NAPA RIVER RUTHERFORD REACH RESTORATION PROJECT
ANNUAL MONITORING REPORT - 2017




Napa County Flood Control and Water Conservation District
804 First Street
Napa, California, 94559
Contact: Jeremy Sarrow
(707) 259-8204

Napa County Resource Conservation District
1303 Jefferson Street, Suite 500 B
Napa, California, 94558
Contact: Paul Blank/Jonathan Koehler
(707) 252-4189

Table of Contents

APPENDICIES

Appendix A Eroding Stream Bank Surveys

Appendix B Photographic Monitoring

1. Introduction

The purpose of this document is to report on the results of surveys performed during calendar year 2017 related to the monitoring program for the Napa River Rutherford Reach Restoration Project (Project). Napa County, in partnership with the Napa County Resource Conservation District (RCD), conducts the monitoring program in accordance with Project permits and as defined in the monitoring plan (Hayes 2012, Sarrow, Blank, Koehler 2015) approved for the Project. The monitoring plan was revised in April 2015 in order to better reflect the long-term schedule of various monitoring tasks over the life of the Project (20 years) and clearly define monitoring protocols based on Project construction being completed in the fall of 2014. The plan outlines monitoring framework and defines protocols utilized for collecting data and evaluating environmental parameters presented in this and previous reports.

Annual monitoring reports from calendar years 2009 through 2016 and the monitoring plan can be accessed online at the Napa County Watershed Information Center and Conservancy (WICC) document repository for the Rutherford Reach Restoration Project: http://www.napawatersheds.org/app_folders/view/5502.

1.1 Project Description

The Napa River Rutherford Reach Restoration Project is a landowner-initiated Project being implemented along a 4.5-mile reach (comprised of approximately 41 parcels owned by 30 different entities) of the mainstem Napa River south of the City of St. Helena between Zinfandel Lane Bridge and the Oakville Cross Road Bridge. Changes in land use and management in the Napa River watershed have resulted in confinement of the river into a narrow channel, loss of riparian and wetland habitat, accelerated channel incision and bank erosion, and ongoing channel degradation and property loss. A suite of restoration approaches have been utilized to achieve the Project's goals and objectives, including: setting back earthen berms from the top of the river bank; creating vegetated buffers between the river and adjacent land uses; creating backwater habitat to provide high-flow refugia for native fish; installing instream structures to improve aquatic habitat; removing non-native invasive and Pierce's disease host plants; planting native understory species; and installing biotechnical bank stabilization to stabilize actively eroding banks.

The Project also includes an annual maintenance program funded by landowner assessments to proactively address debris, bank erosion and to maintain and monitor the restoration features. Maintenance activities include debris removal, downed tree stabilization/relocation, in-channel vegetation management, planting native vegetation, invasive and Pierce's Disease host plant removal, and repairing (as needed) instream habitat structures and other constructed restoration features. This work is conducted under the supervision Napa County Flood Control and Water Conservation District (District) staff in coordination with landowners and their representatives. Maintenance reports from calendar year 2009 through 2017 can be accessed online at the WICC.

The Napa River is presently subject to a Clean Water Act Total Maximum Daily Load (TMDL) action due to impairment from excessive quantities of fine sediment degrading local water quality and beneficial uses. While sediment is a naturally-occurring input to the Napa River, excessive amounts are considered

a pollutant and thus sediment load reductions addressed in this report amount to 'pollutant reductions' in TMDL terms. The Project serves to support the TMDL objective of reducing fine sediment loads and as a result has been designated a regional priority by the San Francisco Bay Regional Water Quality Control Board.

1.2 Project Status and Implementation

As of October 2014, restoration construction for the entire Project, Reaches 1-9, has been completed and the Project is now in the maintenance and monitoring phase. Implementation of the Project will be fully complete by the spring of 2018, following three years of vegetation establishment and maintenance in Reaches 5-9. Beginning in the spring of 2018, long-term monitoring and maintenance of the channel will be funded entirely by the Maintenance Assessment District (MAD) established for the Project comprised of landowners with riverfront property within the Project reach.

For monitoring purposes, the 4.5 mile Project area has been divided into reaches numbered from 1 to 9 starting from the Zinfandel Lane Bridge and ending at Oakville Cross Road Bridge and into construction contract phases numbering 1 through 5. Final design plans for all construction phases of the Project are available at the WICC website: http://www.napawatersheds.org/app_folders/view/3577. See **Table 1** below for summary of construction schedules, Project reaches, and river stationing and construction phases by year.

Table 1: Construction Phases, Reaches, River Stationing and Construction Year

Final Design & Construction Phase	River Reach	River Station	Construction Year
Zinfandel Lane Bridge	Upstream Project Limit	24,857	-
Phase 1-East Bank	Reach 1 and 2	24,857 – 21,875	2009
Phase 1-West Bank	Reach 1 and 2	24,857 – 21,875	2010
Phase 2	Reach 3	21,875 - 16,000	2010
Phase 3A-East Bank	Reach 4	16,000 - 12,000	2011
Phase 3B-West Bank	Reach 4	16,000 - 12,000	2012
Phase 4A	Reach 8 North	7,800 - 5,800	2012 - 2013
Phase 4BC	Reach 8 South	6,400 - 3,400	2013
Phase 5	Reach 6	11,000 – 9,200	2014
Phase 5	Reach 7	9,200 - 7,800	2014
Phase 5	Reach 9	3,400 - 0	2014
Oakville Cross Road Bridge	Downstream Project Limit	0	-

1.3 Restoration Site Descriptions and Elements by Construction Phase and Reach

The restoration elements built in each construction phase (1-5) are summarized in **Table 2** below and are illustrated in **Figures 1-5** below as well. For additional detailed descriptions of each restoration area please refer to previous monitoring reports available on the WICC website. **Table 2** lists restoration features by type, river station location, and year constructed by phase and **Figures 1-5** depict restoration elements, including graded structures, setback berms, and instream structures by construction phase.

As a result of construction and completion of the Project in 2014, 26 floodplain benches spanning 8,580 linear feet with a surface area of 16.8 acres, were constructed in Reaches 1-9. A total of 6 side channel, wetland and alcove features were built totaling 3,054 linear feet, with a surface area of 4.6 acres including the secondary channels constructed at the Round Pond and Wilsey Properties and the backwater alcove features constructed at Rutherford Wine Studios and Cakebread properties. A total of 13 bank stabilization areas were constructed totaling 3,818 linear feet. Additionally, approximately 14,303 linear feet of setback berms were created in order to widen the distance between agricultural activities and the river channel.

Invasive species have been removed or managed, and riparian vegetation has been replanted on 30.5 acres including constructed benches, bank stabilization areas and widened riparian corridors where berms were setback. One hundred and forty nine (149) instream habitat structures, including 112 large woody debris structures and 37 boulder clusters, have been installed and assessed as a result of the Project; see **Table 2** below.

Table 2: Constructed Restoration Elements by Project Reach

River Reaches (9 Total)		Reach 1	Reach 2	Reach 3	Reach 4	Reach 8 North	Reach 8 South	Reach 5,6,7,9	Total
Floodplain Benches	Number	1	4	5	9	1	3	3	26
	Linear Feet	750	1,975	1,265	2,320	11	1450.0	809.0	8,580
	Acres	0.8	3.1	1.7	5.6	1.2	3.2	1.3	16.8
Tributary Alcoves, Created Linear Wetlands, Side Channels, Swales, Culvert outlet	Number	1	-	-	-	1	1	3	6
	Linear Feet	350	-	-	-	589	565.0	1550.0	3054
	Acres	0.7	-	-	-	0.1	2.1	1.7	4.6
Bank Stabilization Areas	Number	-	1	-	3	3	3	3	13
	Linear Feet	-	800	-	485	1,225	605.0	703.0	3,818
Setback Berms/Riparian Area	Linear Feet	-	3,565	1,205	8,665	-	615.0	253	14,303
	Acres	-	-	-	-	-	0.3	0.6	1
Instream Habitat Structures (Large Woody Debris & Boulder Clusters)	Number	15	18	7	26	21	44	18	149
Riparian Area Replanted (Riparian Areas + Bank Stabilization Areas + Instream Benches)	Acres	1.5	4.5	2.2	10.2	2.3	5.6	4.2	30.5

Figure 1: Constructed Restoration Elements Reaches 1 and 2

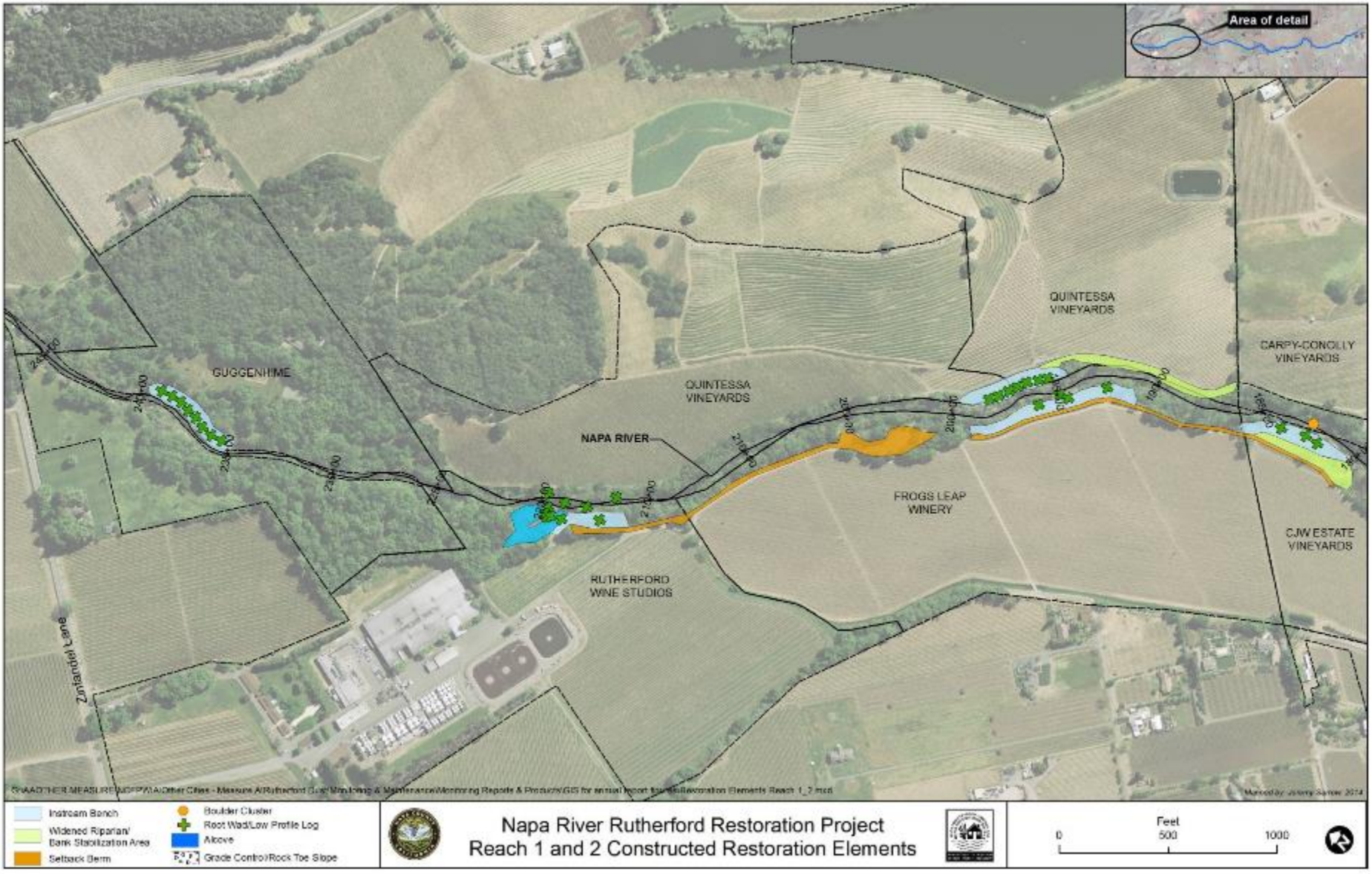


Figure 2: Constructed Restoration Elements Reaches 3 and 4

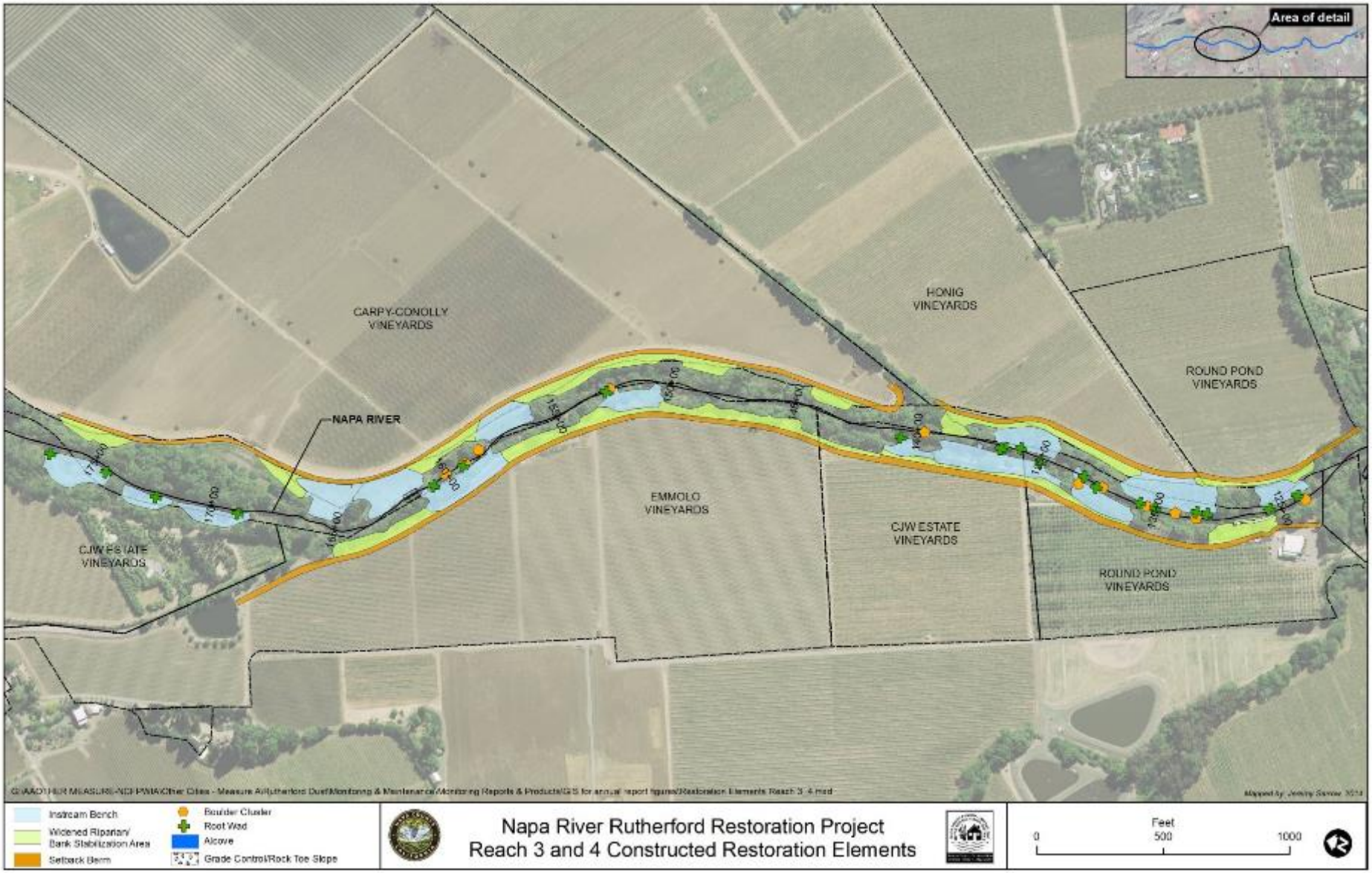


Figure 3: Constructed Restoration Elements Reaches 5, 6, and 7

Figure 4: Constructed Restoration Elements Reach 8

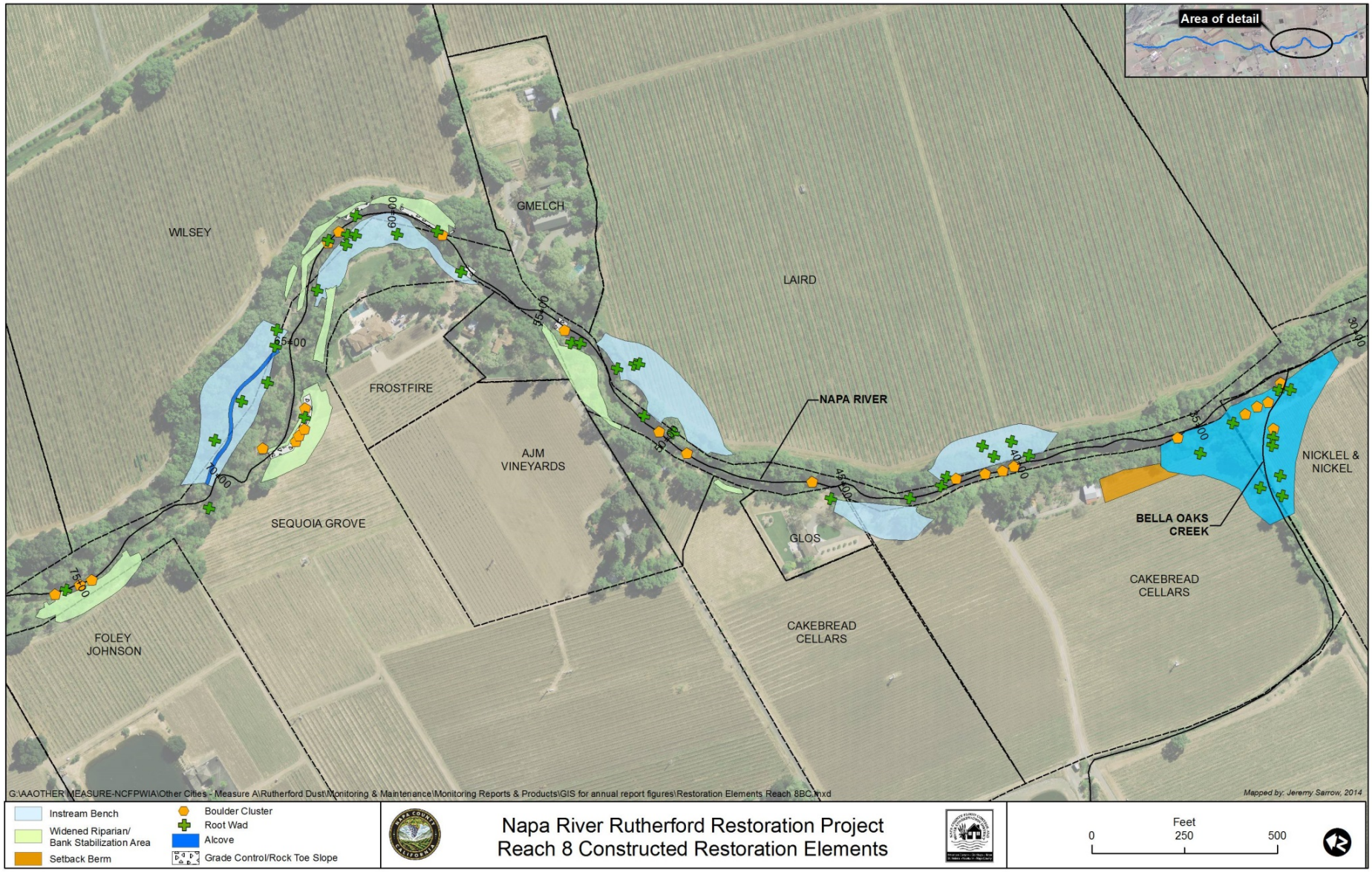
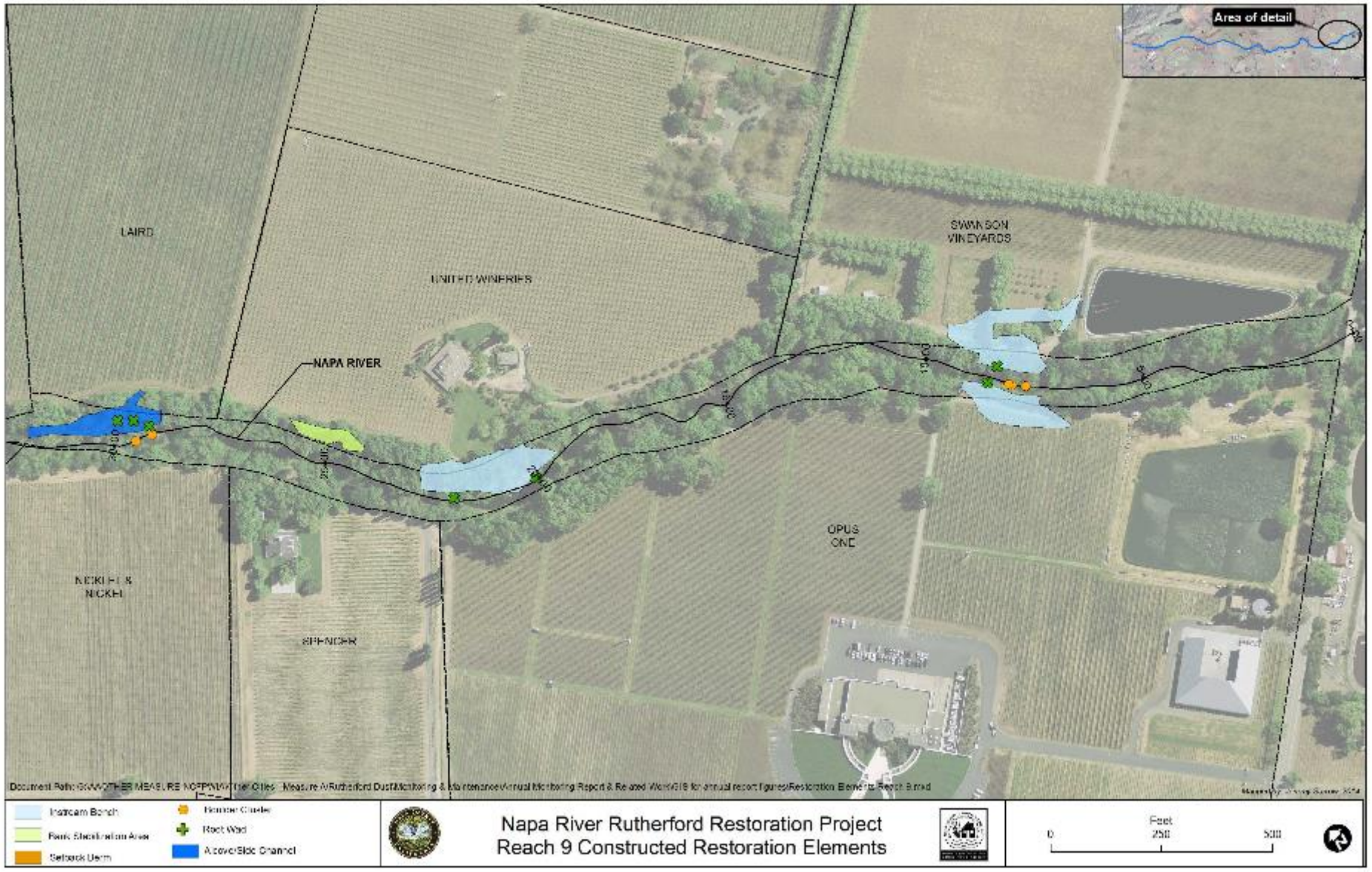


Figure 5: Constructed Restoration Elements Reach 9



2.0 Restoration Goals

Restoration goals defined for the Project in the monitoring Plan and in regulatory permits include the following general categories:

- Sediment Load Reductions and Increased Channel Morphology Complexity
- Aquatic Habitat Enhancement
- Riparian Habitat Enhancement
- Ongoing Stakeholder Participation

2.1 Sediment Load Reduction and Increased Channel Morphology Complexity

Pre-Project Conditions

Changes in land use, construction of earthen berms, and filling of historic channels resulted in increased flow volumes and velocities within the Napa River leading to channel incision and streambank erosion and failure. In addition, inputs of fine sediments to the channel from eroding stream banks and other sources throughout the watershed led to a reduction in the quality and quantity of instream habitat for salmonids and other native fish in the Project reach.

Goals and Desired Outcomes

The goal for this category is to reduce fine sediment inputs to the Napa River by reducing rates of channel bank erosion and bed incision and creating a more stable long term channel configuration. Desired outcomes include:

- Decrease the total amount of eroding streambanks
- Reduce rates of channel incision
- Re-establish geomorphic and hydrologic processes to reconnect the river channel to floodplain areas
- Increase and enhance riverine, riparian, and floodplain habitat value and complexity, particularly to support increased quality and quantity of habitat for Chinook salmon and steelhead trout
- Create inset bankfull (1.5 year flood elevation) and mid-level terraces
- Minimize the need for ongoing channel stabilization and maintenance work

Restoration treatments to reduce sediment load and increase morphologic channel complexity include:

- Increased riparian buffer width
- Setback berms
- Channel reconfiguration, bank stabilization and creation of secondary channels
- Grade-control boulders and weirs

2.2 Aquatic Habitat Enhancement

Pre-Project Conditions

The pre-restoration condition for aquatic habitat within the Project reach generally consisted of long runs and glides, with few deep pools and occasional riffles. Pool depths typically exceeded 3 feet and occasionally reached maximum depths of over 9 feet. When present, cover consisted of deep water, undercut banks, instream woody material and overhead cover in the form of low growing riparian vegetation. In general, less cover and fewer cover types were present in runs and riffles compared to pools. The predominant substrate in the reach was gravel and sand-sized particles. Median particle size (D_{50}) on the bars and riffles sampled in 2005 varied from approximately 8mm to 50mm, with an average of 23mm. In comparison, preferred spawning habitat for Chinook salmon typically consists of bed material ranging from 25 to 102 mm in size. In summary, the diversity and abundance of native fish (including salmonids) in the Rutherford Reach was limited by a combination of factors including: the lack of winter and spring high flow refugia (low velocity flow areas); lack of suitable fall and winter spawning habitat (riffles and coarse gravel), lack of habitat complexity (pool, riffle, glide variability); a high percentage of non-native predatory fish habitat (pools and glides); lack of instream and overhead cover; low summer base flows; and elevated summer water temperatures throughout the Project reach resulting in many areas being unsuitable for juvenile salmonid rearing and spawning.

Goals and Desired Outcomes

The goals/desired outcomes for aquatic habitat in the Project reach include:

- Re-establish geomorphic and hydrologic processes to support a continuous and diverse native riparian corridor
- Increase and enhance riverine, riparian, and floodplain habitat value and complexity, particularly to support increased quality and quantity of habitat for Chinook salmon and steelhead trout
- Increase habitat complexity by increasing variability in pool, riffle and glide habitats
- Decrease the percentage of deep pool and glide habitats that function as predatory fish habitat, and increase the percentage of shallow pool and riffle habitat

Steelhead and Chinook Rearing and Spawning Habitat

- Increase summer rearing and fall and winter spawning habitat and cover by inducing lateral pool scour associated with installed habitat structures (LWD)
- Increase and establish high flow (>500 cfs) and low velocity (<6 fps) bankfull refugia areas to increase fall and winter rearing habitat for 0-1+ steelhead and immigrating/emigrating salmonids
- Increase suitable fall and winter spawning habitat by increasing the frequency and length of riffle habitat; increase the recruitment of coarser spawning gravel by inducing sorting of bed and bar material resulting in increased deposition of spawning-sized sediments and decrease percentages of fines covering riffle crests / pool tail outs

Juvenile Steelhead and Chinook Rearing Habitat

- Increase and establish high flow (>500 cfs), low velocity (<6 fps) bankfull refugia areas to increase spring rearing habitat for 0+ steelhead, and immigrating/emigrating salmonids

- Increase quantity of high velocity feeding lanes by creating relatively high velocity riffle habitat and breaking up low velocity flat-water and pool habitat; induce local velocity accelerations and complexity and channel flow constrictions with installed habitat structures (LWD/Boulders)
- Enhance and encourage coarse sediment trapping for establishing riffle habitat and subsequent invertebrate production
- Increase and establish spring flow backwater pool habitat areas to increase spring rearing habitat for juvenile Chinook, and immigrating/emigrating salmonids
- Increase summer rearing habitat by enhancing pool habitat complexity, depth, and shelter/canopy cover

Restoration treatments installed in-channel to improve aquatic habitat include:

- Large woody debris structures
- Plant material: native willow cuttings, off-bench branch cover, branch bundles
- Constructed riffles
- Backwater alcoves on created instream benches and secondary channels
- Graded instream benches on alternating banks

2.3 Riparian Habitat Enhancement

Pre-Project Conditions

The pre-Project condition of riparian habitat varied considerably throughout the Project reach, depending on channel width, bank steepness and adjacent land uses. In general, Reaches 1, 2, 3, and 5 supported the largest intact stands of mature riparian vegetation. Valley oak (*Quercus lobata*), coast live oak (*Quercus agrifolia*), and California walnut (*Juglans hindisi*) were the dominant species in these reaches. Reaches 3, 5, 6 and 7 supported stands of Fremont cottonwood (*Populus fremontii*), white alder (*Alnus rhombifolia*), red willow (*Salix laevigata*), arroyo willow (*Salix lasiolepis*). In addition, California bay (*Umbellularia californica*), blue elderberry (*Sambucus mexicana*), and California buckeye (*Aesculus californica*) were also found throughout the Project area. The width of the riparian corridor (including vegetated areas along both banks) was greatest in Reach 1 (600 to 800 feet). The riparian corridor in Reaches 3, 5, 6, and 7 was also relatively wide, ranging from 250 to 400 feet in width. Reaches 2, 4, 8, and 9, which were confined by levees or adjacent land use, supported narrow bands of riparian vegetation (150 feet or less).

In many portions of the Rutherford Reach, the riparian understory was dominated by non-native species including Himalayan blackberry (*Rubus discolor*) and periwinkle (*Vinca major*). Other non-native invasive species such as giant reed (*Arundo donax*) were also pervasive throughout the Project area. However, other areas supported substantial patches of native understory species including snowberry (*Symphoricarpos albus*), Santa Barbara sedge (*Carex barbarae*) and California rose (*Rosa californica*).

In general, the extent and diversity of riparian habitat found within the Project area was limited by the morphology of the channel and adjacent land use practices. In most reaches, the confined nature of the

channel prevented the establishment of inset floodplain benches and bars that would enable recruitment and establishment of riparian species. Relevant design criteria included: establishing planting zones based on water surface elevations and distance from channel; establishing a minimum 50' buffer to reduce disturbance to native wildlife and encourage migration; fill existing canopy, increase plant diversity and structure to improve quality for resident and migrant wildlife.

Absent significant change in land use practices and floodplain access, the riparian community will continue to decline as older trees die and recruitment is impaired due to numerous factors (lack of suitable surfaces for colonization, competition with invasive plant species, vineyard encroachment, etc.). Creation of inset flood terraces and bank setbacks increases the area suitable for riparian recruitment. In particular designing terraces for inundation at approximately the 1.5 to 2 year return interval flows creates new disturbance zones where future recruitment may be self-sustaining, assuming invasive species continue to be controlled as part of Project maintenance.

Goals and Desired Outcomes

The goals/desired outcomes for enhancing riparian habitat include:

- Protect existing high value riparian habitat where possible
- Expand the native riparian buffer width and extent
- Remove invasive non-native vegetation and re-plant with native vegetation
- Re-establish geomorphic and hydrologic processes to support a continuous and diverse native riparian corridor

Restoration treatments to improve riparian habitat include:

- Revegetation and maintenance of restored areas with native under- and over-story species
- Vegetation of widened riparian corridor with native under-and over-story species
- Removal and management of invasive non-native plant species

2.4 Stakeholder Participation

Pre-Project Conditions

Landowners participated in the initial planning and design efforts for the Project as well as in separate final design and construction phases.

Goals and Desired Outcomes

The goals/desired outcomes for stakeholder participation include:

- Maintaining ongoing access for team members, including Napa County Flood District, Napa County Resource Conservation District, and contractors
- Minimizing piecemeal efforts at channel stabilization and berm construction on the part of landowners
- Continued landowner leadership, as evidenced via the Landowner Advisory Committee

- Remove invasive non-native vegetation and replanting with native vegetation that will not promote Pierce's Disease in vineyards
- Rehabilitate the river in a way that facilitates permitting agency approval

Elements to maintain stakeholder participation include:

- Conduct landowner advisory committee meetings
- Conduct informational outreach
- Manage channel maintenance and monitoring program

3.0 Monitoring Approach, Indicators and Performance Standards

Performance standards have been developed for each of the Project goals; success of the Project will be evaluated by quantifying progress towards meeting these standards over the life of the Project.

Project monitoring has several components, including:

1. An annual survey of the entire Project reach to observe current conditions and identify if any immediate adaptive management actions are needed;
2. Periodic detailed channel transect, longitudinal profile, and snorkel surveys designed to characterize the long-term habitat response to changing channel conditions based on flow variation and vegetation establishment and document salmonid utilization of restoration features;
3. Phased vegetation establishment surveys to track plant establishment and guide adaptive management of re-vegetated areas;
4. Photo-monitoring at defined stations to capture changes over time;
5. One-time post-construction evaluation of instream habitat structures at representative seasonal flows;
6. Surveys of stakeholder participation.

Refer to the Monitoring Plan (revised April 2015) prepared for the Project for a detailed description of the protocols, frequency of monitoring tasks and data management; see **Table 3** below for a summary of the Monitoring Indicators, Protocols and Performance Standards.

As mentioned previously, for monitoring purposes, the 4.5-mile Project has been divided into nine (9) reaches, with river stationing (RS) based on linear distance along the channel measured in feet. The Project extends from RS 0+00 at the Oakville Cross-road Bridge to RS 248+57 feet at the Zinfandel Lane Bridge.

A Before/After/Control/Impact (BACI) approach is being applied to document long-term changes in geomorphic and aquatic and riparian habitat parameters (Gerstein & Harris, 2005). Monitoring methods have also been chosen to balance the frequency and resolution of data collection in a meaningful and

yet cost-effective manner, while ultimately evaluating the success of each restoration site within the Project reach.

Table 3. Monitoring Indicators, Protocol Summary and Performance Standards

Indicator	Monitoring Protocol	Performance Standard
Sediment Load Reduction and Increase in Channel Morphology Complexity		
Length of eroding banks (L x H or % L)	Eroding Streambank Survey	75% reduction in length of actively eroding banks
Changes in bed deposition and scour relative to cross sections	Cross Section and Thalweg Surveys	Reduction in bed and bank erosion rates
Channel width-to-depth ratio at surveyed cross-sections	Cross Section Surveys	Increase in channel width to depth ratios
Aquatic Habitat Enhancement		
Channel substrate size distribution (median size frequency distribution, % fine sediment)	Pebble Counts, Spawning Gravel	Statistically significant increase in riffle median grain size (D50 mm) and reduction in riffle substrate percentage of fines (<2mm)
Riffle length and frequency	Habitat Typing Survey: Riffle, Glide, Pool Distribution Mapping	30% increase in riffle length or riffle frequency
Residual pool depth	Residual Pool Depth Survey at Installed Instream Habitat Structures	25% increase in residual pool depth in treated locations
Large woody debris structure persistence (# years, % persisting)	Large Woody Debris Survey	Persistence (75%) of installed instream habitat enhancement structures
Flow velocities in constructed high-flow refugia areas (v)	Seasonal Salmonid Habitat Velocity Surveys	Creation of high flow refugia (velocities less than 6 fps) at flows of 500 cfs and above at constructed alcoves and instream bankfull benches

Indicator	Monitoring Protocol	Performance Standard
Riparian Habitat Enhancement		
Area successfully treated (acres)	Area Mapping Percent Cover and Composition Survey	A minimum of 20 acres over the life of the Project
Plant survival at revegetation sites (%)	Vegetation Establishment Surveys and Direct Count Plant Survival and Vigor Survey	80% survival of native plants at revegetation sites at years 3, 5 and 10 post-installation
Percent native vegetative cover: Absence/presence natural recruitment	Area Mapping Percent Cover and Line Intercept Surveys	Greater than 70% native cover and evidence of natural recruitment by year 5 at revegetation sites
Stakeholder Participation		
Landowner Participation in the Restoration Project	Records of Landowner Access Agreements and Maintenance Requests	Majority and owner participation in the Project.
Landowner Advisory Committee participation	Landowner Advisory Committee Meetings Attendance Records	Continued landowner attendance at Landowner Advisory Committee meetings

4.0 Results and Discussion

4.1 Instream Flow Measurements

Tracking and analyzing streamflow in the Napa River Rutherford Restoration Reach is key to identifying channel-forming flows and evaluating changes in stream geometry, bank condition, and sediment load, as well as guiding monitoring activities. Channel-forming flows are flow events that are sufficiently large to move all the mass and sizes of alluvial sediment supplied to the channel, and include a range of intermediate high flows. The most effective channel-forming flow is often associated with the bankfull discharge, which is in turn often associated with a 1.5-year recurrence interval. Although only a rule of thumb, the 1.5-year peak flow is used in this monitoring effort as a threshold to define a channel-forming flow.

Streamflow in the project reach is measured at USGS Station 11456000 NAPA R NR ST HELENA, located at Pope Street Bridge, approximately 2.1 miles upstream of the Project. Real-time and historical stage and flow data for the station are available at waterdata.usgs.gov. The difference in upstream watershed area between the station and the top of the project reach is approximately 5.5%, and similar increases in streamflow can be expected. No significant tributaries enter the river between the station and the top of the project reach. One named tributary, Bale Slough, enters the river along the project reach and by the downstream limit of the Project the watershed area has increased by approximately 25%, and similar increases in streamflow can be expected.

Station 11456000 has been in operation since 1929 and USGS provides peak flow statistics at streamstatsags.cr.usgs.gov. The calculated peak flows for the 1-, 2-, 5-, 10-, 25-, 50- and 100-year floods

are summarized in **Table 4**. USGS does not provide a peak flow statistic for the 1.5-year flood, but it is estimated for the purposes of this monitoring effort at 4,800 cfs.

Table 4. Peak flow statistics for USGS Station 11456000.

Peak Flood	Discharge (cfs)
Mean Annual	3,160
2-Year	5,980
5-Year	10,300
10-Year	13,100
25-Year	16,400
50-Year	18,700
100-Year	20,700

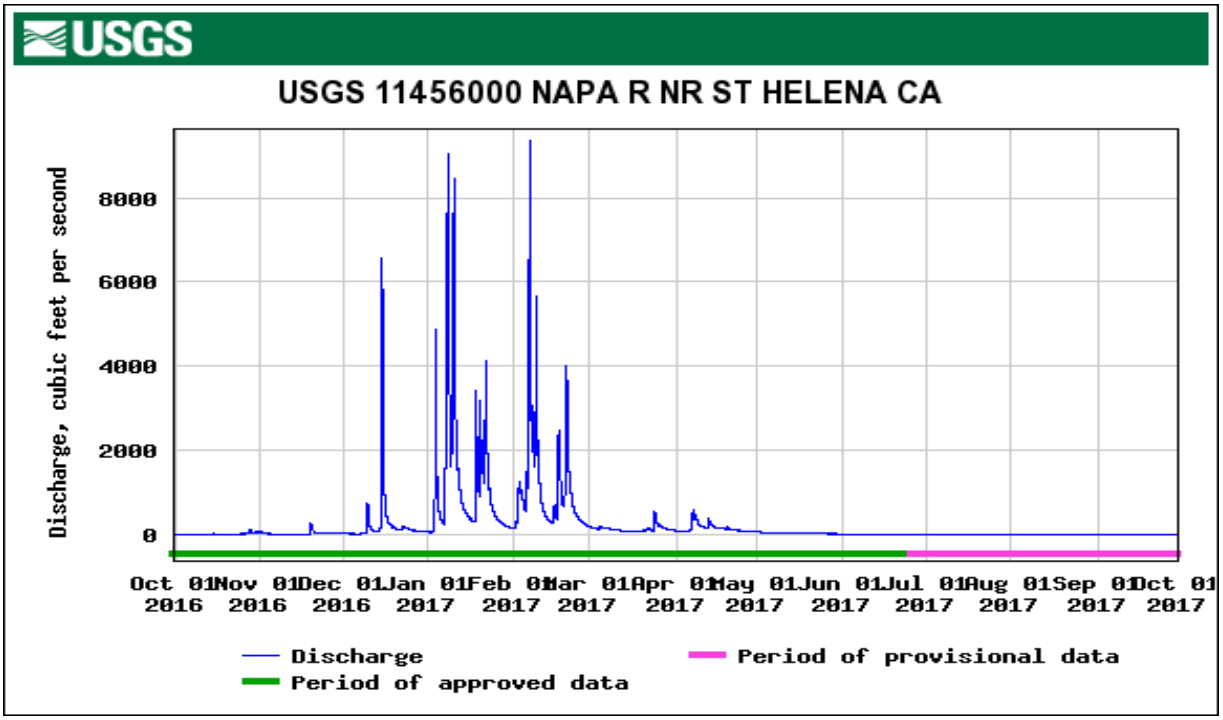
The last rare flooding event occurred on December 31, 2005, prior to construction of the project, when a peak flow of 18,300 cfs was recorded at Station 11456000, making it an approximate 50-year flood. Since that time, all peak flow events have been below 10,000 cfs, or less than 5-year recurrence interval events. Flow events with peak discharges greater than the 1.5-year flood that have occurred since initiation of construction in 2009 are listed in **Table 5.** These events can be expected to have significantly altered the streambed, promoted further erosion of eroding streambank areas, and tested the stability of graded restoration areas.

Table 5. High-flow events and peak discharges greater than 1.5-year flood since initiation of Project construction.

Water Year	Date	Peak Discharge (cfs)
2010-11	Mar 20, 2011	7,330
2010-11	Mar 24, 2011	4,830
2012-13	Dec 2, 2012	9,260
2012-13	Dec 23, 2012	9,690
2014-15	Dec 11, 2014	5,540
2016-17	Dec 15, 2016	6,570
2016-17	Jan 4, 2017	4,890
2016-17	Jan 8, 2017	9,040
2016-17	Jan 10, 2017	8,460
2016-17	Feb 7, 2017	9,340
2016-17	Feb 9, 2017	5,670

During the 2016-17 water year (October 1, 2016 through September 30, 2017), measurable streamflow began at Station 11456000 on October 24, 2016 and continued through early August. The peak flow of the season occurred on February 7, 2017, and was measured to be 9,340 cfs, an approximate 4-year peak flood. Following the last significant storm of the season in mid-April, flows in the river receded until streamflow ended on August 1, 2017. A plot of streamflow measured at Station 11456000 during the 2016-17 water year is included as **Figure 6**.

Figure 6. 2016-2017 streamflow, Napa River Rutherford Restoration Reach, USGS Station 11456000.



The reporting period for this monitoring effort includes the start of the 2017-18 water year (October 1, 2017 through September 30, 2018), and measurable flows in the reach began on November 8, 2017. As of late March, no high-flow events have exceeded the 1.5-year peak flow, with the largest peak flow provisionally estimated at 3,970 cfs. The streamflow data for the entire 2017-18 water year will be presented in the next annual monitoring report.

The Napa River tends to flow perennially through the project reach in wet years, and dry up completely for long sub reaches during the summer months in dry years. Dry-season streamflow data for Station 11456000, including mean monthly discharge statistics, can be found at waterdata.usgs.gov.

4.2 Eroding Streambank Survey

An eroding stream bank survey is conducted annually along the entire length of the channel every year in order to evaluate the extent of stream bank erosion within the Project area and to assess effects on fine sediment loading. During the dry season, the team walks the entire Project reach in the downstream direction and maps the start and end of erosion areas on each bank. For each erosion area, the length and average height of bank erosion is estimated and it is noted whether the erosion affects the whole bank, the top of bank, or the base of bank. In addition, it is noted whether the erosion is due to undercutting or a lack of vegetation. Project restoration efforts addressed stream bank erosion by grading over-steepened banks to a more stable profile and installing biotechnical bank stabilization features such as vegetated soil lifts (VSL's). Additional information regarding monitoring protocols and

performance targets are in the *Monitoring Plan for the Rutherford Reach Restoration of the Napa River* which can be found at www.napawatersheds.org.

The performance standard for reducing stream bank erosion is to reduce actively eroding stream banks throughout the entire Project reach by 75%. During the baseline survey in 2009, 14,674 feet of channel banks were mapped as eroding, or 30% of the channel bank length in the Rutherford Reach. In 2017, 837 feet of channel bank was mapped as eroding or unstable throughout the Rutherford Reach, this is a reduction of 94% compared to the 2009 baseline but an increase from the 455 feet mapped in 2016. The increase in eroding banks measured in 2017 is likely due to the relatively high flows (several large events ranging between the mean annual flood and the 5-year peak flood, see previous Section 4.1 Instream Flow Measurements) experienced during the winter of 2017 which exacerbated erosion at existing sites and created new areas of bank erosion, particularly in Reach 8 of the Project. The results of the surveys from 2009-2017 are summarized in **Table 6** below. See **Appendix A** for figures depicting the location and extent of eroding stream banks mapped during the 2017 survey.

The total linear length of eroding stream banks has steadily decreased as construction of the Project was completed and areas stabilized. Based on the survey results from 2014 through 2017, the Project has realized and surpassed the goal of a 75% reduction in active stream bank erosion throughout the entire Project reach.

Table 6. Results of eroding stream bank surveys, 2009-2017.

Survey	Total Linear Length of Eroding Banks (ft.)	Reduction Relative to 2009 Baseline (%)
2009	14,674	-
2010	9,000	39%
2011	4,800	67%
2012	4,400	70%
2013	5,200	65%
2014	1,840	87%
2015	1,050	93%
2016	455	97%
2017	837	94%

4.3 Sediment Source Reduction Calculations

The sediment TMDL for the Napa River aims to reduce fine sediment delivery from all Napa River mainstem channel incision and bank erosion sources by 19,000 metric tons/year (Napolitano 2009). To measure the reduction in fine sediment sources as a result of the Project, the one-time removal of sediment available for delivery to the channel was measured and amortized over the life of the project (20 years). Added to this value was the estimated reduction in sediment delivery achieved through cessation of ongoing bank erosion, which was continuing to occur at an average rate of 750 metric tons/mile/year over the length of the unrestored channel (Napolitano 2009).

Following the completion of the Project in the fall of 2014, the cumulative amount of fine sediment removed as a result of Project construction grading activities was of 257,260 metric tons. Further, an estimated 16,394 metric tons/year of fine sediment will be prevented from entering the Napa River over the next 20 years. This represents 87% of the total TMDL target reduction for the Napa River watershed from mainstem channel incision and bank erosion sources. See previous years' monitoring reports for additional details regarding annual and cumulative sediment reduction related to the Project and details related to methodology and calculations.

4.4 Longitudinal Profile Thalweg Surveys

Thalweg surveys were not completed in 2017; the most recent thalweg survey was completed in 2016. Thalweg surveys are competed for the entire Project reach once every five years; therefore, the next thalweg survey is scheduled for the fall of 2021. Please refer to previous monitoring reports for past survey results.

4.5 Channel Cross Section Surveys and Pebble Counts

Cross section channel surveys and corresponding pebble counts were not completed in 2017; the most recent surveys were completed in 2015. Cross section channel surveys and pebble counts are completed for the entire Project reach once every five years; therefore, the next cross section and pebble count surveys are scheduled for the fall of 2020. Please refer to previous monitoring reports for past survey results.

4.6 Riffle Survey

In an attempt to gain insight into the accuracy of the riffle count data, the RCD compared the results obtained during the annual channel survey to riffle counts derived from the 2013 and 2016 channel thalweg survey datasets. Based on that comparison (see Section 4.6 from the 2016 monitoring report) it was determined that the results of the riffle mapping surveys may have included significant error, perhaps enough error to obscure the target signal change in riffle counts due to restoration efforts.

Therefore, in an effort to standardize riffle counts for comparison over time and improve the value of this data set, the team will derive the number and lengths of riffle crests from channel thalweg survey data collected once every five years going forward.

4.7 Large Woody Debris and Habitat Structure Surveys

Large woody debris and habitat structure surveys were not completed in 2017; the most recent surveys were completed in 2016. These surveys are conducted every five years; therefore, the next surveys are scheduled for the summer of 2020. Please refer to previous monitoring reports for past results.

4.8 Pool Scour/Residual Pool Depth Surveys

Pool scour/residual pool depth surveys were not completed in 2017; the most recent surveys were completed in 2016. The next survey will be conducted in the summer of 2020. Please refer to previous monitoring reports for past results.

4.9 Vegetation Establishment Surveys

Vegetation establishment surveys are conducted the first 3 years following plant installation and thereafter during years 5 and 10 post-installation. Non-native invasive vegetation is also managed and documented during routine maintenance activities and surveys throughout the year. The target restoration goals and success criteria for vegetation establishment and long-term maintenance include:

- Establishing a minimum of 20 acres of riparian habitat over the life the Project (20 years)
- Minimum survivorship of 80% for all native plants installed at re-vegetation sites within 3 years after being installed, and at years 5 and 10 should be in good health
- Greater than 70% vegetative cover will exist at any given re-vegetation site over the *life* of the Project and evidence of natural recruitment will be documented after year 5 at any given site

The Project was completed in the fall of 2014 and as a result, 30.5 acres of native riparian habitat has been restored and enhanced throughout the 9 Project reaches, exceeding the restoration goal for establishing a minimum of 20 acres of riparian habitat over the life of the Project. A summary of the results from vegetation surveys conducted through 2017, including direct count, percent vegetative cover, line intercept transect surveys and invasive plant management is presented herein.

Direct count and photo documentation

During the fall of 2017, Flood District and contractor staff conducted annual direct count vegetation surveys of all restoration sites in Reaches 4, 5, 6, 7, 8 and 9 shown in **Figure 7** below**.** As stated previously, vegetation establishment surveys are conducted the first three years following plant installation and thereafter during years 5 and 10 post installation, therefore Reaches 1-3 were not surveyed in 2017 but will be surveyed again in 2020 and 2021 respectively. All planted restoration areas were surveyed to determine percent survivorship and qualitative health of installed and naturally recruited vegetation. **Tables 9** through **9** below present the percent survivorship by a given species in reaches 4, 5, 6, 7, 8 and 9 for monitoring year 2017; representational photographs of revegetation sites surveyed can be seen in **Appendix B**. Napa County was responsible for plant establishment and monitoring in Reaches 1 – 4 and 8 while contractors were responsible for monitoring and maintenance in Reaches 5, 6, 7 and 9 in 2017.

Survey results in 2017 for reaches 4 through 9 indicate overall survivorship for installed plants ranged from 79% (Reach 4) to 123% in (Reach 8), at or well above plant establishment criteria set forth in the monitoring plan. In part, the achievement of the survivorship success criteria can be attributed to a significant amount of natural recruitment of willows, cottonwoods, alders and various species shrubs species (in particular coyote brush) throughout the restoration sites. However, it should be noted that acquiring an accurate count in Reach 8, particularly for shrub species like coyote brush and California Rose, was particularly difficult due to the mature understory that has developed at the site making distinctions between an individual species and a clump difficult. We anticipate that the year 10 survey will be closer to an “estimate” of these particular species rather than an accurate count. It should be also noted that some species of trees (bay laurel, black walnut, etc.) demonstrated low survivorship and should perhaps be precluded from future planting pallets at river restoration sites within the area.

Table 7: Reach 4 Woody Vegetation Direct Count/Survivorship Surveys 2017

Common Name	Total Installed	Count 2013	% Survival	Count 2014	% Survival	Count 2015	% Survival	Count 2017	% Survival
White Alder	16	15	94%	23	144%	24	150%	26*	163%
Oregon Ash	128	134	105%	138	108%	125	98%	120	94%
Cottonwood	83	22	27%	38	46%	64	77%	68	82%
Red Willow	63	25	40%	61	97%	85	135%	105*	167%
Arroyo Willow	58	16	28%	93	160%	93	160%	109*	188%
Yellow Willow	9	6	67%	9	100%	9	100%	7	78%
Big Leaf Maple	30	29	97%	18	60%	18	60%	15	50%
California Buckeye	126	86	68%	70	56%	55	44%	55	44%
Black Walnut	201	139	69%	132	66%	98	49%	98	49%
Valley Oak	196	252	129%	204	104%	190	97%	195	99%
Coast Live Oak	175	202	115%	190	109%	98	56%	102	58%
Bay Laurel	133	109	82%	87	65%	75	56%	62	47%
Blue Oak	73	37	51%	67	92%	45	62%	45	62%
California Wild Rose	338	345	102%	354	105%	365	108%	341*	101%
Snowberry	338	240	71%	258	76%	276	82%	259	77%
Coyote Bush	201	231	115%	251	125%	265	132%	260*	129%
Western Spice Bush	51	53	104%	52	102%	34	67%	30	59%
Toyon	100	52	52%	41	41%	41	41%	41	41%
Deergrass	325	290	89%	271	83%	271	83%	275	85%
Total	**2898**	**2506**	**86%**	**2569**	**89%**	**2329**	**80%**	2291	**79%**

* Includes original planted stock and naturally recruited species.

Table 8: Reach 8 (Includes Ritz-Carlton Mitigation Area) Woody Vegetation Direct Count/Survivorship Surveys 2017

Common Name	Total Installed	Count 2014	% Survival	Count 2015	% Survival	Count 2016	% Survival	Count 2017	% Survival
Big leaf maple	59	63	107%	61	103%	59	100%	59	100%
Honeysuckle	26	18	69%	27	104%	18	69%	15	58%
Snowberry	300	467	156%	512	171%	292	97%	310*	103%
California Wild Rose	379	394	104%	531	140%	399	105%	425*	112%
Spicebush	18	14	78%	16	89%	16	89%	15	83%
California Buckeye	98	159	162%	140	143%	121	123%	119*	121%
White Alder	190	185	97%	275	145%	305	161%	344*	181%
Oregon ash	189	157	83%	178	94%	174	92%	150	79%
Fremont's Cottonwood	116	238	205%	298	257%	282	243%	321*	277%
California Black Walnut	114	150	132%	163	143%	121	106%	98	86%
Coyote Bush	195	149	76%	245	126%	225	115%	201*	103%
Valley Oak	225	254	113%	351	156%	309	137%	315*	140%
Bay Laurel	46	41	89%	41	89%	38	83%	30	65%
Toyon	52	79	152%	47	90%	46	88%	39	75%
Coast Live Oak	179	164	92%	264	147%	250	140%	250*	140%
Total	**2186**	**2532**	**116%**	**3149**	**144%**	**2655**	**121%**	**2691**	**123%**

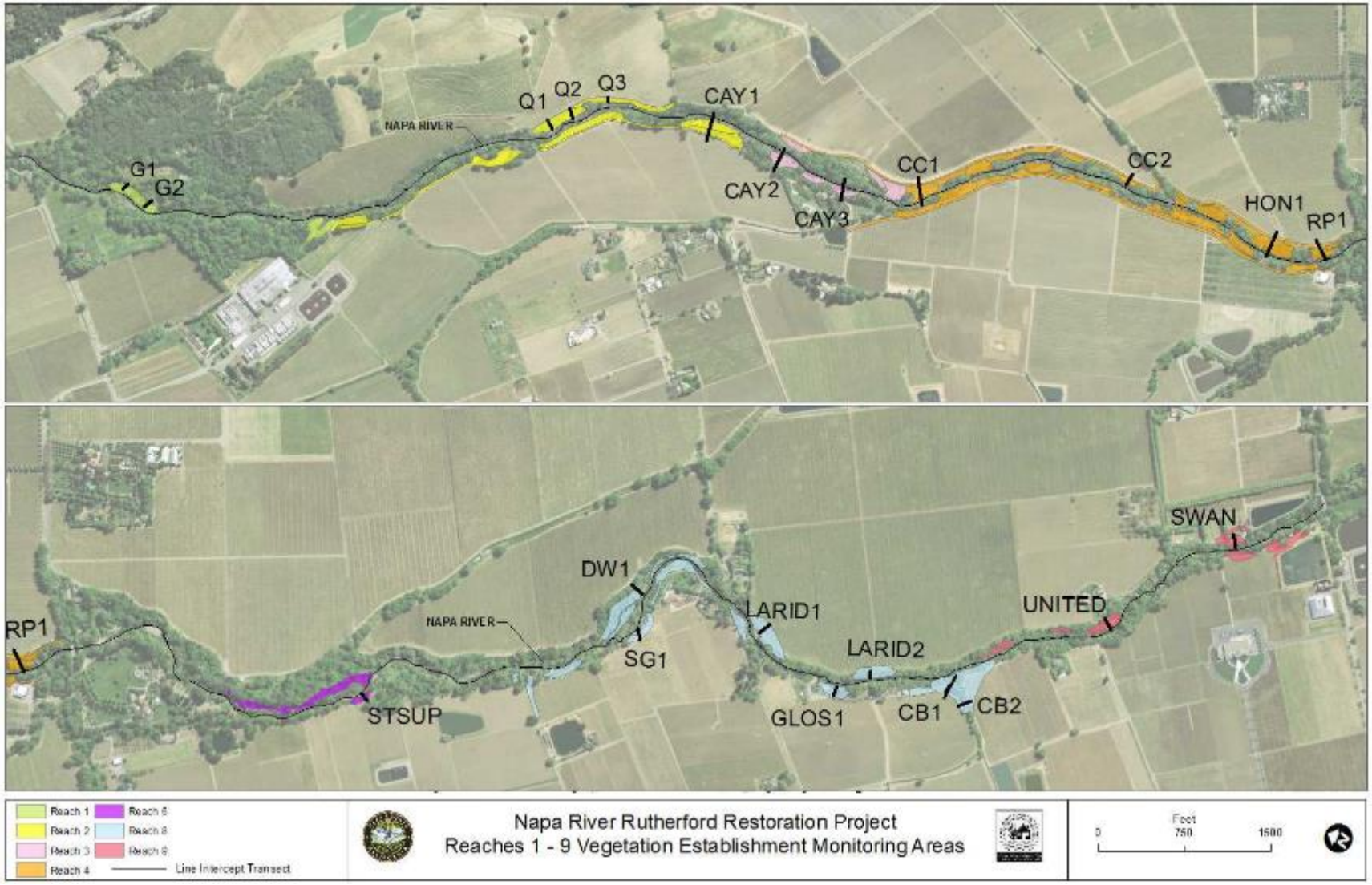
* Includes original planted stock and naturally recruited species.

Table 9: Reach 5,6,7,9 Woody Vegetation Direct Count/Survivorship Surveys 2017

Common Name	Total Installed	Count 2015	% Survival	Count 2016	% Survival	Count 2017	% Survival
Big Leaf Maple	29	29	100%	25	86%	23	79%
California Buckeye	54	36	67%	32	59%	30	56%
White Alder	29	29	100%	36	124%	42*	145%
Oregon Ash	45	45	100%	38	84%	31	69%
California Black Walnut	65	65	100%	60	92%	60	92%
Northern CA Black Walnut *	60	60	100%	60	100%	51	85%
Fremont's Cottonwood	72	72	100%	98	136%	90*	125%
Coast Live Oak	163	153	94%	149	91%	146	90%
Valley Oak	238	238	100%	197	83%	197	83%
Red Willow	106	106	100%	143	135%	156*	147%
Arroyo Willow	48	48	100%	54	113%	32	67%
Bay Laurel	21	21	100%	18	86%	17	81%
Deer grass	343	318	93%	318	93%	318	93%
Coyote Bush	73	73	100%	78	107%	87	119%
Western Spice Bush	35	35	100%	25	71%	19	54%
Hairy Ceanothus	23	23	100%	18	78%	15	65%
Toyon	47	47	100%	45	96%	45	96%
Ninebark	34	34	100%	30	88%	30	88%
California gooseberry	52	52	100%	41	79%	41*	79%
California Wild Rose	148	148	100%	144	97%	165*	111%
Snowberry	91	91	100%	102	112%	122	134%
Total	**1776**	**1723**	**97%**	**1711**	**96%**	**1717**	**97%**

* Includes original planted stock and naturally recruited species.

Figure 7: Location of direct count and line intercept vegetation surveys



Line intercept transect surveys

Line intercept transects have been established at 22 locations in all of the nine monitoring reaches in order to measure changes in vegetative cover and height class within restored areas (Harris 2005). Representative photos of the sites are illustrated in **Appendix B, Photo Monitoring**. The transect lines range from 45 to 111 feet in length and typically span the entire width of a restoration area. **Figure 7** above shows the name and location of each transect line surveyed. **Chart 1** below presents the average relative percent cover, by ground cover type, for all transect lines in Reaches 1- 9 for survey years 2012-2017. Results from the last six years of surveys indicate that the general trend in ground cover has shifted from un-vegetated to herbaceous, with a *gradual* increase of native shrubs and tree cover types; this is to be expected as sites mature and shrubs and trees grow larger and provide more cover and structure at a given restoration area. Now that Project construction is complete, and all restoration sites have been planted, it is anticipated that the vegetation establishment monitoring dataset should continue to show long-term trends leading towards a well developed understory and over story canopy capable of supporting a greater diversity of wildlife and providing greater ecological value within the Napa River.

Chart 1: Average percent cover by ground cover type for line transect surveys (2012-2017)

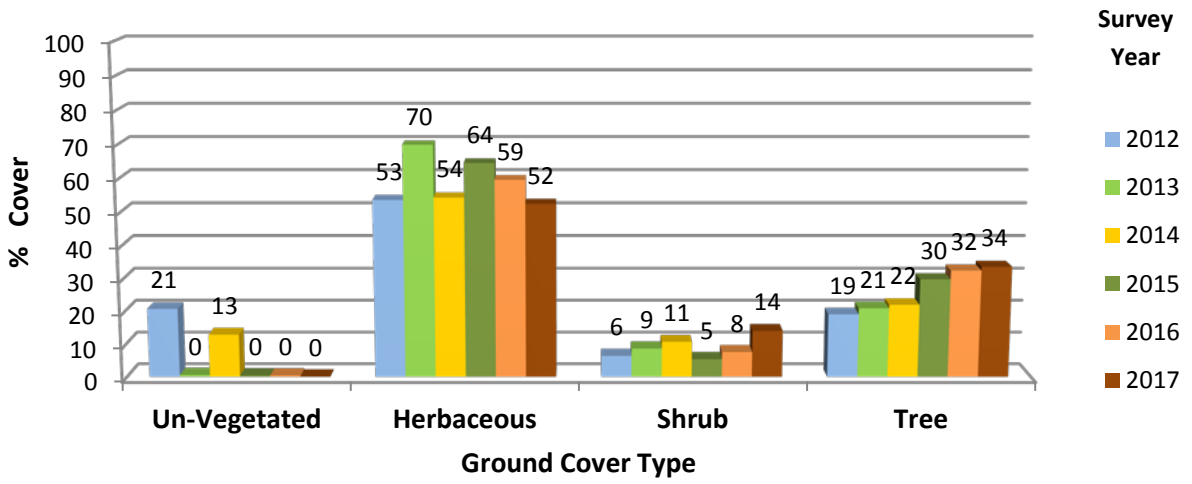
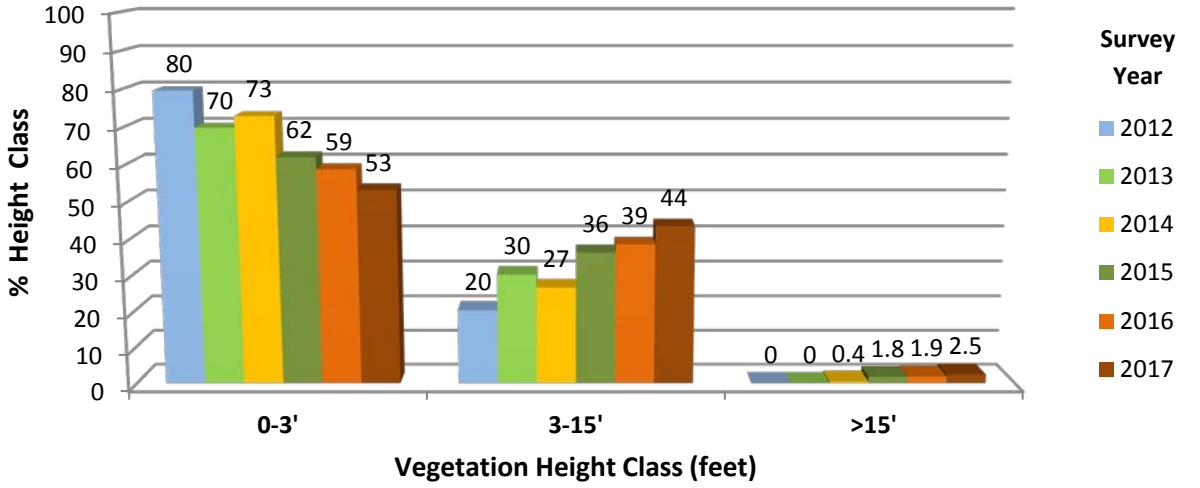


Chart 2 below represents the average height class of measured vegetation along all surveyed transects from 2012 through 2017. Approximately 53% of the vegetation measured in 2017 at a given transect ranged between 0 and 3 feet tall, while approximately 4% of the vegetation measured in 2017 ranged between 3 and 15 feet in height. In 2017 several trees (primarily cottonwoods, willows and alders) measured along transects (G1, CAY2, SG1, CB1 and UNITED) in reaches 1, 3, 8 and 9 measured 15 feet in height or greater, providing data for the next height class and documenting maturation of the over story canopy within Project restoration areas. Representative photos of the monitoring sites are shown in **Appendix B.**

Chart 2: Average height class of herbaceous and woody vegetation for line transect surveys (2012-2017)



As in 2016, results from the 2017 surveys indicate a positive trend in vegetation establishment year over year in both relative vegetative cover and average vegetation height measured at recently constructed restoration areas. Survivorship of installed native woody and herbaceous vegetation in all Reaches for a given species ranged from a low of 41% (Toyon Reach 4) to a high of 277% (cottonwoods Reach 8).

Results from the line intercept surveys also indicate that cover at restoration sites, on average, is approximately 52% herbaceous, 14% woody shrub and 34% tree native cover types with 0% un-vegetated areas at any given transect. Further, in 2017 approximately 53% of installed native vegetation measured between 0 feet and 3 feet in height, 44% measured 3 feet to 15 feet high, and several trees, 2.5%, now measure above 15 feet (primarily cottonwoods, willows and alders) within the restoration areas. In general, these increases in relative cover and average vegetation height represent a positive trend in vegetation establishment at the restored sites, likely providing greater habitat value within the riparian corridor of the Napa River. The installed native vegetation is expected to continue to increase at natural growth rates under typical, non-drought growing conditions.

Invasive plant management

A total of 92,775 square feet (2.1 acres) of non-native invasive and Pierce host vegetation was documented and treated during the 2017 survey. Species documented in 2017 include 31,650 sqft of Himalayan blackberry, 45,950 sqft of native/hybrid CA grape, 4,300 of Vinca, 10,200 sqft of Mugwart and only 675 sqft of Arundo. **Table 10** below shows the total area of invasive and Pierce host plants treated by species since the inception of the Project in 2009 through 2017. As always, the District encourages landowners to contact the County maintenance lead with requests for management of invasive and/or Pierce host vegetation in the riparian zone, beyond the top of bank, that may have not been documented during the channel maintenance survey.

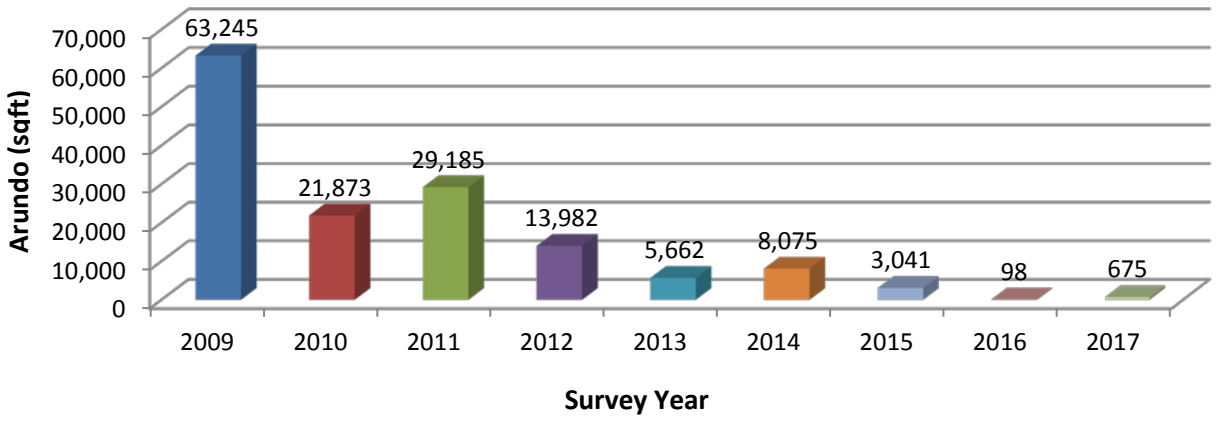
Previous and ongoing efforts to manage and remove Arundo have been successful in significantly reducing the quantity within the Project area; **Chart 3** below depicts the decline of Arundo throughout the Project

area since monitoring and management began in 2009. The area of Arundo documented and treated in 2017 (675 sqft) was more than the previously documented in 2016 (98 sqft). This is likely because two significant new clumps were discovered that had previously gone undetected. Areas of invasive plants that were treated in 2017 that had the potential to cause streambank erosion were replanted with willow stakes and/or broadcast seeded with native species during the winter and spring of 2017 and 2018.

Table 10: Invasive and Pierce host plant species mapped and treated (square feet), 2009-2017

Survey Year	Giant Reed	Himalayan Blackberry	Periwinkle (*Vinca sp.*)	Mugwart	CA Grape	Other Species (Sesbania, Tree of Heaven, etc.)	Total Area Treated
2009	73,180	-	-	-	-	-	73,180
2010	23,599	952	17,389	-	-	86	42,026
2011	30,749	35,809	9,163	-	7,447	49,138	132,306
2012	14,502	2,668	6,951	20,330	-	17,636	62,087
2013	5,662	42,688	1,901	143,959	5,070	17,903	217,183
2014	8,075	206,182	2,620	169,155	23,753	796	410,581
2015	8,562	33,272	8,588	23,252	27,752	-	101,427
2016	98	175,475	3,635	2,975	329,915	-	512,098
2017	***675***	***31,650***	***4,300***	***10,200***	***45,950***	**-**	***92,775***
Total Treated to Date:							**1,643,663 (37.7 acres)**

Chart 3: Arundo mapped and treated (2009-2017)



4.10 Ritz-Carlton Hotel and Caltrans Troutdale Creek Mitigation Monitoring

Ritz-Carlton Mitigation Site

The linear wetland constructed in Phase 4A, Reach 8 North to satisfy the Ritz-Carlton Hotel mitigation requirements is continuing to function as designed. The linear wetland was built in 2012 and was incorporated into the Project as a 589-foot-long secondary channel constructed on Bench 1, of the east

bank of the river between river stations 7,100-6,500 on the Wilsey property. The area functions as a wetland, secondary stream channel and backwater habitat. Cross section RS 6750 bisects this area; results of the cross section survey in 2015 indicated that the width to depth ratio in the area achieved "function width" which indicates the channel is less confined and therefore more likely to recruit new gravel bars and propagate riffle and pool formation which is one of the restoration goals for the Project. Vegetation direct count/survivorship surveys conducted in 2017 for this area ranged between 55% - 277% (included natural recruitment) with an overall plant survivorship of 123% for the site, well above the 80% or greater vegetation survivorship criteria requirements for the site.

Caltrans Troutdale Creek Bridge Mitigation Site

In support of Caltans off-site mitigation requirements for the removal of approximately 251 trees as part of the Troutdale Creek Bridge Replacement Project (No. 21-0004) on State Route 29, 652 trees were planted at restoration sites in Reaches 6, 7 and 9 of the Project with the majority of the trees being installed in Reaches 6 and 9, covering an area of approximately 4.2 acres. Tree species planted included 238 coast live and 106 valley oaks, 54 California buckeyes, 29 big-leaf maples, 45 Oregon ashes, 72 Fremont cottonwoods, 65 California black walnuts, 29 white alders, and 14 red willows. Results of vegetation direct count/survivorship surveys conducted in 2017 for this area ranged between 56% - 147% (includes natural recruitment) with an overall plant survivorship of 97% for all of the sites combined, well above the 80% or greater vegetation survivorship criteria requirements.

Additional monitoring results for the Ritz Carlton and Caltrans mitigation sites, including summaries of the adaptive management measures taken to maintain these sites, are included throughout this report. See **Appendix B** for photographs of both sites.

4.11 Stakeholder Participation Documentation

The Napa River Rutherford Restoration Project is a landowner-initiated project. The leadership of the Landowner Advisory Committee (LAC) and the active participation of landowners at these and other meetings have been central to the success of the Project. Maintaining active landowner participation remains a key element of Project viability; documentation of participation levels demonstrates the success of community engagement with the Project.

A group of 30 property owners own 41 parcels with riverfront property along the Rutherford Reach in Rutherford and Oakville. Temporary construction easements and maintenance access agreements were signed by 100 % of the landowners participating in the Project, and landowners continue to allow access for Project maintenance and monitoring activities.

All 30 landowners included in the Maintenance Assessment District (MAD) receive an annual report prepared by the Flood District documenting routine vegetation, debris and invasive/Pierce host plant management activities and a summary of work conducted pursuant to specific maintenance requests. Records of landowner maintenance requests are maintained by the Flood District. These reports can be accessed online at the Napa County Watershed Information Center and Conservancy (WICC) in the Rutherford Reach Restoration Project document repository (http://www.napawatersheds.org/app_folders/view/5501).

The LAC meets 1-2 times per year (and informally at other events) in order to review and comment on the results of the maintenance survey and work plan, work completed and the budget. Attendance at these LAC meeting generally ranges between 6-15 people, representing approximately 20-50% of the properties in the MAD.

4.12 Photo Monitoring

In channel photo monitoring is conducted concurrently with the annual stream survey and is also conducted annually at established monitoring locations focused on construction/restoration sites which document change over time; photos are also taken opportunistically during periodic high flow events at these locations. Site-specific monitoring of restoration sites creates a visual record of vegetation establishment and seasonal change year over year. As aerial photography becomes available, and as the Project budget allows, the riparian buffer width and stream network are also assessed and incorporated into a spatial database (GIS). Results of annual photo monitoring for the entire Project area (Reaches 1 through 9) conducted in 2017 are shown in **Appendix B.**

5.0 Summary and Conclusions

To date, monitoring results indicate that the majority of river restoration elements implemented throughout the Project are achieving, or are on target to meet, Project goals and performance standards as outlined in the monitoring plan and regulatory permits. The cumulative amount of fine sediment reduced as a result of Project completion is 257,260 metric tons with an estimated 16,394 metric tons/year reduced each year from the Napa River watershed amortized over the next 20 years. This represents 87% of the total TMDL sediment reduction goal for the Napa River watershed. In 2017, 837 feet of channel banks were mapped as eroding or unstable throughout the Rutherford Reach, this represents a slight increase in eroding banks measured in 2016 (455 linear feet) and is likely the result of the multiple high flows events experienced during the winter of 2017 which exacerbated erosion at some existing sites and created several new areas of bank erosion. However, the overall net reduction of eroding stream banks measured since inception of the Project is 94% compared to the 2009 baseline conditions; exceeding the performance standard of a 75% reduction in active stream bank erosion throughout the entire Project reach.

A total of 2.1 acres of non-native invasive and Pierce host vegetation was documented and treated in 2017. Species treated included Himalayan blackberry, native/hybrid CA grape, Vinca, Mugwart and Arundo. Survey results in 2017 for reaches 4 through 9 indicate that overall survivorship of installed native shrubs and trees ranged from 79% (Reach 4) to 123% in (Reach 8), at or well above plant establishment criteria set forth in the monitoring plan. Results from line intercept surveys indicate that native cover, on average, is approximately 52% herbaceous, 14% woody shrub and 34% tree cover types. Approximately 53% of the vegetation measured in 2017 at a given transect ranged between 0 and 3 feet tall, while approximately 44% of the vegetation measured ranged between 3 and 15 feet in height. Several trees (primarily cottonwoods, willows and alders) measured in reaches 1, 3, 8 and 9 in 2017 were 15 feet or greater in height, providing data for the next height class and documenting maturation of the over story canopy within Project restoration areas. In general, the increase in relative

native cover and average height represents a positive trend in vegetation establishment at the restored sites, likely providing greater habitat value within the riparian corridor of the Napa River.

Overall, the created instream and terrestrial habitat is providing important foraging and rearing areas for native wildlife. While measured bank erosion increased slightly from that which was measured in 2016, the slight increase can be attributed to the multiple high flow events experienced during water year 2016/2017 and the rate of erosion can be considered at "back ground" levels. With continued monitoring and focused management of the restored areas the Project reach will continue to provide high value ecological services for the flora and fauna that reside within the Napa River watershed.

6.0 References

Gerstein, J.M. (2005) *Monitoring the Effectiveness of Instream Habitat Restoration*. University of California, Center for Forestry, Berkeley, CA. http://forestry.berkeley.edu/comp_proj/DFG/Monitoring%20the%20Effectiveness%20of%20%20Instream%20Habitat%20Restoration.pdf

Harris, R.R., S.D. Kocher, J.M. Gerstein and C. Olson. (2005) *Monitoring the Effectiveness of Riparian Vegetation Restoration*. University of California, Center for Forestry, Berkeley, CA. http://forestry.berkeley.edu/comp_proj/DFG/Monitoring%20the%20Effectiveness%20of%20Riparian%20Vegetation%20Restorat.pdf

Hayes, G., et al. (2011) *Monitoring Plan for the Napa River Rutherford Reach Restoration Project*. Napa County Flood Control and Water Conservation District, Napa, County, CA. https://www.napawatersheds.org/documents/view/4585

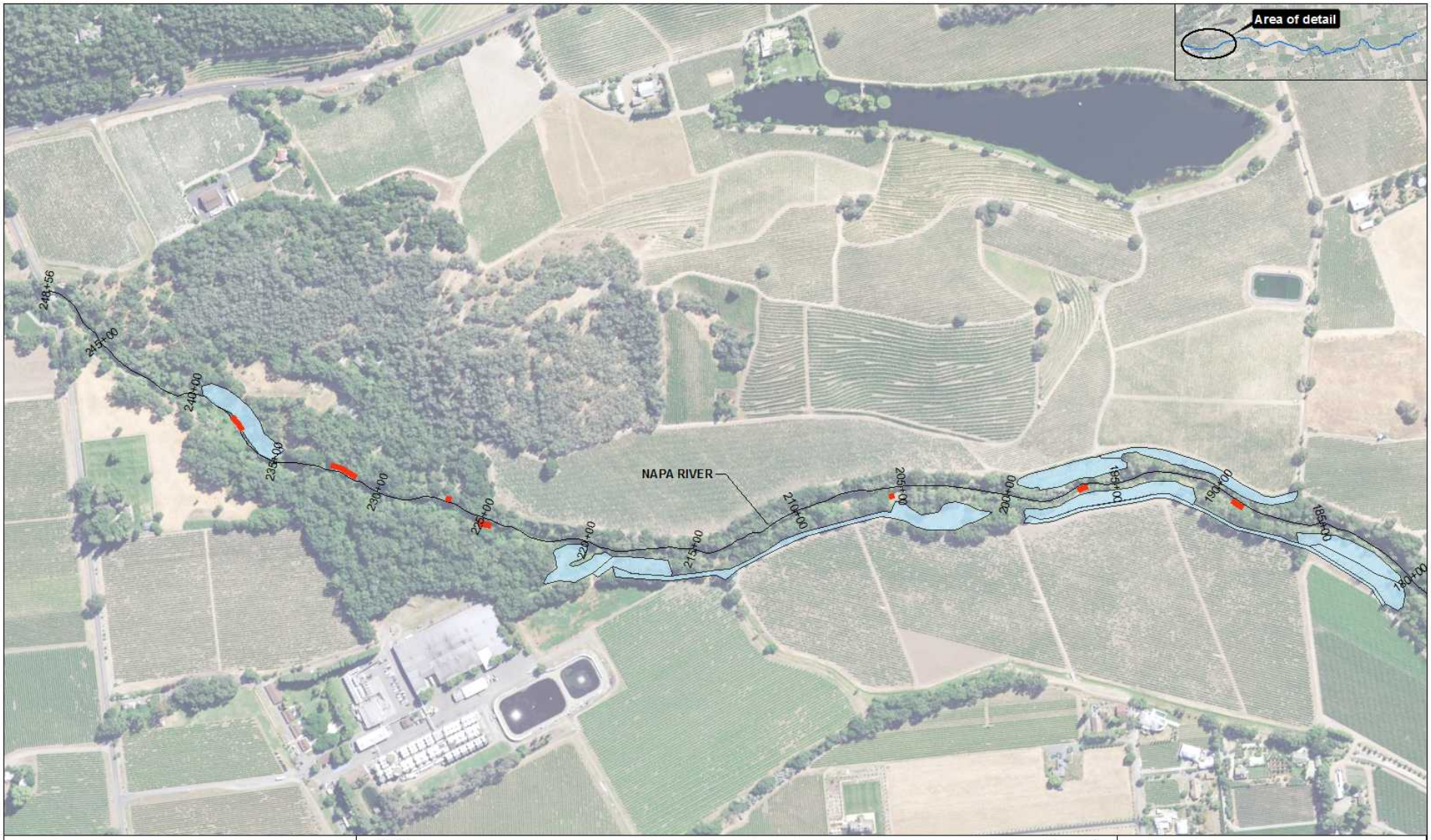
Kondolf, G., Smeltzer, M., and Railsback, S. (2000) *Design and performance of a channel reconstruction project in a coastal California gravel-bed stream*. Environmental Management.

Napolitano, M., et al. (2009) *Napa River Sediment TMDL and Habitat Enhancement Plan*. California Regional Water Quality Control Board San Francisco Region. https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/napasediment/C_NS_Staff_Report_09-09.pdf

Sarrow, J., Blank, P., Koehler, J., (2016) *Napa River Rutherford Reach Restoration Project Annual Monitoring Report 2015*. https://www.napawatersheds.org/documents/view/7805

Sarrow, J., Blank, P., Koehler, J., (2017) *Napa River Rutherford Reach Restoration Project Annual Monitoring Report 2016*. https://www.napawatersheds.org/documents/view/8462

Appendix A
Eroding Stream Bank Survey Figures
2017

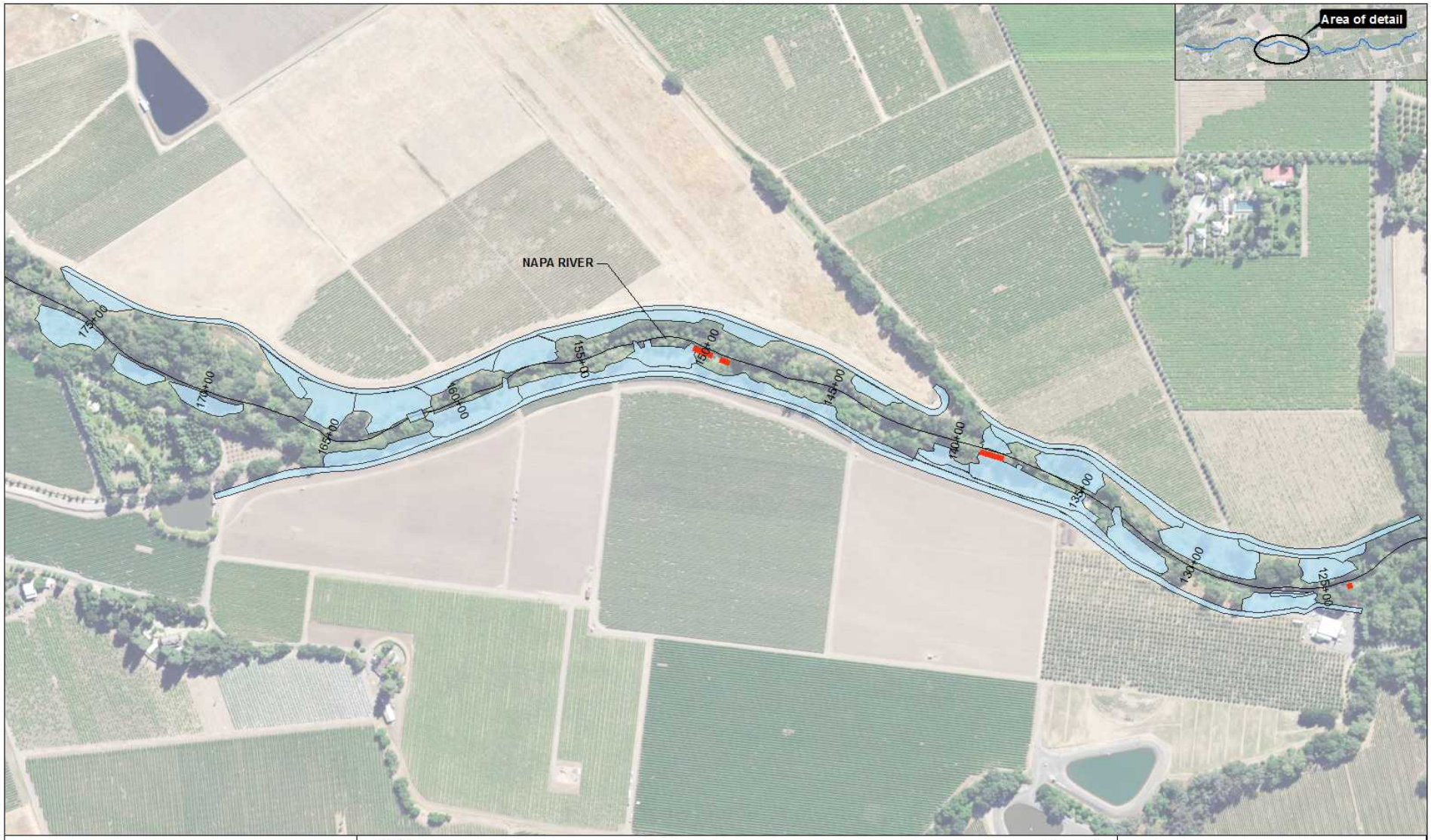


Stream Bank Erosion

Constructed Features

Napa River Rutherford Restoration Project Reach 1-2
Eroding Stream Bank Survey

Feet
0 500 1000

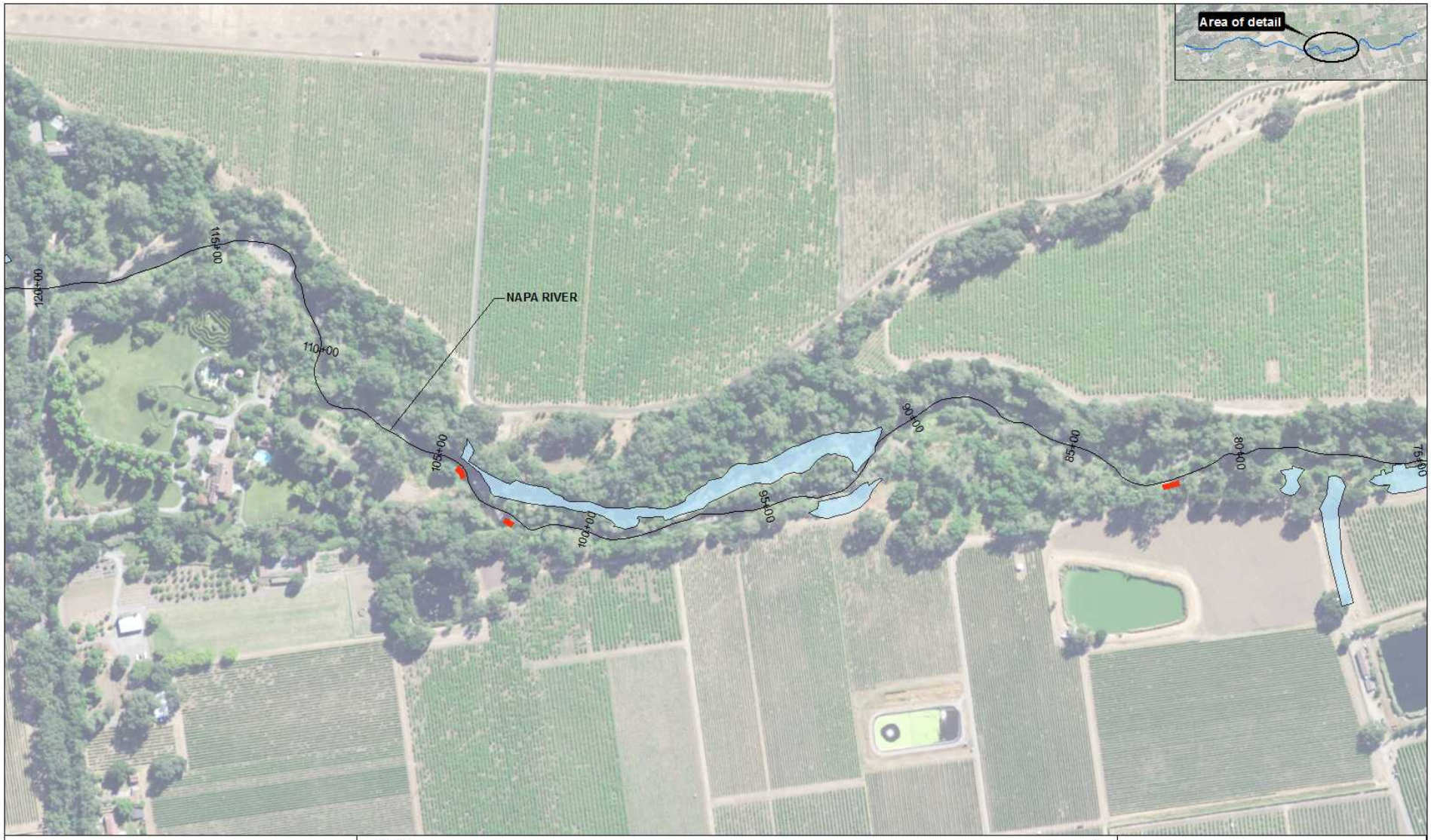


Stream Bank Erosion

Constructed Features

Napa River Rutherford Restoration Project Reach 3-4
Eroding Stream Bank Survey

Feet
0 375 750


Area of detail
NAPA RIVER
120+00
115+00
110+00
105+00
100+00
95+00
90+00
85+00
80+00
75+00
Stream Bank Erosion
Constructed Features
Napa River Rutherford Restoration Project Reach 5-7
Eroding Stream Bank Survey
Feet
0
275
550


Area of detail
NAPA RIVER
60+00
65+00
70+00
75+00
55+00
50+00
45+00
40+00
35+00
Stream Bank Erosion
Constructed Features
Napa River Rutherford Restoration Project Reach 8
Eroding Stream Bank Survey
Feet
0
250
500

Stream Bank Erosion

Constructed Features

Napa River Rutherford Restoration Project Reach 9
Eroding Stream Bank Survey

Feet

0 250 500

Appendix B
Photographic Monitoring
2017

Reaches 1 and 2 East Bank
(Phase 1)

Constructed 2009

Guggenhime
Quintessa

River Station 235+00
Bench: Guggenhime, East Bank

October 2009

June 2011

December 2016

May2017

River Station 195+50
Benches: Quintessa, East Bank

June 2009

December 2016

March 2011

May 2017

River Station 19,550

Benches: Quintessa, East Bank to West Bank

September 2009

December 2016

June 2015

May 2017

Reaches 1 and 2 West Bank
(Phase 1)

Constructed 2010

The Ranch Winery & Trinchero Family Estates
Frog's Leap
Caymus

River Station 219+50

Alcove: The Ranch Winery / Sutter Home, West Bank

September 2009

December 2016

June 2015

May 2017

River Station 198+50
Bench: Frog's Leap, West Bank


August 2010


June 2015


December 2016


May 2017

River Station 191+00

Frog's Leap Bench from Quintessa Road, East Bank

September 2010

December 2016

LWD installation

May 2017

River Station 181+00
Setback Berm: Caymus Bench, West Bank

October 2010

December 2016

June 2015

May 2017

Reach 3
(Phase 2)

Constructed 2010

Carpy Conolly and Caymus

River Station 176+50
Bench 1: Caymus, West Bank

September 2010

June 2015

December 2010

May 2017

River Station 172+00
Bench 2: Caymus, West Bank

October 2010

December 2016

June 2015

May 2017

River Station 168+50

Bench 3: Caymus, Downstream to Upstream

October 2010

December 2016

June 2015

May 2017

River Station 164+20
Bench 4: Carpy Conolly, East Bank

September 2010

December 2016

June 2015

May 2017

River Station 162+00
Carpy Conolly Bench 5, East Bank

September 2010

December 2016

June 2015

May 2017

River Station 144+00 Carpy Conolly Bench 6, East Bank

August 2011

December 2016

June 2015

May 2017

Reach 4 East Bank
(Phase 3)

2011

Honig
Round Pond East Bank

River Station 135+40
Bench 11: Honig, East Bank

October 2011

December 2016

June 2015

May 2017

River Station 130+50
Bench 13: Honig, East Bank

August 2011

March 2012

December 2016

May 2017

River Station 127+50
Bench 13: Honig, East Bank to Upstream

October 2011

December 2016

June 2015

May 2017

River Station 124+25
Bench 14: Round Pond, East Bank

October 2011

December 2016

June 2015

May 2017

Reach 4 West Bank
(Phase 3)

Constructed 2012

Emmolo, Caymus and Round Pond

River Station 161+10
Bench 6: Emmolo, West Bank

May 2012

June 2015

November 2012

May 2017

River Station 157+60
Bench 6: Emmolo, West Bank to Upstream


May 2012


June 2015


August 2012


May 2017

River Station 152+90
Bench 8: Emmolo, West Bank to Downstream

May 2012

June 2015

November 2012

May 2017

River Station 15,000
Bench 8: Emmolo, West Bank Looking Upstream

May 2012

June 2015

November 2012

May 2017

River Station 139+20
Bench 10: Caymus, West Bank to Downstream

August 2012

December 2016

June 2015

May 2017

River Station 135+60

Bench 10: Caymus, West Bank to Upstream

November 2012

December 2016

June 2015

May 2017

River Station 133+30
Bench 12: Round Pond West, West Bank to Downstream

August 2012

December 2016

June 2015

May 2017

River Station 130+80
Bench 12: Round Pond West, West Bank to Upstream

November 2012

Boulder Cluster, Reach 4, March 2015

December 2016

May 2017

River Station 127+80

Bank Stabilization 3: Round Pond West Bank Looking Downstream

November 2012

December 2016

June 2015

May 2017

River Station 126+00
Bank Stabilization 3: Round Pond West, West Bank to Upstream

May 2012

June 2015

December 2012

March 2016

Reach 8 North
(Phase 4A)

Constructed 2012

Foley Johnson (Sawyer), Sequoia Grove, Wilsey

Ritz Carlton Hotel Linear Wetland Mitigation
(Part of Secondary Channel on Bench 1 on Wilsey)

Station 73+30
Reach 8 North, West Bank, Foley Johnson (Sawyer) West Bank

May 2012

October 2012

March 2016

May 2017

Ritz Carlton Hotel Linear Wetland Mitigation (Phase 4A)

Constructed 2012

Part of Phase 4a: Reach 8 North Secondary Channel on Bench 1 on Wilsey

River Station 65+50
Bench 1: Wilsey, Secondary Channel Looking Upstream

September 2012

December 2016

June 2015

May 2017

River Station 66+30
Bank Stabilization 2: Sequoia Grove, West Bank

2011

December 2016

October 2012

May 2017

River Station 66+30

Bank Stabilization 2: Sequoia Grove, West Bank to Upstream

May 2012

December 2016

December 2012

May 2017

Reach 8 South
(Phase 4BC)

Constructed 2013

El Encino (Gmelch), Laird, Frostfire (Davis)
AJM Vineyards (McDowell), Glos
Cakebread, Nickel & Nickel

River Station 61 +00
Reach 8 South, Bench 1: Upstream to Downstream

October 2012

May 2017

December 2016

May 2017

River Station 53+00
Reach 8 South, Bank Stabilization 1: Downstream to Upstream

August 2012

March 2016

November 2012

May 2017

River Station 53+00
Reach 8 South, Bench 2: Upstream to Downstream

August 2012

June 2015

November 2012

May 2017

River Station 44+00
Reach 8 South, Bank Stabilization 3 to Bench 3: Upstream to Downstream

July 2010

December 2016

June 2015

May 2017

River Station 43+00

Reach 8 South, Bank Stabilization 3: Downstream to Upstream

December 2016

February 2013

June 2015

May 2017

River Station 42+00
Reach 8 South, Bench 3: Upstream to Downstream

August 2013

December 2016

June 2015

May 2017

River Station 40+00
Reach 8 South, Bench 3: Downstream to Upstream

August 2013

December 2016

June 2015

May 2017

River Station 36+00, Reach 8 South, Bella Oaks Tributary Alcove: Upstream to Downstream

August 2013

December 2016

June 2015

May 2017

River Station 31+00, Reach 8 South, Cakebread Alcove: Downstream to Upstream

August 2013

March 2016

Alcove LWD Structure May 2017

May 2017

Reach 5, 6 and 7
(Phase 5)
Constructed 2014

Round Pond, Peju,
St. Supery, Foley Johnston

River Station 93+50, Reach 6, Peju-St. Supery Bank Stabilization Area 1, West Bank

July 2014

March 2016

June 2015

May 2017

River Station 92+00, Reach 6, Peju-St. Supery Bank Stabilization Area 1, West Bank

December 2014

March 2016

Boulder/LWD Cluster, BSSR 1, May 2017

May 2017

River Station 103+00, Reach 6, Round Pond Secondary Channel Inlet

July 2014

December 2016

March 2015

May 2017

River Station 104+50, Reach 6, Round Pond Secondary Channel Inlet LWD Structure

December 2014

March 2015

March 2016

May 2017

River Station 97+00, Reach 6, Round Pond Secondary Channel, Mid-reach

July 2014

December 2016

June 2015

May 2017

River Station 95+00, Reach 6, Round Pond Secondary Channel, Mid-reach

July 2014

March 2016

June 2015

May 2017

River Station 91+00, Reach 6, Round Pond Secondary Channel, Outlet

July 2014

June 2015

December 2015

May 2017

Reach 9
(Phase 5)

Constructed 2014

Laird, United
Swanson and Opus One

River Station 29+25, Reach 9, Laird Bank Stabilization Area 2, East Bank

July 2014

December 2016

June 2015

May 2017

River Station 25+25, Reach 9, United Bank Stabilization Area 3, East Bank

July 2014

December 2016

December 2014

May 2017

River Station 22+50, Reach 9, United Bench 1, Upstream to Downstream, East Bank

July 2014

December 2016

June 2015

May 2017

River Station 20+00, Reach 9, United Bench 1, Downstream to Upstream, East Bank

July 2014

May 2017

December 2016

Reach 9, Bench 1, LWD Structure May 2017

River Station 9+00, Reach 9, Swanson Bench 2, Upstream to Downstream, East Bank

July 2014

December 2016

June 2015

May 2017

River Station 7+50, Reach 9, Swanson Bench 2, Downstream to Upstream, East Bank

July 2014

December 2016

June 2015

May 2017

River Station 7+50, Reach 9, Opus One Bench 3, Downstream to Upstream, West Bank

July 2014

December 2016

June 2015

May 2017

River Station 9+00, Reach 9, Opus One Bench 3, Upstream to Downstream, West Bank

July 2014

December 2016

June 2015

May 2017

Beaver Dams, High Flow Events, Instream Habitat/LWD Structures

Beaver Dam, Reach 3, July 2017

High Flow/Out of Channel, Reach 9, Opus One, January 2017

Alcove: The Ranch Winery / Sutter Home, West Bank, January 2016 and May 2016

High Flow Events, Instream Habitat/LWD Structures

Oakville Bridge, January 2017

Reach 9, United, March 2017

Reach 6, Upstream Confluence Round Pond Secondary Channel-Napa River-Bale Slough, March 2017

Reach 6, Downstream Confluence Round Pond Secondary Channel-Napa River, March 2017