Winters Putah Creek Park – Part 2 – Analysis of Project Failures

by Friends of Putah Creek - August, 2019

EXECUTIVE SUMMARY

This document examines shortcomings in planning, engineering, and monitoring methods used by the Solano County Water Agency (SCWA) to alter a one mile+ reach of Putah Creek in the Winters Putah Creek Park project and which are proposed for application to additional reaches of the Creek as it flows over 22 miles to the Yolo Bypass.

Previous work on the Winters Putah Creek Park project has produced less than acceptable results as quantitatively documented in a previous report entitled *Winters Putah Creek Park – Part 1 – Case Study of a Failed Project* by Friends of Putah Creek. Friends of Putah Creek (FOPC) is a non-profit advocacy group devoted to protecting Putah Creek's natural heritage and ecological functions.

This report reviews project practices and outcomes and provides context through the lenses of conservation strategies and best management practices recommended by the following authoritative guides to proper restoration:

1) The recently adopted ***Yolo Resource Conservation Investment Strategy - Local Conservation Plan***,

2) The ***California Riparian Restoration Handbook*** (2nd ed, 2009) by Restoration Ecologist F. Thomas Griggs, Ph.D., and

3)The ***Low-Tech Process-Based Restoration of Riverscapes: Design Manual*** by Utah State University Restoration Consortium.

Putah Creek restoration methods that have been implemented by the Solano County Water Agency (SCWA) are compared to these best management practices as summarized below.

1. Winters Putah Creek Park Violates Many Conservation Strategies and Best Management Practices in the *Yolo Resource Conservation Investment Strategy - Local Conservation Plan* (RCIS-LCP)

The *Yolo Resource Conservation Investment Strategy - Local Conservation Plan (RCIS-LCP)* is a landmark document prepared under the guidance of the Yolo Habitat Conservancy which specifies Conservation Strategies for enhancing the habitat of lands and waterways within Yolo County. These mandated strategies should be viewed as Best Management Practices to be applied to all projects. The Winters Putah Creek Park project violated numerous principles of the RCIS-LCP as identified in sections (a) through (f) below.

a) To meet the goal of maintaining the integrity of natural communities in restoration projects, the RCIS-LCP recommends using only native soils and specifically advises against the use of imported fill and soil compaction.

These recommendations were ignored by SCWA in executing the Winters Putah Creek Park project wherein two to twelve feet of imported heavy, clayey soil was deposited on the creek floodplain and then intentionally compacted.

b) Under the goal of *improving dynamic hydrologic and geomorphic processes in watercourses and floodplains in a way that avoids or minimizes impacts on terrestrial species habitat and increases structural diversity*, the conservation strategy recommendations include:

- Creating riparian management corridors that permit lateral channel migration;
- Creating secondary channels and overflow swales that add riverine and floodplain habitat values (e.g., resting or rearing areas for fish migrating downstream), allowing channels to meander naturally through the floodplain;
- Providing greater topographic and hydrologic diversity, recognizing that depressional features such as ponds and back channels that provide important refugia for species such as western pond turtle and that higher ground in floodplains that can serve as wildlife refugia from floodwaters.

Instead, the new stream channel as engineered by SCWA is designed to be "*stable and self-sustaining*". The floodplain as designed and constructed is a planar surface sloping at a uniform 2% uniform grade across the entire floodplain, eliminating almost all topographical diversity including ponds and high ground. Further, imported and compacted fill is so indurated that potential lateral migration and future meandering is extremely restricted.

c) Under the goal of *maintaining fluvial equilibrium and protecting lacustrine/riverine systems supporting American beavers*, the conservation strategy recommendations include avoiding stream channelization, avoiding unnecessary vegetation removal, and targeting portions of streams that support American beavers for protection including protection of existing beaver dams.

Instead, the relocated stream was highly channelized, utilizing compaction, log revetments, and boulders. Over 90% of the vegetation in the floodplain was removed by bulldozers, ponds that supported beaver colonies were drained and filled, and high banks with occupied beaver dens were leveled. The once thriving beaver population is reduced to one or two animals that occupy a single very small section of creek that, in an eleventh-hour move, was fortunately preserved as a backwater.

d) Under the goal of *maintaining and/or restoring and protecting stream processes and conditions*, conservation strategy recommendations include maintaining subsurface flow, connecting groundwater hydrologically to streamflow in each watershed, and expanding and protecting riparian vegetation.

Instead, earth-moving and deposition of compacted fill imported by SCWA has disconnected the stream from groundwater. Efforts by SCWA to remediate the loss of subsurface flows by testing "French Drain" type channels have been largely unsuccessful. Most riparian vegetation was removed from the flood plain during rechannelization, deposition of fill, and other heavy equipment earth-moving activity.

e) Under the goal of *increasing the area of shaded riverine aquatic habitat for focal fish species and increasing the amount of large wood material in the stream*, recommended conservation strategies include enhancing the biomass of overhanging or fallen branches and in-stream plant material to support the aquatic food web, restoring vegetation along stream-banks, increasing input of large woody material to streams, and installing large woody material directly into streams and along stream banks as a component of restoration or enhancement projects.

Instead all overhanging vegetation was removed when the floodplain was bulldozed and the stream channel was moved, and the majority of woody biomass was eliminated. The compacted earth fill created a dense, root-restricting soil strata that will permanently retard or prevent growth of woody riparian plants.

f) Under the goal of *increasing Western Pond Turtle habitat*, conservation strategy recommendations include protecting occupied areas and adding rocks and logs to aquatic habitat to provide basking sites and cover.

Instead, except for the very short backwater that was not in the engineering plans and was added as an afterthought, slow moving sections and ponds favored by Western Pond Turtles were eliminated, existing basking sites were removed, and known nest sites were bull-dozed.

The actions by SCWA disregard established best practices and violate the fundamental and critical conservation strategies mandated by the *Yolo Resource Conservation Investment Strategy - Local Conservation Plan.*

2. Winters Putah Creek Park Does Not Meet Pre-Project Engineering Analysis and Post-Project Monitoring Recommendations in ***California Riparian Habitat Restoration Handbook, Second Edition***, July 2009 by F. Thomas Griggs, Ph.D., Senior Restoration Ecologist

The *California Riparian Habitat Restoration Handbook* is specifically recognized in the *Yolo Resource Conservation Investment Strategy - Local Conservation Plan* (RCIS-LCP) as an authoritative source that is widely accepted among restoration scientists for conservation actions to restore riparian natural community habitats.

The Winters Putah Creek Park project does not meet pre-project engineering analysis and post-project monitoring recommendations in the *California Riparian Habitat Restoration Handbook.*

It is abundantly clear from this restoration manual that one of the most, if not THE most important criterion when considering the likelihood of success of any restoration project is to have a complete and thorough understanding of pre-existing soils and underlying strata in both the stream bed and the adjacent floodplain. Information and analysis of multiple soil samples from different depths of numerous bores throughout the entire project area are key factors in determining the appropriate replanting strategy for the riparian forest.

Friends of Putah Creek (FOPC) requested any applicable soil or fill analyses information from SCWA on numerous occasions. When nothing was received FOPC issued a Public Record Act Request that included a request for information on pre-existing soil conditions. Almost a year later SCWA has yet to provide the information, suggesting that such an analysis was not completed. With information from such an analysis, SCWA should have chosen to modify plans to deposit and compact the massive volume of foreign clayey fill material in the stream-bed and floodplain.

Subsequent to the completion of the first two phases of the project, FOPC members took surface samples from the new floodplain. It was necessary to use a pick-ax to remove a one-foot square sample, which resembled an adobe brick in density and hardness. In some areas extensive remediation will be required to facilitate the return of a viable riparian forest. Such measures as removal of existing indurated soil, replacement of gravel layers, and back-filling with uncompacted, amended soil will likely be required.

It is also evident from the *California Riparian Habitat Restoration Handbook* that a rigorous and quantitative wildlife monitoring regime is critical to determining success of restoration projects as well as for adaptively managing mitigation efforts and revising future restoration plans. Wildlife monitoring to determine restoration success should include plants, fish, insects, birds, amphibians, and mammals. SCWA is required to complete wildlife monitoring under the 2002 Putah Creek Accord. Wildlife monitoring reports are required to be posted annually within 15 days of receipt by SCWA, but this requirement has been ignored for years.

Friends of Putah Creek requests for all pre-project and post-project wildlife monitoring data for the Winters Putah Creek Park project have been ignored by SCWA even when they were formally required to produce the reports through a Public Records Act Request. It is very telling that SCWA either has not performed the required monitoring or refuses to release the results as required by both the court and standard restoration practices.

3. Winters Putah Creek Park Design Philosophy Conflicts with Proven and Cost-Effective Restoration Strategies Discussed in ***Low-Tech Process-Based Restoration of Riverscapes: Design Manual*** (Utah State University Restoration Consortium, 2019)

The *Low-Tech Process-Based Restoration of Riverscapes: Design Manual* is specifically intended to assist restoration professionals to achieve successful restoration of stream and riparian ecological health in ecosystems degraded by man-made structures and impacts. It provides the underlying design philosophy and tools enabling restoration scientists and practitioners to produce remarkable results in restoring salmon habitat, as referenced in a recent Science article (Science, June 8, 2018, Vol 360 - Issue 6393), by the use of low cost beaver dam analogs and other natural structures costing approximately $10,000 per mile of restored stream. This compares with the equivalent costs of almost $6,000,000 per mile spent on the Winters Putah Creek Park project which has yet to produce evidence that any salmon spawned in the creek are returning as a result of the project. It is apparent that there are substantial differences between the low tech and low-cost methods used by experienced professional restoration ecologists versus the practices employed by SCWA on Putah Creek.

The Winters Putah Creek Park project engineering philosophy conflicts with the proven and cost-effective restoration strategies discussed in this design manual, which uses low-cost structures of natural materials and beavers themselves to add complexity and diversity to floodplains. This is inherently less expensive (by at least 2 orders of magnitude) than floodplain-damaging techniques that rely on massive earth moving machinery to create a constrained stream bed as was done at Winters Putah Creek Park.

For instance, great effort was expended in the Winters Putah Creek Park project to obtain a "stable" and "self-sustaining" Creek form but, as explained by the *Low-Tech Process-Based Restoration of Riverscapes: Design Manual*, these attempts are self-defeating. Quoting the manual, "*Stability is not a hallmark of healthy riverscapes...The desire to reduce uncertainty and precisely predict restoration outcomes has led to practices that tend to emphasize the stability of channels and in-stream structures. In the context of stream restoration, stability has often meant static. Constructed features and attributes such as plan-form, channel width, location of pools and riffles are designed in such a way that they do not change through time. The emphasis on stability requires detailed engineering designs, modeling, and heavy equipment, all of which contribute to the high cost of restoration….**However, population level response of target species*** [e.g., salmon and steelhead] ***to these restoration actions is equivocal***." (Emphasis added)

Certainly, the desired outcome of the work in Winters Putah Creek Park has been questionable. Despite a cost of about $6,000,000 to alter only one mile of Creek, there have been no quantifiable benefits to wildlife. After eight years some areas are still devoid of native vegetation despite extensive planting efforts and hundreds of replanted trees and shrubs have not survived. The loss of pools, undercut banks, and overhanging vegetation caused by the bulldozing of the original Creek channel and floodplain has compromised the kind of habitat that allows native fish populations to thrive. Fish populations have consequently plummeted in the affected areas according to SCWA's own data. There have also been noticeable drops in mammal, bird, and amphibian populations in these areas.

The target species that was supposed to benefit the most from the Winters Putah Creek Park project was fall-run salmon. Despite 2,000 tons of imported spawning gravel and carefully timed supplemental flow releases, after eight years following completion of the first two phases of the project there is still no evidence that salmon from eggs hatched in the creek have returned to spawn.

According to the above design manual, "*A central premise of process-based restoration is that restoration of natural systems (e.g., rivers streams, their floodplains and watersheds) is best achieved by 'letting the system do the work'. Process-based restoration recognizes that to restore ecologically functional riverscapes, we need to restore the physical and ecological processes responsible for creating and maintaining those conditions*."

Friends of Putah Creek fully agrees with the basic premise of this gentle restoration approach in which the return of natural systems is facilitated by invasive plant removal and native plantings rather than by employing brute diesel force to reshape the ecosystem, as has been the hallmark of SCWA's methods. As Jared McKee, an environmental engineer with the US Fish and Wildlife Service and expert in riparian systems and habitat restoration appropriately asked:

"What if restoration was about stream power doing the work, not diesel power?"

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BACKGROUND

In June, 2018, Friends of Putah Creek published a document entitled, *Winters Putah Creek Park – Part 1 - Case Study of a Failed Project*. The following discussion draws from that document.

The stated objectives of the SCWA Winters Putah Creek Park project were to enhance the overall habitat of the section of Putah Creek running through Winters by:

- Removing invasive species such as Arundo, Himalayan blackberry, and Eucalyptus and replacing them with native species
- Lowering water temperatures in Winters and downstream to attract more salmonid migration into these lower sections of the creek and improve salmon spawning success, and
- Improving overall fish habitat to increase fish populations.

The project as implemented by the Solano County Water Agency (SCWA), first used bulldozers and earth-movers to clear and strip most of the mature and mostly native riparian forest from Putah Creek's floodplain in Winters. Over 90% of the mature trees and other shrubs and ground vegetation in the floodplain were removed in this process.

The floodplain was then flattened and, in the first two phases of the project, covered with 70,000 cubic yards of a heavy, clayey imported fill brought in from a distant canal excavation site. This fill was spread with bulldozers into a 2 - 12 ft. deep layer. The entire floodplain was then graded bank-to-bank to a 2% slope and compacted to a density functionally equivalent to a canal or landfill lining. This layer of hard fill is several or more feet thick in most sections of the floodplain.

A new creek channel was then formed in the newly compacted floodplain. The man-made channel was significantly narrower (varying between 26-30 ft width) in most sections than the former one and virtually all pre-existing elements of habitat diversity in the floodplain (including ponds, back channels and swales) were eliminated in its construction.

Unfortunately this process resulted in a project that has failed to deliver on any of the main objectives above and, in fact, has produced some serious unintended adverse side effects, as follows:

1. **Failure to Reestablish a Riparian Floodplain Habitat**

Literally hundreds of seedlings and saplings have been planted in the eight years following completion of the first two phases of the project. Almost all the replants have since died for lack of water, because water cannot move laterally through the soil from the stream to the trees through the dense compacted fill. Nor can precipitation, air, or roots vertically penetrate the hardened surface of the floodplain. In most all parts of the project, the dense compact impermeable fill has completely disconnected the new creek channel from the original porous, gravelly, permeable floodplain. The compacted, hardened fill also blocked creek water from reaching residual mature trees in the floodplain which are now dead or slowly dying due to lack of water transport through the floodplain to their root zones. Apparently, no investigation of soil types, particle size differentiation, or subsurface stratigraphy was performed prior to the project, and during planning no consideration was given to soil conditions, subsurface stratigraphy, or groundwater movement.

2. **Failure to Reduce Creek Temperatures**

Reducing creek temperatures to improve trout habitat was to be a major benefit of rechannelization. It was supposed that stream temperatures would be lowered by increasing stream velocity through the newly narrowed creek channel along with more shading provided by the riparian forest that never developed. Unfortunately, as Solano County Water Agency's own stream temperature and flow data show, there has been no reduction in water temperature as a result of the Winters Putah Creek Park project. A temperature difference that SCWA tried to attribute to the project instead proved to be due to an increase in flow. SCWA can provide no quantitative modeling or engineering studies performed to test or validate the assumption of a desired temperature effect.

3. **Reductions in Fish Population**s

A main objective of the Winters Putah Creek Park project was to improve the creek as native fish habitat. There is no evidence this goal has been achieved based on recently disclosed data. Indeed, SCWA's data show fish populations in the reach of Putah Creek through Winters instead declined by about 67% in the first 4 years after completion of the first two of three phases of the project.

4. **Significant Reduction in Annual Groundwater Recharge due to Impermeable Compacted Soils**

The Winters Putah Creek Park project also had the unseen but very serious consequence of decreasing groundwater recharge. This effect has been neither recognized nor evaluated by SCWA. Due to the high porosity of the original sandy, gravelly bed and floodplain of Putah Creek, Putah Creek water historically was a very significant source of groundwater recharge as it passed through Winters. This is the groundwater relied upon by the City of Winters for municipal needs and by surrounding farmers for irrigation needs. Based on stream flow data recorded by SCWA itself, this recharge has fallen by over 4,000 ac-ft per year – about twice Winters' annual municipal water use for all residential and commercial customers and approximately equal to the amount of water needed to annually irrigate about 1,300 acres of almonds. Apparently, SCWA gave no consideration to the below-ground impacts of the projects, did no quantitative modeling, engineering, or testing of the imported fill that should have been done, and that would have predicted the adverse groundwater impact of so tightly sealing the floodplain that water cannot penetrate it.

EVAULATION OF THE CAUSES OF THE PROJECT FAILURE

In evaluating the root cause of why the project has had so many poor performance results, the following external documents by recognized experts and authoritative sources are referenced. The full documents can be downloaded by clicking on the document name or inserting the following links into a browser.

1. ***Yolo Resource Conservation Investment Strategy - Local Conservation Plan*** (https:// nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=157451&inline),
2. ***California Riparian Restoration Handbook*** (2nd ed, 2009) by Restoration Ecologist F. Thomas Griggs, Ph.D. (https://water.ca.gov/LegacyFiles/urbanstreams/docs/ca_riparian_handbook.pdf), and
3. ***Low-Tech Process-Based Restoration of Riverscapes: Design Manual*** by Utah State University Restoration Consortium (https://www.researchgate.net/publication/ 332304757_Low-Tech_Process-Based_Restoration_of_Riverscapes_Design_Manual_Ver- sion_10).

Design standards, methods, and best practices from these manuals, documents, and reports are sequentially presented below followed by a discussion and application to the engineering, implementation, and post-project monitoring of the Winters Putah Creek Park project.

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1. Winters Putah Creek Park Violates Many Conservation Strategies and Best Management Practices in the Yolo Resource Conservation Investment Strategy - Local Conservation Plan (RCIS-LCP)

The Yolo Resource Conservation Investment Strategy - Local Conservation Plan (RCIS-LCP) was recently prepared for the Yolo Habitat Conservancy. The RCIS-LCP is meant to serve as a broad road map for conservation of all Yolo County ecosystems and species not specifically addressed in the Habitat Conservation Plan / Natural Community Conservation Plan (HCP/NCCP). In many respects the *Conservation Strategies* in the RCIS-LCP may be considered best management practices for ensuring protection of Yolo County's ecosystems and species.

The *Conservation Strategies* contained in the RCIS-LCP are listed in an extensive table identified as **Table 3-3. Conservation Goals and Objectives and Applicable Conservation Actions**. The table divides *Conservation Strategies* into 1) Landscape-Level Goals and Objectives, 2) Natural Community-Level Goals and Objectives, or 3) Species-Level Goals and Objectives.

Within each of these categories, different specific Biological Goals and Objectives are identified followed by Applicable Conservation Actions recommended to ensure the stated Biological Goals and Objectives are met.

Only those important *Conservation Strategies* which are directly applicable *and* which are functionally *NOT* met by the Winters Putah Creek Park project are discussed in this report.

For each applicable *Biological Goals and Objectives* and associated *Applicable Conservation Actions* discussed below, the exact text in the RCIS-LCP is used. Bold, blue high-lighted emphasis is placed on selected text by Friends of Putah Creek to highlight important points where the projects do not follow the excerpted *Biological Goals and Objectives* and associated *Applicable Conservation Actions.*

Table 3-3. Conservation Goals and Objectives and Applicable Conservation Actions

LANDSCAPE LEVEL GOALS AND OBJECTIVES

Goal L1: Large Interconnected Landscapes. Maintain interconnected landscapes in Yolo County with the range of physical and biological attributes (e.g. slope, soils, hydrology, climate, and plant associations) that support the distribution and abundance of focal and conservation species and their habitats, provide for the movement and genetic interchange among populations of focal and conservation species, support adaptive adjustments in species distributions in response to climate change, and sustain native biodiversity	
Biological Goal and Objective	**Applicable Conservation Actions**
Objective L1-4: Natural Community Restoration. Increase the extent of natural communities through restoration, in a manner that maximizes the likelihood of their long-term functioning, taking into consideration of both historic conditions and potential future conditions with climate change.	**L14.1.** Restore species composition and ecological processes in natural communities in areas **with the appropriate soils, hydrology**, and other physical conditions that support the community. **L1-4.2.** Implement initial restoration actions according to **recommendations in a restoration handbook such as Griggs (2009)** that is widely accepted among restoration scientists.

	L1-4.5. Adaptively adjust restoration approaches on the basis of additional knowledge gained from monitoring or observing previously implemented restoration actions. Incorporate knowledge gained from restoration science generally to the extent that it addresses conditions in Yolo County.
	L1-4.7. Use native local soils.
	L1-4.8. Do not import fill.
	L1-4.9. Do not compact soil.

Discussion Added by Friends of Putah Creek

***L1-4.1 and L1-4.2** – One of the key recommendations in Griggs (2009) is that extensive soil analysis of the floodplain be performed to ensure that soils used in remediation support the natural ecosystem and ecological processes of the floodplain. Particle size and mineral content analysis should be analyzed and the results used to determine the soil stratification throughout the entire project area. This is extremely important, as pointed out in Griggs, because it is the nature of the floodplain stratification that primarily determines the lateral transport of water and nutrients in the floodplain.*

Friends of Putah Creek has repeatedly requested that SCWA release information on their analysis of soil samples from the original floodplain and the imported fill and on their stratification analysis of the floodplain. SCWA has provided no such records in response to an official Public Records Act Request. It seems that SCWA failed to perform these necessary preliminary soil and stratification analysis as otherwise recommended by Griggs in the California Riparian Habitat Restoration Handbook (also see below).

***L1-4.5**. - Phases 1 and 2 of the Winters Putah Creek Park project were completed in 2009 – 2011. Almost immediately, the project was challenged because the work on the project went well beyond the scope of the original Mitigated Negative Declaration (MND) environmental assessment of the project. That MND clearly specified that minimal vegetation was to be removed and that no foreign sols were to be brought into the project area. Unfortunately both these MND specifications were violated. Consequently problems with riparian replanting arose immediately that were identified as resulting from the imported fill placed on the floodplain and then compacted. Nevertheless construction of Phase 3 of the project commenced seven years later in October 2018 using identical methods to those known to have failed in Phases 1 and 2 including the removal of almost all vegetation in the floodplain and substantial addition and compaction of imported fill.*

Meanwhile quantitative evidence showed there were serious adverse impacts on groundwater recharge caused by lack of infiltration of water from the creek through the compacted fill into the underlying aquifer. This information was made available to SCWA between completion of Phases 1 and 2 and commencement of Phase 3. Unfortunately, SCWA ignored this new information and failed to adaptively use it in the design and implementation of Phase 3. The same imported fill was again deposited on a riparian floodplain from which all natural features had been removed by heavy equipment. In addition to again violating the provisions of the original MND, SCWA clearly did not "Adaptively adjust restoration approaches on the basis of additional knowledge gained from monitoring or observing previously implemented restoration actions". This directly conflicts with the Conservation Strategy calling for such adaptive management.

L1-4.7, L1-4.8, and L1-4.9 *– The 70,000 cubic yards of fill imported and used in the first two phases of the project and the over 15,000 cubic yards of fill imported and used in the third phase of the project were provided by SCWA from fill left over from decades-old excavation of the South Putah canal. The fill was excavated from an ancient geologic formation depleted of organic matter and containing a high percentage clay. At the project site it was spread and compacted to a depth of from 2 to 12 feet. In no way, form, or fashion can that fill be considered similar or equivalent to "locally native soils" which are primarily sandy loams interspersed in layers with sandy gravel and cobble layers and organically rich silt deposits. As discussed above, SCWA also has not provided any analyses of this imported fill material despite repeated formal requests.*

Use of this imported and compacted fill to create a new floodplain in the project area violates three critical identified Conservation Strategies. The project 1) ***did not use locally native soils*** *which 2)* ***was otherwise imported****. Further, 3)* ***it was compacted to an extraordinary level by the earth-moving contractor*** *per the contract specifications by SCWA itself! These actions violate some of the most basic tenets of restoration science and were done without explanation by SCWA engineers and management personnel. They also violate provisions and declarations in the Mitigated Negative Declaration under which the Winters Putah Creek Park project was installed pursuant to the California Environmental Quality Act (CEQA).*

Goal L2: Ecological Processes and Conditions. Maintain or restore ecological processes and conditions in Strategy Area landscapes that sustain natural communities, native species, and landscape connectivity	
Biological Goal and Objective	**Applicable Conservation Actions**
Objective L2-1: Hydrologic and Geomorphic Processes. Improve dynamic hydrologic and geomorphic processes in watercourses and floodplains in a way that avoids or minimizes impacts on terrestrial species habitat (including the HCP/NCCP) and agricultural land. Allow floods to promote fluvial processes, such that bare mineral soils are available for natural recolonization of vegetation, desirable natural community vegetation is regenerated, **and structural diversity is promoted; or implement management actions that mimic those natural disturbances**.	**L2-1.1.** Restore riverine geomorphic process on the Sacramento River, Putah Creek, Cache Creek, Tule Canal, and other watercourses in the Strategy Area. **Create riparian management corridors that can accommodate natural lateral channel migration**. Relocate levees away from watercourses to reduce the physical forces acting on them, and to allow natural lateral channel migration. • **Create or improve secondary channels and overflow swales that add riverine and floodplain habitat values** (e.g., resting or rearing areas for fish migrating downstream) and provide escape routes for fish during receding flows. • Minimize new bank protection actions, or remove non-critical bank protection features, to **allow channels to meander naturally within the floodplain.**
	L2-1.3. Modify the floodplain to improve function and support focal species. • Modify floodplains in locations where higher ground impedes flow connectivity or capacity, to increase the hydrologic connectivity and capacity of the active floodplain, im-

	prove fish migration, reduce stranding potential, and allow additional riparian vegetation to establish without significantly impeding flows. • **Modify floodplains to provide greater topographic and hydrologic diversity.** Eliminate depressional features (such as isolated gravel pits or deep borrow pits) that strand fish when water recedes, but **recognize that depressional features such as ponds can be important refugia for species such as western pond turtle and giant garter snake.** • **Create higher ground in floodplains that can serve as refugia from floodwaters for wildlife species,** including giant garter snake and California black rail.

Discussion Added by Friends of Putah Creek:

L2-1.1*. - The uniform 2% slope of the entire floodplain produced by the bulldozers and earthmovers destroyed rather than acted to "create or improve secondary channels and overflow swales that add riverine and floodplain habitat values". In fact, virtually all of the lateral and secondary features of the floodplain have been intentionally and completely eliminated by design. Thus, secondary features for "resting or rearing areas for fish migrating downstream" do not now exist in most of Winters Putah Creek Park. Further, because of the hard-pan surface and uniform slope of the floodplain, the fixed channel design does not "create riparian management corridors that can accommodate natural lateral channel migration".*

In fact, the uniform width of the constructed channel was expressly designed to be "self-sustaining" and "to show long-term tendencies to remain in stable condition without accelerated vertical or lateral erosion". The only basis SCWA could provide for this channel design specification was two letters from the design consultants to SCWA which are attached as Appendix A. Unfortunately, these specified static channel design objectives by which the project was constructed clearly conflict with the stated best management practices and goals of the Conservation Strategies, which specify that "structural diversity is promoted; or implement management actions that mimic those natural disturbances".

L2-1.3. - *Project engineers repeatedly claimed the creek and floodplain modifications in the Winter Putah Creek Park would restore the "natural form and function" of the Creek without ever objectively specifying what the "natural form and function" of the Creek should be. In fact, the static monolithic and highly compacted 2% slope of the floodplain after construction is extremely unnatural and dramatically reduces rather than "provide greater topographic and hydrologic diversity".*

All depressional features in Phases 1 and 2 of the floodplain landscape were eliminated including all ponds without "recognizing that depressional features such as ponds can be important refugia for species". Rather than "Create higher ground in floodplains that can serve as refugia from floodwaters for wildlife species", all such high ground was functionally eliminated when the floodplain was flattened and graded to a uniform slope.

Fig. 1 - Recent “Before and After” photos following bulldozing and leveling of a rich riparian floodplain habitat.

Friends of Putah Creek have repeatedly requested that the design criteria and engineering analysis used by SCWA in design of the Creek channel be provided in order to determine consistency with accepted riparian restoration practices. These have not been made available. There is otherwise no evidence that any engineering analysis or modeling of the Creek’s "form and function" was utilized by project engineers.

Rather, SCWA relied on subjective judgments instead of quantitative criteria to establish the Creek project topography. Indeed, the channel designer specifically stated that he “<u>relied on these field observations for project design, and prefers the use of field indicators over other more technical methods of channel design and flow modeling. Modeling is a valuable tool and can be used to support design criteria, but should be verified with field data that documents the natural tendencies of the stream channel form and function</u>.”

In this case, however, it appears that subjective “<u>field observations</u>” were the only criteria by which the channel “<u>form and function</u>” were determined. Even the subjective “<u>field observations</u>” cited by the engineers to guide their design criteria have not been provided or disclosed for independent review despite a Public Records Act request.

NATURAL COMMUNITY-LEVEL GOALS AND OBJECTIVES

Lacustrine

Goal LR1: Stream conservation. Conserve and enhance stream systems in Yolo County.	
Biological Goal and Objective	**Applicable Conservation Action**
Objective LR1.1. Fluvial equilibrium. Maintain and/or restore fluvial equilibrium between erosion and deposition in Strategy Area streams.	**LR1.1-1. Avoid stream channelization.**
	LR1.1-2. Avoid unnecessary vegetation removal.
Objective LR1.2. American beavers. Protect lacustrine/riverine systems supporting American beavers.	**LR1.2-1. Target portions of streams that support American beavers for protection.**
	LR1.2-2. Incorporate beaver management practices into management plans for lands protected by a con-

	servation easement or other instrument providing for perpetual protection of land supporting or potentially supporting this species (where consistent with existing laws and regulations related to flood easement areas). **Such management may include protection of existing beaver dams where possible**, and installation of deceiver or bypass devices where necessary, rather than dam removal. Management may also include wrapping trees identified for retention with wire cylinder tree wraps or cages.
Objective LR1.4: Stream processes and conditions. **Maintain and/or restore and protect stream processes and conditions** in Yolo County streams.	**LR1.4-1.** Encourage maintenance of appropriate minimum stream flows throughout the annual cycle to maintain aquatic life in Strategy Area streams. Flows may not be perennial in many streams, although subsurface (hyporheic) flows often continue to maintain riparian processes even when no surface flow occurs. **Conservation of stream processes is related to maintaining subsurface flow and groundwater that are hydrologically part of the stream-flow in each watershed** (Winter et al. 1998).
	LR1.4-4. **Expand and protect riparian vegetation along Strategy Area streams** where possible in accordance with flood management and operation laws and requirements.

Discussion Added by Friends of Putah Creek:

LR1.1-1 – *Plans for channel modifications of the Creek specified that the Creek channel be uniformly between 26 and 30 ft wide. That channel was lined with compacted fill. The result constitutes "stream channelization" in direct conflict with this Conservation Strategy.*

LR1.1-2 *– Over 90% of the floodplain vegetation was removed in all phases of the Winters Putah Creek Park project in direct conflict with the Conservation Strategy advice to "Avoid unnecessary removal of vegetation". The extensive removal of native vegetation was also in direct conflict with the environmental assessment and the Mitigated Negative Declaration for the project which specified that minimal native vegetation be removed during construction.*

LR1.2-1 and LR1.2-2 *- The Conservation Strategy recognizes the importance of beaver in improving diversity of the floodplain. However, instead of acting to "Target portions of streams that support American beavers for protection" and to "Protect lacustrine/ riverine systems supporting American beavers", the bulldozing and radical alteration of the floodplain and creek channel intentionally removed deep ponds and beaver dens throughout the Winters Putah Creek Park project. Clearly, SCWA plans did not "include protection of existing beaver."*

LR1.4.1 *– As discussed above, clayey imported compacted fill now covers almost the entire flattened floodplain and lines the stream channel of Putah Creek in the Winters Putah Creek Park project. This fill is nearly impermeable to water. The project fill has disconnected the stream from its floodplain and groundwater aquifer. This is reflected in the revegetation failures, death of mature cottonwoods on the floodplain, a drop in groundwater elevations in a monitoring well, and a reduction in groundwater recharge measured by upstream and downstream gauges. Groundwater recharge, once substantial through this loosing reach of Putah Creek, was re-*

duced by up to 4,000 ac-ft per year. Hyporheic flows could not be persisting along a channel lined with compacted clayey fill.

This conflicts with the objective of this Conservation Strategy to "Maintain and/or restore and protect stream processes and conditions" which further notes that "Conservation of stream processes is related to maintaining subsurface flow and groundwater that are hydrologically part of the stream-flow in each watershed". No quantitative modeling, hydraulic testing, or engineering were apparently performed so this adverse hydrologic impact could be predicted before the Imported fill was deposited in the Creek floodplain.

***LR1.4-4**. By removing almost all vegetation in the project area, SCWA clearly violated the Conservation Strategy to "Expand and protect riparian vegetation along Strategy Area streams".*

Fig. 2 - Recent "Before and After" photos of a once vibrant beaver pool habitat in Winters

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SPECIES-LEVEL GOALS AND OBJECTIVES

Focal Fish Species

Goal FISH1: Protected and enhanced focal fish species habitat. Protect and enhance focal fish species spawning, rearing, and migration habitat in Yolo County.	
Biological Goal and Objective	**Applicable Conservation Action**
Objective FISH1.1: **Shaded riverine aquatic habitat.** Increase the area of shaded riverine aquatic habitat in Yolo County that supports focal fish species.	**FISH1.1-1. Maintain, restore, or enhance shade that moderates water temperatures and reduces visibility to predators.**
	FISH 1.1-3. Enhance the biomass of overhanging or fallen branches and in-stream plant material to support the aquatic food web, including terrestrial and aquatic invertebrates that provide food for fish, and to provide habitat complexity that supports a high diversity and abundance of fish species.
Objective FISH1.4: Large Woody Material in streams in Yolo County.	**FISH1.4-1. Restore vegetation along stream-banks, to increase input of large woody material to streams**

	FISH1.4-2. Install large woody material directly into streams and along stream banks as a component of restoration or enhancement projects.
Objective FISH1.6: Restore Fish Habitat in Putah Creek. Support existing efforts to restore Putah Creek habitat in Yolo County to enhance spawning, rearing, and migration of focal fish species.	**FISH1.6-1**. **Restore in-stream spawning, rearing, and migration habitat for focal fish species in Putah Creek**.
	FISH1.6-2. Restore shaded riverine aquatic habitat along Putah Creek.
	FISH1.6-3. Restore geomorphic and fluvial properties along Putah Creek.

Discussion Added by Friends of Putah Creek:

***FISH1.1-1 and Fish 1.1-3** – Long stretches of the Creek were previously almost fully shaded by the lush and mature riparian forest. Rather than "Maintain, restore, or enhance shade that moderates water temperatures and reduces visibility to predators" and "Enhance the biomass of overhanging or fallen branches and in-stream plant material to support the aquatic food web", the project stripped the floodplain of almost all vegetation. This was followed by extensive and repeated failure of plantings. Now most of the creek is exposed to direct sunlight through most of the project length and there is severely diminished overhead canopy to shed leaf litter into the creek to prime the food chain.*

***FISH1.4-1 and FISH 1.4-2** – Putah Creek through Winters once contained substantial amounts of large woody material directly in its channel, consistent with this Conservation Strategy. Rather than implement a project design to "Restore vegetation along stream-banks, to increase input of large woody material to streams", the project cleared much of the 65 year old floodplain forest that had established after the construction of Monticello Dam, then exported or buried much of the large wood, and covered the floodplain with compacted fill so that normal regrowth of large woody plants is not even possible. So both the existing inventory of large wood and the future supply were severely reduced.*

***FISH1.6-1** – SCWA has claimed the radical alteration of the entire Creek channel was necessary to improve the Creek to "Restore in-stream spawning, rearing, and migration habitat for focal fish species".*

Substantial improvement to existing riffles to improve spawning by salmon could have been more easily and inexpensively accomplished with the addition of gravel and cobble to existing reaches of suitable streambed without destruction of the floodplain and rechannelization. What the rechannelization has done instead is remove deep pool rearing habitat and eliminate overhanging trees which provided shade and leaf litter to the aquatic ecosystem. Further, undercut banks were replaced by sloping banks of compacted fill. Suitable habitat for the rearing and migration of salmon smolts and fry through the Winters Putah Creek Park was destroyed in the construction of the new detoured channel.

SCWA claims the floodplain will regenerate through natural processes that will eventually restore suitable habitat, but the failure of vegetation efforts and native species regrowth in the floodplain over 8 years post-project makes this claim highly dubious and speculative at best.

***FISH1.6-2** - "Restore shaded riverine aquatic habitat along Putah Creek". See **FISH1.4-1 and FISH 1.4-2** above*

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FISH1.6-3. *"Restore geomorphic and fluvial properties along Putah Creek."* *Unfortunately, SCWA's efforts at geomorphic restoration of the Creek with the intention to restore "natural form and function" have done just the opposite. The project has ultimately opposed natural fluvial geomorphology and processes with diesel geomorphology.*

Long before the Winters Putah Creek Park project began, after Putah Creek was dammed in 1955, the creek went through a period of channel and floodplain evolution. There was an abrupt change in flow and flood regime and in sediment regime. And there was a blank slate where the active channel and bare sediments stretched bank to bank across the floodplain.

In 2000 the Putah Creek Accord was signed mandating minimum flows into the Creek from the dam. Over the course of the next decade under the new flow regime, vegetation established, sediments became locked in place, and a new channel evolved in equilibrium with the new flow and sediment regime. A mature native riparian forest grew and the Creek habitat and its wildlife flourished. There were some prior anthropogenic disturbances including some floodplain clearing, some gravel extraction, and wastewater ponds on the floodplain but the stream adapted, a mature forest grew, and channel and banks were in equilibrium.

Then a new period of anthropogenic stream alteration ensued when SCWA embarked on a grant-driven process to "restore" the Creek. As part of this restoration, SCWA alleged the Creek needed to be returned to its "natural form and function". SCWA maintains that the proper channel width in Winters should be uniformly between 27 and 30 ft wide and about 1.5 feet deep and that pools should be filled because they were mostly too deep and wide. This is a claim without scientific basis but served as the foundation justification for the radical floodplain clearing and streambed alteration projects over the past decade..

Instead of relying on established engineering principles, however, the geomorphological justification of the proposed channel changes claimed it "relies on field observations for project design, and prefers the use of field indicators over other more technical methods of channel design and flow modeling. Modeling is a valuable tool and can be used to support design criteria, but should be verified with field data that documents the natural tendencies of the stream channel form and function".

Unfortunately, the geomorphological designers provide no field data or engineering or modeling to support their "observations". Instead they simply claimed that with their design "the Putah Creek channel tends to show long-term tendencies to remain in stable condition, without accelerated vertical or lateral erosion". They add, "We have looked closely at the full range of channel dimensions, patterns, and entrenchment ratios to determine what combination of factors tend to provide the most likely conditions for a self-maintaining channel morphology." (See Appendix A). None of this information has been made available to Friends of Putah Creek when seeking to confirm the design of the altered Creek even when formally requested by a Public Records Act Request. It would therefore appear that the consideration of these "full range of channel dimensions, patterns, and entrenchment ratios" do not exist.

SCWA projects in the Winters Putah Creek Park are drastically altering the stream channel, clearing vegetation, and flattening floodplain. However, SCWA claims that natural processes in the future will restore topographical variation in the creek topography where their projects have erased it, and this will provide requisite "secondary channels and overflow swales that add riverine and floodplain habitat values" that are the hallmarks of a vibrant stream ecosystem. However, the geomorphological designers are otherwise claiming their design would provide a "stable condition, without accelerated vertical or lateral erosion" which is in direct conflict with the natural processes creating topographical variation demanded by a healthy Creek ecosystem.

During fall of 2018, SCWA implemented addition al work in the Winters Putah Creek Park which again involved forest clearing and earth moving, stream alteration, construction of a new channel, and filling old channels. This was followed by an extended period of high flood flows in late winter and spring of 2019. During the floods, natural fluvial processes dramatically altered the precise engineered project including filling much of the man-made channel, reshaping the floodplains, and beginning to reestablish the old channel the project had filled. Rather than allowing these natural processes to occur, SCWA returned this summer with a bulldozer and restored their man-made design, undoing the work of the flowing waters, and opposing the natural fluvial geomorphology with diesel geomorphology. That is not restoring "geomorphic and fluvial properties along Putah Creek"

Western pond turtle

Goal WPT1: Maintenance or Increase of Western Pond Turtle Distribution and Abundance. Maintain or increase the distribution and abundance of western pond turtle within its range in Yolo County.	
Biological Goal and Objective	**Applicable Conservation Action**
Objective WPT1.1: Protect and enhance habitat. Increase protection and enhancement or restoration of western pond turtle habitat in riverine and lacustrine and associated upland areas.	**WPT1.1-1.** Place perpetual conservation easements over western pond turtle habitat, **prioritizing occupied areas**.
	WPT1.1-2. Add rocks and logs to aquatic habitat to provide basking sites and cover, as needed.

Discussion Added by Friends of Putah Creek:

WPT1.1-1 *– Western Pond turtle is a listed sensitive species. It was abundant in Putah Creek through Winters prior to rechannelization because it prefers the fresh, slow-moving water for habitat which was provided by numerous ponds and back-channels. Rather than "prioritizing occupied area" for conservation and "to increase protection and enhancement or restoration of Western Pond Turtle habitat", the project destroyed these areas through the use of heavy equipment without regard for protection of this habitat as required by the Conservation Strategies and best management practices.*

WPT1.1-2 *– Although SCWA embedded logs and rocks in the banks of the creek to "provide basking sites" in the Winters Putah Creek Park, they were in fast moving sections of the Creek and are not used by Western Pond Turtles.*

As a result of the loss of favorable habitat, once abundant Western Pond Turtles are now seen much less frequently in the Winters Putah Creek Park project area and then mostly in the unaltered segments and remnant pools. We have requested, without success, pre-project and post-project annual wildlife monitoring reports from SCWA to quantitatively assess the extent of population decline.

Winters Putah Creek Park Does Not Meet Many Pre-Project Engineering Analysis and Post-Project Monitoring Recommendations in California Riparian Habitat Restoration Handbook, Second Edition, July 2009 by F. Thomas Griggs, Ph.D., Senior Restoration Ecologist

The *California Riparian Habitat Restoration Handbook* is cited in the *Yolo Resource Conservation Investment Strategy - Local Conservation Plan* (RCIS-LCP) as an authoritative expert source of initial conservation actions in restoring riparian natural community habitats (see above Applicable Conservation Actions - *"L1-4.2. Implement initial restoration actions according to recommendations in a restoration handbook such as Griggs (2009) that is widely accepted among restoration scientists*").

Applicable recommendations from *California Riparian Habitat Restoration Handbook* are excerpted and reprinted below for comparison with actual practices employed in the initial design and engineering and follow-up monitoring of the Winters Putah Creek Park project.

The full manual is available to readers and covers many different aspects of restoration that are not directly applicable to the Winters Putah Creek Park project or which are not pertinent or applicable to the riparian eco-systems present in the Winters Putah Creek Park project. As a result, only those important sections of the manual that are directly applicable to the Winters Putah Creek Park project are excerpted and further discussed in this report.

For these applicable sections, the exact text in the *California Riparian Habitat Restoration Handbook* are excerpted and discussed below. Bold, blue color-highlighted emphasis is placed on selected text by Friends of Putah Creek to highlight important points we wish to make to facilitate the discussion of the project shortcomings we offer following each of the excerpted sections.

VI. Design Objectives

B. Objective 2: The Horticultural Potential

Horticultural restoration requires knowledge of local site conditions in order for a planting to successfully establish. It is common for restoration projects to include a three year maintenance regime, during which the plants are irrigated, weeds are controlled and mortality is kept under a specified level by re-planting. Beyond this period of maintenance, species will only survive if they are well matched to the site conditions. Species of plants must be matched to soil types and hydrologic conditions under which they will grow and prosper. Consequently, the first step in developing a plan and a list of species for any riparian restoration project is a detailed site evaluation that describes soils and local hydrology. Ecological preferences of select riparian plants are provided in Appendix 3.

1. Soils

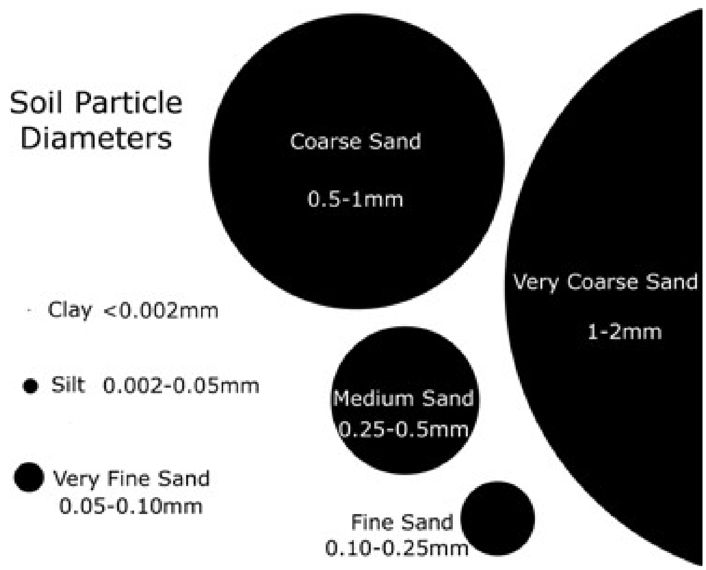
Soil conditions are the most important factors that determine the survival and growth of any species. (If any species cannot grow in the soil on a site, then the restoration planting will fail). Examination of the NRCS web soil surveys for the project site will help determine how many soil cores are needed to ground truth the soil maps. **Soil cores will also provide information about the soil texture and stratification across the site.**

Depth to the water table must also be determined at multiple locations throughout the site. The number of soil cores and measurements to water table will vary by site but soil surveys, river atlases, and aerial photos can help.

a. Texture and Stratification

Soil texture, the proportion of gravel, sand, silt, and clay (Figure 6), usually varies greatly across the entire site. Often this variation is because riparian floodplains receive coarse sediments — sand and gravel over-bank flows which deposit on top of finer sediments. Likewise, soil **texture can dramatically vary with depth, resulting in stratification of the soil profile. This layering of different textures can result in coarse sediments — sand and gravel — lying above or below much finer silts and clays. Plant root growth will be greatly affected by these discontinuities in the soil profile. The movement of irrigation water through the soil profile also will be affected by these discontinuities, which in turn will affect root growth** .

Figure 4: Soil Particle Size



To a large extent, soil texture, determines the survival and growth rate of each species (see Section XIII for a comparison of ecological tolerances among selected riparian species). For example, species such as cottonwood and sycamore grow rapidly in soils that have a high proportion of sand, while valley oak grow best in heavier soils composed mostly of silt and clay. **Soil texture is critical to plant survival and growth because the soil particle sizes determine the water holding capability.** Large particles such as sand allow water to drain quickly and cannot hold water for extended periods. Smaller particles such as silt do not allow water to drain quickly and as a result water is available to plant roots for a longer duration.

Lenses of course soil in the soil profile will affect the growth of plants; lenses of gravel may prevent species that require access to the water table from surviving.

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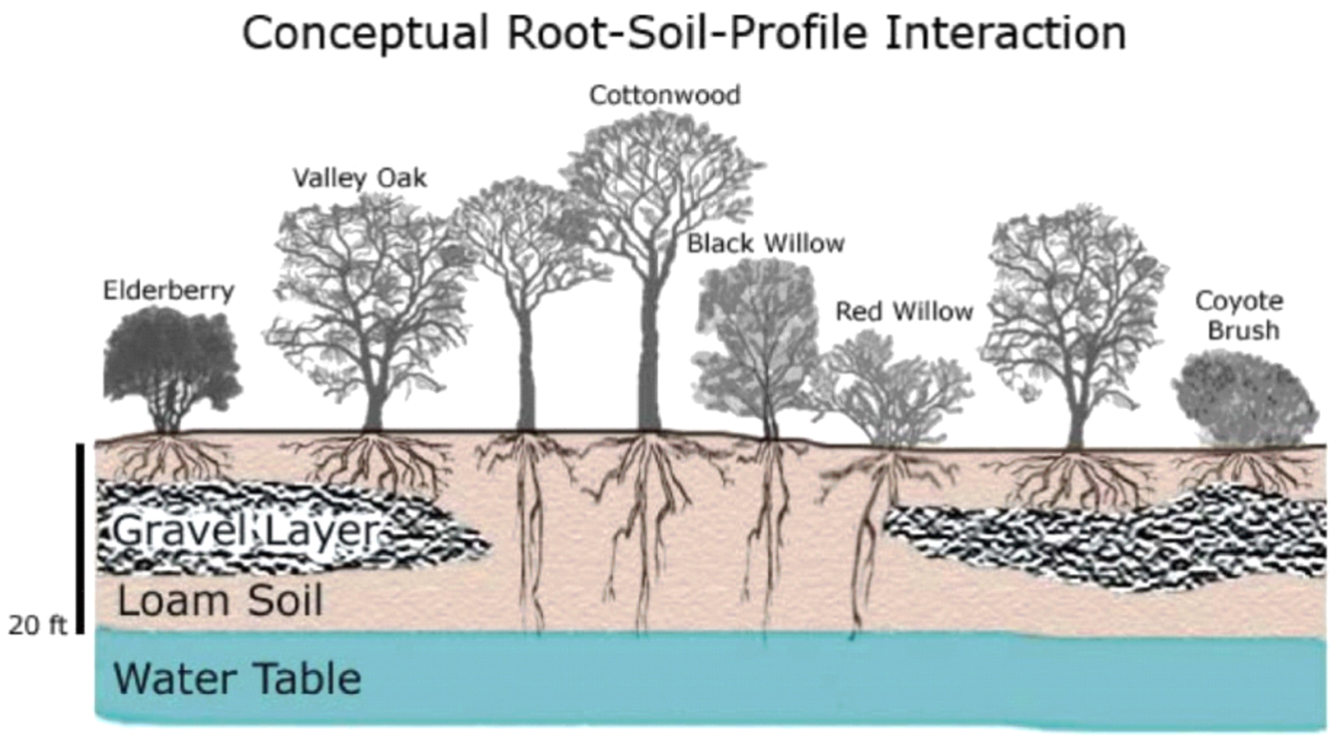

Figure 5: Root-Soil Profile Interaction

b. Depth to Water Table

Depth to water table is second in ecological importance behind soils for determining species survival, growth and the community structure of the vegetation. Depth to water table must be known for several points across a site, as it may vary by several feet. Deep soil-augur cores and soil pit samples taken on the site will al- low the depth to water table to be measured if water is reached, or estimated if soil be- comes moist at the bottom of the pit. Depth to the water table can also be measured with multiple piezometers placed into the ground that reach the ground water table. Cottonwood and willows absolutely must grow their roots into the upper portion of the water table within the three-year maintenance period, or they will die when irrigation is stopped. Other species of trees and shrubs will prosper by growing their roots into the water table, however, this is not a requirement for survival. Soil profile and depth to water table interact and can be a problem for root growth if the top of the water table is within a layer of cobbles or gravel where roots cannot grow well, making the water table functionally out-of-reach of the roots.

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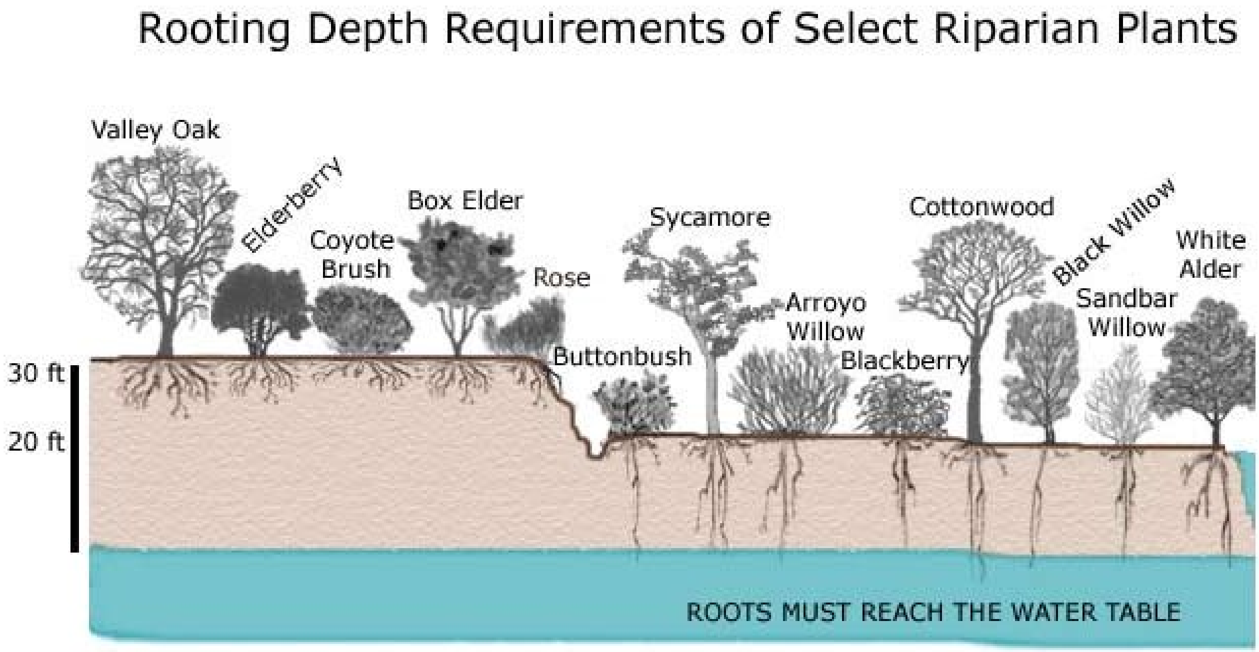
Figure 7: Rooting Depth Requirements of Select Riparian Species



Rooting depth requirements of riparian species must be known, along with the depth to the water table across the site, so that planted species will survive and thrive after irrigation is no longer applied.

Nutrients in Soils (natural vs. fertilizer)

Riparian soils are some of the richest in the state. Deep loamy soils, in combination with a water table within reach of plant roots, support rapid growth throughout the growing season for all species. Naturally occurring nutrients in the soil are abundant and readily available for plant growth. For example, stem cuttings of willow and cottonwood can grow to 6 feet tall the first season and valley oak grown from an acorn can grow to 4 feet the first year. With this kind of plant performance, additional fertilizer at the time of planting is not necessary.

Discussion Added by Friends of Putah Creek:

It is abundantly clear from this restoration manual that one of, if not THE most important criteria for success of any riparian restoration project is to have a complete and thorough understanding of existing soils in both the streambed and the adjacent floodplain. Information and analysis of multiple soil samples from different depths of numerous bores throughout the entire project area are key factors in determining the appropriate replanting strategy for a riparian forest.

This is all the more important if massive volumes of fill material are imported and deposited on a streambed and floodplain as they were by SCWA at the project. The fill also completely lacked the nutrients that promote rapid plant growth in natural and normal riparian soils like those either removed or covered by fill at the Winters Putah Creek project.

We have requested the soil information used by SCWA on numerous occasions. None was provided, indicating to us that they probably never took these most basic steps to ensure the success of their project.

Subsequent to installation of the first two phases of the project, we took our own post-project soil samples from the new floodplain. It required a pick-ax to dig out a one foot deep chunk of fill so hard it resembled an adobe brick or concrete. We do not believe a viable riparian forest will ever grow in this floodplain without extensive remediation or complete removal of this compacted and hardened fill.

VII. Monitoring Riparian Restoration Projects

A. Implementation Monitoring

The purpose, significance, and success of a riparian restoration project can be, and at times are required to be, monitored throughout the entire process. This means monitoring can take place before implementation, during restoration, and after implementation. The California Rapid Assessment Method (CRAM) is a statewide, standardized method to monitor wetlands (which include riparian areas) in a cost-effective and scientifically defensible manner. The methods and handbook are available online (www.cramwetlands.org). Given the ecological complexity of any restoration site, many unknowns will affect the performance of the plants. Consequently, implementation requires an adaptive management approach to the timing and level of intensity of management actions during implementation.

B. Measuring "Restoration Success"

Restoration success of the project will be determined by how well the goals for the project were met. Not only will success therefore be different for each restoration project, success can also be measured at several different levels.

1. The Contract Level

Contracts require some kind of quantitative measure of performance to evaluate success. Most call for a cumulative survival of all plants and trees after the maintenance period of at least 70 percent. Percent cover of the entire site by native species is a reasonable performance goal when grasses or other herbaceous species are planted.

2. Horticultural Success

In addition to survival, height and cover, or diameter at breast height of individuals of all species can be measured annually to track growth. Permanently marked sample plots are the ideal design, since they can also be used for post-project monitoring. Recent advances in the restoration of riparian understory species allows for restoration success to be defined as the percentage of the entire site that is covered by native species.

3. Wildlife Use

Monitoring of use of the restoration planting by wildlife species is the ultimate measure of success of any riparian restoration project. The methods of monitoring depend on the original goals of the project and wildlife for which the restoration was designed. Monitoring methods will also depend on the resources available for monitoring, including time. Long- term monitoring is the best way to understand how wildlife respond to the project site. It is best to select wildlife that are considered umbrella species, which are species that represent many other species, and to select a range of umbrella species that represent multiple habitat requirements. Land bird monitoring is an excellent way to measure restoration success, because birds are relatively easy to locate and observe and they cover a wide range of habitat types . A diversity of birds on the site means the restoration successfully provided a diversity of habitat to them. Presence and absence monitoring is a useful indicator of the wildlife present on the site. More detailed surveys that can provide demographic data such as nesting success, mortality rates and monitoring over many years will indicate whether the site is functioning as quality habitat for breeding or as a site that wildlife use temporarily.

Discussion Added by Friends of Putah Creek:

It is clear that a rigorous and quantitative wildlife monitoring regime is critical to measuring success of restoration projects in addition to adaptively managing efforts for mitigation and revising future restoration plans. Wildlife monitoring to determine restoration success should include plants, fish, insects, birds and mammals. Putah Creek wildlife monitoring is also required by SCWA under the 2002 Accord, which specifies minimum Creek flows among other things. These wildlife monitoring reports are required to be posted annually within 15 days of receipt by SCWA yet this reporting requirement has been routinely ignored for years by SCWA.

Friends of Putah Creek has repeatedly requested all pre-project and post-project wildlife monitoring for the Winters Putah Creek Park project without success. It is very telling that SCWA either has not performed the required monitoring or refuses to release the results as required by both the court and standard restoration practices.

Winters Putah Creek Park Design Philosophy Conflicts with Proven and Cost-Effective Restoration Strategies Discussed in ***Low-Tech Process- Based Restoration of Riverscapes: Design Manual***., 2019, Utah State University Restoration Consortium

The recently published *Low-Tech Process-Based Restoration of Riverscapes: Design Manual* provides the underlying design philosophy and tools for restoration scientists to restore riparian and salmon habitat. These methods produce significant increases in salmon spawning and fry development by using low cost beaver dam analogs and other natural material structures costing approximately $10,000 per mile of restored stream. In comparison costs of the Winters Putah Creek Park project were over $6,000,000 per mile.

Yet the Winters project has yet to produce any evidence of creek-born salmon returning eight years after completion of the first two phases of the project. What is apparent are substantial differences in the experience and mindset of the restoration ecologists and scientists describing their successful low-cost restoration strategies and that of the SCWA engineers and project managers who have produced very costly and destructive failures.

The full Design Manual is available to readers and covers many different aspects of riparian restoration. However, only those important sections of the manual that are directly applicable to the Winters Putah Creek Park project are excerpted and further discussed in this report.

For these applicable sections, bold, blue highlighting is placed on selected text by Friends of Putah Creek to emphasize important points to facilitate discussion of the Winters Putah Creek Park project shortcomings following the excerpted sections.

EXECUTIVE SUMMARY

Stream and riverine landscapes or riverscapes are made up of a series of interconnected floodplain, groundwater, channel habitats, and their associated biotic communities that are maintained by physical and biological processes that vary across spatial and temporal scales. An over-arching goal of riverscape restoration and conservation is to improve the health of as many miles as possible, while ensuring those systems achieve and maintain their potential in self-sustaining ways. This design manual is intended to help the restoration community more efficiently maximize efforts to initiate self-sustaining recovery of degraded riverscapes at meaningful scales.

Structural-starvation of wood and beaver dams in riverscapes is one of the most common impairments affecting riverscape health. At a basic level, a riverscape starved of structure drains too quickly and efficiently, lacks connectivity with its floodplain and has simpler more homogeneous habitat. By contrast, a riverscape system with an appropriate amount of structure provides obstructions to flow. What follows in the wake of structurally-forced hydraulic diversity are more complicated geomorphic processes that result in far more diverse habitat, resilience, and a rich suite of associated ecosystem services.

The purpose of this design manual is to provide restoration practitioners with guidelines for implementing a subset of low-tech tools - namely post-assisted log structures (PALS) and beaver dam analogues (BDAs) - for initiating process-based restoration in structurally-starved riverscapes. While the concept of process-based restoration in riverscapes has been advocated for at least two decades, details and specific examples on how to implement it remain sparse.

Here, **we describe 'low-tech process-based restoration' as a practice of using simple, low unit-cost, structural additions (e.g., wood and beaver dams) to riverscapes to mimic functions and initiate specific processes. Hallmarks of this approach include:**

- An explicit focus on the processes that a low-tech restoration intervention is meant to pro- mote
- A conscious effort to use cost-effective, low-tech treatments (e.g., hand-built, natural materials, non-engineered, short-term design life-spans)
- '**Letting the system do the work', which defers critical decision making to riverscapes and nature's ecosystem engineers**

Importantly, the manual conveys underlying principles guiding use of low-tech tools in process-based restoration in systems impaired by insufficient structural complexity. Although intended to be simple, low-tech restoration still requires some basic understanding of water- shed context, riverscape behavior and channel evolution, and careful planning.

The manual provides interested practitioners with sufficient conceptual and applied information on planning, design, permitting, construction and adaptive management to get started, as well as references to additional information and resources. Detailed design and construction guidance is provided on two effective low-tech tools: 1) beaver dam analogues (BDAs) for mimicking beaver dam activity, and 2) post-assisted log structures (PALS) for mimicking wood accumulation in riverscapes.

Throughout the manual, readers are reminded that the structures themselves are not the solution, but rather a means to initiate specific, desirable processes. Ultimately, embracing the design principles will help practitioners better understand the ‘why’ behind structural interventions and allow for more efficient and effective riverscape restoration.

IMPLICATIONS FOR PRACTICE

- Riverscapes are composed of connected floodplain and channel habitats that together make up the valley bottom.
- The scope of degradation of riverscapes is massive. Tens of thousands of miles of riverscapes are in poor or fair condition.
- Structural-starvation is both a direct cause of degradation, as well as a consequence of land use changes and direct modification of stream and riparian areas.
- **Engineering-based restoration tends to emphasize channel form and stability, rather than promoting the processes that create and maintain healthy riverscapes, which leads to increased costs and a limited ability to restore more miles of riverscapes.**
- **Process-based restoration focuses on restoring physical processes that lead to healthy riverscapes. Low-cost, simple, hand-built structures have been used for over a century. Restoration principles are needed to guide the use of low-tech structures in order to address the scope of degradation, which will require that practitioners “let the system do the work.”**
- The overarching goal of low-tech restoration is to improve the health of as many miles of riverscapes as possible and to promote and maintain the full range of self-sustaining riverscape processes.

“What if restoration was about stream power doing the work, not diesel power?”
— Jared McKee (USFWS)

RESTORATION REVIEW

Engineering-based Restoration

While there are a wide variety of approaches and techniques used in stream restoration we contend that engineering-based approaches have been, and continue to be, the most widely used. **Rather than address specific techniques used in engineering-based restoration (e.g., channel reconfiguration, engineered log jams), here we highlight themes that we believe limit the ability of such an approach to effectively scale up to address the scope of degraded riverscapes.**

These include i) precisionism and the need for certainty, ii) an emphasis on stability, and iii) high cost and limited spatial extent.

Our intent in this section is not to suggest that engineering-based approaches to restoration should be replaced by the low-tech approach outlined in this manual. Engineering-based approaches to restoration are and will continue to be useful in many riverscapes, especially on larger rivers and in areas where uncertainty cannot be tolerated, as in areas with significant infrastructure. Rather, due to their location and size, many riverscapes could be more effectively restored using low-tech methods.

Many restoration funders and land managers are expected to evaluate the success of restoration projects by specific criteria, which creates a need for restoration practitioners to design projects that have a high certainty of meeting project objectives. As a result of these pressures, and in order to avoid uncertainty in outcomes, restoration often focuses on stability.

Stability

Stability is not a hallmark of healthy riverscapes. While healthy riverscapes can be generally characterized by a collection of attributes (e.g., Stage 0), the specific location of structural elements and habitat features changes through time while reach-scale metrics remain relatively constant. The desire to reduce uncertainty and precisely predict restoration outcomes has led to practices that tend to emphasize the stability of channels and in-stream structures. In the context of stream restoration, stability has often meant static. Constructed features and attributes such as plan-form, channel width, location of pools and riffles are designed in such a way that they do not change through time.

An example of the emphasis on channel stability is the extensive use of rip-rap on meandering channels to prevent lateral migration. Importantly, lateral migration is the process responsible for the creation of meandering channels, limiting this process necessarily means the stream will not be able to function naturally. Another example of the emphasis on stability can be shown with the use of in-stream structures. Adding wood to degraded streams is generally considered to improve habitat conditions and is a common restoration practice. Wood is typically added to streams by constructing large woody debris structures that simulate log jams (e.g., engineered log jams (ELJs)); or by designing log structures to be static by cabling, burying, or using boulders to secure wood in place. The emphasis on stability requires detailed engineering designs, modeling, and heavy equipment, all of which contribute to the high cost of restoration. Studies have generally found that such structures do increase local geomorphic diversity. **However, population level response of target species (e.g., salmon or steelhead) to these restoration actions is equivocal.**

High Cost – Limited Footprint

Emphasizing stability and certainty leads to highly-engineered restoration projects that necessarily increase the cost of restoration. The results of the high cost, per unit length of stream, inevitably results in fewer stream miles being restored. This is important for at least two distinct reasons. First, we are unlikely to be able to address the scope of degraded riverscapes using a high-cost approach to restoration. Second, many ecological goals of restoration must be addressed at large spatial scales. For example, improving in-stream and floodplain habitats to affect a population level response in salmon necessarily requires restoring large spatial extents. In short, reach-scale projects are unlikely to achieve many ecological goals.

Process-Based Restoration

In many degraded streams and rivers, the processes that sustain healthy riverscapes have been altered by both watershed-scale changes (e.g., conversion of forest to agriculture) and reach-scale alterations (e.g., channelization, removal of wood and beaver). Generally, restoration has focused more on restoring riverscape form without addressing the underlying processes responsible for that form. In response, the scientific community proposed a process-based restoration philosophy.

Process-based restoration is defined as protecting, enhancing, and/or restoring "normative rates and magnitudes of physical, chemical, and biological processes that sustain river and floodplain ecosystems". A central premise of process-based restoration is that restoration of natural systems (e.g. rivers streams, their floodplains and watersheds) is best achieved by 'let-

ting the system do the work'. Process-based restoration recognizes that to restore ecologically functional riverscapes, we need to restore the physical and ecological processes responsible for creating and maintaining those conditions.

Low-Tech Process-Based Restoration

We define low-tech process-based restoration of riverscapes as, simple, cost-effective, hand-built solutions that help repair degraded streams. In the context of process- based restoration, low-tech approaches are designed to "kickstart" processes that allow the stream to repair itself" . Historic and current examples of low-tech restoration, as both a label and an approach, are abundant. These low-tech restoration approaches, such as simple rock and wood structures, management with beaver, and time-controlled grazing management rely primarily on human labor, natural materials, and changes in management to restore hydrologic, ecologic, and geomorphic processes.

Discussion Added by Friends of Putah Creek:

Low-technology "process-based" creek and stream restoration using beavers, beaver dam analogs, or other low-cost, in-stream structures using natural materials to add complexity and diversity to floodplains is inherently less expensive (by at least 2 orders of magnitude) than comparative restoration techniques using massive earth-moving machinery to form a "precision - engineered" streambed as was practiced at Winters Putah Creek Park. In addition to the financial advantages, there are also substantial ecological advantages. For instance, great effort has been expended in Winters Putah Creek Park to obtain a "stable" and "self- sustaining" Creek form.

*Yet according to the authors of the Low-Tech Process-Based Restoration of Riverscapes: Design Manual, these attempts are self-defeating because "Stability is not a hallmark of healthy riverscapes...The desire to reduce uncertainty and precisely predict restoration outcomes has led to practices that tend to emphasize the stability of channels and in-stream structures. In the context of stream restoration, stability has often meant static. Constructed features and attributes such as plan-form, channel width, location of pools and riffles are designed in such a way that they do not change through time. ….The emphasis on stability requires detailed engineering designs, modeling, and heavy equipment, all of which contribute to the high cost of restoration….**However, population level response of target species (e.g., salmon or steelhead) to these restoration actions is equivocal.**"(Emphasis added)*

Certainly that has been the response in Winters Putah Creek Park. Despite a cost of $6,000,000 to alter only one mile of Creek, there have been no quantifiable increases in benefits to wildlife. Its compacted imported fill has prevented reforestation and caused hundreds of planted trees and shrubs to die over many years. And we know the loss of pools, undercut banks, and overhanging vegetation caused by the bulldozing of the original Creek channel and floodplain has resulted in the loss of almost all in-creek habitat required by native fish populations, which have consequently plummeted in the affected areas according to SCWA's own data. There have also been noticeable drops in mammalian and bird populations in the area SCWA targeted for alteration.

Indeed, the focal species that was supposed to most benefit from this Winters Putah Creek Park project was fall-run salmon. Yet 8 years following completion of the project's first 2 phases there is no evidence a single salmon has been hatched and reared in the Creek and then returned there to spawn.

According to the authors of this design manual, "A central premise of process-based restoration is that restoration of natural systems (e.g., rivers streams, their floodplains and water- sheds) is best achieved by 'letting the system do the work'. Process-based restoration recognizes that to restore ecologically functional riverscapes, we need to restore the physical and ecological pro- cesses responsible for creating and maintaining those conditions."

Friends of Putah Creek fully agrees with the basic premises of this low technology restoration solution promoted in this design manual. Restoration of the Creek requires a much lighter touch than the heavy-machine, diesel-powered, over-engineered mindset of SCWA which has proved particularly destructive in the Winters Putah Creek Park.

We prefer the approach favored by one experienced US Fish and Wildlife Service ecologist:

***"What if restoration was about stream power doing the work, not diesel power?"** — Jared McKee (USFWS)*

Appendix A – See Following Pages

STREAMWISE

Stream Assessment and Restoration

Achieving restoration goals with natural stream form, processes, and function.

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July 27, 2011

Rich Marovich
Streamkeeper
Lower Putah Creek Coordinating Committee

Dear Rich,

In response to the resource agency question regarding "*appropriate channel width*" I offer the following thoughts for consideration:

During the past twelve years of work on Putah Creek and its tributaries, we have spent innumerable hours in the field studying the creek and the current conditions. We have looked closely at the full range of channel dimensions, patterns, and entrenchment ratios to determine what combination of factors tend to provide the most likely conditions for a self-maintaining channel morphology.

Given the changes to sediment delivery and flow regime imposed by the upstream impoundments, calculation of such conditions is greatly facilitated by use of careful field observations of the stable channel form. Indeed, these observations are the foundation of design specifications for many of the successful projects we have worked on over the past twelve years.

The key to accurate approximation of the stable condition is to document areas where the stream channel forms its own dimensions through depositional features. Many of these sites are formed by recent channel avulsion, or through building point bar deposition below Dry Creek confluence, where gravel bedload sediment is in ample supply.

We have found a very consistent tendency for the channel to settle into a dimension of approximately 27 to 28 feet in width, with riffle control mean depth of approximately 1.5 feet. When coupled with adjacent inset floodplain features that allow for the dissipation of flood energy, the Putah Creek channel tends to show long-term tendencies to remain in stable condition, without accelerated vertical or lateral erosion. This condition is optimal for the establishment of native riparian vegetation, such as sedge, alder, willow, and cottonwood.

StreamWise relies on these field observations for project design, and prefers the use of field indicators over other more technical methods of channel design and flow modeling. Modeling is a valuable tool and can be used to support design criteria, but should be verified with field data that documents the natural tendencies of the stream channel form and function.

I hope this summary helps resolve any concerns over our design for the Winters Putah Creek Park and allows the project to move forward in a timely manner.

Thanks for the opportunity to comment on this important issue,

Rick Poore
StreamWise

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Department of Environmental Design

July 25, 2011

University of California
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Rich Marovich
Solano County Water Agency

Dear Rich,

As a professional geomorphologist, I have been studying Putah Creek for the past 10 years. One of the issues on Putah Creek is that - due to previous manipulations to the creek - the channel width has been “over-widened.” In coordination with others, I have done field studies on the creek that suggest that the geomorphically appropriate width (the width that would self-form according to the existing hydrology of the creek) is significantly less than what is observed in many places today. These field studies suggest that the geomorphically (hydrologically) appropriate width is approximately 30 feet.

If I can provide other information, please let me know.

Sincerely,

Eric Larsen

Eric Larsen, Ph.D.
Research Scientist
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