2 PROJECT DESCRIPTION

2.1 PROJECT LOCATION

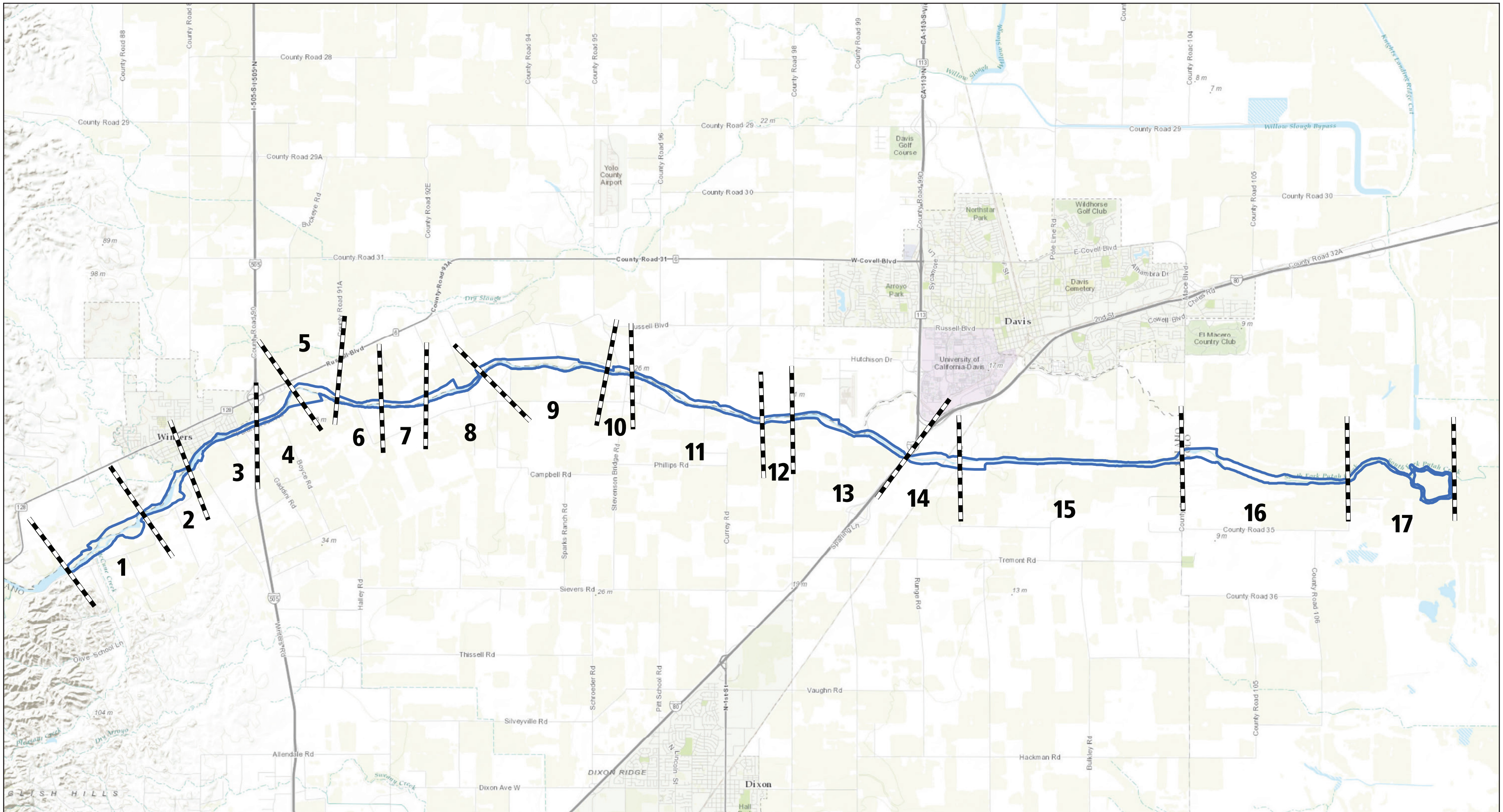
Putah Creek Restoration Upper Reach Program activities would occur within and along an approximately 24.2-mile length of Putah Creek, extending from the downstream face of the Putah Diversion Dam (PDD) to the western boundary of the Yolo Bypass Wildlife Area (YBWA), as shown in Figures 1-1 and 1-2 in Chapter 1, *Introduction.* The Program footprint (Program Area) includes the creek, its riparian area, banks, terraces, adjacent wetlands, and adjacent seasonally flooded riparian forest, and encompasses approximately 1,354 acres. Through most of the Program Area, the creek forms the border between Solano and Yolo counties, with the exceptions of two reaches that lie entirely within Solano County (I-80 to Old Davis Road Reach and Old Davis Road to Mace Reach) and two reaches that lie entirely within Yolo County (Mace Road to Road 106A Reach and Road 106A to YBWA Reach), on the eastern edge of the Program Area.

The Program Area is bordered to the south in many places by rural Putah Creek Road, various intermittent farm roads to the south and north, and by the Cities of Winters and Davis to the north. The precise boundaries of the Program Area are shown in **Figure 2-1**.

2.2 PROJECT BACKGROUND

Although Lower Putah Creek (including its riparian corridor) is one of the largest remaining tracts of high quality wildlife habitat in Yolo and Solano counties and provides habitat for a unique assemblage of fish and wildlife species native to the Central Valley, it is characterized by altered channels and eroding banks, habitat loss and degradation, flood and flood control related impacts, invasive weed infestations, and other problems. Lower Putah Creek offers a unique opportunity to develop restoration projects to optimize benefits to fish, wildlife, and other resources.

In the Program Area, the Putah Creek channel is, in many locations, no longer in natural form and function. Gravel extraction, channelization, vegetation removal, and other channel modifications have caused significant degradation of natural channel form, process, and ecology.



Project Study Area Boundary

Stream Reaches (East to West)

1. NAWCA/Mariani
2. Duncan-Giovannoni
3. Winters Putah Creek Nature Park
4. East of 505
5. Warren
6. Upper McNamara
7. Lower McNamara
8. MacQuiddy (Lester)
9. Russell Ranch
10. Stevenson Bridge
11. Glide Ranch
12. Nishikawa
13. Olmo-Hammond-UCD
14. I-80 to Old Davis Road
15. Old Davis Road to Mace
16. Mace to Road 106A
17. Road 106A to Yolo Bypass Wildlife Area

N

0 1 2 3

MILES

Figure 2-1

Program Area Map with Reach Locations

Source: BSK Associates

Ecological damage has been compounded by the trapping of sediments behind the Channel. As a result, the Putah Creek channel has become deeply incised, and is generally lacking in pool-riffle-run sequences, natural meander patterns, and functional floodplains. Gravel extraction operations have created reaches of over-wide channel, characterized by long, featureless pools and devoid of floodplains. Extensive Gravel Mining Occurred on Putah Creek West of Winters (circa Putah Creek Road at Olive School Road) as shown in a 1952 photo (**Figure 2-2**). These reaches cannot 'self-adjust' to more natural morphology, because flow velocities are insufficient to mobilize sediment, and natural gravel recharge is substantially arrested. In this condition, the creek is virtually devoid of riffles and spawning habitat, and lacks the materials and functions needed to build such features naturally.

Figure 2-2 1952 Photo Showing Extensive Gravel Mining on Putah Creek West of Winters (Putah Creek Road at Olive School Road)

Source: SCWA Archives.

2.3 PROGRAM OBJECTIVES

CEQA requires that an EIR include a statement of the underlying objectives to be achieved by a proposed project (CEQA Guidelines Section 15124 subd. [b]). These objectives are intended to help the lead agency develop a range of reasonable alternatives, and to aid decision makers in preparing findings including, if necessary, a statement of overriding considerations.

The overall Program purpose is to restore and rehabilitate the creek channel, banks, and associated habitats to more natural, self-sustaining form and function, consistent with the current (post-Monticello Dam) hydrologic regime. The Program would be implemented to stop further degradation of the creek corridor and to "jump-start" natural geomorphic and ecological processes in site-specific locations.

In the Lower Putah Creek Restoration Project planning process, goals and objectives were established by a group of stakeholders. The goals and implementing objectives for the Upper Reach Program are:[1]

GOAL 1: IMPROVE PASSAGE, REARING, AND EMIGRATION OF ADULT AND JUVENILE SALMONIDS IN PUTAH CREEK	
At YBWA/Upper Reach Boundary	
Objective 1.3	Provide for effective fish passage for essential life history stages – i.e., structural passage and recruitment and emigration flows – between the Yolo Bypass and Putah Creek above the Yolo Bypass Wildlife Area
Between YBWA and Putah Diversion Dam	
Objective 1.4	Provide for effective fish passage for essential life history stages – i.e., structural passage and recruitment and emigration flows – on Putah Creek from the YBWA boundary to upstream spawning grounds below the Putah Diversion Dam
Objective 1.5	Restore, enhance, and maintain spawning and rearing physical habitats and processes on Putah Creek below the Putah Diversion Dam
Objective 1.6	Provide necessary flow regimes and water quality conditions for recruitment, rearing, and emigration of self-sustaining runs of salmonids on Putah Creek
Objective 1.7	Incorporate natural planform and cross sectional geomorphology that supports structural habitat complexity and natural hydrologic, geomorphic, and ecological processes

GOAL 4: PRESERVE AND ENHANCE, WHERE POSSIBLE, EXISTING BENEFICIAL USES INCLUDING PUBLIC ACCESS, WILDLIFE VIEWING, HUNTING AND FISHING, BALANCED WITH EXISTING, ENHANCED, AND RESTORED ECOLOGICAL FUNCTIONS	
Objective 4.1	Maintain a balance of existing fish and wildlife habitats, hunting, fishing, wildlife viewing, and other public benefits including water supply and agriculture between the PDD and YBWA

[1] Six goals were established for the Lower Putah Creek Restoration Project. Goals 2 and 3 were specific only to the Project on the Yolo Bypass Wildlife Area, Goal 5 is specific only to the Upper Reach Program

GOAL 5: ENHANCE HABITATS FOR DELTA NATIVE FISHES AND WILDLIFE WITHIN THE PUTAH CREEK PROJECT UPPER REACH	
Objective 5.1	Provide for effective fish passage for essential life history stages – i.e., structural passage and recruitment and emigration flows – on Putah Creek above YBWA to upstream spawning grounds below the Putah Diversion Dam (same as Objective 1.4)
Objective 5.2	Restore, enhance, and maintain spawning and rearing physical habitats and processes on Putah Creek below the Putah Diversion Dam (same as Objective 1.5)
Objective 5.3	Provide necessary flow regimes and water quality conditions to support anadromous and other native Delta fishes on Putah Creek
Objective 5.4	Incorporate natural planform and cross sectional geomorphology that supports structural habitat complexity and natural hydrologic, geomorphic, and ecological processes (same as Objectives 1.7)
Objective 5.5	Maintain and enhance native riparian vegetation communities along Putah Creek below the Putah Diversion Dam
Objective 5.6	Maintain a balance of existing fish and wildlife habitats, hunting, fishing, wildlife viewing, and other public benefits, including water supply and agriculture, between the PDD and YBWA (same as Objective 4.1)

2.4 PROGRAM ACTIVITIES

The proposed Program activities are designed to work together in a comprehensive manner to achieve the Program objectives identified above, and have been grouped to simplify the analyses of their effects for the purposes of CEQA and associated environmental permits. The activities would be implemented (singly or in combination) in a series of individual actions (projects), applied to specific locations within the Program Area, as determined by site-specific conditions. For purposes of description of site conditions and of proposed locations for the various activities, the Program Area has been divided into a series of stream segments (Project subreaches) (see Figure 2-1). Individual Project subreach maps are provided in **Appendix C.**

Activities proposed under the Upper Reach Program fall into three general categories: (1) channel reconfiguration, (2) vegetation management, and (3) maintenance. A more detailed description of the activities to be undertaken within each of these categories follows. As stated above, site-specific Project implementation may entail application of one or a combination of these activities. All in-stream activities would be implemented adaptively, based upon understanding of the ecosystem and its changes over time. A site-specific Adaptive Management Plan would be developed for each individual project, based on the desired environmental outcomes and the potential for environmental impacts.

2.4.1 Channel Reconfiguration

A “stable” stream is in dynamic equilibrium when, over time, sedimentation processes are balanced so that the channel, while adjusting locally to variable conditions, maintains the same general morphological character. A stream's morphology is a result of its response to two principal driving variables—runoff and sediment yield—acting in concert with channel boundary conditions to determine the channel planform, cross section, and grade. Boundary conditions include the valley slope, geology, resistance, substrate type and size, and vegetation. They may also include natural or man-made controls such as dams, bridges, and water levels of receiving water bodies. Changes in sediment load, flow regime, and boundary conditions can disrupt this balance, resulting in rapid morphologic changes. When long-term erosion exceeds sedimentation, channel incision occurs. Channel modification, such as enlargement or straightening for flood control or water diversions, is probably the most common human-induced cause of channel incision, and often results in the most severe cases. Other human-induced causes of channel incision include reduced sediment load due to upstream dams. In a typical incising channel, the streambed degrades until the critical bank height is exceeded and the bank fails, increasing channel width and sediment load. In severe cases, nick points and nick zones migrate upstream and destabilize large parts of the system, including tributaries. Over time, the stream will move toward a new equilibrium. However, in systems (such as Putah Creek) where incision is initiated by watershed changes that affect hydrology and sediment yield, a new equilibrium may take decades or even centuries to achieve (Fischenich, 2000).

As is typical of incised channels, Putah Creek in the Program Area is deep, broad, and lacks a defined or stable low flow channel. The banks are steep and subject to ongoing failure. Pool and riffle habitat is lacking and riparian vegetation is often rare or absent. The original floodplain habitat has become hydrologically disconnected from the stream. Channel incision has been a major cause of floodplain and wetland deterioration and loss. For these reasons channel reconfiguration on Putah Creek is a high priority.

Proposed Program activities would reconfigure degraded areas of the creek channel to more natural cross sectional form (confined, sinuous low flow channel with adjacent floodplain surfaces) to stabilize eroding banks, facilitate channel shading with bank-side riparian vegetation, lower water temperatures, and improve habitat values for native fish species. A narrower (more efficient) low flow channel would also serve to increase flow velocities, restore competency of the channel to mobilize gravels (for spawning), and restore geomorphic processes that support natural channel and ecosystem dynamics. Implementation of these activities would expand the geographical extent of high quality habitat for native fish species, including local fall-run Chinook salmon and steelhead, and increase riparian habitat by converting shallow, open water areas to floodplains. Channel reconfiguration activities may consist of modifications to channel geometry, construction of grade/flow control structures, stabilizing channel banks, improving spawning gravels, and/or filling abandoned gravel pits. These activities are described in detail below.

Channel Geometry

As described above, the role of physical structure is important to restoration strategies that seek to improve the ecological function of stream systems. Channel reconfiguration and realignment actions are applied to restore geometry, meander, sinuosity, substrate composition, structural complexity, re-aeration, stream bank stability, re-establishment of riffle substrates, re-establishment of riparian vegetation, and stabilization of stream banks.

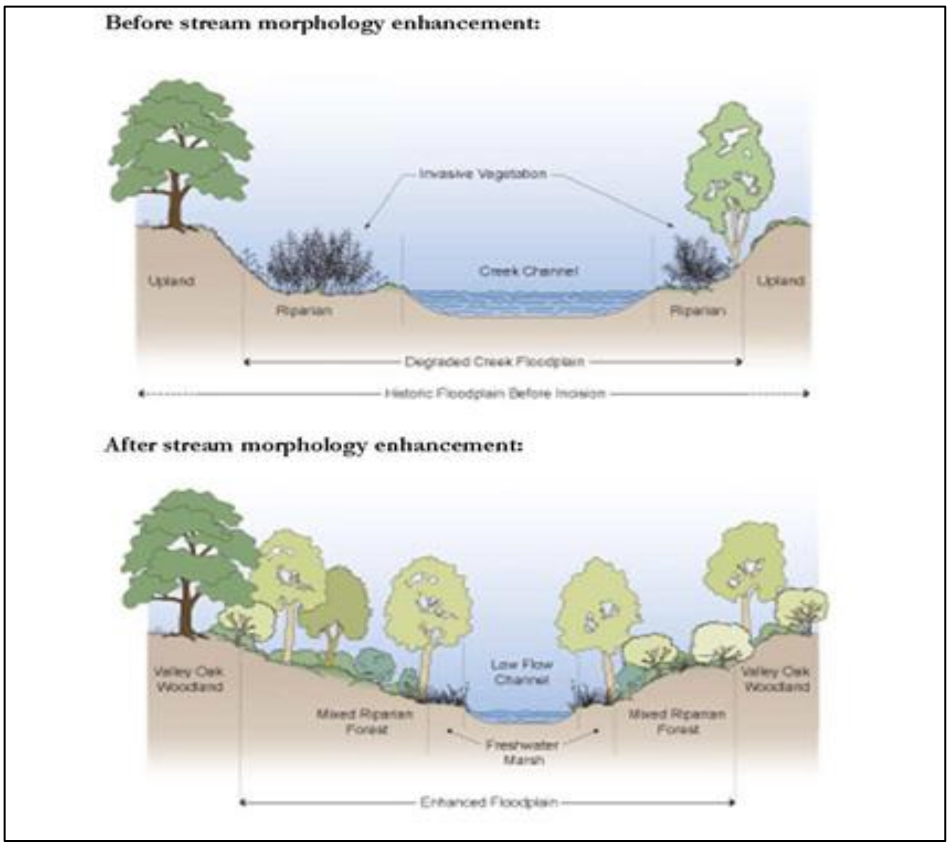
Program actions to restore functional channel morphology on Putah Creek may include modification of channel cross-section, planform, and longitudinal profile. Each potential component of channel geometry modification activities is described below.

Create Low Flow Channel and Floodplain

Naturally meandering alluvial streams produce floodplains with spatially diverse hydrology and plant types, and often contain a variety of wetlands. These floodplain wetlands serve many functions and provide important habitats for a diversity of fish and wildlife species. Floodplains are especially important to fishes inhabiting streams and rivers. Due to their high productivity and quickly warming waters in spring, floodplains are important spawning and rearing areas for many fish species. Floodplain wetlands act as nutrient and sediment sinks—improving water quality in the stream. They also provide storage capacity that can decrease magnitude of downstream floods, benefiting stream fishes and riparian landowners. Animals other than fish also rely on floodplain habitat. Many amphibians and reptiles require floodplain habitats for some or all of their life stages, and floodplain habitat loss has been linked to declines in some species. Neotropical birds rely upon riparian habitats associated with floodplains for feeding and roosting. Much of the migratory waterfowl in the United States could not survive without access to healthy floodplain habitat, and many animals that are not generally thought of as wetland species thrive in floodplains because of their natural productivity.

To create a low flow channel bordered by functional floodplain surfaces, alluvial material from within the stream corridor would be excavated and placed within the (currently over-wide) channel (**Figure 2-3**). Modified channel dimensions, including channel invert width, channel bank slopes, and floodplain width, would be determined based upon reach specific conditions. In reaches that were heavily mined for gravel, substantial quantities of fill may be required to create the desired channel morphology. In such cases, appropriate material would be obtained from adjacent agricultural lands or from other local sources (the Putah South Canal spoil site, for example).

Figure 2-3 Typical Channel Reconfiguration



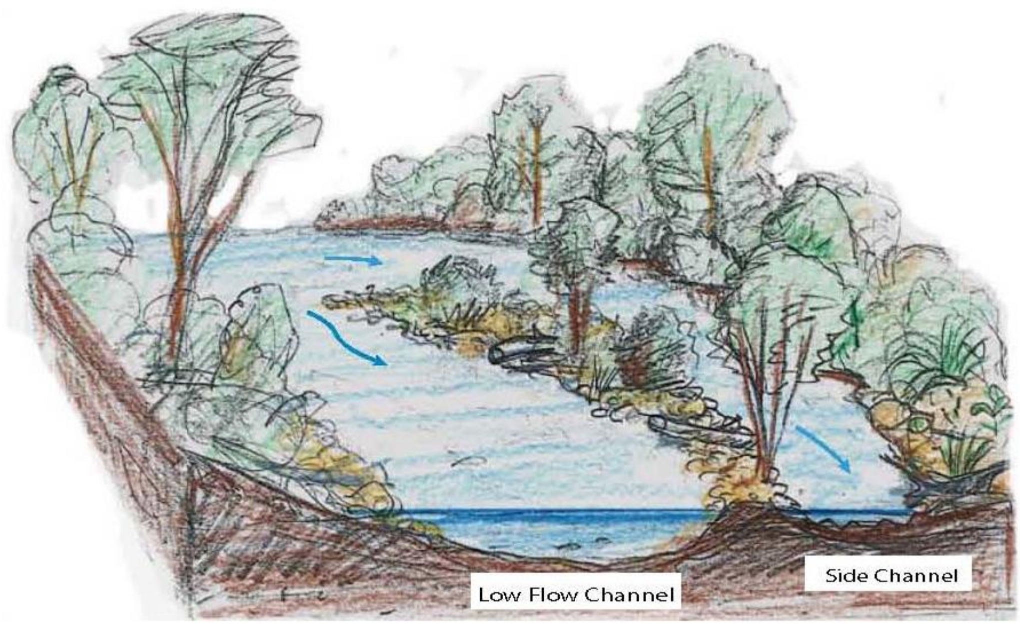
Source: EDAW, 2005.

Create Side Channels

Secondary side channels carry flows from the main creek channel through adjacent floodplain areas before rejoining the main channel downstream. Side channels can reduce high stage flow rates and velocities in the main channel during storm events. These areas can also provide important habitat for salmonids due to lower velocities, cover (large wood, pools, edge complexity), and higher food production.

In areas where the stream corridor is wide enough, secondary side channels may be excavated adjacent to the main low flow channel. These channels would have smaller cross sectional areas than those of the main low flow channel (**Figure 2-4**). The side channels would be constructed by excavating and grading to define a new channel. Side channel geometry would be determined based upon site specific design flows and channel configuration. The side channel edges would be graded to create transitional habitat and cover as flow rates rise and fall during the winter months. Wood structures (see Section 2.4 below, *Install Large Woody Debris*) may be installed to provide habitat, channel complexity, and to maintain hydraulic and geomorphic function within the channels. The new side channels would provide velocity refugia, areas for foraging, and protection from predators. The side channels would provide similar function during larger storm events and would also alleviate erosive forces in the main channel that are causing bank erosion in some locations on Putah Creek.

Figure 2-4 Main Channel and Side Channel – Typical

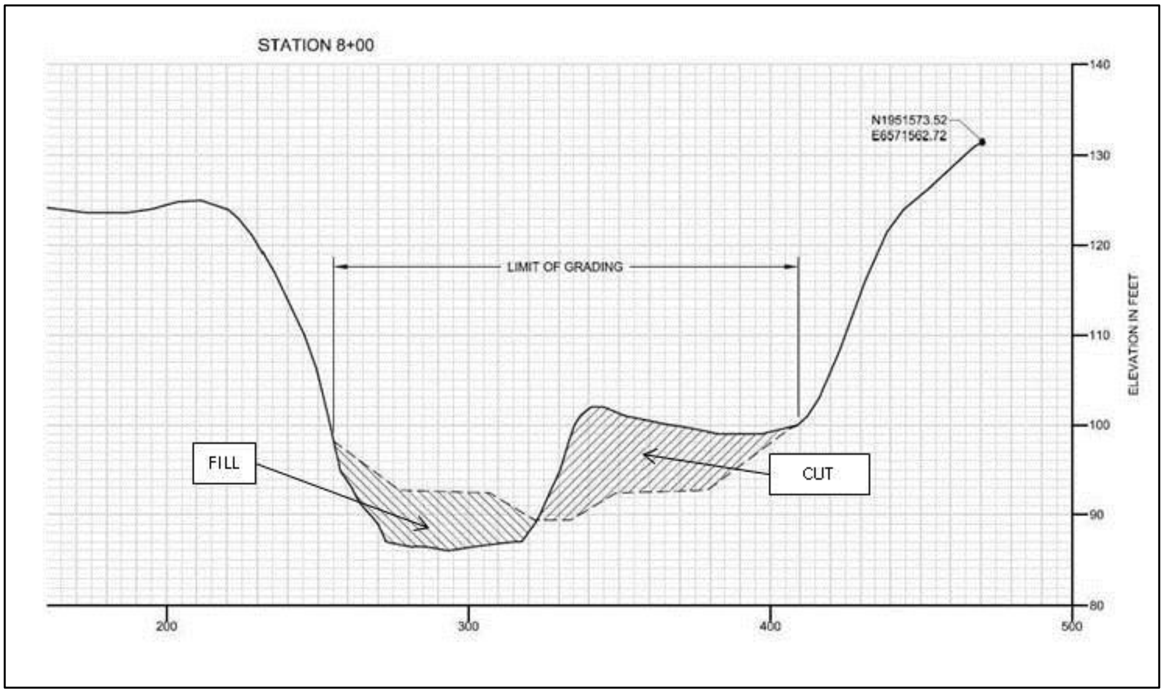


Source: ESA, 2014.

Reposition Thalweg

In areas where the channel thalweg (the deepest point in the channel cross section) has been negatively "captured" by an in-channel pool, or its location is contributing to bank instability, the thalweg would be repositioned within the active channel. Thalweg repositioning would involve excavating a new thalweg and/or filling all or portions of the old thalweg with the excavated material (**Figure 2-5**). In reaches where the thalweg is repositioned, work may also include repositioning of sand or gravel bars to function properly with the realigned channel thalweg.

Figure 2-5 Grading to Reposition Thalweg – Typical



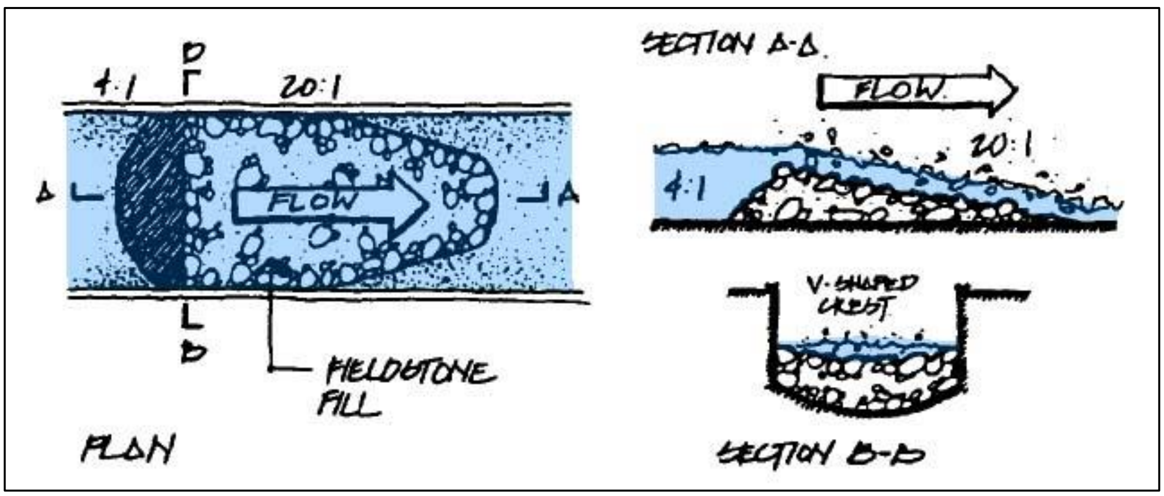
Source: LPCCC, 2015.

Construct Riffles

Riffle and pool habitats are lacking in Putah Creek and are critical to successful enhancement efforts. Riffles, high points in the channel bed with higher flow velocities, provide spawning habitat if suitable gravel size and flow conditions are present. Pools, low points in the channel bed with slower velocities, provide valuable and necessary locations for juvenile salmonid rearing, cover, and foraging and are resting locations for migrating adults. As noted previously, the formation of riffle-pool sequences in Putah Creek has been disturbed by construction of structures that artificially control the slope of the water surface, by excavation of the channel for gravel mining and other activities, by long, straight, and confined reaches, and by entrapment of stream sediments behind the Monticello and Putah Diversion dams.

Riffles would be constructed by placing appropriately sized (relatively coarse) substrate material into the active channel to raise the channel invert adjacent to or within existing in-channel pools, or by realigning the low flow channel so that it crosses suitable in-channel gravels, and filling the former channel (**Figure 2-6**). Appropriately sized gravels would be collected from within the reach or imported from local sources. Gravels would be placed into the stream bed using a loader. Where gravels must be imported, the majority would come from the nearby Putah South Canal spoil site. A maximum of 10,000 cubic yards of gravel would be placed in the Program Area per year. In some locations, wood structures would be installed in conjunction with gravel placement activities to induce channel sinuosity, bar formation, and to support natural processes that would continue to form and/or maintain riffles and pools. Installation of wood structures at the channel margins would also provide (immediate) critical cover and foraging habitat for fish (see *Construct Log Revetments*, below).

Figure 2-6 Constructed Riffle – Typical Plan and Section Views



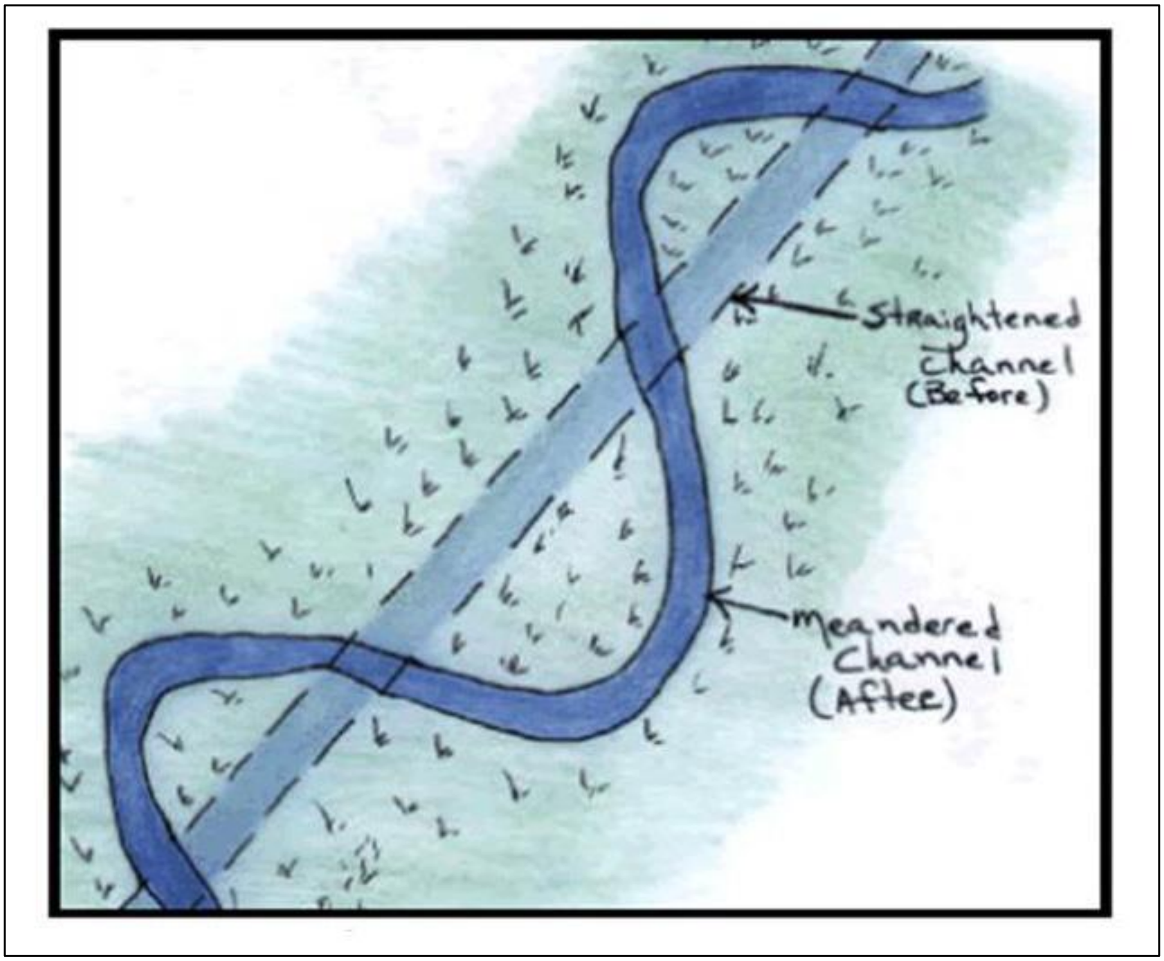
Source: Hough, 1993.

Increase Channel Sinuosity

Stream meander restoration is the restoration of natural alignment, channel capacity, and meander relationships to establish a functional, stable stream consistent with the modern hydrologic regime. This type of channel reconfiguration would transform a straightened stream reach to a more curvilinear planform, based upon channel size and meander relationships in conjunction with expected flow and sediment regimes and the geomorphology of the area. Meandering channels offer physical stability and support natural ecological functions of the stream corridor. Meandering channels typically have higher levels of physical habitat diversity than straightened channels.

In areas of the stream corridor where low flow channel and floodplain morphology exists, but with an unnaturally straight alignment, a new meandering low flow channel alignment would be excavated and the excavated material would be used to fill the old, straightened channel alignment (**Figure 2-7**).

Figure 2-7 Stream Meander Restoration – Schematic



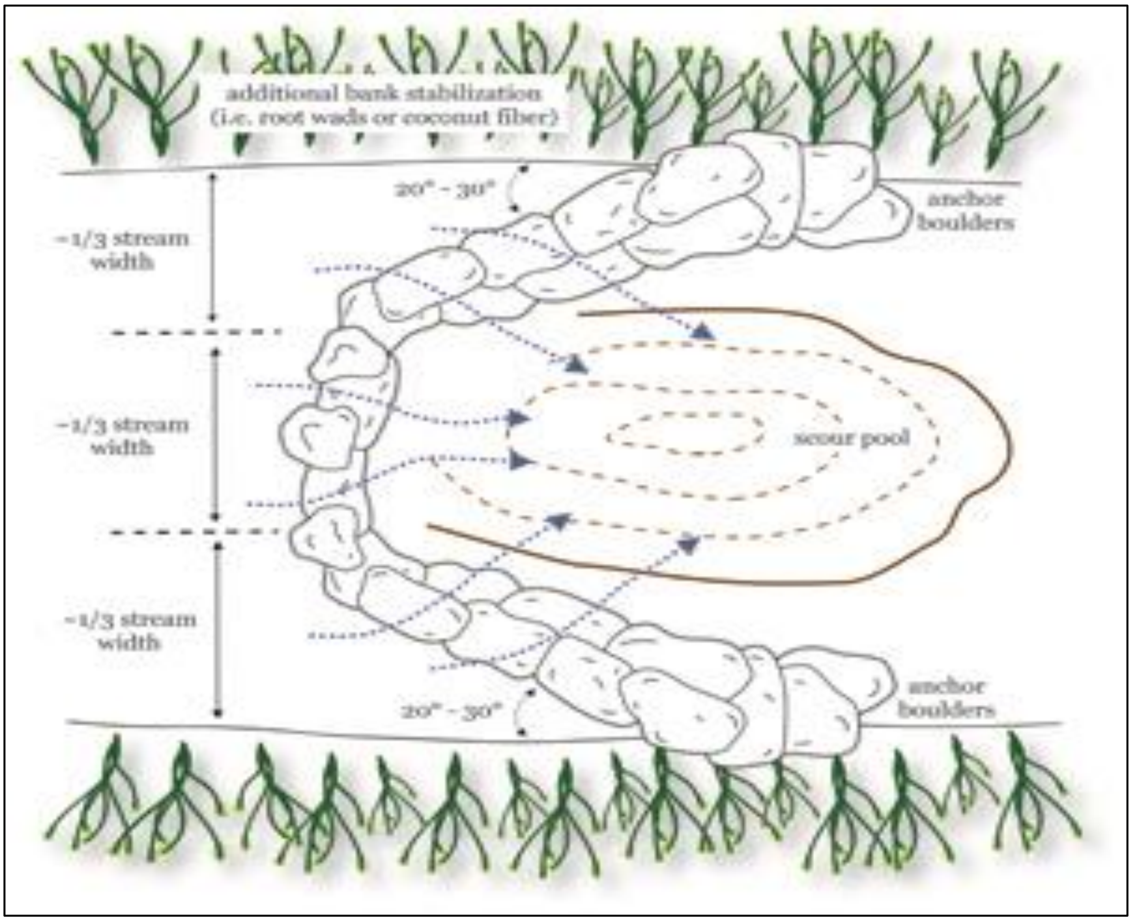
Source: USACE, 2007.

Construct Grade/Flow Control Structures

Grade control structures, such as rock cross-vanes and weirs, can decrease near-bank shear stress, velocity and stream power, but increase the energy in the center of the channel. Rock cross-vanes and similar grade control structures would be installed to establish grade control, reduce bank erosion, create a stable width/depth ratio, and maintain channel capacity, while maintaining sediment transport capacity and sediment competence (**Figure 2-8**). The cross-vane also can improve stream habitat by: 1) increasing bank cover due to a differential raise of the water surface in the bank region, 2) creating holding and refuge cover during both high and low flow periods in the deep pool, 3) developing feeding lanes in the flow separation zones (the interface between fast and slow water) due to the strong down-welling and up-welling forces in the center of the channel, and 4) creating spawning habitat in the tail-out or glide portion of the pool.

Rock sizes and placement locations of grade control structures in Putah Creek would be determined based on site-specific conditions and calculations of bank-full shear stress. Large boulders used in constructing these features would be gathered on-site (where possible) and/or imported from local sources.

Figure 2-8 Rock Cross-Vane – Typical Plan View



Source: Hill et al., 2007.

Stabilize Channel Banks

Maintaining stable banks is the foundation of stewardship and water quality protection efforts along the creek. Bank erosion contributes fine sediments to the creek that degrade the water quality and habitat conditions for salmonids and other aquatic species. Increased sediment reduces visibility needed for foraging, can cover or bury incubating salmonid eggs, and the associated increased level of nutrients can reduce oxygen levels in the water.

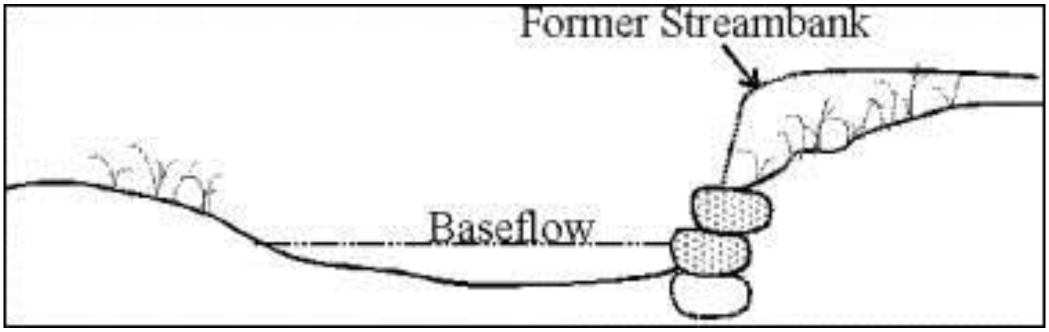
Priority would be given to bank stabilization methods that can provide multiple benefits (e.g., cover, velocity refuge, shade, and foraging opportunities). Channel bank stabilization methods that may be employed include installation of rock revetment, log revetment, root wads, and/or large woody debris. These structural approaches may also incorporate the use of native plant materials (e.g., willow fascines, live stakes and cuttings, brush matting) and/or geotextiles/erosion control fabric. Rock material used in these installations would be sourced on-site to the extent possible. Large logs and or root wads would primarily be sourced on-site or from neighboring agricultural operations (dead orchard trees and eucalyptus removed in riparian forest management, for example). Live native cuttings and brush would similarly be collected on-site or from adjacent lands.

Construct Rock Revetments

Along streams, the most erosion prone area is the toe of the stream bank. Failure at the toe of the stream bank can result in failure of the entire bank and lead to large influxes of sediment to the stream. Rock (or boulder) revetments serve to protect the most vulnerable portion of the stream bank. Rock revetments are often combined with other bank stabilization measures to protect the stream bank area above the revetment.

Rock revetments would be created by first excavating a trench below the invert of the stream along the toe of the stream bank. In this trench, a series of generally large, flat or rectangular boulders would be placed as a foundation for the revetment stones. Once the foundation stones were been installed, the revetment stones would be placed on top the foundation stones (**Figures 2-9** and **2-10**). Rocks or boulders would be placed up to the ordinary high water elevation. If protection is needed higher on the bank, a second set of rock may be placed on top of the first. Rock size would be determined based on reach specific stream velocity conditions. Used alone, rock revetments have only a modest potential to enhance stream habitat. Rock revetment may be combined with planting of live cuttings in interstices between the rocks to increase habitat value.

Figure 2-9 Rock Revetment Concept Drawing



Source: The Stormwater Manager's Resource Center.

Figure 2-10 Rock Revetment Under Construction

Source: Pier+Kieli, 2007.

Construct Log Revetments

Log revetments are constructed by cabling logs along eroding stream banks to deflect, absorb, and diffuse the erosive force of stream flows. To facilitate sediment settling, brush is densely packed around the large logs (**Figure 2-11**).

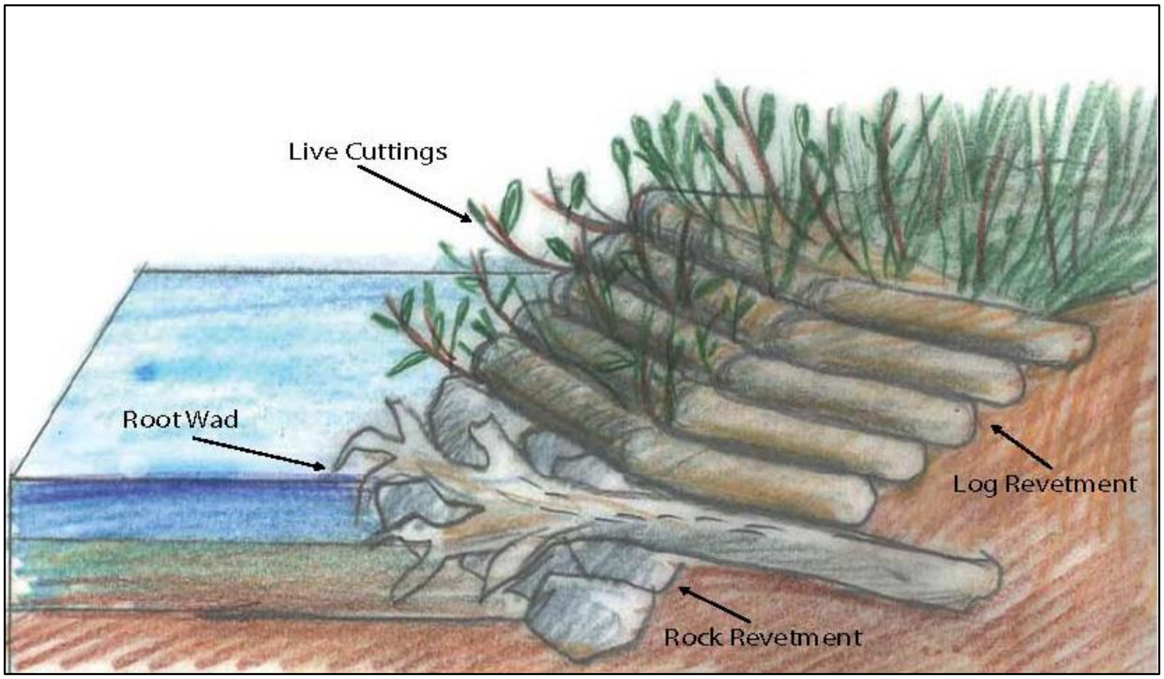
Figure 2-11 Log Revetment Immediately Post Construction

Source: ESA, 2014.

Logs would be placed at the streambed, bank toe, and bank, up to the ordinary high water elevation, aligned along the channel banks, and stacked on top of each other. Logs would be anchored to the bed and bank of the channel and attached to each other using cable, rebar, or other similar materials. Logs used to construct revetments would typically vary between 12 and 36 inches in diameter.

Live plant cuttings, brush, and in some cases, soil (where log revetments are installed in conjunction with creation of floodplain surfaces, for example) would be packed between the logs and into the eroding banks, and incorporated with log revetments to further stabilize the structures and to provide forage and refugia for fish and other aquatic and terrestrial wildlife. Log revetments can work in tandem with other stream bank stabilization techniques, such as rock revetments, root wads, and live willow cuttings (**Figure 2-12**).

Figure 2-12 Log Revetment, Rock Revetment, and Root Wad Combination, Using Live Cuttings



Source: ESA, 2014.

Install Root Wads

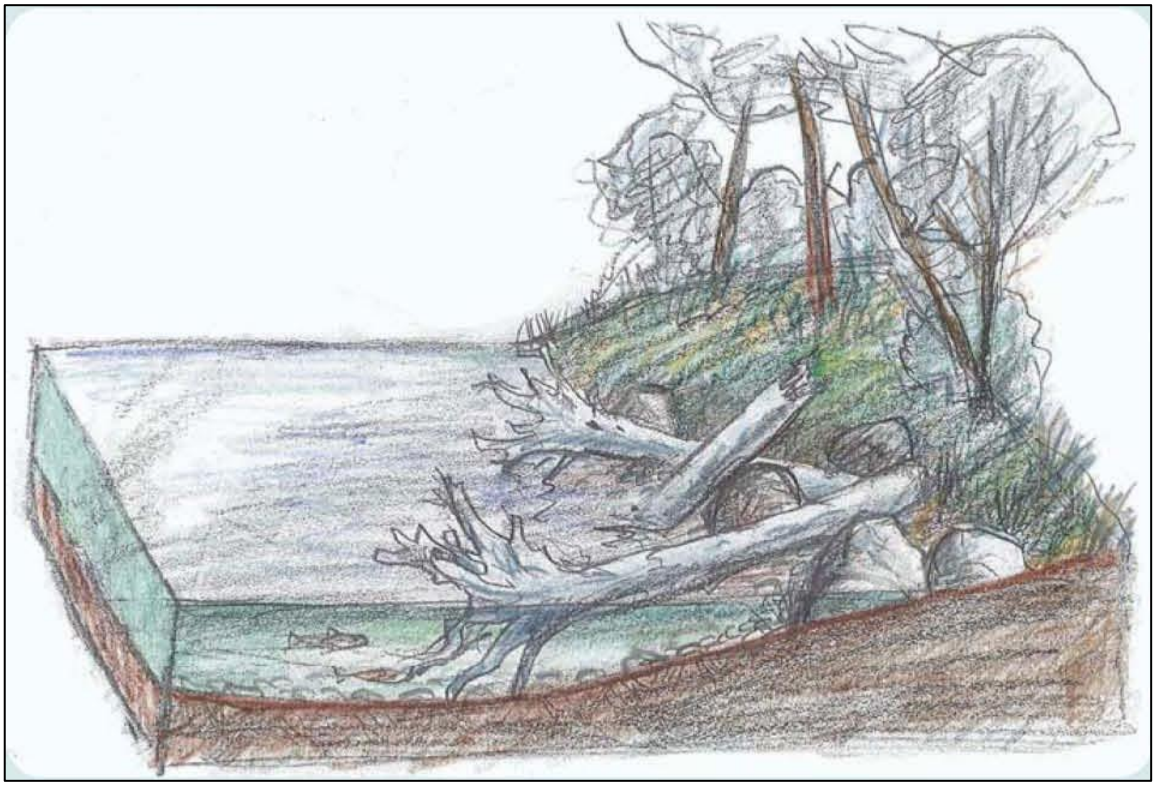
Root wads are log installations that can be embedded in the stream bank to deflect flow against the bank, create instream habitat for fish and other aquatic species, and add roughness to the channel and floodplain. Root wads provide cover, velocity refuge, shade, and foraging locations for fish (perennially in the main channel and seasonally on the floodplain, under high flow conditions). Root wad structures can provide necessary cover and food sources for salmonids immediately following construction.

Root wads would be constructed by embedding the trunk of a “footer log” into the bank, below the thalweg, topped diagonally by a second log, with root crown and roots projecting into the channel to form an “X”. The logs would be anchored to the bed and bank of the channel and attached to each other using cable, rebar, or other fasteners (**Figure 2-13**).

Install Large Woody Debris

Large wood is a vital component of creek systems because it provides lasting structural and habitat components and creates hydraulic conditions that support more sustainable off-channel habitats. Large wood structures can be used to create local scour holes for riffle and pool enhancement, flow deflection, and cover and edge complexity. These

Figure 2-13 Root Wad



Source: ESA, 2014.

structures support significant habitat complexity by creating trapping sediment, and providing cover for fish over a range of flows and depths. The placement and orientation of multiple wood structures can be used to create areas of flow constriction, to direct or turn flow, and to induce scour to maintain openings at connections to side channels.

Large wood structures installed under the Program would typically consist of one to three logs with intact root wads. Construction would include excavation and trenching to embed logs, driving logs into the bank and bed, and interlocking individual logs. The logs would be stabilized using large boulders for ballast, pinning with other logs that would be driven vertically into the bank, or using existing trees to interlock the logs (**Figure 2-14**). Large logs and anchoring boulders would primarily be sourced on-site or from neighboring agricultural operations.

Improve Fish Spawning Gravels

Gravel mining and changes in flow regimes created by dam construction have left many salmon-bearing Pacific coast gravel-bed rivers and streams in geomorphically and biologically dysfunctional states. Trapping of coarse gravels has led to deficits in the

Figure 2-14 Large Woody Debris Anchored by Boulders

Source: ESA, 2014.

reaches below the dams. These coarse gravels are a necessary characteristic of spawning beds, so a gravel deficit leads to a reduction in spawning habitats. Poor intragravel conditions, primarily associated with low permeability (caused by an excess of fine material) and/or armoring of substrate materials, have degraded spawning areas. Gravel is a mobile material, so is important for maintaining geomorphic processes that lead to dynamic and diverse stream channels. Since construction of the Monticello Dam, habitat in Lower Putah Creek for spawning and other salmon life stages has become severely degraded, and salmon populations have drastically declined.

The general aim of this category of activities is improvement of spawning habitat, but also the restoration of the geomorphic and biological functioning of the stream such that spawning habitat is naturally maintained over the long term. Program activities would include gravel augmentation, salvage of gravel for reuse, and loosening of gravels embedded in the creek bed by scarification. Each potential spawning gravel improvement activity is described in more detail below.

Gravel Augmentation and Salvage

Gravel augmentation or gravel replenishment means artificially adding gravel suitable in size distribution for salmon spawning and fry emergence to existing riffles in the streambed where these riffles lacks sufficient or suitable gravel.

Gravel would be augmented in riffles to restore and/or improve conditions in gravel bar deposits for salmon spawning. Gravels would be salvaged from within the Program site from activities that involve excavating gravels, or gravels would be imported to the site. Where gravels must be imported, the majority would come from the nearby Putah South Canal spoil site. Gravels would be placed into the streambed using a loader.

Loosen Embedded Gravels by Scarification

In locations where armoring has rendered streambed gravels unsuitable for use by spawning salmon, gravel scarification may be undertaken to loosen embedded gravels. Scarification would be accomplished using excavators to loosen gravels that are impacted by cementation.

Fill Abandoned Gravel Pits

Historically, side channels on Putah Creek were mined for gravel and disconnected from the stream and its floodplain. Wetland and riparian habitat around these side channels was also destroyed. Fish and aquatic organisms lost access to the slower water flows and adjacent floodplain wetlands the mined areas formerly provided. By filling abandoned gravel pits and reconnecting these areas to the functional creek corridor, these areas would be returned to a more natural state and provide habitat for the threatened Chinook salmon.

The Program would fill and reconnect former gravel pits to the creek as off-channel habitat. Abandoned gravel pits would be filled to floodplain elevation. Isolated (off-channel) pool areas would be retained or may be created. In some locations, fill would be placed to slightly lower elevations to create wetland habitat within the footprint of abandoned gravel pits. Fill material would consist of clean soil and rock. If not available within the site, these materials would be imported from local sources, such as the Putah South Canal spoil site, where a mix of native soil, rock, and gravel is available. Restored gravel pits would be planted with appropriate native plant species (see *Plant Native Vegetation* discussion, below).

2.4.2 Vegetation Management

The vegetation patterns of Putah Creek have changed significantly due to the operation of the Monticello and Putah Diversions dams, agricultural diversions, and other disturbances. Active vegetation management would be undertaken, and would include both invasive vegetation removal and establishment of new native plantings. For the benefit of salmonid habitat, plantings would be designed to: manage stream bank and channel stability; shade the main channel and newly created off-channel habitats; provide surface sediment filtering; provide food sources; restore structural diversity; suppress invasive species; and provide sources of small organic debris and wood for the channel. These activities are further described below.

Remove Invasive Plants

Invasive vegetation control activities would occur year round. Weed control activities would typically be accomplished in combination with clearing and grubbing, and followed by revegetation with native wetland and riparian plant species. Invasive vegetation control would be accomplished via manual/mechanical removal, chemical control, or a combination of these methods (**Table 2-1**). Temporary access trails may be created to facilitate weed control activities. Creation of such temporary access features would be undertaken during the construction season.

A. Manual and/or Mechanical Removal – Mechanical equipment, such as bulldozers, scrapers, weed whackers, and hand tools, including broom wrenches, would be used to remove invasive weeds and other nuisance vegetation.

B. Chemical Control – Herbicides that are approved by the California Department of Pesticide Regulation would be used in accordance with their labels to control invasive weeds and other nuisance vegetation, such as *Arundo donax*, *Lepidium latifolium, Rubus armeniacus*, *Tamarix* spp., and *Ailanthus altissima*.

Plant Native Vegetation

The LPCCC plants native vegetation in all seasons to enhance fish and wildlife habitat and to deter regrowth of invasive weeds. The LPCCC operates a nursery that propagates native plants from locally collected seeds and cuttings or purchased seeds from local sources. Native plants of up to 4 inches diameter at breast height (DBH) may be transplanted at revegetation sites. Some revegetation sites may also serve as on-site growing grounds for native transplants. Growing grounds sites would be planted at higher densities to compensate for future removal. Such growing ground sites are typically located 100 feet or more from the low flow channel to minimize potential for

Table 2-1 Invasive Vegetation Control Methods

	Mechanical			Herbicides						
Species	**Excavator**	**Loader/ Dozer**	**Weed Wrench**	**Glyphosate**	**Triclopyr**	**Imazapyr**	**Aminopyralid**	**Clorsulfuron**	**Diothopyr**	**Isoxaben**
Almond (*Prunus dulcis*)	✓		✓		✓	✓				
Arundo (*Arundo donax*)	✓			✓						
Black Locust (*Robinia pseudoacacia*)	✓		✓		✓	✓				
Catalpa (*Catalpa bignoniodes*)	✓		✓		✓	✓				
Edible Fig (*Ficus carica*)	✓		✓		✓					
English Ivy (*Hedera helix*)	✓				✓	✓				
Eucalyptus (*Eucalyptus sp.*)	✓		✓	✓						
Fennel (*Foeniculum vulgare*)		✓		✓						
Himalayan Blackberry (*Rubus discolor*)	✓	✓		✓						
Pampas Grass (*Cortaderia sp.*)	✓			✓						
Milk Thistle (*Silybum marinum)*		✓		✓			✓			
Pepper tree (*Shinus molle*)	✓				✓	✓				
Perennial Pepperweed (*Lepidium latifolium*)				✓				✓		
Tamarisk (*Tamarix sp.*)	✓				✓					
Tree-of-Heaven (*Ailanthus altissima*)	✓			✓	✓	✓				
Tree Tobacco (*Nicotiana glauca*)			✓	✓	✓					
Vinca (*Vinca major*)		✓		✓						

Table 2-1 Invasive Vegetation Control Methods

	Mechanical			Herbicides						
Species	**Excavator**	**Loader/ Dozer**	**Weed Wrench**	**Glyphosate**	**Triclopyr**	**Imazapyr**	**Aminopyralid**	**Clorsulfuron**	**Diothopyr**	**Isoxaben**
Virginia Creeper (*Parthinocissus quincifolia*)		✓		✓						
Winter Annual Weeds (pre-emergent)		✓		✓					✓	✓
Yellow Starthistle (*Centaurea solstitialis*)		✓		✓			✓			

flood flow obstruction. The LPCCC would install native plant poles, cuttings, seeds, container plants, and plugs following weed management and site preparation activities, such as clearing and grubbing (see Section 2.5.1 below).

2.4.3 Maintenance of Habitat Enhancement Sites

Adaptive management plans including site-specific performance criteria would be established for each project implemented under the Upper Reach Program. Maintenance and monitoring would be conducted, and corrective measures implemented where these criteria were not achieved. Maintenance activities at sites where creek and habitat enhancement activities have been implemented would include irrigation, invasive plant species control, replanting of failed native plantings, adjustments/repairs to damaged or failed structures, and maintenance of some long-term access points. These activities are described below.

Irrigate Native Revegetation Sites

Irrigation is expected to be used for up to three years at revegetated sites to establish native plantings. Different irrigation methods may be used depending on the site (e.g., low pressure low impact spray heads, drip irrigation, bubblers), but all irrigation components would be above ground and temporary. Longer-term irrigation (beyond the first three years) may be needed to maintain plants or irrigate new plantings if the original plantings fail to meet success criteria.

Manage Non-Native Vegetation at Restored Sites

Invasive species would be removed using hand, mechanical, and/or chemical methods as necessary (Table 2-1).

Maintain Long-Term Access Points

With landowner agreement, the LPCCC Streamkeeper may establish access easements at key locations along the creek for the purposes of long-term restoration/enhancement site management. In such cases, the access points created during restoration project construction would not be fully revegetated, and would be managed to allow Streamkeeper access and use of small equipment/vehicles, such as ATVs or front loaders. These access points would be developed with local landowners for the purposes of the Program and are not intended to provide public access where such access is not expressly granted by the landowner.

2.5 CONSTRUCTION RELATED ACTIVITIES

Implementing the Program would entail varying degrees of temporary site manipulation and/or disturbance. This section describes Program implementation construction activities.

2.5.1 Site Preparation

Site preparation activities would include clearing and grubbing, vegetation management, and installation of protective fencing around sensitive resources on or adjacent to Project work areas.

Clearing and Grubbing

Clearing and grubbing would include removal of debris, vegetation, and/or minor demolition (of relict structures, for example). Vegetation would be cleared to the ground surface, and large tree roots would be removed. Where feasible, native vegetation removed from the site would be salvaged for re-use in restoration activities. Non-native species would be chipped and/or removed to an appropriate disposal/recycle facility. All refuse and debris would be removed from the site and legally disposed of.

Vegetation Management

Vegetation management activities may include the removal of invasive vegetation, native plant protection, and removal or trimming of vegetation in areas of the Project sites where grading or placement of biotechnical, rock, or other materials would occur, and/or to facilitate access.

Invasive plants would be removed using manual, mechanical or chemical treatments or a combination of these, as appropriate to the specific target species (see Section 2.4.2 above and Table 2-1).

Existing native vegetation or other sensitive resources to remain within or adjacent to the Project site may be identified and protected with fencing prior to commencement of invasive species treatments and/or site disturbing activities (including construction of temporary access ramps/roads). Elderberry shrubs (*Sambucus sp.*), which provide habitat for the federally listed valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), typically would be protected in place following the standard elderberry protection guidelines; however, on some sites a mitigation plan may need to be prepared to identify measures to transplant or replace elderberry shrubs. Such determination would be made on a project-specific basis. (See Section 3.4, *Biological Resources*, of this PEIR for further discussion.)

2.5.2 Project Access

Materials and equipment would be delivered to the Project area via surface roads. Trucks and vehicles would access the Project Areas via Putah Creek Road and local private roads on the north or south side of Putah Creek. Existing roads in the Program Area would be used as the primary access for construction of the bank protection measures. Access to the stream bank would be via existing roads wherever possible. Internal access within the Program implementation areas would be restricted to disturbed areas once initial site preparation activities had commenced.

During construction, existing roads through the subject site(s) would be cleared of vegetation (to a width of approximately 12 feet) and may be nominally improved (graded and possibly surfaced with gravel and rock or potentially matting/cribbing) to accommodate heavy equipment and trucks.

Should access across adjacent property be needed for Program implementation, landowners would be notified prior to commencement of construction activities, and the necessary authorizations (e.g., access easement agreement, road maintenance agreement) would be obtained to ensure minimal disruptions to their land and daily activities. These agreements would contain measures to minimize dust on private roads by maintaining low vehicle speeds (less than 10 mph) and by watering roads. The agreements would also provide for proper notification in advance of construction access, maintain access for agricultural traffic, grading or laying gravel to improve roads disturbed by construction traffic, schedule access around irrigations, avoid travel over wet ground, and other measures negotiated with the landowners.

Construction materials, including any needed soil, sand, and aggregate, would be hauled from a commercial or previously permitted quarry or borrow site located within 30 miles of the Program Area.

Construction Access to Channel

Construction equipment access to the stream channel and floodplain for implementation of Program activities would be via existing access ramps and roadways. In some cases these are overgrown and would need to be cleared and grubbed. Following completion of construction and post construction establishment activities, cleared access features would be re-graded to match natural contours and fully revegetated with appropriate native plant species, except where they are intended to be maintained for future use.

2.5.3 Construction Staging Areas

For projects where staging areas would be needed for storage/staging of vehicles, fuels, materials, and other associated construction equipment, these would be designated in previously disturbed areas and/or in areas along the tops of the upper creek terraces with easy access to the stream banks and (constructed temporary or existing) access points. Staging areas would be cleared of any vegetation and/or debris. Adjacent native vegetation would be protected. Following completion of project activities necessitating the use of staging areas, these areas would be cleared of any equipment and/or debris and revegetated with appropriate native plant species.

2.5.4 Temporary Flow Diversion

Flow diversion is typically implemented where channel reconfiguration activities are to be implemented over a long stream reach, in a reach where a deep pool is located, or where alternate methods of separation of the work area from the flowing stream are not feasible. In some cases, regulatory agencies may require stream diversion to allow work in a stream channel. For projects that require temporary diversion/dewatering of the active channel, prior to commencement of earth moving activities within the creek channel, temporary diversion pipe(s) and sheet-pile coffer dam would be installed. Diversion pipe(s) would be placed such that they are aligned with the thalweg of the design channel. Fill would be placed around the pipe(s) to floodplain elevation. Following completion of in-channel activities, flows would be released into the restored channel, and diversion pipe(s) and coffer dam would be removed.

2.5.5 Construction Schedule

Based on current and anticipated resource levels (staff and funding), physical constraints to work in or near the creek (e.g., high flows, species work window restrictions, mandatory flow releases), and the intent of the Program to limit construction-related impacts, it is anticipated that a limited number of projects would be implemented each year. Depending on site conditions and the results of pre-construction surveys, construction would occur during the months between April and October. The various wildlife and stream flow release constraints on work scheduling are shown below (**Table 2-2**). On average, 12 construction workers would be on-site, and a maximum of 20 workers would be working on any given work day. Construction is expected to occur primarily during daytime hours 8:00 a.m.to 5:00 p.m., Monday through Friday; however, if needed, construction could occur between 7:00 a.m. and 7:00 p.m. No nighttime construction or weekend work is anticipated.

2.5.6 Site Specific Project Reaches and Locations

This PEIR is intended to cover activities that may be implemented along Putah Creek between the Putah Diversion Dam and the Yolo Bypass Wildlife Area (the Putah Creek Restoration Project Upper Reach). For the purposes of Program planning and implementation, the Upper Reach has been further divided into 17 Project reaches (Figure 2-1). Specific activities are anticipated within each Project reach as determined by current conditions. **Table 2-3** shows the Project activities anticipated to be implemented at each project reach within the overall Project Area. Preliminary versions of maps and summaries of conditions and anticipated activities and outcomes for the individual project reaches are provided in Appendix C.

2.6 ANNUAL SCOPE OF ACTIVITIES

The Program has been designed to minimize environmental impacts of overlapping projects by including the following annual construction limits:

- Implementation of the proposed Program activities would be limited to a *combined* total maximum of 640 acres per calendar year, with a typical range from 20 to 60 acres/year; and a maximum annual total Project length of five stream miles, with a typical distance of 2 miles per year. Work in any one activity category would not exceed 60 acres per year in order to minimize potential impacts. Activities would be conducted in a discontinuous pattern to further avoid or minimize any potential construction-related effects.
- Gravel augmentation and salvage would be limited to 500 cubic yards each, per year.
- No more than 61 new riffles would be created each year within the Project Area, each requiring approximately 170 cubic yards of gravel, for a total maximum of 10,187 cubic yards of gravel placed per year.
- In the Solano County portion of the Project Area, the maximum number of one-way 3- and 4-axle truck trips would be 42 per day. In the Yolo County portion of the Project Area, daily 3- and 4-axle truck trips would not exceed 19 one-way trips.
- Construction materials, including any needed soil, sand, and aggregate, would be hauled from a commercial or previously permitted quarry or borrow site located within 30 miles of the Project Area.

Table 2-2 Program Work Scheduling Limitations

	January	February	March	April	May	June	July	August	September	October	November	December
Biological Restrictions[a]												
Swainson's Hawk			Mar. 15	No intensive new disturbances within ½-mile of active nests (away from urban development)[b]				Aug. 15*	Sept. 1			
Breeding Birds		Feb. 1			Require Survey[c]			Aug. 31				
Valley Elderberry Beetle	Transplant only in November through first 2 weeks in February										Transplant only in November through first 2 weeks in February	
Hydrologic Restrictions[a]												
In-water work	Work restriction through April 15				Unrestricted work when Los Rios Check Dam is in Place[d]							No later than Dec. 15

Note: *If a Management Authorization or BO is obtained.

[a] Additional restrictions may be required by trustee agencies.

[b] See Mitigation Measure 3.4-5.

[c] If construction, grading, or other project-related improvements are scheduled during the nesting season of protected raptors and migratory birds (typically February 1 to August 31), a focused survey for active bird nests shall be conducted by a qualified biologist within 15 days prior to the beginning of project-related activities (see Mitigation Measure 3.4-6).

[d] Work shall be timed with the driest time within the channel. The time period for completing the work within the flowing or standing water of the watercourses shall be confined to the period of April 15 to the date when boards are pulled at the Los Rios Check Dam (not later than December 15). Work within the dry portion of the stream zone shall be timed with awareness of precipitation forecasts and likely increases in stream flow and river flood stages. Construction activities within the stream zone shall cease until all reasonable erosion control measures, have been implemented prior to all storm events. Construction equipment and material shall be removed from the floodplain if inundation is likely. Revegetation, restoration and erosion control work is not confined to this time period.

Sources: BSK Associates, 2015; typical CDFW conditions for work on Putah Creek.

Table 2-3 Activities within Project Subreaches

	NAWCA\Mariani	Duncan-Giovannoni	Winters Putah Creek Nature Park	East of 505	Warren	Upper McNamara	Lower McNamara	Lester	Russell Ranch	Stevenson Bridge	Glide Ranch	Nishikawa	Olmo-Hammond-UCD	I-80 to Old Davis Road	Old Davis Road to Mace	Mace to Road 106A	Road 106A to Yolo Bypass
Channel Reconfiguration																	
Create low-flow channel and floodplain	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Create side channels	✓	✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Reposition thalweg	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construct riffles	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Increase channel sinuosity	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construct rock cross-vane grade/flow control structures	✓		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stabilize channel banks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construct rock revetments	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construct log revetments	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Install root wads	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Install large woody debris	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Improve fish spawning gravels	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	
Gravel augmentation	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	
Loosen embedded gravels by scarification	✓				✓			✓		✓		✓					
Fill abandoned gravel pits		✓	✓	✓		✓	✓		✓		✓		✓			✓	

Table 2-3 Activities within Project Subreaches

	NAWCA\Mariani	Duncan-Giovannoni	Winters Putah Creek Nature Park	East of 505	Warren	Upper McNamara	Lower McNamara	Lester	Russell Ranch	Stevenson Bridge	Glide Ranch	Nishikawa	Olmo-Hammond-UCD	I-80 to Old Davis Road	Old Davis Road to Mace	Mace to Road 106A	Road 106A to Yolo Bypass
Vegetation Management																	
Remove invasive plants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Manual and/or mechanical removal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Chemical control	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Plant native vegetation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pole planting	✓				✓		✓	✓	✓	✓		✓	✓			✓	✓
Cuttings	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Seedlings	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Seeding (drill/direct)	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
Container plants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Plugs	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Transplant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Maintenance of Habitat Enhancement Sites																	
Irrigate native revegetation sites	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Manage non-native vegetation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Manual and/or mechanical removal				✓					✓	✓		✓	✓				
Chemical control	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 2-3 Activities within Project Subreaches

	NAWCA\Mariani	Duncan-Giovannoni	Winters Putah Creek Nature Park	East of 505	Warren	Upper McNamara	Lower McNamara	Lester	Russell Ranch	Stevenson Bridge	Glide Ranch	Nishikawa	Olmo-Hammond-UCD	I-80 to Old Davis Road	Old Davis Road to Mace	Mace to Road 106A	Road 106A to Yolo Bypass
Maintain long-term access points	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Construction Related Activities																	
Temporary flow diversion		✓				✓	✓		✓	✓	✓		✓		✓	✓	
Temporary staging areas	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Site Preparation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Clearing and grubbing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vegetation management	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Installation of protective fencing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: ESA Associates, Inc., 2015.

2.7 PROJECTED PROGRAM OUTCOMES

Project goals and projected Program outcomes (with implementation of all anticipated individual reach projects) are presented in **Table 2-4**.

Table 2-4 Project Goals and Projected Outcomes

Goal	Objectives		Projected Outcome by Program Activity		
			Channel Reconfiguration	Vegetation Management	Maintenance of Habitat Enhancement Sites
1 Improve passage, rearing and Emigration of adult and juvenile salmonids in Putah Creek	1.3 1.4	Provide for ***effective fish passage for essential life history stages—i.e., structural passage and recruitment and emigration flows***[a]—between the Yolo Bypass and Putah Creek above the Yolo Bypass Wildlife Area (Objective 1.3) and on Putah Creek from the YBWA boundary to upstream spawning grounds below the Putah Diversion Dam (Objective 1.4)	Modifying channel geometry by creating a confined low flow channel would enhance flow depths for fish passage. Constructing in-channel pools would provide resting locations for migrating adults. Constructing grade/flow control structures would remove velocity barriers to and provide sufficient flow depths for fish passage. Bank stabilization and large woody debris features would provide velocity refuges, resting and foraging locations. Specific to the Mace to Road 106A subreach project: replacing the current seasonal earthen fill crossing with modular box culverts and providing a fish ladder or equivalent natural feature would improve fish passage between the YBWA and Putah Creek upstream of Road 106A.	N/A	N/A
	1.5	Restore, enhance, and maintain spawning and rearing physical habitats and processes on Putah Creek below the Putah Diversion Dam	Modifying channel geometry by creating low flow channels and floodplains and constructing riffles would restore and enhance spawning and rearing habitat. Constructing grade/flow control structures would create spawning habitat in glide portions of pools. Improving fish spawning gravels would enhance spawning habitat. Restoring 171 acres of open water pools to 89 acres of reconfigured channel and 82 acres of floodplain habitat would provide important spawning and rearing areas for many fish species. Bank stabilization measures that incorporate live plant material (log revetments, root wads, large woody debris) would provide cover, velocity refuge, shade, and foraging locations for fish (perennially in the main channel and seasonally on the floodplain, under high flow conditions).	Planting native vegetation would provide food sources, restore structural diversity, provide sources of in-stream small organic debris and wood, and increase shaded riverine area cover, therefore restoring and enhancing spawning and rearing physical habitats. Removing invasive plants would support establishment of native vegetation and thus support restoring and enhancing spawning and rearing habitat.	Irrigating and maintaining restored native riparian vegetation and managing non-native vegetation would promote establishment of native over non-native vegetation, which is turn would support spawning and rearing habitat.

Table 2-4 Project Goals and Projected Outcomes

Goal		Objectives	Projected Outcome by Program Activity: Channel Reconfiguration	Projected Outcome by Program Activity: Vegetation Management	Projected Outcome by Program Activity: Maintenance of Habitat Enhancement Sites
	1.6	Provide necessary ***flow regimes***[1] ***and water quality conditions for recruitment, rearing, and emigration of self-sustaining runs of salmonids*** on Putah Creek	Restoration of 82 acres of functional floodplains would support salmonid runs and other fish species— floodplains are important spawning and rearing areas for many fish species. Floodplain wetlands also act as nutrient and sediment sinks—improving water quality in the stream. Bank stabilization actions provide refugia and forage locations and would reduce contributions of fine sediment to the creek waters from unstable, eroding banks. Bank erosion contributes fine sediments to the creek that degrade the water quality and habitat conditions for salmonids and other aquatic species. Increased sediment reduces visibility needed for foraging, can cover or bury incubating salmonid eggs, and the associated increased level of nutrients can reduce oxygen levels in the water. Bank stabilization measures that incorporate live plant material (revetments, root wads, large woody debris) would provide shade (lower water temperatures), and foraging locations for fish (perennially in the main channel and seasonally on the floodplain, under high flow conditions).	Planting native vegetation would enhance water quality by stabilizing channel banks and filtering surface water runoff thereby by reducing erosion and fine sedimentation loads and improve water temperature by providing shade along low flow channel and off-channel habitats.	Maintaining native revegetation and managing non-native vegetation would help native tree and other vegetation establish over time. Established native riparian vegetation would provide more channel shading and surface sediment filtering, improving water quality conditions.
	1.7	Incorporate ***natural planform and cross sectional geomorphology*** that supports ***structural habitat complexity and natural hydrologic, geomorphic, and ecological processes***	Modifying channel geometry by creating low flow channels and floodplains (providing habitat complexity), side channels (providing velocity refugia, foraging area, and protection from predators), repositioning the thalweg (providing stabilization of channel form), increasing channel sinuosity (increasing structural complexity), and filling abandoned gravel pits (creating floodplain and wetland habitat) would support natural hydrologic, geomorphic, and ecological processes.	Planting native vegetation would help to provide stability to reconfigured channel planform and cross section, thus supporting outcomes described under Channel Reconfiguration.	Irrigating native revegetation and managing non-native vegetation would provide stability to reconfigured channel planform and cross section, thus supporting outcomes described under Channel Reconfiguration.

Table 2-4 Project Goals and Projected Outcomes

Goal		Objectives	Channel Reconfiguration	Vegetation Management	Maintenance of Habitat Enhancement Sites
			Projected Outcome by Program Activity		
4 Preserve and enhance, where possible, existing beneficial uses including public access, wildlife viewing, hunting and fishing, balance with existing, enhanced, and restored ecological functions.	4.1	Maintain a ***balance of existing fish and wildlife habitats, hunting, fishing, wildlife viewing, and other public benefits*** including water supply and agriculture between the PDD and YBWA[b]		N/A	Maintaining long-term access points would support a continued balance of wildlife, hunting, fishing, wildlife viewing, and other public benefits. Specific to the Olmo-Hammond-UCD subreach project: maintaining access would greatly enhance the natural setting and learning opportunities for Camp Putah (a week-long summer camp for Davis youth).
5 Enhance habitats for Delta native fishes and wildlife within the Putah Creek Project Upper Reach	5.1	*Same as Objective 1.3*			
	5.2	*Same as Objective 1.5*			
	5.3	Provide necessary ***flow regimes***[a] ***and water quality conditions to support anadromous and other native Delta fishes*** on Putah Creek	*Same as Objective 1.6*		
	5.4	*Same as Objective 1.7*			
	5.5	***Maintain and enhance native riparian vegetation communities*** along Putah Creek below the Putah Diversion Dam	Bank stabilization measures that incorporate live plant material would promote native riparian community enhancement along channel banks.	Converting 82 acres of open water to floodplain habitat, which would be planted with riparian vegetation, would enhance native riparian communities along Putah Creek. Removing 94 acres of invasive plants and planting them with native riparian vegetation would enhance riparian vegetation communities.	Irrigating restored areas of native revegetation and managing non-native vegetation would enhance native riparian vegetation communities
	5.6	*Same as Objective 4.1*			

[a] Flow regimes to support effective fish passage and to provide conditions necessary for recruitment, rearing, and emigration of salmonids, other anadromous fish, and other native Delta fish are provided by the Putah Creek Accord.

[b] The program would maintain current public uses along Putah Creek including hunting, fishing, wildlife viewing, public access, and water uses for agriculture. The program also contains annual limits of Project activities and would typically occur at a range of 20 to 60 acres/year. Activities would be conducted in a discontinuous pattern to minimize any potential construction-related effects that may affect public uses.