CACHE CREEK
ANNUAL STATUS REPORT
2010

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Chapter 1 - EXECUTIVE SUMMARY

1.1 PURPOSE OF THE REPORT

The Yolo County Board of Supervisors adopted the Cache Creek Resources Management Plan (CCRMP) and Cache Creek Improvement Program (CCIP) in 1996, creating an integrated strategy for enhancing the resources of the lower Cache Creek. The CCRMP is a river management plan that eliminated in-channel commercial mining, restores habitat along the creek banks, and established an ongoing program for ensuring erosion control, bank stabilization, and floodway management. The CCRMP provides the policy framework for restoration of the 14.5 mile Lower Cache Creek. It includes specific implementation standards and the CCIP. The CCIP is the implementation plan for the CCRMP that identifies categories of specific restoration/protection projects along a precisely defined stretch of creek, including: bank stabilization, channel maintenance, revegetation, and habitat restoration.

Information and landowner participation are critical components in the implementation of the CCRMP and CCIP. The monitoring mandated by the CCIP provides data on stream flow, water quality, erosion, and vegetation that guides creek management recommendations of the three-member Technical Advisory Committee (TAC). The TAC has held eight (8) public meetings during 2010 and the Manager of Natural Resources (or TAC members) has attended meetings of the Cache Creek Conservancy, the Cache Creek Stakeholders Group, the Mercury Technical Work Group, the Yolo County Water Resources Association, Floodsafe YOLO, and CalFed (and its successors).

The CCRMP and CCIP are evolving programs that adjust and adapt in response to new creek conditions. Data and public input collected over the past year have been reviewed by the TAC and provide the foundation to make recommendations for the continuing management and planning of Cache Creek. This Annual Report provides the County with a review of the TACs analysis for 2010.

1.2 ACCOMPLISHMENTS

Yolo County has implemented an annual monitoring program since 1997. Since that time, more than thirty in-channel projects have been undertaken, with review by County Staff and the Cache Creek TAC. These projects have been varied, from bank stabilization and habitat enhancement to flood capacity improvement. Each year TAC reviews these project sites, collects and analyzes creek data, and makes new recommendations to the County for consideration under the CCRMP/CCIP.

Thirteen activities were completed in 2010 as part of CCIP or CCRMP guidelines. These activities included monitoring work, public meetings, public outreach, permitting, and program activities. A brief description of each activity is given here:

1. Eight (8) public **Technical Advisory Committee (TAC) meetings** were held during 2010. TAC meetings were attended by TAC members, County Staff, members of various agencies, and the public.

2. County staff began the process of seeking **reauthorization of general permits** required for the efficient implementation of the CCRMP, including a Section 404 Discharge Permit from the US Army Corps of Engineers, a Biological Opinion for Valley Elderberry Longhorn Beetle from the US Fish and Wildlife Service, a Streambed Alteration Agreement (Section 1601/1603) from the California Department of Fish and Game, reauthorization of regulations in the State Surface and Mining Reclamation Act that recognize the CCRMP as the functional equivalent of a Reclamation Plan for CCIP projects, and a Section 401 Water Quality Certification from the Central Valley Regional Water Quality Control Board.

3. The County did a thorough review of the annual **aerial survey contract**, and put the revised contract up for bid. Several important changes were made to the contract language. The boundaries for the photo area were expanded slightly based on input from the TAC biologist

and geomorphologist. A three year contract was signed with Towill, Inc. after a review of all applicants. The 2010 final product includes aerial photographs and orthophotoquads, topographic mapping, Digital Terrain Models (DTMs), and Digital Elevation Models (DEMs).

4. The TAC conducted its **annual Creek Walk** on Friday August 27 and Monday August 30, 2010. The Creek Walk is one of the requirements of the CCIP. Fifteen or more participants walked each day, and covered the entire CCRMP area over a two day period by driving between some stretches. Participants included the TAC, gravel producers, community stakeholders, and County Staff. The TAC produced Creek Walk reports for each discipline, and recommendations from the Creek Walk reports are included in this annual report.

5. **The 100-year flood capacity** was considered by doing a HEC RAS analysis for a two-mile reach of the creek in the CCRMP area using aggradation data from the 2010 digital terrain model (DTM) and the results from HEC RAS modeling of the same creek segment prepared for a prior bank stabilization project .

6. The TAC developed a strategy for creating a **new HEC-RAS model** and held on-going discussions with DWR's FloodSAFE California and Wood Rogers. This coordination with downstream stakeholders will allow HEC-RAS models assembled by Yolo County to interface with downstream modeling in the Yolo County settling basin.

7. **The seven CCRMP reach boundaries** were digitized to match the original Technical Studies boundaries as closely as possible. There are several map versions of the reach boundaries, some drawn by hand or with low precision. GIS files of the boundaries for each reach were made utilizing data from 2010 DTM files.

8. **Channel bed changes (aggradation)** were considered through three separate analyses: recommendations from the Technical Studies Report of 1995, empirical sediment transport estimates, and Towill DTM analyses. All methods of analysis show that the channel is aggrading. Analyses included here suggest that the magnitude of aggradation, which is less than one foot in four years, will not significantly affect the 100-year flood capacity.

9. **Channel morphology** and slope was analyzed **by reach**. This work will continue with the 2011 report. The slope of each reach was determined using GIS analysis and data pulled from the DTM's, and channel characteristics were described for each reach. Understanding the relationship between the channel characteristics, such as slope, and rates of aggradation will allow the TAC to anticipate how changes to the stream channel will alter the rate of aggradation.

10. The county continued the **annual water quality monitoring program,** with sampling events during the first fall flush, peak winter flow, and low flow summer conditions. Hydrology was also examined by plotting the recurrence interval for flood events, and comparing results from 2010 to previous years.

11. County staff and TAC members **participated in regional partnerships** involving Cache Creek, including CalFed's successors, the Bay Delta Conservation Plan, Flood Safe Yolo and the Yolo Water Resources Association, the Cache Creek Stakeholders Group, and the Mercury Technical Work Group of the Regional Water Quality Control Board's Total Maximum Daily Load (TMDL). These groups meet periodically to coordinate regulatory and ecological issues in the San Francisco Bay/Delta region. Yolo County is an important stakeholder in these groups because of water quality and sediment issues in the watershed.

12. The TAC reviewed a major **bank stabilization** project (CEMEX). Emergency levee repair work was completed in fall 2010 at three sites between RM 21.0 and RM 19.3. The bank was laid back to a 3:1 slope at two sites, and a 1.7:1 slope at a third site. Concrete keyways were constructed at the base of the new slopes, sediment was added and compacted, and native

grasses were planted on the higher benches. Since that time the low flow channel has shifted to the north bank.

13. The County expanded **partnerships** with the Yolo County Sheriff's Department and Cache Creek Conservancy to reduce problems associated with illegal OHV use in Cache Creek.

1.3 SUMMARY OF SIGNIFICANT FINDINGS

Based on monitoring and observations during 2010, the TAC has come to the following conclusions:

1. **The 100-year flood capacity** was considered using HEC RAS analysis for a 2-mile sample reach of the CCRMP area. Aggradation data from a TOWILL digital terrain model (DTM) and the results from the HEC RAS study suggest that the magnitude of aggradation in the creek channel, which is less than one foot in four years, does not appear to have significantly affected the 100-year flood capacity.

2. **Channel bed changes (aggradation)** were considered through three separate analyses:
The Technical Studies (1995) estimated annual sediment yield at Capay. The Technical Studies estimated that about 210,000 tons per year (140,000 cu yd per year) of sand and gravel will accumulate, if all of the material were trapped in the CCRMP reach. The Technical Studies estimated that sand and gravel replenishment would take about 505 years at this rate.
Empirical sediment transport estimates were made by the TAC geomorphologist, based on observed flows for 2006-2010. This analysis estimated that 2,955,975 tons of material were transported in 4 years for an average of 738,994 tons/yr. The sand and gravel portion is assumed to be 23%. Therefore the average over the time period is about 170,000 tons (113,312 cu yards) per year.
TOWILL DTM analyses show that 1,270,826 cu yards collected in 2006-2010, for an annual average of 317,707 cu yd/yr.

	Cu yards /yr
Towill estimated aggradation	317,707
TAC modeled sand and gravel transport	113,312
Technical studies estimate	140,000

One preliminary interpretation of these data is that the channel bed of the CCRMP area is aggrading faster than estimated in the Technical Studies (1995). This conclusion must consider the strong influence that the 2006 year had on the results (see recommendations).

3. **Channel morphology** is **related to the rate of aggradation**. Understanding the relationship between the channel characteristics, such as slope, and rates of aggradation will allow us to anticipate how changes to the stream channel will alter the rate of aggradation. There appears to be fairly good correlation between the longitudinal slope and the rate of aggradation for the middle reaches of the creek. The lower the slope, the greater the aggradation. For the Capay and Rio Jesus Maria reaches, this is not the case.

4. **Surface water levels** of ammonia, orthophosphate, TPH as diesel, boron, fecal coliform and total coliform bacteria are elevated in many samples. Color and pH regularly exceed published guidelines, and high summer temperatures are a continuing problem.

5. A preliminary analysis shows that the extent and density of **native riparian vegetation** do not appear to have changed significantly since 1998.

6, There has been significant reduction in the population, density, and extent of **tamarisk and arundo** since 1998 .

1.4 NOTABLE VARIATIONS FROM PREVIOUS YEARS

The annual Creek Walk, TAC analysis, and TAC meetings did not identify any notable variations from previous years. Creek flows in 2010 were below the 2 year recurrence interval, so it was a relatively quiet water year on the Creek that did not produce any significant alterations to channel morphology, water quality, or riparian vegetation. The TAC will continue to monitor water quality issues near Gordon Slough. County Staff and the TAC have also reviewed the original monitoring and reporting requirements, and there is a new emphasis on streamlining the program and getting back to the fundamental activities required by the CCRMP and CCIP.

1.5 RECOMMENDATIONS

The CCRMP provides clear guidance about the methods used to assess physical and biological conditions in Cache Creek. Within this framework, the TAC has made recommendations for management of the creek. It should be noted that these recommendations do not represent permanent solutions to specific problems associated with Cache Creek. These recommendations may be modified in the future, as trends are refined through monitoring data and as the creek responds to implementation of the plan and natural variations in rain fall.

1.5.1 Review of Prior Recommendations

The status of recommendations from prior annual reports will be reviewed in conjunction with the 2011 annual report, which will be completed in early 2012.

1.5.2 New Recommendations

Recommendations are listed by discipline, and are not prioritized. These recommendations will form the basis for TAC activities during 2011.

Geomorphology Recommendations:

1. **HEC RAS modeling** of the entire CCRMP reach should be completed and analyzed in the 2011 annual report. This will allow an analysis of the **100-year potential** for the entire CCRMP reach area.

2. Adopt a protocol for **bed material** sampling and a description of how the data will be used.

3. Estimate the **annual rate of channel bed aggradation** over time utilizing additional DTM data. DTM data from prior to 2006 should be added to the study. In addition, a frequency analysis of the flows should be done to consider the relative influence of the 2006 data on the results in this annual report.

4. Continue to study the relationship between rates of aggradation and channel characteristics in various reaches of the creek. Incorporate additional DTM data collected prior to 2006 to the analysis. A frequency analysis of flows should be done to determine the relative influence of the exceptionally high 2006 flows on the results.

5. Develop a protocol and sampling schedule to measure **bed armoring** based on analysis of existing bed armoring data.

6. Update **reach descriptions** using more accurate georeferenced length measurements for each of the reaches.

7. Report on the flood potential directly upstream from **Huff's Corner** (Rio Jesus Maria reach), including location and magnitude of flow potential at this site.

Hydrology and Water Quality Recommendations:

8. Continue **to work with County disaster relief** personnel to maximize the technical expertise of the TAC during creek flood events.

9. Upgrade turbidity monitoring methods to include **continuous turbidity monitoring**. This newer technology will allow better tracking of sediment and contaminant loads.

10. Address high summer **water temperatures** by restoring native shrubs and trees in the riparian zone for shade. Surface water temperature control is an important part of channel restoration.

11. Monitor levels of orthophosphates, diesel fuel, fecal coliform, and total coliform in creek water.

12. Resume **methylmercury** monitoring in the CCRMP study area. Add more **wells to th**e **groundwater monitoring program** and expand analysis of the groundwater data for wells that are less than one mile from Cache Creek.

Biology Recommendations:

13. Conduct surveys of the Andregg vegetation transects in order to develop baseline data to support CCRMP-wide **vegetation monitoring**.

14. **Conduct a study of vegetation classes** in the riparian zone utilizing the color aerial photos.

15. Assess and possibly **update the CCRMP boundaries to compensate for channel migration**.

16. Review and **modify the Andregg vegetation transects for changes caused by channel migration**.

General Recommendations:

17. Continue to monitor OHV impacts and work with the and Yolo County Sheriff's Department to reduce the illegal OHV activity in Cache Creek and work with the Cache Creek Conservancy to respond to erosion and vegetation damage caused by OHV activity.

1.5.3 Channel Improvement Priorities:

The Creek Walk and TAC site visits during 2010 identified the need for several channel improvement projects:

1. Examine the effects of removing spur dikes downstream from the Scheuring property, RM 21.6. Consider the Test 3 line and stream entrance to the I-505 bridge.

2. Coordinate with YCFCWCD on reconstruction of the Moore siphon, RM 18.1.

3. Remove vegetation under the Highway 94B bridge (Stevens bridge), RM 15.9.

4. Consider bank repair at RM 20.8, where the toe of the levee is eroded.

5. Repair minor erosion at the emergency bank stabilization sites, RM 20.8 - 19.8

Chapter 2 - HYDROLOGY AND WATER QUALITY

Cache Creek is a flashy hydraulic system, and this provides challenges for flood protection, bank stability, and riparian restoration. River flows are low during the hot summer months, and it can be a challenge to maintain adequate water supply for habitat and vegetation. Winter and Spring flows can be very high, and this has eroded banks and damaged infrastructure repeatedly. In addition to the challenges of managing flow extremes, there are water quality issues on Cache Creek. The CCRMP requires annual water quality monitoring to identify problems, and this section summarizes the flow and water quality issues in the study area.

In this annual report, "water years" are used to organize the data. A water year starts on October 1 when stream flow is low, and ends on September 30 of the next year. This is a convenient way for hydrologists to look at water trends by season. The terms "stream", "river", and "creek" will also be used interchangeably to refer to Cache Creek.

2.1 River Flow and Stream Hydrographs

The TAC is required by the CCIP to analyze stage and flow on Cache Creek on an annual basis. Measurements were downloaded from California Data Exchange web site (http://cdec.water.ca.gov/), and plotted several different ways to meet this requirement. Stream flow was compared for different years using the recurrence interval curve for Cache Creek (Figure 2.1.a). Cache Creek experienced a low or moderate water year in 2009, and a wetter year in 2010. A recurrence interval for the Yolo gauge plotted by Leathers (2010) shows that flows in the 1000 - 20,000 cfs range are relatively common on Cache Creek (Figure 2.1.a), and the 2009 and 2010 peak flows fall within this range. Stream stage was not analyzed directly, but the gauging stations convert stream stage to flow. This language from the CCIP should probably be updated, because it would be very unusual to measure stream stage directly in our modern digital era. Stream flow for cache Creek was plotted vs. time to produce hydrographs for the upstream and downstream gauging stations (Figures 2.1.b, 2.1.c).

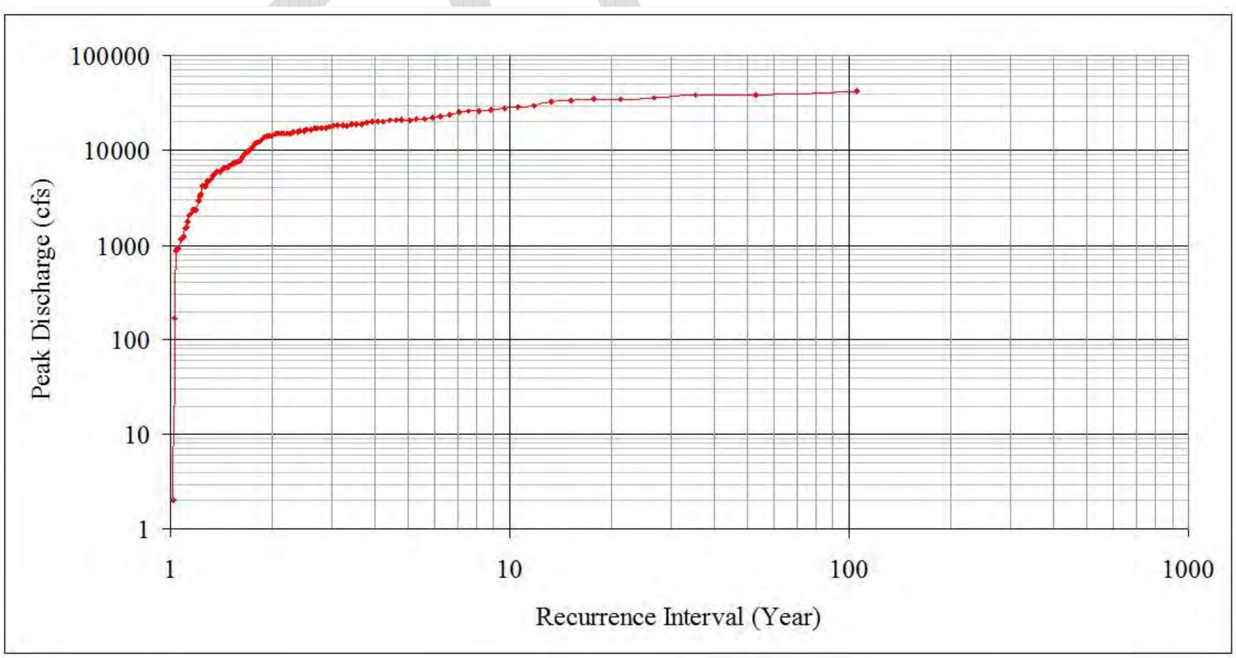

Figure 2.1.a: Recurrence interval for flows at the Yolo gauge, from Leathers (2010).

In 2009, the annual peak flow at the Yolo gauge was approximately 3000 cfs (Figure 2.1.c). This equates to slightly more than a 1 year event. This means that an average water year will have flows at least as high as the events experienced on Cache Creek in 2009. The peak flow in 2010 was approximately 10,000 cfs at the Yolo gauge. Using the same recurrence interval curve, the 2010 water year was slightly less than a 2 year event. This means that, on average, Cache Creek will have similar flows one out of every two years.

The CCIP requires flow monitoring at the upstream and downstream ends of the study area. The upstream flow monitoring requirement is met at the Rumsey gauge, located approximately 18 miles upstream from Capay Dam. This site has had data quality problems, and low flow was not accurate until late 2010, when the site was reconfigured. In general, peak flows are lower at the upstream (Rumsey) gauge. Groundwater input and runoff contribute to peak flow at downstream sites.

The downstream monitoring requirement is met at the Yolo gauge, located at the I-5 bridge. This is a USGS gauging station with a long term record and continuous maintenance. Data from the Yolo gauge are high quality, and are available on-line on the California Data Exchange Center (http://cdec.water.ca.gov/) and USGS web sites. Gaps in the hydrograph (Figure 2.1.c) are a result of low flow summer conditions and water exports from Capay Dam. This diversion causes Cache Creek to dry up before it reaches the Yolo gauge, and the stream disconnects for several months each year. Cache Creek was an ephemeral stream before humans modified the system, so this summer dewatering may not be entirely artificial.

The upstream (Rumsey) and downstream (Yolo) gauges respond differently to low flow events (Figures 2.1.b, 2.1.c). Small upstream events are recorded at the Rumsey gauge, but these events are sometimes damped or missing from the downstream Yolo gauge. This is caused in part by agricultural diversions from Capay Dam, and major diversion point for irrigation water that is located between the two gauges. The downstream Yolo gauge is often dry during the hot summer months, when agricultural diversions are at their highest level and creek flows are at their lowest level.

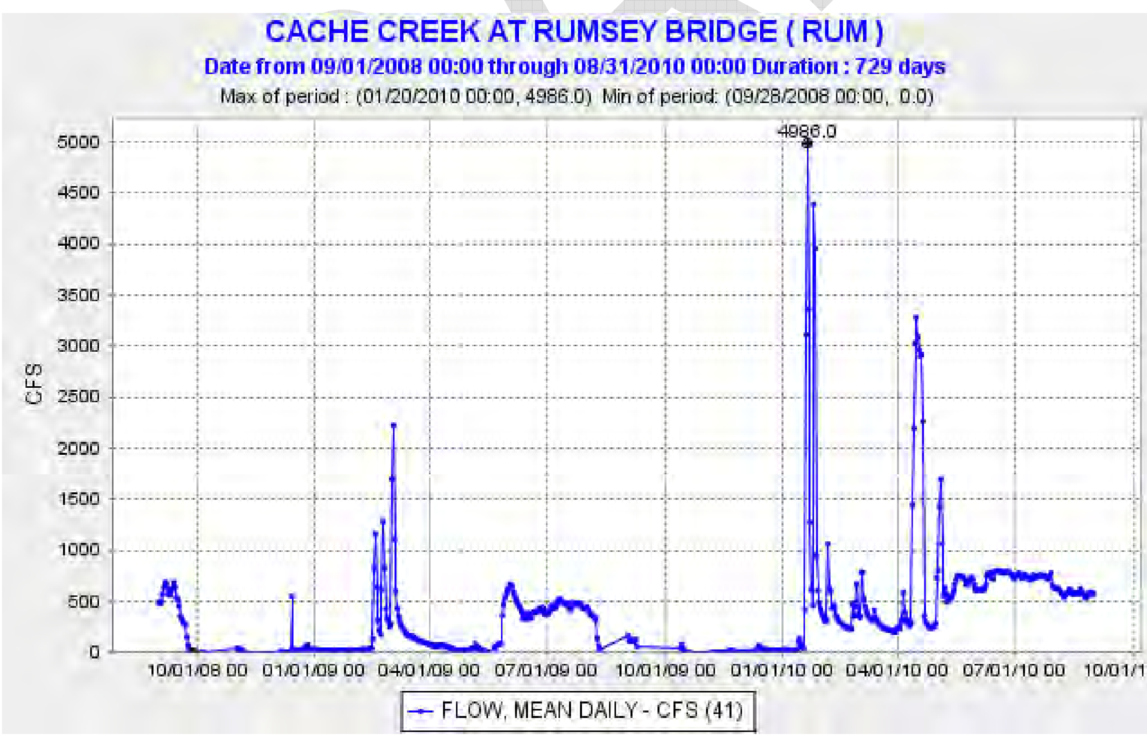

Figure 2.1.b: Hydrograph showing two years of river flow at the Rumsey gauge, located approximately 18 miles upstream from the CCRMP study area. From the California Data Exchange web site, June 2011.

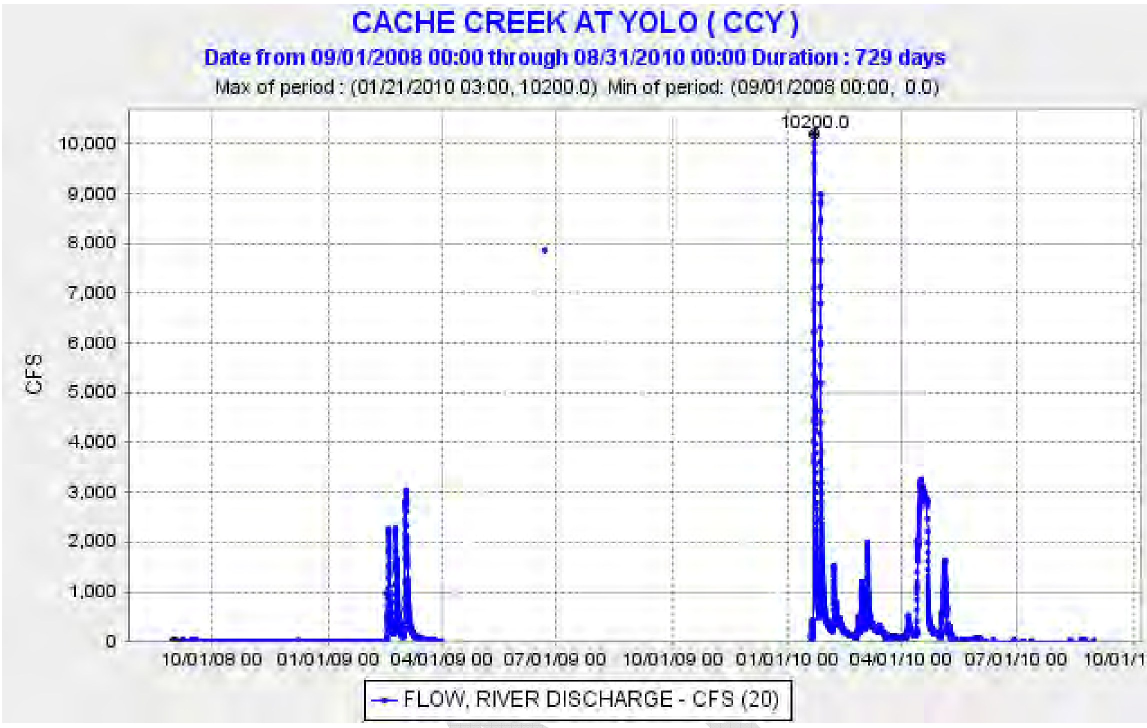

Figure 2.1.c: Hydrograph showing two years of river flow at the Yolo gauge (I-5 Bridge), located at the downstream end of the CCRMP study area. From the California Data Exchange web site, June 2011.

2.2 FLOOD MONITORING

The maximum flow for the past two years was slightly more than 10,000 cfs, approximately a two year event on a recent rating curve (Figure 2.1.a), and did not trigger any flood watch activities. Yolo County has worked to open lines of communication with the disaster relief coordinator, so that the expertise of the TAC can be available during a flood event. Flood monitoring Recommendation: Continue to work with County disaster relief personnel, and make sure that the TAC is properly trained before the flood season starts. This will include taking an on-line training course.

2.3 SURFACE WATER QUALITY

Water samples were collected and analyzed as part of the CCRMP mandate to evaluate water quality annually. Samples were collected by County Staff, and analyzed by a certified environmental lab for more than 50 compounds or elements. The following water quality summary covers the water years 2009 and 2010, and builds on the water quality analysis performed by the TAC hydrologist in 2008. A water year is different from a calendar year; a water year starts October 1 and ends on September 30, so it begins with the fall and winter rains, and ends during the long, hot, dry summer months when river flows are low. Water quality data from the 2009 and 2010 water years were added to graphs produced in 2008 to give a better indication of long term trends and water quality in the CCRMP area.

Three water quality sample sets were collected during each water year. The first sample was a "first flush" sample, collected during the first heavy rain of the water year. This is a time when pollutants are swept into the stream after accumulating on the land surface for months. It is often a worst-case scenario, and shows water quality conditions when contaminants are at their highest levels. The first flush occurs on Cache Creek when sustained rainfall reconnects the Creek with continuous flows from Capay Dam to the I-5 bridge. This usually occurs in November or December, but depends on seasonal rains. In 2009 the first flush sample was not collected until February. The second water quality sample is called the "peak flow" sample, and characterizes water quality during the largest storm of the year. This is usually in January or February, although it can be difficult to determine which flow will be the largest of the year as the events are in progress. In 2009 the peak flow sample was not collected until April. It was a dry winter, and the sampling crew waited for a significant storm to arrive. The last water quality samples were collected during "low flow" conditions at the end of the water year. This usually occurs in September or October. Dates for each sampling event for the 2009 and 2010 water years are summarized in Table 2.1.a:

	First flush sample	Peak flow sample	Low flow sample
2009 water year	February 16, 2009	April 8, 2009	August 26, 2009
2010 water year	January 19, 2010	February 24, 2010	October 13, 2010

Table 2.1.a: Dates for water quality sampling events.

Water quality data for water years 2009 and 2010 are included in Appendix E. For the sake of brevity in this report, quality assurance/quality control (QA/QC) data are not included with the water quality results. However, the TAC hydrologist examined these data at a superficial level, and did not observe any significant errors or inconsistencies. Statistical methods and controls used by the chemistry lab were not verified; however only certified labs with extensive experience were used. All indications demonstrate the lab analyses and results to be valid. Blank and replicate samples were run to help isolate potential problems, and values reported by the labs were determined to be appropriate.

Many of the patterns described in 2008 are still present. None of the water samples from the 2009 and 2010 water years had pesticides or herbicides above the detection limits. These samples are listed as non-detect (ND) on data sheets, and results are not plotted in this report. The analysis protocol currently involves analysis for whole suites of chemical pollutants that have not been detected since sampling began in 1999. When compounds are above detection limits but below maximum contaminant levels, no recommendation is made for the compound. Other compounds have a mix of non-detect readings and elevated contaminant levels. These compounds are plotted and discussed in the following section to show trends through time at different locations on the creek, and a recommendation is given for each compound. Non-detect values are plotted as zero values on these graphs.

Dissolved Oxygen (D.O.)

The dissolved oxygen curve has seasonal spikes, with higher D.O. in the winter and lower D.O. in the summer (Figure 2.1.d). Dissolved oxygen varies seasonally because oxygen solubility is related to the temperature of the water. Dissolved oxygen levels range from 9-13 mg/l in the winter months, and are near saturated values. Dissolved oxygen levels drop in the summer months because warmer water holds less dissolved oxygen. Algal blooms may also contribute to low D.O. content in the summer months as decomposition of dead algae consume some of the available dissolved oxygen. All main channel samples have relatively high D.O. values given these limits.

Gordon Slough has lower D.O. values, and this is consistent with the muddy, slower moving water that passes through the slough. Warm, slow-moving water maximizes the production of algae, and decomposition of the algae consumes oxygen. This becomes a concern because low oxygen conditions are also a factor in the production of methylmercury.

Dissolved Oxygen recommendation: No action is recommended for the low dissolved oxygen values, except to continue monitoring work near Gordon Slough.

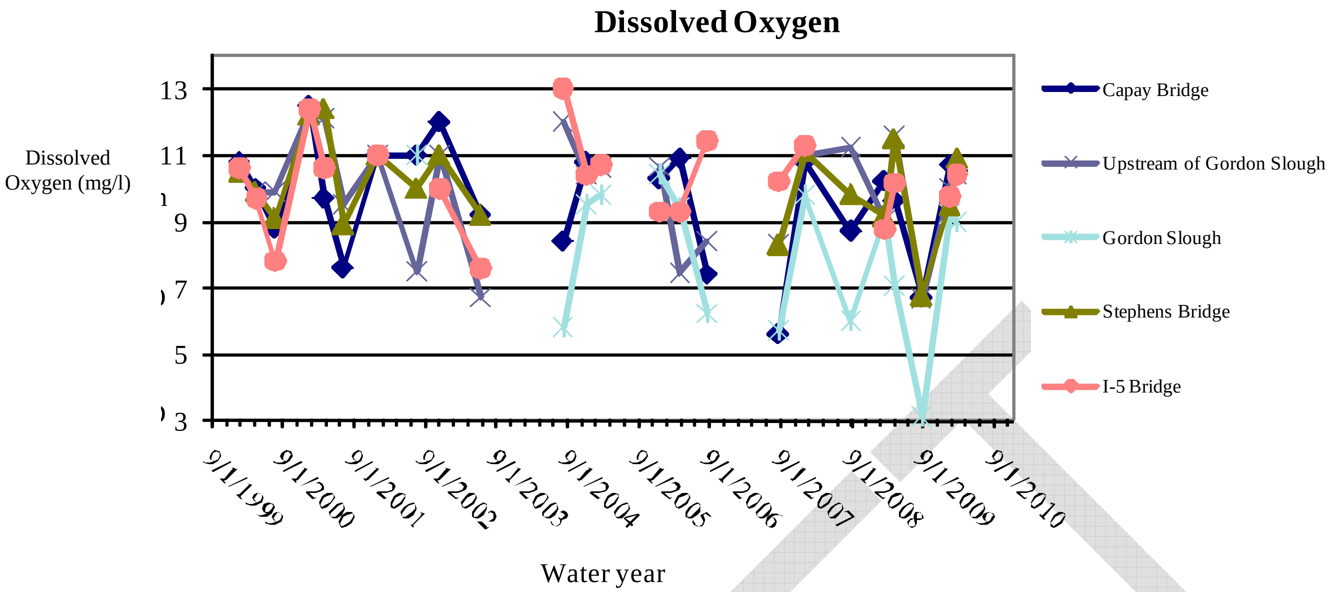

Figure 2.1.d: Dissolved oxygen levels at monitoring sites in the CCRMP area.

Acidity (**pH)**

The pH values from surface water in Cache Creek are slightly basic (Figure 2.1.e). This is typical of many rivers in California, and is a minor water quality issue. The underlying geology and dissolved constituents in surface water contribute to pH, and rivers can be either slightly basic or slightly acidic. A single acidic sample from the I-5 Bridge site on 8/17/05 looks like an anomaly, and may be a sampling or equipment error. Gordon Slough samples tend to have lower pH, and the pH has dropped slightly at Gordon Slough in the last two years. This trend toward more neutral conditions (lower pH) is probably a result of the decomposition of organic matter in the muddy, organic-rich runoff that flows through Gordon Slough.

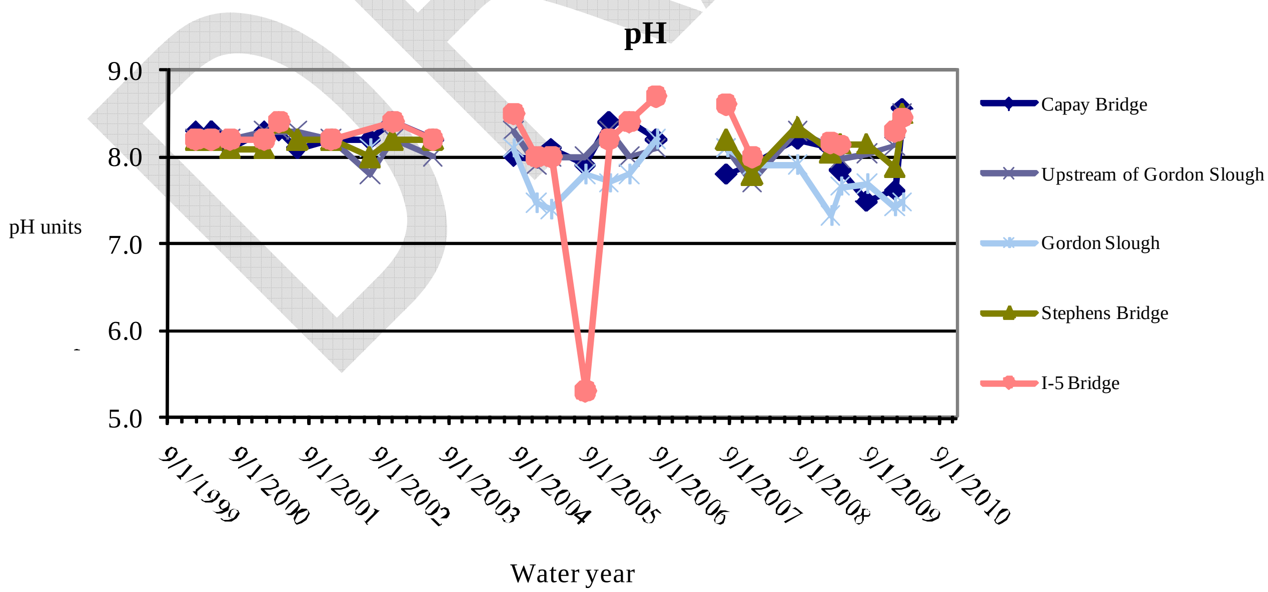

Figure 2.1.e: pH values at monitoring sites in the CCRMP area.

Temperature

Surface water samples show seasonal temperature variations in Cache Creek (Figure 2.1.f). Summer water temperatures are usually above 70° F, and often above 80° F. All summer temperature samples exceed the Regional Water Quality Control Board (RWQCB) surface water objective of 68° F. Winter temperatures range from 40° to 50°, and are within the recommended range for resident native and anadromous fish. High summer temperatures on Cache Creek are related to low flow. Cache Creek becomes disconnected during the summer months. Flow is limited or absent in the upper 10 miles of creek within the CCRMP study area, and water collects in shallow pools. This leads to high temperatures that promote bacteria and algal growth, and non-native fish populations.

Elevated summer water temperature is one of the largest water quality issues on Cache Creek, and is partially responsible for the abundance of non-native fish and limited aquatic diversity.

Temperature recommendation: High summer water temperatures could be partly addressed by actively restoring native shrubs and trees on the banks for shade, and promoting the deposition of large woody debris in the channel. Large woody debris has several positive effects. Scour holes form near logs and root wads, and cooler groundwater may exchange with stream water in deep scour holes and pools. None of these steps will completely address the extreme temperature problem or lack of flow, but mature native vegetation and in-stream woody debris would promote lower temperatures on Cache Creek. Cache Creek is a naturally ephemeral creek, which means that the creek goes dry in some reaches during the summer. The natural summer channel would have had a series of disconnected scour holes and pools for aquatic habitat, which could be mimiced on restoration projects. Water temperature control is an important part of channel restoration.

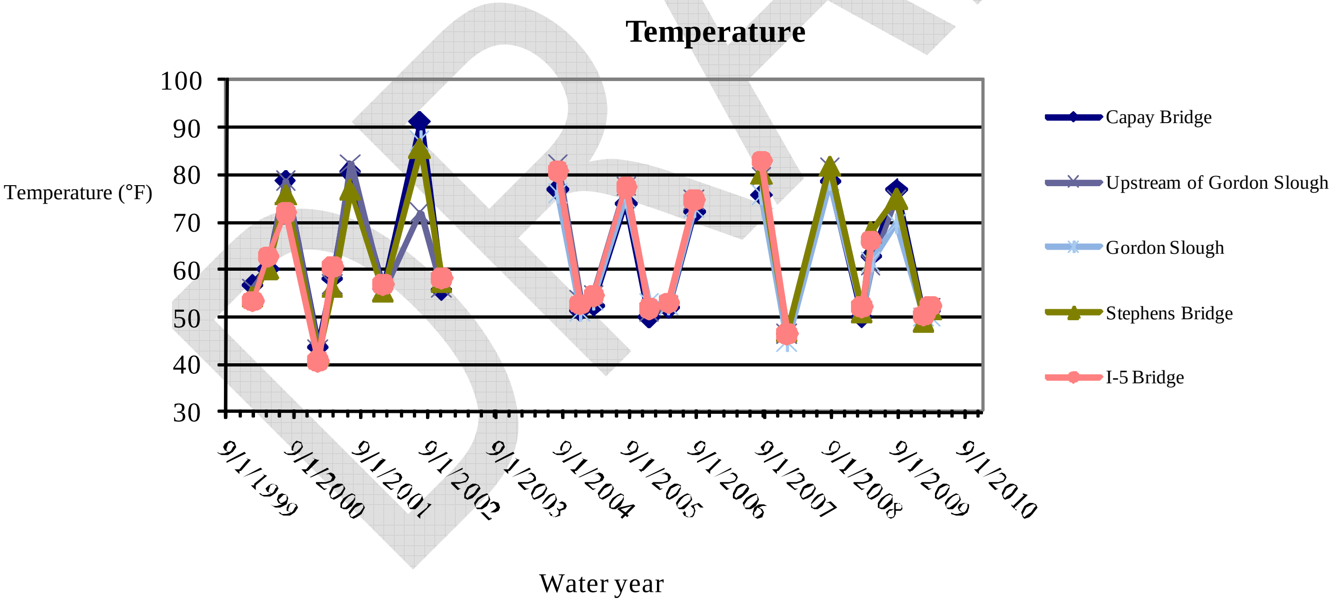

Figure 2.1.f: Temperature levels at monitoring sites in the CCRMP area.

Color

Color is regulated in drinking water, but guidelines for habitat and human contact are not specific unless a "nuisance or adverse effect" exists. The secondary drinking water standard of 15 color units is frequently exceeded in surface water samples from Cache Creek. High color readings are often related to high flows and muddy storm water in the first flush and peak flow sampling events. Gordon Slough has only been sampled since 2005, but samples collected from Gordon Slough have higher color values than any other sampling site on the CCRMP study area for any given sampling event (Figure 2.1.g). This is caused by the high suspended load in sediment that flows through Gordon Slough. The spike at the Capay Bridge site in August 2005 is probably a localized issue, and may be from algal growth in a stagnant pool.

Color recommendation: No action, because Cache Creek is not used as a drinking water source.

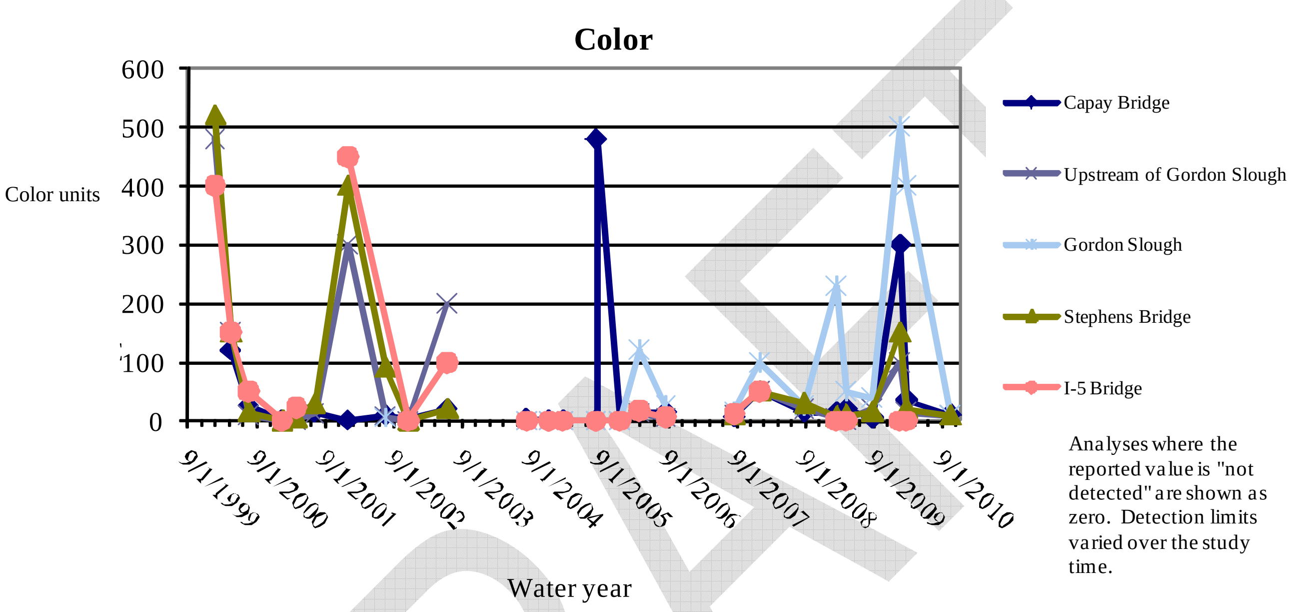

Figure 2.1.g: Color measurements at monitoring sites in the CCRMP area.

Total Dissolved Solids (TDS)

Total dissolved solids are related to flow, and often increase during low flow conditions when there is more time for sediment/water interaction. High flows tend to dilute the system and reduce TDS concentrations, although this relationship is not always true. Residence time, solubility of the sediment, and composition of the bedrock are complicating factors. Guidelines for TDS have a complex sliding scale based on salinity, and the RWQCB states that TDS should not "… cause nuisance or adversely affect beneficial uses." Cache Creek usually has TDS values below the State Department of Health Services (DHS) recommended level of 500 mg/l, but this is not an enforceable guideline. Incursions as high as 1500 mg/l may be allowed depending on flow. Values of TDS observed in the CCRMP area during the past two years approach or exceed the 500 mg/l level (Figure 2.1.h), and may be undesirable from a habitat standpoint.

Total Dissolved Solids recommendation: TDS could be reduced by limiting sediment load to the creek (limiting flow from tributaries or effluent pipes) or increasing stream flow. However, at this time this is not a high priority item compared to other identified issues in this report. No action is recommended this year; this will be reexamined next year.

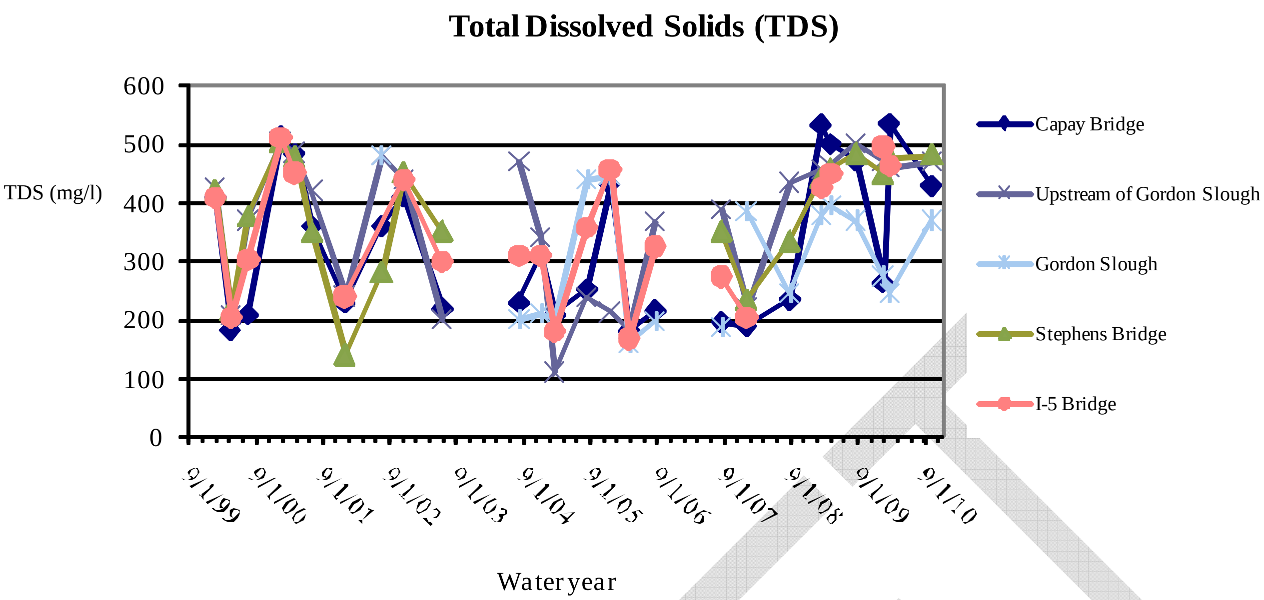

Figure 2.1.h: TDS (Total dissolved solids) values at monitoring sites in the CCRMP area.

Total Suspended Solids (TSS)

Total suspended solids have a strong correlation with flow, and high flows result in high concentrations of suspended sediment. This relationship is especially important as new mercury loads are imposed on watersheds because mercury is carried by fine suspended sediment. Most watersheds are monitoring suspended sediment as a proxy indicator of mercury load. New optical instruments can be calibrated to measure water turbidity (clarity), and this in turn is related back to flow. Partnerships with YCFCWCD and the USGS will allow Yolo County to develop these relationships on Cache Creek. TSS measurements made during the surface water sampling program provide an indication of patterns in the CCRMP area (Figure 2.1.i); although continuous turbidity monitoring would be much more effective (see below). Regulatory agencies do not list specific limits or standards for TSS, other than the RWQCB guideline not to "… cause nuisance or adversely affect beneficial uses".

Total suspended solids recommendation: No new actions are recommended because continuous turbidity monitoring will soon take the place of TSS monitoring.

Turbidity

Turbidity is a measure of the clarity of the water and is an optical measurement. Increases in turbidity are strongly correlated with increases in stream flow on Cache Creek. Turbidity is closely related to total suspended sediment (TSS) described in the previous section, but does not rely on actual physical measurement of the water. Turbidity measurements are indirect and can be taken continuously. This makes turbidity a valuable proxy indicator of TSS, after a relationship has been established between turbidity and TSS at a site.

Recommended maxima for turbidity range from 5 NTU (Nephelometric Turbidty Units) for drinking water to a sliding scale developed by the RWQCB that allows for increases of 10- 20% above background levels. Turbidity levels on Cache Creek often exceed 5 NTU or 20% above background levels (Figure 2.1.j). Turbidity maxima are often more than two orders of magnitude above recommended levels. High turbidity is a serious water quality problem on Cache Creek, but the current sampling method does not show all of the variability.

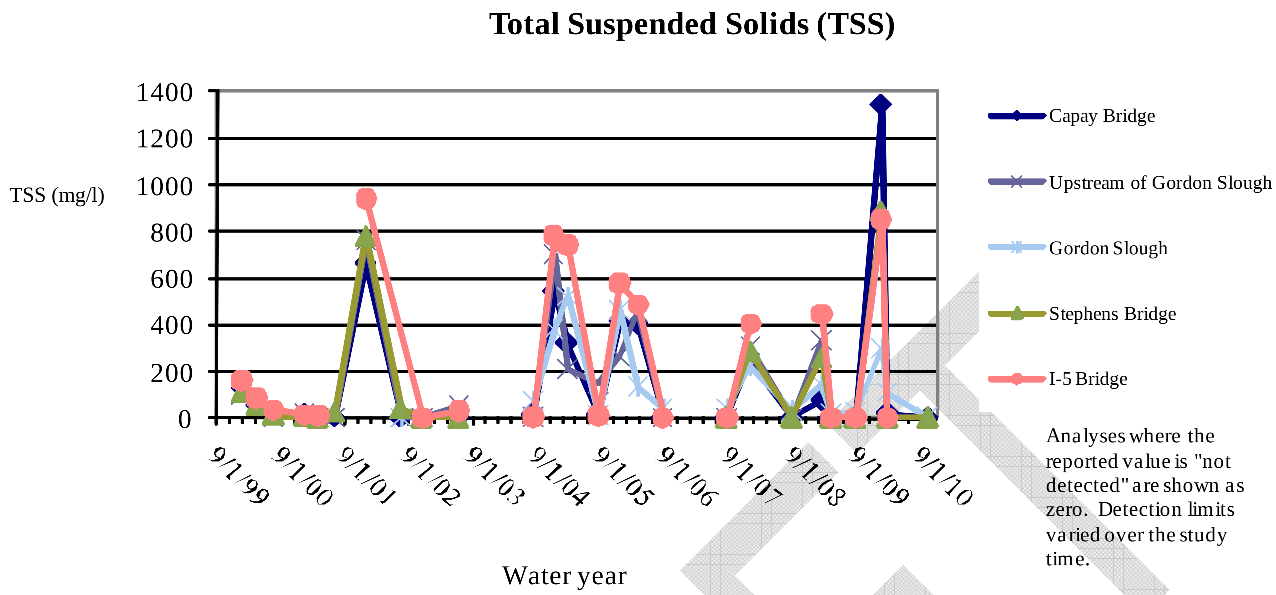

Figure 2.1.i: TSS (Total suspended solids) values at monitoring sites in the CCRMP area.

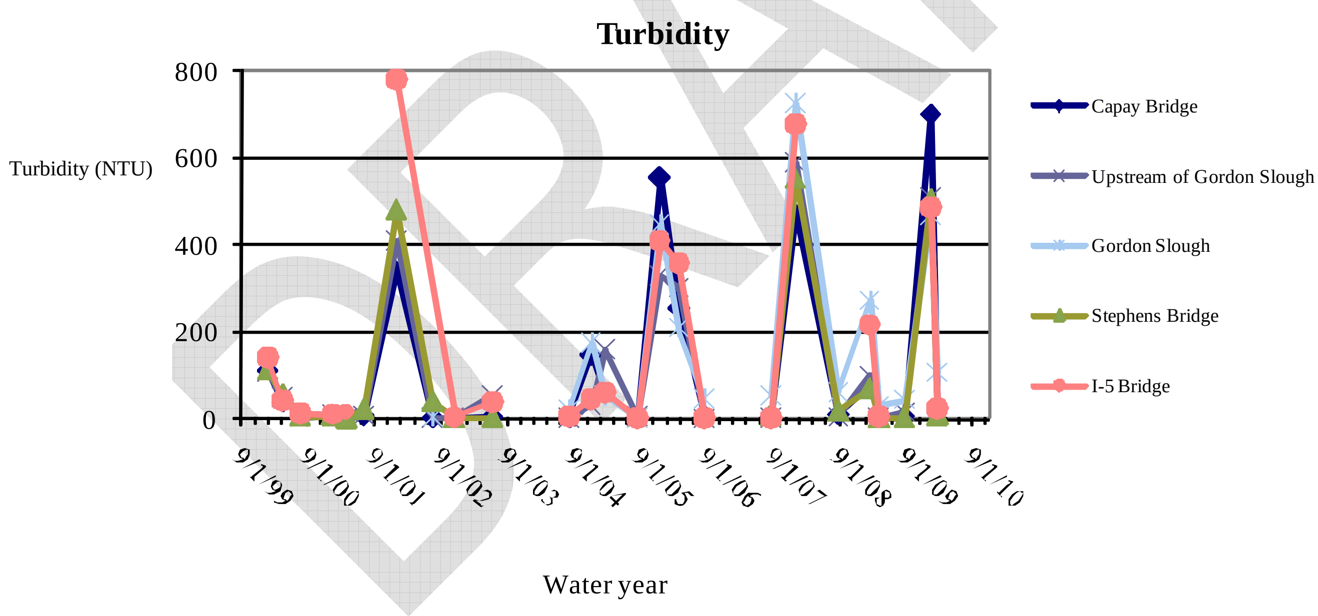

Figure 2.1.j: Turbidity measurements at monitoring sites in the CCRMP area.

Turbidity monitoring recommendation: Turbidity monitoring methods should be upgraded to include continuous turbidity monitoring. This newer technology will allow better tracking of sediment and contaminant loads. Yolo County should continue to work with the USGS, DWR and YCFCWCD to obtain a continuous turbidity record at the upstream and downstream ends of the CCRMP area.

Ammonia nitrogen

Ammonia is highly variable in the CCRMP area and many peaks in ammonia correlate with the first flush that occurs in winter (Figure 2.1.k). Early ammonia measurements (1999 - 2004) often had maximum values at the downstream I-5 sample site. Based on detailed sampling that began at Gordon Slough in 2004, there is likely an ammonia source near or upstream from the Gordon Slough drainage. Ammonia is often related to agricultural sources, with ammonia delivered to farm fields as a bioavailable source of nitrogen. Ammonia nitrogen is not regulated by the RWQCB, although the US EPA guidelines for aquatic life have a sliding scale for ammonia maxima that ranges from 0.3 - 0.5 mg/l. Ammonia levels discharged from Gordon Slough have at times exceeded this recommended maximum. High levels of available nitrogen in the form of ammonia also promote algal growth in Cache Creek during the hot summer months.

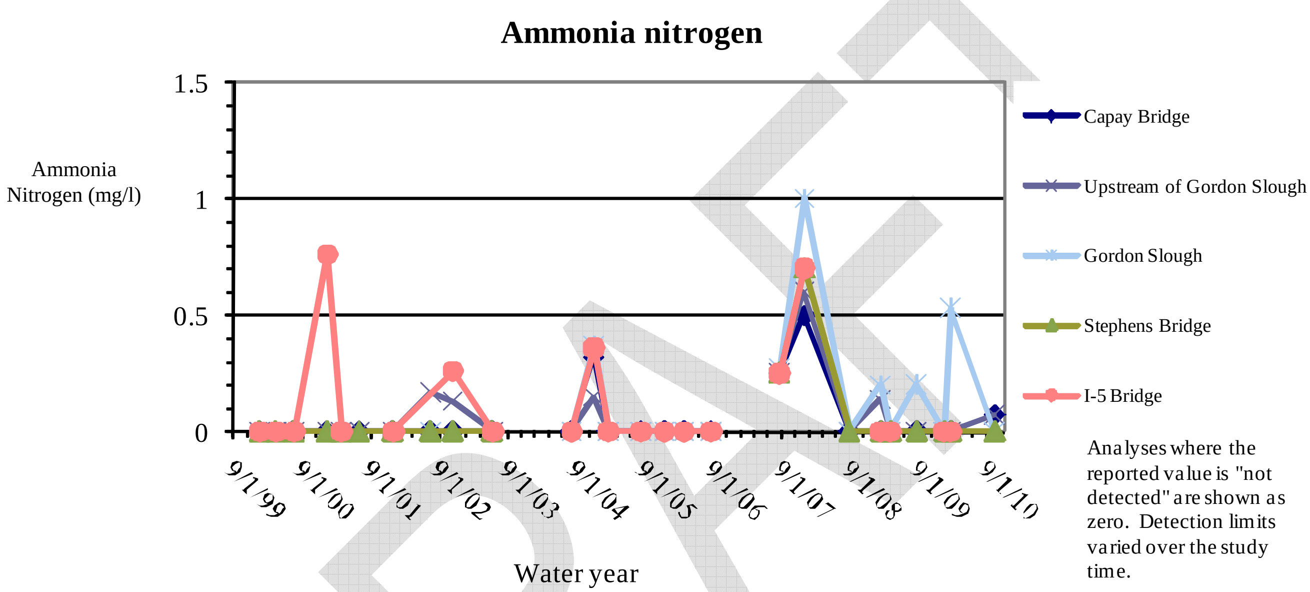

Figure 2.1.k: Ammonia concentrations at monitoring sites in the CCRMP area.

Ammonia Nitrogen recommendation: Resolution of this issue likely falls outside of the CCRMP boundaries and the TACs purview. Continue to monitor ammonia levels and determine an appropriate course of action.

Nitrate nitrogen

Nitrate nitrogen is a component of the nitrogen cycle and forms easily from ammonia, sewage, animal waste or naturally occurring nitrogen sources. Nitrate forms under oxidizing conditions in near-surface environments, and is regulated by the EPA and RWQCB. These agencies have limits of 10 mg/l and 45 mg/l respectively, although the reporting method is slightly different. The adverse health effects of nitrate on humans are well documented. All measured nitrate levels in the CCRMP area are below 10 mg/l (Figure 2.1.l), although nitrate levels are elevated. Nitrate is a nutrient source for algae and the steady background levels of 1-4 mg/l nitrate probably contribute to algal blooms during the warm, low flow summer months.

Nitrate nitrogen recommendation: Continue to monitor nitrate nitrogen, no additional action.

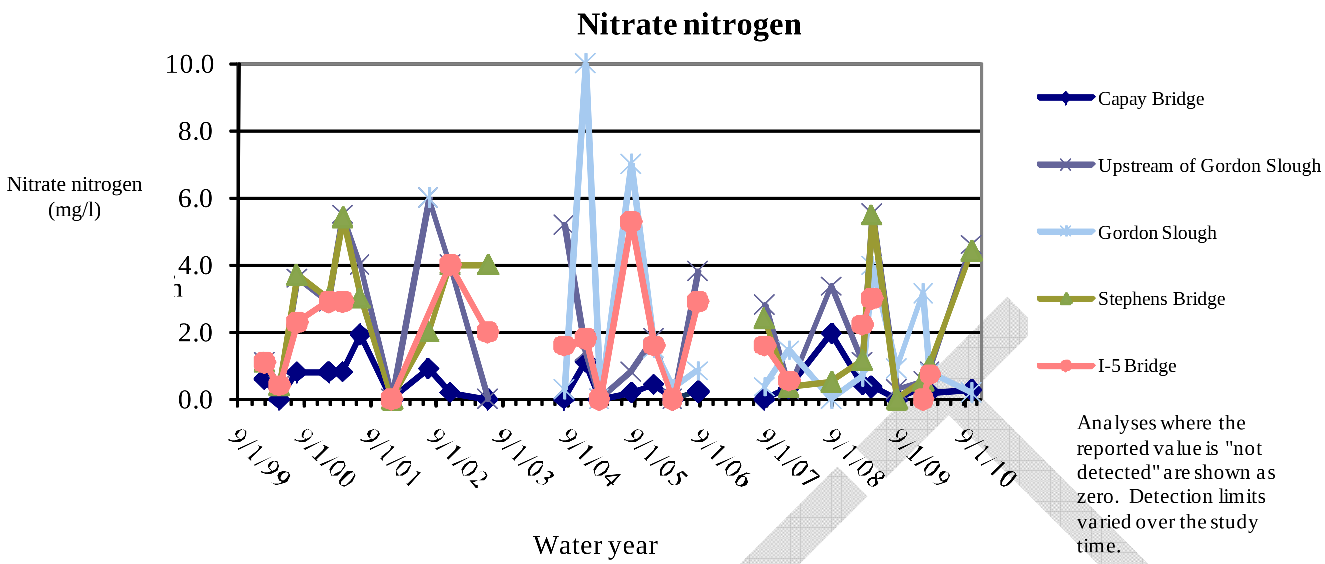

Figure 2.1.l: Nitrate nitrogen concentrations at monitoring sites in the CCRMP area.

Nitrite nitrogen

Nitrite is a less common component of the nitrogen cycle that forms under reducing conditions. Nitrite levels are regulated to less than 1 mg/l by the EPA and RWQCB. Nitrite has not been a problem on Cache Creek, with the exception of the first flush event in 2005, when excess nitrite was detected at the downstream end of the CCRMP study area (Figure 2.1.m).

Nitrite nitrogen recommendation: Continue to monitor nitrite nitrogen; no additional action.

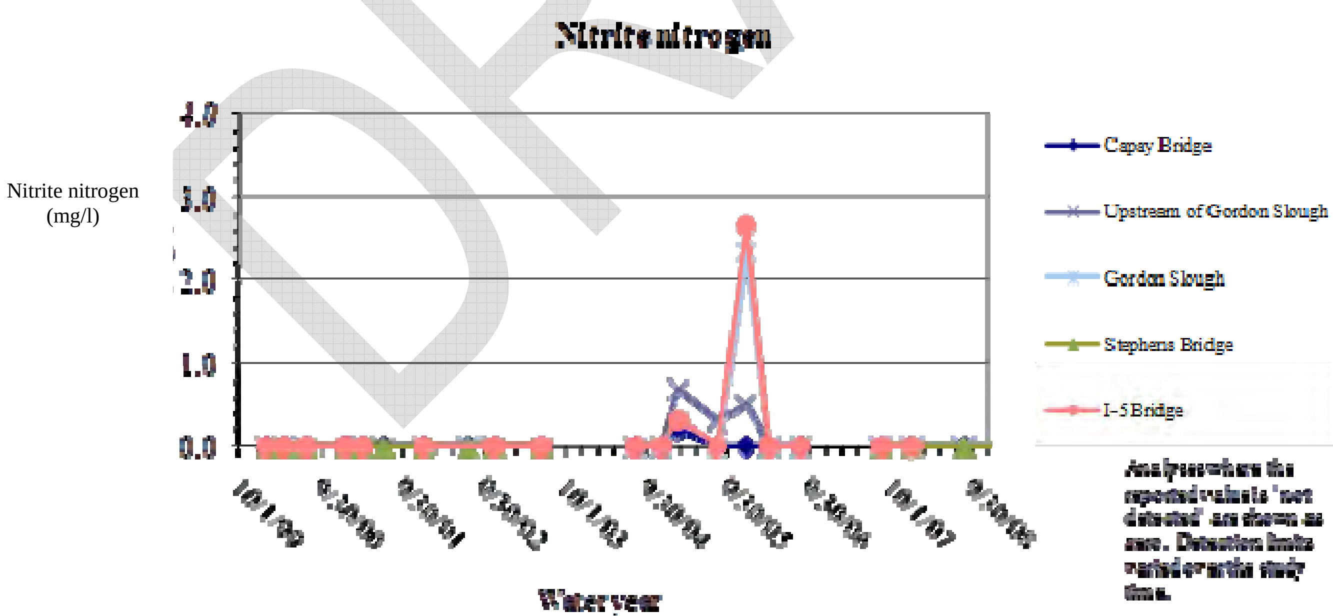

Figure 2.1.m: Nitrite Nitrogen concentrations at monitoring sites in the CCRMP area.

Total Kjeldahl nitrogen (TKN)

Total Kjeldahl nitrogen (TKN) refers to a lab technique that measures ammonia plus organic nitrogen concentrations. Organic nitrogen usually comes from plant or animal proteins and usually increases with the first flush or high winter flow measurements on Cache Creek (Figure 2.1.n). Gordon Slough has had elevated TKN values. Regulatory agencies have not established a maximum contaminant level for TKN, although the US EPA is considering adding TKN to the federal drinking water standards. TKN levels on Cache Creek are relatively low, and show a correlation with ammonia levels. TKN is not a significant problem in most samples from Cache Creek. An elevated low flow summer reading from the Capay Bridge is an anomaly, and may be from an isolated pool of water.

Total Kjeldahl nitrogen recommendation: Continue to monitor total Kjeldahl nitrogen; no additional action.

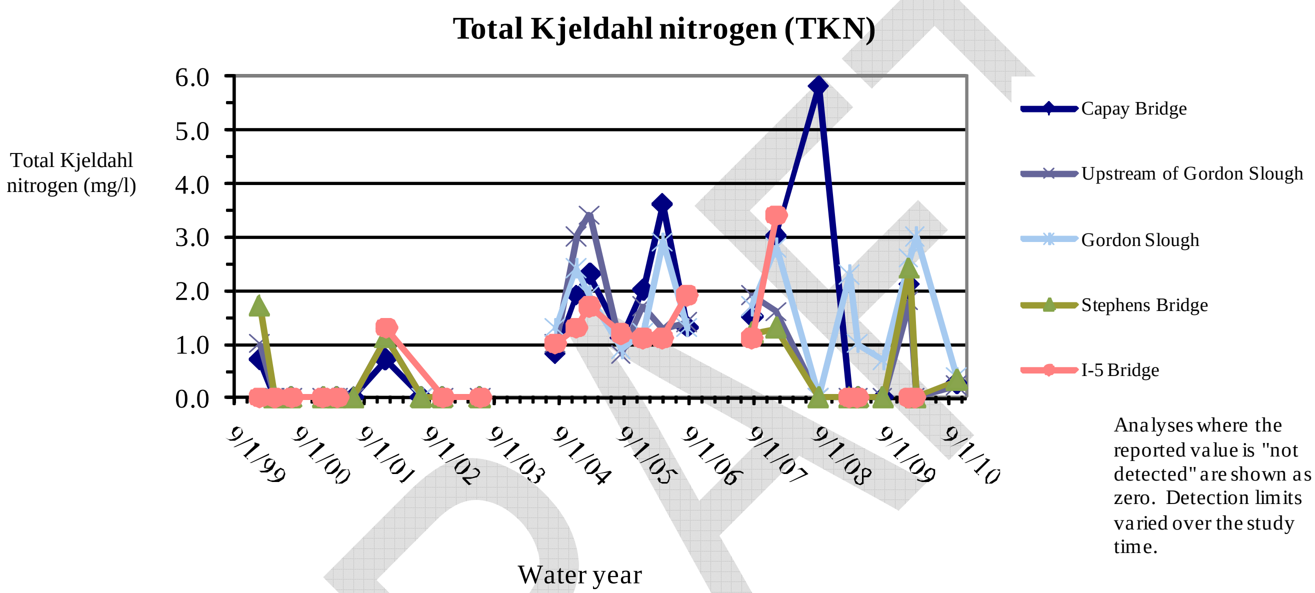

Figure 2.1.n: Total Kjeldahl Nitrogen concentrations at monitoring sites in the CCRMP area.

Calculated organic nitrogen (TKN - NH_3)

Calculated organic nitrogen equals measured TKN minus measured ammonia. This is an indirect method of determining organic nitrogen, and has some obvious flaws. Several of the early organic nitrogen values from Cache Creek are negative (Figure 2.1.o), which is not possible. This indicates that TKN and NH_3 values are so low they are within the error level of the instrument and method. Calculated organic nitrogen levels rise slightly after 2004, and are more meaningful. Organic nitrogen values are driven by the TKN values, and closely parallel the TKN graph. There are no state or federal regulatory standards for organic nitrogen, and it is not a significant problem in the CCRMP study area.

Mineral nitrogen (Nitrate plus Nitrite)

Mineral nitrogen is the sum of nitrate plus nitrite, and is the inorganic nitrogen constituent. Mineral nitrogen is a naturally occurring component in river systems, but excess nitrate can also be added through the nitrogen cycle by converting ammonia or bioavailable nitrogen to nitrate. Mineral nitrogen levels on Cache Creek are higher than we would expect from a bedrock source, so extra nitrate or nitrite contribution is suspected. This could be from a variety of sources, including runoff, farm waste, septic systems, excess fertilizer, pipes or drains that contribute to nearby waterways etc,. Nitrate values control this calculated measurement, because nitrate values are significantly higher than nitrite values. Nitrate correlates strongly with river flow, so higher flow events result in higher mineral nitrogen values on Cache

Creek (Figure 16). Gordon Slough and the Stevens Bridge sites have higher concentrations of mineral nitrogen than other sites on Cache Creek, and this is probably because of water quality issues (excess nitrate) from water sources upstream from Gordon Slough. The excess mineral nitrogen (nitrate) may feed algal blooms on Cache Creek during the summer months. There are no regulatory guidelines for mineral nitrogen.

Mineral nitrogen recommendation: Continue to monitor mineral nitrogen. No additional action.

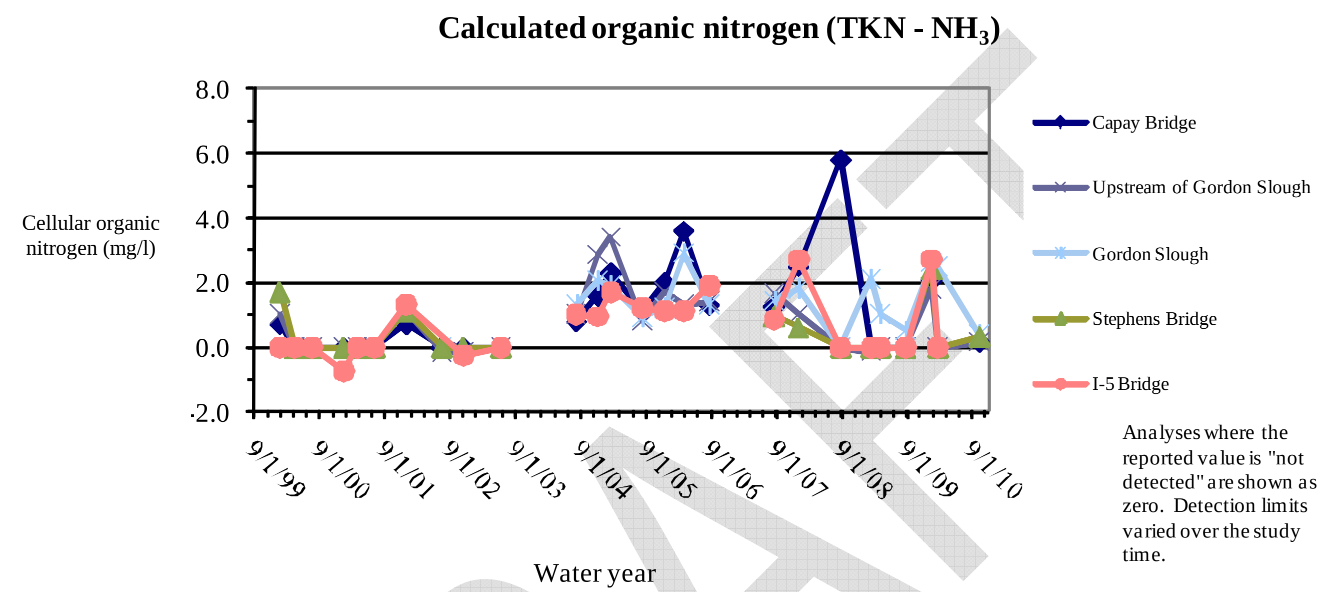

Figure 2.1.o: Total organic nitrogen (TKN - ammonia) concentrations at monitoring sites in the CCRMP area.

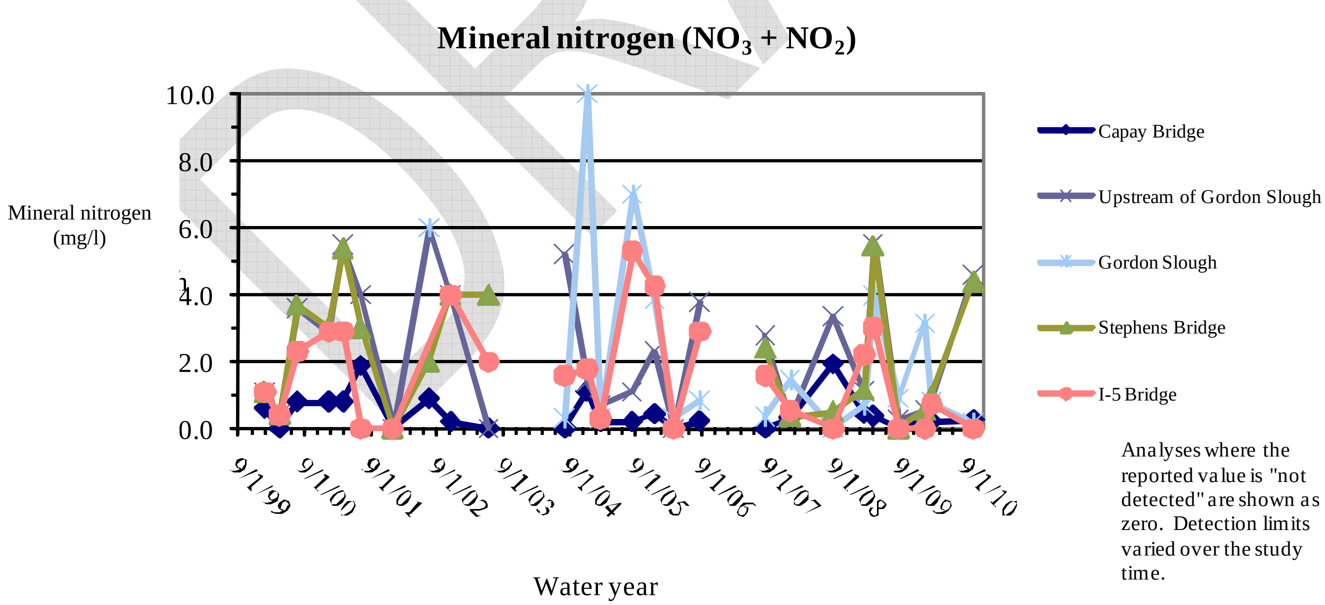

Figure 2.1.p: Mineral nitrogen (nitrate plus nitrite) concentrations at monitoring sites in the CCRMP area.

Orthophosphate phosphorus (PO_4 phosphorus)

Orthophosphate phosphorus occurs naturally in streams and forms from decomposition of underlying bedrock material and recycling of plant material that has assimilated orthophosphate. Orthophosphate is also added to farm fields because it is an essential plant nutrient. Excess orthophosphate is probably from agricultural sources. Orthophosphate may enhance algal blooms in streams, especially during the hot summer months. US EPA water quality standards for aquatic life have a maximum contaminant level of 0.1 mg/l for orthophosphate, although other regulatory agencies do not list this compound. This level is exceeded in the 2010 samples from Gordon Slough (Figure 2.1.q).

Orthophosphate phosphorus recommendation: This is a new problem, and levels of orthophosphate are high enough that this should be investigated if it recurs. The recommended action is to continue to monitor orthophosphate levels and determine an appropriate course of action.

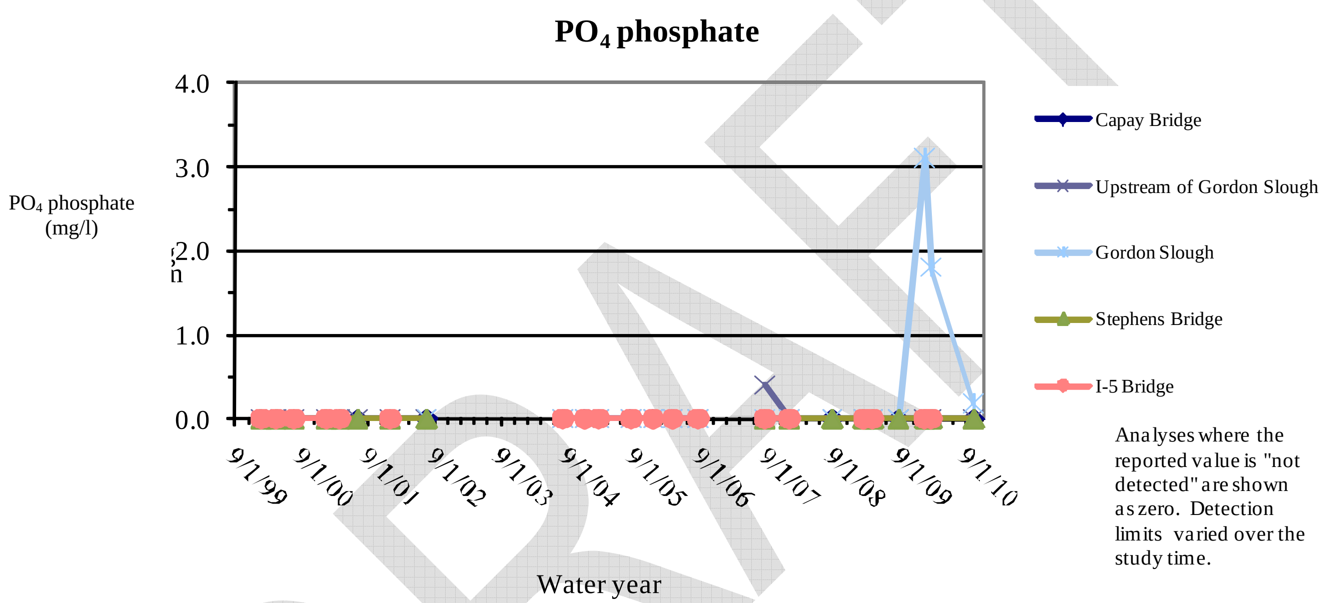

Figure 2.1.q: Orthophosphate (PO_4) concentrations at monitoring sites in the CCRMP area.

TPH as Diesel

TPH (total petroleum hydrocarbon) as diesel concentrations were noted as a water quality problem in 2008 and this problem continues through the 2009 and 2010 sampling events (Figure 2.1.r). Upstream sites tend to have the lowest values. Gordon Slough has the highest values in the CCRMP study area for 2010. The highest TPH as diesel concentrations occur during the first flush and peak flow samples, and correlate with high flow on Cache Creek. Low flow summer sampling events do not usually detect significant concentrations of diesel in surface water samples. TPH was not detected in significant amounts in the CCRMP area prior to 2004. Lower values before 2004 could be an artifact of a different lab or sampling method, although this is speculative. The source may also have been introduced since 2004. Possible sources of diesel fuel include leaky diesel pumps near drainages, leaky storage tanks, heavy equipment in or near the creek, or surface runoff through equipment yards. Diesel is not a common fuel for OHV vehicles, so OHV trespassers are unlikely to be the source.

TPH as diesel is not regulated by most agencies, although the RWQCB Basin Plan has a taste and odor threshold for diesel oil of 100 µg/l, with oil and grease not to affect "beneficial use". This 100 µg/l level has been exceeded several times in recent years, and elevated TPH as diesel seems to occur during high flow events every winter since 2004.

TPH as diesel recommendation: Seek to identify the source of diesel fuel in Cache Creek and determine an appropriate action.

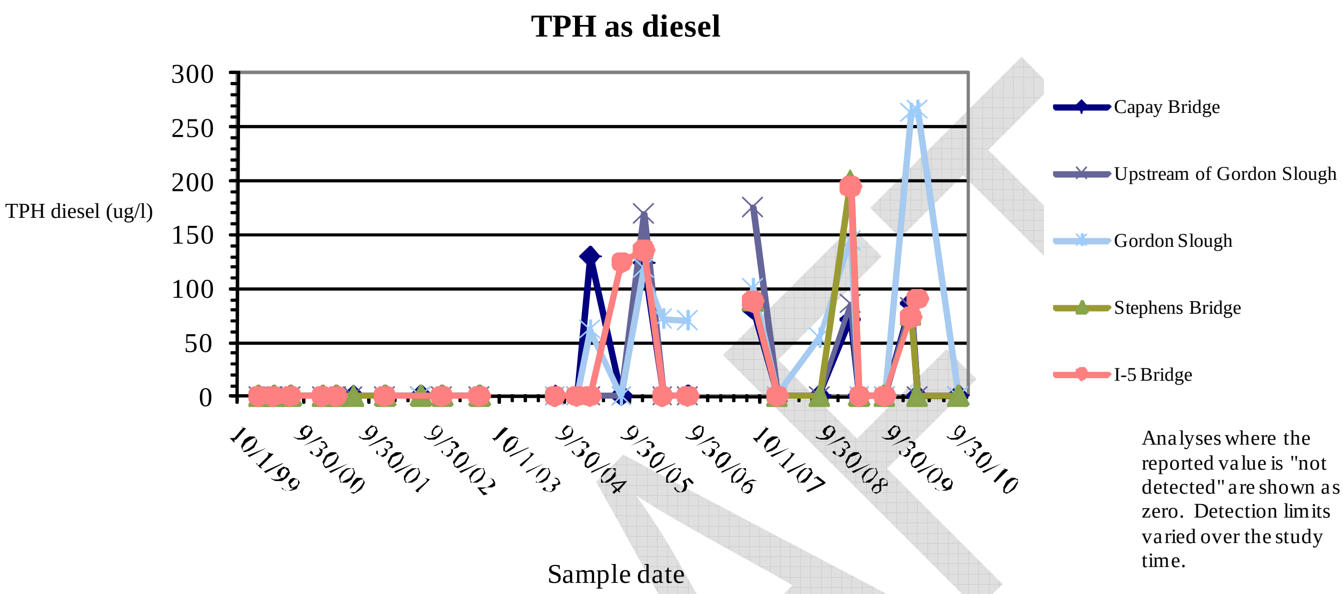

Figure 2.1.r: Total petroleum hydrocarbon (TPH) concentrations as diesel, measured at monitoring sites in the CCRMP area.

TPH as Gasoline

TPH (total petroleum hydrocarbon) as gasoline has not been detected in any samples in the CCRMP area, in past or recent sampling events. This puts the diesel problem from the last section in perspective, and points toward a larger industrial engine or storage facility.

Total Boron

Boron is a naturally occurring pollutant in the Cache Creek watershed, and enters the system through dissolution of bedrock. Elevated boron levels are common in coastal watersheds that drain rocks of the Franciscan Complex, and little can be done to eliminate the problem. Boron is toxic to plants, and the best strategy may be to dilute boron-rich waters with water from a different source before applying to farm fields. In some areas this has been accomplished by mixing groundwater (well water) and surface water. Boron may be toxic or stunt plant growth at levels ranging from 1-4 mg/l, with toxicity depending on the crop. Boron levels are plotted in µg/l, with 1000 µg = 1 mg. This means that levels of 1000 - 4000 µg/l are potentially harmful to plants. Surface water samples from Cache Creek are often in this range (Figure 19). The US EPA drinking water standard for boron is 100 µg/l, so most surface water samples from Cache Creek surface water have exceeded the drinking water limit.

Boron concentrations from Cache Creek do not appear to correlate with season or flow, although spikes or trends are visible in Figure 2.1.s. Boron levels from Gordon Slough are consistently lower than other sampling sites in the CCRMP area, especially since 2005. This is good from a water quality standpoint, and points to a different water source for the water that flows through Gordon Slough. Stream water may be diluted by groundwater or some other source in or near Gordon Slough.

Boron recommendation: Although boron is a pollutant and problem, there are no practical solutions to the problem, and this is not a water quality issue that needs to address at the present time.

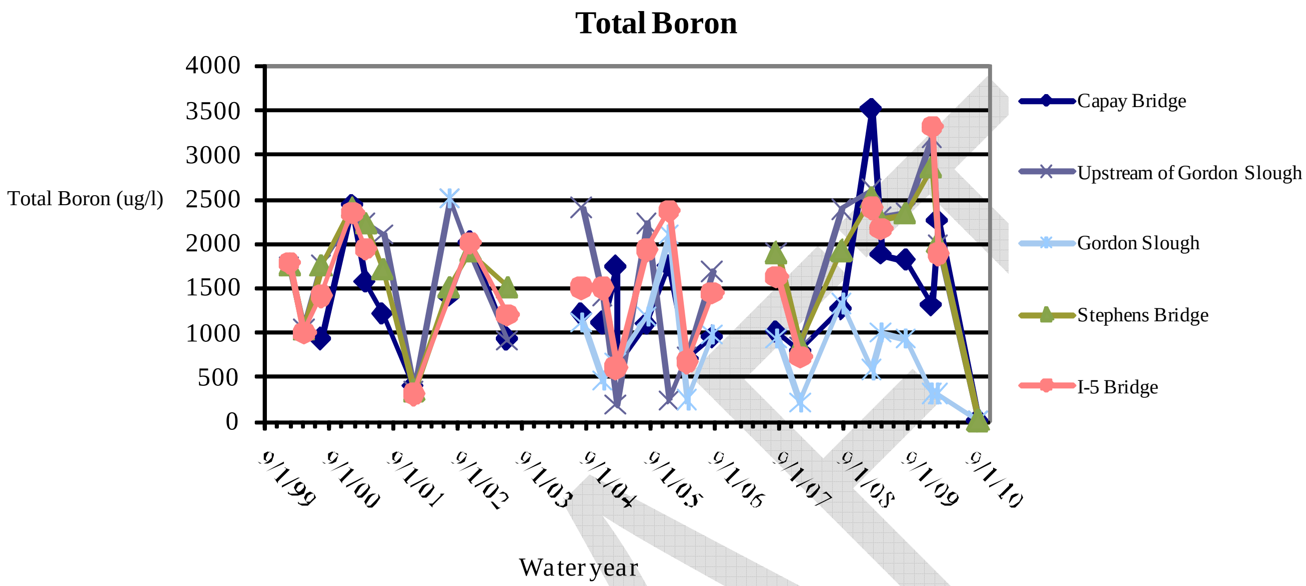

Figure 2.1.s: Total boron concentrations at monitoring sites in the CCRMP area.

Dissolved mercury

Dissolved mercury is derived from mercury mines in the Coast Range of California, and has spread through the watershed. Upper Cache Creek is currently the largest contributor of mercury to the San Francisco Bay/Delta region, and new mercury total maximum daily load (TMDL) limits will continue to focus attention on the Cache Creek mercury problem. Liquid metallic mercury is relatively insoluble in water, and all recent water samples have had dissolved mercury levels below the practical detection limits (Figure 2.1.t). The spike in 2004 may be a sampling error or a single contribution to the creek. It has not recurred.

Dissolved mercury recommendation: The single spike in dissolved mercury has not occurred again, so no additional action is recommended beyond the required monitoring.

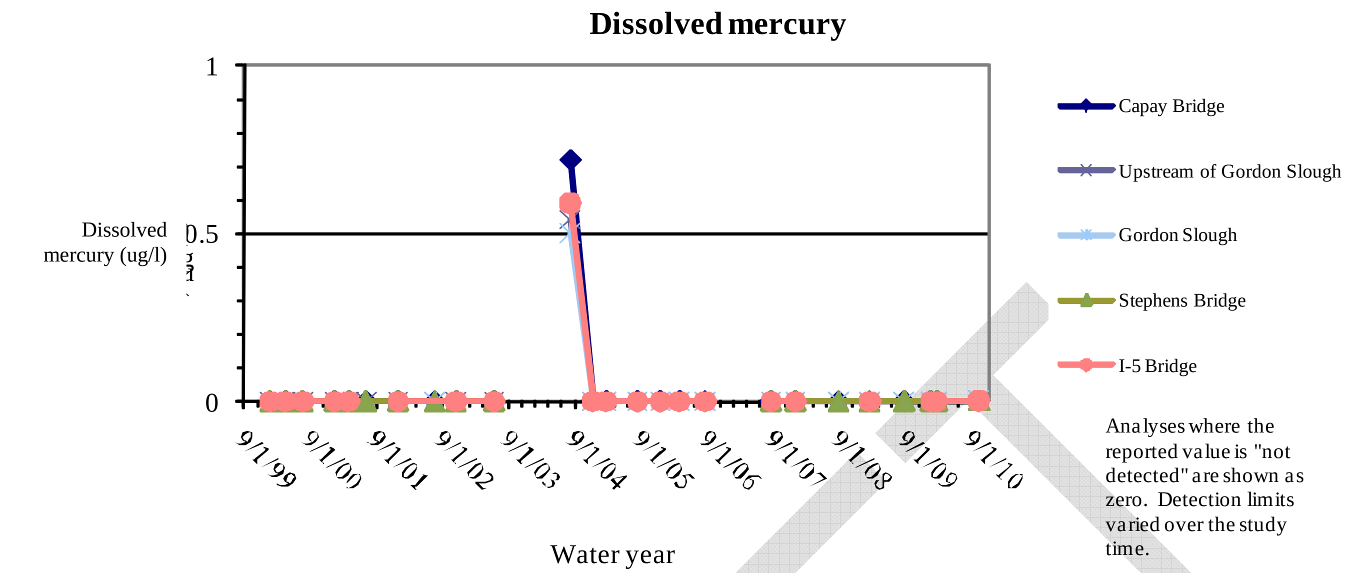

Figure 2.1.t: Dissolved mercury concentrations at monitoring sites in the CCRMP area.

Total mercury

Total mercury is similar to dissolved mercury, but samples are not filtered before they are analyzed. This leaves clay particles and organic matter in suspension and mercury can sorb to these compounds. Total mercury values are usually higher than dissolved mercury values. Total mercury tends to increase during high flow events that mobilize fine sediment and organic matter.

Total Mercury recommendation: At the present time regulatory agencies do not have a total mercury standard. All recent total mercury samples from Cache Creek have had total mercury levels below detection limits (Figure 2.1.u), so no action is recommended.

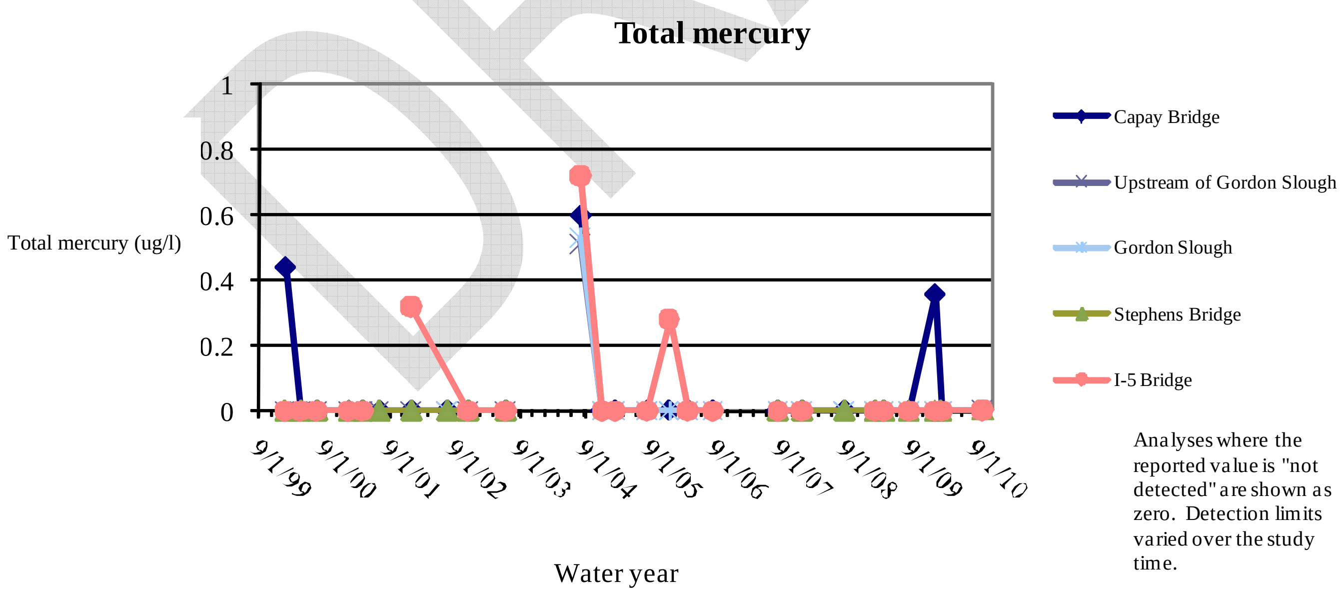

Figure 2.1.u: Total mercury concentrations at monitoring sites in the CCRMP area.

Fecal coliform bacteria

When fecal coliform bacteria are present in natural waterways, the usual source is the intestinal tracts of higher mammals. This source can be humans, deer, cattle, sheep or other related users of the water and riparian habitat. Fecal coliform bacteria multiply rapidly after introduction into the waterway, especially during warm, low flow summer conditions. The Central Valley RWQCB Basin Plan has a sliding scale for fecal coliform bacteria based on several samples per 30 day period, with a range of acceptable maxima from 100 - 400 counts/100 ml of sample water. This would apply to swimming contact. Yolo County does not measure water quality at this frequency, so results may not be directly comparable to Basin Plan requirements. The drinking water standard for fecal coliform is 0 per sample.

Results from several years of sampling in the CCRMP area show high variability, although fecal coliform bacteria are almost always present in very high levels (Figure 2.1.v). The lowest values are generally on the upstream end of the CCRMP area, and fecal coliform counts tend to increase downstream. Gordon Slough has had the highest bacteria counts in most recent sampling events, with a peak in February 2010 that exceeded 160,000 counts/100 ml. This is a high value for winter conditions, and suggests direct upstream input from a septic system, cattle yard, or similar source.

Fecal coliform recommendation: Seek to identify the source of the problem. Cache Creek will be significantly cleaner if the source of fecal coliform bacteria is identified and eliminated. Standing water allows the bacteria to breed, so one possible solution is to increase flow.

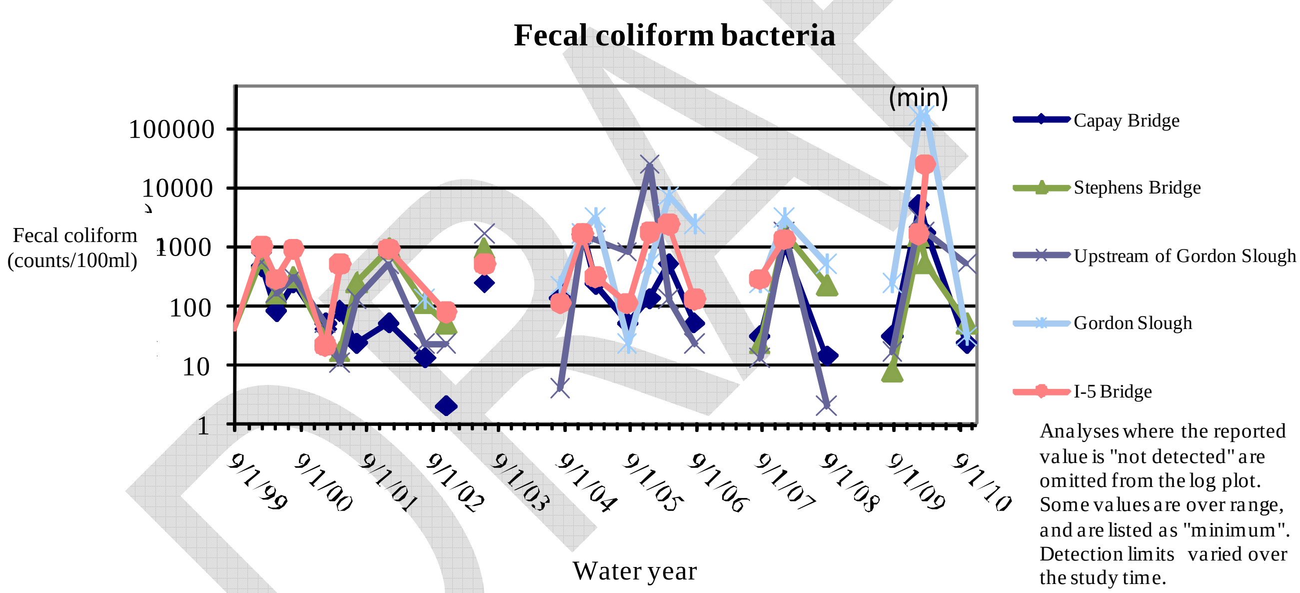

Figure 2.1.v: Fecal coliform bacteria counts at monitoring sites in the CCRMP area.

Total coliform bacteria

Total coliform bacteria are not regulated in natural waterways, but many of the health issues with fecal coliform are also present with total coliform bacteria. Total coliform counts include fecal coliform and other related bacteria, and have a variety of sources. They can cause infections in swimmers and recreational water users, and gastrointestinal problems when present in drinking water. Total coliform bacteria tend to increase during the warm summer months and in low flow areas. Total coliform bacteria are abundant in Cache Creek water samples (Figure 2.1.w), and closely follow trends observed in fecal coliform bacteria.

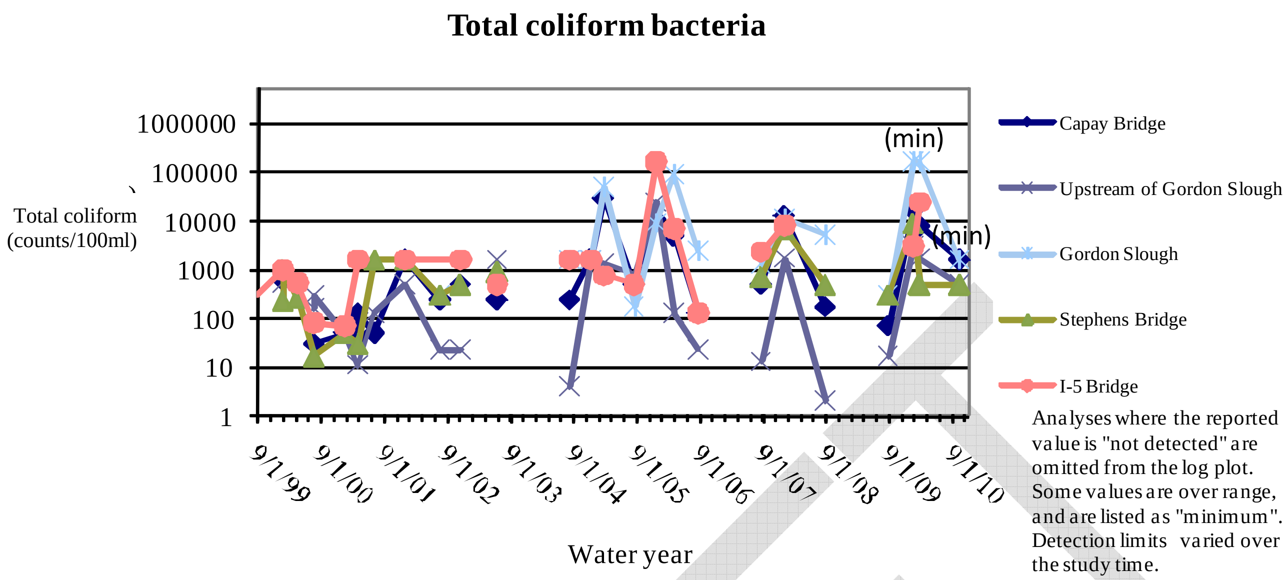

Figure 2.1.w: Total coliform bacteria counts at monitoring sites in the CCRMP area.

Total coliform bacteria recommendations: Reduce bacteria counts by increasing flow where possible. Consider other actions as appropriate to minimize human contact with elevated conditions which tend to occur in the hot summer months.

Organophosphate Pesticides and Chlorinated herbicides

Yolo County spends a significant amount of the sampling budget analyzing for these compounds. They require complex extraction procedures in the lab, and are treated as suites of compounds by the lab. No detections were recorded in the past two years, or at any time since sampling began under the CCRMP program. Some of these compounds have been prohibited for more than 40 years, but the long residence time and known harmful effects on humans have led regulatory agencies to require continued sampling and analysis for these groups.

Recommendation – Consider eliminating these constituents from the list of analyzed compounds.

2.4 METHYLMERCURY AND BIOACCUMULATION

Mercury-bearing ores are found throughout the upper Cache Creek watershed. These ore deposits are made available to the stream environment through several pathways. Some mercury is contributed by geo-thermal springs, some flows directly from mines into local rivers, and some is leached from ore bodies by natural and industrial processes. Liquid metallic mercury is relatively inert in the environment, and does not pose a large environmental risk. When liquid metallic mercury transforms to other forms it becomes a larger problem. Mineral forms of mercury can be transformed through chemical and/or biological processes into organic mercury compounds (including mono-methylmercury). This organic form can be readily taken up into the food chain by aquatic insects (macroinvertebrates). These organisms are eaten by small fish, which in turn are consumed by larger animals. The mercury is passed on to each predator through a process called biomagnification, accumulating in larger and larger amounts as it moves up the food chain. Several previous studies (Schladow, 2003; Schladow 2004; Schladow 2005) have documented parts of the mercury problem, but there is no on-going methylmercury monitoring program.

Standard methods for sampling and analyzing dissolved mercury in surface water are not adequate to detect the more hazardous form of methylmercury. This should be addressed in order to accurately characterize the mercury problem on Cache Creek and methylmercury contributions to the local environment, settling basin and bay/delta region.

Methylmercury recommendation: Consider participation in a regionally supported monitoring program to analyze methylmercury in lower Cache Creek. This would be in addition to the required dissolved mercury sampling. This should be coordinated with the Regional Water Quality Control Board, USGS, YCFCWCD, DWR and other appropriate entities.

2.5 GROUNDWATER LEVELS AND ANALYSIS

Groundwater data is available from several on-line sources. Information for this report was taken from the Yolo County Water Resources Information database, accessed at: http://wrid.facilitiesmap.com/index.cfm. This database has secure access, and can be filtered to show a variety of geographic and topographic features. Data were accessed in August 2011, and are used to meet two requirements of the CCIP:

- Install groundwater monitoring piezometers in streams, and monitor water levels.
- Coordinate with local landowners, and establish voluntary sharing of groundwater data.

More than 200 deep groundwater wells are in the Yolo County Water Resources Database, and other wells are available if the search is widened to include shallow wells and monitoring sites. Groundwater level data are also available on-line at the USGS Water Resources Division Web site, and the CA Department of Water Resources (CDEX) web site. All wells used in this report are from the Yolo County Water Resources Information Database.

Wells were selected for analysis based on the following criteria:

- Proximity to the creek (< 0.5 mile lateral distance from Cache Creek)
- Well is currently active
- Appropriate well depth (if known)

Ten wells qualified for analysis, although construction information was incomplete for half of the wells (Table 2.5.a). This missing information is a problem, because the water level in a well can vary because of differences in the well depth, screen length, and depth of the screened interval. All of these factors vary between wells used for the groundwater analysis. Well depths in this study ranged from 77 ft to 336 ft, and several depths were not listed. It may not be possible to compare water levels between wells unless more information about well construction is included in a future study.

There is an additional problem with this dataset because water levels were collected at different times of the year. This also makes it difficult to compare data directly between wells because pumps turn off and on, seasons change, and recharge may be different with time. This reinforces the point that this dataset is acceptable for identifying broad seasonal trends, geographic patterns, annual trends or longer term climatic change. It is not appropriate for shorter term comparisons between wells.

These wells are distributed fairly evenly along Cache Creek from Capay Dam to I-5, and provide an upstream-to-downstream record of water levels near Cache Creek (Figure 2.5.a). Water levels were plotted as elevation above sea level, so there is a common datum for comparison of groundwater information (Figure 2.5.b). Groundwater is deepest along the upstream or western edge of the CCRMP study area. Wells in this region have groundwater elevations almost 200 ft below sea level. Groundwater rises moving downstream or toward the east. Wells in the center of the CCRMP study area have depth to the groundwater table ranging from 150 to 120 ft below sea level. Groundwater continues to rise downstream, and at the eastern or downstream end of the CCRMP area, groundwater levels approach sea level.

This shows the influence of the Bay/Delta region. Land surface elevation decreases along a broad slope from the crest of the Coast Range to Woodland. Along this pathway, groundwater levels rise to meet the land surface, resulting in significant groundwater contributions to Cache Creek.

Well I.D.	Well construction information
10N02W16R001M	
10N02W14A001M	135 ft hole depth
10N01W18A001M	
10N01W16G001M	
10N01W17A001M	
10N01W23P001M	80 ft well depth
10N01W24L004M	100 ft well depth
10N01E29K001M	336 ft well depth
10N01E22B001M	336 ft well depth
10N01E14M001M	

Table 2.5.a: Wells used for groundwater analysis. Information was accessed August 2011 from http://wrid.facilitiesmap.com/index.cfm.

Groundwater levels near Cache Creek are steady or have risen slightly in the past 55 years (Fig. 2.5.b). This positive trajectory indicates that groundwater is pumped at a sustainable rate near Cache Creek.

Factors that influence more than one well show regional influences, and may be related to climate. Wells in the center of the CCRMP study area have groundwater levels that correlate very closely. Broad dips and peaks in the signal show wet and dry periods. A decrease in water levels from 1982 to 1991 was a dry period, and wet years are shown as spikes.

The shortest term variability in groundwater levels appears as noise or chatter on the hydrograph (Figure 2.5.b). Short term variability is caused by seasonal changes. Water levels drop in the summer due to pumping and evapotranspiration. Water levels rise in winter as rains recharge the groundwater system. Seasonal variability ranges from 10 to 20 ft for most wells. This pattern is natural, although pumping increases the magnitude of change in many wells.

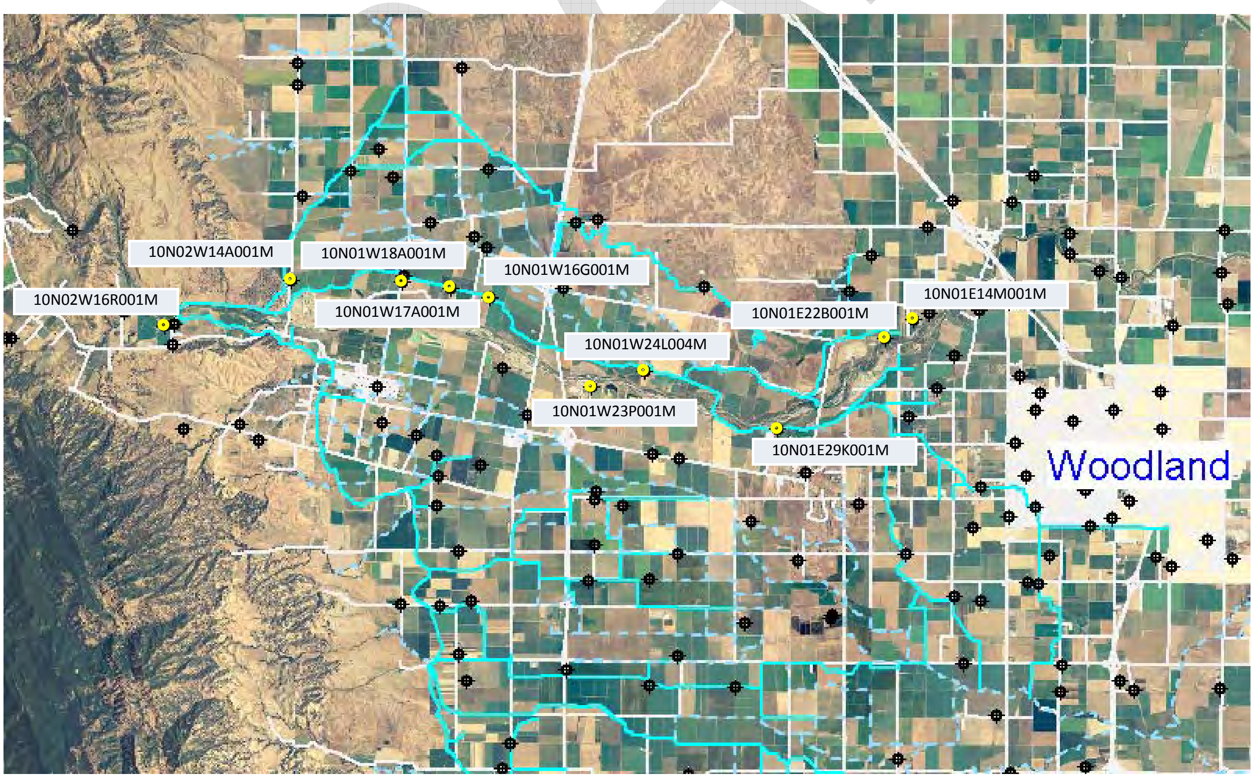

Figure 2.5.a.: Groundwater wells used to plot water table trends are distributed across the CCRMP study area. Upstream is to the left (west). Modified from http://wrid.facilitiesmap.com/index.cfm.

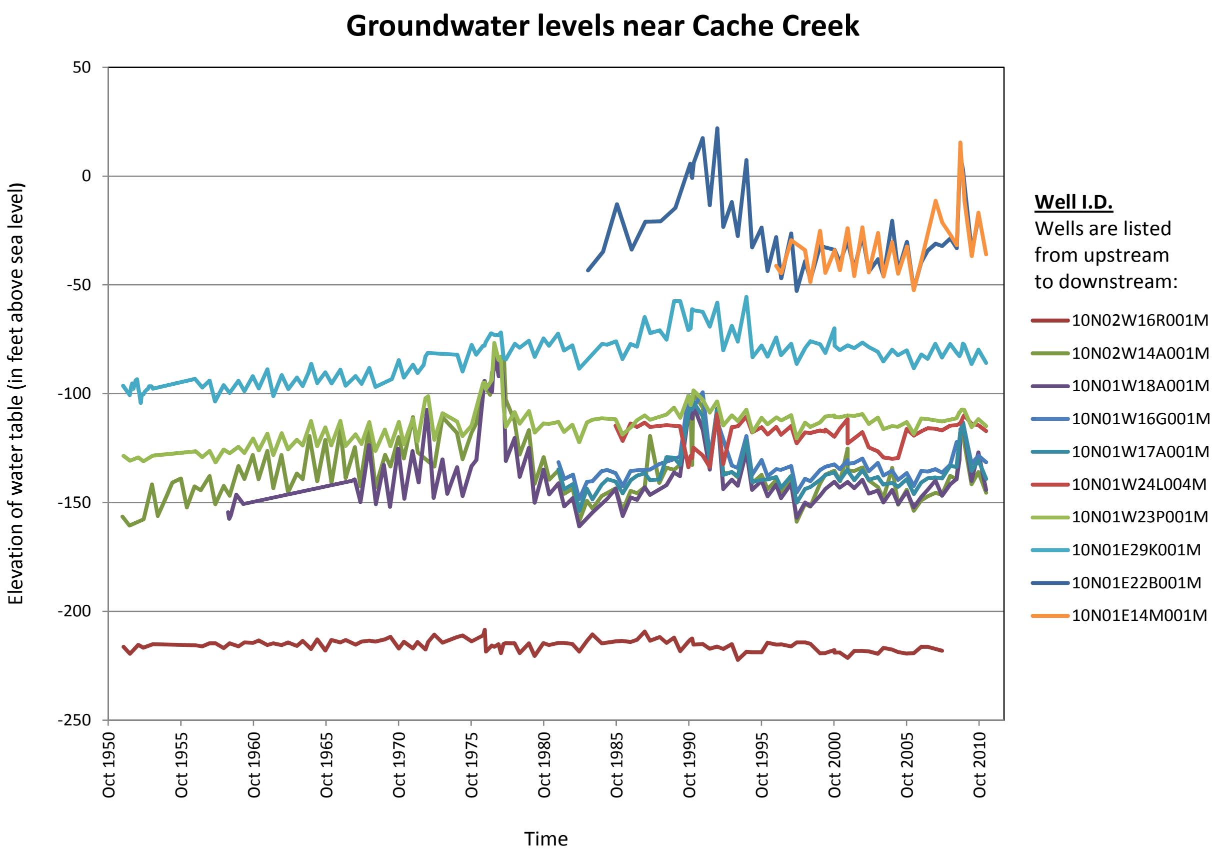

Figure 2.5.b: Groundwater levels (elevation of the water table) for ten wells near Cache Creek. Wells are listed from upstream to downstream in the key. Groundwater levels rise downstream.

Overall groundwater trends are positive and there are no immediate concerns. Groundwater systems are often impacted by overpumping in other parts of the country. This does not appear to be a problem in the CCRMP area. Groundwater information hasn't been assembled for several years, so the main recommendation for groundwater is to adhere to the CCIP guidelines, and include groundwater analysis in the annual reports. This activity is already required under the CCIP, so it will not be listed as a recommendation.

Groundwater recommendation: The groundwater portion of the report should be expanded in future years to include other nearby wells. The following wells could be added from the Yolo County Water Resources Information database:

- 10N01W07R002M
- 10N01W21J001M
- 10N01E14K001M
- 10N01E13L001M

This expanded analysis would give a more comprehensive picture of groundwater levels and patterns near Cache Creek.

2.6 OVERVIEW OF GROUNDWATER AND SURFACE WATER PATTERNS BY REACH

Surface water flow and surface water quality do not lend themselves to a reach-by-reach analysis in the same way that biological resources or geomorphic features are reported. Surface water flows and surface water quality are relatively consistent between reaches of the stream, because there are few diversion points or tributaries to Cache Creek. A large portion of the water is diverted at Capay Dam, and bypasses several reaches of the creek by flowing through the West Adams canal. Water from the West Adams canal reenters Cache Creek at Gordon Slough. At this point the quantity and quality of surface water change due to the influx from Gordon Slough.

Groundwater patterns are also larger scale, and there is little difference in groundwater levels between many reaches of Cache Creek. The main groundwater pattern is an increase in the groundwater surface elevation from the upstream headwaters in the west to the downstream outflow in the east. The water table rises gently to meet the land surface from west to east, and groundwater contributions become more important downstream.

2.7 SUMMARY OF SURFACE WATER AND GROUNDWATER RECOMMENDATIONS

2.7.1 Hydrology recommendation

River flow and flood monitoring were discussed in more detail in sections 2.1 and 2.2. A single recommendation was extracted from these sections:

1) Continue to work with County disaster relief personnel, and make sure that the TAC is properly trained before the flood season starts. This may include taking an on-line training course that is several hours long.

2.7.2 Water quality recommendations

Water quality was discussed in more detail in section 2.1. Many compounds were not detected in significant concentrations, and no action was recommended for these compounds. When a contaminant has one or two high values, the recommendation is to continue monitoring. When a parameter or compound frequently exceeds recommended levels, a recommended action is listed in this summary:

1) Temperature recommendation: High summer water temperatures could be partly addressed by actively restoring native shrubs and trees on the banks for shade. Temperature control is an important part of channel restoration.

2) Total dissolved solids (TDS) recommendation: TDS could be reduced by limiting sediment load to the creek (limiting flow from tributaries or effluent pipes) or increasing stream flow. This is a low priority.

3) Turbidity monitoring recommendation: Turbidity monitoring methods should be upgraded to include continuous turbidity monitoring. This newer technology will allow better tracking of sediment and contaminant loads.

4) Orthophosphate phosphorus recommendation: This is a new problem, and levels of orthophosphate are high enough that this should be investigated if it recurs. The initial action is to watch orthophosphate levels closely. Future actions could include a report to the RWQCB.

5) TPH as diesel recommendation: Seek to identify the source of diesel fuel in Cache Creek and determine an appropriate action.

6) Fecal coliform recommendation: Seek to identify the source of the problem. Standing water allows the bacteria to breed, so one possible solution is to increase flow.

6) Total coliform bacteria recommendations: Reduce bacteria counts by increasing flow where possible. Consider other actions as appropriate to minimize human contact with elevated conditions which tend to occur in the hot summer months.

2.7.3 Methylmercury recommendation

Methylmercury was discussed in more detail in section 2.4. The recommendation for the 2010 annual report is:

7) Methylmercury recommendation: Begin to monitor methylmercury in the CCRMP study area. This should be coordinated with the Regional Water Quality Control Board, USGS, YCFCWCD, DWR and other interested groups.

2.7.4 Groundwater recommendation

Groundwater was discussed in more detail in section 2.5. Preliminary results show that the elevation of the water table increases downstream, toward the Yolo Bypass and settling basin. It ranges from 200 ft below sea level near Capay Dam to 10 ft above sea level near the I-5 bridge.

8) Groundwater recommendation: Add more wells and expand analysis in the next annual report.

Chapter 3 - GEOMORPHOLOGY AND CHANNEL HYDRAULICS

3.1 OVERVIEW

Cache Creek is a dynamic braided river system. The flow volumes can mobilize significant amounts of aggregate material during higher than average flow years. In braided systems such as Cache Creek, high flows can also alter the topography of the creek in a short period of time, redistributing material by eroding in some areas and depositing in other areas.

Figure 1 Photo of new channel deposits from Esparto Bridge County Rd 87 at flows of 5,000 to 6,000 cfs

The capacity to transport sediment affects both the hydraulic characteristics and vegetation within the creek channel. Aggradation and degradation change the elevation of the streambed, which influence aquifer recharge, flow dynamics, and channel bank shift patterns. Channel topography, which is determined by the coarse sediment deposition patterns, is also one of the most important factors in determining flood capacity. Finally, vegetation is dependent upon the deposition of silt to provide a rooting medium, especially in cobble-prone streams such as Cache Creek.[1]

Long term monitoring of the creek, done in order to document the changing channel topography due to erosion and deposition, has been performed, largely in the form of digital terrain models (DTM's), but past data has not been regularly analyzed. In this report, deposition patterns for 2006-2010 are summarized based on the 2010 DTM data.

[1] From 1999 Cache Creek Annual Status Report

3.2 FLOOD CAPACITY

3.2.1 FLOOD CAPACITY SUMMARY

The analyses included here suggest that the magnitude of aggradation, which is less than one foot in four years (see section below “Annual Sediment Replenishment”), will not significantly affect the 100-year flood capacity. In the limited sample reach, the 100-year, 200-year, and 500-year recurrence interval floods are all well contained within the existing banks. These results are based on a small reach, only 2 miles out of 17[2] of the total miles of the CCRMP reach, but suggest that much of the CCRMP area will have similar results.

3.2.2 FLOOD CAPACITY ANALYSIS

One of the roles of the TAC, as defined by the CCIP, is to identify areas where existing channel capacity can no longer contain a 100-year flood event[3]. This requires an analysis with a hydraulic model, such as HEC-RAS. In 2011, the TAC will utilize a HEC-RAS model, developed in coordination with the Department of Water Resources’ FloodSAFE California, to evaluate flows to check for areas where the capacity is less than the 100-year flood level. There is no useable HEC RAS model currently available that covers the entire CCRMP area. Therefore, no assessment can be made of the entire CCRMP area. In lieu of a total study, a limited study was done, as described below.

As the DTM data show (below in this report under “Annual Sediment Replenishment”), there has been net aggradation of the channel between 2006 and 2010. Net aggradation of the bed means that the bed surface elevation will, on the whole, be higher. The channel capacity depends on the channel cross section bed and bank topography. Any net change in the bed and bank topography (i.e. the cross section shape) will result in a change in channel capacity. An analysis of the change in channel capacity will be done when the HEC RAS analyses are completed later in 2011. Until that time, it is not clear whether there has been any significant change in flood capacity or not in the CCRMP area. Because there is net aggradation, as reported below, the flood capacity is likely to have decreased. The analyses included here suggest that the magnitude of aggradation, which is less than one foot in four years, will not significantly affect the 100-year flood capacity.

A HEC RAS study was done for about a 2 mile-reach of Cache creek in 2009 by Cunningham Engineering[4]. “*The study area begins approximately 1,000 feet west (upstream) of the I-505 bridge and extends east approximately 10,700 feet*.”[5] See Figure 2.

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[2] Note that many descriptions of lower CCRMP cite that that segment is 14.5 miles long. The 17 miles cited here is the sum of the reach lengths as described in the Technical Studies (1995). The length as measured along the 2010 low flow channel was 18.4 miles. In future reports, this will be clarified.

[3] Objectives 2.3-3, 2.3-5, and performance standard 2.5-8

[4] Cunningham Engineering Technical memorandum entitled “Project description” October 2009

[5] Cunningham Engineering Technical memorandum entitled “Project description” October 2009

Figure 2 Aerial photo showing the reach for which the limited 2-mile HEC RAS study was done

The study area begins approximately 1,000 feet west (upstream) of the I-505 bridge and extends east approximately 10,700 feet.

The following analyses utilized the model that was developed in this reach, and new analyses were done to estimate the water surface elevation of the 100, 200 and 500-year recurrence interval floods. The values for discharge of the floods were taken from an analysis of data at the Capay gage done by Kammon Engineering[6]. Estimates were 61500, 75000, and 85000 cfs for the 100, 200 and 500 year recurrence interval floods respectively. The reach has a relatively narrow width (relative to much of the CCRMP area). It is expected that flood capacity here will tend to be less than areas were the channel is wider. This study of the selected area is intended to be a partial study, in lieu of a more thorough study of the entire CCRMP area.

Figure 3 shows cross section bed topography and water surface elevations for the 100, 200 and 500-year recurrence interval floods. The axes scales are not readable at the small scale of the plots in the report, but the main point of showing the graphs is clear. The axis (y or vertical axis) that represents the depth ranges have plots that range from a total of 30 feet to a total of 50 feet. The 100-year, 200-year, and 500-year recurrence interval floods are all well contained within the existing banks in this location. The plots suggest that relatively small aggradations of the bed on the order of 1-2 feet would make relatively small difference in the flood water surface elevations.

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[6] Watershed-Based Assessment of Hydrologic and Geomorphic Conditions in Cache Creek through Capay Valley Yolo County, California. *Prepared for the* Yolo County Resource Conservation District. Kamman Hydrology & Engineering, Inc., May 19, 2010

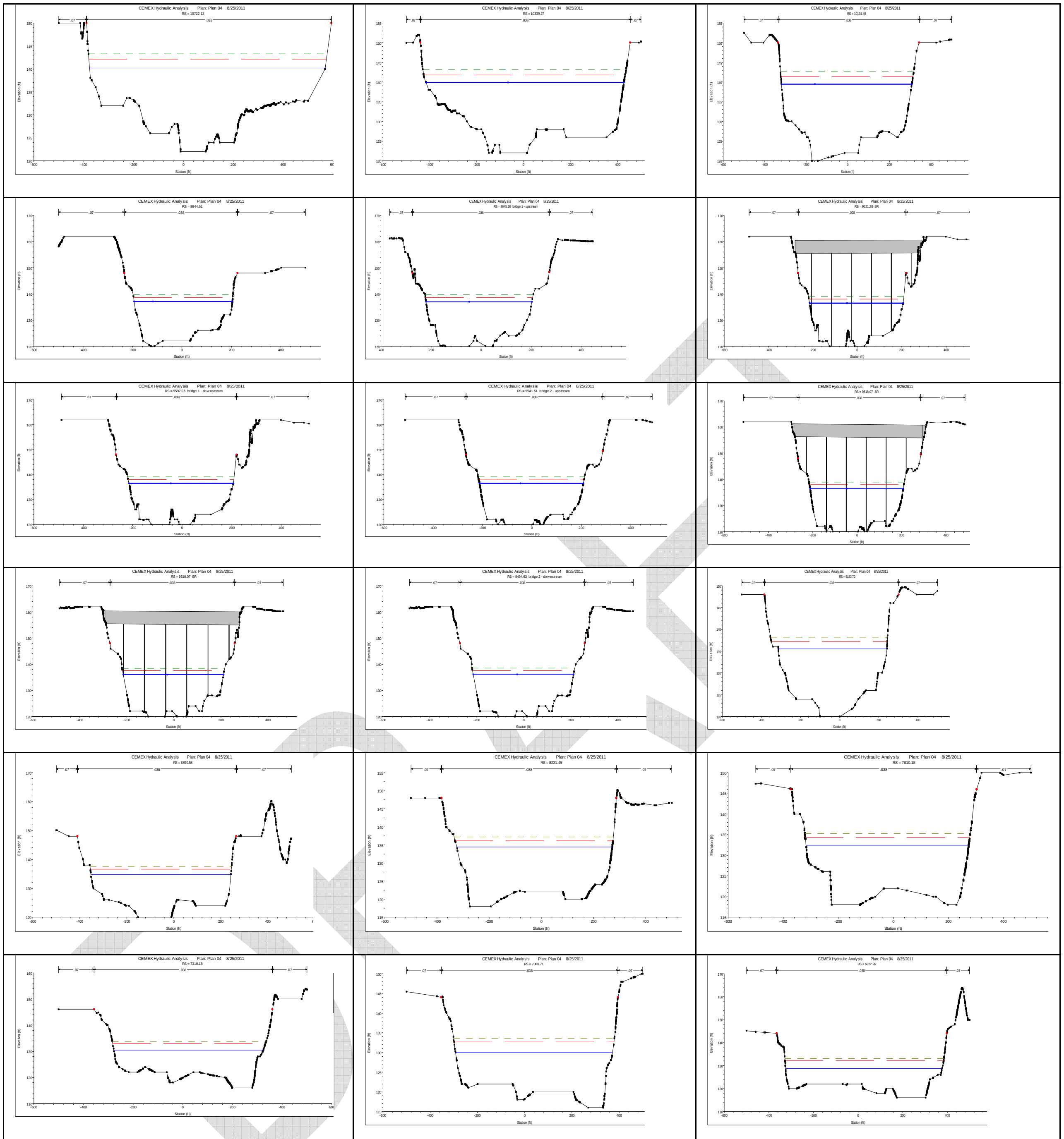

Figure 3 HEC RAS plots showing the cross section bed profile and flood elevations

The 100-yr flood is shown in solid blue line; the 200-yr flood is shown as large red dashed lines; the 500-yr flood is shown with small dashed green lines.

3.3 BED MATERIAL SIZE

In the past few years, there have been no measurements of the bed material load. Grain size distributions, therefore, have not been calculated, either from bulk material samples or from pebble counts. A protocol for field sampling, and a description of how the data will be used, should be developed in 2011.

3.4 SEDIMENT TRANSPORT, SUSPENDED SEDIMENT AND BED LOAD

There are many terms used to describe the sediment material that is transported in a river, and there is more than one system of nomenclature describing similar characteristics. This can lead to confusion even among a group of experts in the field. A simple explanation follows, which is intended to inform the discussions, which follow, of “sediment transport” in Cache Creek. For the purposes of this report, there are two important components – the material that ultimately composes the bed of the stream, and the material that washes through the system. In Figure 4, these are called “bed material load” and “wash load.” The important component for Cache Creek aggregate purposes is the bed material load, because this controls what controls the channel form, what is deposited for vegetation, and what controls flood capacity. The wash load is an important component when considering water quality. One of the main sources of confusion is that the total sediment load in a river can also be classified by the physical mechanisms of transport, which are separated into three components: 1) wash load, 2) bed load, and 3) suspended bed material load (often simply called suspended load) (Figure 4). In the following discussions, “suspended load” will be used to mean suspended bed material load.

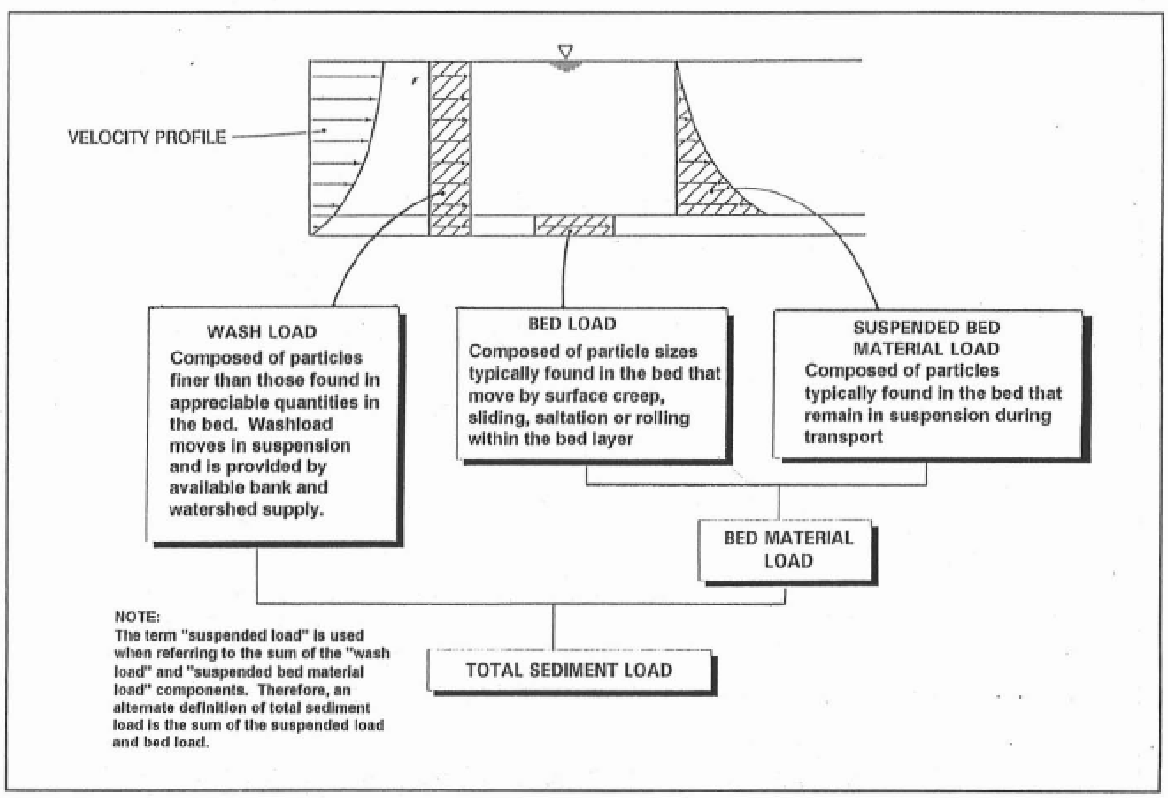

Figure 3.2-7 The components of total sediment load (modified from Mussetter et al., 1994)

Figure 4 Description of sediment load in Cache Creek

(Technical Studies and Recommendations for the Lower Cache Creek Resources Management Plan, 1995)

No known field measurements of sediment transport were recorded in the time period covered for this annual report. In order to estimate the sediment transport of material over a period of time empirical relationships have been made which relate the sediment transport to the flow. These are called sediment transport rating curves and are commonly used to estimate sediment transport in a system. Such a sediment transport rating curve was developed for Cache Creek based on pre-1996 data[7].

"*Best-fit lines through USGS published suspended sediment loads plotted against discharge generated the following relationships:*

$Q_s = 0.00018Q^{2.2}$ [Equation 1]

for flows less than 6,000 cfs. and

$Q_s = 0.2Q^{1.4}$ [Equation 2]

for flows greater than 6,000 cfs where Q_s =sediment discharge and Q = water discharge."

These equations were the basis of the suspended load sediment transport rating curve that was developed for Cache Creek.

Bedload measurements were also used to develop a relation between the suspended load and bedload[8]. The bedload was determined to be "*an average of 6 percent of the measured suspended load*." In the former study, they "*chose to calculate bedload as a fixed percentage of suspended load.*" In those studies they "*then applied the suspended and bedload transport functions to each mean daily flow for each annual runoff period and summed the annual totals*.[9]"

In order to estimate the sediment transport quantities for this annual report, a similar procedure was used to determine an estimate of the total sediment transport for the years 2005-2010, for which flow data were available. Flow values were taken for a calendar year from January 1 to December 31. Mean daily flow values were taken from the USGS gage at Yolo (USGS 11452500 CACHE C A YOLO CA). The Yolo gage was used because it had the only complete flow record for this time period. Because this gage tends to record flows that are slightly lower than most of flows for the CCRMP study reach, it is expected that the estimates in this annual report are slightly less than what they might be for the study reach as a whole.

Based on these data and the empirical relationship in the suspended load rating curve, total sediment transport was calculated in tons. The results for 2005-2010 are shown in Figure 5. As Figure 5 shows, 2006 had considerably more total sediment load transport than the other years. In order to compare these results with the flow values the mean annual flow (determined from the same flow records) was plotted for 2005-2010 (Figure 6).

It is clear from the two graphs that the sediment transport follows the same pattern as the flow, as represented by the annual average of the mean daily flow.

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[7] Technical Studies and Recommendations for the Lower Cache Creek Resources Management Plan, 1995.
[8] "Technical Studies and Recommendations for the Lower Cache Creek Resource Management Plan" (Technical Studies)
[9] Technical Studies p. 3.3-24

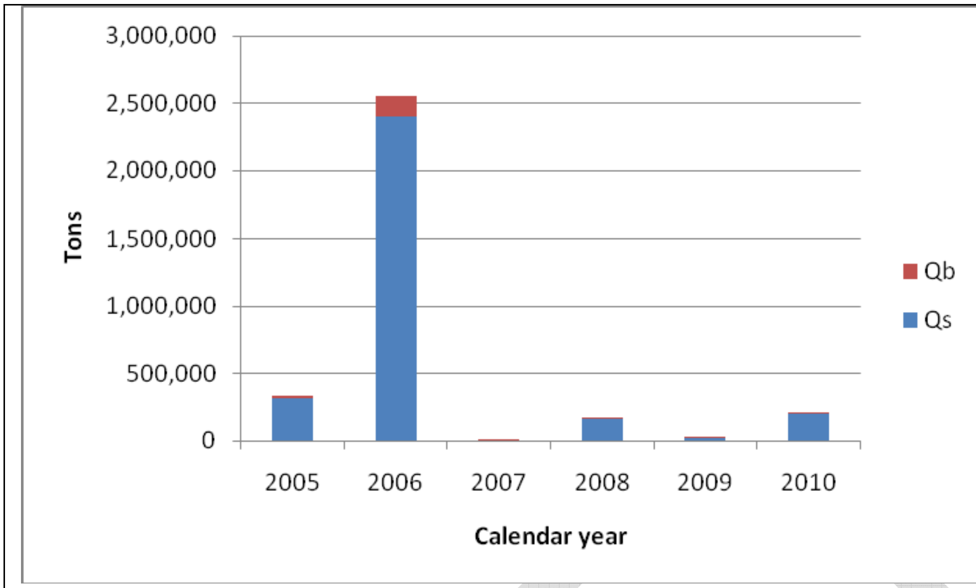


Figure 5 Total sediment transport in tons

QB is bedload; Qs is suspended load. The red represents the bedload portion of the total load.

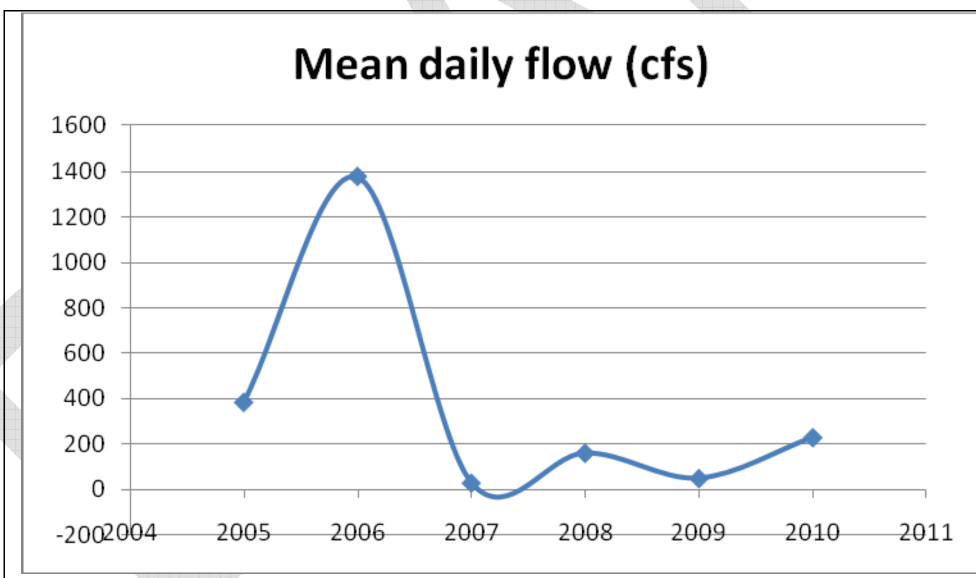


Figure 6 Annual average mean daily flow for flows on Cache Creek at the Yolo gage

Because there is a great variation in observed sediment transport at specified flows, and because actual transport in any year might differ from an empirical estimate, another useful way to consider the patterns over a number of years is to consider the **relative** total quantities from year to year. For example, the data in Figure 5 were also plotted **non-dimensionally**, where each value was considered to be a percentage of the maximum (the load in 2006).

The results (Figure 7 and Table 1) show the total load in 2006 was 10 to 20 times the load in any of the other years.

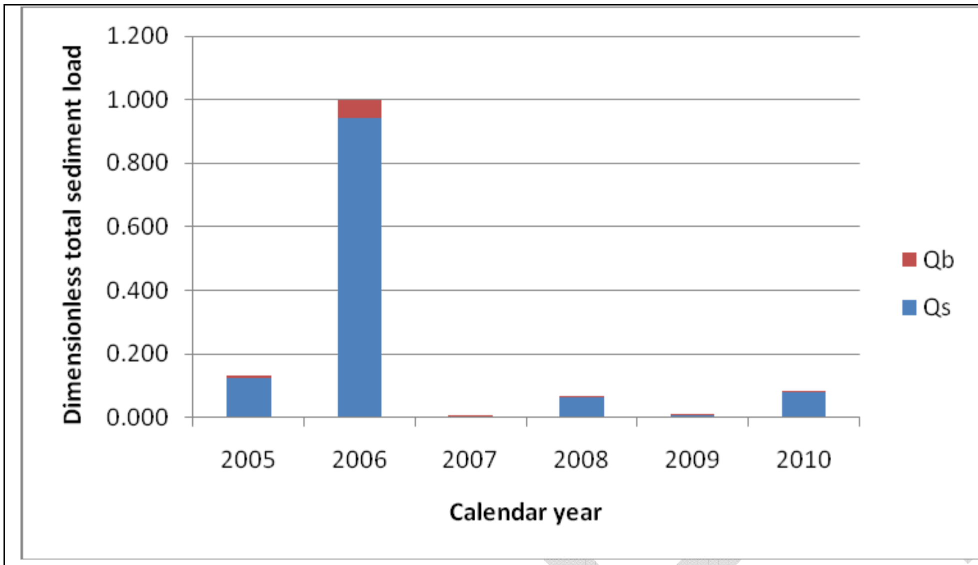


Figure 7 Total l dimensionless sediment transport

Calendar year	Total load
2005	13%
2006	100%
2007	0%
2008	7%
2009	1%
2010	8%

Table 1 Total dimensionless sediment transport

Values are given as a percentage of the 2006 load

3.5 ANNUAL SEDIMENT REPLENISHMENT

Table 2 shows the results of a DTM analysis that was performed by Towill[10]. Ground surface elevations from 2006 were compared with similar 2010 data in order to estimate the cut and fill in that time period. For the purposes of this annual report, it is assumed that the "no buffer" case well represents the active

[10] Towill, Project Report. 2010 Aerial Mapping Project for the Lower Cache Creek Study Area in the County of Yolo, CA. 2010.

bed of the channel. The data show 1,270,826 cubic yards of net aggradation.

	No Buffer				
Area	**Fill**	**Cut**	**Net Mass**	**Planimetric Area (Total)**	**Planimetric Area (Total)**
	Cu. Yds.	Cu. Yds.	Cu. Yds.	Sq. Ft.	Acres
1	123,474.0	3,686.4	119,787.6	2,985,833	68.5
2	365,724.5	56,413.4	309,311.1	16,570,776	380.4
3	334,548.4	71,056.6	263,491.8	12,161,446	279.2
4	167,293.2	28,758.0	138,535.2	5,018,624	115.2
5	271,888.0	36,578.5	235,309.5	10,184,357	233.8
6	225,219.7	66,916.1	158,303.6	6,313,749	144.9
7	56,584.8	10,497.2	46,087.6	1,051,819	24.1
Total	1,544,732.6	273,906.2	1,270,826.4	54,286,604	1,246.2

	50' Buffer				
Area	**Fill**	**Cut**	**Net Mass**	**Planimetric Area (Total)**	**Planimetric Area (Total)**
	Cu. Yds.	Cu. Yds.	Cu. Yds.	Sq. Ft.	Acres
1	153,522.3	11,531.2	141,991.1	4,160,509	95.5
2	389,773.4	59,096.9	330,676.5	118,114,875	2,711.5
3	361,554.3	75,689.0	285,865.3	13,154,623	302.0
4	206,759.4	32,506.6	174,252.8	6,173,480	141.7
5	295,456.2	41,816.1	253,640.1	11,629,055	267.0
6	269,214.5	73,440.9	195,773.6	7,988,506	183.4
7	69,442.9	18,149.7	51,293.2	1,667,552	38.3
Total	1,745,723.0	312,230.4	1,433,492.6	162,888,601	3,739.4

Table 2 Cut, fill and net mass for 2006-2010 (Towill, 2010)

The net aggradation was plotted for each reach (Figure 8). Because some reaches are significantly larger than other reaches, the spatial rate of aggradation in tons/acre was also calculated (Figure 9). The most upstream reach, the Capay Reach, had the second largest rate of aggradation. The most-downstream reach, Jesus-Maria, had the largest. There are many things that determine the rate of aggradation, including local channel bed slope and width-depth ratio. In order to investigate this relationship, the rate of aggradation was plotted against the slope (Figure 10). This was based on the hypothesis that less the slope, the more the aggradation. In the graph, only data for the middle five reaches was done.

The results in Figure 10 show that there is a fairly good correlation (for the middle reaches) between the longitudinal slope and the rate of aggradation. For the Capay and Rio Jesus Maria reaches, this is not the case. The reasons for this were not investigated for this annual report. In a future annual report, more thorough correlations will be sought between rates of aggradation and channel characteristics. Understanding the relationship between the channel characteristics, such as slope, and rates of aggradation will allow us to anticipate how changes to the stream channel will alter the rate of aggradation.

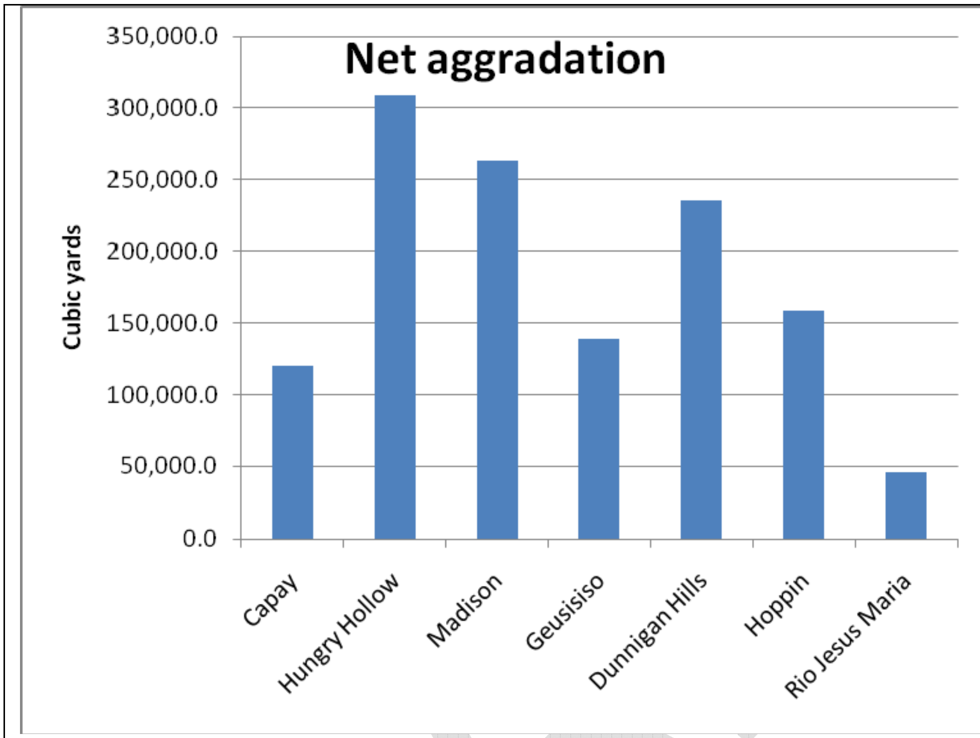


Figure 8 Net aggradation by reach

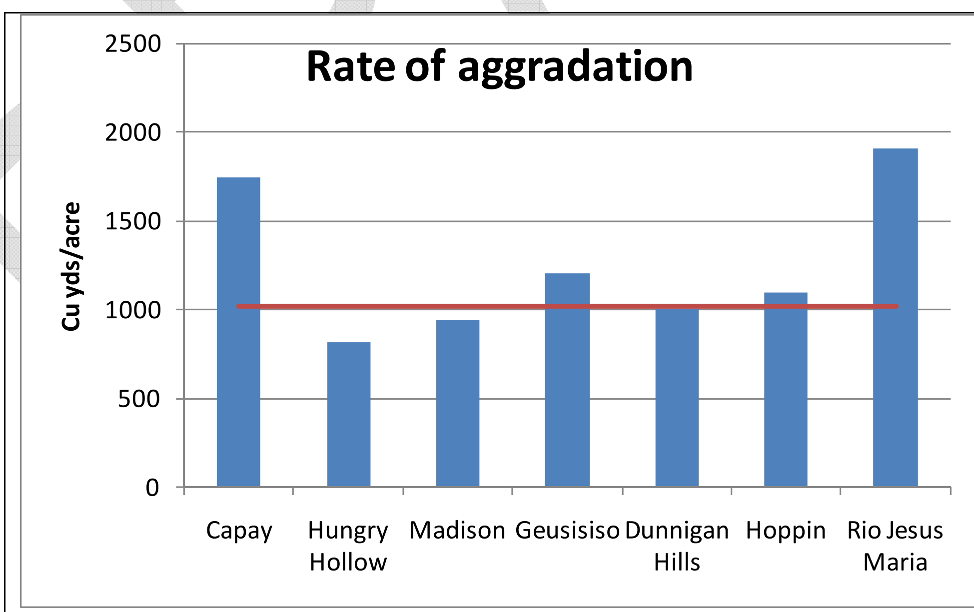


Figure 9 Rate of aggradation per acre by reach

The red line is the average value.

	Cu yd/ acre
Capay	1748
Hungry Hollow	813
Madison	944
Geusisiso	1202
Dunnigan Hills	1006
Hoppin	1092
Rio Jesus Mari	1909

Table 3 Rates of aggradation by stream reach

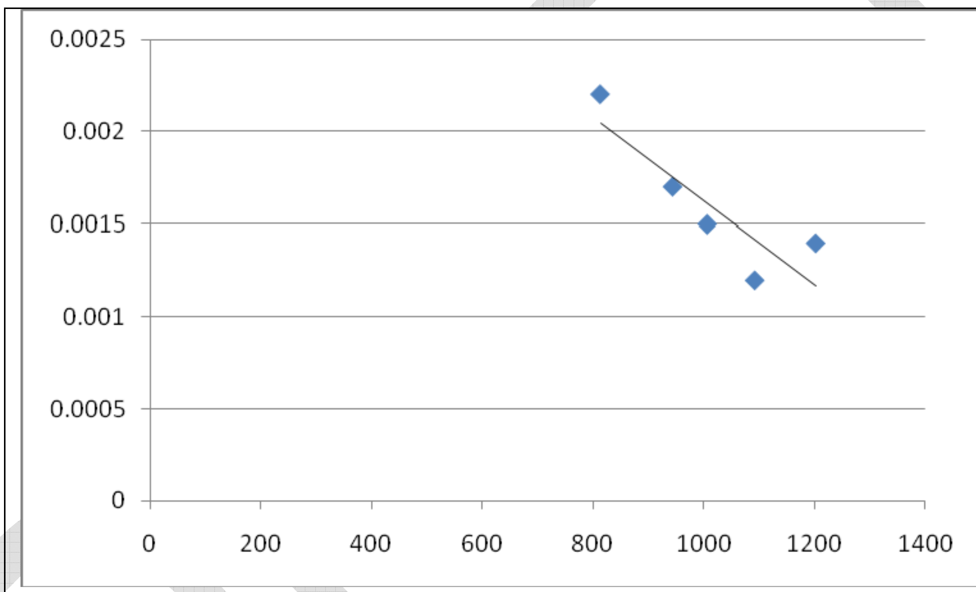


Figure 10 Rates (cu yd / acre) of aggradation plotted against bed slope

3.5.1 ANNUAL SEDIMENT REPLENISHMENT ANALYSIS

In order to put the current rates of bed aggradation into perspective, two other related estimates of aggradation were analyzed: 1) the Technical Studies 1995 estimates and 2) the empirical sediment transport 2006-2010 estimates made for this annual report.

The Technical Studies estimated annual sediment yield at Capay (Table 4). The Technical Studies estimated that about 210,000 tons per year (140,000 cu yd per year[11]) will accumulate, if all of the

[11] This assumes that one yard of material weighs 1.5 tons.

material were trapped in the CCRMP reach. The Technical Studies estimated that sand and gravel replenishment would take about 505 years at this rate[12].

Estimated Annual Sand Load at Capay 160,700 tons
Estimated Annual Gravel Load at Capay 49,400 tons
Estimated Annual Fine Materials Load 717.600 tons
Estimated Total Annual Yield at Capay 927,600 tons

	Tons	Percentage of total load
Total	927,000.00	100%
Fines	717,600.00	77%
Sand	160,700.00	17%
Gravel	49,400.00	5%

Table 4 Technical Studies estimates of annual sediment load

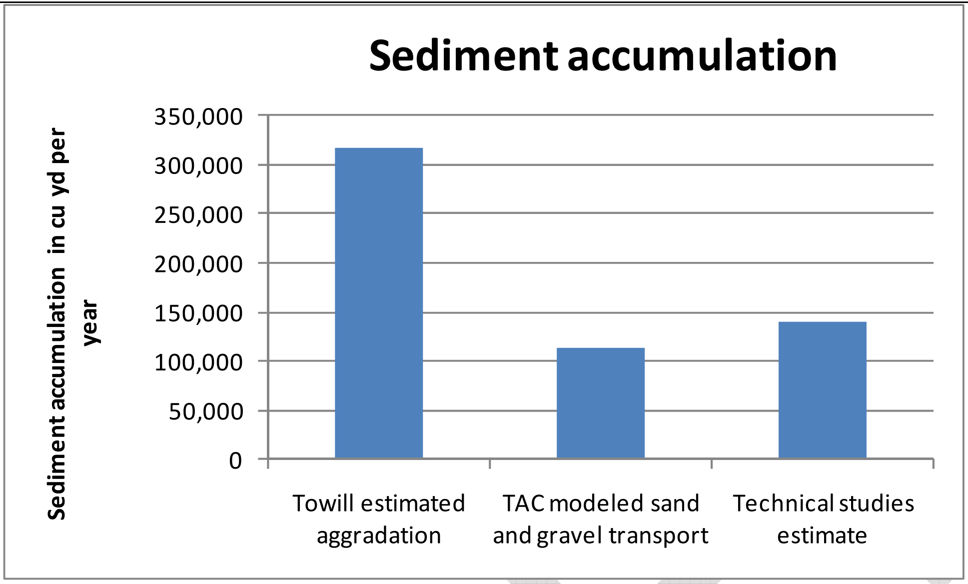
The empirical **sediment transport estimates** based on observed flows for 2006-2010[13] estimate that there were 2,955,975 tons of material transported in 4 years (Table 5) for an average of 738,994 tons/yr. The portion of this that represents sand and gravel is assumed to be 23% (Table 4). Therefore the average over the time period is about 170,000 tons (113,312 yds) per year.

Year	Total transport (tons)
2006	2,548,356
2007	3,935
2008	172,673
2009	19,995
2010	211,015
Total	2,955,975

Table 5 Total load estimate based on current sediment transport analyses

TOWILL DTM analyses show that 1,270,826 cu yards collected in 2006-2010, for an annual average of 317,707 cu yd/yr.[14]

[12] Technical Studies p. 3.3-32.
[13] Note that these years were used in order to make a comparison with Towill's DTM analyses which only covered 2006-2010.
[14] The values are based on LIDAR data from August 2006, which would include the deposition due to the heavy rains of that year.



	Cu yards /yr
Towill estimated aggradation	317,707
TAC modeled sand and gravel transport	113,312
Technical studies estimate	140,000

Figure 11 Average annual sediment accumulation in Cache Creek CCRMP area

Sediment accumulation estimates made with different approaches can easily differ by a factor of 10. In this context, the estimates reported in **Figure 11** are remarkably similar. In the 2011 annual report, these results will be reanalyzed, with any new data available, and some conclusions will be hypothesized. One preliminary interpretation is that the CCRMP area is aggrading over twice as fast as the Technical Studies estimated it would.

3.6 ARMORING

Armoring of the bed surface material refers to a coarse layer of material occurring on a surface layer of the channel bed which covers layers of bed material below which are smaller in size. Because larger material takes more force from flowing water to mobilize (i.e. be transported) the surface layer in essence “armors” the subsurface finer material. Armoring is a natural occurrence in most gravel and sand bed rivers. In order to measure bed armoring, samples are made of the surface layer and of the subsurface layer, which are analyzed for size distribution. The degree of bed armoring has been correlated with the balance between the sediment supply and the amount transported. No known recent measurements have been made that would allow us to estimate bed armoring. A review of bed armoring data to date, and a recommendation on how to proceed in the future will be included in the next annual report.

3.7 MATERIAL EXTRACTED IN-CHANNEL

Section 8-3.404.(c).(2) of the Yolo County Flood Damage Prevention Ordinance states that sand and gravel may only be removed from the CCRMP area if necessary to: 1) provide flood control; 2) protect existing structures; 3) minimize bank erosion; and, 4) implement the Test 3 boundary. Aggregate removed as part of a channel improvement project is not counted towards a mining operator's maximum annual allocation, in order to provide an incentive for companies to participate in creek restoration activities.[15] During the 2010 calendar year, no known aggregate was removed from the channel. As required under Section 8-3.404 of the Yolo County Flood Damage Prevention Ordinance, the TAC is responsible for making recommendations on all proposed projects located within the CCRMP area. The recommendations are then forwarded to the Floodplain Administrator for a final decision. In 2010, the TAC made recommendations for approval on one project, a bank stabilization project carried out by CEMEX near its aggregate facility, on the South bank of Cache Creek, east of I-505.

The CEMEX project was necessary in order to restore Cache Creek to the pre-erosion flow condition, reducing the possibility of further erosion to the south bank of the creek to maintain the required mining setback, to restore the creek to its "natural" condition, and to reduce potential damage to nearby mining equipment along the south bank of this reach. The project disturbed approximately 2.5 acres. In October 2010, the Yolo County Floodplain Administrator approved a Flood Hazard Development Permit for CEMEX to reconstruct three locations on the south side of Cache Creek. The low flow channel at the time of construction was located along the north bank of the creek.

Two of the sites were incised during the 2005-2006 winter storms. Materials used for the reconstruction included cobble and/or recycled concrete for keyways, and approximately 7,000 cubic yards of fill material consisting of a mixture of Horizon A & B soil and gravel and cobbles. One of the site was undercut by the location of the low-flow channel. CEMEX backfilled the incised area with Horizon A & B soil and gravel and cobbles. A drought tolerant weed-free grass mix was established on the graded and backfilled areas.

3.8 REACH OBSERVATIONS

3.8.1 REACH OVERVIEW

In the original technical studies, the Technical Studies identified 9 reaches of lower Cache Creek that were distinguished as geomorphically distinct. Seven of those reaches, as identified below, fall within the CCRMP boundary. In this annual report, the same nomenclature as in the Technical Report was used.

3.8.2 REACH DELINEATION

The reaches were delineated with a map in the Technical Studies, and since that time, the TAC has used these reaches for descriptive and analytical purposes. Because the current annual report includes new analyses on a reach by reach basis, the GIS reach extents in use in 2010 were compared with the original reach extents in the Technical Studies. Although the two were fairly well aligned, and the 2010 GIS reach extents were effective for qualitative descriptions, there were divergences of almost 1000 feet in some of the boundaries when the 2010 GIS reach extents and the Technical Studies boundaries were compared (Figure 13). For that reason, a new GIS coverage was made, which corresponds with the original Tech Studies boundaries.

3.8.3 REACH "RIVER MILES"

The River Miles are taken from a line that was established that does not run down the current low flow active channel, and therefore is a "naming system" that may not correspond to distances used for analytic purposes. Figure 12 shows an example of the river mile markers compared with the low flow channel. In the reach-by reach analyses, the 2010 measured distance along the low flow channel was used as the length.

[15] Cache Creek Annual Status Report 1999; p. 27.

Figure 12 River miles compared with low flow channel

Figure 13 Reach delineation revised

The dashed light line is the pre-2011 GIS delineation. The red line is the delineation taken from the Technical studies.

Based on having found this discrepancy, it is recommended that the reach descriptions be updated, including length of reach. The 2011 annual report will reevaluate reach by reach characteristics that are not covered in this report.

3.8.4 LONGITUDINAL WATER SURFACE PROFILES (SLOPES) BY REACH

The slope (longitudinal water surface profile) is important because it determines such things as sediment transport. In general it is preferable to use the longitudinal bed surface profile, but, because the DTM data does not penetrate through the water surface, water surface elevations at low flow are used instead. The slopes over long distances will be identical for these two metrics. Sediment transport is proportional to a power function of the slope. Lower slope reaches, and areas within reaches which have lower slopes, will tend to deposit more material. Understanding the local differences in slope, and how those may change over time, is a way to assess and understand the reach specific geomorphic dynamics, sediment transport dynamics, and perhaps depositional patterns. In the Technical Studies, basic geomorphic characteristics were identified for each reach by North West Hydraulics Consultants (NHC). Included in these characteristics were the reach length, the slope, and other factors (Table 6). Because the data for reach length and slope were available from the existing 2010 DTM, these were analyzed and compared with the values from the 1995 Technical Report.

The sum of the reach lengths from the Technical Report is 17.2 miles and 18.4 miles from the DTM analysis (Table 6 and Figure 14). The difference could result from different methods of measuring the lengths. The DTM measurements were made along the curved trace of the channel at low flow. Except for the most upstream and most downstream reaches, all reaches were longer from the 2010 DTM data than reported in the Technical Report.

The slopes for the 2010 DTM data are shown in Figure 15. The slopes for both data sets are tabulated in Table 6 and compared in Figure 14. The average of the slopes is less for the 2010 data. It is one hypothesis that the lower overall slopes in 2010 compared with 1995 data would explain a greater deposition rate in more recent data, as suggested in the aggradation data analyzed in this report.

	NHC Reach length (mi)	NHC Slope (ft/mile)	HNC Slope (ft/ft)	2010 DTM length (mi)	2010 DTM Slope (ft/ft)
Capay	2.1	10.8	0.0020	2.1	0.0016
Hungry Hollow	2.8	11.3	0.0021	3.3	0.0022
Madison	2.5	12.4	0.0023	2.9	0.0017
Geusisiso	2.3	6.2	0.0012	2.4	0.0014
Dunnigan Hills	2.8	9.9	0.0019	3.0	0.0015
Hoppin	3.3	7.4	0.0014	3.7	0.0012
Rio Jesus Maria	1.4	7	0.0013	1.0	0.0014
Total length	17.2			18.4	
Average slope			0.0018		0.0016

Table 6 Slopes by reach (Technical Studies and analysis of Towill DTM data)

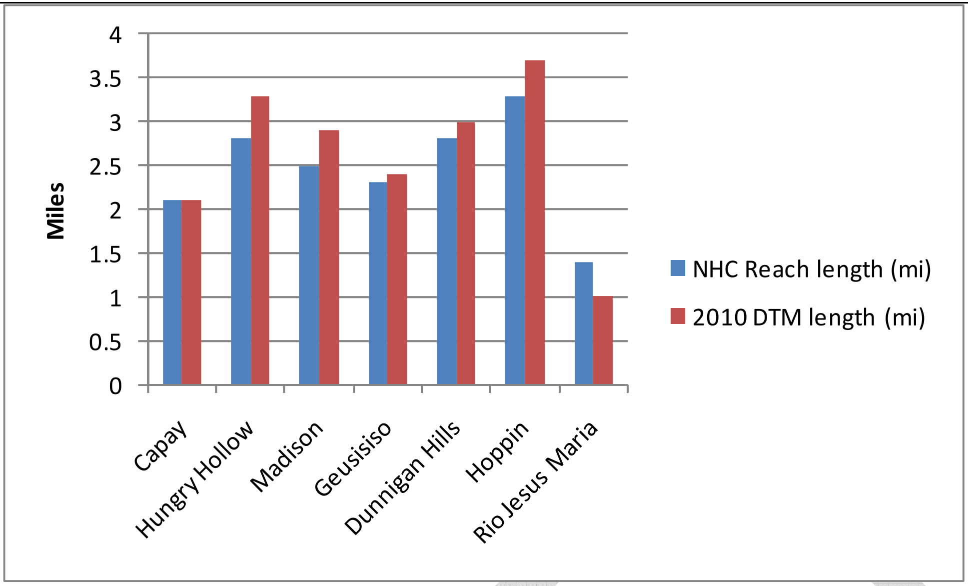


Figure 14 Reach lengths in miles

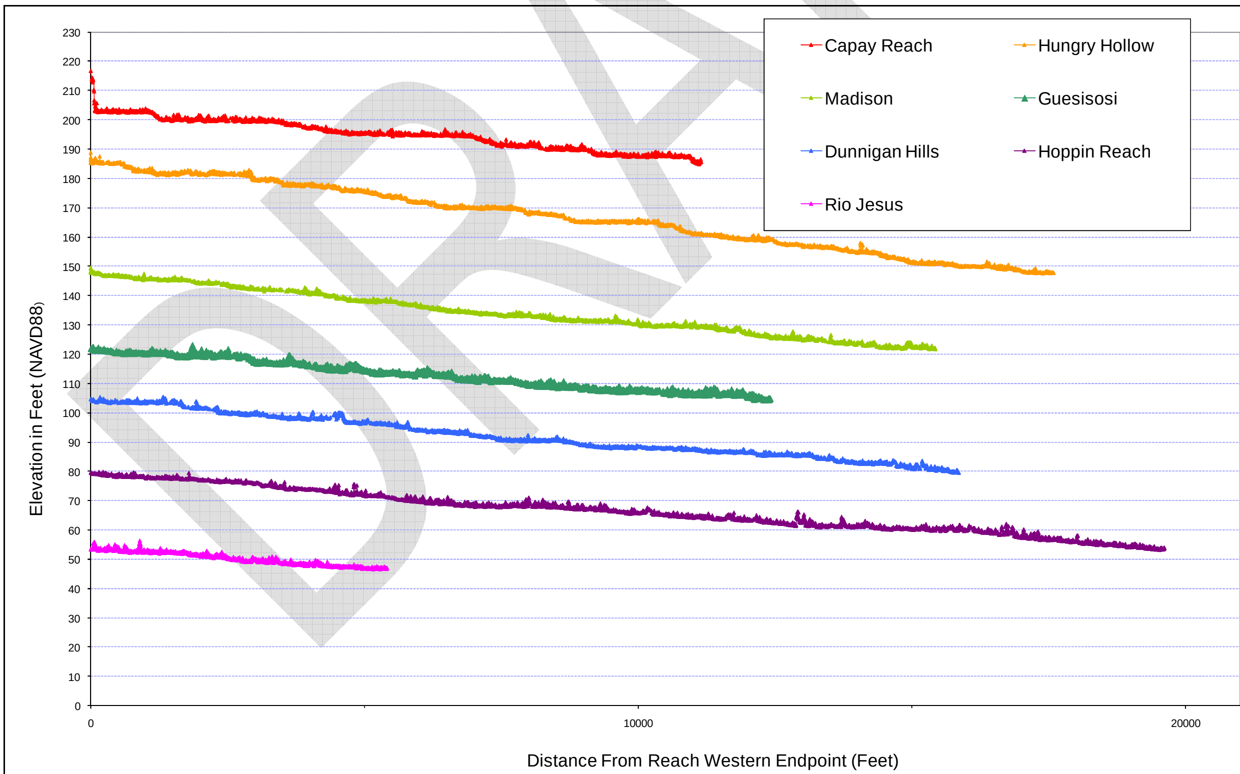


Figure 15 Longitudinal slopes from 2010 DTM

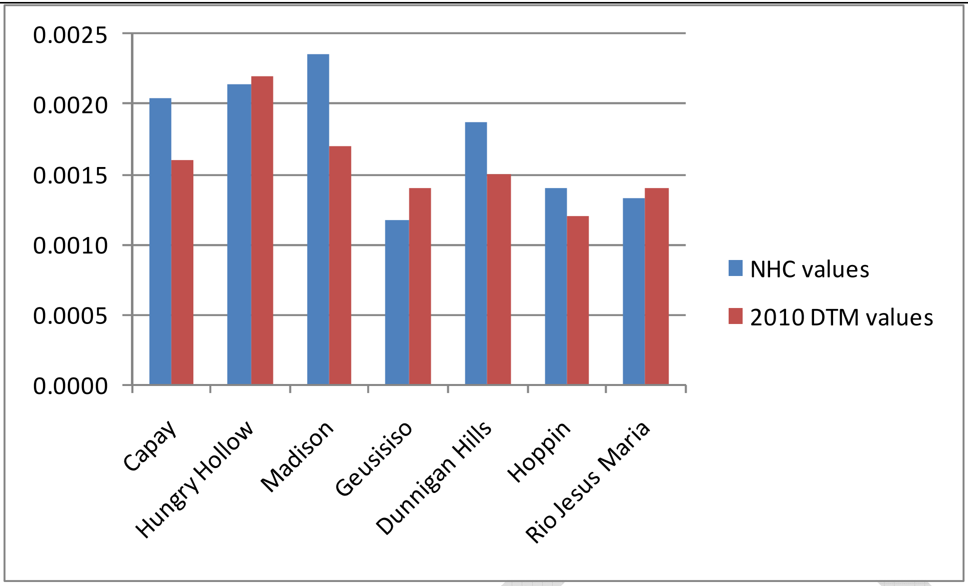


Figure 16 Comparison of slopes

3.9 REACH BY REACH COMPARISONS

In the following descriptions, the reach lengths, the reach river mile stations (RM) and the slopes are new values which were developed from recently available data. In each reach description, the new values are compared with ones quoted in the 1995 Technical Studies.

3.9.1 CAPAY REACH (RM 28.45 TO 26.35)

Figure 17 Capay reach RM 28.45 to 26.35

The Capay Reach (Figure 17) currently extends approximately 2.1 miles from Capay Dam to the Capay Bridge (RM 28.45 to 26.35). It has an average slope of approximately 0.0016, which is the average for the entire CCRMP reach. The 2010 measured length is the same as that reported in 1995. The slope in 2010 is significantly less than 0.0020, which is what it was in 1995. The reach has one of the two fastest rates of aggradation in 2006-2010, aggrading at about 170% of the average in the CCRMP area. In the downstream segment of this reach, the channel widens significantly suggesting a change in bed or bank conditions.

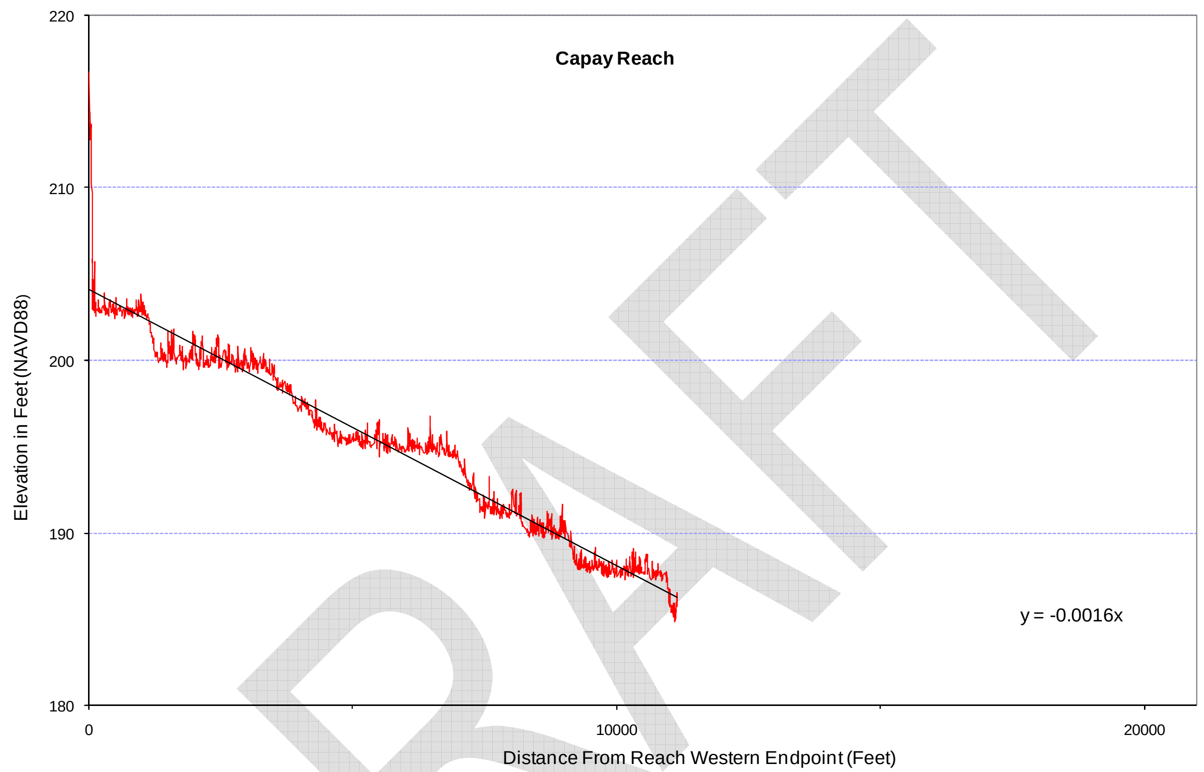


Figure 18 Capay reach longitudinal profile (slope) with analyzed trend line

The longitudinal profile (Figure 18) shows that there are 6 areas where the profile is essentially flat, with steeper sections in between. A hypothesis, which will be investigated in the 2011 annual report, is that the flat areas correlate with areas where the deposition occurs.

There has been reference to a "nick point" that is reputedly traveling upstream, apparently somewhere in this reach. A nick point is a major channel instability which has the potential to "run upstream" and destabilize the banks, the bed, and the sediment transport. A nick point has the potential to cause infrastructure damage. Technical documumentation of this condition is not known to exist. The longitudinal changes in bed elevation over time should be documented in order to identify whether there is a nick-point and, if so, how it is migrating upstream.

3.9.2 HUNGRY HOLLOW REACH (RM 26.35 to 23.50)

The Hungry Hollow Reach (Figure 17) currently extends approximately 3.3 miles. It has an average slope of approximately 0.0022, which is significantly steeper than the other CCRMP reaches. The 2010 measured length is the same as that reported in 1995. The slope in 2010 is roughly the same as it was in 1995 (0.0021). The reach had the lowest rate of aggradation in 2006-2010, aggrading at about 80% of the average in the CCRMP area. The low rate of aggradation may be explained by the relatively steeper slope.

The longitudinal profile (Figure 19) shows that there are three areas where the profile is essentially flat, with steeper sections of relatively uniform slope in between.

Figure 19 Hungry Hollow slope

Figure 20 Hungry Hollow Reach RM 26.35 to 23.50

3.9.3 MADISON REACH RM (RM 23.50 TO 21.1)

The Madison Reach (Figure 22) currently extends approximately 2.9 miles from RM 23.5 to the I-505 Bridge. It has an average slope of approximately 0.0017, which is roughly the average of all the CCRMP reaches. The 2010 measured length is 0.4 miles longer than what was reported in 1995. The slope in 2010 is significantly less than it was in 1995 (0.0023), at which time it was the steepest of all the reaches. The reach had the second lowest rate of aggradation in 2006-2010, aggrading at about 90% of the average in the CCRMP area.

The longitudinal profile (Figure 21) shows that there are two areas, which are nearly next to each other where the profile is essentially flat, with steeper sections of relatively uniform slope in the rest of the reach.

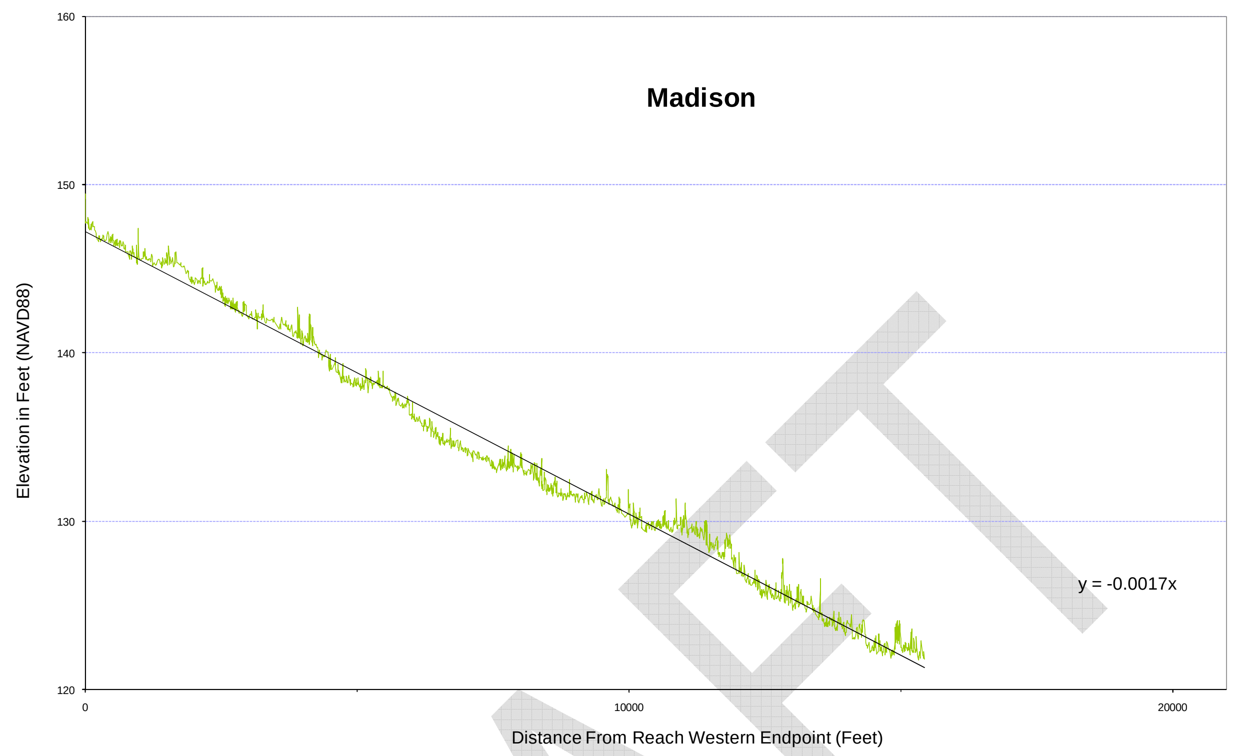


Figure 21 Madison reach slope

Figure 22 Madison reach RM 23.50 to 21.1

3.9.4 GUESISOSI REACH (RM 21.10 TO 18.85)

The Guesisosi Reach (Figure 23) currently extends approximately 2.4 miles from RM 21.10 (the I-505 bridge) to a location upstream of Moore siphon crossing. It has an average slope of approximately 0.0014, which is less than the average of the CCRMP reaches. The 2010 measured length is 0.1 miles longer than what was reported in 1995. The slope in 2010 is slightly more than it was in 1995 (0.0012), at which time it was the least steep of all the reaches. The reach had a greater than average rate of aggradation in 2006-2010, aggrading at 118% of the average in the CCRMP area.

Figure 23 Guesisosi Reach RM 21.10 to 18.85

The longitudinal profile (Figure 24) shows that there are two areas, where the profile is essentially flat, with steeper sections of relatively uniform slope in the rest of the reach.

The channel from bank to bank is relatively narrow in this section.

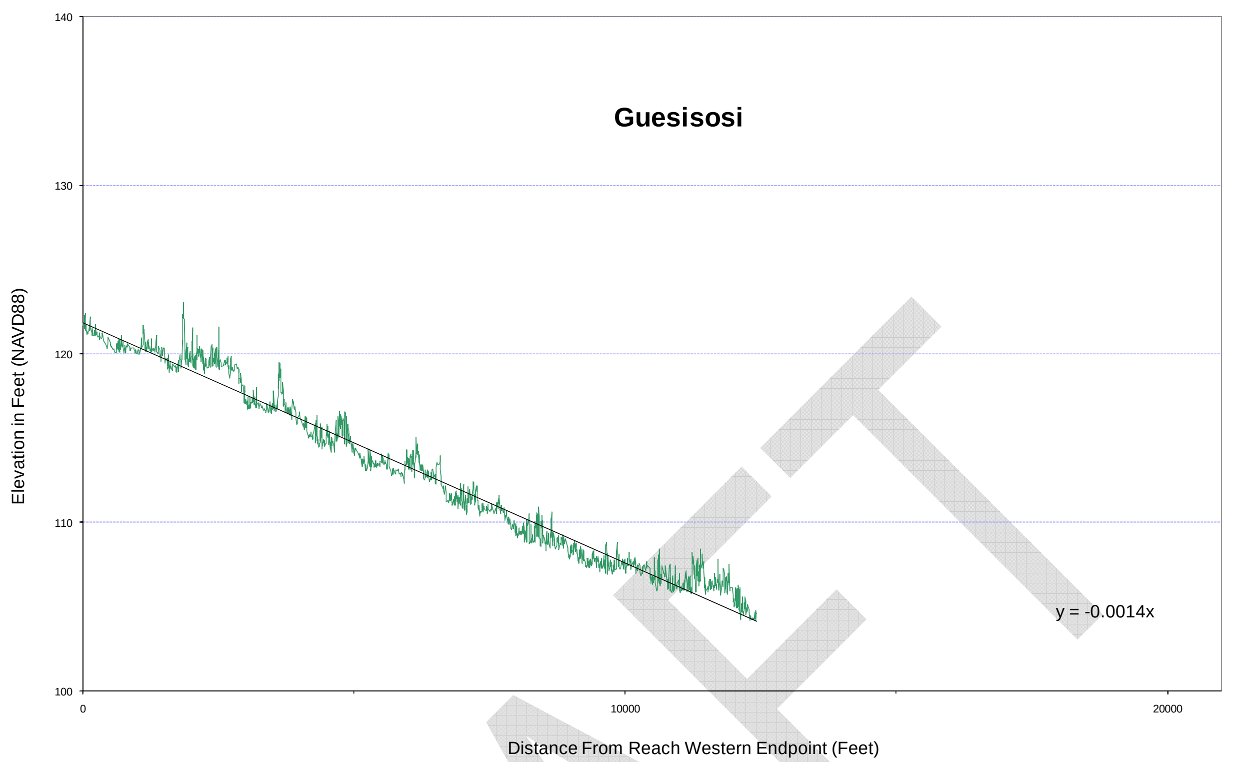


Figure 24 Guesisosi Reach slope

3.9.5 DUNNIGAN HILLS REACH (RM 18.85 TO 15.9)

The Dunnigan Hills Reach (Figure 25) currently extends approximately 3.0 miles from RM **18.85** to Stevens Bridge (RM 15.9). It has an average slope of approximately 0.0015, which is roughly average for the CCRMP reaches. The 2010 measured length is 0.2 miles longer than what was reported in 1995. The slope in 2010 is significantly less than it was in 1995 (0.0019). The reach had an average rate of aggradation in 2006-2010,aggrading at 99% of the average in the CCRMP area.

The longitudinal profile (Figure 26) shows 5 areas where the profile is essentially flat, with steeper sections of relatively uniform slope in the rest of the reach.

Figure 25 Dunnigan Hills RM 18.85 to 15.9

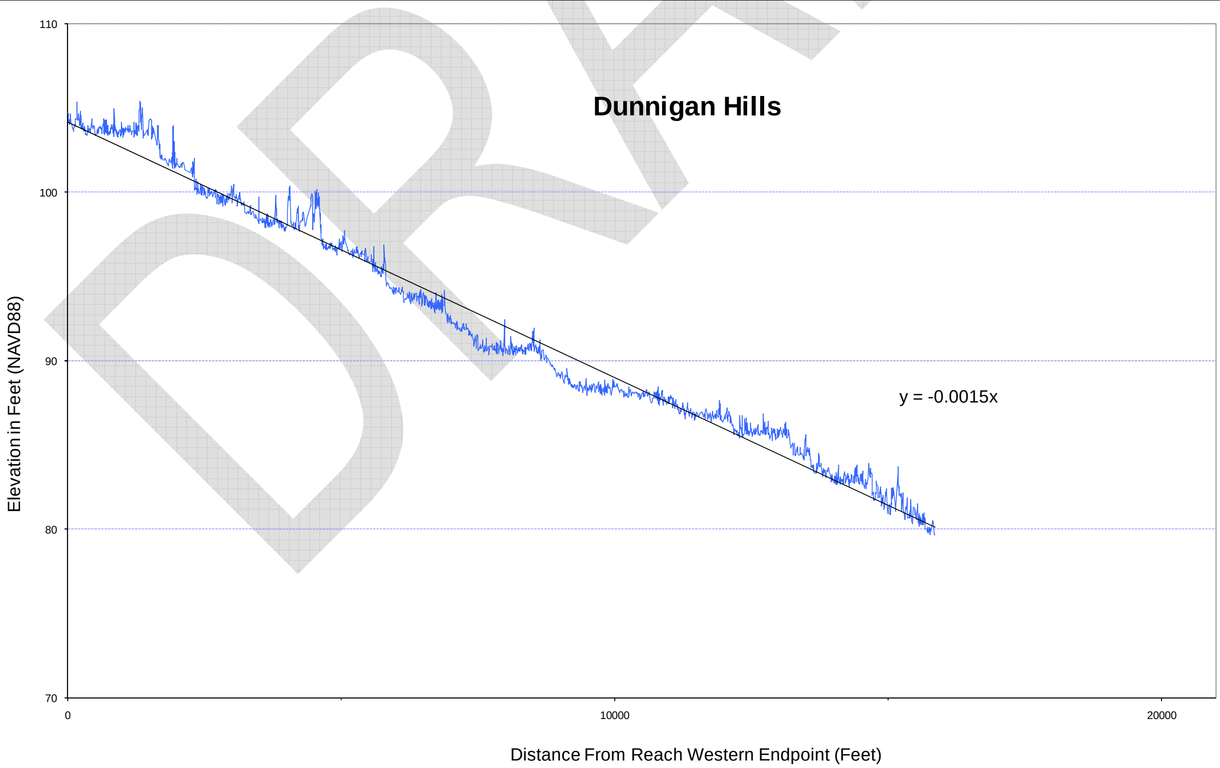


Figure 26 Dunnigan Hills slope

3.9.6 HOPPIN REACH (RM 15.9 to 12.6)

The Hoppin Reach (Figure 27) currently extends approximately 3.7 miles from Stevens Bridge (RM 15.9) to RM 12.6. It has an average slope of approximately 0.0012, which is less than average for the CCRMP reaches. The 2010 measured length is 0.4 miles longer than what was reported in 1995. The slope in 2010 is less than it was in 1995 (0.0014). The reach had a slightly more than average rate of aggradation in 2006-2010, aggrading at 107% of the average in the CCRMP area.

The longitudinal profile (Figure 28) shows 2 areas where the profile is essentially flat, with steeper sections of relatively uniform slope in the rest of the reach.

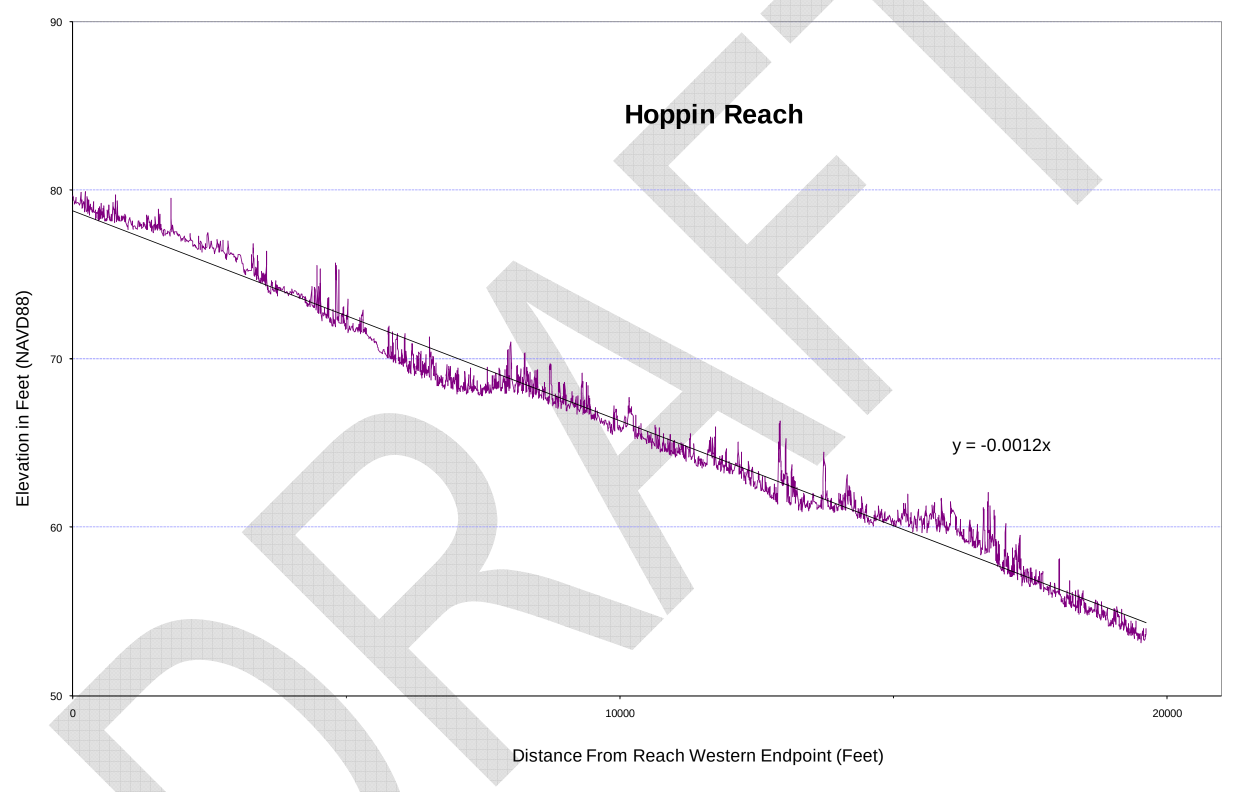


Figure 27 Hoppin Reach slope

Figure 28 Hoppin Reach RM 15.9 to 12.6

3.9.7 RIO JESUS MARIA (RM 12.6 TO 11.7)

The Rio Jesus Maria Reach (Figure 29) currently extends approximately 1.0 miles from RM 12.6 to the CCRMP boundary at RM 11.7. It has an average slope of approximately 0.0014, which is slightly less than average for the CCRMP reaches. The 2010 measured length is 0.4 miles shorter than what was reported in 1995. The slope in 2010 is slightly more than it was in 1995 (0.0013). The reach had the highest rate of aggradation in 2006-2010, aggrading at 187% of the average in the CCRMP area. This is attributable to its location at the lowest elevation in the watershed. Typically more materials are deposited at the lowest elevations points.

The channel in this reach is confined in narrow, relatively high banks.

The longitudinal profile (Figure 28) shows no flat areas.

The TAC is aware of concerns that the area immediately upstream from Huff's corner floods at less than 100-year recurrence intervals.

Recommendation: For the next annual report, records of flooding in this area, including location and magnitude of flow, will be examined and recorded in the annual report.

Figure 29 Rio Jesus Maria RM 12.6 to 11.7

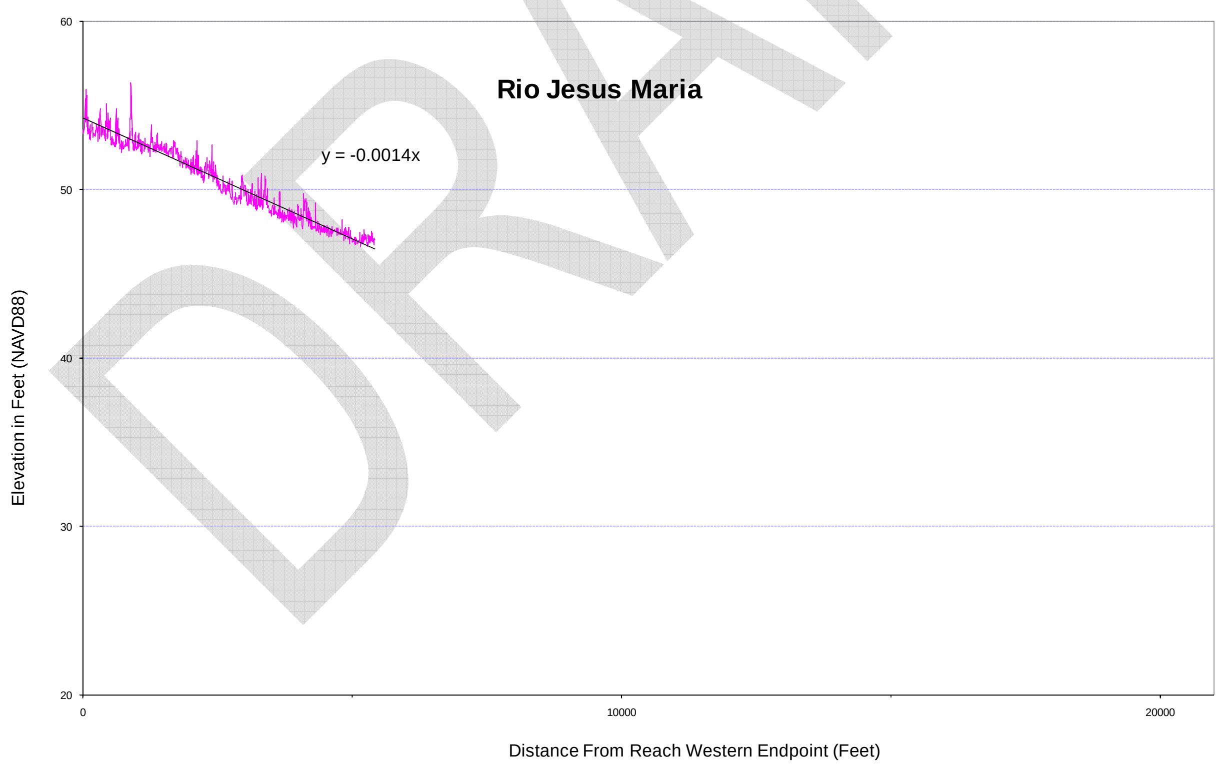


Figure 30 Rio Jesus Maria slope

3.10 BRIDGE CONDITIONS

Due to their importance in providing transportation links, as well as the public investment they represent, the protection of bridge structures is one of the highest priorities designated in the CCIP (CCRMP Performances Standards 2.4-12, 2.5-2, and 2.5-3). The study area includes four bridges, three of which are owned by the County and one by the California Department of Transportation (Caltrans). A brief summary of channel conditions, including information from Caltrans bridge inspection surveys at each bridge is provided below.

3.10.1 CAPAY BRIDGE (COUNTY ROAD 85) RIVER MILE 26.35

The river width here is constricted by a factor of 0.5 as it flows under this bridge (the current Capay Bridge was built in 1997). Heavy boulders have been imported to reinforce the outermost bridge abutments, with apparent success. Upstream from the bridge, on the right hand side (looking downstream), where there are steep banks with exposed soils, there is a bench or terrace where the TAC was told that the local land owners are concerned about the erosion. A routine bridge inspection done by Caltrans on 11/08/2007 reported "no indications of scour."

TAC recommendation: Document bank shift in on the right hand bank.

Figure 31 Capay Bridge (County Road 85) River Mile 26.35

3.10.2 ESPARTO BRIDGE (COUNTY ROAD 87) RIVER MILE 24.4

Low spur dikes are located upstream from the bridge, on the left (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. In this location, the left-hand bank pier has eroded with a scour hole observed here. Other piers seem to be buried under 6-10 feet of mobile stream gravels. The left hand side scour near the bridge is excessive and deserves continued attention. It was observed that the main active channel of the creek at the bridge was on the right hand side (of the channel boundary) before three years ago, and during the last three years the channel was on the left hand side.

A routine bridge inspection done by Caltrans on 10/19/2006 reported that "The channel showed signs of aggradation. Local scour measurement indicates (sic) improvement compared to measurements from the previous investigation. Pier 3 showed 6" of undermining throughout the length of the pile cap. Pier 8 pile cap is exposed up to 6" on the downstream side. Pier 9 pile cap and a foot of steel pile at the upstream side are exposed. There is drift and debris accumulation about 10 cubic yards at the upstream side of Pier 9."

Figure 32 Esparto Bridge (County Road 87) River Mile 24.4

3.10.3 INTERSTATE 505 BRIDGE (RIVER MILE 21.0)

The channel is constricted by a factor of 0.5 to 0.7 times the normal width as it passes under the Highway I-505 bridge site. This bridge has an unusual longitudinal vane (pier) construction on the abutments that interferes with any flow that is not perpendicular to the bridge. As a result, scour pools have formed around each abutment. Although the area appears to have scoured, it is not clear how much scour has occurred. The uncertainty emphasizes how important it is to have a history of pictures and bed profiles at a site.

Figure 33 Interstate 505 Bridge (River Mile 21.0)

The bridge was fully inspected by Caltrans on 10/12/05 when the water level was low. Scour holes at each pier and an exposed footing at Pier 3 were noted.

3.10.4 COUNTY ROAD 94B BRIDGE

A bridge inspection by Caltrans of 10/24/2007 states that “Abutment 1 is undermined up to 18 inches horizontally from the face of the footing to underneath the footing along 10 feet. This condition is caused by the settlement and consolidation of the soils beneath the abutment footing which is not founded on piles.” That inspection also lists previous work recommendations, as follows:

02/14/2001

Repair the scour and stabilize the embankment to mitigate the general scour occurring from stream bed degradation along Cache Creek.

02/14/2001

The local agency shall provide appropriate scour countermeasures to mitigate current problems at all piers and abutments.

01/07/1999

Check the bridge foundations for scour after high flows.

It is not clear which of these recommendations have been followed. This should be investigated for the 2011 annual report.

Figure 34 County Road 94b Bridge

4 - VEGETATION AND WILDLIFE

Vegetation along and within Cache Creek is presently restricted by a number of factors including: high flow velocities, limited area for riparian expansion, timing (particularly the timing of the receding limb of the hydrograph) of the seasonally wetted channel area, and/or shallow groundwater availability. As a result, the CCRMP area is dominated by willow shrubs and invasive annual weedy vegetation (mainly drought tolerant grasses, mustards, and thistles). Mature riparian forest is rare, only found in small patches and recruitment is essentially absent. This has been the base condition following in-channel mining, although it does appear that some willow recruitment is occurring, and will be quantified in future investigations. That recruitment is not visible on aerial photos, until it spreads laterally.

The historic mining, the narrow bridge cross-sections, and what appears to be influence from mining road crossings all have influenced the plan view shape (map) and vertical profile (cross-section) of the channel. This shape provides the geomorphologic and hydraulic template on which the vegetation forms and is thus highly modified from historic patterns. The hydrology has also been altered to some degree by upstream diversion and water uses. The wildlife that relies upon this vegetation as habitat is thus constrained to small areas of intact habitat.

4.1 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 cattails, tules and sedges at the water's side to grasses and forbs, and progressing upward in the canopy, to shrubs and vines, small trees, and finally, emergent cottonwoods, sycamores (in some cases) 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, aquatic mammals and particularly bird diversity (England *et al*., 1984). Riparian plant communities are both dependent upon river fluvial processes, but also profoundly influence stream channel characteristics once established.

Vegetation can increase bank stability, but physical processes can overcome the stabilizing influences of plant growth. This is particularly true in Cache Creek where numerous restoration areas in and adjacent to the channel have simply been washed out or stranded (River Miles 25-25.9, 24, 23.4, and 21-22). 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). But mature cottonwood gallery forests can deflect even very large floods, and can withstand significant periods of inundation and sediment overtopping.

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 1400 ft. band of willow and cottonwood vegetation between a comparatively narrow channel bank to a band of oaks. A 400-foot bank of willow and cottonwood vegetation was found from the opposite bank to where it entered a band of oaks. The channel itself was only 99 feet wide. Thus, this particular reach was characterized by a relatively narrow channel and a wide band of vegetation. In 2010, for that same reach (River Mile 19), an analysis of the aerial photographs showed the total width between the levees was 938 feet, the approximate riparian width was 446 feet wide and the channel was 148 feet wide. This provides further evidence of a 50% increase in channel width and a 75% reduction in riparian width under current channel conditions.

An 1857 survey of the creek at the location of present day Road 94B described a relatively small active channel (187 feet) out of a total of 2,800 feet of floodway. Of this floodway, about 1,297feet were found on the north bank, and another 1,320 feet were found on the south bank. In 2010, for that same reach (River Mile 15.9), an analysis of the aerial photographs showed the total approximate riparian width was half of its extent in 1857 to the north and 20% to the south (1,430 and 219 feet respectively). The channel width was essentially the same, although this is because the bridge location controls this dimension.

4.2 Vegetation Analysis

4.2.1 Summary

The 2010 high-resolution aerial color photographs provided an opportunity to complete a limited retrospective spatial analysis and comparison to the 1998 aerial photos, and comparison of both of those datasets to the to the 2006 Yolo Natural Heritage Program (NHP) vegetation dataset. These analyses are intended to lay the analytical foundation for standard methods for reviewing the full length of lower Cache Creek within the CCRMP area, as well as to initiate the actual assessment of vegetation change, and by inference habitat change, within the plan area.

This effort examined the various transects proposed and used for vegetation assessments and determined that most of the 2002 Andregg transect locations were sufficient for the purposes of this and future vegetation analysis. This validates the ongoing efforts and provides information for the planning and development of future ecological studies. The 2006 Cache Creek Vegetation Monitoring report was also reviewed and contrasted to the 2010 and 1998 aerial photos and the Yolo Natural Heritage Program mapping project.

4.2.2 Goals:

The following goals provided guidance for this effort

- To gain a better understanding of the riparian and upper terrace vegetation conditions in 1998 and compare those to 2010.
- To gain a better understanding of the Yolo Natural Heritage Program mapped riparian and upper terrace vegetation conditions in 2006 and compare those to 1998 and 2010.
- To provide an analytical assessment of the 2010 riparian vegetation and landscape conditions along the 12 Andregg-established transects.

The following methodology was used:

Step 1. Compare the earliest available (1998-9), suitable (orthorectified, georeferenced) aerial photos of the CCRMP to the most recent aerial photos (2010). These dimensionally accurate and spatially precisely located photos can be compared almost exactly for each reference location. The comparison includes coarse-level (landscape and reach level) assessment of relative channel position, vegetation area and extent, relative size class, and if discernable, by species.

Step 2. Compare the earliest available (1998-9), and the most recent (2010), suitable (orthorectified, georeferenced) aerial photos of the CCRMP to the Yolo NHP dataset. These precisely located aerial photos can be compared to each vegetation or land use classification (polygon) compiled by NHP for each reference location. The comparison includes coarse-level (landscape and reach level) assessment of relative channel position, vegetation or land use class, area and extent, and if discernable, by species or association.

Step 3. Take the coarse scale analysis from steps 1 and 2, and refine it to the sub-reach scale (100m belt transect) for the purposes of "ground truthing" in the field, using the Andregg Vegetation Transects for these more detailed comparisons. This analytical assessment can provide validation of the 2010 aerial photo and the NHP datasets for that transect, as well as providing a statistically sound, technical basis for monitoring vegetation dynamics over time.

4.2.3 Prior Vegetation Studies

A detailed vegetation survey of Cache Creek from Clear Lake to the Settling Basin near Woodland, including 6 cross-sections within the CCRMP, was performed by Zentner & Zentner[16] in 1993. The

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[16] 2003, Zentner & Zentner, Report: Cache Creek Environmental Restoration Program

survey included cross-sections near bridges that cross Cache Creek at County Roads/highways 82, 85, 87, I-505, 94B and I-5. This analysis was reviewed and not found suitable for comparison to the current effort. It was not used for further analysis. Moreover, as a general caveat, while ensuring ease of access to the creek is a consideration for any sampling effort, the bridge locations are typically hydraulically constrained and subject to greater scour (shear) forces, all-terrain vehicle (ATV) trespass, and consequential weed invasion.

In 1996, Tracy Bunnester completed a report entitled Baseline Data on the Plant Communities of Cache Creek. This report had a more detailed plant list, one that essentially matched the genus and species of plants currently found on the Creek, and those on the local plant list. The report did not identify the locations of the transects, but it was utilized to provide a double check on the range of expected results.

The percent area covered by each species and cover class can provide a proxy that, with some re-interpretation, could be used for future field work. Dr. Jeff Hart performed a LiDAR assessment of the CCRMP in 2006[17] (Hart, 2007) that can be used for comparative analysis in 2011.

4.2.4 Methods and Sources

Aerial Photos- The earliest available orthorectified and georeferenced aerial photos that were available from the County's extensive datasets were the 1998 set, and a three-panel (upstream) set from 1999 that offered better contrast (all images were in black and white). These were compared to the exceptional quality 2010 color aerial photos (also orthorectified and georeferenced) from Towill. The data was of increasing quality from 1998 to the present, and is currently of very high quality. These photos were loaded into a Geographic Information System (GIS) workstation running ARC GIS 10.0. The GIS allowed non-pertinent areas to be "clipped" or masked from the datasets using the CCRMP boundary from the County GIS shape files to eliminate all areas outside of the CCRMP[18].

Similarly, the 2006 Yolo Natural Heritage Program (NHP) vegetation dataset was imported into the GIS and clipped to meet the CCRMP boundary. The NHP dataset came from a variety of sources, including Chico State University and the Department of Water Resources Tributaries Study, and included 21 different land classes ranging from water to upland oak. For the purposes of this analysis these classes were aggregated to a subset of nine classes by combining similar vegetation and use classes. For example, the class 'barren anthropogenic' was added to the class 'urban/built up', and all agricultural classes were combined.

Table 1. Vegetation Analysis By Class by acre, compiled by NHP (2006).

Barren – Anthropogenic	9.32
Barren - Gravel and Sand Bars	721.26
Blackberry NFD Super Alliance	0.28
Blue Oak Alliance	2.91
California Annual Grasslands Alliance	73.95
Deciduous Fruits/Nuts	151.5
Field Crops	30.71
Fremont Cottonwood-Valley Oak-Willow (As -Sycamore) Riparian Forest NFD Association	195.35
Giant Reed Series	43.30
Grain/Hay Crops	59.79
Intermittently Flooded to Saturated Deciduous Shrubland	189.47
Mixed Fremont Cottonwood - Willow spp. NFD Alliance	65.1
Mixed Willow Super Alliance	36.71
Pasture	84.24
Tamarisk Alliance	81.65
Truck/Nursery/Berry Crops	35.92

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[17] March 17, 2007 Memo to C. Alford from Dr. J. Hart

[18] Note: Since the 1996 boundary was established there are several areas where the creek has migrated outside of the original boundary.

Upland Annual Grasslands & Forbs Formation	330.94
Urban or Built-up	124.91
Valley Oak Alliance	7.28
Valley Oak Alliance – Riparian	34.17
Water	199.43

Table 2. Consolidated Land Classes by acre, derived from NHP (2006)

Anthropogenic Barren, Urban/Built up	134.23
Naturally Barren	791.26
Crops/Pasture	362.16
Invasive weeds (Tamarisk, Blackberry and Arundo)	125.23
Uplands/Grasslands	404.89
Valley/Blue Oaks	10.19
Riparian Forest	294.62
Riparian Shrubs	226.18
Water	199.43
Total Acreage 2,548.23	

The NHP vegetation layer generally matches the 1998 alignment. A comparison of the 1998 aerial photos with the NHP vegetation classes showed reasonable approximation to the vegetation class boundaries, although the class demarcations for anthropogenic barren land included areas of the upper terrace of the channel [See Transect 2] that would be reclassified as channel in the localized analysis of CCRMP vegetation. Finally, the water class is dependant on the water year and date of flight, so this class provides little information since it is so highly variable. For this reason it was not used for this report but, in future analyses, it can be aggregated with the gravel class for acreage estimations for channel-influenced bare ground, but retained in its own layer to show the thalweg and its variation in location from year to year.

Visualization-These data were compared on a reach by reach basis by switching between years, and switching between datasets. While the detection of change and comparison was completed manually for this initial investigation, the strengths and weaknesses of each of the dataset were apparent and did not require a re-classification or creation of synthetic layers.

CCRMP Boundary- The CCRMP boundary generally follows the 100-year floodplain in the upper reaches. In the lower reaches, the 100-year floodplain is much more extensive than the top of bank and the CCRMP boundary. The 2010 Towill aerial survey data used a broader (wider) boundary for the CCRMP, which in many cases more accurately reflected the current 100-year floodplain. For the purposes of this analysis the formal County GIS boundary was used. There is some variation in the locations of this boundary relative to the 100-year floodplain throughout the CCRMP, some of which appears to be a mapping offset error. The offset or registration error is apparent in several areas where the CCRMP boundary is offset to the north and east at fixed features, such as bridges and weirs. In addition to the normal mapping errors, some variation is clearly due to channel migration. The net consequence of this variation is that the analysis for each land class will not be comparable for the boundary if it is changed. Fortunately, since the vegetation information is now on GIS, the analysis can be re-run if boundary updates occur. Total acres become less and less ecologically relevant and change detection becomes increasingly difficult if the boundary is not updated.

Transect Locations- A host of transects have been provided to the TAC, including the 2002 Andregg Vegetation Transects, used here. Each set of transects had a different purpose and orientation. For example, there is a set of transects that was used for a coarse-scale survey at the major bridges in 1993, described above. There is also a “vegetation survey” transect set (Leathers, 2010) that is very similar to the Andregg transects, but which run north to south, rather than perpendicular to the river. The Leather transect locations are very close to the Andregg locations, but offset to less-disturbed areas. These have also been added to the GIS database for comparative purposes. While they have the advantage of the minimal human disturbance, they are at (varying) oblique angles to the channel, and have the result of eliminating the possibility of showing width/depth/ratio changes and vegetation gradients without relying on indices. This is because the area of each class coverage is to some degree dependant and correlated to the relative angle that the stream crosses the transect. This is eliminated by the perpendicular transects used by Andregg. While at some point the Andregg transects may end up with skew in relationship to the direction of the channel based on channel migration, the transects can be rotated to compensate.

4.2.5 Discussion

The aerial photos provided a consistent dataset, and analysis of them a consistent approach, to assessing the creek at the watershed (14.5 miles long) and the reach (2 mile long) basis. The older photo sets were fairly indistinct and specific species were very difficult to discern without ground truthing at the sub-reach level (100 yard). The 2010 data were very high resolution (fine granularity) and in many cases allowed for reasonable distinction to the species level in the upper canopy. The aerial photos are useful for a plan view assessment of areas which is otherwise not possible. It also provides an invaluable temporal record. However, the manual use of the photos for change detection, such as vegetation dynamics is difficult and time consuming.

Based on a review of the transects, significant changes to native riparian vegetation extent or density do not appear to have occurred since 2006, with the exception of Transects 11 and 12 for cover of trees and shrubs. Most minor changes in areal extent appear to be from mapping issues in the 2006 dataset, or channel migration. Beyond those two considerations some increase in shrub extent was visible in Transects 1, 4, and 9, and riparian forest extent in Transects 4, and 10. Declines in riparian forest were noted in Transect 8.

There has been significant reduction in both tamarisk and arundo densities and extent for the same time period based on the comparison of photos for the same locations, throughout the creek. For example, all transects appeared to either be the same between years or had a reduction in tamarisk, with the exception of Transect 4. Quantifying the degree of change is difficult due to the dead tamarisk and arundo canopy relicts, as well as the re-sprouting that is happening on a far smaller scale. It does not appear that any significant replacement of these invasives by native species is occurring at these locations, visible in the aerial photos. Nor would it be expected since there has been no replanting of natives. The transects are intended to help ground truth these visual observations and mapping the herbicide application efforts can help fill in missing information.

There has been some channel migration, associated with channel redirection in some cases, and some meandering within the banks (upper terrace). One of the many challenges with this sort of analysis is identifying proximate causes and indirect causes of reach- and site-specific features. For example, River miles 27.1, 26.7, 26, 25.6, 25.3 all had interesting dynamics that should be further analyzed The ecological utility of each of the Andregg transects is discussed in the following section. Transects that traverse reaches that have been highly disturbed by artificial means (either by ground disturbance or from bridge hydraulics) were considered of limited value. Transects with a distinct bank, intact mature native vegetation, braiding or restoration activities (for comparative purposes) were considered valuable for assessment.

It is important to note that the geomorphology and the hydraulic dynamics are important drivers of the ecological conditions, and thus the resulting plants and animals that occupy the creek. As a result, in order to understand the current vegetation patterns on the landscape and the need for (and the design of) restoration projects, a detailed understanding of these physical features and flood processes needs to occur and be described.

4.2.6 Analysis of the Andregg Vegetation Transects

The Andregg Vegetation Transects were analyzed with regard to their ongoing utility for long-term vegetation monitoring. In addition, the changes in vegetation classifications were assessed over a five year period using 2010 aerials and the NHP's 2006 vegetation classifications. It should be noted that the NHP vegetation classifications were gathered as part of a separate County-wide mapping project, and are intended for large-scale planning. Nevertheless, the NHP data represent the most comprehensive vegetation classification available at this time. The following analysis uses the NHP classes as a baseline data set for assessing ongoing vegetation changes in the CCRMP area. Though there are some differences in vegetation classifications, noted below, that will need to be considered in order to fully utilize the NHP data, they do in fact provide a useful baseline for ongoing assessment of vegetation change in the CCRMP area.

Acreage estimates for vegetation classes in each of the transects are included in Appendix B. The data there include: 1) acreage estimates based on the 2006 NHP data; 2) a comparison of acreage estimates based on the 2006 NHP data and ocular analysis of the transects utilizing the 2010 aerial photos; and 3) 2006 NHP vegetation classes layered over the 2010 aerial photos. An analysis of each of the Andregg Vegetation Transects led to the following conclusions:

Transect 1. (Capay Reach, Andregg YC_01-TC_02) This transect is in the most upstream CCRMP reach, which is one of the most-highly developed reaches. Overall, the vegetation type and extent is determined by the adjacent farming and the Capay Dam, but also by the very shallow bedrock that acts as a confining layer. This confining layer reduces the depth that plant roots can extend, but this is mitigated somewhat by a series of seeps and springs created by the canals on each side that provide constant water along that confining layer to the riparian plants. Those seeps and springs contain a variety of herbaceous plants that would otherwise not be found at those locations. There remains considerable invasive weed populations just upstream of this transect.

The spillway portion of the Capay Dam and its eroded area were essentially identical in the photos and by NHP classes. The NHP Urban or Built-up class polygon was skewed, and included the flood scoured area, increasing the total acreage of that class disproportionally. The Truck/Nursery/Berry Crops class polygon was smaller than the actual farmed area. This figure also shows the skew and misalignment of the CCRMP boundary. Tamarisk and arundo populations were significantly reduced in this transect. This transect is of limited value ecologically since it has very high disturbance and anthropogenic features.

Transect 2. (Hungry Hollow Reach, Andregg YC_05-TC_06; Note: 03-04 are consistently missing in all of the records) This transect is located in an area where the bedrock is still close to the surface (just upstream of the transect), but it is dominated by a large fan of sediment. This is a normal feature created by the change in valley form. The confining layer, while reducing rooting depth, may provide more water for plants that would be available otherwise. This is a difficult area for traditional restoration because of its high natural dynamism, and reports of lower water tables just downstream of this transect (CCRMP Pg. 52).

This figure shows the significant lateral channel migration from north to south. Despite that channel migration, the upper terrace remained in the same location. This shows a typical condition seen throughout the creek, whereby meander movement arcs to the adjoining floodplain, but does not generally create lateral bank erosion as measured by the most severe distance lost. This figure also shows the skew and misalignment of the CCRMP boundary. Finally, the NHP Urban or Built-up class polygon was skewed, and included the upper terrace area, increasing the total acreage of that class disproportionally. While disturbed, this transect is of useful value ecologically since it has high braiding (multiple overlapping channels or anastomose), restoration and anthropogenic features.

Transect 3. (Hungry Hollow Reach, Andregg YC_07-TC_08) The transect is located within the same reach as Transect 2, but it is outside of the fan area and the confining layer is no longer visible near the surface. This is one of the widest and visibly the driest reaches of the creek, with large expanses of annual grasslands dominated by invasives and no riparian forest.

This figure also shows the significant lateral channel migration from north to south. Despite that channel migration, the upper terrace remained in the same location. This figure also shows the skew and misalignment of the CCRMP boundary particularly to the south. Finally, the NHP Urban or Built-up class polygon again included the upper terrace area, increasing the total acreage of that class disproportionally. While disturbed, this transect is of value ecologically since it has high braiding/anastomose, restoration and levee features.

Transect 4. (Madison Reach, Andregg YC_09-TC_10) This transect is the transitional zone between the highly braided upstream reaches and the more confined downstream reaches. It only contains a few remnant patches of riparian forest. This area appears to be amenable for revegetation efforts, and would provide the foundation of a vegetated corridor linking reaches.

This figure also shows the significant lateral channel migration from south to north. Despite that channel migration, the upper terrace remained in the same relative location. This figure also shows the skew and misalignment of the CCRMP boundary due to the channel migration. Finally, the NHP Urban or Built-up class polygon to the north included the upper terrace area, increasing the total acreage of that class disproportionally. While disturbed, this transect is of useful value ecologically since it has high braiding, restoration and levee features.

Transect 5. (Madison Reach, Andregg YC_11-TC_12) This transect is very similar to Transect 4, with the same opportunities for restoration and challenges due to the highly modified terrain. This figure also shows the significant lateral channel migration to the north with upper terrace erosion and bank cutting. This figure also shows the skew and misalignment of the CCRMP boundary. The creek falls outside of the CCRMP boundary in this transect. While disturbed, this transect is useful ecologically since it has high braiding, bank stabilization, restoration and levee features.

Transect 6. (Guesisosi Reach, Andregg YC_13-TC_14) This transect is very similar to Transects 4 and 5, with the advantage there is some remnant riparian forest to build from downstream. This figure shows the skew and misalignment of the CCRMP boundary to the south. The Pasture and Mixed willow super alliance polygons to the south are incorrect. While disturbed, this transect is useful ecologically since it has high braiding, bank stabilization, restoration and levee features.

Transect 7. (Guesisosi Reach, Andregg YC_15-TC_16) This transect is in better condition than most of the upstream transects and is central to providing contiguous riparian cover to the upstream reaches. It can be thought of as an anchor to maintain that connectivity. This figure shows the slight lateral channel migration to the north. This figure also shows the skew and misalignment of the CCRMP boundary. The water polygon to the south is incorrect. While disturbed, this transect is of value ecologically since it has high braiding, bank stabilization, restoration and levee features.

Transect 8. (Dunnigan Hills Reach, Andregg YC_17-TC_18) This transect has patches of surrounding riparian and wetland habitat. While not as densely covered with riparian forest as would be suitable to be called continuous canopy and internal habitat, it does provide ecological corridor attributes. This figure shows the slight lateral channel migration to the north. This figure also shows the skew and misalignment of the CCRMP boundary. While disturbed, this transect is of value ecologically since it has complex vegetation features.

Transect 9. (Dunnigan Hills Reach, Andregg YC_19-TC_20) This transect has some of the best expanses of mixed riparian forest and as a result, best canopy cover on the creek. This portion of the reach is the foundation for upstream and downstream habitat. While not in historic condition, portions could be used for reference assessments to compare restoration or reclamation projects to current conditions. This figure shows a stable split channel. This figure also shows the skew and misalignment of the CCRMP boundary to the south. While disturbed, this transect is of value ecologically since it has exceptionally complex vegetation features.

Transect 10. (Hoppin Reach, Andregg YC_21-TC_22) This transect is the transition between the well-vegetated upper reach and the nearly bare lower reaches. The transition to high banks associated with channel entrenchment and loss of floodplain width essentially strands the historic riparian forest and provides no new growing space for regeneration. This location still has a broad enough floodplain to accomplish traditional restoration. This figure shows a stable channel. This figure also shows the skew and misalignment of the CCRMP boundary to the south. While disturbed, this transect is of value ecologically since it has exceptionally complex vegetation features.

Transect 11. (Rio Jesus Maria Reach, Andregg YC_23-TC_24) This transect is deeply entrenched and has limited potential for restoration under current conditions. For successful large-scale riparian restoration, significant modeling and coordination must be completed. This figure shows a stable channel. This figure also shows the skew and misalignment of the CCRMP boundary to the north. While disturbed, this transect is of value ecologically since it has stable vegetation features.

Transect 12. (Rio Jesus Maria Reach, Andregg YC_25-TC_26) This reach is very similar to the upstream reach at Transect 11. It does have potential to expand the floodplain with re-grading on the north bank. This figure shows significant erosion repair. This figure also shows the skew and misalignment of the CCRMP boundary, ending before I-505. While disturbed, this transect is of value ecologically since it has large restoration features.

4.2.7 Conclusions and Recommendations

To aid in analysis by future TAC members, an unsupervised classification of the color aerial photos done by the aerial survey contractor may be of significant benefit. This should be established after the ground truthing component fully developed. Despite the time needed to complete the classification with the degree of accuracy needed to provide management decision support, completing this once, accurately, would provide a foundation for future rapid analysis. To that end, CCRMP boundaries should be updated and the permanent transects (Andregg) should be reviewed for minor modifications in the 2011 analysis. Specifically, the CCRMP boundary can be updated in 2011-2 to include the areas that the channel has migrated by using the HEC-RAS model to define the 100-year flood boundary, as originally intended. The areas near Woodland that were originally revised outside of the 100-year flood elevation would not need to be changed.

4.3 Annual Invasive Weed Management

No specific reports or analyses have been completed in 2010 to assess annual invasive weed establishment or treatment. It is clear from the creek walk that invasive species, such as perennial pepperweed/white top (*Lepidium latifolium*), are establishing throughout the creek, but the degree and extent of that establishment is uncertain.

Strategically, it is critical to identify existing and new threats and respond to them in a concerted top to bottom fashion in the watershed. The most expeditious means of accomplishing this is collect the data during the existing weed spraying program. Each invasive species, its approximate extent, and any treatment, should be identified on a handheld GPS unit and mapped in GIS. Without this information it is not possible to determine the success of the weed management program, which at this time is conducted only by herbicide application. As articulated in the CCRMP and CCIP, a tactical re-vegetation in the areas that have been treated should be implemented. Fast growing replacements, such as local willow species and native grasses can be established readily on barren or sparsely weeded sites, with supporting irrigation as needed.

Consistent with page 22 of the CCIP, landowners with significant weed problems should be engaged to see if further management can be completed through cooperative agreements.

4.4 Major Channel Stabilization Recommendations/Maintenance

The CCIP (Chapter 3) lists several priorities to be used by staff in allocating resources for improvement projects. The priorities include: channel stabilization near state and county bridges; implementation of the "Test 3" profile to improve flow efficiency; levee removal (where appropriate) to widen the floodplain; construction of groundwater recharge projects; and revegetation. After reviewing present creek conditions and discussions with affected landowners, recommended channel improvement priorities for purposes of vegetative management are as follows:

Continue to identify and clear invasive species, such as tamarisk (*Tamarix* sp.), giant reed (*Arundo donax*), milk thistle (*Sillybum marinarum*), Italian thistle (*Carduus pycnocephalus*), yellow star thistle (*Centaurea solstitialis*), Himalayan blackberry (*Rubus* sp.), ravenna grass (*Saccharum ravennae*), and fig (*Ficus* sp.) throughout the planning area. The historic treatment areas have some re-sprouting of tamarisk and arundo. Other weeds are not treated, or treated on a limited basis. These invasive, non-native plants can and do replace native habitat and in the case of arundo, tamarisk, and Himalayan blackberry, can adversely affect stream flow. Removal of these species will allow for the establishment of more diverse native flora and would improve flood capacity. However, removal alone is not a solution in itself. As identified in the CCRMP-CCIP, revegetation with native species is critical in reducing the re-establishment of these and other invasive species.

- Vegetation – use of vegetation alone rather than stone, concrete, timber or other materials at appropriate erosion/stabilization sites (CCIP, Figure 26). Effective solutions may also involve combinations of structural (stone or concrete) features with vegetative alternatives in the form of "biotechnical solutions" (CCIP, Figure 27) to erosion and/or stabilization problems. For example, CCRMP Action 4.4-1 describes desirable methods for bank and channel protection including willow spiling (retaining walls constructed of woven willow stems from which trees will sprout), spur dikes to deflect the current away from the bank and create areas for vegetation, and cabling dead trees along the bank to provide both bank stabilization and additional habitat.

Vegetation has been used extensively throughout the creek for restoration, and in some cases, stabilization of the channel. The use of vegetation by itself for redirecting flow does occur with very dense, high roughness plants such as arundo, tamarisk, and Himalayan blackberry. Arundo is very effective for redirection, and the tamarisk and Himalayan blackberry achieve the same result, but over a longer period of time. This is not a desirable form of stabilization because these plants also lead to promotion of fire, inadvertent channel deflection, sediment accumulation and entrenchment, and loss of habitat for many native plants and animals. Native willows are less effective deflectors of stream energy, and the willows and cottonwoods have different life strategies and hydraulic effects.

Willows are early colonizers (early seral) of fresh gravel bars, and backwater areas, and have a wide range of tolerance for flooding and shading. That broad range of tolerance comes from the several native and a few introduced species that fill specialized ecological niches from gravel bars to fairly dry terraces. The willow species that border the creek (non-tree forms) have the ability to fold over and provide a very smooth surface for floods to wash over them with minimal damage. Cottonwoods are an early seral species which sprout on freshly aggraded surfaces, typically after significant high water events. They can also fold over as saplings, but they have the ability once established to tolerate repeated flooding and several feet of channel aggradation. As early seral species, they colonize new surfaces, grow very quickly and die fairly early, typically in the 80-110 year range. They cannot tolerate fully shaded (closed) canopy cover by other trees.

Future projects that use vegetation alone or in combination with other materials for erosion/stabilization sites should be identified and closely monitored for information that can better inform the program. Observation and analysis should continue particularly in the Dunnigan Hills reach where bio-based erosion control projects have been shown to be successful and there is a relatively high water table.

4.4.1 Channel Maintenance Activities

In 2010, there have been no TAC identified needs for vegetation removal for hydraulic capacity with the exception of the weed management along the north banks in the Jesus Maria Reach. The upper Capay Reach, Dunnigan Hills Reach, and Rio Jesus Maria Reach contain expanses of tamarisk, Himalayan blackberry, and arundo, but these populations do not appear to have discernable hydraulic influence. Review of channel conditions in the field or from the aerial photos in 2010 did not identify any specific vegetation removal needs outside of the described weed issues.

Chapter 5- ADMINISTRATION

The Cache Creek Area Plan (CCAP) administration underwent significant change in 2010 primarily due to County Departmental and Division restructuring. As a result of the struggling economy, the Parks and Natural Resources Department was split, with the Natural Resources portion becoming a division under the County Administrator's office. As part of the restructuring, a new Natural Resources Coordinator was brought in to administer the CCAP program including staffing changes to meet program goals. As part of this reorganization, the Off-Channel Mining Plan (OCMP) implementation was contracted to the County Planning and Public Works Department (PPW). In addition, all new mining permit applications and Flood Hazard Development Permits will be processed through PPW. Finally, outside consultant assistance was retained to assist with the process of rebuilding the program, providing oversight, management, and audit services. It is anticipated that these services will continue through the 2011 program year. Significant progress was made in 2010 to re-align staff and consultant work with program goals and objectives. Relationships with core partners have been re-established or strengthened through improved communications. The production of this Annual Report, the first since 2006, demonstrates the renewed commitment of all the CCAP partners in meeting the intended purpose and goals of the CCAP.

5. 1 FUNDING

The CCAP, and specifically the Cache Creek Resources Management Plan (CCRMP) and Cache Creek Improvement Program (CCIP), are funded through aggregate mining fees paid by aggregate producers within the CCAP boundary. The Gravel Fee Mining Ordinance, adopted by the Board of Supervisors in 1996 and amended in April, 2007, requires a series of fees to be placed on each ton of gravel sold (not mined) within the CCAP, for monitoring and restoration of the creek, as well as administration of the program.

5.1.1 GRAVEL MINING FEE BREAKDOWN BY FUND

Pursuant to the Gravel Mining Fee Ordinance, Section 8-11.01(a) and (c), the calculated fee split over ten years is as follows:

Effective Dates	Total ¢ per ton	CCRMP	M/R	OCMP	CCC	Surcharge[1]
1/1/97 to 3/31/07	*0.2*	*0.1*	*0.02*	*0.03*	*0.05*	*0.10 (original)*
4/1/07 to 12/31/07	0.45	0.25	0.02	0.08	0.1	0.2
1/1/08 to 12/31/08	0.468	0.26	0.021	0.083	0.104	0.2
1/1/09 to 12/31/09	0.487	0.271	0.021	0.087	0.108	0.2
1/1/10 to 12/31/10	0.506	0.2813	0.0223	0.0901	0.1123	0.2
1/1/11 to 12/31/11	0.526	0.292	0.023	0.094	0.117	0.2
1/1/12 to 12/31/12	0.547	0.3041	0.0241	0.0974	0.1214	0.2
1/1/13 to 12/31/13	0.569	0.3163	0.025	0.1013	0.1263	0.2
1/1/14 to 12/31/14	0.592	0.3292	0.026	0.1054	0.1314	0.2
1/1/15 to 12/31/15	0.616	0.3425	0.0271	0.1096	0.1368	0.2
1/1/16 to 12/31/16	0.64	0.355	0.028	0.113	0.142	0.2

Note: Cents-per-ton fee split shown to four decimal places only where necessary to allow for exact split of collected fees.

1) No proportional annual increase on the Production Exception Surcharge

Source: TSCHUDIN CONSULTING GROUP, June 2, 2010

The Fee Ordinance establishes the amount of the gravel mining fees and how they are to be spent, pursuant to the following guidance:

The **CCRMP Implementation** Fee is to be used to implement the CCRMP and CCIP. Specifically, it can be used for the design and construction of projects for channel stabilization and bridge protection; the design and construction of channel maintenance projects; monitoring, modeling, and flood watch activities per the CCIP; and compensation of the TAC.

The **Cache Creek Conservancy Contribution** is to be used for habitat restoration and enhancement along Cache Creek, and revegetation projects consistent with CCRMP creek stabilization objectives.

The **Off Channel Mining Plan (OCMP) Administration** fee is to be used for the implementation of the OCMP, administration of the long-term mining permits and Development Agreements, and inspection of mining and reclamation operations.

The **Maintenance and Remediation Fee** is to fund a long-tem, interest-bearing account for the following future activities: the correction of mercury bioaccumulation problems after reclamation has been completed, if necessary; clean-up hazardous materials contamination after reclamation is completed, if necessary; extended environmental monitoring of the off-channel mines, including data gathering and groundwater modeling, beyond that required in the mining permits; and maintenance of publicly held lakes within the plan area. No expenditures may be drawn from the Maintenance and Remediation fund until January 2027, at which time the fund shall be made available for the activities identified in this section. Starting in January 2047, the funds may be made available for implementation of the CCAP, including; habitat restoration; creation of open space and passive recreation opportunities; and creek restoration and stabilization.

The Twenty Percent **Production Exception Surcharge** of $0.20 per ton is collected for any amount of aggregate sold in excess of annual permitted production. These funds are to be divided evenly between the CCRMP Implementation fund and the Maintenance and Remediation fund.

In 2009 the total aggregate sales within the CCAP totaled 2,190,454 tons, resulting in fees due in 2010 of $1,066,751. It should be noted that, at the discretion of the County, up to 35 percent of the CCRMP fee paid by aggregate producers may be offset by costs incurred from participating in channel improvement projects. However, such offsets cannot be utilized for bank protection mitigation measures required under the off-channel mining permits. A total of $70,961.63 was offset in 2010. This represents work performed in 2009 by Syar Industries for grading at Herger/Skaife and a County Road 89 site, and for work done by Teichert Aggregates at the Correll Rodgers site.

5.1.2 CCRMP Budget

The Cache Creek Area Plan (CCAP) budget, per the Gravel Mining Fee Ordinance, consists of three distinct funds: The CCRMP, The OCMP and the Maintenance and Remediation funds. For a complete breakdown of the CCAP budget, please see the Final County Budget available on line at www.yolocounty.org.

The FY 2009-10 and 2010-11 budgets contain funding for several long-term CCAP required elements, including the 10 year CCAP update, the 5 year riparian survey and map, and the HEC RAS model. In 2011, staff will establish a contingency fund that will be utilized to fund such long term requirements that are not annual program activities.

Finally, those expenditures above and beyond the anticipated revenue are covered by the residual program fund balance. For FY 2009-10, the beginning balance for the CCRMP fund was $1,523,177.

5.1.3 GRANTS

One grant funded project was implemented in the CCRMP area in 2010. Yolo County Parks was awarded a grant in the amount of $189,000 from the California Natural Resources Agency as part of the final round of Proposition 50 funding in June, 2006. This project enabled a number of enhancements at Capay Open Space Park prior to 2010, including the planting of various native trees and plants, trail development, and the installation of shade shelters and information kiosks. The grant funds were also used to provide additional user amenities such as benches and picnic tables constructed from recycled materials. The final project enabled by this grant was the installation of an ADA compliant handicap accessible ramp into the creek bed in 2010.

5.2 APPLICATIONS FOR IN-CHANNEL ACTIVITIES

As required under Section 8-3.404 of the Yolo County Flood Damage Prevention Ordinance, the TAC is responsible for making recommendations on all proposed projects located within the CCRMP area. The recommendations are then forwarded to the Floodplain Administrator for a final decision. This past year, the TAC made recommendations for approval on one project, a bank stabilization project carried out by CEMEX near its aggregate facility. The details of that project were as follows:

Zone File No. 2010-045 (CEMEX)

Project Location: South bank of Cache Creek, east of I-505, approximately 1.5 miles northeast of the town of Madison (APN: 049-070-04, -05, -06, -09, -10, -11, -19, -21, and 025-450-01).

Project Description: In October 2010, the Yolo County Floodplain Administrator approved a Flood Hazard Development Permit (Zone File No. 2010-045) for CEMEX to reconstruct three locations on the south side of Cache Creek: Sites “D”, “E” and “F”. The low flow channel at the time of construction was located along the north bank of the creek.

Sites “D” and “E” were incised during the 2005-2006 winter storms. Materials used for the reconstruction included cobble and/or recycled concrete for keyways, and fill material consisting of a mixture of Horizon A & B soil and gravel and cobbles. Site “F” was undercut by the location of the low-flow channel. CEMEX backfilled the incised area with Horizon A & B soil and gravel and cobbles. A drought tolerant weed-free grass mix was established on the graded and backfilled areas.

The project disturbed approximately 2.5 acres. Approximately 7,000 cubic yards of fill was implemented into the bank repairs.

The proposed streambank stabilization project was necessary in order to restore Cache Creek to the pre-erosion flow condition, reducing the possibility of further erosion to the south bank of the creek to maintain the required mining setback, to restore the creek to its “natural” condition, and to reduce potential damage to nearby mining equipment along the south bank of this reach.

5.3 STATUS OF PROGRAMMATIC PERMITS

The CCRMP relies on several programmatic federal and state permits that allow for annual implementation of in channel activities and for successful adaptive management. The County is in the process of seeking reauthorization of several of these permits, which streamline the process for channel improvement and habitat restoration projects in the CCRMP area. The status of each of these permits is summarized below:

5.3.1 U.S. Army Corps of Engineers (USACE)

Construction activities within wetland areas, as defined under the Federal Clean Water Act, require prior approval of a Section 404 permit from the USACE. USACE issued Regional General Permit No. 58 for in-stream activities conducted within the CCRMP area in July, 1997. This permit was renewed in May,

2004. The County applied for reauthorization of this permit in 2010. As long as a proposed project shows that it is consistent with the requirements of the CCRMP by obtaining a Flood Hazard Development Permit from Yolo County, and meets the conditions required by the USACE for the General Permit, it is anticipated that a separate Section 404 Individual permit will not be required once the Regional General Permit has been reauthorized. The RGP #58 is a valuable streamlined process for supporting habitat restoration and channel stabilization on Lower Cache Creek, and is integral to achieving the goals and objectives of the CCAP and of multiple partner agencies.

5.3.2 U.S. Fish and Wildlife Service (USFWS)

As a part of the approval process for the Section 404 permit, the USACE is required to consult with the USFWS regarding a project's potential effects on Federally listed threatened and endangered species. The USFWS is focused on the impacts of the CCRMP on the valley elderberry longhorn beetle (VELB) and the giant garter snake. A new biological opinion may be required by the USFWS in order to reauthorize the Section 404 permit.

5.3.3 California Department of Fish and Game (CDFG)

Construction activities within the defined bed and banks of stream channels require prior approval of a Streambed Alteration Agreement (1600 Permit) from the CDFG. CDFG originally issued a 1600 Permit for in-stream projects within the CCRMP area in 1997. This permit was reauthorized in 2002, but expired in December, 2007. In August, 2008, the 1600 authorization was replaced by a Section 1602 Memorandum of Understanding, which establishes an individual project permit template. Reauthorization of the 1600 permit will be sought in 2011. As long as a proposed project shows that it is consistent with the requirements of the CCRMP by obtaining a Flood Hazard Development Permit from Yolo County, and meets the conditions required by the CDFG for the 1600 Permit, a separate Stream Alteration Agreement from the CDFG will not be required once the 1600 Permit has been reauthorized.

5.3.4 Regional Water Quality Control Board (RWQCB)

A general 401 Water Quality Certification, permitted by the RWQCB, is required in order to implement the Army Corps 404 Permit. The 401 Certification was originally approved in July, 1999, and reauthorized in August, 2002. As the certification is tied to 404 permit reauthorization, reauthorization of the 401 Certification will be sought following the anticipated reauthorization of the 404 permit in 2011. As long as a proposed project shows that it is consistent with the requirements of the CCRMP and meets the conditions required by the State Water Resources Control Board, separate 401 Certification from the SWRCB will not be required once the 401 Certification has been renewed.

5.3.5 Central Valley Flood Protection Board

In 1980, the State Reclamation Board (now the Central Valley Flood Protection Board) staff determined that Cache Creek is a "designated floodway." However, at the request of Yolo County, the Reclamation Board declined to adopt floodplain regulations concerning proposed construction projects within the creek channel. Under Section 8414 of the State Water Code, if the Reclamation Board declines to adopt floodplain regulations for the designated floodway, then the local agency having jurisdiction over the project area may adopt regulations. These regulations have the same force and effect as those adopted by the State Reclamation Board.

The requirement for floodplain regulations is fulfilled by the Cache Creek Resource Management Plan (CCRMP) and Cache Creek Improvement Plan (CCIP), as implemented under the Flood Hazard Development Ordinance (Chapter 3 of Title 8 of the County Code), which continue to fulfill the State Water Code requirements.

5.3.6 California Department of Conservation

The CCRMP is recognized in Section 2715.5 (PRC) of the state Surface Mining and Reclamation Act as the functional equivalent of a general reclamation plan for implementation of the CCRMP/CCIP. Specific and detailed plans for improving channel shape, erosion protection, and riparian habitat are implemented by the County, individual mining companies, and other private parties under a "blanket" mining and reclamation permit held by the County. This was first authorized under Assembly Bill 297, sponsored by Assembly Member Helen Thomson in 1999. The second authorization, Assembly Bill 1984 (sponsored by Assembly Member Lois Wolk) passed in 2004. The third authorization, Assembly Bill 646 (sponsored by Assembly Member Wolk) passed in 2007.

5.4 PARTNER ORGANIZATIONS AND OTHER CREEK-RELATED PROGRAMS

The following entities are important partners with the County in implementing the CCRMP and CCIP:

5.4.1. Cache Creek Conservancy (CCC)

The Cache Creek Conservancy (CCC) is a 501(c)3 non-profit corporation whose mission is to promote the restoration, enhancement and prudent management of the stream environment along Cache Creek from Capay Dam to the Yolo Settling Basin. The Conservancy, created in 1996, manages land for wildlife habitat, controls invasive plants, and provides environmental education within the lower Cache Creek. It receives fees generated by the Cache Creek Area Plan, as well as funding from state, federal, and foundation grants. The Conservancy is staffed by an Executive Director, an Administrative Assistant, a Tamarix and Arundo Project Coordinator, and a Habitat Restoration Manager, working under the direction of an independently elected Board of Directors. The Conservancy and the County have collaborated on a number of joint ventures related to the creek, including management of County-owned lands such as the Correll-Rodgers property, WildWings Park, the Milsap property, and the Cache Creek Nature Preserve, the most significant natural lands thus far dedicated to the County through the CCRMP. In 2010 the Conservancy undertook an aggressive invasive species removal contract in the CCRMP area.

5.4.2 Yolo Chapter of the California Construction and Industrial Materials Association (CalCIMA)

CalCIMA is the industry representative for the sand and gravel producers mining lands in the CCAP program area. CalCIMA and the member Producers are active partners in the implementation of the CCAP. The members of the Yolo Chapter of CalCIMA that participate in the CCAP include Granite, Syar, Teichert, and CEMEX. In 2010, the County and CalCIMA resumed regularly scheduled meetings in order to stay better informed and to garner the necessary feedback and participation in program implementation.

5.4.3 Yolo County Flood Control and Water Conservation District (YCFCWCD)

YCFCWCD’s mission is "To plan, develop, and manage the conjunctive use of the District's surface and groundwater resources to provide a safe and reliable water supply at a reasonable cost, and to sustain the socioeconomic and environmental well-being of Yolo County." YCFCWCD’s boundaries cover 195,000 acres of Yolo County, including the entire CCRMP area. The District operates Clear Lake, Indian Valley Reservoir, and owns the majority of water rights for Cache Creek. As such, YCFCWCD plays a central role in determining the flow of surface water within the Cache Creek watershed. The Capay Diversion Dam, at the upstream end of the CCRMP area, provides some of the water that the District distributes through more than 150 miles of canals and laterals. YCFCWCD is an important partner in stream restoration projects, including the wetlands at the Cache Creek Nature Preserve. In 2010, the Producers and County joined forces and agreed to participate in the groundwater database program that is directed by the District for the Water Resources Association of Yolo County (WRA). This WRA program complies with the California Statewide Groundwater Elevation Monitoring program (CASGEM). Participation in the CASGEM program entitles participants, including the County and the CCAP program, to certain grant funding that otherwise would not be available.

5.4.4 Yolo County Resource Conservation District (RCD)

The Yolo County Resource Conservation District (RCD) commits to protect, improve, and sustain the natural resources of Yolo County. Resource Conservation Districts were first created as a result of the “Dust Bowl” crisis. Originally focusing on soil and water issues, the mission has broadened to include fish and wildlife habitat restoration, farmland preservation, and control of invasive plant and animal species. The Yolo RCD provides technical guidance, education, and on-site expertise for private landowners and growers, cities, schools, agencies, businesses, and research institutions. The County partners with RCD in the management of Capay Open Space Park. RCD is a lead agency in managing invasive plants in the Cache Creek watershed.

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