2008 Creek Walk Summary

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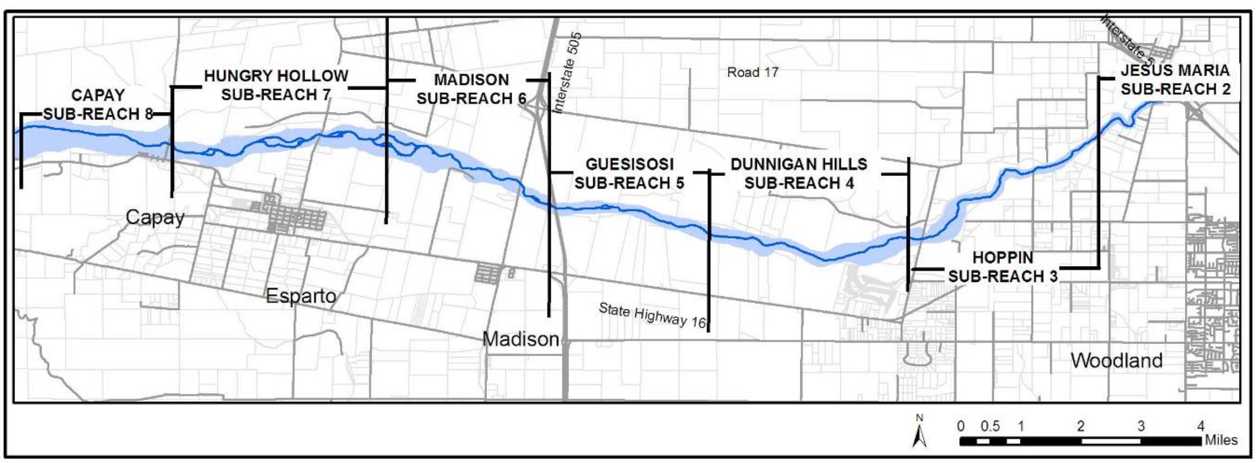
2008 CREEK WALK SUMMARY

INTRODUCTION

Each year, the County leads, as a public Cache Creek Technical Advisory Committee (TAC) meeting, an inspection of the Cache Creek channel and active floodplain. The inspections are conducted as a walking tour of the channel within the Cache Creek Resource Management Plan (CCRMP) area, beginning at the Capay Dam and ending at the I-5 Bridge. Usually, the inspection (Creek Walk) is performed during the late spring or early summer, after the flows in Cache Creek have subsided to low flow conditions and the County has received the annual aerial photographs. The Creek Walk is conducted over two or three days to cover the entire area and requires moderate physical exertion.

The Creek Walk is open to the public and on numerous inspections; the attendees have included interested landowners; Yolo County staff; representatives from federal, state, and local entities (e.g. Regional Water Quality Control Board, RWQCB; the Natural Resource Conservation Service, NRCS; Yolo County Flood Control and Water Conservation District, YCFCWCD; the University of California-Davis, UC Davis); environmental groups, and students.

The inspections are opportunities to observe and document channel conditions and verify the aerial photos and the Digital Terrain Models DTMs. During Creek Walks, the TAC and County staff are able to observe the performance of completed bank stabilization and habitat restoration projects implemented under the CCRMP. On many inspections, landowners and specialists involved in these projects are present to discuss achievements and lessons learned during and after implementation of the projects. The Creek Walk is an ideal time for the public to spend time with the TAC and County staff in the natural environment of Cache Creek, discussing observations and concerns, and providing input on channel erosion problems and habitat restoration opportunities. The CCRMP area is shown below separated into 8 sub-reaches, 7 of which occur between the Capay Diversion Dam and I-5.



*Note: The following descriptions utilize the river mile (RM) marker system, a commonly used river marking system established by the U.S. Army Corps of Engineers (ACE) in 1964, to reference approximate locations along a flowing water body. The RM's along Cache Creek begin at the Cache Creek settling basin and follow the historically mapped channel centerline so that these locations remain the same regardless of where the channel shifts over time. The RM designation no longer accurately measures the distance along the channel centerline due to channel migration however, the markers act as geographic place names that assist in defining specific locations referenced along a waterway.

The 2008 Creek Walk was conducted on the June 9, 10, and 11. Fifteen to 18 participants attended the event each day (Appendix 1). The Creek Walk included evaluations of channel changes and notable erosion that occurred during the 2007-2008 winter flows as well as evaluations of projects completed or in progress. We also did a cursory evaluation of Cache Creek's biological resources.

BACKGROUND

Geologic background

The Cache Creek watershed lies within the southeastern part of the northern California Coast Ranges. The coastal range and the hills which form the watershed of Cache Creek are the result of plate tectonic activity, a boundary between two tectonic plates where their meeting causes the land to rise and shift as the plates make contact with each other. The historic Cache Creek stream channel, particularly the upper section, is located in a valley that is continuing to form as the surrounding hillsides continue to uplift, and as the bed of the creek channel continues to downcut. The California Coast Range is composed of metamorphosed deep sea sediment and altered volcanic rocks that provide substantial loads of sediment to the Cache Creek watershed. Active landslides and fluvial processes in the upper watershed are sources of this active sediment load (Moores and Moores 2001).

Geomorphology and Sediment transport dynamics

The entire watershed or drainage basin of Cache Creek is slightly more than 1000 square miles, measured from the town of Yolo to the uppermost headwaters of the watershed. Cache Creek (like its sister to the south, Putah Creek has its headwaters in the Mayacmas Mountains of the coastal range. Cache Creek terminates in a settling basin in the Yolo Bypass west of the City of Sacramento. Historically, Cache Creek did not flow year-round. It has an episodic hydrology that is characterized by brief, intense flows. The upper watershed is narrow and steep, and the runoff from the hillsides is concentrated quickly to create "flashy" flood events. A "flashy" system is characterized by frequent periods of floods, sediment deposition, plant regeneration and growth; periods of stasis; then periods of extreme events; thus, rapid change has been the rule rather than the exception for Cache Creek (CCRMP 2002). Because the coastal mountains in the upper watershed provide large volumes of eroded sediment, the relatively intense flashy flows have historically carried large, coarse sediment supplies. Historically these creek flows and sediment loads have created a creek system that is quite dynamic, shifting the channel, forming and reforming mid-channel bars, and changing in location over time. (CCRMP 2002) Geologists and geomophologists refer to this as a bedload or braided stream.

While Cache Creek's natural form has been constantly changing over time, starting in the 1950's extensive in-stream mining has also contributed to the changing nature of Cache Creek. *"The annual sediment supply to the area within the CCRMP is about one million tons, (of which about 150,000 tons is sand and gravel). Annual in-stream excavation of sand and gravel has averaged some two million tons, however, which has resulted in a cumulative deficit of nearly 80 million tons since mining intensified in the 1950s. At the natural rate of replacement, it would take over 500 years to replenish the material removed."* (CCRMP 2002) Changes to the sediment supply by in-stream mining have led to changes in the dynamics of Cache Creek.

Cache Creek flows out of Clear Lake, which is a natural lake, although Cache Creek Dam was constructed in 1914 to increase its capacity and to regulate flows. Cache Creek Dam is situated five miles downstream from Clear Lake and was built to store water in Clear Lake that would normally have run-off into the Sacramento River. Indian Valley Reservoir is the other major upstream reservoir, and was constructed in 1974-1975 by the YCFCWCD. The Indian Valley Reservoir enters

Cache Creek from the north, and has the capacity to block and store sediment from higher in the watershed.

From Clear Lake to its terminus in the settling basin, Cache Creek passes through several distinctive and characteristic reaches. From Clear Lake to an area upstream from the Capay Valley, the hillslopes are steep and erosive forces are active because of the geologically active Coast Range. The Capay Valley reach is a sediment transport region from the Coast Range. The Capay Diversion Dam is located approximately two miles above the town of Capay on Cache Creek. This dam serves as the headworks for the agricultural canal system. Downstream from the Capay Dam, Cache Creek flows in a single channel or series of braided channels that are bounded by high terraces. The width between terrace walls varies from a little over 100 m at bridge constrictions to almost 400 m in the wider, more open reaches.

Historically, the 28-mile reach from Capay Dam to the settling basin varied from a wide, relatively steep and braided channel system at the upstream end to a narrow channel that cut deeply into fine alluvial deposits at the lower end. Within this lower reach considerable variation occurs due to a variety of geological constraints. For example, bedrock constriction in the Dunnigan Hills sub-reach elevates the groundwater to the surface, thereby encouraging riparian vegetation. A longitudinal plane view of lower Cache Creek drainage shows an hour-glass configuration. The channel from below Capay Dam to the vicinity of Moore Crossing is typically wide. Below Moore's Crossing to the Stevens Bridge (CR-94B), the channel narrows. Below CR-94B to near Yolo, the channel widens again.

Specific characteristics of the sub-reaches are described below preceding site-specific discussions of the reaches.

General Ecology

The Creek Walk was not intended to be a detailed biological survey, but rather to provide a common context for understanding both broad scale and site-specific ecological changes in Cache Creek over time. With that understanding, the following biological observations are simply incidental observations, which are influenced by the time of year, the time of day, and the large number of Creek Walk participants. While not completed under ideal conditions, the observations can provide a sense of current condition of vegetation, and relative plant species assemblages, as well as coarse-common ecological themes. Please note that when species name changes are disputed or have local adoption, we have attempted to provide the most current and regionally identifiable description. Wherever possible, identification is attempted to the lowest subspecies, when capture of the animal is not possible or warranted. This Creek Walk is not an attempt to identify all of the species present, and many species of insects, plants, small mammals, fish, aquatic invertebrates, and aquatic macrophytes were present but were either not observed, or were not able to be characterized given the time constraints.

Riparian vegetation

Riparian vegetation refers to plant communities associated with rivers and creeks. These plant communities tend to be made up of multiple layers of vegetation, starting at ground level with sedges, grasses and forbs, and progressing upward in the canopy, to shrubs and vines, small trees, and finally emergent cottonwoods, sycamores and oaks at the tallest level. These plant communities are home to a great diversity of plant and animal life, from stream edge dependent fishes and aquatic mammals to a diverse bird population (England et al. 1984). Riparian plant communities are both dependent upon river fluvial processes, but also profoundly influence stream channel characteristics once established.

Riparian plant communities are adapted to start their regeneration cycle with flooding and sediment deposition. This disturbance cycle fosters the appropriate conditions so that seeds are released to alighting on moist sediment. This is followed by germination and growth as stream and groundwater levels gradually decline. In the case of some riparian plants, such as the Fremont cottonwood, the seeds are many, but very small and contain little nutrition to survive long periods of time (Karenburg and Sutter 2003). This contrasts with the Valley Oak which relies more on animals to cache its large seeds, instead of bare moist ground (Pavlik et al. 2000). Both strategies are effective if natural processes are not modified.

Vegetation can increase bank stability, but physical processes may overcome the stabilizing influences of plant growth. Riparian plants have adapted many strategies to deal with the frequent natural disturbance (Baker 1990). For example, a vegetation community consisting of multi-stemmed, flexible vegetation, such as willows, stands a better chance of surviving flood events than do single trunked, isolated trees (Amlin and Rood 2001). More mature cottonwood gallery forests can deflect even very large floods, and can withstand significant periods of inundation and sediment overtopping.

Once established, riparian vegetation can greatly modify stream behavior. The presence of vegetation locally slows stream velocity and increases sedimentation (Arcement and Schneider, Undated; Scott et al. 1997). As continued plant establishment and growth continues, higher landforms develop that in turn affect river behavior. For example, vigorous stands of vegetation can divert flow in other directions, which may or may not be beneficial from a modern river management perspective.

Very little has been described about early conditions along Cache Creek, let alone anywhere in the Central Valley. The earliest aerial photographs are a set of 1937 prints from the ACE. Historic reports discuss changes and reduction of native riparian vegetation due to human clearing and cutting (Thompson, 1961; Katibah, 1984). Cache Creek was one of the earliest areas to be settled for agriculture, with Gordon establishing one of the first Ranchos in the early 1840's. Sprauge and Atwell (1869) commented on the early loss of oak woodlands and streamside vegetation in Yolo County. This loss of vegetation would accelerated erosion, widened channels, increased water velocities, increased bed degradation, lowered the water table, and caused the abandonment of the existing floodplain. Before modern alterations occurred, the elevation difference between the Creek and the floodplain would not have been as great as it is today. It is reasonable to assume that the higher alluvial plains would have been dominated by Valley Oaks and the lower elevation zones between channels would have been occupied primarily by willows and cottonwoods.

Historically, the presence of vegetation tended to stabilize the banks of both high flow and low flow channels. Some historical perspective is revealing: an 1851 Mt. Diablo Meridian Line survey crossed Cache Creek about two miles east of the present day I-505 Bridge. The survey documented a 430 m band of willow and cottonwood vegetation that surrounded a comparatively narrow channel. A band of oaks was also described, the later presumably found on a higher terrace. The channel itself was only 30 m wide. Thus, this particular reach was characterized by a relatively narrow channel and a wide band of vegetation. An 1857 survey of the present day CR-94B described a relatively small active channel (57 m wide) out of a total of 855 m of floodway. Of this floodway, about 395 m were found on the north bank, and another 402 m were found on the south bank. Little mention was made of vegetation in this survey.

As described previously, Cache Creek is a flashy system. Because of this, the vegetation along Cache Creek is characterized by plants that withstand heavy flows and stream velocities, plants that reestablish themselves quickly or easily through vegetative growth and resprouting, or plants that are effective at seed dispersal. Episodic vegetation loss is natural along Cache Creek, but may have been exacerbated by the higher than historic stream velocities due to narrowed river floodways and bed degradation due to in-channel mining. In areas where in-channel mining has occurred much of the vegetation had been removed from within the active creek channel. Active restoration has not occurred in most of these areas to reestablish vegetation, but rather most vegetation regeneration in these areas has occurred on its own.

While in channel-mining has had an effect on the vegetation community, the presence of the Capay dam, agricultural run-off, and the availability of late season flows (found in tailwater and/or from water deliveries for irrigation along the canals by the YCFCWCD) also affect the plant communities along Cache Creek. In many areas of the Central Valley, highly regulated rivers through dam construction, channel alterations, levee construction, and various channel maintenance activities have seriously affected natural patterns of vegetation regeneration. Since in-channel mining has been removed from the CCRMP area there have been increases of vegetation cover; however, comparisons have not been made between before and after mining was removed in-channel (Completing this comparison would greatly aid us in the management and monitoring of the CCRMP area).

The riparian forest and associated vegetation require constant reworking to provide different age classes of plants. The extent of existing (and potential) riparian vegetation associated with Cache Creek is impressive. In some areas (e.g. RM 15.7) large stands can be seen that have tall trees and wide patches. There is an opportunity to support and develop a continuous riparian forest of good quality and extent along Cache Creek. Generally, the plantings closer to the Creek have faired better than those on higher terraces where conditions are much drier. On some of the driest sites (e.g., Granite and Teichert projects), more drought-tolerant native species should be used. To create and maintain a functional riparian corridor, a minimum width and functional patch size need to be identified and planned.

2008 OBSERVATIONS

Plant species were relatively similar in composition from upstream to downstream, with only 2 locations with noticeable new cottonwood growth both within Subreach 3 and near the obvious low-water line. Perennial Pepperweed (*Lepidium latifolium*) appeared to increase downstream, with an even more distinct gradient and increase in density for Arundo (*Arundo donax*) and Tamarisk (*Tamarix parviflora)* in the subreaches closest to I-5 (3 and 2). Unique to the lower Cache Creek area, a big patch of yerba santa (*Eriodictyon californicum***)** was noted.

The middle subreaches (7, 6, 5, and 4) had broad expanses of floodplain and significant internal riparian complexity, and nearly continuous rafts and mats of filamentous algae (Chlorophyta apparently *Cladophora* spp., but also potentially *Oedogoonium, Ulothrix spp.* in the winter, and a few masses of what appeared to be *Spirogyra spp.*). Fly larvae and flat worms (*Planaria spp.,* family Planariidae) predominated. Small leaches (Class: Hirudinea) were evident, and a large leach on a Western Pond Turtle.

The geomorphology of the middle reaches, broad gravel plains with scattered scour holes and large woody debris, appeared to have a significant influence on the observed species, much in the same way that the confined reaches had. There was very little riparian shading because of the width, and the temperatures were not moderated. The isolated pools in the scour holes and deepest bends were dominated by filamentous algal colonies. Where the scour holes were shaded by willow cover, (mainly to the northern side of Cache Creek) some stranded fish (mainly small Ciprinids) were observed in very deep holes. It is possible that these fish could survive until flows fill the Creek. Cover and silt made identification impossible, however a subset of these locations should be seined and the species identified.

As the reaches again narrowed, riparian trees provided more cover, and the overall plant species richness increased again. It is difficult to tell if the bird numbers increased due to the decreasing available riparian area (less hectares per river kilometer/mile) or due to the greater area of mature trees per hectare. However, the diversity of observed bird species increased significantly, as did the number of bird observations (Table 1.).

Wildlife

Crayfish (presumably *Procambarus clarkia* and *Pacifastacus leniusculus*) and crayfish tracks were apparent throughout the Creek Walk. Flame Skimmer Dragonflies (*Libellula saturata*) and Eight-Spotted Skimmer *(Libellula forensic)* were common. Small White or Cabbage White Butterflies *Pieris rapae* (introduced) were observed feeding on mustards. Familiar Bluet Damselflies (*Enallagma civile*), Domesticated Bees (*Apis mellifera*) and Western Kingbirds (*Tyrannus verticalis*) were also observed. American Beaver (*Castor canadensis*) sign was present in several reaches, with 3 small beaver dams in the upper subreaches and discernable bank burrows in the lower subreaches. Black-tailed Deer (*Odocoileus hemionus*) sign and observations were common and so were Raccoon (*Procyon lotor*) signs (tracks/scat).

Low densities of snail (family Physidae) and their egg masses were evident in the upper subreaches, but dropped off in the lower subreaches. Introduced Asian Clams (*Corbicula manilensis* nee *C. leana* Prime, *C. fluminalis)* were common throughout the first two subreaches (8 and 7), but in low densities, and significantly less than within equivalently positioned reaches of neighboring Putah Creek.

Several species of frogs and toads were observed on the Creek Walk. Most were in the tadpole stage, but some had metamorphosed. The majority of adult amphibians observed were Bullfrogs (*Lithobates catesbeianus*); however, in the lower subreaches, there appeared to be a transition to more California Toads (*Bufo boreas halophilus*)**.** Hyla (presumably Pacific Tree Frog) tadpoles were observed in scour holes in the middle reaches. A Western Pond Turtle (*Actinemys marmorata*, in the *marmota-pallida* intergrade zone) was observed in the middle subreaches. This animal was in excellent condition. Two species of snakes were observed: an Aquatic Gartersnake (*Thamnophis atratus* intergrade) and a Valley Gartersnake *(Thamnophis sirtalis fitchi*),

Unfortunately, Bank Swallows (*Riparia riparia*) were localized to only 2 visible banks, and participants identified that the colony on the most downstream reach had abandoned the site apparently due to caving, and appear to have decreased from prior Creek Walks. However, there are several potential locations for Bank Swallow nesting areas that were not examined during the Creek Walk, and they should be thoroughly censused.

Weed control
The Cache Creek Conservancy (CCC) has done an admirable job of managing the invasive plant species in the streamside corridor. However, one concern is that other weed species (such as Perennial Pepperweed) are coming in to fill the void. This will continue to be the case as each new plant species invades the Central Valley. It is critical to identify new threats and respond to them in a concerted top to bottom fashion in the watershed.

Despites CCC's efforts, some landowners along Cache Creek still have significant stands of invasive species, and ditches and laterals associated with the Creek have uncontrolled weed infestations. Landowners with significant weed problems must be engaged to see if further management can be completed. A strategic approach for emphasizing immediate re-vegetation with native species must be concurrently implemented with the weed management program. Fast growing replacements, such as local willows species and native grasses can be established readily on barren or sparsely weeded sites, with supporting irrigation. The CCC can be a valuable partner in support of this concurrent revegetation.

River shape, migration, and infrastructure management
One common theme that came up on the 2007 Creek Walk and again on the 2008 Creek Walk was the recognition of the tension between the natural process of river migration ("channel shift") and the desire for infrastructure management and protection. Dikes, riprap, other types of bank protection, and reconstruction projects have all been used to restrain or redirect river migration. In many cases, well-designed efforts to restrain or redirect the river have failed, or have had unforeseen consequences that will now lead to further action being required. In many circumstances, money, effort, and time can be saved by giving the river more room to carry out natural processes of channel shift. Projects need to consider linkages (process-based and spatial, and negative and positive) between projects. The most direct application of this approach in river mechanics is to ask how the actions at one area in the river affect the rest of the river, and, in particular, the contiguous upstream and downstream areas.

In addition, Cache Creek is one of the few areas in this part of the Central Valley that has appropriate Bank Swallow habitat, which requires a freshly eroding bank of relatively fine-textured sediment (Garrison et al., 1987). Projects that restrain the movement of the bank can be detrimental to this habitat creation and maintenance for this State-listed species.

The following sections of this document present the significant reach-by reach observations and recommendations made during the 2008 Creek Walk.

CAPAY SUBREACH (SUBREACH 8)

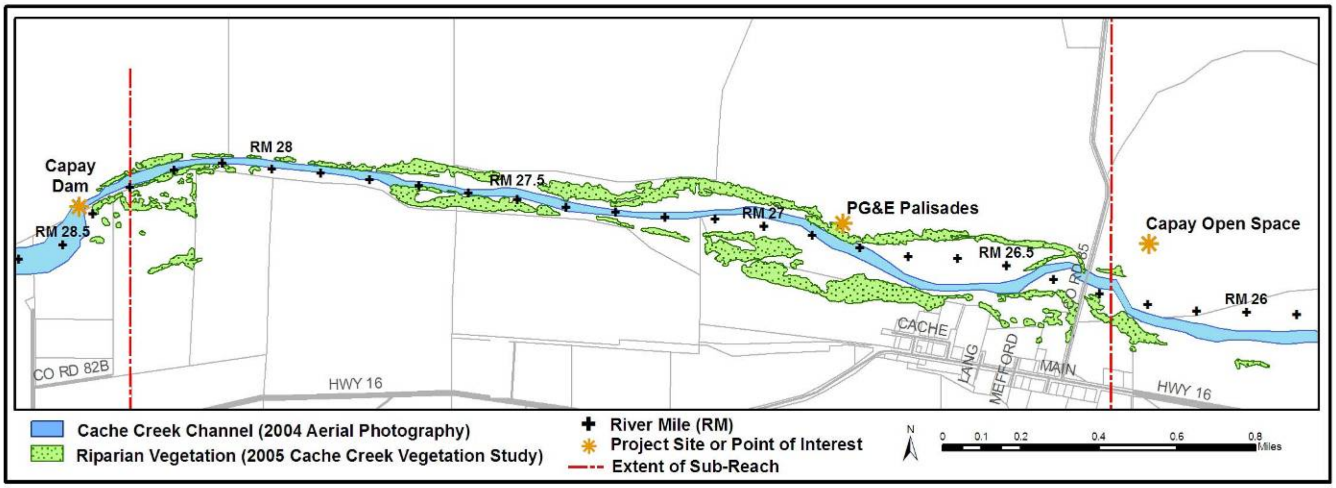


Figure 2. Capay Subreach (Subreach 8) from the Capay Dam to the Capay Bridge (RM 28.3-26.3)

The Capay Subreach measures 2.0 miles in length, with an average width of 536 m, a depth of 6 m, and a slope of 3.3 m/mile (0.0020). As such, it can be described as a steep, confined and incised subreach with hillside and stream bottom bedrock controls formed by outcrops of the Pliocene Tehama formation in the creek bed. Considerable scour occurs in this subreach and bedrock is commonly exposed. Between 1959 and 1980 there has been at least 4.7 m of channel degradation at the site of the Capay Diversion Dam. Channel incision may have resulted from the following factors: 1) channel narrowing projects by landowners; 2) construction and improvement of Capay Bridge; and 3) installation and operation of the Capay Diversion Dam. There is minimal lateral erosion in this sub-reach, and very little deposition occurs (especially in the upper part of the subreach).

There are relatively good stands of native vegetation in selected areas along this subreach. Water was observed seeping from both banks at the contact between bedrock and the overlying alluvial

Figure 3. Stands of native vegetation on north bank in Capay Reach.

sediments. The seeps seem to sustain vegetation development in this reach and have been observed within the reach during every previous Creek Walk. These seeps are caused by extensive surface irrigation that results in interflow at the base of the soil profile, along the top of the less permeable bedrock boundary. On the north bank an extended terrace supports a mixed stand of Northern

California Black Walnut (*Juglans hindsii*) and Valley Oak (*Quercus lobata*). Other native species documented in the Capay Subreach are the same as in preceding years, including: Sandbar Willow (*Salix exiquia*), Arroyo Willow (*S. lasiolepis*), Black Willow (*S. gooddingii*), Fremont Cottonwood (*Populus fremontii*), Creeping Wildrye (*Leymus triticoides*), Santa Barbara Sedge (*Carex barbarae*), Mulefat (*Baccharis salicifolia*), and Oregon Ash (*Fraxinus latifolia*). Exotics invasive species include Arundo or Giant Reed (*Arundo donax*), Pampas Grass (*Cortaderia selloana*), and tamarisk (*Tamarix* sp.). Licorice-root (*Glycyrrhiza lepidota*) was noted as present in 2006 when Jeff Hart spoke about its cultural significance; however, it was not specifically observed in the past 2 years.

Over the past several years, natural regeneration of plants continues; however, because of the scouring effect of Cache Creek and the restrictive nature of the Tehama bedrock formation, only limited growth is anticipated. The lower part of this subreach is characterized by a shift to thin patches of sediment deposition rather than erosion. Abundant young cottonwood seedlings which now approach several years of age in some areas have colonized the fine sediment. The thin soil and sediment profile and shallow, impermeable bedrock will continue to limit seedling success.

Figure 4. Seeps at the base of the soil profile in the Capay Sub-Reach caused by irrigation and drainage from the West Adams Canal.

The confined nature of the initial reach also provided pool habitat at this time of year, which was used by carp species (family Cyprinidae) and what appeared to be Brown Trout (*Salmo trutta*). Western Pond Turtles (*Actinemys marmorata***)** were also observed (Cache Creek is in the *marmota-pallida* intergrade zone). While attached filamentous algae were clearly visible, they did not dominate the stream at the time of observation.

Some limited numbers of stonefly larvae were observed (approximately 0-1 per 250 cm^2). Dragonfly nymph cases were found in small numbers in the litter line (approximately 1 per meter), but striders and even riparian spiders were limited.

Capay Dam (RM 28.4): The 2008 Creek walk began at the Capay Diversion Dam, an irrigation structure that was constructed in 1914. Max Stevenson, Water Resource Associate for the YCFCWCD, led a tour of the dam and control house. This dam is for agricultural diversions only, and does not provide significant flood control. The dam marks the upstream extent of the Cache Creek Resources Management Plan (CCRMP) area, and forms a biological boundary. Upstream fish populations tend to be dominated by native trout, and downstream fish populations are mostly non-native. (CCRMP 2002)

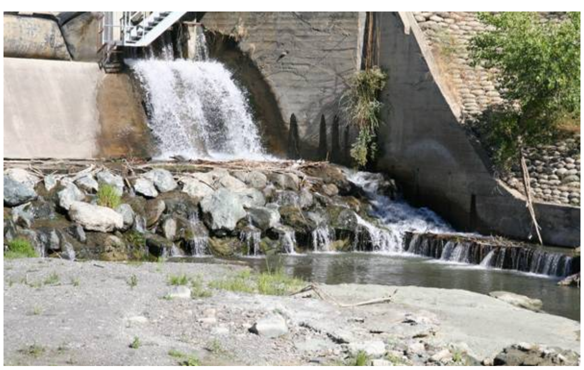


Figure 5. Scour along north bank below Capay diversion dam.

Winter flows easily overtop the dam, and Max said that sediment also passes freely over the dam during high flows. The pond upstream from the dam is shallow (probably 2 m max.), and a rubber bladder fine-tunes discharge during low flow summer conditions. The channel below the dam shows extensive erosion, especially near the north bank. Almost all loose gravel has been scoured from the channel on the downstream side, leaving patches of eroded, cohesive Tehama Formation. High flows have scoured up to 3 m into underlying sediments of the Tehama Formation. In the past year, a concrete and boulder patch on the apron has eroded slightly, although side-by-side comparison of photos taken one year earlier shows little large-scale change to the apron:

Figure 6. 2007 photo of Capay diversion dam.

Downstream from the dam, the stream is incised approximately 6m on the south bank, and there is lesser incision on the north bank. This leaves higher fluvial terraces above and separated from the main channel. Grouted rip-rap appears to have stabilized erosion along the right and left edges of the base of the dam. Larger rip-rap (boulders) has also stabilized the dam abutments on both sides. Scour near the middle of the dam will be an increasing concern in the upcoming years, as high winter flows will continue to erode the central area. The stream runs almost entirely on bedrock, with little natural sediment in the channel. Immediately below the dam and downstream to roughly RM 26.8, the bed, and, to a certain extent, the banks of Cache Creek, are composed of erosion resistant silty sand from the Tehama formation. The single-thread channel is laterally confined by steep banks.

The channel in this area is a naturally transporting reach (a reach where sediment is transported through and not deposited). Where there are in-channel deposits of gravel, they tend to direct the flow so that the flow is more concentrated at the bank. Much of this channel segment may be located on an old alluvial fan, which would be a natural cause of channel incision. A map of the contours and material composition of the fan would be useful in considering the channel and its dynamics in relation to the fan.

From a habitat standpoint, this is a highly degraded and un-natural area. The potential for in-channel restoration is limited as long as this is a release point for high winter flows.

Geotechnical studies are currently underway for a California Environmental Quality Act Environmental Impact Report (EIR) and proposal to update the dam. Preliminary geotechnical work provided to the TAC in summer 2007 showed that the dam could be susceptible to rotational failure, although this work assumed that the dam's side wings were not structurally attached. A less conservative analysis would have assumed some structural contribution from the wings. The dam has surficial cracks, as noted in previous geotechnical reports, but analysis showed that these cracks do not affect the integrity of the concrete structure. Current proposals call for an expanded apron and grade control structure downstream from the dam, and these plans will be circulated through the

TAC. The most pressing structural concern near the dam may be the 1 m of undercutting along the north bank spillway.

The installation of a grade control structure would reduce bed erosion and possible nick point migration. Grade control structures placed downstream of a scour zone can promote infilling with gravels and sands, which could be positive for the scour near the apron.
Some issues to consider in relation to a possible grade control structure:

1. The stream could "end run" eroding around the ends of the structure.
2. There could be increased scour downstream of the structure, creating a scour hole where the hardening ends.
3. Continued local scour may occur immediately off the end of the apron.
4. A good location for a grade control structure would be at a "pinch point" where the channel narrows naturally.

Tanya Meyer from the Yolo County Resources Conservation District (Yolo RCD) showed the group photos of non-native plants that are being removed upstream from the dam. Tamarisk and *Arundo donax* are currently targeted. Yolo RCD has a grant to remove non-native species, and is experimenting with the Tamarisk beetle (*Diorhabda elongate*), a non-native beetle that eats the invasive tamarisk plants. In the initial years of the experiment the beetle didn't move very far, but Tanya said that last year the beetle migrated downstream to Guinda. This is a significant migration, and an encouraging sign for the effectiveness of the beetle in removing tamarisk plants. Much of the tamarisk that was eaten by the beetle in the first year of the study has grown back, but it may take a number of years of defoliation by the beetles to kill each tamarisk plant.

Tanya also described a CALFED grant that the Yolo RCD shares with Kamman Hydrology and Engineering Inc. to study stream channel dynamics upstream from the Capay dam. This study will use modern and historical data to show trends in channel morphology, sediment transport and erosion. It will be paired with a similar study downstream from Capay dam that is supported by the Yolo County Department of Parks and Resources.

Thin sand and gravel bars begin to appear in the channel bottom at RM 28.2. These bars are up to 1 m thick (maximum), and form a thin veneer on the underlying bedrock. An old, abandoned drain pipe enters the creek bed at RM 28.1. This pipe does not appear to be an immediate threat because no discharge was present, but it would be good to remove the metal from the creek bed. Seeps and springs contribute water to the stream from both banks at RM 28.0. These seeps probably are associated with agricultural field watering on the south bank, and result from irrigation water seeping

Figure 8. Seeps along the south bank at RM 28.2.

Figure 9. *Arundo donax* along left bank levee at RM 27.6.

through the soil profile. Seeps on the north bank may be leakage from the unlined irrigation canal.

The channel narrows at RM 28.0 and large stands of Arundo line the riparian zone at RM 27.8 - 27.6, intermixed with cottonwood and walnut. Cottonwoods are older and more established, and the walnut trees form a younger understory that Creek Walk biologists said may inhibit other desirable plant growth.

Ravenna grass (*Saccharum ravennae*) was also common at the edges of the irrigation canal that travels along the north bank levee. John Watson from the CCC said that spraying will start soon to remove this invasive plant.

PG&E Pipeline/PG&E Erosion Control Palisades (RM 26.9)
Project Type: Erosion Control/Planting
Date of Implementation: 1998   **Project Partners:** Rinker, Yolo County Planning and Public Works (PPW)
The only "restoration" project for the Capay Subreach is the palisades project. This project is found on the north bank. This project was implemented prior to implementation of the CCRMP to protect

Figure 10. Prior to 2008 (left photo), sediment had been effectively trapped at the steel piles and nets next to the concrete pillow blanket. In 2008 (right photo), this sediment had been eroded away.

upstream nets and soft groins had trapped finer sediment above the pipeline, resulting in sediment and sand/gravel bar accumulation along the north bank. The trapped sediment has allowed vegetation to regenerate, as noted in 2007, including Cottonwoods and, unfortunately, Arundo. In 2006, a "pillow blanket" of hardened concrete sacks was installed to cover and protect an international gas pipeline that crosses under Cache Creek and had been damaged by the 2005-2006 winter flows.

Figure 11: Beaver dam at Pacific Palisades pillow blanket.

Figure 12. Restoration work done at the PG&E Palisades site.

Significant changes have occurred since the 2007 Creek Walk. Sediment has collected in new areas, erosion patterns have changed, and beavers have raised the water level upstream from the pillow blanket. A beaver dam is attached to the pillow blanket along the south bank. The beavers utilized the solid abutment of the pillow blanket and eroded clay bedrock as anchor points. Comparing photos between years there is no significant difference in the water levels before and after the beaver dam was created. The scour found at the Palisades is probably unrelated to the beaver dam. Any sediment deposition that occurs due to the beaver dam occurs at low flow. At high flows, the beaver dam is insignificant as far as affecting the flow and sediment dynamics (deposition or erosion) are concerned. The scour that occurred upstream of the concrete blanket occurred at much higher flows as Cache Creek overtopped the pillow blanket. There is also no apparent negative impact due to the beaver dam on the stream morphology. Large, heavy chunks of pillow blanket have been tossed onto the top of the protective pad, and erosion has undercut the top edge of the pillow blanket. A 1-1.5 m deep scour hole is present on the upstream edge of the pillow blanket, and the concrete has been undercut by at least 60 cm in places. Loose pillows have also been moved in behind the sediment traps along the north bank (see figure 6 above). Erosion of this intensity would probably occur during peak winter flows. This area is a continuing concern, and the pillow blanket seems like a temporary solution that requires annual maintenance. A significant portion of the concrete was visible, and this may be due to localized erosion and migration of a nickpoint that has moved through this area. The concrete blanket reduces or eliminates in-channel geomorphic processes locally. Erosion ideally should be addressed before high flows return next winter to avoid losing larger chunks of the protective blanket or to prevent complete failure of the blanket and breach of the pipe. As it is required by the DFG to do work in-channel prior to October 31, it is unlikely that work will be completed this year, but should be planned for the 2009-2010 season. The beavers are part of this system, and design or construction people should consult with biologists or ecologists to consider the effects of a new concrete patch on the beavers. The beavers might also be considered a nuisance and removed, although this is likely to be controversial and not entirely necessary.

Restoration planting associated with the Palisades consists of Valley Oak, Red Willow (*Salix laevigata*), Western Redbud (*Cercis californica*), Black Walnut, Blue Elderberry (*Sambucus mexicana*), and Deergrass (*Muelenbergia regens*). Plants have been in the ground for several years now, with moderate success.

Recommendations and Items to Investigate **(RM 26.9)*:***

1. A long-term solution is needed for the concrete blanket and the international pipeline crossing Cache Creek. Repair work was completed in 2006 and there is significant erosion to the blanket only two years after this work was completed. PG&E should be contacted in order to discuss maintenance and long-term solutions for this area.
2. Monitor the nick point and estimate its travel speed. Anticipate any issues that it may cause. For example, what will happen when the five-foot incision of the nick point reaches the dam?

3. Document and monitor species that have been recruited and established on the new sediment bars.
4. Monitor the percent cover of Arundo and whether it has increased since last year.
5. Remove Arundo in the area and replant with natives.
6. Obtain the Palisades planting plan and monitor the area for plant health and survivorship.

Figure 13: Red Sesbania at RM 26.8.

River mile 26.8-26.4 observations: The channel widens at RM 26.8, resulting in deposition of a mid-channel sand and gravel bar complex. Bedrock is visible along 2-3 m high incised banks, especially along the south bank. This indicates that the gravel cover is relatively thin. The bedrock is of an erodible material. The south bank at RM 26.6 experienced approximately 6 m of lateral erosion during the high winter flows as noted in 2006. This erosion occurred directly across from the large in-channel gravel bar. Erosion and bank loss at this site may be linked to the upstream PG&E Palisades project, so future designs or fixes of the Palisades project should consider nearby landforms and stream processes. Soil exposure and erosion in this area has caused the soil to dry out and trees to die from exposure and attrition. In 2006, it was noted that dead, mature trees from the top of the bank continue to fall into the channel as the area gradually erodes, providing large woody debris to the local stream environment. This large woody debris enters the channel and is moving downstream. Invasive Red Sesbania (*Sesbania punicea*) is common along the creek margin at RM 26.8.

In 2007, a significant water quality hazard was noted as present at RM 26.6, where twenty or more vehicles are abandoned on private property in a make-shift junk yard. This water quality hazard was still present in 2008. The closest vehicles are less than 35 m from the high water bank. These used vehicles are a potential source of motor oil, coolant, and differential fluids, and when the vehicles decay and leaks develop, the fluids will leak down-gradient into Cache Creek. Permeable surface soil and extensive irrigation will exacerbate the process. Pollutants can travel hundreds of meters per year through this material, and can flow preferentially along the less permeable bedrock boundary, allowing contaminated water to seep directly into Cache Creek. It would be better for the stream environment if the vehicles were moved farther back from the creek bank, or removed from the site and recycled by a junk yard. If Cache Creek is eroding along the south bank, which should be verified using aerial photography, this would make the junk yard and water quality issue more pressing.

Figure 14: Bank protection boulders upstream from Highway 85.

The north bank is the site of an earlier bank stabilization project that protects the Adams canal and extends downstream to the CR-85 Bridge. In this region, the active channel shifts toward the south bank as the channel widens to more than 300 meters. Ben Adamo (Granite Construction Company) remembered that construction may have dated back to 1995 or 1997. Bank control is important along this reach, as the stream approaches the bridge. In general the slope of the north bank is more gradual in the stabilized area, and the south bank is steeper and more incised. The bank protection project consists of cottonwoods, willows and some young walnut trees growing in between small boulders. These boulders form a hardened lower surface more than 2 m tall at the toe of the slope, although vegetation covers the boulders in some areas. The bank is now relatively stable, and vegetation continues to grow and strengthen the system. This bank protection project is an example of a successful attempt of bank stabilization.

Recommendations and Items to Investigate* (RM 26.8-26.4)*:

1. The Yolo County Department of Parks and Resources should contact the land owner at RM 26.6 about moving the vehicles. A larger buffer zone between the Creek and the vehicle yard would be preferred.
2. Investigate to determine if erosion on the south bank of the channel downstream of the Palisades has the potential to endanger infrastructure or high-value agricultural land. If so, assist landowner with erosion control options and potential mid-channel bar alterations. Also evaluate how upstream activities may be influencing the lateral migration of the channel.
3. Investigate the "nickpoint": find its location and establish a survey program to track its possible movement.

Capay Bridge, CR-85 (RM 26.35): The river width is constricted by a factor of 0.5 as it flows under this bridge. It appears that the stream channel widens naturally downstream from the CR-85 Bridge, and we speculate that the bridge was located strategically at a narrow place upstream from where the channel naturally widened. The channel transforms at this location from a single thread, relatively narrow channel upstream to a wider, multithread channel downstream. It is likely that this area is the transition zone where the channel transforms from a "transport reach" to a "depositional

Figure 15: Bedrock exposure upstream from CR-85 Capay Bridge.

Figure 16: Cliff swallows under CR-85 Capay Bridge.

reach". Bedrock is exposed upstream from the Capay Bridge, and the gravel surface is spotty and thin as a result of flow constriction and scour. This implies a scarcity of gravel in the reach, although scour does not appear to be a problem around the bridge abutments. Heavy boulders have been imported to reinforce the outermost bridge abutments, with apparent success. In 2006, the Digital Terrain Model (DTM) data indicated that the retreat of the bank just upstream of the bridge had been minimal and that the spur dikes on the north bank (RM 26.5) immediately upstream of the Capay

Bridge continue to perform well in providing bank protection and riparian habitat is flourishing within the structure. The underside of the bridge is the home to a large colony of cliff swallows- possibly several hundred in total.


Figure 17: Beaver dam downstream from CR-85 Capay Bridge.

In the main channel, beavers have been active upstream from the bridge, forming and enhancing small ponds. These beaver dams are new since the 2007 Creek Walk, and raise river stage in localized areas. Carp and catfish are common in the deeper pools. We did not see any problems posed to the river morphology by the beaver dams. There appears to be scour around the bridge. The Yolo County Parks and Resources staff should coordinate with PPW and Caltrans staff regarding management around the bridges. A qualified engineer should regularly inspect the bridges and County staff and the TAC should be informed of these reports.

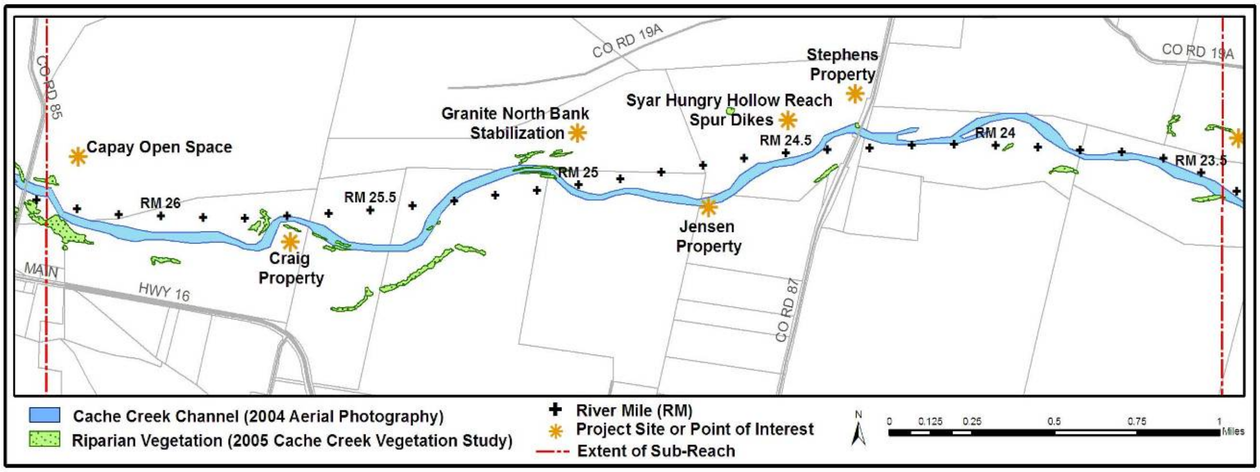
Recommendations and Items to Investigate (RM 26.35):

1. A meander that is developing along the north bank may pose an erosion hazard to the north ramp of the Capay Bridge. This could be addressed with control structures along the north bank, upstream from the Bridge. Recommendations included continued monitoring of the meander position and lateral erosion. It would also be instructive to compare the current configuration compared to past years.
2. Monitor the riparian vegetation downstream from the spur dikes.
3. Monitor mid-channel aggradation.
4. Consult with PPW and Caltrans on management and inspection of bridges crossing the Creek. There may be a need for channel reorientation and/or sediment removal to address the adverse orientation of the low flow channel that is a potential erosion hazard to the Capay Bridge abutments.

Capay Subreach General Recommendations:

1. **Continue coordination with landowners to promote and implement invasive species removal program (throughout the subreach):** As the uppermost subreach within the CCRMP area this is particularly important in controlling the spread of invasive species to areas downstream. Areas with particularly high densities of tamarisk were noted at RM 27.7 and RM 27.2 to RM 26.8.
2. **Coordinate invasive species removal efforts with riparian restoration projects (throughout subreach):** The soil and groundwater characteristics of the Capay subreach are conducive to riparian vegetation as noted by the naturally occurring stands of vegetation in the area. Restoration projects should be coordinated so that appropriate vegetation is used to fill in areas where invasive species eradication has occurred. The establishment of native vegetation in areas previously occupied by invasive species promotes the maintenance of the vegetated corridor that exists within the Capay subreach, increases the habitat value of vegetated areas, and makes re-establishment of invasive species more difficult. Natural recruitment of native species should be monitored, in addition monitoring invasions by other non-native species after removal efforts. Monitoring may also show whether erosion has increased due to invasive plant eradication.

HUNGRY HOLLOW SUBREACH (SUBREACH 7)



The average width of this subreach is 472 m and it has an average depth of 3.5 m. The slope averages 3.44 m/mile (0.0021). Compared to the Capay subreach, downstream from the Capay Bridge the channel widens and tends to become braided with multiple channels and mid-channel bars. In this reach, mining reduced the degree of braiding and the width of the band occupied by the actively migrating channel. A 30 cm cap of silty loam overlies the coarser mid-channel stream channel deposits. This is probably a result of lower stream velocities in the wide, shallow channel area.

Figure 19. Capay Open Space Park prior to construction.

Vegetation. Regeneration is slow or absent in this reach, apparently due to comparatively higher terrace elevations and lower groundwater levels. The regeneration that has occurred consists mostly of Mulefat and some Fremont Cottonwood and is restricted to a narrow zone adjacent to creek. The presence of occasional individuals of Red Willow on some parts of the high terrace casts some doubt on the lack of groundwater availability, at least during the last several years, as being totally restrictive to tree growth. However, the well-drained substrate and lack of organic soil likely reduce the rate of growth and seedling establishment.

Capay Open Space (RM 26.3)
Project Type: Habitat enhancement and public access
Size: 41 acres **Date of Implementation:** 2004-2007
Development Agreement: No. 96-289 (Resolution No. 04-150/Agreement No. 04-275)
Project Partners: Granite Construction Company, Yolo County PPW

The inspection within the Hungry Hollow subreach began at the Capay Open Space Park (RM 26.3). The Capay Open Space site was donated to Yolo County as part of Granite Construction Company's development agreement amendment in December, 2002. The County developed a park design that went through extensive public review and was approved by the Board of Supervisors. The park is open as of August 8, 2008 and provides the public with access to Cache Creek. Site improvements completed include California native grass, shrub, and tree plantings; trails; picnic areas, potable water, a parking area, restrooms, and an area for the park host. Plantings were done in cooperation with a contractor, the Center for Land Based Learning (CLBL), and Student and Landowner Education and Watershed Stewardship (SLEWS). Irrigation was installed. An access ramp to the Creek is under contract to be built in the fall of 2008, and will include access for the physically disabled. Construction will be completed in 2008. Approximately 26 acres of the site lies within the active Cache Creek floodway and will not be developed with any improvements. The remaining 15 acres of the site is located at a higher elevation above Cache Creek in the oak savannah grassland and provides space for passive recreation elements. The 2008 Creek Walk survey revealed that the site is generally doing well despite difficult conditions. An outdoor education center will be added in the near future, and the park will eventually expand to include an adjacent reclaimed aggregate mining pit. This pit will be flooded and converted into a small lake. TAC members discussed the implications of flooding a mining pit, and agreed that this process will be watched closely to maximize environmental benefits. A lake would ideally have more shoreline and diversity than a single pit configuration, and should avoid anaerobic bottom conditions that could lead to methylmercury production. In creating the lake, the "edge habitat" should be assessed in order to maximize the length of edge relative to the open water area. Edge habitat has higher wildlife value.

Figure 20. Bank protection extending downstream of Capay Bridge

Vegetation. The most extensive re-vegetated area in the Capay Open Space Park occurs on the upper terrace. The site quality varies from relatively good at the western portion of the site to relatively poor at the lower and eastern portion of the site. The variability is the result of different soil quality, as is reflected in the sparse growth of the herbaceous matter on poor gravelly soils and relatively lush growth on the soils containing more fine soil particles. On the deeper loam soils, oak trees are robust and growing very well. On the poor, gravelly soils, many of the trees are stunted. Reclaimed mine sediment at the Capay Open Space site has poor soil quality (high gravel and sand content), and revegetation has been difficult. On these tougher sites, redbud and quail bush (*Atriplex lentiformis*) are doing relatively well. Results are mixed along the bank protection site. Along the top of bank, California wild rose (*Rosa californica*) and other small shrubs are surviving. Mid-slope grass plantings appear problematic. Most of the willow toe plantings appear to have eroded away as a consequence of the 2006 flows. Topsoil and irrigation water additions may be necessary to sustain some plant species. TAC member, Jeff Hart, suggested in 2007 that soil amendments should be included in future plantings on the site and other sites within the subreach. Unfortunately, conditions do not appear to have changed significantly in 2008.

Adjacent to the Capay Open Space and extending from 110 m to approximately 760 m downstream from the Capay Bridge, a keyway was constructed beneath the toe and compacted fill was placed above it to provide bank protection. The project included slope and toe protection by planting with native grasses, shrubs, willows, and cottonwoods.

Recommendations and Items to Investigate (RM 26.3):

1. Complete educational interpretive signs at Capay Open Space Park.
2. Make soil amendments for any future plantings done at the Capay Open Space Park. Soil amendments can be made in the holes of any new plantings using compost. In addition, compost can be applied near the base of existing plantings which would invigorate the slow growing plants. Adding compost will increase nutrient availability and provide a slow-release fertilizer. Compost piles used to create the compost need to heat up to at least 120 degrees F in order to kill pathogens and weed seed.
3. The County should incorporate the planting plans for Capay Open Space Park and the Granite Bank Stabilization into its GIS vegetation maps.

Craig Property Restoration Experiment (RM 25.7)
Project Type: Erosion control and habitat enhancement
Size: <1 acre **Date of Implementation:** 1998
Project Partners: Cache Creek Aggregates (Granite), CCC, landowner, Yolo County PPW

Figure 21. Craig Property eroding bank due to Creek meander.

The Craig Property site is located on a south bank section of the Hungry Hollow Sub-reach in an area that has historically experienced significant amounts of erosion due to channel meander migration. During the 1997-1998 winter season this area lost approximately one acre of riparian terrace as the low-flow channel moved 33 m from its previous location. The County obtained permission from the landowner to implement an experimental form of erosion control utilizing straw bales interlocked with willow stakes as bank protection on the site and paid for the plantings. Small willows that are 1-3 (or more) years old have taken root at the edge of a channel-margin gravel bar, and the channel has migrated to the north, away from the site. Cache Creek Aggregates (Granite Construction Company) modified the earthwork while the CCC planted native vegetation.

As early as 2006, there was little that remained of the installed straw bales and plantings. The intention of the straw bales was not to provide a permanent fix but to foster restoration, which in turn might retard bank erosion. The straw bales have long since degraded and/or washed away with high flows. Poor soil quality at the site caused the plants to perish early in the project maintenance period.

Jensen Property (RM 25.4)
Project Type: Erosion control and habitat enhancement
Size: <1 acre **Date of Implementation:** 2003-2004
Project Partners: landowner, Yolo County PPW

Figure 22 (above) and 23 (below). Creek meander eroding bank and concrete posed to fall into the Creek.

The Jensen project is a downstream component of erosion projects that were previously completed to protect the Capay Bridge from scour and channel reconfiguration. The project utilized bio-engineering measures for erosion control which included the use of root wads, rock, and willow and cottonwood pole plantings instead of traditional riprap. The County worked with a consultant to design the project, reviewed the Flood Development Permit, and paid all planning and implementation costs associated with the project. Questa Engineering was contracted through the CCRMP to complete the design. By the summer of 2005, 5-6 low spur dikes were constructed with the tops of the dikes being at the level of the 2-yr recurrence interval flow. Initially, the installed plants thrived. Sustained high flows in the winter of 2005-2006 completely washed out the project and some structures now lie in a jumbled pile in the low flow channel. The willow stakes put in place didn't have time to take hold and establish. The coarse, dry soils at this site are not only non-cohesive (consequently, easy to erode), but also result in poor plant growth. The tall bank has been eroding and will continue to erode. This is a natural process, particularly in this area. Looking closely at the curvature of the river channel in this location, the erosion is located at the point (in the channel planform configuration) of maximum channel shift, which is downstream from the point of maximum curvature and downstream from the apex of the meander. The current planform suggests that this location of maximum channel shift will move downstream in a way that can be anticipated. Rates of bank retreat will decrease in the current area over time, and the area immediately downstream will become the more active zone. Currently, however, the Jensen property is at the outside of a meander bend, and is inherently unstable and highly erodible.

Large concrete slabs at the top of a 4 m high terrace along the south bank are poised to fall into the creek channel when the channel shifts in that direction (which is likely to be soon). Slabs that have already fallen into the Creek have exposed rebar, and are a navigational and safety hazard. Continued erosion will result in more of this construction debris falling into the channel. These slabs are an attempt by the property owner to stabilize the bank and prevent further property loss. In this area and in others where spur dikes are used, or might be used, we recommend that the concrete not be used, if possible. We should investigate if there are environmental hazards or toxic issues with broken concrete. This was an ongoing discussion on the Creek Walk. We discussed the possibilities of using in-channel (maintenance) mining in order to protect against high near-bank velocities and therefore bank erosion. This is best considered on a site-by-site basis.

Issues at this site extend back at least to December 2005, when a hard point (rock structure) was added to the meander. Some Creek Walk members hypothesized the stream has migrated more than 50 m to the south in the last 2-3 years, resulting in significant property loss. This could be confirmed with air photos. The stream has now cut behind (south) of the original hard point, so the hard point is no longer effective. There was some discussion of rates of erosion at the site, and rates may be lower. In any case, the orchard along the south bank would be threatened by additional erosion, and the concerns of the property owner are noted. Although erosion and bank migration are a valid concern at this site, the method of bank stabilization needs to be addressed. TAC members felt that it is not acceptable to allow large slabs of concrete to fall into the active channel. Rebar is exposed, there are aesthetic and safety issues, and the stream is not being maintained in a natural state. The property owners should be made aware of these environmental concerns.

We can expect that because of the channel meander, creating another bank stabilization project at this site would not only be costly and probably ineffective again, but could transfer the problem to another area. A conservation easement might provide a more viable long-term solution. Conservation easements can be used as a way to compensate people for land that would be lost due to bank retreat. Because land owners are impacted by natural processes of channel shift, conservation easements are practical and economical for land owners. The land owner receives economic aid in the form of a conservation easement rather than incurring very large expenses trying to protect the land from erosion.

Recommendations and Items to Investigate **(RM 25.4)**

1. This is an area of definite concern, with rubble that continues to be in imminent danger of falling into the channel. The County should meet with the Jensen family in order to discuss possibilities for this area.

2. The County should evaluate the causes of the original project failure with the project designers and landowner and establish guidelines for repair or replacement.

3. The County should investigate the environmental hazards related to using broken concrete for bank stabilization projects.

Granite North Bank Stabilization (RM 24.95)
Project Type: Erosion control
Size: **Date of Implementation:** 2002
Project Partners: Granite Construction Company, Yolo County PPW

The Granite bank stabilization project was initially constructed by compacting the toe of the slope and using fill with a protected toe on areas of the north bank between 2002 and 2003. Repairs to the bank stabilization project were made in 2005 following moderately high creek flows. The toe of the bank eroded again during the 2005-2006 winter flows. Granite also planted native vegetation on the bank and installed drip irrigation to promote successful plant establishment. The County reviewed the project and issued the Flood Hazard Development Permit for this project. Bank stabilization at this site allows commercial mining within 66 m of the active channel, under the guidelines of the CCRMP. More than 600 m of the north bank have been stabilized, and the company submitted a plan to stabilize another 300 m of bank in August 2007. The project was approved by the TAC, but the project has been held up since during its review by ACE. The existing bank stabilization has been fairly effective on a broad scale, although localized scour has undercut portions of the bank, exposing some of the boulders that anchor the toe of the bank (see photo). These erosional scars are tens to hundred meters long, and are at the level of the stream channel. It appears that the lower rock embankment was not planted. The higher embankment was planted with a variety of species, such as Fremont Cottonwood, Interior Live Oak (*Quercus wislizeni*), pine, *Ceanothus* sp., and other species. The site would benefit greatly from a riparian (vegetative) buffer on the lower slope and at the base of the slope. The active channel is closer to the north bank along this reach, and the site should be monitored closely for signs of additional erosion. Continued erosion would threaten a nearby haul road and gravel pit. The higher embankment area was

Figure 24 (above), 25 (below left), and 26 (below right).
Granite Co. bank stabilization eroding at the toe.

previously planted primarily with grasses. This embankment was constructed for sound proofing neighbors from Granite's operations.

Recommendations and Items to Investigate **(RM 24.95)**

1. Reconstruction needs to be completed along the bank toe of the Granite property to protect the integrity of the upper portion of the bank.
2. The County needs a copy of the planting plan of the embankment.
3. The plan to stabilize an additional 300 m of bank needs immediate review by ACE with immediate implementation when permitting is complete.

The channel widens to approximately 300 m downstream from RM 25 as it approaches the CR-87 Esparto Bridge. Banks are higher in this reach, with 6-8 m of between the channel bed and the top of the terrace.

Figure 27. The CR-87 Esparto Bridge abutments.

CR-87 Esparto Bridge (RM 24.4): Low spur dikes are located upstream from the bridge, on the north bank. These spur dikes have trapped fine sediment, are vegetated, and seem to be working as control structures. The river's width is constricted by a factor of 0.3-0.5 as it flows under the bridge. Four large concrete abutments are located in the active channel, and there are scour holes 1-1.5 m deep around the abutments, but they are in remarkably good shape considering the amount of flow constriction under the bridge. Longitudinal gravel bars form downstream from each abutment. Rip-rap boulders and slabs from an older bridge are visible along the north and south banks on the downstream side of the bridge. The bridge structure seems to have sufficient hard points (spur dikes) and structural control to maintain the current channel configuration, although the gravel bed stream is

Figure 28. Mid-channel vegetation and gravel bar deflects low flows to the sides upstream from the Esparto CR-87 bridge.

Figure 29. Scour at toe of slope, south bank at the Esparto CR-87 Bridge.

highly erodible and mobile. The active channel is about 150 m wide at the bridge, and erosion has cut the toe of the fill material near the south bank. Erosion should be carefully monitored after each future high flow event due to the mobile bed and highly erodible bed material, but there do not appear to be significant erosion problems at this time. In the future, channel migration is likely to cause erosive pressure along the north bank as high flows focus on the outside of a meander bend as it approaches the bridge. Mid-channel gravel bars are common downstream from the bridge, where sediment consists of sand and gravel, with gravel in the pebble to cobble size range. Sediment is more abundant in this reach than in nearby upstream sections of the river, and may be several meters thick. Young willow shoots have started to colonize mid-channel bars, and rare Valley Oaks are present on higher marginal terraces. Low grade control structures on the north bank deflect flow toward the bridge, and appear to be effective. Vegetation forms a "V" at RM 24.4, just upstream from the CR-87 Esparto Bridge, deflecting flow to both outside edges. It may be necessary to do some preventative maintenance or gravel skimming to remove the mid-channel bar directly upstream of the Bridge, allowing flow to pass directly down the center line. Natural vegetation has helped to stabilize the embankments and cliff swallows (*Petrochelidon pyrrhonota*) have active colonies under the bridge.

Recommendations and Items to Investigate for the CR-87 Esparto Bridge **(RM 24.4)**

1. Assess and monitor the area where high flows focus on the outside of a meander bend as it approaches the bridge. If necessary, implement preventative erosion control measures to protect public infrastructure.
2. Consider removing the mid-channel gravel bars and sediment in order to allow flow through the center of the bridge and decrease erosive pressure on the banks.
3. This area should be monitored closely during and after high flow events. Bed surveys could be used to monitor bed elevation changes.

Syar Spur Dikes (RM 24)

Downstream from the CR-87 Esparto Bridge and on the south bank, spur dikes deflect flow toward the channel center. These spur dikes are several years old, and are on the Syar property. Although

Figure 30 (left) and 31 (right). At RM 24, Sediment deposition between Syar spur dikes and scour at toe of spur dikes.

mature vegetation is absent, the spur dikes and intervening lowlands have collected a layer of silty sand that sustains a grassy cover. The toes of all spur dikes have been eroded, and this should be monitored carefully. Previous Creek Walk reports noted similar erosion at the toe of these dikes. One possible solution to prevent erosion and prevent exposure of concrete rubble would be to use concrete rubble in the body of the spur dike, and natural boulders on the toe of the dike. As noted above, we still need to investigate the environmental hazards associated with using concrete in the

Creek. With this proposed solution, the concrete and boulders would be covered with soil and vegetated. If the toe eroded, natural boulders would be revealed and not concrete rubble. In addition, improving the vegetation on the spur dikes would not only help prevent erosion, but would increase wildlife habitat on Cache Creek.

Figure 32. Syar South spur dikes and revegetation (RM 24).

Syar Spur Dike Bank Protection /Fulton Stephens Revegetation (North Bank, RM 24.3)

The areas around spur dikes are relatively well vegetated. Fulton Stephens and the CCC have planted various native and non-native species with varying success. After trenching elongated pits and inserting and partially burying willow cuttings, the Creek has deposited additional sediment.

Syar Spur Dikes (South Bank, RM 24.1 to 23.9)

These dikes have been poorly vegetated. This is due in no small measure to the location on a high dry terrace with the water table evidently too low for plants to access. Some erosion is occurring on the ends of several of the spur dikes; this was noted in 2006 as well.

Hungry Hollow Subreach Recommendations 2008:

1. Complete disabled creek access and educational interpretive center at Capay Open Space Park.
2. Research the toxicity and environmental impact of using broken concrete rubble in a stream environment.
3. Work with the Jensen family to clean up the concrete rubble and rebar in Cache Creek and develop a sustainable plan to deal with the rapidly eroding section of their property.
4. Resolve any issues with the ACE for the Granite Bank Stabilization proposal and implement the bank stabilization project.
5. Use the In-Channel Maintenance Mining Ordinance to remove the mid-channel gravel bar that has accumulated upstream from the CR-87 Esparto Bridge. Work with PPW in order to design feasible solutions for this section of the Creek.
6. Work with Syar to fix the spur dikes and better revegetate them. This should help protect them from further damage and improve the wildlife habitat in the area.
7. Assess soil condition and water requirements for plant species specified in projects. Include soil amendments or topsoil when planting within the Hungry Hollow Subreach and assure a water source for plant establishment.

MADISON SUBREACH (SUBREACH 6)

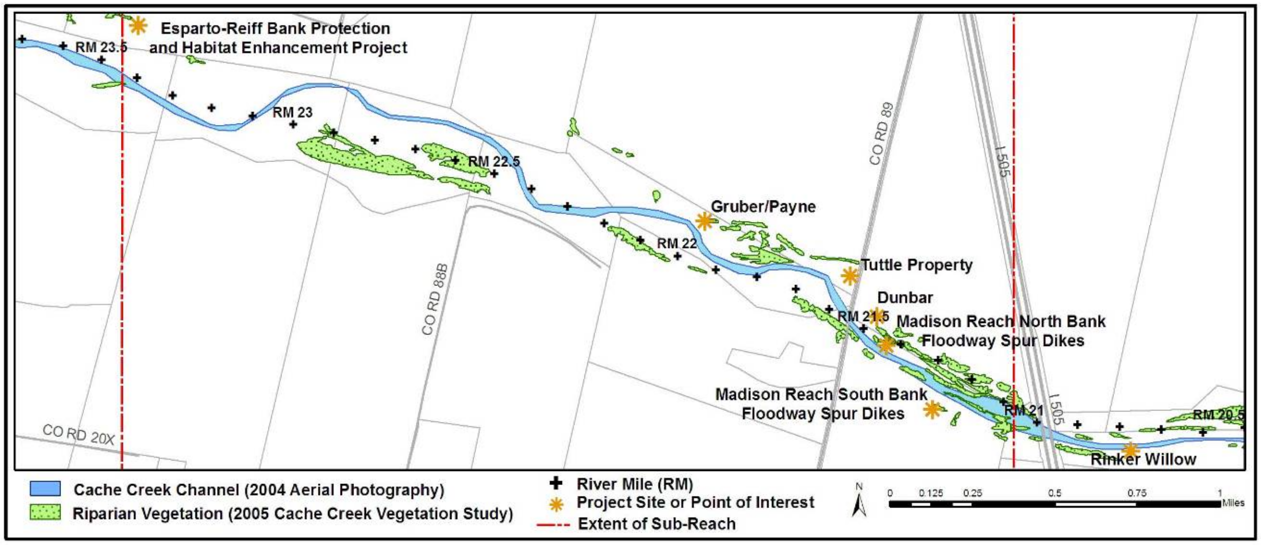


Figure 33. Esparto-Reiff Bank Protection/Habitat Enhancement to the I-505 Bridge (RM 23.5-21.1)

Physical Conditions. The 2.5 mile long Madison Subreach extends between the CR-87 Esparto Bridge and Interstate 505 (I-5). The average slope is 3.9 m/mile (0.0024). The channel is narrow at 211 m wide compared with the Hungry Hollow subreach. The average depth is 5.9 m. The area is characterized by extensive cobble bars. With the lowered water table, there is less water available. Consequently, vegetation is sparsely developed.

Vegetation. This subreach has occasional patches of Mulefat, Red Willow, Arroyo Willow, Sandbar Willow, and Fremont Cottonwood on the floodplain and lowest terrace. Regeneration is sparse.

Esparto-Reiff Bank Protection/Habitat Enhancement Project (RM 23.6-23.2)
Project Type: Erosion Control and habitat enhancement
Size: 670 linear meters **Date of Implementation:** 1997-1998
Project Partners: Teichert, Yolo County PPW
This project was designed and implemented by Teichert to protect approximately 670 linear meters of the north bank in the Madison Sub-reach. This project was progressively constructed and has been inspected during Creek Walks over the last several years. A riprap prism was constructed to deflect creek flows away from the bank and allow vegetation to become established. Levees were constructed to protect two wash water ponds. Coir fabric material was used on the prism and portions of the levees to impede erosion along the bank, increase sedimentation, improve soil development, and, in turn, improve vegetation establishment. Teichert also seeded the area with native grasses and planted riparian vegetation between the prism and levee to further retard erosion and improve habitat. The County reviewed and issued the Flood Development Permit for the project. The results are fairly good for this project. A dense stand of willows have grown up from the trench. A Teichert monitoring document showed that phase I target species had covered 81.4% of the area, whereas phase II plantings amounted to 62.4%. Native grasses are doing fairly well on the slope. At the time of the July 2007 survey, the grasses were brown and dormant.

It was noted in 2006 that the in-channel vegetation may have benefited from high winter flows. The winter flows inundated the area and brought sediment to the area. The prism design appeared to effectively slow and deflect flows, and, in turn, protected the vegetation from being washed out. The low berm and willow prism protect the north bank from erosion during moderately high flows. The berm was constructed with concrete rubble as part of the base structure. The concrete rubble was considered by some as unsightly. In 2008, we noted again the unsightly concrete rubble, where it has become exposed in this berm. The method of a berm near the channel with a "trench" behind it, which is filled with vegetation, all of which protects the bank, seems to be an effective solution. It was suggested by Eric Larsen that, perhaps, the berm could be more temporary. Without the concrete rubble, the berm might more easily disintegrate leaving the riparian zone as the "bank protection". However, the high berm borders a settling pond, and it is essential to maintain a buffer zone between the stream and the mining operation at this location. The levee protects wash water ponds at this site, and any significant breach in the levee would release fine sediment to the stream, resulting in a severe water quality issue.

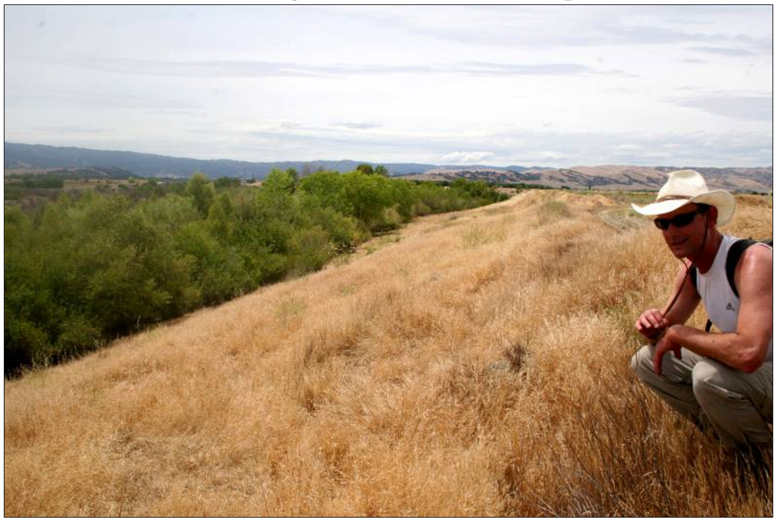


Figure 34. Esparto-Reiff bank protection/habitat enhancement.

Drip irrigation was used to establish vegetation on the low berm, and larger vegetation is well-established. A buffer zone of 5-10 year old willows is now growing at the base of the bank, and the vegetation continues to grow without any additional watering. The downstream area of this project may have needed more irrigation and is not growing as successfully as the upstream area of the project.

Moving downstream, the channel is wide and open, with abundant mid-channel gravel bars and clumps of low, young vegetation. Banks on the south side stream margin are gently sloping, and gravel deposits appear to be thicker along the south bank. Vegetation traps sand on the tops of gravel bars, and some bars look relatively stable. Much of the vegetation is tamarisk that has been sprayed and killed.

Figure 35: Erosion at the levee toe, RM 23.2.

Figure 36: Bare concrete rubble protects the base of the levee at RM 23.2.

Teichert Bank Protection Project (RM 23-22.8)
Project Type: Erosion Control and Bank Stabilization
Size: **Date of Implementation:** 2006-2007
Project Partners: Teichert, Yolo County PPW

Figure 37. Esparto-Reiff bank protection/habitat enhancement.

Bank erosion occurred at this Teichert site after the floods of 2006. Several protection measures were implemented, including root wads, restoration, and coir fabric placed on the slope. Questa Engineering designed a series of cabled-together root wads to redirect the flows. One hundred fifty meters of cabled oak root wads were added on the downstream end of the project in 2006. Root wads were tied together with cables and placed in the channel at RM 22.8, but they are too far from the base of the levee to provide protection during high flows. Several of these root wads have scour holes on the downstream sides, and cattails are growing in low, marshy ponds that surround the root wads. The root wads have failed to protect the levee. The root wads have not had a strong influence on flow or sediment accumulation in this configuration. The planform of the channel on the photos of higher flows in 2006 suggests that this will be an area where significant channel forces will be directed at the bank due to the natural processes of channel shift that are likely to occur here. This is likely to be an area that continues to experience significant dynamic channel shifting.

Figure 38 (left) and 39 (right). Teichert bank protection with scour behind root wads and loose soil on top of levee.

The levee looks especially vulnerable at RM 22.8. Loamy soil has been added recently as a cap on the levee, and the soil looks loose and unconsolidated. This is also a low spot in the levee. The loosely consolidated soil would not be resistant to erosion at higher flows, and the low elevation makes the area vulnerable to overtopping. The main channel hugs the north bank at low flows, and meander patterns suggest that higher flows would be directed at the weak spot in the bank. This area should be protected before winter rains arrive, and is one of the more pressing problems observed on the Creek Walk. In addition, there was a road near the top of the soil berm that appears to be too close to the top edge of the berm and promotes soil erosion and an unstable area.

Recommendations and Items to Investigate **(RM 23.6-22.8)**
The downstream end of the Esparto-Reiff Bank Protection and Habitat Enhancement project has some erosion issues, and construction is not as environmentally or aesthetically friendly. The base of the levee is eroded at RM 23.2, and a gravel spill at RM 22.8 covers a drain pipe. The levee looks especially vulnerable at RM 22.8. Large piles of concrete rubble form a protective berm at the base of the levee, but there is no soil cover or protective vegetation.

1. Success criteria need to be evaluated of the Questa Engineering designed levee repair.
2. The County needs to work with Teichert to develop an alternative to using exposed concrete in Cache Creek for bank protection. Bioengineering designs should be encouraged.
3. Soil and plantings should be evaluated and only native species to Cache Creek should be used to revegetate the area.
4. The County should meet with Teichert to inspect and explore options for this area.

A large drainage pipe at RM 22.5 should be investigated because of water quality concerns. This pipe is about 40 cm in diameter, and looks relatively new. It is probably an agricultural drain from the nearby orchard, but this is a potential source of contaminants to the stream. The preferred approach is to avoid artificial drainage into the stream wherever possible. A secondary terrace or bluff in the main channel may restrict drainage from the pipe to a backwater or oxbow area directly under the pipe. This containment would have a filtering effect, and may partially mitigate the effects of agricultural drainage. Fine sediment has accumulated on the terrace surface, and willows are more established at this site. Bank Swallow nests were observed at RM 22.4, and are restricted to the loamy cap that overlies coarser, gravel-rich channel sediments.

Figure 40. Drainage pipe has outflow onto a low terrace surface contained within the main channel.

The channel narrows at RM 22.2, and bed material becomes coarser. Several old car tires are abandoned in the creek bed in this area, and at least 10 car tires were observed since the start of the day 2 Creek walk. These car tires would be a good target for Creek Week or a creek cleanup project-possible through an energetic group of Boy Scouts or other service-minded group.

Grube/Payne Project (RM 22.3-21.8)
Project Type: Erosion control and habitat enhancement
Size: **Date of Implementation:** 2005-2006
Project Partners: California Audubon, Center for Land-Based Learning, landowner, Natural Resources Conservation Service (NRCS), Teichert, Yolo County PPW

The County coordinated with the landowner, provided a fee credit to Teichert for earth work related to drainage improvements, coordinated with California Audubon and the Center For Land-Based Learning to develop and implement a habitat enhancement plan, and paid for habitat enhancement and irrigation on the site. The landowner agreed to provide in-kind assistance with equipment use and services for the habitat enhancement project. This site was constructed in 2005 to address problems with agricultural drainage into the stream. The bank showed signs of gullying due to the uncontrolled agricultural runoff from an improperly installed pipe, which was suspended over the gully. In 2006, it was noted that repairs to the main drainage pipe were necessary to minimize further erosion according to NRDC specifications.

Initial construction efforts of the project were not entirely successful, and a new plan to construct a settling pond and drainage pipe need to be planned. A settling pond is a good solution to these problems. Marshy vegetation will consume excess nutrients and filter out a large proportion of other pollutants. It will be important to maintain the vegetation, so the constructed pond and wetland will need continuous water supply, or should be deep enough so that aquatic and riparian vegetation can interact with the water table.

The channel is wide, with many different braids, and has abundant longitudinal gravel bars upstream from this reach; therefore, the site isn't a creek meander. Nesting or burrowing holes were commonly seen in the loamy soil that caps the gravel bed river deposits both in 2007 and 2008. Bluffs used by the Bank Swallows should receive protection from construction/restoration activities, as the birds are a California listed threatened species, and also protected under the federal Migratory Bird Treaty Act.

The 2008 Creek Walk group did not walk through this site, but many of the concerns are the same from previous years. This project has stalled, and it would be good to contact the landowner and resume discussions about work on this site.

Recommendations and Items to Investigate **(RM 22.3-21.8)**

1. **(RM22.3-22.1)** Implement a habitat restoration project on ~20 acre area of bank terrace to promote a vegetated corridor along this section of Cache Creek for both habitat value and erosion control. Utilize existing pond and agricultural runoff as a source of water. (Need to locate the original project plan)
2. (**RM22.1)** Reconstruct agriculture tailwater pipe to NRDC standards preventing further erosion.
3. **(RM21.8)** Implement a habitat restoration project on the ~24 acre area of bank terrace to promote a vegetated corridor along this section of Cache Creek for both habitat value and erosion control. Utilize agricultural runoff as a source of water. (Need to locate the original project plan)

Scheuring Property (Old Madison Bridge Site) Dunbar Project (RM 21.7-21.5)
Project Type: Erosion control and habitat enhancement
Size: <1 acre **Date of Implementation:** 2002-2003
Project Partners: landowner, Syar, Yolo County PPW
At the location of the former Madison Bridge site, severe erosion has removed approximately 305 m of bank, laterally eroding up to 39.6 m. The erosion removed a significant section of pavement, threatened the stability of power-line poles, completely washed out previous bank restoration efforts, removed as many as 5 acres of walnut orchards, and significantly eroded the most upstream of the spur dikes. The erosion removed most of the fine-grained material from two-thirds of the upstream-facing portion of the spur dike.

Anecdotal information suggests that over 20 acres of agricultural land was removed by channel shift processes previous to the land being purchased by the current owners, suggesting that this site has had a long history of channel shift.

Figure 41. Bank erosion at the outside bend of the meander at the Scheuring property.

The South Bank has been restrained near RM 21.7 and due to the constriction of natural channel meandering to the south, may be promoting accelerated rates of migration onto the north bank. The curvature of the creek bend at this location is tight and appears to be tighter than it would be if the spur dikes had not been installed. The north bank adjoining the Scheuring property has a sharply curved bank that causes stream velocities to be high adjacent to the bank. Part of this curvature is caused by the dike immediately downstream.

It is possible that the dike promoted accelerated bank erosion at this site. It is also possible that the spur dikes will be outflanked by the channel shifting and that the water will flow around the end of the dikes soon. It is also possible that the channel will continue to be constrained in this area, and that the combination of limited channel shift on the south bank near RM 21.8 and the restraint at RM 21.5 (causing an exaggerated curvature to the channel just upstream) will continue to accelerate bank erosion rates on the north side near RM 21.6.


Figure 42: Active erosion at RM 21.6 north bank.


Figure 43: Active erosion of upstream spur dike, RM 21.55 north bank.

Plantings of native grasses and trees during the 2002/2003 bank stabilization effort were successful (according to previous reports), but erosion continues to remove material from this site. The landowner provided irrigation necessary to get plants established. The County purchased native plants for the project and worked with the CCC to plant them. Plants were established at the top of bank, and have done relatively well (due to irrigation and good soil), but some were washed away with general erosion of the site. This is an actively eroding area, and the meander will continue to migrate northward and downstream. A large volume of riprap would be required to stabilize the

north bank against the continuous erosive forces of the meander bend. This may be a case where it is more cost effective to look at more broad, sustainable solutions rather than try to protect a specific part of the Creek bank. Plants were originally installed on the steep, south facing and dry bank. For the most part, these plants perished. Meanwhile, severe erosion washed away any evidence of this well-intentioned effort.
The broken concrete core of the spur dike constructed here was disturbed although large pieces remained in place. The spur dikes downstream of the damaged spur dike showed little sign of erosion. Vegetation between the spur dikes is thriving and several inches of sediment have accumulated over the past year. The spur dikes are buried, covered with vegetation that dates back to 2002, and are barely visible. Loamy soil up to 0.60 m thick blankets the areas between the spur dikes along the north bank.

At this site, we discussed the possibility of in-channel mining as a method of reducing erosive forces on the bank. However, it is possible that this would only provide moderate or little relief of the erosive forces. A HEC-RAS investigation could be performed to study the effect of dredging a channel on the south side. Such a channel would redirect the flows away from the bank at low flows, but could possibly have little effect at higher flows that would inundate the dredged channel, and would create high stream velocities on the bank in question. Conservation easements are a better and more economic way for the landowner to manage such locations prone to be lost due to natural processes of channel shift.

Recommendations and Items to Investigate **(RM 21.7-21.5)**

1. A long-rang examination of the dynamics at this site considering the tendencies of migration and the likely path of future migration would be useful. Questa Engineering in 2006 assessed whether the meander bend at this site was likely to be a threat to the I-505 Bridge in the near future. This report should be found and reviewed. In reading the report questions to consider would include: Will the pathway of the channel shifting continue far enough to impact the I-505 Bridge and is this site the right spot to do something? What is the area of influence of the meander pattern over the next several decades? Is there a possibility of allowing an extended area to allow natural channel shift?

2. One suggestion was to remove vegetation on the large mid-channel bar in order to alleviate channel shift. This removal conflicts with the goal of planting vegetation for habitat. The vegetation on the bar that was suggested for removal is self-generating and self maintaining. In 2007, John Sterling, Trustee for H.T. Harvey & Associates, noted the bank would be perfect for several 100 Bank Swallows and noted the presence of swallows on site. These swallows have all established on this site since the bank formed.

3. Design an erosion control project that deflects the energy of the channel meander located upstream of the Dunbar site and reform the existing upstream spur dike at the Dunbar site to stabilize the north bank. Significant accumulation of fine particle soil has occurred behind the existing spur dikes and both planted and naturally occurring vegetation has flourished showing that in-channel vegetation within this subreach can survive as long as it is protected from high energy flows. Repair of the eroded spur dike should be investigated as a component of the design of any further bank protection designs for the area.

Tuttle Property (RM 21.6)
A settling pond was constructed in order to slow down and filter agricultural tailwater to both improve water quality of water entering Cache Creek at this site and to decrease erosion. The settling pond was not observed during the 2007 or 2008 Creek Walks. The County obtained landowner permission to construct the settling pond and provided a fee credit to Syar to build it. Settling ponds are an excellent way to remove undesirable chemical constituents from runoff.

Floodway Spur Dikes Upstream of I-505 Bridge (RM 21.4-21.1)
Project Type: Erosion control
Size: ~12 acres **Date of Implementation:** 1998
Project Partners: Caltrans, landowner, Syar, Yolo County PPW
In 1998, Syar constructed an erosion control project upstream of the I-505 Bridge to straighten the channel heading towards the bridge. The County obtained California Department of Fish and Game (DFG), ACE, and RWQCB permits or certifications and was granted landowner permission necessary to implement the erosion control project. This project was particularly important because the bridge supports are curtain walls that are not designed to handle lateral forces from the Creek. The County paid for the engineering design, negotiated the design of the erosion control project with Caltrans, and provided fee credit to Syar to construct groins and relocate the channel.

The dikes have been very effective at trapping fine sand and silt as noted in 2006. Up to 1.5 m of fine sediment has accumulated between and downstream from these dikes. Grasses and young

Figure 43: Erosion at upstream (south bank) spur dike, RM 21.3 in 2007 (left) and 2008 (right).

willow volunteers are growing on the sediment, and the south bank spur dikes have stabilized the channel and deflected flow toward the center of the I-505 Bridge. Young willows have started to grow at the creek margin, but older, established vegetation is absent. It seems likely that the original project did not include soil amendments, and future projects should consider soil amendments to enhance vegetation and root growth. The core of boulders and construction debris is visible along the spine of the spur dikes, where vegetation is spotty or absent. Concrete blocks used as rip-rap are not natural, and it would be better to use more natural materials whenever possible during future projects. Concrete could also be used as a core instead of a cap on the spur dikes when more structural stability is desired. This would address engineering and aesthetic concerns. More and larger vegetation would be desirable on the south bank spur dikes. The north and south dikes have been generally stable and effective at stabilizing the bank and deflecting the creek flow toward the center of the channel.

The tip of the upstream spur dike (south bank side) is highly eroded, and this erosion was noted in previous Creek Walks. This upstream spur dike impinges on a meander bend and forces flow toward the channel center, so it is subject to the highest erosive force. The second spur dike (in a downstream direction) also has erosion at the tip, although this erosion is less severe. This would be a good site for a quick comparative study between old and new air photos. It is difficult to tell how much of the upstream dike has been removed without this comparison. Erosion should be monitored carefully at these spur dikes. Beavers have built a low dam across a portion of the Creek at RM 21.5, although this does not have any significant effect on the carrying capacity of the stream.

Figure 44: Erosion at second downstream spur dike (south bank), RM 21.25.

Recommendations and Items to Investigate
(RM 21.4-21.1)

1. It was noted in 2006, that the tip of the most upstream dike was eroded and a relatively deep scour hole had formed in the channel adjacent to the dike. Erosion of the south bank (three to four foot high vertical bank) was noted just upstream from this dike. Aerial photographs need to be viewed to see whether there was further erosion between 2006 and 2008.
2. The County should work with the landowner and Syar to cap the spur dikes, amend the soil, and establishing a greater diversity of vegetation along and in between the spur dikes and on the upper portions of the rip-rapped slopes.

Madison Subreach General Recommendations:
OHV use, trespassing, and vandalism have been on-going problems for the Syar Construction company site and for this subreach in general. In addition, OHVs are coming in at locations of present and old bridges across Cache Creek. New signs and restricted parking near the I-505 Bridge may help control the problem, but stricter enforcement and dedicated off-road vehicle parks have been discussed as mechanisms to address the problems.

GUESISOSI SUBREACH (SUBREACH 5)

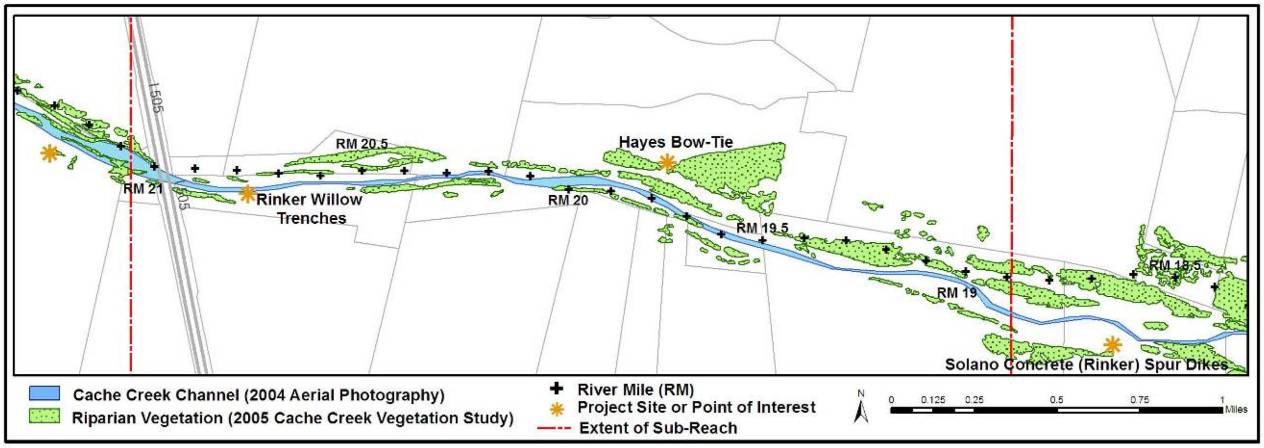


Figure 45. Guesisosi Subreach-I-505 Bridge to before Rinker Spur Dikes (River Miles 21.1 – 18.9)

Physical Characteristics. The Guesisosi Subreach begins downstream of-Highway 505 and ends 2.3 miles downstream. The Guesisosi subreach flattens out-with a slope of 1.9 m/mile (0.0012). The average width is 187 m and average depth is 5.7 m. The channel varies from somewhat straight in the upstream part to meandering in the downstream part. The water table is relatively high in comparison to the other subreaches due to the presence of a bedrock constriction along the Dunnigan Hills-Plainfield Ridge lineament.

I-505 Bridge (RM 21.0)

The channel is constricted by a factor of 0.5 to 0.7 times the normal width as it passes under the I-505 Bridge, resulting in increased stream velocity. This bridge has a longitudinal pier construction on the abutments that interferes with any flow that is not perpendicular to the bridge. As a result, extensive scour pools up to 1.5 m deep have formed around each abutment. This structure should be monitored during and after high flow events to assess damage to the bridge support structures. The visual inspection did not reveal any significant changes around the bridge supports since the 2007 Creek walk.

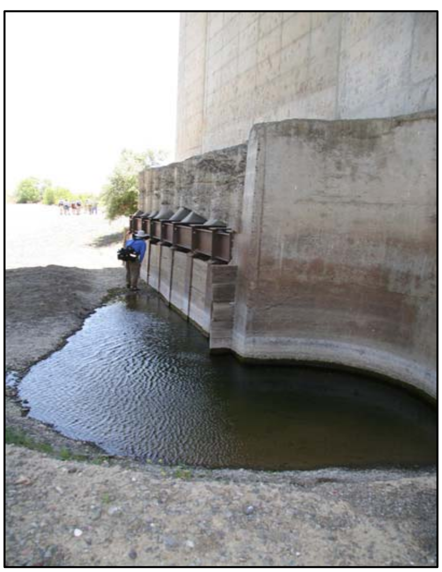


Figure 46: Scour along support vane under I-505 Bridge.

Figure 47: Scour hole on upstream end of I-505 Bridge support.

River miles 20.9-20.7 (North Bank). Tamarisk was sprayed by the CCC on the north bank, below I-505 and opposite the CEMEX USA plant. There appears to be some bank erosion here, perhaps due to removed vegetation. Mulefat has grown up in this area after spraying.

Rinker Habitat Enhancement/Erosion Control Willow Trenches (RM 20.8-20.7)
Project Type: Erosion control and habitat enhancement Size: ~215 lineal meters
Date of Implementation: 1998
Project Partners: Solano Concrete (Rinker Materials), Yolo County PPW
This project was implemented due to erosion occurring north of the Rinker processing plant. It consisted of a curtain wall of riprap keyed into the streambed at a depth of 1.8 m, a 0.60 m weir extending above the ground surface, and planting two hundred willows behind the weir. This project was implemented by Rinker with a Flood Hazard Development Permit that was reviewed and issued by the County. The restoration efforts were moderately successful.

Figure 48. Tamarix killed by spraying.

Flow continues to be constricted on the downstream side of the I-505 Bridge, as Cache Creek

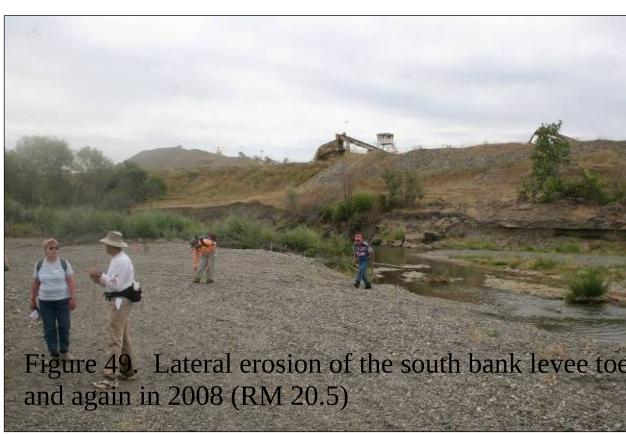


Figure 49. Lateral erosion of the south bank levee toe and gravel spill along the Rinker Inc. property in 2007 and again in 2008 (RM 20.5)

approaches the CEMEX gravel plant (formerly known as Solano Concrete Company and Rinker, Materials). The downstream reach is degraded and less natural than nearby upstream sections. Artificial levees constrain flow and protect the gravel plant along the south bank, and the base of the levee is eroded and undercut on the north and south banks downstream from RM 20.8. Spoil piles from the gravel plant line the top of the levee along the south bank, and there is a gravel spill under a conveyor at RM 20.5. Larger blocks of concrete are sometimes visible near the base of the levee, and probably serve as an erosion-resistant core. The effectiveness of this core and levee system is questionable, because many larger blocks are now part of the eroded debris. Questioned about this, Mark Hirzy from CEMEX was hopeful that there was erosion resistant material buried in the high berm that would protect the berm if the toe continued to undercut the bank; however, the TAC views this bank as having a high risk of failure. Sandy loam caps much of this levee, and vegetation is patchy, with variable age. Some older willow and cottonwoods are mixed with younger shrubs.

Figure 50. Meander undercuts the levee at RM 20.45.

A gravel conveyor runs along the south bank from RM 20.6 to RM 19.2. This long stretch has similar issues throughout. The stream meanders back and forth across a narrow, constrained floodplain, and erosion is intensified at the outside of each meander bend. The levee is undercut by meanders, and vegetation is destabilized. This stretch of Cache Creek does not have a natural look or "feel", and in-stream habitat value is limited. There is little natural floodplain in this section, and the long-term stability of the levee system is questionable. The levees are especially narrow and look lower from RM 20.3 to RM 19.3; there may be issues with the ability of the channel to carry a larger flood without overtopping the levee system. This could be estimated by measuring the cross-sectional area of the stream to estimate flood capacity. A gravel spill below the conveyor transfer site at RM 19.7 is over-steepened and unstable. The levee on the CEMEX side of Cache Creek has many points in danger of failure or in need of improvements. In 2007, CEMEX presented to the TAC bank stabilization plans for a limited section of its levee. While eventually plans were approved by the TAC for a few of the sections in need of repairs, CEMEX has failed to complete everything necessary in order to proceed with work. The County would enjoy the opportunity to work with CEMEX to develop a more long-term plan that addresses bank erosion and off-channel mining program set-back requirements, and also improves erosion control and habitat value of this section of the Creek.

Figure 51: Gravel spill below conveyor transfer site at RM 19.7.

Figure 52: Low conveyor belt at RM 19.5.

Downstream from the undercut area, fairly tall cottonwoods are falling into the channel due to bank erosion. This increases the erosion potential, and reduces the riparian buffer.

Figure 53: Low, oversteepened bank with loose blocks at RM 19.4.

Figure 54: Broad vegetated north bank, steep bare south bank at RM 19.4.

On the south bank of the channel near the CEMEX site, there is a section vegetated with willow, cottonwood, and some eucalyptus. The eucalyptus is highly invasive and should be removed. This bank has a more gradual slope than most of the other sections of levee, has a “natural” look, and is appealing aesthetically. Partly because of the vegetation and because it is not steep, there is little or no erosion in this section of bank protection between the Creek and CEMEX’s property. This is true in spite of the fact that the channel is relatively narrow here.

Adjacent to the bank, in the channel, there is a large deposit of gravel, with a downstream slump-face of about 1.5 m in elevation. For some locations, the removal or skimming of the in–channel bars would provide benefit for the long-term stability of Cache Creek. If Cache Creek is continuing to deposit gravel and other sediment sizes, it will aggrade unless skimmed. Such aggradation can tend to intensify the flow strength on the adjacent bank, as it seems to be doing in this area. Bar skimming in areas like this could tend to alleviate erosion on the bank. The County’s In-Channel Maintenance Mining Ordinance approved this year by the Board of Supervisors will be useful for working in areas like this on the Creek. Skimming the mid-channel bar in this location would alleviate pressure on the bank. The magnitude of the near-bank velocity reduction using a HEC-RAS model should be modeled.

Figure 55. Location for proposed bank stabilization by CEMEX approved by the TAC in 2007.

Recommendations and Items to Investigate (RM 20.9-18.6)

1. CEMEX must complete bank stabilization construction within the next year in order to be in compliance with set-back requirements and levee protection for off-channel mining. This bank stabilization only addresses one section of the bank at risk to the toe undercutting.
2. At the CEMEX conveyer transfer points, these areas need to be regraded and planted with native species to prevent erosion into the Creek of fine sediments and to protect the levee at this section.
3. As there are a number of other areas also indicated in danger of levee failure or undergoing bank erosion, CEMEX must complete bank stabilization plans for the entire extent of their property and work in conjunction with Yolo County, Caltrans, the DFG, and the ACE.
4. CEMEX must consider elements of the CCRMP, the CCIP, and the County Code in their planning efforts. Of particular note, the HEC-RAS analysis should cover 1000' upstream of CEMEX's property and 1000' downstream of CEMEX's property and any bank stabilization needs to incorporate the latest bioengineering techniques.
5. CEMEX should use the In-channel Maintenance Mining Ordinance (ICMMO) to remove deposition caused by lower flow rates between RM 20.8 and 20.4. This will decrease incision of banks outside gravel bars, including an area dangerously close to CEMEX's operations and conveyor belt.
6. CEMEX will need to submit a Flood Hazard Development Permit (FHDP) application which must be reviewed by the TAC and approved by Yolo County, Caltrans, DFG, and ACE.
7. CEMEX needs to complete the bank stabilization as approved by Yolo County, Caltrans, the DFG, and the ACE for the entire length of their property including affected areas upstream and downstream from their property.

Hayes Bow-Tie (RM 19.8)
Project Type: Habitat enhancement
Size: ~37 acres **Date of Implementation:** 1997-2000
Project Partners: CCC, landowner, Rinker, Yolo County PPW

The Hayes Bow-Tie was formerly a gravel mining area in the 1960's. The site habitat enhancement project was a coordinated effort between the landowner, Rinker, Yolo County, and the CCC. The County obtained the permission of the landowner to implement the project and provided Rinker with a fee credit to do the earthwork necessary to hydraulically connect the site to the active floodplain. Rinker worked with the county to cut into an elevated access road in the middle of the bow-tie to allow water to flow into the old pit sites to encourage silt accumulation and vegetative growth. We did not observe the Hayes-Bow-tie project at RM 19.8 at close range during the 2008 Creek walk.


Figure 56. Large gravel bars in the Guesisosi Sub-reach

River Miles 19.2-19: This subreach of the river looks very natural, with gently sloping banks, connection between the channel and the floodplain, established riparian vegetation, and broad, naturally formed longitudinal gravel bars. A loamy soil layer up to 1 m thick covers many gravel bars. Dense stands of cottonwoods and willows at the channel edge are 10-20 years old (or older), and mid-channel bars have younger vegetation along isolated meanders and abandoned oxbows. Large woody debris is common along the banks and in the channel, providing habitat heterogeneity. This subreach could be used a model for future restoration plans.

As natural as this area seems, heavy usage by OHVers has scoured the in-channel gravel bar. While the soil may be gravelly and, thus, inherently difficult for vegetation to establish, OHV use would have caused further erosion and prevented more vegetation establishment in this reach.

Guesisosi Subreach General Recommendations:

1. Monitor the I-505 abutments and use HEC-RAS to examine longer term solutions for the I-505 Bridge that would reduce scour and risk to the abutments.

2. See the recommendations above for CEMEX's property in the CCRMP area.

DUNNIGAN HILLS SUBREACH (SUBREACH 4)

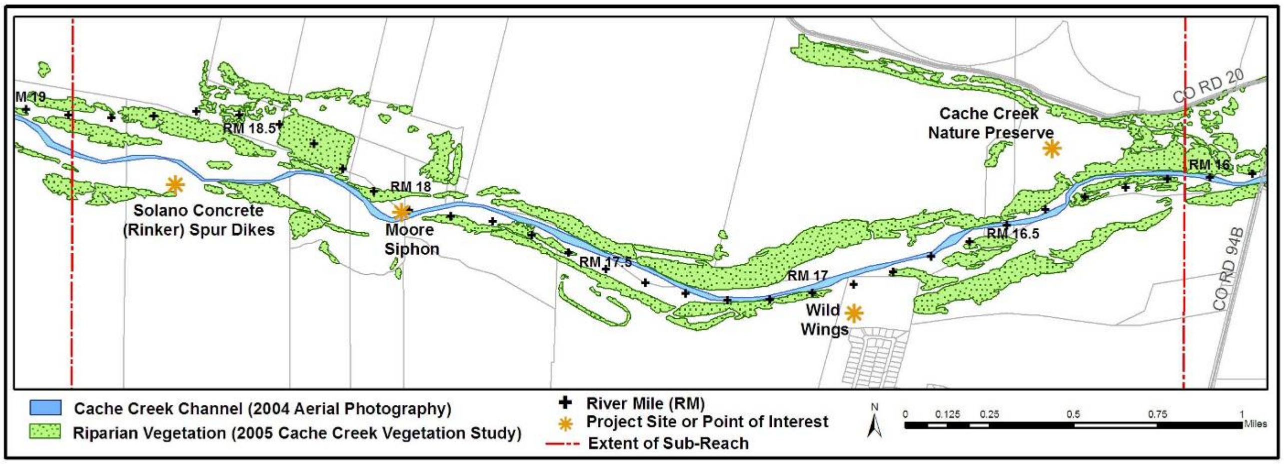


Figure 57. Dunnigan Hills Subreach. Moore Siphon to Stevens Bridge (River Miles 18.9 – 16.1)

Physical Characteristics: The Dunnigan Hills Subreach extends downstream from the Guesisosi Subreach about 2.8 miles to just upstream of Road 94B – Stevens Bridge. Compared to the Guesisosi, the slope increases slightly, with an average slope of 3 m/mi (0.0018). The average width is 268 m. This subreach has well-developed meander bends and a high water table. Additional water probably comes in the form of leakage from the West Adams Canal.

The south bank is locally oversteepened and eroded at the outside of a meander bend at RM 18.8. At RM 18.6, concrete blocks are caving into the active channel along the south bank. These blocks serve as rip-rap, and were part of the Rinker erosion control spur dikes, installed in 1998. The dikes are highly eroded, and were originally installed to direct flow away from the south bank. This creates a large meander to the north at RM 18.2, forcing flow to enter the Moore Siphon area at a high angle (RM 18.0). Any future restoration or bank protection projects in this area should consider the purpose of the spur dikes and their effect on downstream structures. It might be possible to

Figure 58 and 59. Eroded spur dikes at RM 18.6, south bank in 2007 (left) and 2008 (right).

modify or remove the spur dikes and direct flow straight through the Moore Siphon. This area is noted as the location where the ground water rises almost to the surface. The location of the Moore

Siphon is near where historically the stream remained wet in even the driest times. The groundwater table is forced close to the surface in this location by the subsurface geology.

Rinker Erosion Control Spur Dikes (RM 18.6)
Project Type: Erosion Control. **Size: 365 lineal meters**
Date of Implementation: 1998. **Project Partners: Rinker, Yolo County PPW**
In 2006, the Creek Walk noted, *"Spur dikes have been almost completely removed by erosion. This erosion appears to have occurred primarily over the last year and the previously protected bank is vulnerable to erosion."* This is still the case. This project site is located upstream of Moore's Crossing consisting of down-stream facing spur-dikes. This project was implemented by Rinker with a Flood Development Permit that was reviewed and issued by the County.

Recommendations and Items to Investigate **(RM 18.6)**
There are a number of sites along the south bank that are experiencing back retreat. It might benefit planning and execution if all the projects were considered at one time. This way projects could be evaluated and prioritized more effectively.

Car in channel (RM18.5): An abandoned and burned car in the channel poses water quality and safety concerns at RM 18.5. This car should be removed so that additional automotive fluids are not released into the Creek. This (and several similar cleanup projects downstream) might be good mitigation projects for a large company that owns heavy equipment.


Figure 60 and 61. Burnt car in the Creek needing to be removed from Creek (left), Moore Siphon (right).

Moore Siphon (RM 18.0)
The Moore Siphon is a 66" pipe that passes under the main channel of Cache Creek, delivering irrigation water for the YCFCWCD. High winter flows have eroded the cover from the pipe several times, and in December 2005, a large storm removed the pipe. Approximately 20 m of pipe was replaced and covered with large diameter riprap as a temporary solution. Several proposals have been vetted for this site as a more permanent solution, including rewetting the channel between Capay Dam and the Moore Siphon, hanging the pipe from the I-505 Bridge, and reinforcing the current pipe crossing. All parties agree that the present situation is untenable, and will need to be addressed in TAC discussions. People who designed and constructed the riprap protection in April 2006 should be commended for using natural boulders instead of the concrete slabs that are common in other bank protection projects. Several rebar spikes and old metal shards are still present in the

creek bed at this site, and should be removed when the next iteration of the Moore Siphon is constructed.

Figure 62. Large old cottonwoods downstream from Moore Siphon.

The channel is narrow and constrained at this point, and erosion will continue to be an issue. Channel width is reduced by a factor of 2, and large blocks on the south bank prevent additional meander migration. Banks consist of highly erodible sand and gravel, with loamy lenses and caps. This area is immediately downstream from a pair of tight bends. The curvature of both of these bends suggests that the channel will tend to shift laterally, first toward the north, downstream from RM 18.1, and then toward the south, immediately upstream from the existing Siphon crossing. This appears to be a very dynamically shifting area, and is likely to continue to be so due to the natural configuration of the channel near this area.

The channel is narrow and incised downstream from the Moore Siphon. Grain size is variable, with sandy caps on coarser mid-channel gravel bars. Vegetation stabilizes the bars, and the dead vegetation is tamarisk that has been sprayed. Pea gravel and coarse sand are common in the stream bottom. Gravel size ranges from pebble to cobble, a decrease from upstream coarse gravel reaches. Several crushed automobiles were used as rip-rap at RM 17.8, and this should be discouraged. These cars may leak toxic fluids into the stream, and this could be an action area for a cleanup operation. OHV trails are not vegetated, and OHV use has clearly impacted this reach of the stream.

Figure 63. Crushed car stabilizes the bank at RM 17.8.

Downstream from the Moore siphon on the left bank, there are large old cottonwoods and remnant fallen cottonwoods on the bank which form a barrier to bank erosion. At this location the active stream channel is fairly narrow.

In terms of vegetative restoration for channel banks, the left bank shows a useful model of tree recruitment to allow old trees to grow up and fall down and protect the bank. This is a good model for creek restoration, and would mimic the natural way that banks have been protected from bank erosion. This would also provide excellent habitat value both on the land and in the water.

Old spur dike levee configuration (RM 17.5 – 17.2): On the south bank, the channel was shifting towards a canal. Low elevation spur dikes with a levee behind it were designed by Bob MacArthur and installed. From visual inspection these are currently buried. The area has re-vegetated, and further channel shift in this direction seems to be prevented by the re-vegetated higher ground. We should examine the history of this site and see what we could learn about successful use of dikes to promote natural sedimentation and revegetation. A bedrock exposure near RM 17.1 shows that gravel thickness is variable, with 2-3 m thick gravel bars common over the bedrock surface.

Figure 64. Complex sandy bars with established vegetation and dead tamarisk at RM 17.1.

Figure 65. Bedrock exposure near RM 17.1.

Drain pipes
Several large (12" – 18") drain pipes empty directly into the stream along this subreach. These may be agricultural drains, or other discharge from private landowners. In either case, direct discharge to the Creek poses water quality issues. Whenever possible, settling basins or wetlands should be used to filter discharge before it spills into the stream. Drain pipes that hang out into the stream should be removed. This would be consistent with the goal of the CCRMP to maintain the channel in a natural state. Concrete slabs also line the south bank near RM 17.2. These slabs are not consistent with the nearby natural state of the river.

Figure 66. Wild Wings.

Wilds Wings Open Space
Project Type: Habitat enhancement and public open space
Size: 5 acres **Date of Implementation:** 2004-2006
Project Partners: Wild Wings LLC, Yolo County PPW
The 5-acre Wild Wings Open Space Project provides public creek access, riparian and upland habitat, and an educational trail with interpretive panels. The County acquired the site and negotiated with Wild Wings LLC to make site improvements. As part of the development agreement Wild Wings LLC was required to develop terrace park landscaping and a half-mile loop trail. A bridge was installed on the site to cross the YCFCWCD canal to provide public access from the neighboring Wild Wings development to the Wild Wings Open Space site. Native plantings, grading and loop trails have restored this site to a more natural and easily accessible point for the general public. In 2007, some green tamarisk shoots were still visible poking through gravel bars in the main channel area, although

much had been removed (treated). Vegetation on the Wild Wings Open Space site is largely natural, with a few invasive plants. Invasive plants will be an on-going issue at this site.

Creek walk members did not inspect the open space area, but this should be a part of the Creek Walk or future county inspections. Some Creek Walk members said that Wild Wings discharges surface water into Cache Creek, and this should be investigated. Housing developments like Wild Wings often use chemical lawn services, and discharge from irrigated lawns contains pesticides and herbicides. It would be better to let the discharge settle in a pond or constructed wetland area than to discharge runoff from the housing development directly into Cache Creek. It would be important to explore the Wild Wings community runoff plans to investigate the quantity, quality, and patterns of the urban runoff, trying to identify the water quality impacts to Cache Creek.

Cache Creek Preserve (RM 16.4)
Project Type: Habitat enhancement and public open space
Size: 130 acres **Date of Implementation:** 1999-2000
Project Partners: CCC, Teichert, Yolo County PPW
The Cache Creek Preserve provides valuable riparian and wetland habitat, public access to Cache Creek, interpretive trails, and educational opportunities. Teichert Land Company donated the property that forms the Cache Creek Nature Preserve to the County in March of 1999 pursuant to a Master Agreement between the County and Teichert. The County formed a License Agreement with the CCC under which the Conservancy would manage the Nature Preserve for the County subject to the provisions of the License Agreement. The County acquired grant funds to construct wetlands and trails on the site. A boardwalk allows access to the pond, and the Nature Preserve is used by school groups to view wildlife and demonstrate ecological principles. A barn is available for indoor meetings and activities, and nature trails. This is excellent use of an old gravel pit, and is one of the success stories of Cache Creek. We also toured the nearby burned area that resulted from a grass fire in 2007.

A graded ramp to the Creek cuts along the CCC and Teichert property line providing easy access to the CCC property by trespassers. No one has admitted to or knows when the ramp was created, but it is not vegetated and, thus, releases a significant quantity of sediment from the degraded bank and the ramp itself into the Creek. This ramp needs to be fenced and/or gated to prevent trespassers from accessing the CCC property and the bank needs to be replanted with riparian vegetation.

Dead tamarisk is common upstream from the Stevens (CR-94B) Bridge. This is a result of an aggressive eradication program by the CCC. Diverse mid-channel bars have older, established willow cover (more than 5 years old), and silty loam caps the coarser mid-channel gravel beds. Cottonwoods up to 20 years old line the north and south banks and the north bank is gently sloping. There is a plan to add more native vegetation to the south bank.

Salisbury/Gordon Slough (RM 16.2)
Project Type: Erosion Control, Public Access
Size: <1 acre **Date of Implementation:** 2003
Project Partners: CCC, YCFCWCD, Yolo County PPW
This project addressed erosion conditions that threatened the concrete drop spillway and access bridge across the Gordon Slough. A structural collapse of these structures would have eliminated the only access road to the CCC and blocked the diversion system for the East Adams Canal. The County acquired all permits for this project and paid a third of the cost split between the CCC and YCFCWCD to widen the stream, stabilize banks and structures, and conduct necessary mitigation

efforts. Permitting was significant because the project is outside of the CCRMP general permit area and because of potential impacts to the Valley Elderberry Longhorn Beetle (VELB), (*Desmocerus californicus dimorphus*).

Runoff from Gordon Slough enters Cache Creek immediately upstream from the CR-94B Bridge. Yolo County has designated this as a monitoring point for water quality, and there is an obvious problem with high turbidity here. High turbidity persists for a mile or more downstream from this confluence. Other chemical constituents also have elevated levels. This site is also monitored by the RWQCB, and YCFCWCD. Tim Horner suggested that the Salisbury/Gordon Slough might be a target for more comprehensive restoration, including grading and wetlands construction in the low-lying areas. A more sinuous channel would allow fine sediment deposition, and a settling basin or wetlands area would help the downstream turbidity issue as the Slough enters Cache Creek. Other Creek Walk members pointed out that high winter flows would continue to overtop any constructed channel or wetlands system.

Figure 67. Vegetation on south bank at outfall of Gordon Slough and just west of CR-94B.

River mile 16.5-16.1: Four large heavy equipment tires (> 1.5 m diameter) have been discarded or lost in the main channel just downstream from the Nature Preserve. These tires could be removed by an energetic volunteer group during a Creek Week cleanup. Access would be possible through the Cache Creek Nature Preserve, and a group of volunteers could roll the tires much of the way.

Figure 68. Tires need to be removed from Creek.

Dunnigan Hills Subreach General Recommendations:

1. **RM 18.6-18.1:** Previously constructed spur dikes are almost completely eroded away. This erosion appears to have occurred primarily over the last 2 years. The previously protected bank is vulnerable to erosion and should be assessed for further bank protection. Any future restoration or bank protection projects in this area should consider the purpose of the spur dikes and their effect on downstream structures. It might be possible to modify or remove the spur dikes, and direct flow straight through the Moore Siphon.
2. **(RM 18.5) Abandoned and burned car:** Remove and properly dispose of the car in the Creek.

3. **(RM 18) Moore Siphon:** Assist YCFCWCD in developing a long-term solution to the Moore siphon crossing. The YCFCWCD submitted an initial grant proposal to conduct a feasibility study for the project to DWR that was reviewed by TAC members and presented at a regular CCRMP TAC meeting. The proposal was not funded. The project will be brought back to the TAC in the future.
4. Drain and other discharge pipes pose water quality problems for Cache Creek. Work with property owners to create settling ponds or constructed wetlands to filter agricultural run-off before it enters Cache Creek.
5. Coordinate with the Wild Wings community to better understand and monitor its runoff plans. Investigate the quantity, quality, and patterns of the urban runoff, trying to identify the water quality impacts to Cache Creek. Develop a solution with the community if one does not already exist in the plans.
6. Work with CCC to develop comprehensive habitat restoration plan for the Nature Preserve. Incorporate grading and wetland construction in order to help control turbidity problem from Salisbury/Gordon Slough entering Cache Creek.
7. Coordinate with other water quality groups in order to better sample and monitor water quality on Cache Creek. Recent coordination with other water quality groups may result in a different sampling pattern in upcoming years. It would be helpful to have comparative information or coordination between groups to avoid duplication of chemical tests, and to alert other groups or interested parties to water quality problems.

HOPPIN SUBREACH (SUBREACH 3)

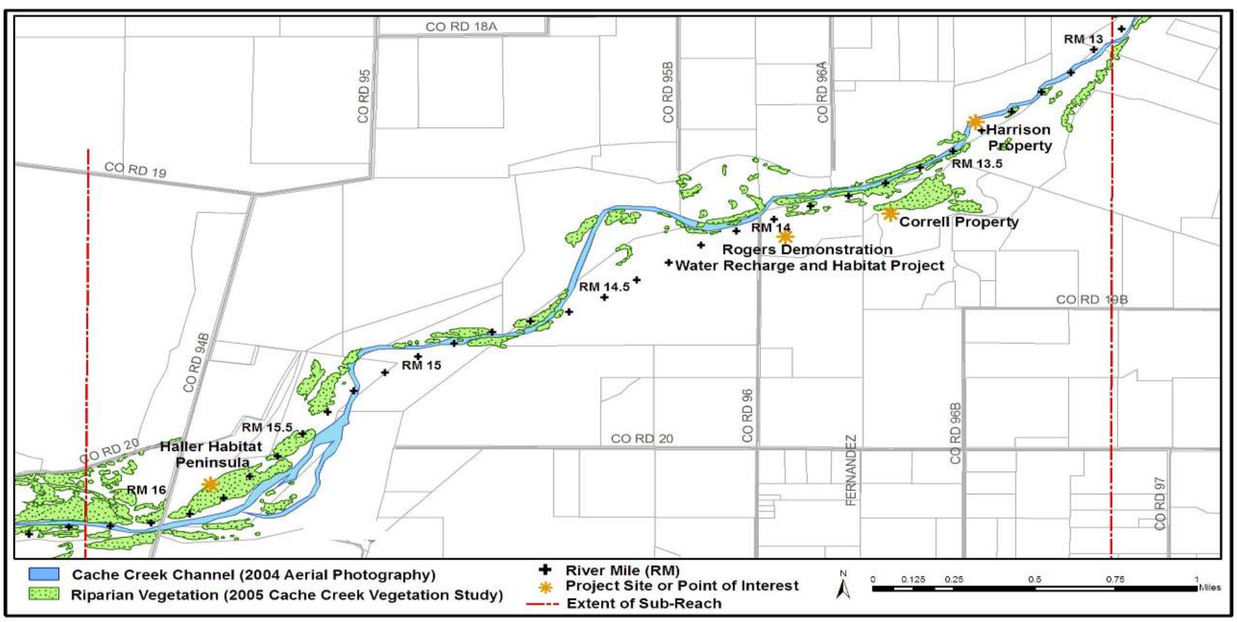


Figure 69. Hoppin Subreach (Subreach 3)- Stevens Bridge (CR-94B) to the narrows of leveed portion of channel (River Miles 16.1 – 12.9)

Physical Characteristics. The Hoppin subreach extends 3.3 miles downstream from the vicinity of the Stevens Bridge. It has a slope of 2.3 m/mile (0.0014). Compared to adjacent subreaches, the Hoppin Subreach is wide at 483 m and deep at 9.9 m. It has well developed meander bends.

The CR-94B marks the approximate upstream margin of the Hoppin subreach. The Hoppin subreach begins a zone with decreasing floodplain width and more deeply incised channels. While vegetation is more prevalent than in the Hungry Hollow and Madison subreaches, a pattern of high terraces and narrow channels creates a separation of water and vegetation. Gravel bar formation is common in this subreach as is channel migration. A significant amount of channel and vegetation disturbance due to illegal OHV activities within Cache Creek was noted during the Creek Walks in 2007 and 2008, particularly in the upper Hoppin subreach. Several aggregate industry employees and landowners have mentioned occurrences of cut fences and damaged property due to OHV activities.

Figure 70. Narrow stretch of Creek with native vegetation.

Vegetation. Good native vegetation development below CR-94B Bridge. Native species that are present, include: Cottonwood, Gooddings willow (*Salix gooddingii*), Red Willow, Sandbar Willow, Mulefat, Valley Oak, Wild Cucumber (*Marah macrocarpus*), Creeping Wildrye, Mugwort, and California Wild Rose. There has been good cottonwood regeneration along this section of Cache Creek. Tamarisk and Arundo are non-native species abundant in this subreach. The GIS survey revealed 67.23 acres of riparian forest.

Various factors in the Hoppin Subreach foster good development of riparian vegetation compared to the upper subreaches: 1) groundwater is closer to the surface which positively effects the availability of water to plants; 2) fine-grained sediment is present especially below the conveyer bridge; and 3) there is an increased flow of summer water related to irrigation practices in the area.

The CR-94B Bridge has scour pools up to 1 m deep around the abutments. Flow is constricted by a factor of 3 under the bridge, and erosion will continue to be a problem at this site. The channel widens dramatically downstream from the bridge, and banks have a gentle slope. Low banks are covered by older, established vegetation at the edges, and midstream bars have silty caps with young willow growth.

Figure 71: Scour pool under CR-94B Bridge.

Figure 72: Abandoned car at RM 15.4.

Haller Habitat Peninsula (**RM 15.8**)
Project Type: Habitat enhancement
Size: 8+ acres **Date of Implementation:** 1996-1999
Project Partners: Teichert, Yolo County PPW

This project consists of 8+ acres of a former mining pit area downstream of CR-94B. The site was planted with a variety of riparian species including: Valley Oak, California Box Elder (*Acer negundo californicum*), Toyon (*Heteromeles arbutifolia*), Fremont Cottonwood, and Western Redbud. The site was also planted with 366 Blue Elderberry seedlings to provide habitat for the federally-listed

Figure 73: Teichert conveyor belt (left) and stream crossing (right).

VELB. Teichert has conducted maintenance and monitoring on the site over the past ten years. The County has negotiated and holds a conservation easement on the property. This site was not visited during the 2007 or 2008 Creek Walk. The planting seems to be located in a place that will increase the width of the extent of riparian plants, which will provide valuable habitat benefit.

River mile 15.5 and downstream: In 2007 and 2008 we noticed an abandoned and burned car that poses a water quality, aesthetic and safety problem. The car should be removed before (additional) automotive fluids are released into the channel. This is a relatively natural reach, with low (3-4 m high) graded banks, abundant established riparian vegetation, and mid-channel gravel bars that have formed by natural stream processes. Younger vegetation (mostly willows) is starting to take root on the mid-channel gravel bars, and will tend to stabilize the bars in the absence of high flows.

River mile 15.3 (Teichert crossing): The Teichert gravel company annually applies for a Flood Hazard Development Permit to erect a temporary stream crossing at this site during the summer months. A portable bridge is installed over the channel, allowing work crews to drive between gravel plant sites without a lengthy detour to county roads. Vehicle traffic is generally discouraged in the active channel, so this exception should be treated carefully. The moveable temporary bridge should cause less impact than the previous stream-drive-through.

Figure 74. Loamy soil cap.

River mile 15 (Conveyor belt): Stepped or graded banks and naturally occurring mid-channel gravel bars give this subreach a natural, unaltered look. High turbidity from Gordon Slough still persists in the water. Larger vegetation (mostly willows) is well-established on riparian margins, and small willow shoots are starting to grow on mid-channel bars. Yellow Star Thistle (*Centaurea solstitialis*) and Perennial Pepperweed are common invasive non-native plants along this subreach. Some mid-channel bars have up to 0.60 m of loamy soil cap (Figure 74). The channel becomes more constricted below RM 14.9, due in part to levee construction and bank protection near gravel pits. Bank Swallows were seen nesting along the left bank at RM 14.3. This loamy soil cap and high bank should be preserved to protect the swallow habitat.

Figure 75: Upper levee bench with Creeping Wildrye at RM 14.3.

The channel becomes much narrower at RM 15.1, and there is an abandoned car in the Creek at RM 15.0 that should be removed. The conveyor crossing at RM 15.0 does not have any significant erosion issues. The channel continues to incise within the setback levee, and by RM 14.8 bluffs up to 6 m high are present on both sides of the active channel. This gives a stepped cross-sectional profile, with an incised channel contained within the constructed levee system. Bluffs are made of sandy, loamy floodplain material, and older established willow, cottonwood and walnut trees line the banks. Silt, sand and gravel accumulate in mid-channel bars, and the channel bottom is lined with granule- to pebble-sized grains within a sandy matrix. Arundo and young willow shoots trap sediment on mid-channel bars, and algal mats are common in the slow-moving water. The broad, gently sloping surface that lies along the north bank at RM 14.3 allows some floodplain connection to the main channel. On the south bank, the upper levee bench has Creeping Wildrye, Mugwart, abundant non-native Yellow Star Thistle and Perennial Pepperweed are common along this sub-reach. Non-native plants (especially dead Arundo) are common on the lower bench and in the channel. The combination of narrow, steep bluffs and finer sediment size give this section a different character than the coarser upstream subreaches. The channel widens slightly at RM 14.0, although banks are still steep and up to 6 m high.

Correll-Rodgers Habitat Enhancement Project (RM 13.9-13.4)
Project Type: Groundwater recharge and habitat enhancement
Size: Rodgers-30 acres, Correll-38.9 acres
Date of Implementation: Rodgers site 1997-1999, Correll site 1996-1998

Project Partners: Teichert, Yolo County, YCFCWCD, CCC, Center for Land Based-Learning, landowner

The Rodgers Demonstration Water Recharge and Habitat Project site was a retired gravel mining site that was converted into a water recharge and habitat improvement project in accordance with the Teichert (Woodland) long-term off-channel mining permit plan (Development Agreement No. 96-286). Site ownership was transferred from Teichert to the County and the two entities negotiated design and implementation of the improvement plan for the site. Improvements to the site included the construction of an overlook area with the help of the Center for Land Based-Learning's SLEWS program. The project included the revegetation of three zones based on elevation features: shoreline, middle terrace, and upper terrace.

The Correll site, once a part of the Lone Star gravel operation, was presented as a gift to the County by Mr. Richard Correll in the fall of 1996. A broad revegetation and habitat restoration plan was put in place, and the initial plantings were completed. This includes native plants (grasses) at the top of a

Figure 76. Rodgers pit with controlled burn at south edge and failed Magnolia pipe.

Figure 77. Restoration in Rodgers pit, RM 13.8.

ridge, although the ridge site lacks irrigation water. In 1998, a portion of the south bank of the Correll site was removed in order to allow sediment to be brought in to enhance the site for riparian vegetation and to allow stormwater to exit the site. Cottonwoods were planted to increase perch sites and shading and invasive species were removed. The YCFCWCD wanted to use these pits as recharge basins to the underlying groundwater system, but they determined that the amount of recharge occurring was insignificant. Although such ponds can be picturesque, open water is less desirable as wildlife habitat than riparian forest. In the areas where the standing water is from intercepting the ground water table, a transition to riparian forest might require infilling to raise the ground surface elevation.

In the past year, Yolo County developed the Correll-Rodgers Pond Enhancement Feasibility Study with consultant Foothill Associates and subconsultant Domenichelli & Associates in order to better link the Correll and Rodgers sites to each other and to the Creek and to improve the wildlife habitat on the site. Several design alternatives were proposed with public input and a public comment period. Based on a detailed hydraulic analysis using HEC-RAS on both the existing and proposed conditions, the preferred alternative was created by the consultants, Yolo County Parks and Resources staff, TAC members, and public input. Priority was given to habitat enhancement, connecting the Creek better to the site, and restoring habitat in a self-sustaining manner.

The first (upstream) gravel pit at RM 14.0 has little habitat value in its current configuration, with non-native grasses covering a flat, featureless bottom. A controlled burn was recently conducted at this site to reduce non-native vegetation. A broken agricultural drain from the Magnolia canal cut an erosional scarp into the south side of the pit some time prior to 2007. The scarp is still present. Pools of shallow water were standing in the bottom of the pit during the 2008 Creek Walk.

The Rodgers pit at RM 13.85 has more habitat complexity, with low sculpted islands and trees of varying ages covering the pit bottom. Barry Baba from Teichert described the planting and restoration efforts that led to this habitat enhancement. Soil was taken on-site, and used as cover for the island features. This use of islands creates more shoreline and has added habitat benefits. Up to 1 m of water is present on the pit bottom. Non-native Star Thistles and native, but weedy, Cocklebur (*Xanthium strumarium*) are common on the pit slopes, and there is non-native grass cover on the pit walls. The battle with non-native plants is on-going at this site.

The Correll pit at RM 13.7 lies immediately downstream from the Rodgers pit, and also has varied vegetation and topography. These pits are connected by a low berm and floodgate system, although site restoration plans call for elimination of the berm and seamless connection between the two pits. The Correll pit was dry at the time of the 2008 Creek Walk. A willow and cottonwood forest provides riparian habitat at the downstream end of the pit, with willows dominant. This forest provides good cover in a riparian zone that is often barren, and should be preserved during any upcoming restoration projects. The berm and inlet structure that separate the Correll pit from the main stream channel have been overtopped by high flows, and there is significant erosion in low lying areas that connect the Correll pit to the main channel. OHV use has been a problem near the Correll-Rodgers pits, and several strategies have been used to limit OHV use. Brush piles, fencing, gates and signs have all been tried, but OHV use continues to be a problem in this part of Cache Creek. Integrating all of the above strategies and using natural barriers seems like it will be a more sustainable and effective solution.

Figure 78: Eroded berm separates Correll pit from Cache Creek at RM 13.7.

Figure 79: Brush used to block OHV traffic at RM 13.6.

For more details regarding the Correll-Rodgers sites, please refer to the Feasibility Study.

***Recommendations and Items to Investigate* (RM 13.9-13.6)**

1. Erosion of the embankment adjacent to the overflow structure needs to be addressed.
2. The restoration and implementation plan needs to be completed for the Correll-Rodgers site.
3. Natural barriers need to be installed to prevent trespassing by OHVers.

River mile 14 and downstream: The stream channel begins to incise more at about RM 14, and the river now has 6 m high banks. These banks are noticeably constricted, and the bed material is predominantly sandy, rather than the gravel/sand mixture that was present just upstream. River flow is also lower at this point compared to upstream flow volumes. River mile 14 marks a change in river morphology and function.

The CCC did a tamarisk/Arundo removal project in this area to "maintain flood capacity". Flood control is an important issue here. The channel in this vicinity is much more confined than it is upstream.

Harrison Property (RM 13.45)
Project Type: South bank erosion control and habitat restoration project
Size: 1.85 acres **Date of Implementation:** 2004
Project Partners: landowner, Yolo County PPW
The Harrison Property project was implemented by the Yolo County PPW with permission from the landowner as a habitat enhancement and erosion control project in conjunction with the demolition and replacement of the 99W Bridge located approximately 2.25 miles downstream. The Harrison Site consists of a 1.85 acre, narrow riparian corridor, located on the south bank of the Hoppin Subreach. Minor grading, bank stabilization, removal of invasive species, and the planting of approximately 452 riparian plants occurred on the site in 2004. The County continues to maintain and monitor the site.

Figure 80. Drain pipe with unknown source.

Yolo County has a contract for Tamarisk and Arundo removal starting downstream from RM 13.45, although Tamarisk removal will not begin until later in the summer, when herbicide treatments are most effective. There is a distinct difference between upstream areas where invasive plant removal has not occurred, and downstream areas where chemical and physical treatment have taken place. Vegetation removal and herbicide treatment have generally been effective, and new plantings of native plants on the high banks have been successful since the planting operation began in 2004. The north bank is steeper than the south bank at RM 13.45, with up to 6 m of channel incision. The south bank may be equally high downstream from the Correll pit, but the slope is more gradual. A large drain pipe has an outlet into the stream at about RM 13.45, although the pipe may be plugged or out of service. Pipes like this raise questions about water quality and potential drainage into the stream, and it would be good to eventually remove the pipe. The channel is very narrow downstream from RM 13.0, and flood conveyance is limited by the channel's narrow cross-sectional area. Patches of clay bottom at RM 12.9 show that the sediment cover here is thin. The Creek banks are 7-8 m high downstream from RM 12.9, and the channel bottom consists of silty sand and clay with some gravel bars.

***Recommendations and Items to Investigate* (RM 13.4):**

1. A large drain pipe of unknown origin hangs over the channel at RM 13.45. It would be helpful to know the source of this pipe, and several other smaller diameter white PVC pipes that hang from the bank in this area. Each of these pipes may introduce water quality problems, whether from agricultural drainage or other waste water input. These drains should be located precisely, and landowners should be questioned about the source and type of discharge from each. Old, unused pipes could then be removed.
2. Revegetate the lower bank areas. Fence vegetation, rather than using tubex tubes, for animal predation and protection from OHV usage. The PPW has worked with Mr. Harrison to put in gates, develop other OHV deterrents, and replant vegetation.

JESUS MARIA SUBREACH (SUBREACH 2)

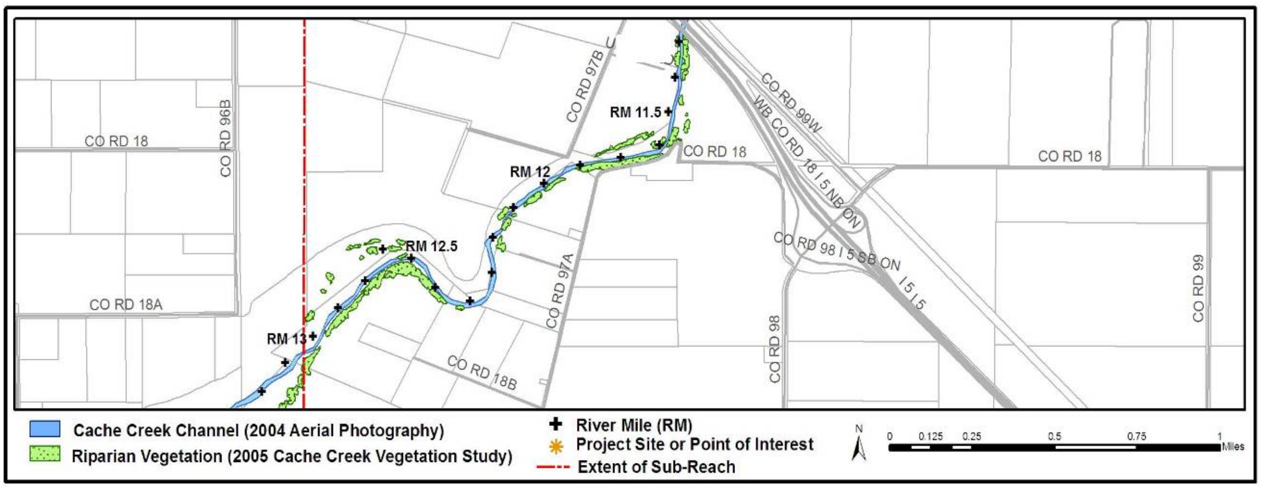


Figure 81. Jesus Maria Subreach- Upstream of I-5 (River Miles 12.9 – 11.3)

Physical Description. The Jesus Maria Subreach is the most downstream portion of the CCRMP. It is a 7.5-mile long subreach with an average slope of 2.1 m/mile (0.00142). It extends downstream to the settling basin. The relatively narrow channel (117 m wide) is deeply incised into fine-grained alluvial sediments. The banks are steep and up to 12.7 m high. Active erosion of the toe of the banks, especially on the outside of tight meanders that characterize the reach, maintains the steep banks. Bank failures are evident as bank slides on both the north and south bank. This constricted portion of the channel is not able to carry larger (10 yr) events without overtopping, and poses serious ecological and political questions for the residents of Yolo County and Woodland. Levee setbacks near RM 11 and 12 have protected valuable cropland when high winter flows breached the old levee system. Residents will need to decide on a sustainable plan for this area, and increased flood protection or bypass spillways need to be considered. This will be a difficult discussion, and the CCRMP could be used to initiate or facilitate discussions.

Vegetation. Only 10.74 acres of riparian forest were mapped in this reach. The presence of Perennial Pepperweed is widespread and often comes into areas where tamarisk has been removed.

Projects. The principal projects along this subreach have been weed control. However, considerable tamarisk cover remains in the reach. Severe erosion occurred in the spring of 2006 at CR-18, an area referred to as Huff's Corner (RM 11.6). The Yolo County PPW completed work on the area in the fall of 2007.

A local landowner has used orchard slash material, concrete and fence posts as rip-rap on the south bank near RM 12.8. This material appears to have been dumped from the top rather than placed on the bank as part of a bank stabilization project, and is not effective at reducing erosion. Much of the debris would float during high flows, and might pose safety risks downstream as it collects against a bridge or other structure. Yolo County should discuss with the landowner options for this area. Large woody debris can be beneficial, but it needs to placed carefully and anchored. Any bank stabilizations by landowners within the CCRMP must be brought before the TAC for approval before being implemented.

The channel is significantly narrower downstream from RM 12.5, and is constrained by agricultural levees along the north bank. A small setback levee at RM 12.1 provides additional flood capacity, but the benefits are limited and the levee does not appear to be engineered. Channel width averages about 250 m, and may be less than 100 m at RM 11.6 (Huff's corner). This reach poses a threat to the City of Woodland, because a relatively small event could overtop the system and flood parts of the city. Channel walls (bluffs) are 10-12 m high. Mature vegetation lines the top of the banks only in parts of this area. Channel walls grow higher (the stream is narrower, and more incised) in a downstream direction. Older cottonwood, Valley Oak, and walnut trees are common, and there is some tamarisk in the creek bottom and along the walls of the bluffs. Buildings are undermined as the channel migrates to the south at RM 12.35, and concrete slabs from an old foundation pad lie along the south bank. An entire barn had fallen into the channel from the Reynolds property along the south bank. The CCC worked with the property owner to remove a substantial portion of the material that had fallen into the Creek. This reach has significant issues with bank stability, and erosion has impinged on several existing structures. This is a case where it is better to be proactive than reactive. It would be better to dismantle buildings at the top of the scarp than to remove the pieces from the creek bottom after the structures have collapsed. Removing unstable buildings would also prevent water quality and safety issues from impacting the channel. This area needs immediate attention. Yolo County needs

Figure 82. Slash pile on south bank at RM 12.8.

Figure 83 and 84. Concrete slabs in creek at RM 12.35 and Reynolds Barn collapsing into Creek.

to work with the landowners in this area in order to create a solution. The landowner who helped remove a collapsed shed after last year's Creek Walk should be commended.

Continuing downstream, large woody debris lies in the stream bottom where cottonwoods have collapsed into the channel. This poses some problems with flood conveyance, but there is an offsetting habitat benefit to having large woody debris in the system. Most stream ecologists are advocates of the benefits of large woody debris, citing increased cover, structure, formation of scour pools, and contribution of organic matter to the system. Naturally occurring woody debris should be left in Cache Creek when it does not threaten flood conveyance or structures.

A partially buried 40-gallon drum was observed in the south bank at RM 12.5. This could be a water pollution hazard, and should be inspected carefully by trained personnel, then removed. Older drums of this type can often contain liquids or residues of material that are highly toxic to aquatic life. Slabs of concrete and waste from orchard pruning have also been dumped over that bank at about RM 12.7. Bank cleanup and landowner education would be worthy goals at these sites.

Huff's Corner (RM 11.6)

Huff's Corner is on a highly erodible outer meander bend in the river, and is inherently unstable. The river channel in this location has a sharp river bend. The radius of curvature ("tightness") of the bend and the discontinuity from straight to curved channel are one of the most extreme examples on Cache Creek that we visited. The typical (natural) meander wavelength of this portion of Cache Creek is much longer than the existing bend at Huff's corner. Such very tight bends cause high velocities and can produce high forces that tend to erode banks. The curved channel has a very tight apex and sharply-angled bend. This causes extreme hydraulic pressure on the banks. Sharp angles tend to cause flow accelerations that can transmit high flows downstream and perhaps accelerate erosion on the opposite bank downstream from the current project. The river will continue to migrate

Figure 85. Huff's Corner CR-18 prior to bank stabilization work in 2007.

Figure 87. Huff's Corner looking upstream prior to bank stabilization work in 2007.

eastward toward existing structures, and it may be a problem to maintain the channel in the present configuration. The current desire is to retain the existing bank line out of fear of impacting nearby private land and I-5, but a "relieved" or "relaxed" bank line in the vicinity of the corner could redirect the flows in a way that would not cause as much upstream or downstream disturbance. This could be done in such a way that would not negatively alter the flow as it passes under I-5.

A major bank stabilization project was completed at Huff's corner after the 2007 Creek Walk. The completed bank protection project at Huff's Corner engineered the slope, altered a mid-channel bar, and protected the bank with riprap or hard structures. Previous to constructing the engineered slope, Huff's Corner had 10 m high bluffs dropping straight to the channel below at CR-18. A sediment prism was added to the base of the south bank, and large angular boulders were used to armor the surface to a height of 5- 6 m above the channel bottom. This work covered sections at the Huff's corner bend, and immediately downstream. Rough field estimates based on channel cross section and water velocity of 1 m/s show that the new armoring would protect the bank at flows of up to about 45,000 cubic feet per second (cfs).

There are still significant issues with bank stability at this bend in the river even after completion of the Huff's Corner Bank Stabilization project by Yolo County PPW. The stream is forced to take an unusually tight turn at Huff's corners, and the force of the river will continue to erode this bend during high flow events. Flows higher than 45,000 cfs could cut through the unprotected bank, possibly resulting in sudden, catastrophic failure. There are also concerns about a mid-channel island that remains in the stream bed. TAC members understood that the island would be removed to increase flood conveyance capacity, but most of the island remains after the project had been completed (see figure 51). Fill was added on the north side of the island to construct a haul road for the project, and this further diminished channel capacity at the site. This year's TAC members were not part of the Huff's corner project review, but it would be valuable to compare project plans to the work that was completed. This might be a site where managers decide it is more cost effective to purchase a conservation easement than to keep repairing the bank.

Figure 88: Cracks in soil at the edge of the road (Huff's Corner) show that the south bank is unstable.

It is possible that the repair job at this location may accelerate flow and perhaps promote downstream erosion. In addition, there may be accelerated erosion on the same side of the bank as the current erosion, but both upstream and downstream of the construction. Such upstream and downstream consequences are common when bank restraint is placed site-specifically. The consequent erosion will then require future projects. If this project fails during subsequent high flows, a more sustainable design should be considered. The success of the revegetation effort should be re-examined to see if a more successful plant mix and water system could be use to stabilized the surface.

CR-18 that parallels the south bank was re-paved downstream from Huff's corner. Cracks at the edge of the new pavement show that the hillslope is very unstable. This section of road may be especially prone to failure if the bank is saturated from below by high flows from Cache Creek. This needs to be evaluated by a licensed engineer, but the road may not be safe for vehicle traffic after heavy rains or high flows. A setback or different road alignment should be considered.

The CCC has an aggressive invasive plant removal program along this sub-reach, and tamarisk removal has been very effective.

Jesus Maria Subreach General Recommendations:

1. The CCC has done some clean up of the barn material that has fallen down the bank into the creek channel. There is still material in the Creek and at least one other structure is in danger of falling into Cache Creek in the future. There needs to be coordination with the landowner in order to remove this structure before it falls in the Creek.
2. Notify the PPW about cracking and scour at the Huff's Corner Bank Stabilization site.
3. Coordinate with landowners, DWR, and the CCC to promote and implement the invasive species removal program within the active floodplain. The County set up a 2-year contract with the CCC to remove tamarisk in the Jesus Maria Subreach.

ENTIRE CCRMP AREA RECOMMENDATIONS

The ecological assessment is constrained by the type of monitoring which has been performed. However, some relative assessment is possible. Overall, the Cache Creek system is in significant jeopardy for invasive species, streambank instability associated with fill and debris, as well as impacts associated with erstwhile stabilization activities. The ecological conditions show significant historic impacts to the riparian forest in terms of stand ages, stand/patch sizes, structural diversity, and native species diversity.

The streambank is eroded in many places due to what appears to be normal channel process. In several places the erosion appears to be associated with direct modifications, such as OHV use or dumping, or as the result of attempted stream stabilization activities. OHV bank damage is apparent due to mechanical movement of the bank and associated plant damage. Palisades of Arundo in the lowest reaches appear to have impact on channel deflection.

It is unclear which areas of rubble, fill, and debris have been permitted by the ACE, DFG (1600 Series permit), and RWQCB (401 Certification, Water Discharge Requirement, or Order) permits. It is critical that the areas with permits be identified and those without permits be brought into compliance. There are numerous areas where fill has been recently placed in the channel or on eroding banks and have no visible best management practices employed or any accepted structural controls. There are several places where stream stabilization techniques have been employed, but these have failed and have not been repaired. There are several areas of particular concern that overlap the geomorphic and ecological fields, the unstable north bank of CEMEX's property, the overall health of the Lower Cache Creek watershed, the Teichert levee, the concrete rubble falling into the Creek at several orchards, the barn collapsing into Cache Creek, and the low success of revegetation.

Over the last 40 years, our understanding of aquatic ecosystem responses to increased sediment and nutrients has matured to the point that there are well-established indices and metrics for quantifying impairment. The USEPA has several programs now that provide consistent methodological approaches to understanding aquatic ecosystem impacts and the potential effects on function. Despite the cursory nature of the Creek Walk, the observed aquatic species assemblages were indicative of the classical effects of eutrophication.

While there are many recommendations listed throughout the Creek Walk Summary, based on discussions at publicly attended TAC meetings, the more pressing priorities and recommendations have been distinguished. These priorities and recommendations have been divided up first by subreach and projects, and then by general recommendations for the entire CCRMP area. In some instances, the TAC members requested putting their names next to what they deemed as their highest priorities. This in no way signified that the other items were not important, but was rather done in order to help guide us in implementing the CCRMP.

The following should be priorities (not in order of priority) for the TAC and the Parks and Resources Department for the management of the CCRMP:

TAC project specific highest priorities and recommendations

1. **(RM 26.9)** A long-term solution is needed for the concrete blanket and the international pipeline crossing Cache Creek. Repair work was completed in 2006 and there is significant erosion to the blanket only two years after this work was completed. PG&E should be contacted in order to discuss maintenance and long-term solutions for this area. (#1 Horner, Ringelberg, Larsen)
2. **(RM 26.9)** Monitor the nick point at PG&E site and estimate its travel speed. Anticipate any issues that it may cause. For example, what will happen when the five-foot incision of the nick point reaches the dam? Identify and track its migration over time. (#1 Horner, Ringelberg, Larsen)
3. **(RM 21-19.3)** CEMEX must complete bank stabilization construction within the next year in order to be in compliance with set-back requirements and levee protection for off-channel mining. This bank stabilization addresses one section of the bank at risk to the toe undercutting and there are other areas of CEMEX's north bank needing bank stabilization. (#2 Horner, Larsen, Ringelberg)
4. (**RM 25.4**) Remove concrete in the channel (Tim Horner #3, Larsen, Ringelberg)
5. (**RM 25.4**) Remove concrete on the bank poised to fall in the channel. This is an area of definite concern, with rubble that continues to be in imminent danger of falling into the channel. The County should meet with the Jensen family in order to discuss possibilities for this area. The County should evaluate the causes of the original project failure with the project designers and landowner and establish guidelines for repair or replacement. (Tim Horner #3, Larsen, Ringelberg)
6. (**RM 21.7-21.5**) A long-rang examination of the dynamics at the Scheuring Property (Old Madison Bridge Site) is needed considering the tendencies and the likely future migration. We need to find the report done by Questa Engineering in 2006 which assessed whether the meander bend at this site was likely to threaten the I-505 Bridge. Will the pathway of the channel shifting continue far enough to impact the I-505 Bridge and is this site the right spot to do something? What is the area of influence of the meander pattern over the next several decades? Is there a possibility of allowing an extended area to allow natural channel shift? (Larsen, Ringelberg, Horner)
7. (**RM 26.6**) The Yolo County Department of Parks and Resources should contact the land owner about moving the vehicles. A larger buffer zone between the Creek and the vehicle yard would be preferred. (Tim Horner #4, Ringelberg, Larsen)
8. (**RM 13.9-13.4**) Complete the restoration and implementation plan for Correll-Rodgers and begin implementation. (Tim Horner #5, Larsen)

Subreach Specific Recommendations and Priorities

CAPAY SUBREACH

1. **(RM 26.9)** A long-term solution is needed for the concrete blanket and the international pipeline crossing Cache Creek. Repair work was completed in 2006 and there is significant erosion to the blanket only two years after this work was completed. PG&E should be contacted in order to discuss maintenance and long-term solutions for this area.

MADISON SUBREACH

2. Teichert Bank Protection Project (RM 23-22.8) Success criteria need to be evaluated of the Questa Engineering designed levee repair. The County needs to work with Teichert to develop an alternative to using exposed concrete in Cache Creek for bank protection. Bioengineering designs should be encouraged. Soil and plantings should be evaluated and only native species to Cache Creek should be used to revegetate the area. The County should meet with Teichert to inspect and explore options for this area.
3. A long-rang examination of the dynamics at the Scheuring Property (Old Madison Bridge Site) is needed considering the tendencies and the likely future migration. We need to find the report done by Questa Engineering in 2006 which assessed whether the meander bend at this site was likely to threaten the I-505 Bridge. Will the pathway of the channel shifting continue far enough to impact the I-505 Bridge and is this site the right spot to do something? What is the area of influence of the meander pattern over the next several decades? Is there a possibility of allowing an extended area to allow natural channel shift?
4. OHV use, trespassing, and vandalism have been on-going problems for the Syar Construction company site and for this subreach in general. In addition, OHVs are coming in at locations of present and old bridges across Cache Creek. New signs and restricted parking near the I-505 Bridge may help control the problem.

GUESISOSI SUBREACH

5. Monitor the I-505 abutments and use HEC-RAS to examine longer term solutions for the I-505 Bridge that would reduce scour and risk to the abutments.
6. CEMEX must complete bank stabilization construction within the next year in order to be in compliance with set-back requirements and levee protection for off-channel mining. This bank stabilization addresses one section of the bank at risk to the toe undercutting and there are other areas of CEMEX's north bank needing bank stabilization.
7. At the CEMEX conveyer transfer point, this area needs to be regraded and planted to prevent erosion into the Creek of fine sediments and to protect the levee at this section.
8. Use in-channel mining to remove deposition caused by lower flow rates between RM 20.8 and 20.4. This will decrease incision of banks outside gravel bars, including an area dangerously close to CEMEX's operations and conveyor belt.

DUNNIGAN HILLS SUBREACH

9. Work with CCC to develop comprehensive habitat restoration plan for the Nature Preserve. Incorporate grading and wetland construction in order to help control turbidity problem from Salisbury/Gordon Slough entering Cache Creek.
10. Coordinate with other water quality groups in order to better sample and monitor water quality on Cache Creek. It would be helpful to have comparative information or coordination between groups to avoid duplication of chemical tests, and to alert other groups or interested parties to water quality problems.

HOPPIN SUBREACH

11. Complete the restoration and implementation plan for the Correll-Rodgers site.
12. Natural barriers need to be installed to prevent trespassing by OHVers.

JESUS MARIA SUBREACH

13. The CCC has done some clean up of the barn material that has fallen down the bank into the creek channel. There is still material in the Creek and at least one other structure is in danger of falling into Cache Creek in the future. There needs to be coordination with the landowner in order to remove this structure before it falls in the Creek.

14. Notify the PPW about cracking and scour at the Huff's Corner Bank Stabilization site.

CCRMP Area Recommendations and Priorities

1. OHV use, trespassing, and vandalism have been on-going problems. In addition, OHVs are coming in at locations of present and old bridges across Cache Creek. New signs and restricted parking near bridges may help control the problem, but stricter enforcement and dedicated off-road vehicle parks were also discussed as mechanisms to address the problems. A plan needs to be developed in order to determine OHV management in the Cache Creek Watershed and in Yolo County in general. Preventing OHV access at the CR-87 Bridge is one of the first steps needed to help protect Cache Creek. (Horner, Ringelberg, Larsen)
2. Create a 50-100 year plan for the CCRMP area. (Horner, Ringelberg, Larsen)
3. Create a plan for Cache Creek Channel migration processes. Channel migration processes are inherent in the flow of water and sediment. Cache Creek has a relatively high sediment supply, and its channel shifting characteristics are inherently dynamic. In relation to the Creek's dynamic nature, it will tend to cause channel shift on the current margins of the active channel (bank erosion). The pathway of future channel shifts is limited and can be forecasted to some degree. *[Note: this is addressed to some degree by the studies by Larsen and Horner.* By forecasting future creek dynamics, the following benefits will be provided:
    a. Bank protection costs will be avoided.
    b. Maintenance costs associated with previous bank protection can be avoided.
    c. Anthropogenic restoration and maintenance of riparian vegetation will be reduced.
    d. Regeneration and maintenance of riparian vegetation will occur naturally.

    (Horner, Ringelberg, Larsen)
4. A survey should be completed every 5 years of every subreach at randomly selected intervals, including: plants, invertebrates, birds, mammals, reptiles, amphibians, and fish. A more difficult (more expensive) survey would be of the microbial community. Standardized, repeatable, statistically, and scientifically accurate protocols should be implemented. Any survey should sample at least 3 different times during the year so as to document species only seasonal to the area. Some of this we could contract out, but some we could definitely do in house with the help of volunteers, graduate students, and staff.
5. Perform assessments using statistically appropriate survey methodologies for aquatic invertebrate taxa and standard water quality parameters (temperature, conductivity, color, dissolved oxygen, phosphorus and nitrogen), at both low and moderate flows.
6. Species with special protection or requiring special management should be identified for focused long-term monitoring.
7. Establish aquatic species surveys for snails (presence, absence and densities), clam(s) (presence, absence and densities), and algae species along the transects (at a minimum). It would be useful to complete site-specific seine net assessments (ad hoc) for fish species (see http://bioregion.ucdavis.edu/where/fishlist.html) within floodplain pools to identify which species remain during low flows and within groundwater pockets.
8. Perform the initial sampling of the new plots and the historic transects.

9. Establish semi-annual sampling for water quality parameters at the main drains (particularly the Correll-Rodgers site), at the primary upwelling and downwelling locations, and at specific transects.
10. Establish a permit cross-reference. Which sites, and which locations within sites are permitted by the ACE, DFG (1600 Series permit), RWQCB (401 Certification, Water Discharge Requirement, or Order)? It is critical that the areas with permits be identified and those without permits be brought into compliance.
11. Complete HEC modeling using most the recent DTM data and stage data to evaluate potential increased flooding hazards related to changes in channel morphology.
12. Contract with GIS/Engineering consultant to provide a quantitative assessment of significant volumetric changes in channel capacity and areas of excessive erosion over the period 1997-2007 in order to document significant aggradation and bank erosion within CCRMP area. This assessment will be important to understand the overall watershed sediment budget (where the sediment comes from and where it goes) in order to put site-specific issues into context.
13. Coordinate with CCC to develop an on-going invasive vegetation removal program to prevent the proliferation of tamarisk and Arundo on bars and channel margin.
14. As a long-range vision, an extended river corridor might save money and effort. Riparian restoration efforts that have been done and are being planned could also be reduced if more natural river processes provided the circumstances so that the riparian forest could be self-generating and self-maintaining.
15. Perform a LiDAR canopy assessment.
16. Establish an integrated GIS and modeling component.
17. Finalize a revegetation species list, including estimated ratios and densities.
18. Define the standard (e.g. dust, weeds, and stormwater sediment control) and monitoring protocols for restoration projects.
19. Look at grant opportunities for helping fund projects.

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APPENDIX 1: 2008 CREEK WALK ATTENDEES

Day 1—June 9, 2008—18 people

1. David Pratt-Public, Tuleyome
2. Eric Larsen- TAC, Geomorphologist
3. Frank Goddard-CCC, Landowner
4. John Watson-CCC
5. Erik Ringelberg-TAC, Riparian Biologist
6. Kevin Schwartz-Yolo County Resource Specialist
7. Max Stevenson – YCFCWCD (at Capay Dam only)
8. Tami Leathers-Graduate Student, Sacramento CSU, Geology, Yolo County Extra Help
9. Tanya Meyer-Yolo RCD Vegetation Management (at Capay Dam only)
10. Tim Horner-TAC, Hydrogeology, Sedimentology, Stratigraphy
11. Yasha Sager-Granite Construction Company
12. Justin Toll-Granite Plant Manager (at Capay Open Space Park only)
13. John Rosapepe-Tuleyome
14. Jim Barrett-Landowner
15. Sally Barrett-CCC Board, Landowner
16. Molly Ferrell-CCC, Habitat Restoration Manager
17. Jeff Clark-CCC, Education Coordinator
18. Ted Pearson-Syar (only at the Syar spur dikes)

Day 2—June 10, 2008—18 people

1. Terry Howard-Teichert Esparto Plant Manager (at Esparto Plant only)
2. Brian King-Teichert, Assistant Project Manager
3. Ben Adamo-Granite Construction, Plant Operations and Permitting Coordinator
4. David Pratt-Public, Tuleyome
5. Tanya Meyer-Vegetation Management Specialist, Yolo RCD
6. Erik Ringelberg-TAC, Riparian Biologist
7. Eric Larsen- TAC, Geomorphologist
8. Frank Goddard-CCC, Landowner
9. John Watson-CCC
10. Kevin Schwartz-Yolo County Resource Specialist
11. Lynnel Pollock-CCC, Executive Director
12. Mark Hirzy-CEMEX, Operations
13. Tami Leathers-Graduate Student, CSUS, Geology, Yolo County Extra Help
14. Tim Horner-TAC Hydrogeology, Sedimentology, Stratigraphy (CSUS)
15. Jeff Clark-CCC, Education Coordinator
16. Fred Vanderwold-CCC, Board Member
17. Molly Ferrell-CCC, Habitat Restoration Manager

Day 3—June 11, 2008—15 people

1. David Pratt-Public, Tuleyome
2. Eric Larsen, TAC, Geomorphologist
3. Erik Ringelberg, TAC, Riparian Biologist
4. Ben Adamo, Granite Construction Company
5. Laurie Brajkovich, Granite Construction Company
6. Molly Ferrell, CCC, Habitat Restoration Manager
7. Kevin Schwartz, Yolo County Parks and Resources, Resource Specialist
8. Jeff Clark, CCC, Education Coordinator
9. Fred Vanderwold, CCC, Board Member
10. Warren Westrup, Yolo County Parks and Resources Director
11. Brian King, Teichert, Assistant Project Manager
12. Barry Baba, Teichert Habitat Restoration Specialist
13. Frank Goddard, CCC, Landowner
14. Lynnel Pollock, CCC, Executive Director
15. Tim Horner-TAC, Hydrogeology, Sedimentology, Stratigraphy