance

McQueeny Property
Suisun Creek Watershed Program
Riparian Habitat Enhancement Plan
Wooden Valley Creek, Napa County, California

SHEET NO. 4 OF 4 SHEETS

Figure 37. The Location and Extent of the Riparian Corridor along Suisun and Wooden Valley Creeks in the Suisun Creek Watershed – Section 4

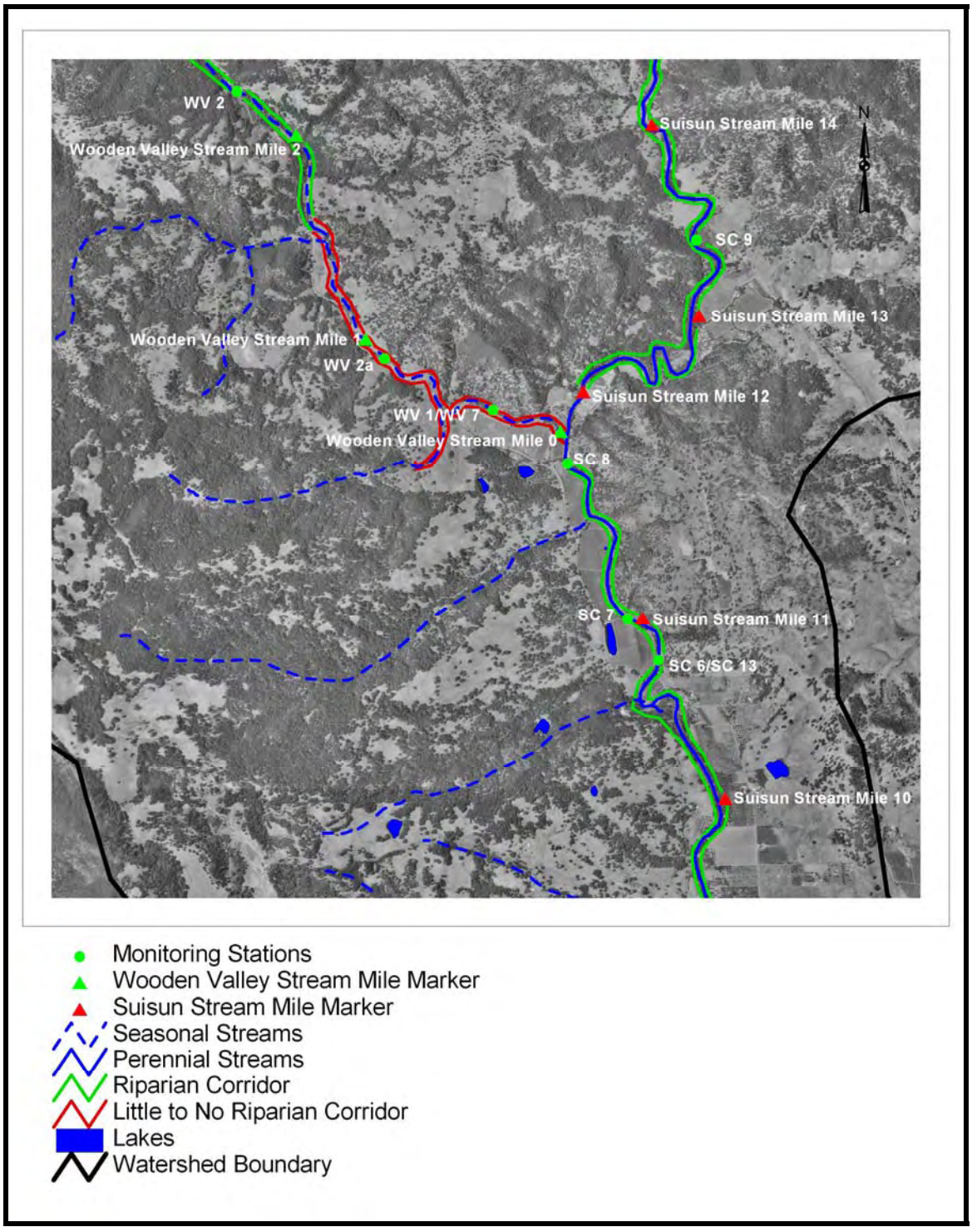


Figure 39. The Location and Extent of the Riparian Corridor along Wooden Valley and White Creeks in the Suisun Creek Watershed – Section 2

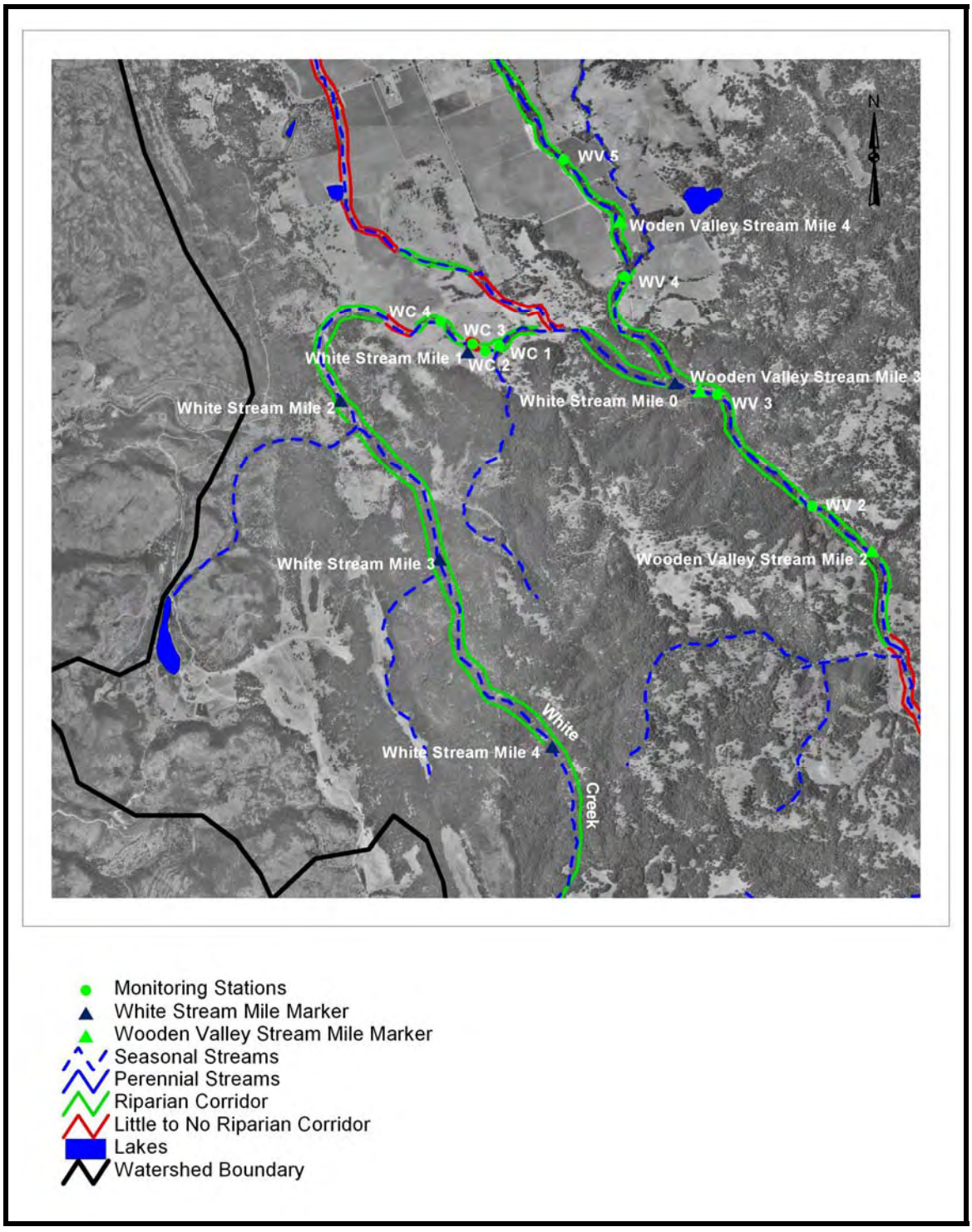


Figure 40. The Location and Extent of the Riparian Corridor along Wooden Valley and White Creeks in the Suisun Creek Watershed – Section 1

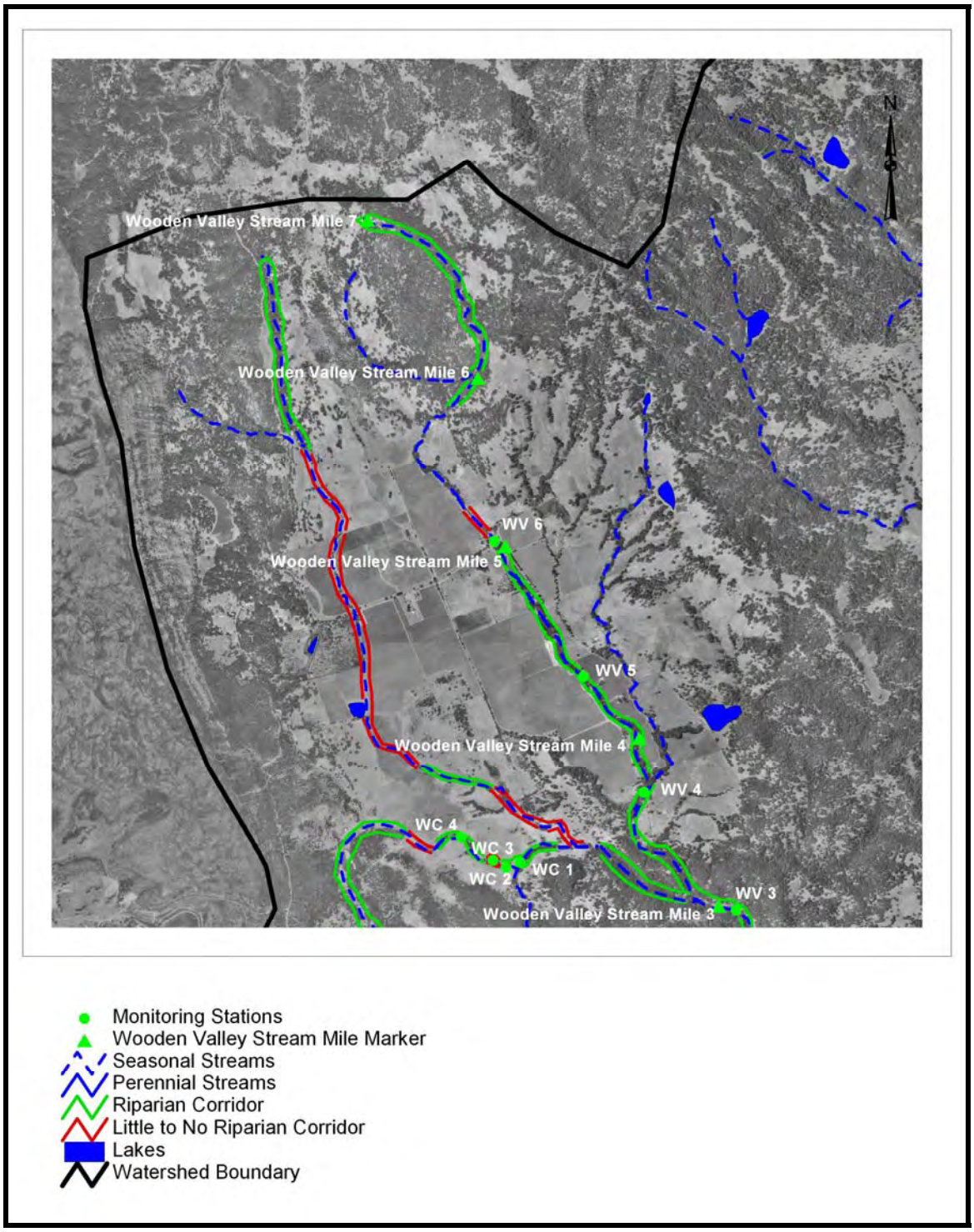


Figure 14. A Portion of Wooden Valley Creek Subbasin Illustrating Year-Round and Seasonal Creeks in Blue and Ephemeral Creeks in Black

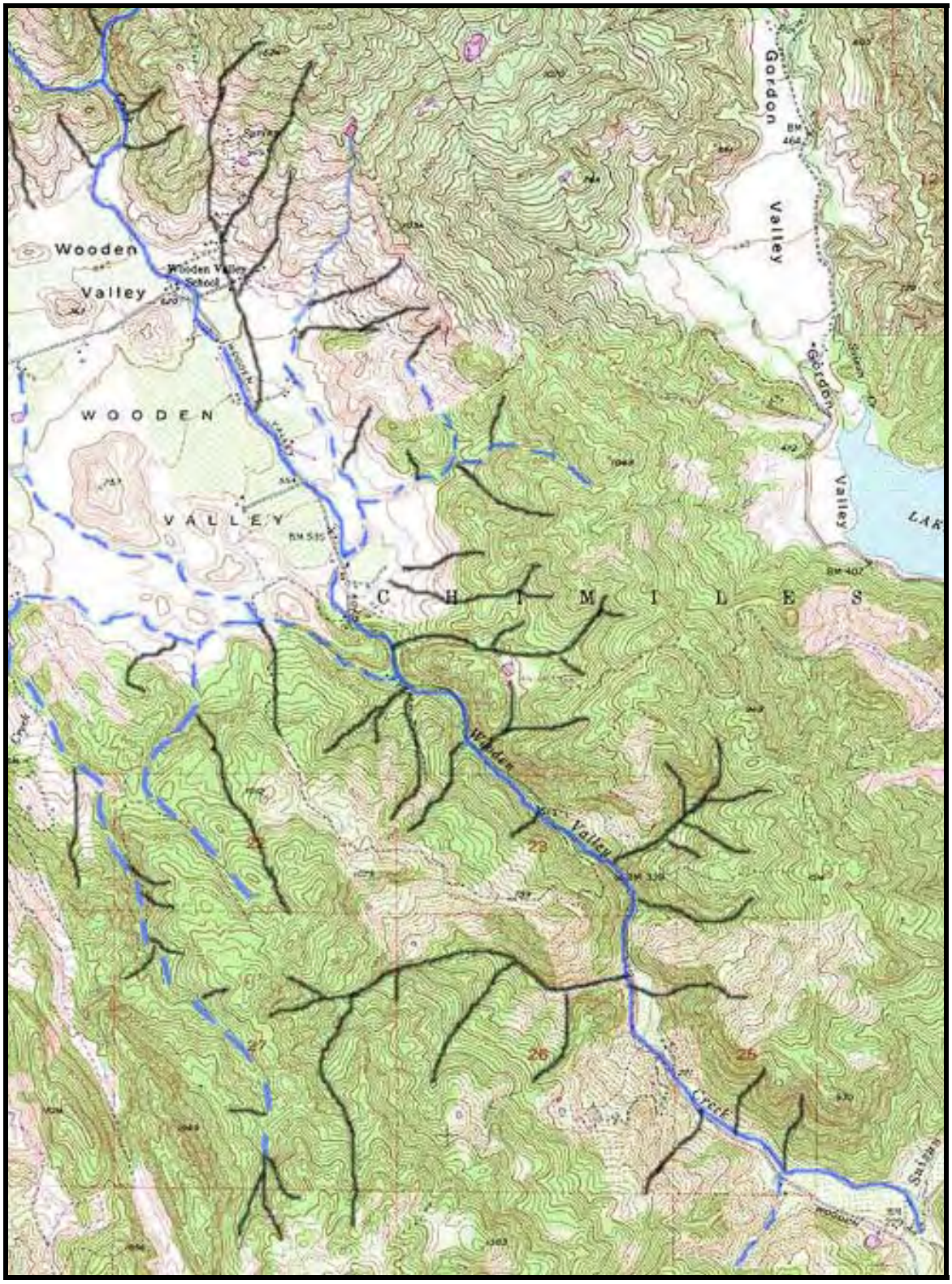


Figure 19. Slope Classes of Wooden Valley Creek

Figure 6. Potential Study Reaches (PSR) of Wooden Valley Creek

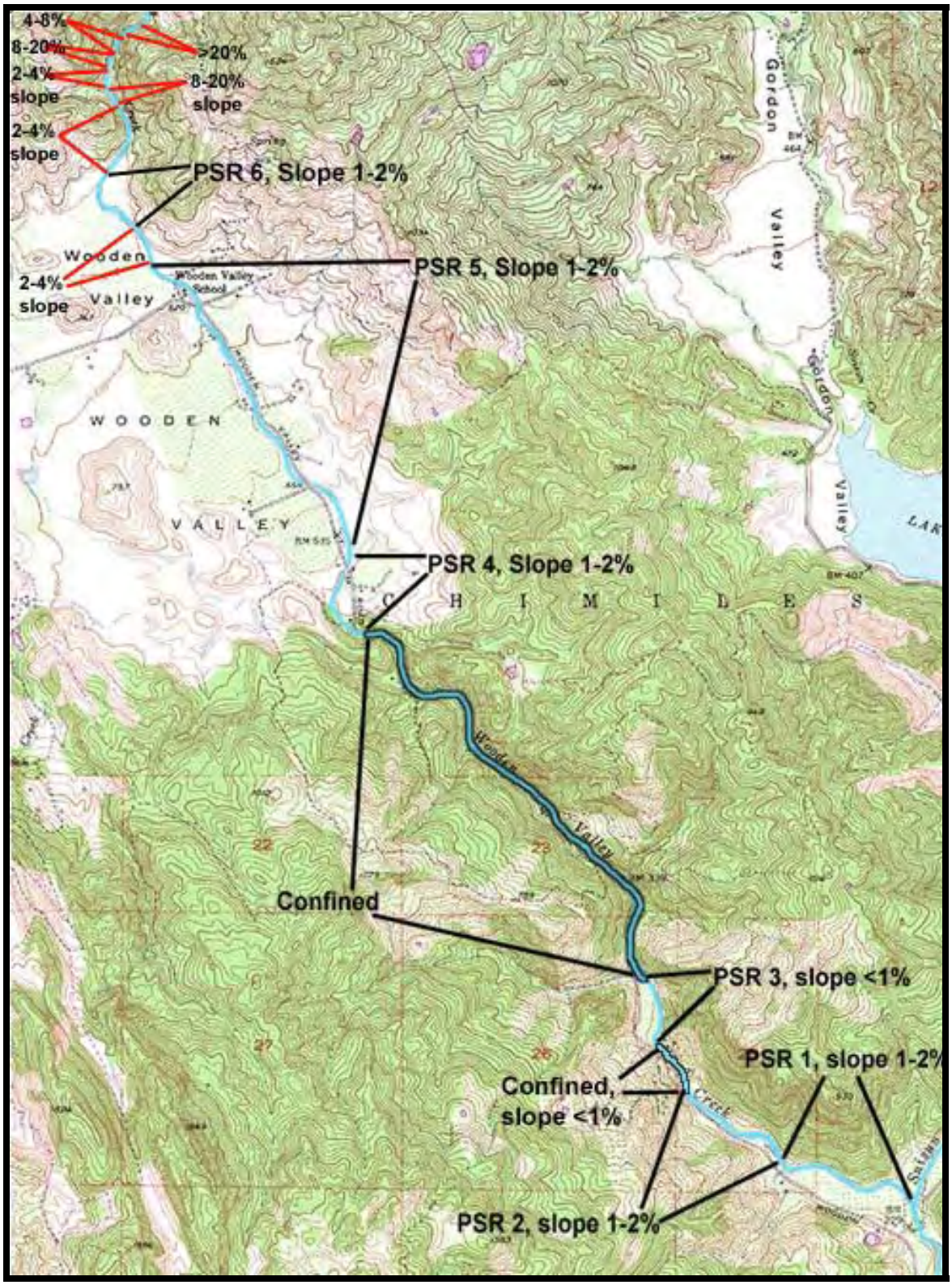


Figure 24. Confined and Unconfined Sections of Wooden Valley Creek

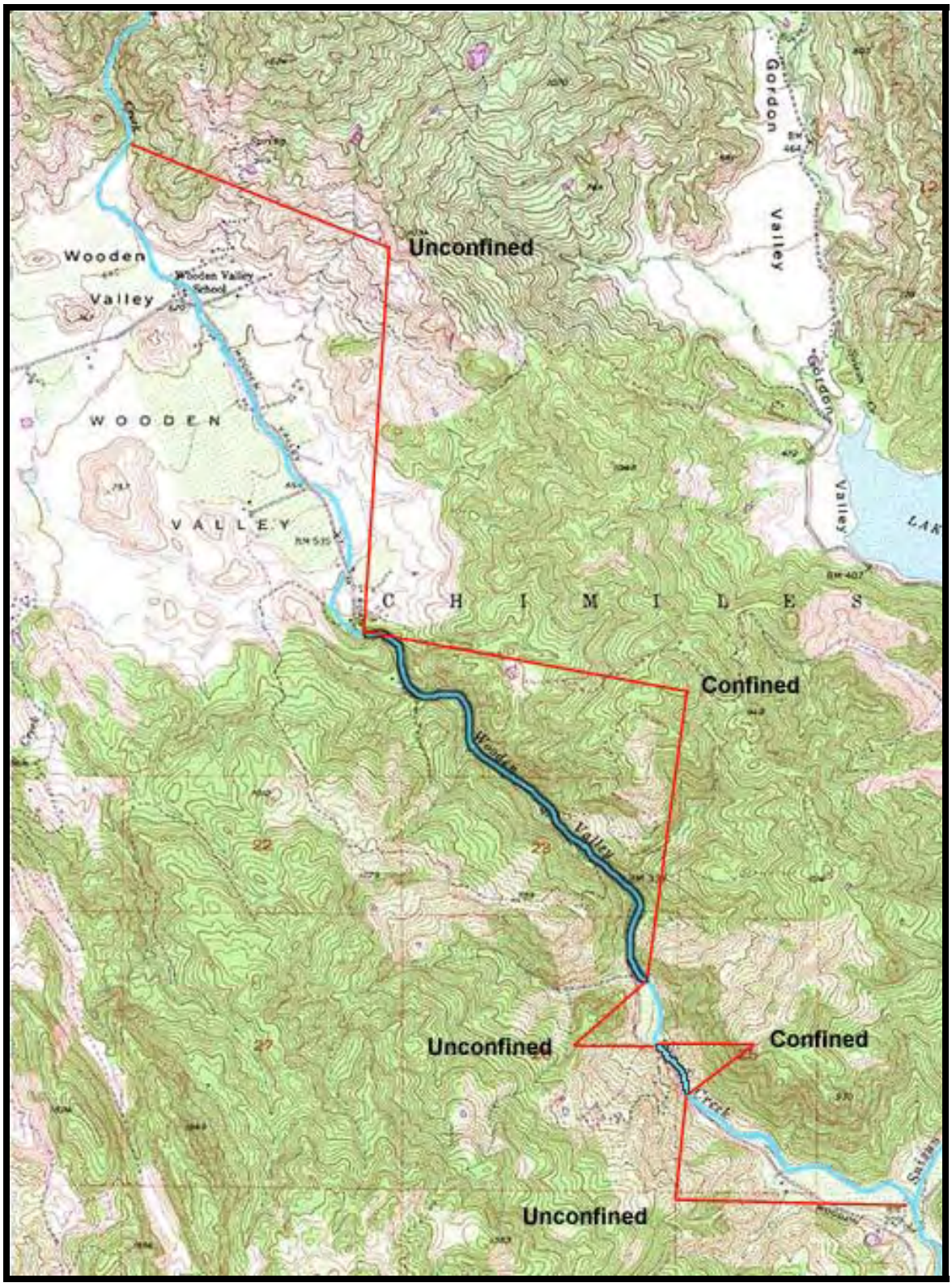


Table 13. Description of Water Temperature Monitoring Stations in Suisun Creek Watershed (cont.)

Station Number	Location; Nearby Landmark	Type of Channel	Width/ Depth (in ft.)	Slope	Flow	Average % Canopy Cover	Comments
Tributary: Wooden Valley Creek							
WV 1 WV 7 AIR downstream	WV study reach #1; stream mile 0.5	unconfined alluvial	45/1	<1%	Natural runoff; regularly dries up by August	25%	Previous major bank erosion has been repaired with rock riprap; willows have re-grown on banks and in channel; no major overstory; same station in both 2002 & 2003; Hanson station #18 April-August 2001
WV 2a	Stream mile 1	unconfined alluvial	40/2.3	<1%	Natural runoff; isolated pools by July/August	48%	Pool created by drop structure; rest of channel dry; station only in 2003
WV 2	Near Wooden Valley Rd. bridge #1; stream mile 2	confined	N/A	<2-4%	Natural runoff	N/A	Good vegetative cover with perennial flow; same station in both 2002 & 2003; vandalism in 2003 with some loss of data
WV 3	Near Wooden Valley Rd. bridge #2; stream mile 3	confined	13/1.5	<2-4%	Natural runoff perennial flow; downstream of confluence with White Creek; consistently greater flow than WV 4	92%	Station experienced vandalism in 2002 with some loss of data; new site ~ 500 ft. upstream used in 2003; rocky, well-shaded creek
WV 4	Near Wooden Valley Rd. bridge #3; stream mile 4	confined	8/1.5	<2-4%	Natural runoff; perennial flow; observed consistently less flow than WV 3	91%	New culvert installed at Wooden Valley Bridge in 2002; same station in both 2002 & 2003; rocky, well-shaded creek
WV 5	Near Wooden Valley Rd. bridge #4; stream mile 4.5	partially confined	11/0.9	<1-2%	Natural runoff; perennial flow with low summer levels	93%	Some erosion in channel with mature trees undercutting; same station in both 2002 & 2003
WV 6 upstream	Near Wooden Valley Rd. bridge #5; stream mile 5	unconfined	8/0.8	<1-2%	Natural runoff; perennial flow with low summer levels	82%	Road culvert cleared of sediment in 2003 with riprap on upstream banks; instrument destroyed as part of riprap project; data lost for portion of 2003; station only in 2003
Tributary: White Creek							
WC 1 downstream	Stream mile 0.75	unconfined	12/1	<1%	Natural runoff; groundwater fed pool; continuous flow downstream of this point in both 2002 & 2003	82%	Dense riparian cover and groundwater fed pool; live steelhead juveniles up to 4" observed both years, but 3 dead steelhead juveniles found in late summer 2002
WC 2	Stream mile 0.76	unconfined	N/A	<1%	Natural runoff; site dried up by August both 2002 & 2003	92%	Inadequate riparian cover upstream of small pool
WC 3	Stream mile 0.77	unconfined	N/A	<1%	Natural runoff; site dried up by July or August both 2002 & 2003	33%	Inadequate riparian cover to maintain pool; dead juvenile steelhead found in 2002
WC 4 upstream	Stream mile 1.25	unconfined	6/2	<1%	Natural runoff; groundwater in isolated pools in summer	93%	Isolated groundwater fed pools in largely summer dry channel; dense alder grove; same station in both 2002 & 2003

Table 14. Suisun Creek Water Temperature Monitoring Summary (cont.)						
Station	**Year**	**7-Day Moving Average of Average Daily Temperature**	**7-Day Moving Average of Average Daily Maximum Temperature**	**Daily Range**	**Number of Hours >70ºF (in hours)**	**Comments**
TRIBUTARY: WOODEN VALLEY CREEK						
WV 1 downstream	2002 (Figures 79-82)	Jun-Jul: 69-75ºF Aug-Sep: dried up	Jun-Jul: 60-90ºF Aug-Sep: dried up	4-10ºF	Jun-Jul: 10-20 hrs Aug-Sep: dried up	Station completely dried up by August
	2003 (Figures 159-162)	Jun- Jul: 68-72ºF Aug-Sep: dried up	Jun- Jul: 65-85ºF Aug-Sep: dried up	3-7ºF	Jun-Jul: 5-16 hrs Aug-Sep: dried up	Station completely dried up in August
	Summary: *Poor steelhead rearing – dries up*					
WV 2a	2003 (Figures 163-166)	Jun-Aug: 61-71ºF Aug-Sep: 67-69ºF	Jun-Aug: 65-78ºF Aug-Sep: 69-72ºF	1-14ºF	Jun-Aug: 4-15 hrs Aug-Sep: 1-10 hrs	Relatively high water temperatures with somewhat long periods of water temperatures over 70ºF
	Summary: *Marginal to too warm for steelhead rearing*					
WV 2	2002 (Figures 83-86)	Jun-Aug: 63-67ºF Aug-Sep: 58-65ºF	Jun-Aug: 65-71ºF Aug-Sep: 60-66ºF	1-4ºF	Jun-Aug: 2-10 hrs Aug-Sep: 0 hrs	Cool average maximum water temperatures; low range and low number of hours of temperatures greater than 70ºF
	2003 (Figures 167-170)	Jun-Aug: 61-67ºF Aug: 63-67ºF	Jun-Aug: 63-68ºF Aug: 65-68ºF	<1-1ºF	Jun-Aug: <1-2.5 hrs Aug: 0 hrs	Cool average maximum water temperatures; low range and low number of hours of temperatures greater than 70ºF
	Summary: *Very good for steelhead rearing*					
WV 3	2002 (Figures 87-90)	Jun-Aug: 61-65ºF Aug: 60-63ºF	Jun-Aug: 65-68ºF Aug: 62-66ºF	1-4ºF	Jun-Aug: 1-6 hrs Aug: 0 hrs	Cold maximum temperatures; low number of hours of temperatures in excess of 70ºF
	2003 (Figures 171-174)	Jun-Aug: 59-67ºF Aug-Sep: 61-66ºF	Jun-Aug: 63-71ºF Aug-Sep: 65-70ºF	1-5ºF	Jun-Aug: 4-9 hrs Aug-Sep: 2-5 hrs	Cold maximum temperatures; low number of hours of temperatures in excess of 70ºF
	Summary: *Very good for steelhead rearing*					
WV 4	2002 (Figures 91-94)	Jun- Jul: 60-65ºF Aug-Sep: 58-64ºF	Jun- Jul: 64-69ºF Aug-Sep: 60-66ºF	0.5-5ºF	Jun- Jul: 2.5-5 hrs Aug-Sep: 0 hrs	Cold average maximum temperatures; very low number of hours of temperatures in excess of 70ºF
	2003 (Figures 175-178)	Jun- Jul: 59-66ºF Aug-Sep: 60-65ºF	Jun- Jul: 62-70ºF Aug-Sep: 60-66ºF	<1-5ºF	Jun- Jul: 2-5 hrs Aug-Sep: 0 hrs	Cold average maximum temperatures; very low number of hours of temperatures in excess of 70ºF
	Summary: *Very good for steelhead rearing*					
WV 5	2002 (Figures 95-98)	Jun- Jul: 60-64ºF Aug-Sep: 59-63ºF	Jun- Jul: 64-66ºF Aug-Sep: 60-65ºF	<1-6ºF	Jun- Jul: 0 hrs Aug-Sep: 0 hrs	Cold average maximum temperatures; no hours of temperatures in excess of 70ºF
	2003 (Figures 179-182)	Jun- Jul: 61-66ºF Aug-Sep: 60-65ºF	Jun- Jul: 61-67ºF Aug-Sep: 60-65ºF	<1-3.5ºF	Jun- Jul: 0 hrs Aug-Sep: 0 hrs	Cold average maximum temperatures; no hours of temperatures in excess of 70ºF
	Summary: *Excellent for steelhead rearing*					
WV 6 upstream	2003 (Figures 183-186)	Jun- Jul: 60-64ºF Aug: 63-64ºF	Jun- Jul: 61-66ºF Aug: 63-64ºF	1-9ºF	Jun- Jul: 2.5 hrs Aug: 0 hrs	Cold average maximum temperature; few hours of temperatures in excess of 70ºF
	Summary: *Excellent for steelhead rearing*					

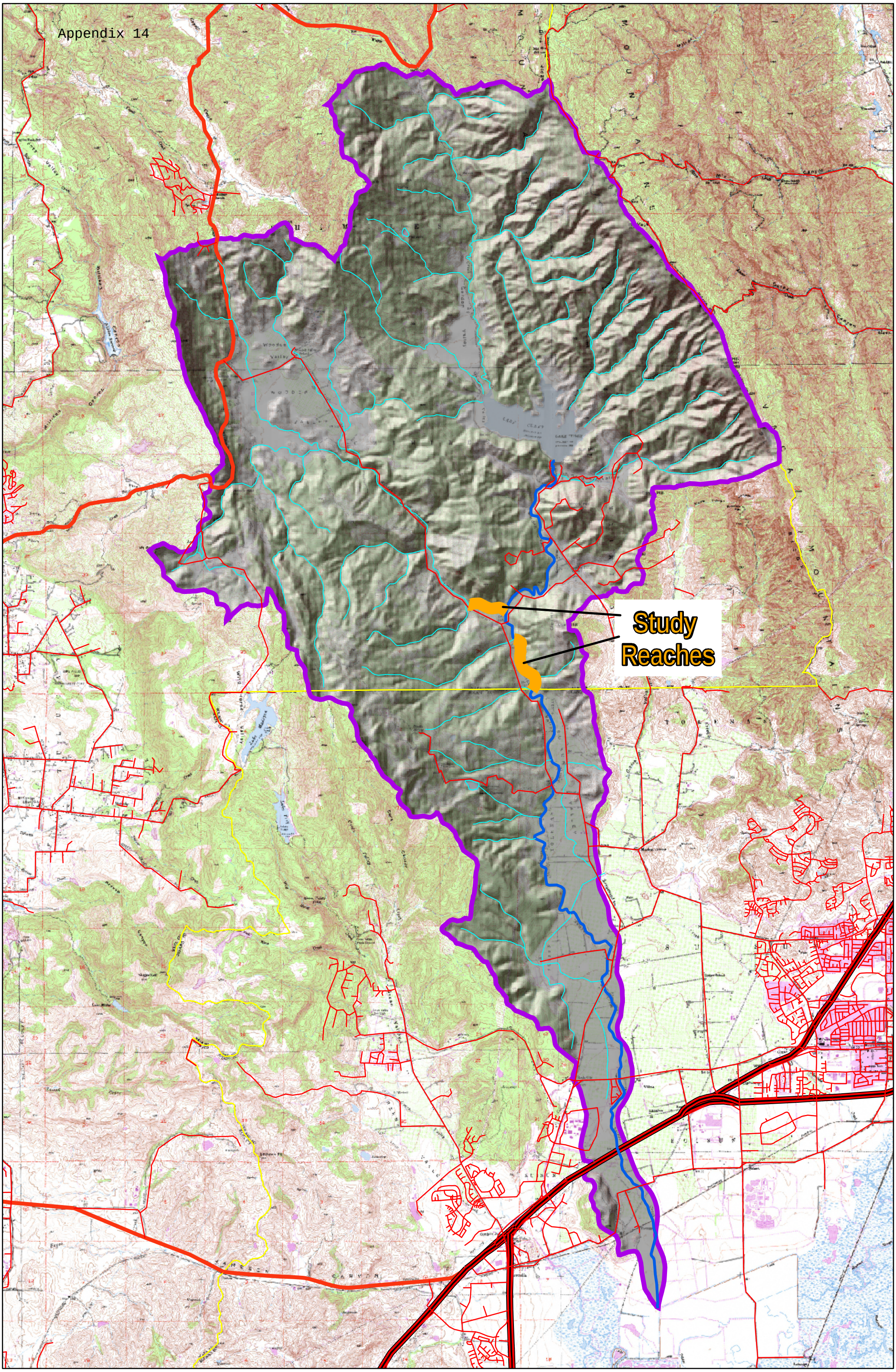
Table 14. Suisun Creek Water Temperature Monitoring Summary (cont.)						
Station	**Year**	**7-day Moving Average of Average Daily Temperature**	**7-Day Moving Average of Average Daily Maximum Temperature**	**Daily Range**	**Number of Hours >70ºF (in hours)**	**Comments**
TRIBUTARY: WHITE CREEK						
WC 1 downstream	2002 (Figures 99-102)	Jun 25- Jul: 60-63ºF Aug-Sep: 57-62ºF	Jun 25- Jul: 62-65ºF Aug-Sep: 58-62ºF	<1-5ºF	Jun 25- Jul: 0 hrs Aug-Sep: 0 hrs	Cold average maximum temperature; no hours of temperatures in excess of 70ºF
	2003 (Figures 187-190)	Jun 1- Jul: 59-66ºF Aug-Sep: 58-65ºF	Jun 1- Jul: 61-70ºF Aug-Sep: 60-70ºF	1-10ºF	Jun 1- Jul: 3-8 hrs Aug-Sep: 4-7 hrs	Relatively cold average maximum temperatures; relatively low number of hours over 70ºF
	Summary: *Very good for steelhead rearing*					
WC 2	2002 (Figures 103-106)	Jun- Jul: 66-68ºF Aug-Sep: dried up	Jun- Jul: 69-70ºF Aug-Sep: dried up	<1-1ºF	Jun- Jul: 0 hrs Aug-Sep: dried up	Station completely dried up in July
	2003 (Figures 191-194)	Jun- Jul: 64-69ºF Aug-Sep: dried up	Jun- Jul: 68-80ºF Aug-Sep: dried up	1-6ºF	Jun- Jul: 2-9 hrs Aug-Sep: dried up	Station completely dried up in July
	Summary: *Poor steelhead rearing – dries up*					
WC 3	2002 (Figures 107-110)	Jun- Jul: 65-70ºF Aug-Sep: dried up	Jun- Jul: 72-78ºF Aug-Sep: dried up	1-10ºF	Jun- Jul: >20 hrs Aug-Sep: dried up	Station completely dried up
	2003 (Figures 195-198)	Jun- Jul: 60-71ºF Aug-Sep: dried up	Jun- Jul: 63-74ºF Aug-Sep: dried up	1-7ºF	Jun- Jul: 3-21 hrs Aug-Sep: dried up	Station completely dried up
	Summary: *Poor steelhead rearing – dries up*					
WC 4 upstream	2002 (Figures 111-114)	Jun- Jul: 61-65ºF Aug-Sep: 57-62ºF	Jun- Jul: 61-69ºF Aug-Sep: 58-63ºF	1-12ºF	Jun- Jul: 1-7 hrs Aug-Sep: 0 hrs	Cold average maximum temperatures; few hours of temperatures over 70ºF
	2003 (Figures 199-202)	Jun- Jul: 58-68ºF Aug-Sep: 59-65ºF	Jun- Jul: 65-70ºF Aug-Sep: 60-65ºF	<1-7ºF	Jun- Jul: 25 hrs Aug-Sep: 0 hrs	Relatively cold average maximum temperatures; few hours of temperatures over 70ºF
	Summary: *Very good for steelhead rearing*					

Appendix 13

Table 15. Water Quality Monitoring 2002 and 2003											
Station*	**Tributary System**	**Date**	**Water Temperature (ºF)**	**Dissolved Oxygen (mg/l)**	**pH**	**Ammonia -Nitrogen (mg/l)**	**Converted Ammonia (mg/l)**	**Nitrate Nitrogen (mg/l)**	**Converted Nitrate (mg/l)**	**Phosphate (mg/l)**	**Dissolved Oxygen (% saturation)**
SC 2	Suisun	6/27/02	69	9.4	8	0.1	0.13	0	0	0	
		8/2/02	70	9.8	8	.075	0.975	0.5	2.2	0	
		9/27/02	63	8.8	8	0.1	0.13	0.25	1.1	0	
		10/29/02	55	6.5	7.6	0.2	0.26	0.25	1.1	0	
		8/20/03									99.2
SC 3	Suisun	6/26/02	72	10	8.2	0.1	0.13	0.25	1.1	0	
		8/2/02	73	10	8	0.25	0.325	0.5	2.2	0	
		9/27/02	65	8.1	8	0.2	0.26	0.3	1.32	1	
		10/29/02	57	7.4	7.9	0.25	0.325	0.5	2.2	0	
		8/20/03									79.0
SC 4	Suisun	6/26/02	72	10	7.8	0.25	0.325	0.5	2.2	0	
		8/2/02	70	8.8	7.8	0.375	0.4875	0.5	2.2	0	
		9/27/02	66	8	N/A	0.1	0.13	0.25	1.1	1	
		10/29/02	55	7.7	7.4	0.2	0.26	3	13.2	0	
		8/20/03									113.0
SC 5	Suisun	6/26/02	74	9.2	7.8	0.1	0.13	0.5	2.2	0	
		8/2/02	72	6.4	7.8	0.5	0.65	0.25	1.1	0	
		9/27/02	63	9	7.6	0.1	0.13	0.25	1.1	0.1	
		10/29/02	55	7.9	7.7	0.2	0.26	0.25	1.1	0	
		8/20/03									115.0
SC 6	Suisun	6/26/02	71	8.5	8.1	0.25	0.325	0.25	1.1	0	
		8/2/02	N/A	7.8	8	0.25	0.325	0	0	0	
		9/27/02	62	9.5	8.1	0.1	0.13	0.25	1.1	1	
		10/29/02	55	9.6	8	0.5	0.65	0.25	1.1	0	
		8/20/03									116.0
SC 9	Suisun	8/1/02	76	9.2	8.3	0.25	0.325	0.25	1.1	0	
		9/26/02	66	9	8.1	0.3	0.39	0.25	1.1	1	
		10/29/02	57	9.3	8.2	0.35	0.455	0.25	1.1	0	
		8/21/03									94.3
WV 2a	Wooden Valley	6/26/02	76	9	8.2	0.25	0.325	0	0	0	
		8/1/02	88	N/A	8.2	0.1	0.13	0.25	1.1	0	
		9/26/02	75	5	7.6	0.35	0.4555	0.25	1.1	0	
		10/29/02	63	3.1	7.6	0.7	0.91	0.25	1.1	0	
		8/22/03									69.5

Table 15. Water Quality Monitoring 2002 and 2003 (cont.)											
Station*	**Tributary System**	**Date**	**Water Temperature (ºF)**	**Dissolved Oxygen (mg/l)**	**pH**	**Ammonia -Nitrogen (mg/l)**	**Converted Ammonia (mg/l)**	**Nitrate Nitrogen (mg/l)**	**Converted Nitrate (mg/l)**	**Phosphate (mg/l)**	**Dissolved Oxygen (% saturation)**
WV 3	Wooden Valley	6/26/02	64	9.5	8.1	0.1	0.13	1	4.4	0	
		8/1/02	70	8.4	8	0.1	0.13	0.75	3.3	0	
		9/26/02	63	8.4	8	0.25	0.325	0.25	1.1	1	
		10/31/02	48	7.9	8	0.2	0.26	0.25	1.1	0	
		8/20/03									95.5
WV 5	Wooden Valley	6/26/02	63	9	7.4	0.25	0.325	3	13.2	0	
		8/1/02	66	7.4	7.4	0.25	0.325	4	17.6	0	
		9/26/02	64	6.4	6.9	0.1	0.13	2	8.8	1	
		10/31/02	55	6.1	7.1	2	2.6	0.25	1.1	0	
		8/21/03									68.5
WV 6	Wooden Valley	6/26/02	64	7.5	7.4	0.25	0.325	0.5	2.2	0	
		8/1/02	68	7.6	7.4	0.25	0.325	0.175	0.77	0	
		9/26/02	62	3.8	7.5	0.2	0.26	0.25	1.1	0	
		10/31/02	62	2.9	7.7	0.2	0.26	0.25	1.1	0	
		8/21/03									28.5
WC 1	White	9/26/02	58	5.1	7.7	0.2	0.2	0.26	N/A	N/A	
		10/31/02	51	1.1	7.5	0.2	0.26	0.25	1.1	0	
		8/21/03									49.8
WC 4	White	6/26/02	62	N/A	7.6	0.1	0.13	0.25	1.1	0	
		8/1/02	60	1.6	7.4	0.1	0.13	0.25	1.1	0	
		9/26/02	61	1.8	7.5	0.2	0.26	0.25	1.1	0	
		10/31/02	54	2.9	7.5	0.5	0.65	0.25	1.1	0	
		8/21/03									25.0

* See Figure 7 for station locations



Jackson, 2007

Wooden Valley Creek Cross Sections

Table 4. Summary of thalweg and water surface elevations and the water depth at the thalweg for the Wooden Valley Creek cross sections. The change in the thalweg and water surface elevations and water depth at the thalweg, relative to 2001, are also shown.

Water Surface Elevation	2001	2002	2005	2006
X-Sect 1	92.91	None	None	93.81
X-Sect 2	92.92	None	None	94.48
X-Sect 3	93.76	None	None	94.44
X-Sect 4	93.79	92.59	92.63	94.46
X-Sect 5	96.14	None	None	96.51
X-Sect 6	96.16	None	None	97.51

Change in Water Surface Elevation Relative to 2001	2002	2005	2006
X-Sect 1			0.90
X-Sect 2			1.57
X-Sect 3			0.69
X-Sect 4	-1.20	-1.16	0.66
X-Sect 5			0.37
X-Sect 6			1.35

Thalweg Elevation	2001	2002	2005	2006
X-Sect 1	92.45	92.55	93.34	93.67
X-Sect 2	92.33	92.28	93.35	92.03
X-Sect 3	93.49	93.42	92.41	91.73
X-Sect 4	92.26	92.16	92.27	92.32
X-Sect 5	95.69	95.94	96.47	96.18
X-Sect 6	95.32	95.60	97.01	96.92

Change in Thalweg Elevation Relative to 2001	2002	2005	2006
X-Sect 1	0.10	0.89	1.22
X-Sect 2	-0.05	1.02	-0.30
X-Sect 3	-0.07	-1.08	-1.76
X-Sect 4	-0.10	0.01	0.06
X-Sect 5	0.25	0.78	0.49
X-Sect 6	0.28	1.69	1.60

Water Depth at Thalweg	2001	2002	2005	2006
X-Sect 1	0.46	None	None	0.14
X-Sect 2	0.59	None	None	2.45
X-Sect 3	0.27	None	None	2.71
X-Sect 4	1.53	0.43	0.36	2.14
X-Sect 5	0.45	None	None	0.33
X-Sect 6	0.84	None	None	0.59

Change in Profile Distance Relative to 2001	2002	2005	2006
X-Sect 1			-0.32
X-Sect 2			1.87
X-Sect 3			2.45
X-Sect 4	-1.10	-1.17	0.60
X-Sect 5			-0.12
X-Sect 6			-0.25

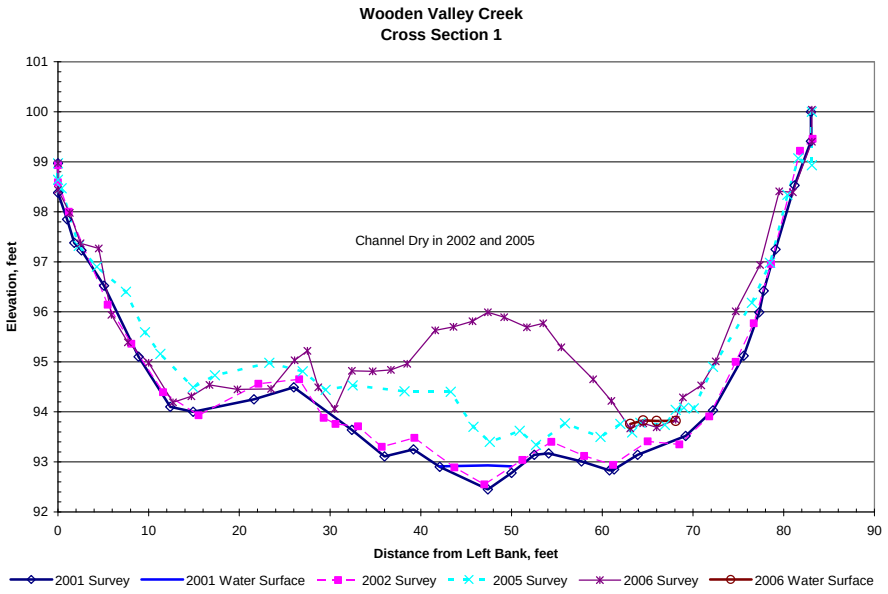


Figure 10. Wooden Valley Cross Section 1.

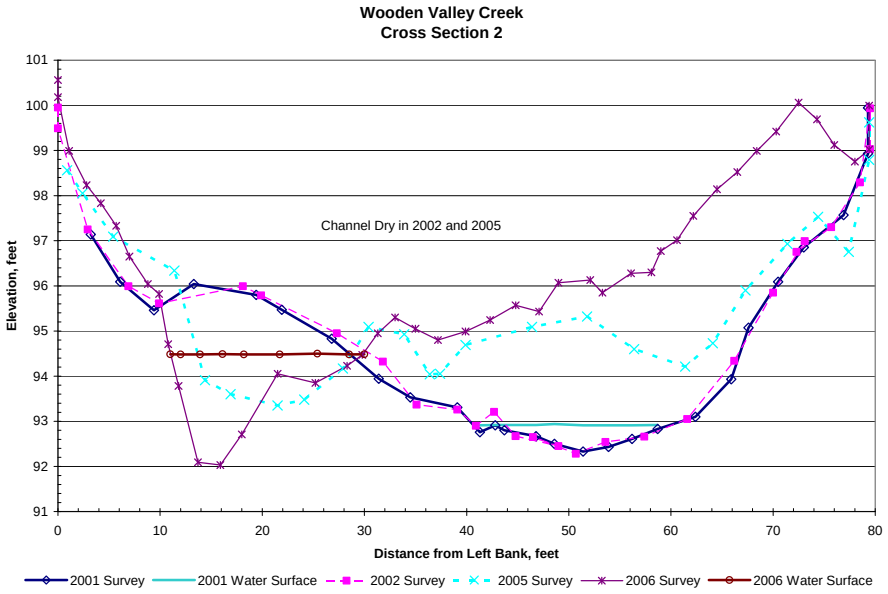


Figure 11. Wooden Valley Cross Section 2.

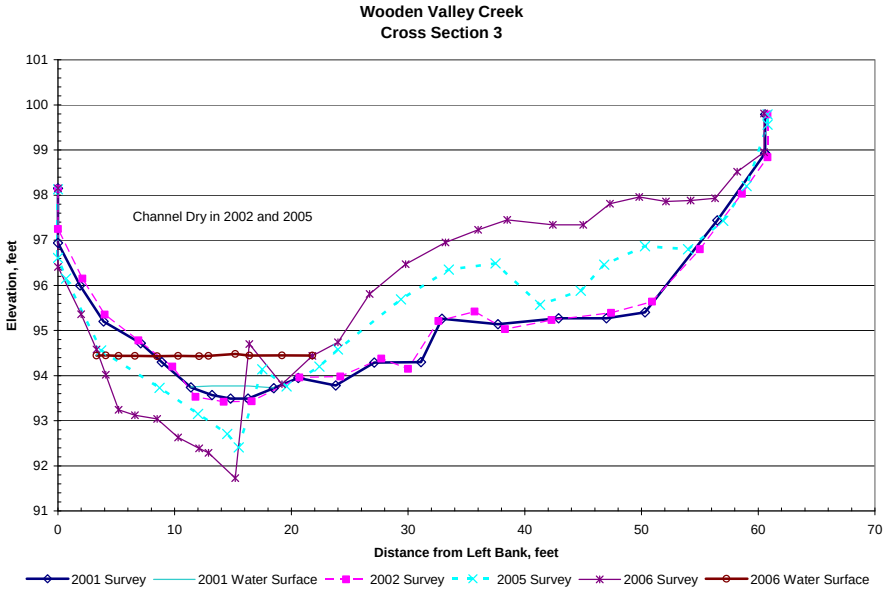


Figure 12. Wooden Valley Cross Section 3.

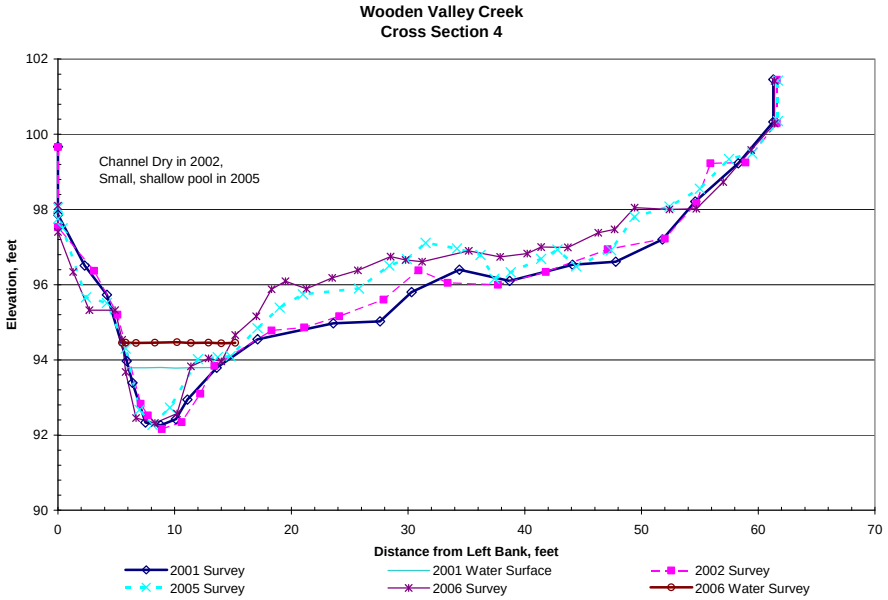


Figure 13. Wooden Valley Cross Section 4.

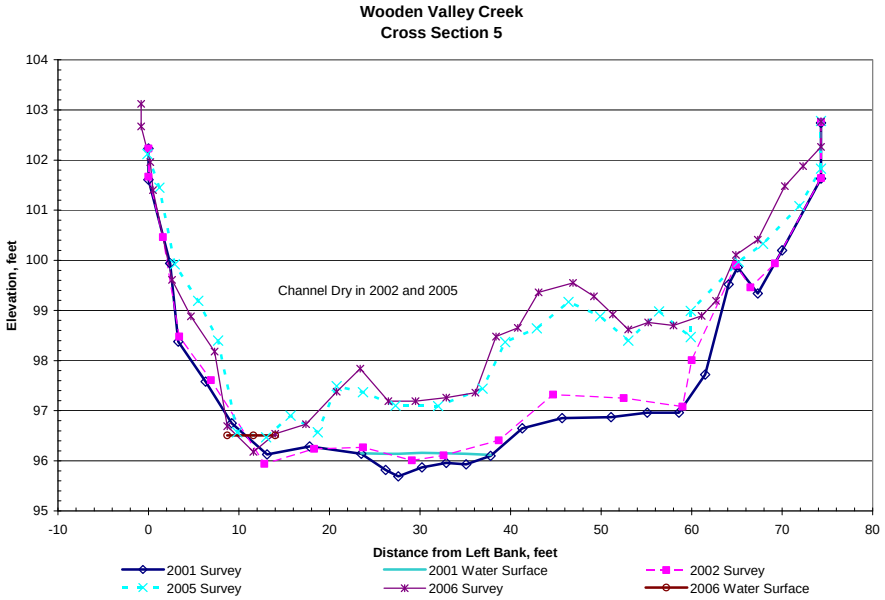


Figure 14. Wooden Valley Cross Section 5.

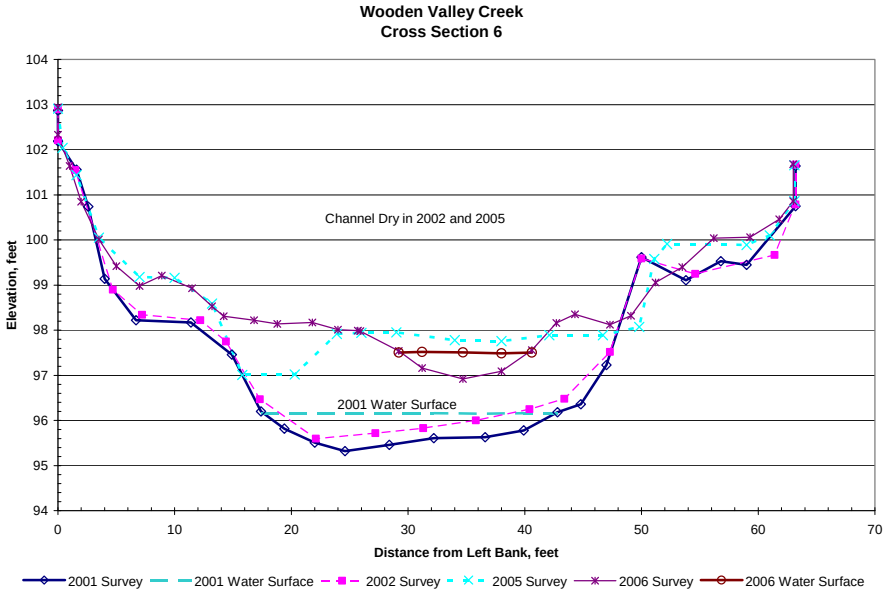


Figure 15. Wooden Valley Cross Section 6.

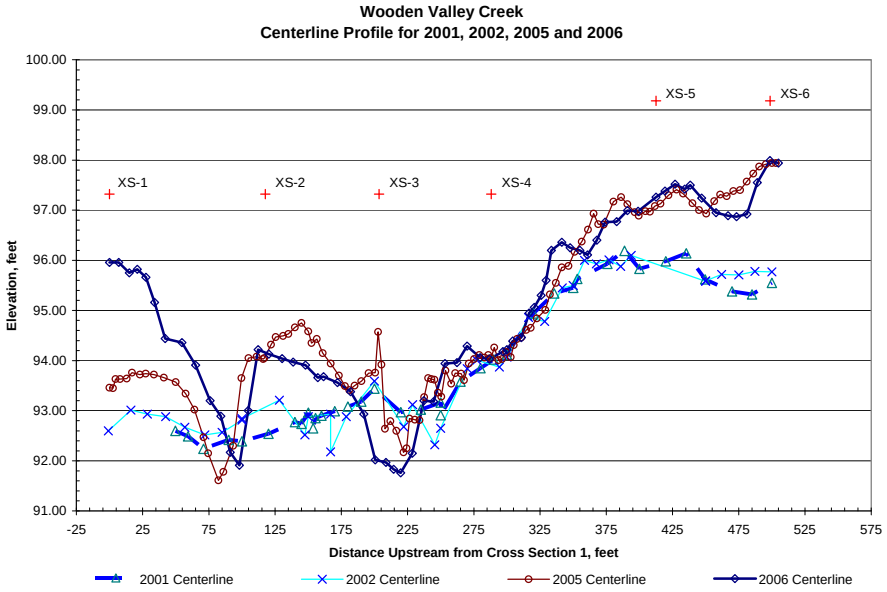


Figure 16. Wooden Valley Cross Centerline Profile.

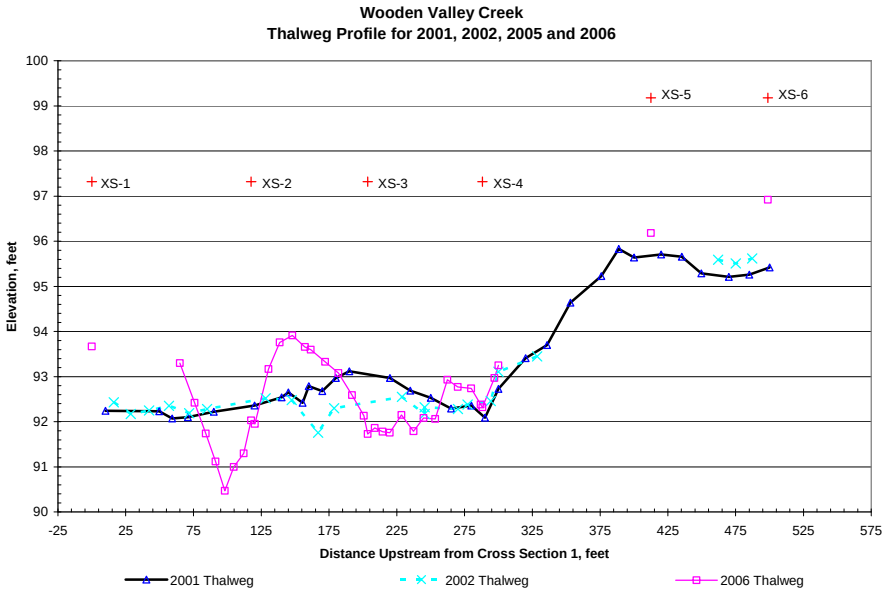


Figure 17. Wooden Valley Cross Thalweg Profile.

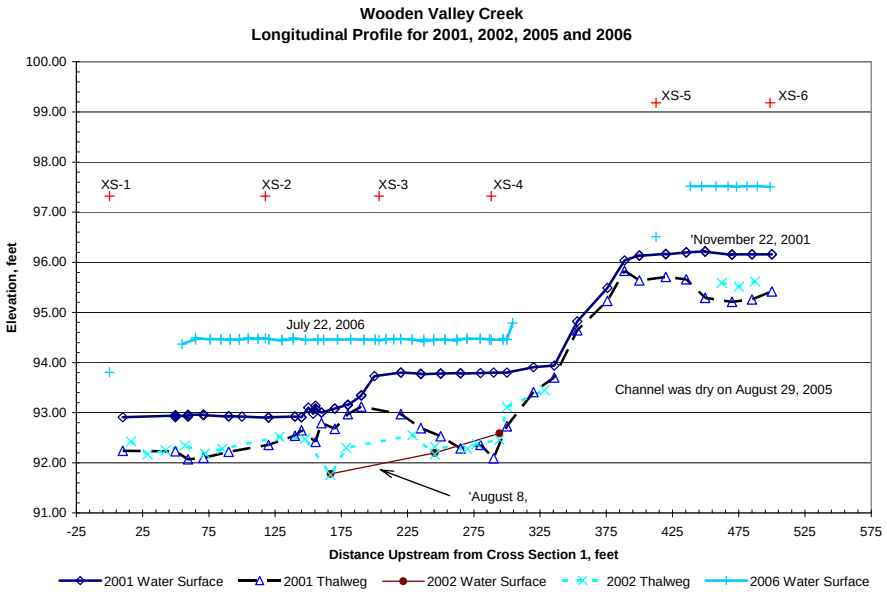


Figure 18. Wooden Valley Cross Water Surface Profile

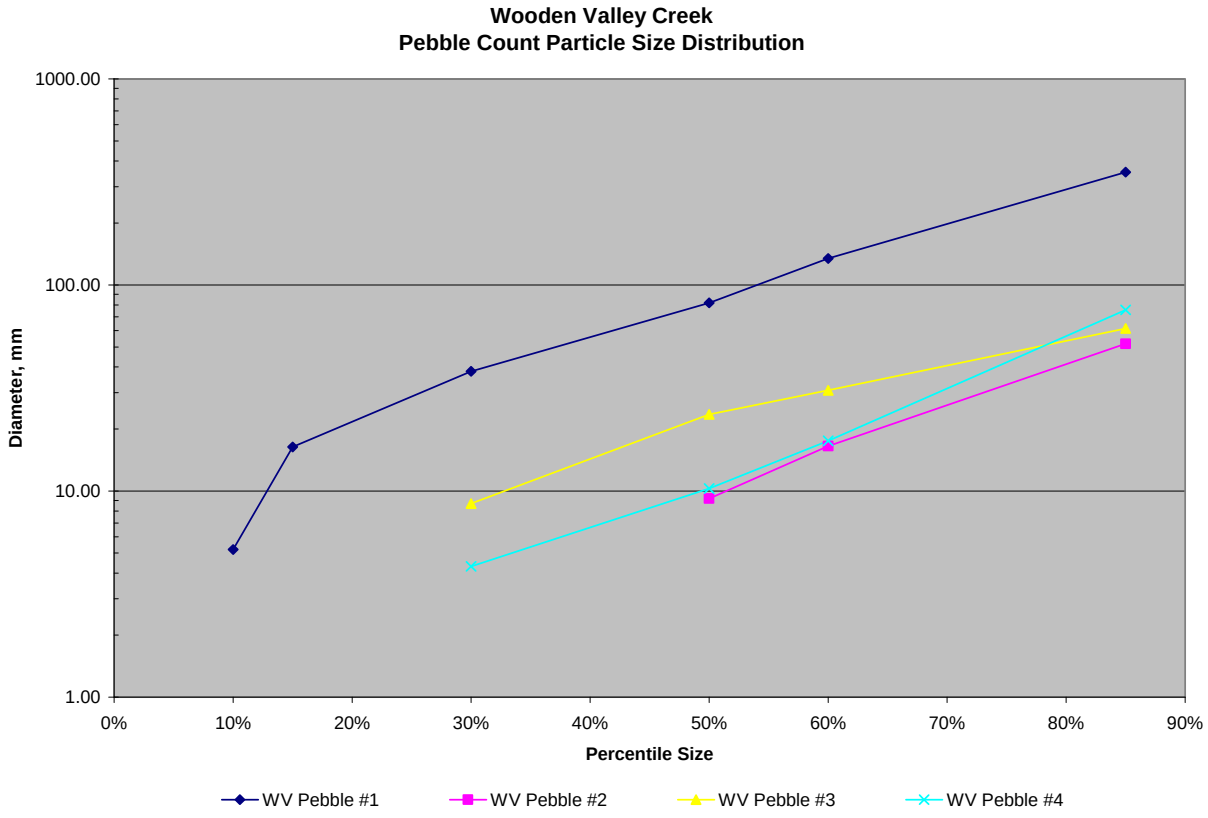


Figure 4. Wooden Valley Creek surface particle size distribution from pebble counts

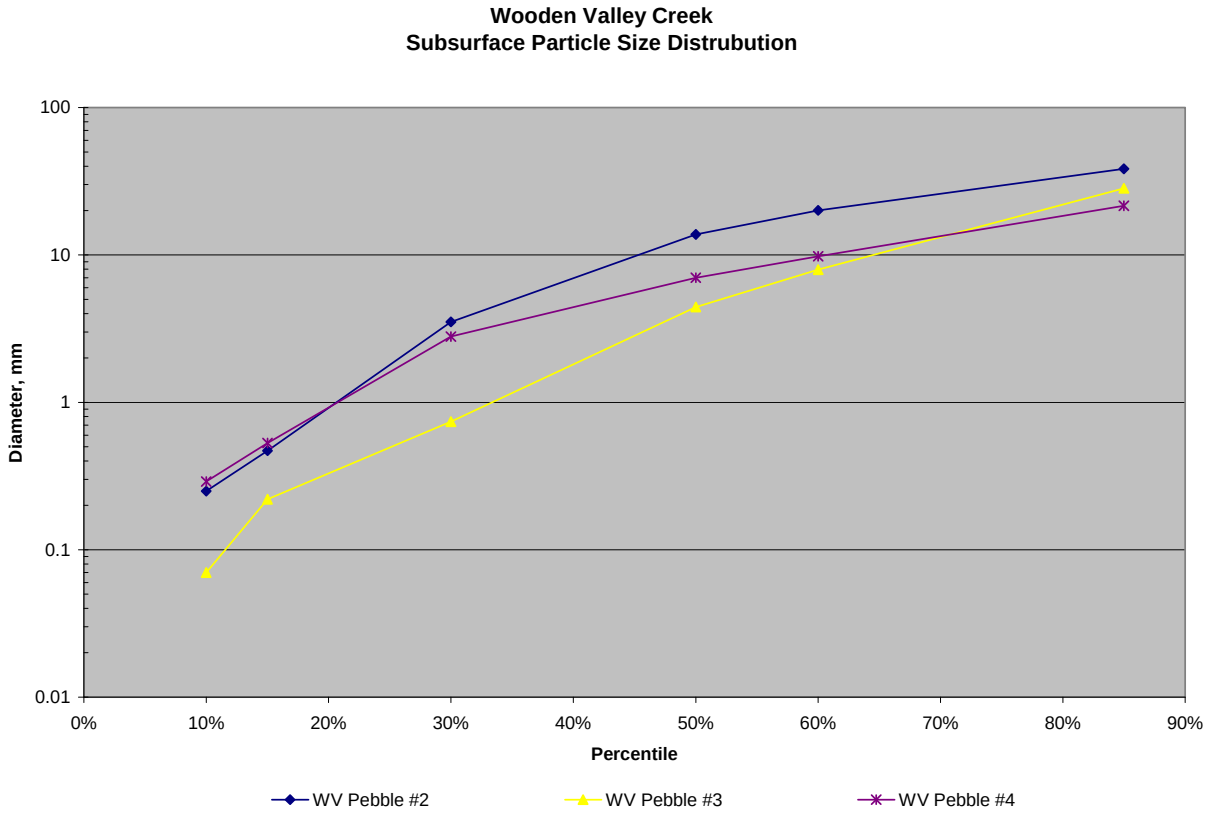


Figure 5. Wooden Valley Creek subsurface particle size distribution.

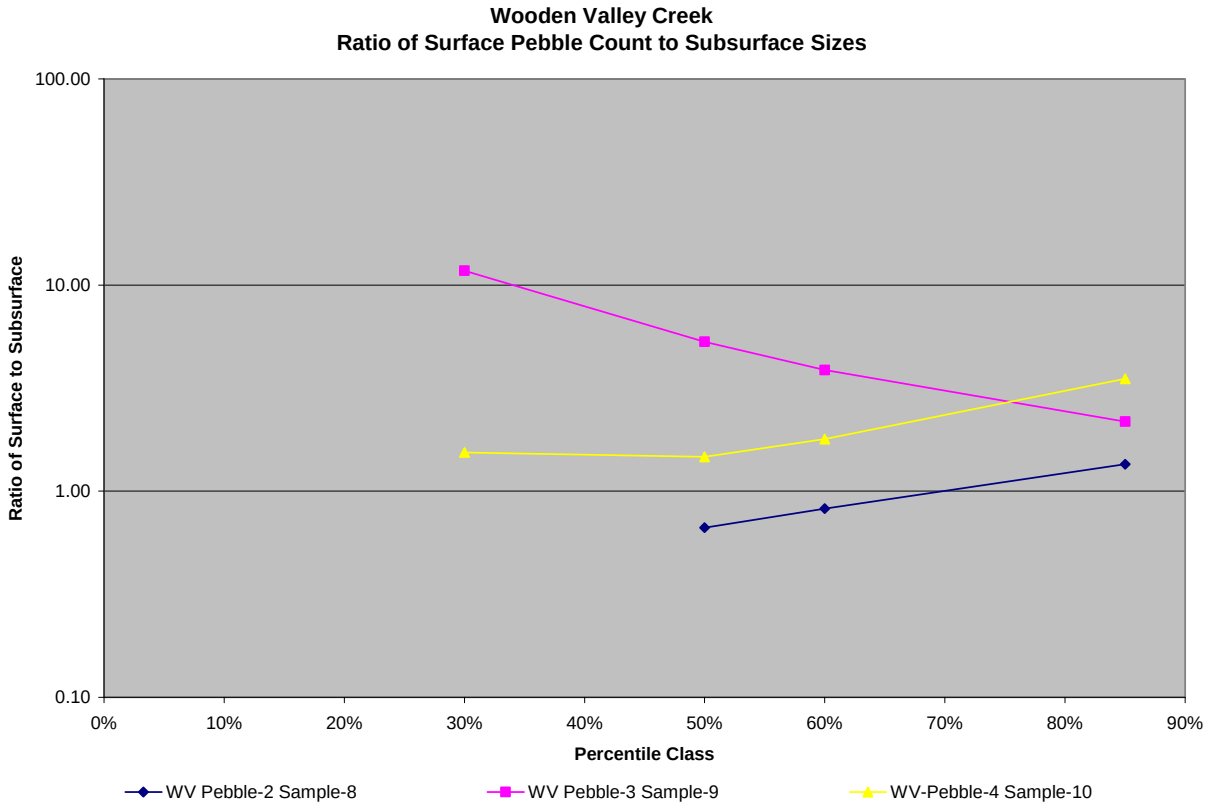


Figure 6. Ratio of surface pebble count to subsurface size for each percentile class for Wooden Valley Creek.

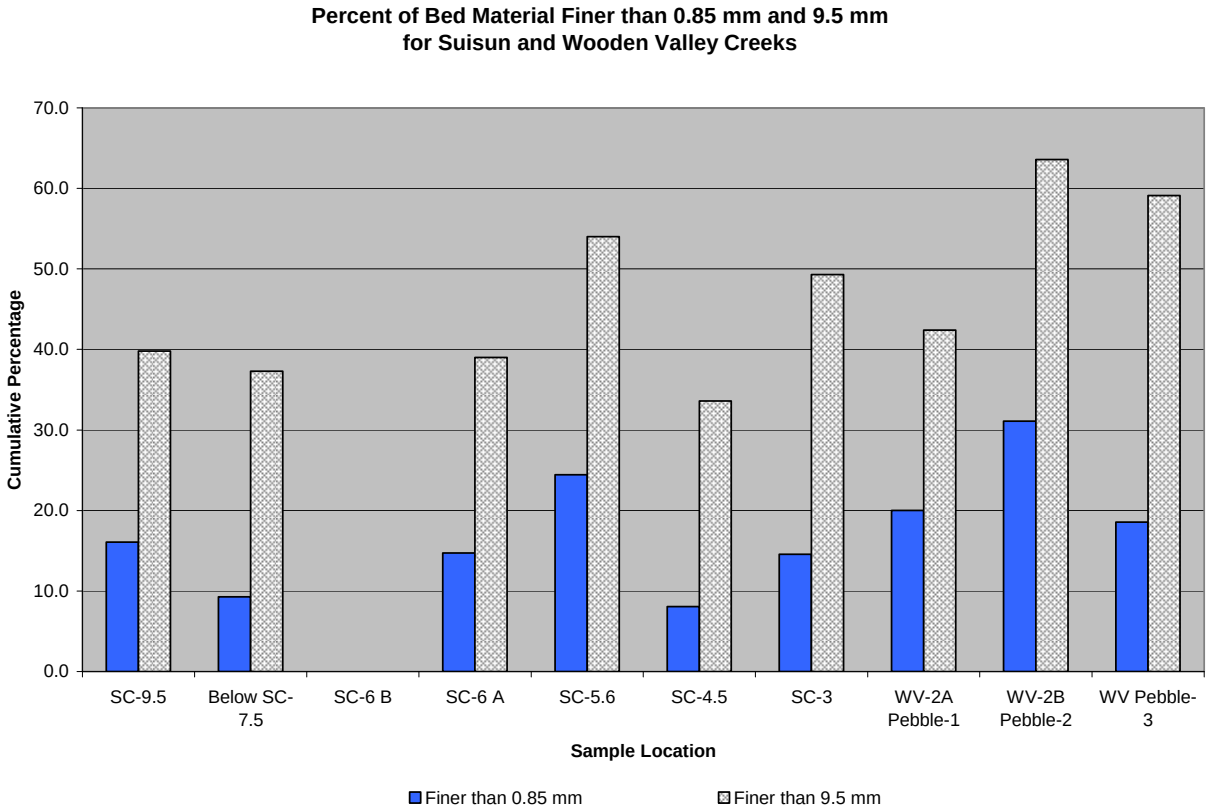


Figure 7. The cumulative percentage finer that 0.85 mm and 9.5 mm of each of the subsurface samples for Suisun and Wooden Valley Creeks. The cumulative percentage finer than 0.85 and 9.5 mm have been used by researchers in the past to relate the volume of fine sediment in the streambed to the survival-to-emergence of salmonid eggs.

Appendix 17

Evaluation of Re-vegetation in Terms of 1) Interim Objective Achievements and 2) Landowner Involvement

Restoration Objectives	Measurable Outcomes	Achieved Outcome	McQueeny Role	Record of Landowner Participation/Role in Documentation/Monitoring	Notes and Recommendations	Source
Planting late Winter, 2009 - early Spring, 2010, supervised by restoration ecologists	Plantings in within timeframe, and kept alive through proper maintenance	Yes. Plants in place roughly according to plan, in specified zones.	Minimal: input/approval of planting design during planning phase.	Circuit Rider Productions does not reference farmer role. Enhancement plan references landowner participation generally (see paper Problem Statement section). FFF photo-monitoring documents plants condition/survival only.	Original plantings may have occurred under 'formal' guidance of ecologists and/or FFF staff, but subsequent replacement plantings were done by McQueeny, independently. Photo-documentation may not capture explanations for certain documented conditions/changes in plantings, locations, protective and irrigation structures.	Circuit Rider Productions, Inc. McQueeny Property - South Suisun Creek Watershed Program, Riparian Habitat Enhancement Plan. Wooden Valley Creek, Napa County, CA: CALFED Watershed Program Implementation Project, 2007; Laurel Marcus & Associates, and California Sportfishing Protection Alliance. Final Suisun Creek Watershed Assessment and Enhancement Plan, February 2004; McQueeny, Dan. "McQueeny property and restoration site visit." Site Visit and Interview, November 20, 2010.
Plants installed with protective hardware and weed mats	Plants installed with appropriate hardware, as outlined in Plan document.	Mostly. Plants installed with hardware, but some uprooted, and some outgrowing their screen.	None in initial planting, but McQueeny responsible for maintenance and re-installing following a) uprooting by wild pigs or cattle, or b) re-planting failed plants.	Circuit Rider Productions does not reference farmer role other than plant maintenance. Enhancement plan references landowner participation generally (see paper Problem Statement section). FFF photo-monitoring documents plants condition/survival only.	Any maintenance to plants, including hardware is McQueeny's duty. Photo-documentation may not capture explanations for certain disturbed or changed hardware installations. Some of the observed plants were overgrowing their hardware, and adjustments to that hardware would need to be made by McQueeny - who may not have the time or resources to attend to all plants within the restoration.	Circuit Rider Productions, Inc. McQueeny Property - South Suisun Creek Watershed Program, Riparian Habitat Enhancement Plan. Wooden Valley Creek, Napa County, CA: CALFED Watershed Program Implementation Project, 2007; McQueeny, Dan. "McQueeny property and restoration site visit." Site Visit and Interview, November 20, 2010.
Species color-coded surveyor flags at plant location	Flags installed, color-coded according to position, and remain in place.	Somewhat. It appears plants were installed with flags, but many are no longer present.	Maintain flag placement during any maintenance activities, or following disturbance by wild animals or cattle.	None.	Flags do not appear to remain fixed to the plants, which are not made more visible by the flags, and whose species must then be identified through observation. Therefore, the flags appear ineffective/useless, and potential maintenance for outside monitoring (FFF) is an undue burden on the landowner, if required (due to what looks like common disturbance/removal either from wild animals, cattle, or weather events).	Circuit Rider Productions, Inc. McQueeny Property - South Suisun Creek Watershed Program, Riparian Habitat Enhancement Plan. Wooden Valley Creek, Napa County, CA: CALFED Watershed Program Implementation Project, 2007; McQueeny, Dan. "McQueeny property and restoration site visit." Site Visit and Interview, November 20, 2010.
Cattle fencing installed 15 ft. from seedlings; cattle excluded until plants are mature	Fencing installed so as to adequately keep cattle away from seedlings until mature.	Mostly. Electric fencing is installed, but there are some breeches, and due to unevenness of landscape (hilly), and regular rotation of cattle (requiring training, especially of younger cattle to mind the electric fence) fencing is not always completely successful.	High. McQueeny independently installed the new fencing (at his own cost); maintains electric fencing (charge will go down occasionally); devised a new rotational schedule for his cattle throughout his property to provide for restoration activities; must train cattle (especially young cattle) to respond properly to fence; must continually repair and re-align fence according to natural environmental disturbances (weather/ animal)	Circuit Rider Productions references rancher installation and maintenance. Enhancement plan references landowner participation generally (see paper Problem Statement section). FFF photo-monitoring does not document fencing success other than what might indirectly result in plant survival - but the connection would be unknown through this monitoring.	The fencing is a critical component of the restoration success, as keeping cattle from the riparian vegetation is key to restoring riparian cover. This is McQueeny's most important management role, and the most labor intensive for him, as it involves devising an entirely new range management system, and re-training his cattle herd. There is no monitoring or accounting for the success and efforts of his work other than through indirect impacts it may have on plant survival - as plant survival is the only formally documented outcome measure. Negative outcomes might potentially be linked to fencing failure, but those outcomes would not be recorded as such.	Circuit Rider Productions, Inc. McQueeny Property - South Suisun Creek Watershed Program, Riparian Habitat Enhancement Plan. Wooden Valley Creek, Napa County, CA: CALFED Watershed Program Implementation Project, 2007; Laurel Marcus & Associates, and California Sportfishing Protection Alliance. Final Suisun Creek Watershed Assessment and Enhancement Plan, February 2004; McQueeny, Dan. "McQueeny property and restoration site visit." Site Visit and Interview, November 20, 2010.
Irrigation System: watering every 7-10 days	Irrigation system installed according to plan documents.	Mostly. Irrigation system is in place, but in a different manner than originally planned: original plan was for well source to feed into 3 storage tanks, then to feed out into drip irrigation piping. Ultimately, the system in place is a single plastic pipe with individual drips to plants, and no use of the storage tanks due to problems with getting adequate pressure through pipes.	Irrigation was installed by Circuit Rider Productions, but is maintained and monitored by McQueeny. The drip is on a timer (2x/week), and any problems/stoppages must be addressed by McQueeny.	Circuit Rider Productions states that landowner is responsible for maintenance and irrigation schedule. Enhancement plan references landowner participation generally (see paper Problem Statement section). FFF photo-monitoring documents plants conditions, and due to aboveground irrigation, will also document status of irrigation piping and drip.	The irrigation as installed appears to be functioning, but not using the 3 storage tanks that are now installed on his property. He plans to re-use these to create drinking troughs for the cattle on his property as alternatives to their needing to access the stream corridor in search of water. This process will go undocumented because documenting McQueeny's role in irrigation/water supply management only goes so far as to document whether or not seedlings are receiving adequate water, not the larger picture of range management and how that coincides with irrigation of the restoration plants.	Circuit Rider Productions, Inc. McQueeny Property - South Suisun Creek Watershed Program, Riparian Habitat Enhancement Plan. Wooden Valley Creek, Napa County, CA: CALFED Watershed Program Implementation Project, 2007; Laurel Marcus & Associates, and California Sportfishing Protection Alliance. Final Suisun Creek Watershed Assessment and Enhancement Plan, February 2004; McQueeny, Dan. "McQueeny property and restoration site visit." Site Visit and Interview, November 20, 2010.

Evaluation of Re-vegetation in Terms of 1) Interim Objective Achievements and 2) Landowner Involvement

Restoration Objectives	Measurable Outcomes	Achieved Outcome	McQueeny Role	Record of Landowner Participation/Role in Documentation/Monitoring	Notes and Recommendations	Source
Weed removal: twice in spring, once in fall	Weeds removed.	N/A (beginning in Spring, 2011)	High. This is entirely tasked to McQueeny, but he has not yet needed to do any manual weeding, as the plants are relatively new, and the first spring has not yet come.	Circuit Rider Productions states landowner is responsible for weeding. Enhancement plan references landowner participation generally (see paper Problem Statement section). FFF photo-monitoring documents plants conditions, and will also document status of weed removal around seedlings.	Whether or not weeds are adequately removed by McQueeny should be clear through photo-monitoring, but only in limited capacity. McQueeny weeds when he has time, and may not be able to catch/maintain certain weeding activities that might potentially adversely affect seedlings. Whether or not planting success occurs in part due to weeding activity will thus remain an unknown.	Circuit Rider Productions, Inc. McQueeny Property - South Suisun Creek Watershed Program, Riparian Habitat Enhancement Plan. Wooden Valley Creek, Napa County, CA: CALFED Watershed Program Implementation Project, 2007; Laurel Marcus & Associates, and California Sportfishing Protection Alliance. Final Suisun Creek Watershed Assessment and Enhancement Plan, February 2004; McQueeny, Dan. "McQueeny property and restoration site visit." Site Visit and Interview, November 20, 2010.
Non-native eradication to be carried out through physical (non-chemical) processes, and through approved herbicide use	Eradication reduces the number of non-natives along riparian corridor.	Unsuccessful. There have been 4 rounds of eradication through herbicide spraying (Aqua-Shield by Monsanto), none yet through manual removal techniques. While herbicides removed some of the Himalayan Blackberry (non-native), McQueeny found that there was an abundant new outcropping following his original herbicide attempts, which occurred mostly in the dry stream bed and non-planted banks. Blackberries were not encroaching on native plant seedlings.	High. This is entirely tasked to McQueeny - both chemical (herbicide) and manual removal. This is time consuming, and requires a certain level of expertise. McQueeny has been largely unsuccessful in removing non-natives throughout the site in general, but planted areas appear to be clear. The blackberries re-establish easily, despite repeated use of herbicide.	Circuit Rider Productions states landowner is responsible for manual and chemical removal. Enhancement plan references landowner participation generally (see paper Problem Statement section). FFF photo-monitoring documents plants conditions, and will also document status of blackberry removal.	This is another important responsibility critical to success of the proect, for which there appears to be no active monitoring or follow up in communication between FFF and McQueeny, other than the expectation that he will eradicate non-native vegetation using recommended methods. Eradication appears to be successful to the effect of keeping blackberries away from new seedlings, but the blackberries are pervasive throughout the stream corridor. McQueeny has several explanations about why this is occuring (root structures, re-seeding from upstream, and even suggests they might be growing more abundant due to lack of cattle trampling). None of these inputs are recorded or considered in management or monitoring as far as can be observed. McQueeny also has plans for how he might alternately address the problem following the close of his contract (rotate his goats around riparian parcels to trim vegetation).	Circuit Rider Productions, Inc. McQueeny Property - South Suisun Creek Watershed Program, Riparian Habitat Enhancement Plan. Wooden Valley Creek, Napa County, CA: CALFED Watershed Program Implementation Project, 2007; Laurel Marcus & Associates, and California Sportfishing Protection Alliance. Final Suisun Creek Watershed Assessment and Enhancement Plan, February 2004; McQueeny, Dan. "McQueeny property and restoration site visit." Site Visit and Interview, November 20, 2010.

Appendix 18

Zone 14 Vegetation

# (along creek from S to N)	Re-Veg Type	Veg status	Overstory Density (%)	Veg elevation (ft)	GPS Location (degrees N)	GPS Location (degrees W)	Photographs
1	CA bay-laurel	dead	27	259	38.33163	122.14629	 
2	CA bay-laurel	alive	23	259	38.33167	122.14631	 
3	CA bay-laurel	dead	47	262	38.3317	122.14632	
4	CA bay-laurel	dead	17	283	38.33422	122.17634	

Zone 14 Vegetation

# (along creek from S to N)	Re-Veg Type	Veg status	Overstory Density (%)	Veg elevation (ft)	GPS Location (degrees N)	GPS Location (degrees W)	Photographs
5	Valley oak	alive (healthy)	13	296	38.30464	122.24574	 
6	CA bay-laurel	alive	13	297	38.33281	122.14424	 
7	Coast live oak	alive	6	302	38.33234	122.14491	 
8	Coast live oak	alive	0	295	38.33197	122.14644	 

Zone 14 Vegetation

# (along creek from S to N)	Re-Veg Type	Veg status	Overstory Density (%)	Veg elevation (ft)	GPS Location (degrees N)	GPS Location (degrees W)	Photographs
9	Coast live oak	alive	0	283	38.33198	122.14643	 
10	Valley oak	alive (heatlhy)	0	273	38.33203	122.14645	 
11	Oregon ash	alive	0	257	38.33223	122.14655	 
12	Oregon ash and Coast live oak	both alive (healthy)	0	248	38.33223	122.14650	 

Zone 14 Vegetation

# (along creek from S to N)	Re-Veg Type	Veg status	Overstory Density (%)	Veg elevation (ft)	GPS Location (degrees N)	GPS Location (degrees W)	Photographs
13	Oregon ash and Coast live oak	both alive (healthy)	0	243	38.33226	122.14651	 
14	CA bay-laurel	alive	0	234	38.33234	122.14651	 
15	Oregon ash	alive	0	237	38.33241	122.14652	 
16	Unknown	alive (healthy)	0	235	38.33248	122.14650	 

Zone 14 Vegetation

# (along creek from S to N)	Re-Veg Type	Veg status	Overstory Density (%)	Veg elevation (ft)	GPS Location (degrees N)	GPS Location (degrees W)	Photographs
17	Valley oak	alive	0	239	38.33250	122.14647	 
18	Valley oak	alive	0	234	38.33254	122.14648	 
19	Live oak	alive	0	233	38.33259	122.14650	 
20	CA bay-laurel	alive	0	232	38.33266	122.14646	 

Image 1: planted sapling uprooted by wild pigs.

Image 2: same uprooted sapling as in Image 1 above. McQueeny's two dogs, which roam the property freely and herd cattle, and the electric cattle fencing can be seen in the background.

Image 3: looking north up eastern bank of lower Wooden Valley Creek along zone 14 of the McQueeny restoration site; plantings (along stream bank) on right of image.

Image 4: looking south down eastern bank of lower Wooden Valley Creek along zone 14 of the McQueeny restoration site; plantings down center (along stream bank) of image.

Image 5: Invasive Himalayan Blackberry plants (multiple) in stream bed of lower Wooden Valley Creek along zone 14 of the McQueeny restoration site, approximately 30 feet into stream bed from planting # 15.

Image 6: Invasive Himalayan blackberry plant in stream bed of lower Wooden Valley Creek along zone 14 of the McQueeny restoration site, adjacent (though further than 20 feet) from native plantings along eastern stream bank.

Image 7: Invasive Himalayan blackberry plant in stream bed of lower Wooden Valley Creek along zone 14 of the McQueeny restoration site, adjacent (though further than 20 feet) from native plantings along eastern stream bank.

Image 8: Invasive Himalayan blackberry plants along western stream bank of lower Wooden Valley Creek (stream bed is braided towards the northern end of zone 14 and splits into three segments: west, central, and east – zone 14 plantings are on eastern bank). Blackberry is less pervasive along eastern bank, but as shown above, abundant along the steep slope of the western bank where there were no plantings (this year).

Image 9: *See Image 8*. Additional invasive Himalayan blackberry along western stream bank in zone 14.

Image 10: Example of height of native planting and protective mesh pocket.

Image 11: Electric cattle fencing on McQueeny property; note that improvisational adjustments are made to the fence in order to accommodate the hilly landscape – in this case, the fencing is tied down by plastic rope and a barbell (orange rope tided to white fence can be seen near the right corner of the photograph). McQueeny must constantly make these types of adjustments to control cattle movement.

Image 12: Electric cattle fencing running through an outcropping of invasive Himalayan blackberry.

Image 13: Looking north at the beginning of zone 14 along the eastern bank of the lower Wooden Valley Creek. From left to right we see: stream bed with pioneer vegetation, slightly elevated floodplain, and stream bank (along which natives are planted). The elevation from flood plain to stream bank (where saplings are planted) is approximately 3-4 feet in height throughout zone 14.

Image 14: Cow manure on irrigation pipe. The cattle have partial access to the stream (electric fence is visible in the background, blocking cattle from a section of the McQueeny property), and because the irrigation runs the entire length of the lower Wooden Valley Creek through McQueeny's property, the irrigation piping runs through actively grazed plots of land.

Image 15: Looking west across Lower Wooden Valley Creek; heavily vegetated area on right has been fenced off from cattle grazing for 3 years. This is not restored zone 14, but an adjacent un-planted segment of the lower Wooden Valley Creek directly behind (and north of) McQueeny's home.

Image 16: *See image 15.* This is looking east across the same section of Lower Wooden Valley Creek on the McQueeny property.

Image 17: View of the entire stream bed (this is same location as in images 14 and 15 above) in the non-restoration segment of the lower Wooden Valley Creek behind McQueeny's house (just south of restored zone 14). Stream bed width is approximately 30 feet at this point (which is narrower than the stream bed north in restored zone 14).