

NAPA RIVER RUTHERFORD REACH RESTORATION PROJECT ANNUAL MONITORING REPORT - 2018



Reach 8, May 2018

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1. Introduction

The purpose of this document is to report on the results of surveys performed during calendar year 2018 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 2017 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 2018 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. Beginning in the spring of 2018, long-term monitoring and maintenance of the channel is now funded entirely by the Maintenance Assessment District (MAD) established for the Project and 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

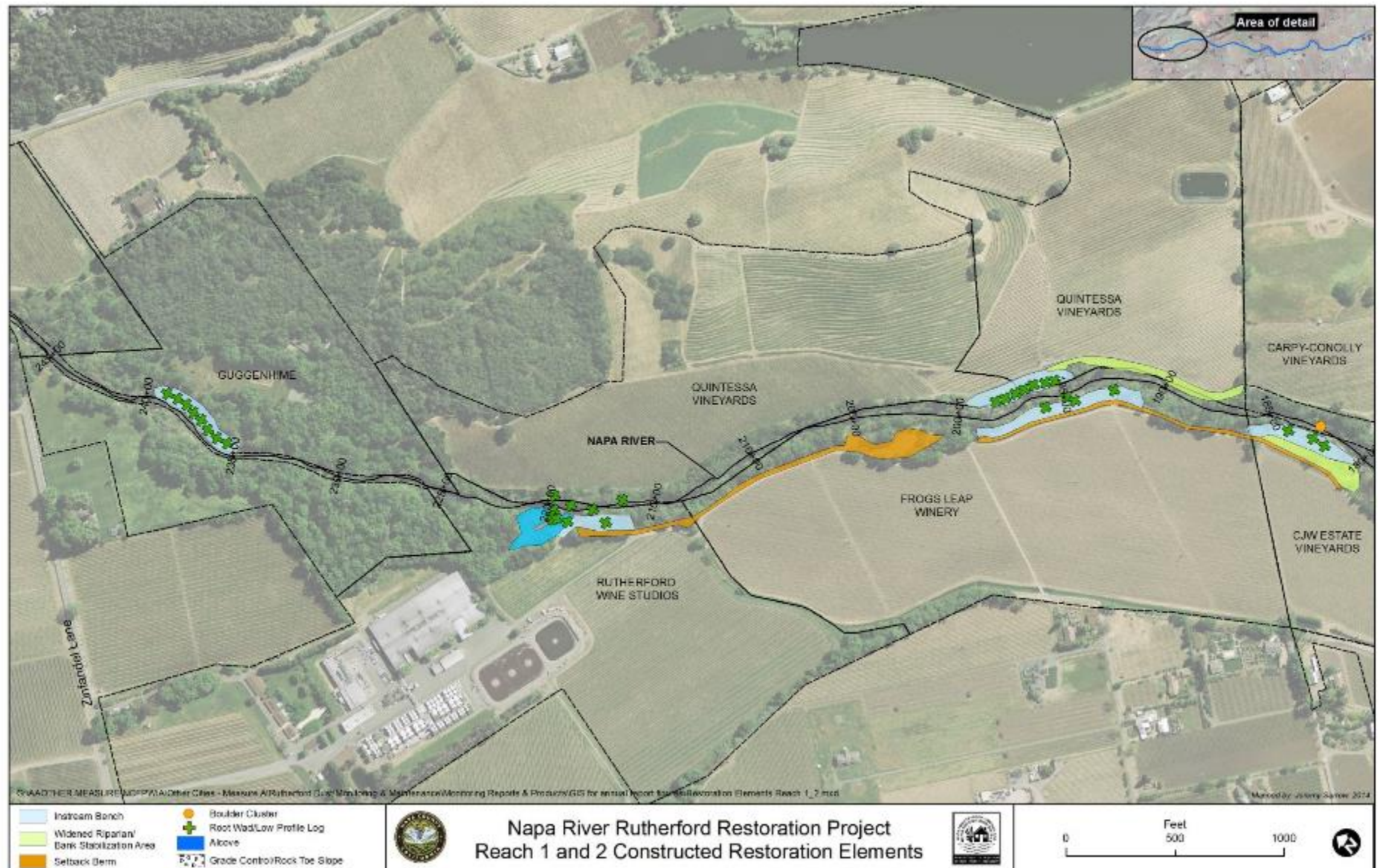


Figure 2: Constructed Restoration Elements Reaches 3 and 4

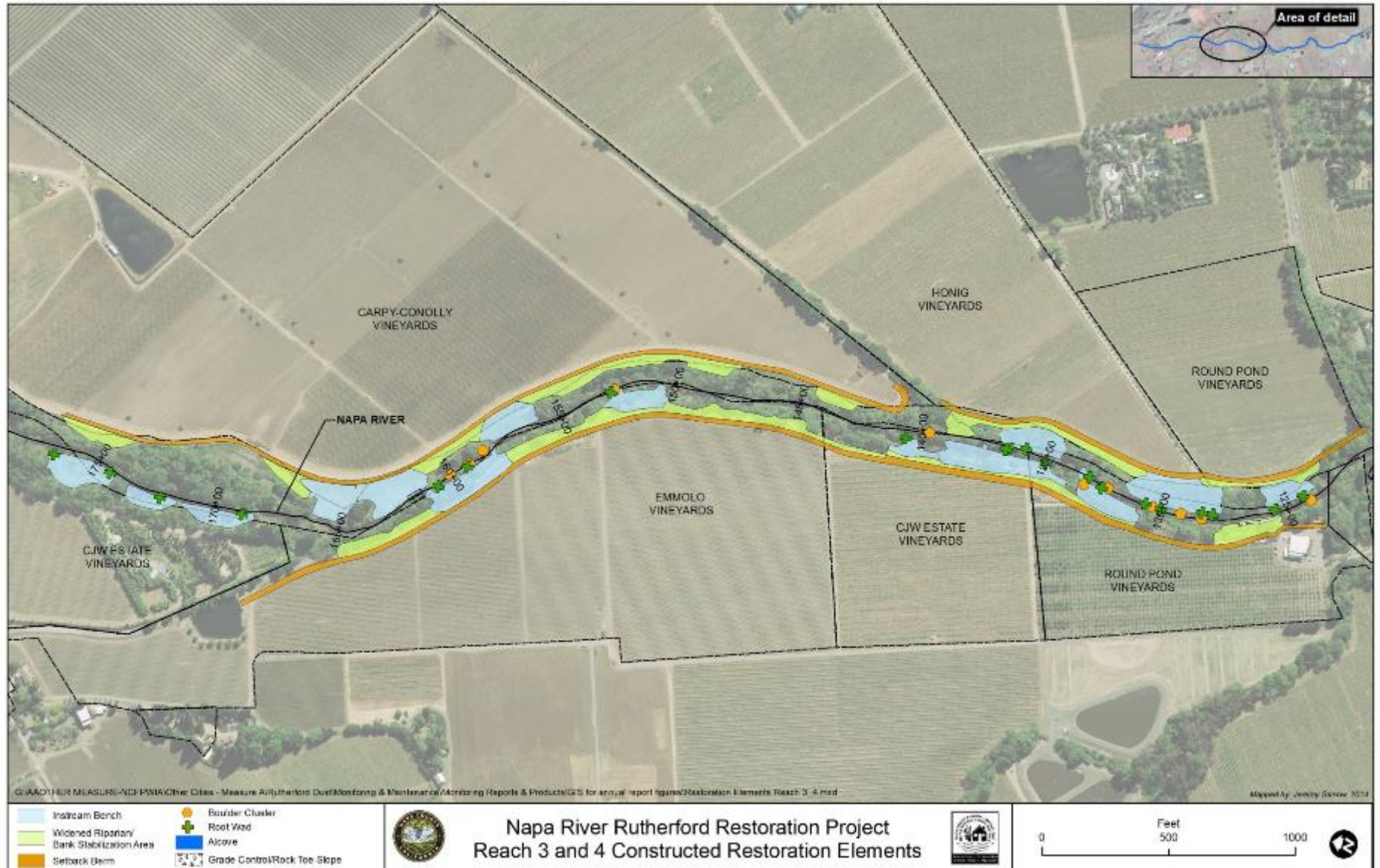


Figure 3: Constructed Restoration Elements Reaches 5, 6, and 7



Figure 4: Constructed Restoration Elements Reach 8

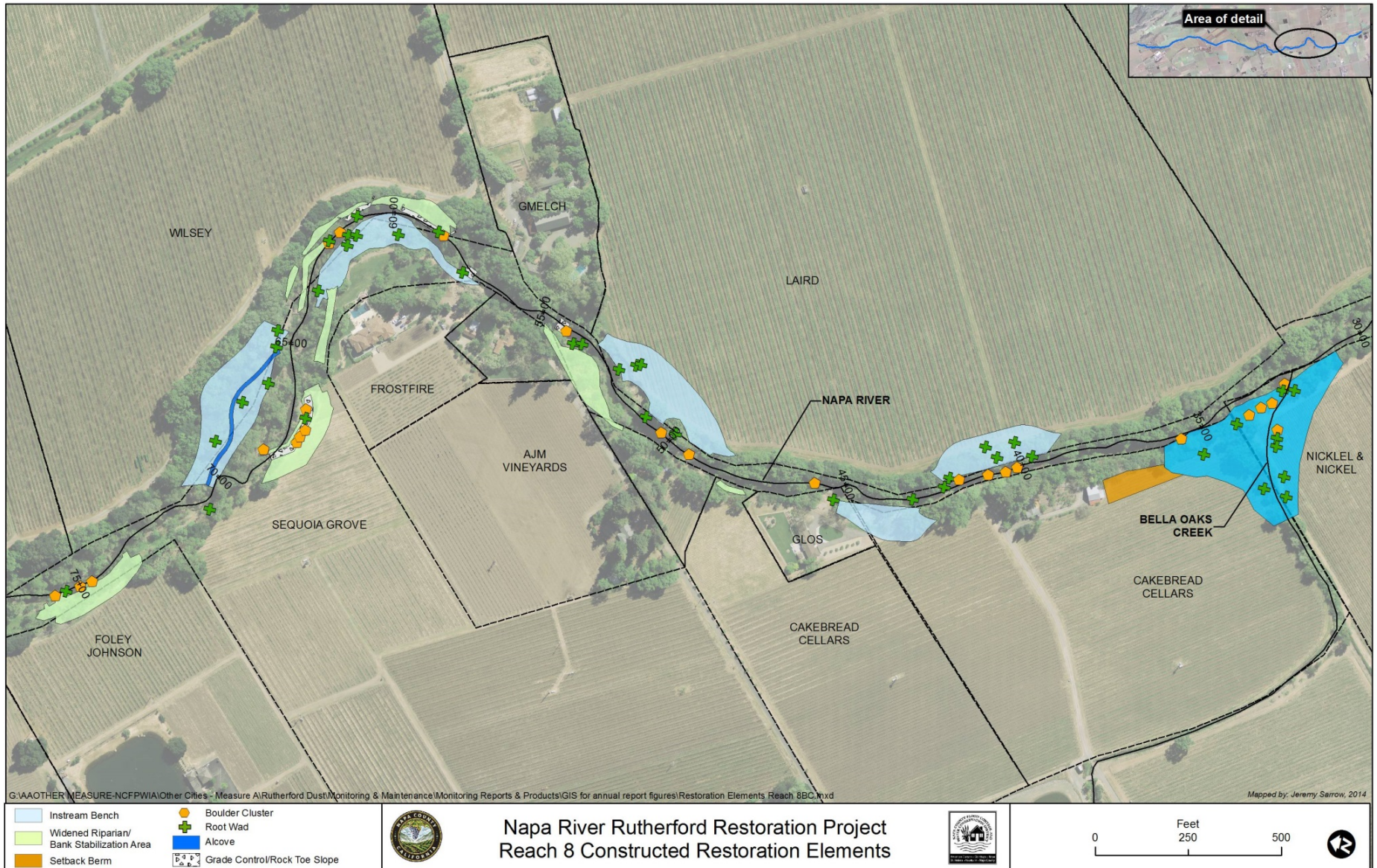
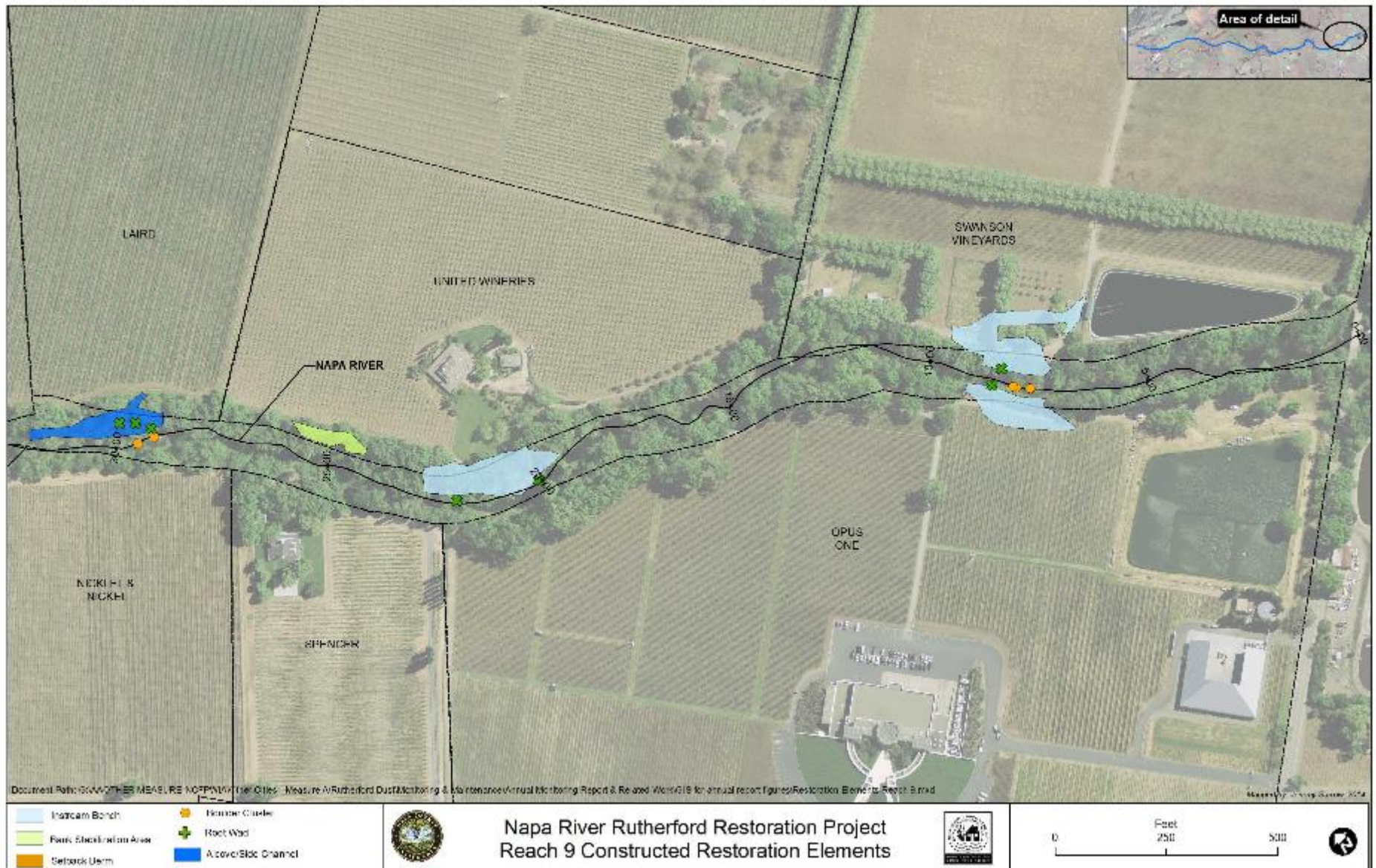


Figure 5: Constructed Restoration Elements Reach 9



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

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- 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*), and 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

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- 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 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
<i>Sediment Load Reduction and Increase in Channel Morphology Complexity</i>		
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
<i>Aquatic Habitat Enhancement</i>		
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
<i>Riparian Habitat Enhancement</i>		
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
<i>Stakeholder Participation</i>		
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 Hydrologic Conditions

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 11456000 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 discharges for the 1-, 2-, 5-, 10-, 25-, 50- and 100-year

flow events are summarized in **Table 4**. USGS does not provide a peak flow statistic for the 1.5-year flow, 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

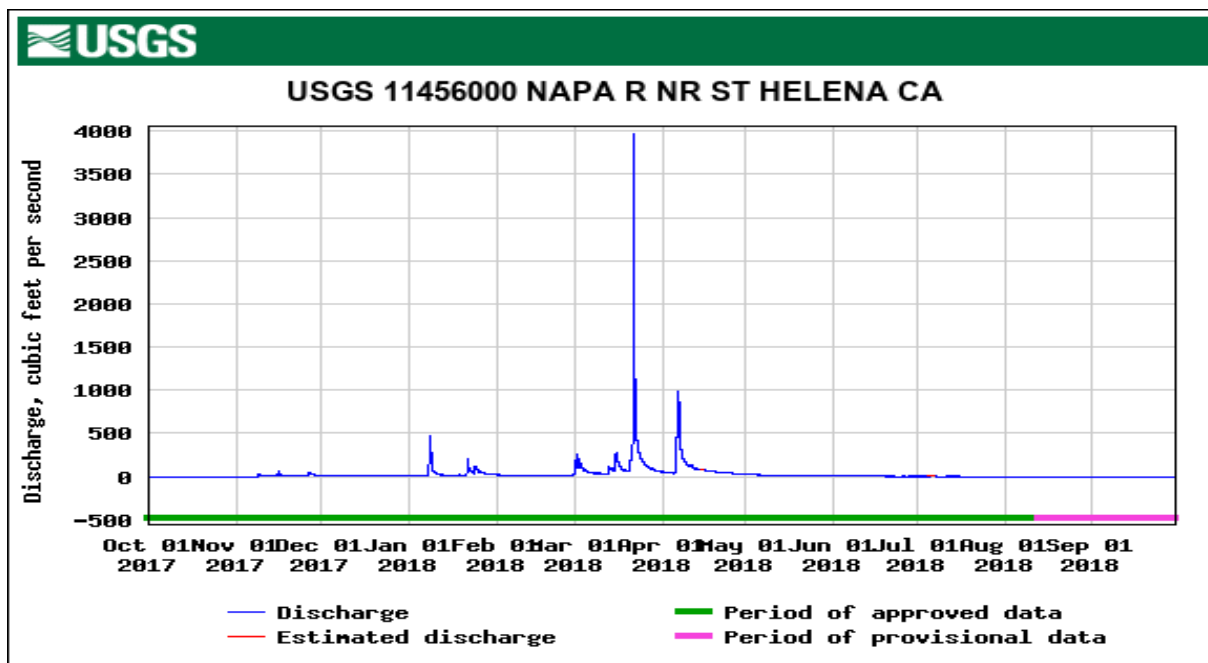
The last rare flooding event occurred on December 31, 2005, prior to construction of the project, when a peak flow of 18,300 cfs was recorded at Station 11456000, making it an approximate 50-year flood. Since that time, all peak flow events have been below 10,000 cfs, or less than 5-year recurrence interval 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 2017-18 water year (October 1, 2017 through September 30, 2018), measureable streamflow began at Station 11456000 on November 8, 2017 and continued through late July. The peak flow of the season occurred on March 22, 2018, and was measured to be 3,970 cfs, an approximate 1.2-year flow. Following the last significant storm of the season on April 7, 2018, flows in the river receded until measurable streamflow subsided on July 20, 2018. A plot of streamflow measured at Station 11456000 during the 2017-18 water year is included as **Figure 6**.

Figure 6. 2017-2018 streamflow, Napa River Rutherford Restoration Reach, USGS Station 11456000.



The reporting period for this monitoring effort includes the start of the 2018-19 water year (October 1, 2018 through September 30, 2019), and measurable flows in the reach began on December 14, 2018. As of mid-February, two flow events have exceeded the 1.5-year peak flow with the largest peak flow provisionally estimated at 6,460 cfs. The streamflow data for the entire 2018-19 water year will be presented in the next annual monitoring report.

According to historical streamflow data from Station 11456000, Napa River flow at the gage site typically subsides in July and begins again in October or November. Rarely, the river will flow near-perennially, drying out for only a small number of days, usually in September. During the dry period, conditions in the Rutherford Restoration Reach vary, with sub-reach conditions ranging from completely dry, to isolated pools, to trickling. 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 2018, 526 feet of channel bank was mapped as eroding or unstable throughout the Rutherford Reach, this is a reduction of 96% compared to the 2009 baseline. The average height of eroding streambank measured in 2018 was 18.8 feet, erosion was typically located at the base of the stream bank. While 2018 continued the overall trend in a decrease in bank erosion throughout the Project reach the next large flow event equivalent to a 10 year or greater reoccurrence interval will likely reverse this trend. Streambank erosion in a natural process and is variable in any given year influenced by many factors including peak stream flow, lack of vegetative cover and other factors such as downed trees. The results of the surveys from 2009-2018 are summarized in **Table 6** below. See **Appendix A** for figures depicting the location and extent of eroding stream banks mapped during the 2017 and 2018 surveys.

Table 6. Results of eroding stream bank surveys, 2009-2018.

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%
2018	526	96%

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 2018; the most recent thalweg survey was completed in 2016. Thalweg surveys are completed 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 2018; 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, 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 number and lengths of riffle crests from the channel thalweg survey data collected once every five years will be used to inform riffle counts and analysis.

4.7 Large Woody Debris and Habitat Structure Surveys

Large woody debris and habitat structure surveys were not completed in 2018; 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 2018; 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 2018, including direct count, percent vegetative cover, line intercept surveys and invasive plant management is presented herein.

Direct count and photo documentation

During the fall of 2018, Flood District staff conducted annual direct count vegetation surveys of all restoration sites in Reaches 5 through 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 1-4 were not surveyed in 2018 but will be surveyed again in 2020 and 2021 respectively. Planted restoration areas in reaches 5-9 were surveyed to determine percent survivorship and qualitative health of installed and naturally recruited vegetation. **Tables 7** and **8** below present the percent survivorship by a given species in reaches 5 through 9 for monitoring year 2018; representational photographs of revegetation sites surveyed can be seen in **Appendix B**.

Survey results in 2018 for reaches 5 through 9 indicate overall survivorship for installed plants ranged from 106% (Reaches 5, 6, 7, 9) 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 shrubs species throughout the Project. However, it should be noted that acquiring an accurate count at these sites as they mature, particularly for shrub species (coyote brush, California Rose, etc.) is becoming increasingly difficult due to the mature under and over story that has developed at the sites 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 8 (Includes Ritz-Carlton Mitigation Area) Woody Vegetation Direct Count/Survivorship Surveys 2018

Common Name	Total Installed Reach 8	Count 2014 Reach 8	Count 2015 Reach 8	Count 2016 Reach 8	Count 2017 Reach 8	Count 2018 Reach 8	% Survival
Big leaf maple	59	63	61	59	59	55	93%
Honeysuckle	26	18	27	18	15	8	31%
Snowberry	300	467	512	292	310	349	116%
California Wild Rose	379	394	531	399	425	425	112%
Spicebush	18	14	16	16	15	15	83%
California Buckeye	98	159	140	121	119	119	121%
White Alder	190	185	275	305	344	365	192%
Oregon ash	189	157	178	174	150	120	63%
Fremont's Cottonwood	116	238	298	282	321	309	266%
California Black Walnut	114	150	163	121	98	98	86%
Coyote Bush	195	149	245	225	201	255	131%
Valley Oak	225	254	351	309	315	315	140%
Bay Laurel	46	41	41	38	30	25	54%
Toyon	52	79	47	46	39	42	81%
Coast Live Oak	179	164	264	250	250	250	140%
Total	2186	2532	3149	2655	2691	2750	123%

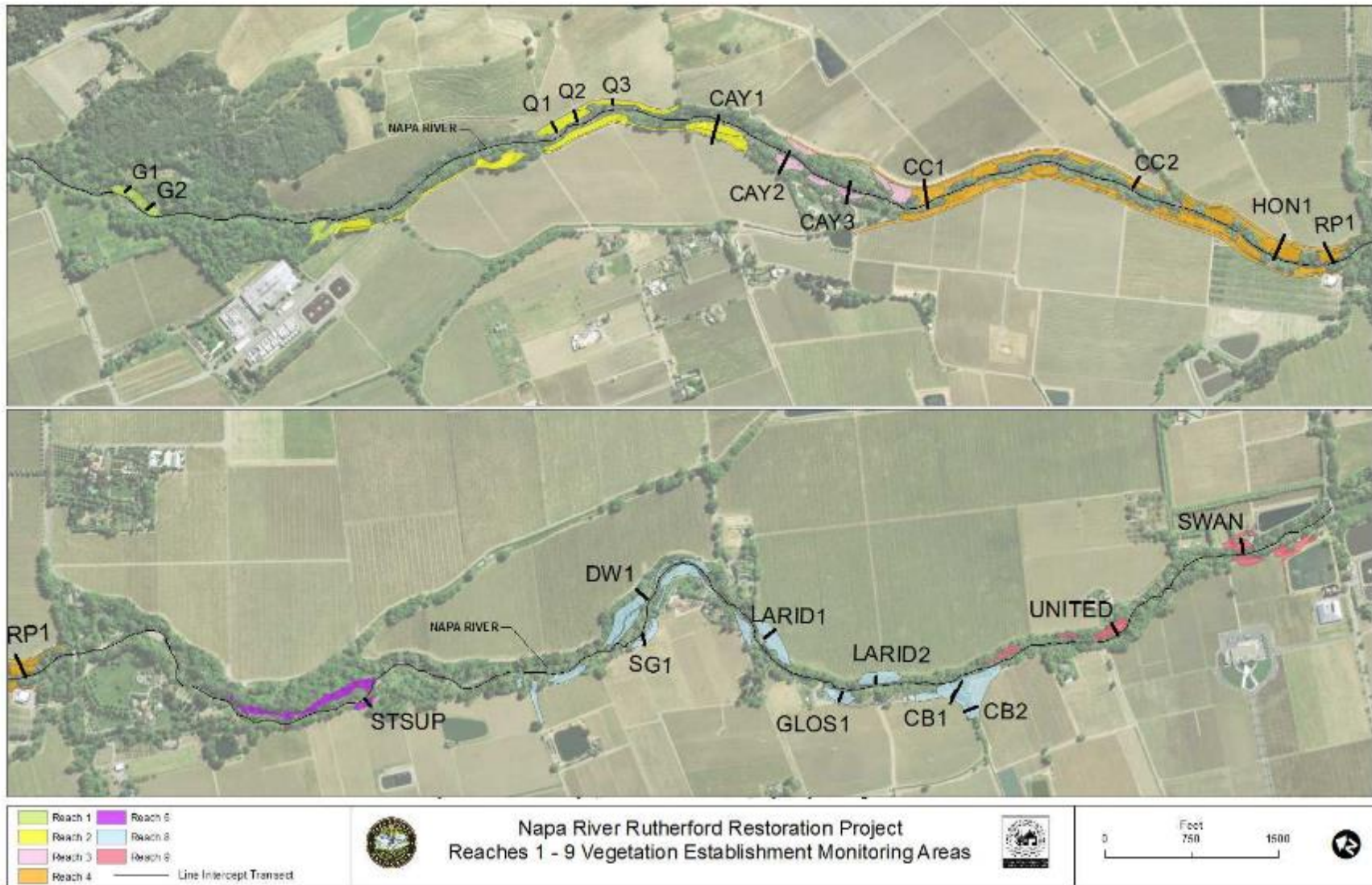
* Includes original planted stock and naturally recruited species.

Table 8: Reach 5,6,7,9 Woody Vegetation Direct Count/Survivorship Surveys 2018

Common Name	Total Installed 2015	Count 2016 Reach 5,6,7,9	Count 2017 Reach 5,6,7,9	Count 2017 Reach 5,6,7,9	Count 2018 Reach 5,6,7,9	% Survival
Big Leaf Maple	29	29	25	23	17	59%
California Buckeye	54	36	32	30	36	67%
White Alder	29	29	36	42	58	200%
Oregon Ash	45	45	38	31	23	51%
California Black Walnut	65	65	60	60	60	92%
Northern CA Black Walnut *	60	60	60	51	51	85%
Fremont's Cottonwood	72	72	98	90	102	142%
Coast Live Oak	163	153	149	146	146	90%
Valley Oak	238	238	197	197	197	83%
Red Willow	106	106	143	156	167	158%
Arroyo Willow	48	48	54	32	32	67%
Bay Laurel	21	21	18	17	17	81%
Coyote Bush	73	73	78	87	102	140%
Western Spice Bush	35	35	25	19	17	49%
Hairy Ceanothus	23	23	18	15	12	52%
Toyon	47	47	45	45	45	96%
Ninebark	34	34	30	30	35	103%
California gooseberry	52	52	41	41	41	79%
California Wild Rose	148	148	144	165	172	116%
Snowberry	91	91	102	122	187	205%
Total	1433	1405	1393	1399	1517	106%

* Includes original planted stock and naturally recruited species.

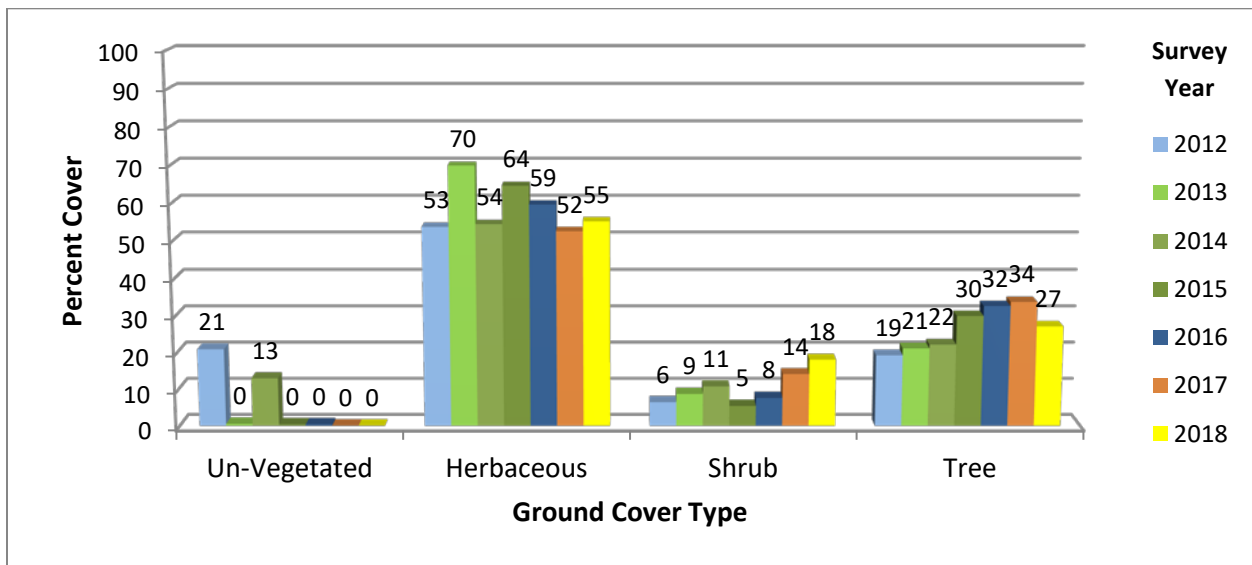
Figure 7: Location of direct count and line intercept vegetation surveys



Line transect surveys/percent cover

Line transects have been established at 22 locations in all of the nine monitoring reaches in order to measure change in vegetative cover 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 2012-2018. As in previous year's surveys herbaceous is the dominate cover type follow by over story/trees and woody shrubs respectively. Results of the surveys indicate that the general trend in ground cover type 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.

Chart 1: Average percent cover by ground cover type for line transect surveys (2012-2018)



Visual estimation of percent native vs non-native species by cover type was determined to be approximately 60-70% native species for herbaceous cover with the remaining 40%-50% being non-native annual grasses and perennials such as *vinca sp.* Woody shrub cover was estimated to be approximately 70%-80% native (coyote brush, CA blackberry, snowberry, CA rose, etc.) with the remaining 20%-30% non-native woody cover being comprised of species such as Himalayan blackberry and red sesbania, etc. Tree cover type was estimated to be comprise of primarily native species, 85%-90% (primarily cottonwoods, willows, alders and oaks), within the restoration areas surveyed while the remaining 10%-15% non-native tree species detected were black locust, tree of heaven and the occasional London plain sycamore.

In general, the percent relative cover and native vs non-native species cover surveyed at the restoration sites is representative of a managed, established restoration area providing greater habitat value within

the riparian corridor of the Napa River then adjacent non-managed areas with a low percentage of cover and native plant species.

Invasive plant management

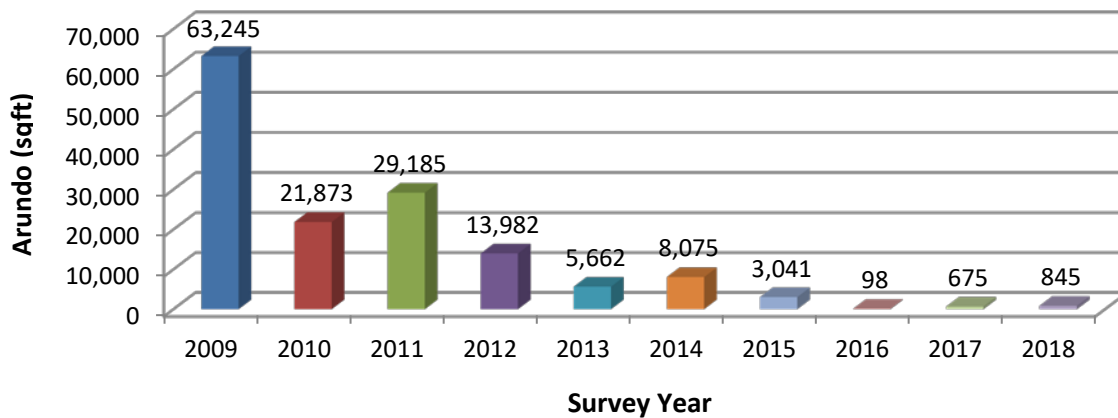
A total of 86,115 square feet (1.9 acres) of non-native invasive and Pierce host vegetation was documented and treated during the 2018 survey. Species documented in 2018 include 17,800 sqft of Himalayan blackberry, 45,150 sqft of native/hybrid CA grape, 5,000sqft of *vinca sp.*, 17,320sqft of Mugwort and only 845 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 2018. 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 2018 (845 sqft) was more than the previously documented in 2017 (675 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 2018 and 2019.

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

Survey Year	Giant Reed	Himalayan Blackberry	Periwinkle (<i>Vinca sp.</i>)	Mugwort	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
2018	845	17,800	5,000	17,320	45,150	N/A	86,115
Total Treated to Date:							1,729,778 (39.7 acres)

Chart 3: Arundo mapped and treated (2009-2018)



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 2018 for this area had an overall plant survivorship of 123% for the site, well above the 80% or greater vegetation survivorship criteria requirements for the site. This number includes natural recruitment.

Caltrans Troutdale Creek Bridge Mitigation Site

In support of Caltrans 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 2018 for this area (including natural recruitment) had an overall plant survivorship of 106% for all of the sites combined, well above the 80% or greater vegetation survivorship criteria requirement.

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 30-50% 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 2018 are shown in **Appendix B**.

4.13 Snorkel Surveys

Periodically the Napa County RCD performs complementary fish and wildlife monitoring which helps inform achievement of restoration goals and objectives for the Project. During the spring of 2018 RCD staff conducted snorkel surveys throughout the entire Project reach; the survey focused on installed habitat structures in order to document use by steelhead, Chinook salmon and other native fishes. A

summary of the fish observed during the snorkel survey is presented in **Table 11** below and the entire survey report is contained within **Appendix C**. In summary no juvenile Chinook salmon were observed and steelhead abundance was low, however several age classes (young-of-year, 1+, 2+) of steelhead were observed during the survey indicating spawning and rearing occurred within the Project reach. Additionally, evidence of Pacific lamprey spawning was widespread throughout the survey reach.

Table 11: Aquatic species observed

Common Name	Scientific Name	Densities Observe	Notes
Steelhead	<i>Oncorhynchus mykiss</i>	Low	size classes ranged from ~50-200mm, found primarily in run/riffle habitat
Pacific Lamprey	<i>Entosphenus tridentatus</i>	Low	spawning nests relatively abundant in pool tail-outs, 2 carcasses observed
California Roach	<i>Hesperoleucus symmetricus</i>	Medium	common throughout survey
Three-spine Stickleback	<i>Gasterosteus aculeatus</i>	Medium	common throughout survey
Sacramento Sucker	<i>Catostomus occidentalis</i>	Low	common but not abundant throughout survey
Sacramento Pikeminnow	<i>Ptychocheilus grandis</i>	Low	single observation (1 school of 3-5 fish)
Bluegill	<i>Lepomis macrochirus</i>	Low	single observation
Northwestern Pond Turtle	<i>Actinemys marmorata</i>	Low	single observation
Red Swamp Crayfish	<i>Procambarus clarkii</i>	Low	
American Bullfrog (tadpole)	<i>Lithobates catesbeiana</i>	Medium	common throughout survey

5.0 Summary and Conclusions

To date, monitoring results indicate that 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 2018, 526 linear feet of stream bank was mapped as eroding or unstable throughout the Rutherford Reach, this represents a decrease from linear footage of eroding bank measured in 2017 (837 linear feet) and a reduction in bank erosion sites detected in 2018 (13) as opposed to 20 bank erosion sites surveyed in 2017. The overall net reduction of eroding stream banks measured since inception of the Project is 96% 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 1.9 acres of non-native invasive and Pierce host vegetation was documented and treated in 2018. Species treated included Himalayan blackberry, native/hybrid CA grape, Vinca, Mugwort and

Arundo. Survey results in 2018 for reaches 4 through 9 indicate that overall survivorship (when including natural recruitment) of installed native shrubs and trees was 106% (Reaches 5-7 and 9) and 123% at Reach 8, well above plant establishment criteria set forth in the monitoring plan. Results from line intercept surveys indicate that native cover, on average, is approximately 55% herbaceous, 18% woody shrub and 27% tree cover types. In general, the successful natural recruitment of native species (leading to survivorship counts greater than 100%) and the increase in relative native cover represents a positive trend in vegetation establishment at the restored sites, providing greater habitat value within the riparian corridor of the Napa River. Snorkel surveys conducted in the spring of 2018 found several age classes (young-of-year, 1+, 2+) of steelhead utilizing the aquatic habitat structures indicating spawning and rearing is occurred within the Project reach.

Overall, the created instream and terrestrial habitat is providing important foraging and rearing areas for native wildlife. Bank erosion decreased from that which was measured in the previous year and is likely taking place at the rate which can be considered a “back ground” rate. 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>

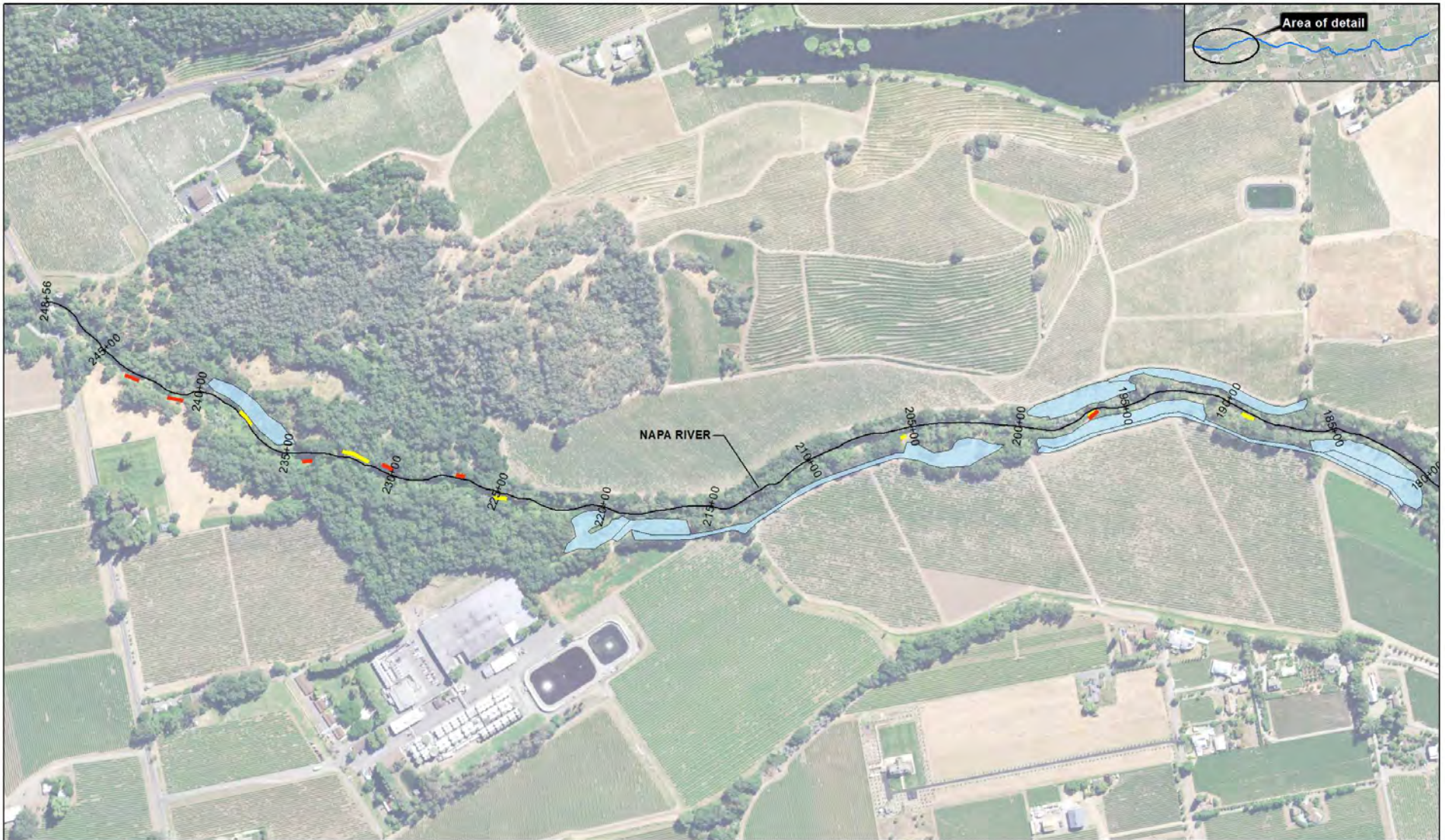
Napolitano, M., et al. (2009) *Napa River Sediment TMDL and Habitat Enhancement Plan*. California Regional Water Quality Control Board San Francisco Region.

https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/napasediment/C_NS_Staff_Report_09-09.pdf

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

Sarrow, J., Blank, P., Koehler, J., (2017) *Napa River Rutherford Reach Restoration Project Monitoring Plan 2017*.

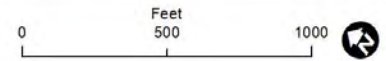
Appendix A
Eroding Stream Bank Survey Figures
2018



- █ Stream Bank Erosion 2018
- █ Stream Bank Erosion 2017
- █ Constructed Features



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

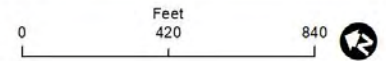




- Stream Bank Erosion 2018
- Stream Bank Erosion 2017
- Constructed Features



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

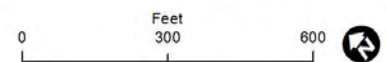




- █ Stream Bank Erosion 2018
- █ Stream Bank Erosion 2017
- █ Constructed Features



Napa River Rutherford Restoration Project Reach 5-7
Eroding Stream Bank Survey

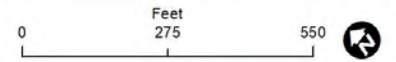




- █ Stream Bank Erosion 2018
- █ Stream Bank Erosion 2017
- █ Constructed Features



Napa River Rutherford Restoration Project Reach 8
Eroding Stream Bank Survey

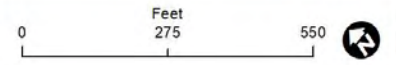




- █ Stream Bank Erosion 2018
- █ Stream Bank Erosion 2017
- █ Constructed Features



Napa River Rutherford Restoration Project Reach 9
Eroding Stream Bank Survey



Appendix B
Photographic Monitoring
2018

**Reaches 1 and 2 East Bank
(Phase 1)**

Constructed 2009

**Guggenhime
Quintessa**

River Station 235+00
Bench: Guggenime, East Bank



October 2009



June 2011



December 2016



June 2018

River Station 195+50
Benches: Quintessa, East Bank



River Station 19,550
Benches: Quintessa, East Bank to West Bank



**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



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



River Station 191+00
Frog's Leap Bench from Quintessa Road, East Bank



September 2010



December 2016



LWD installation



April 2018

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



**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 2018

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



October 2010



December 2016



June 2015



May 2018

River Station 168+50
Bench 3: Caymus, Downstream to Upstream



October 2010



December 2016



June 2015



May 2018

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



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



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



**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



April 2018

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



August 2011



March 2012



December 2016



April 2018

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



October 2011



December 2016



June 2015



April 2018

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



October 2011



December 2016



June 2015



April 2018

**Reach 4 West Bank
(Phase 3)**

Constructed 2012

Emmolo, Caymus and Round Pond

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



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



May 2012



June 2015



August 2012



May 2018

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



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



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



River Station 135+60
Bench 10: Caymus, West Bank to Upstream



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



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



November 2012



Boulder Cluster, Reach 4, June 2018

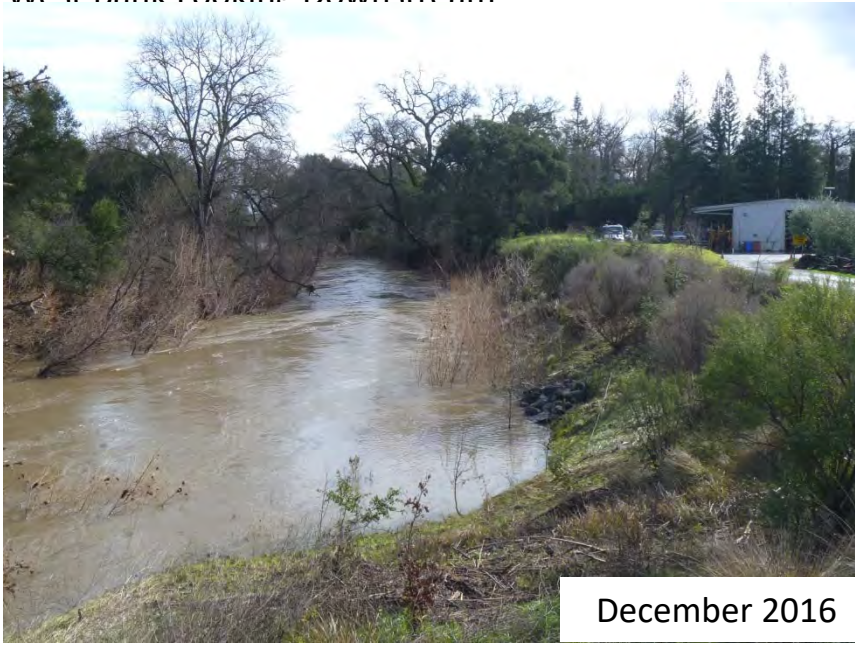


December 2016



May 2018

River Station 127+80
Bank Stabilization 3: Round Pond West Bank Looking Downstream



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



**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



March 2016



October 2012



April 2018

**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



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



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



**Reach 8 South
(Phase 4BC)**

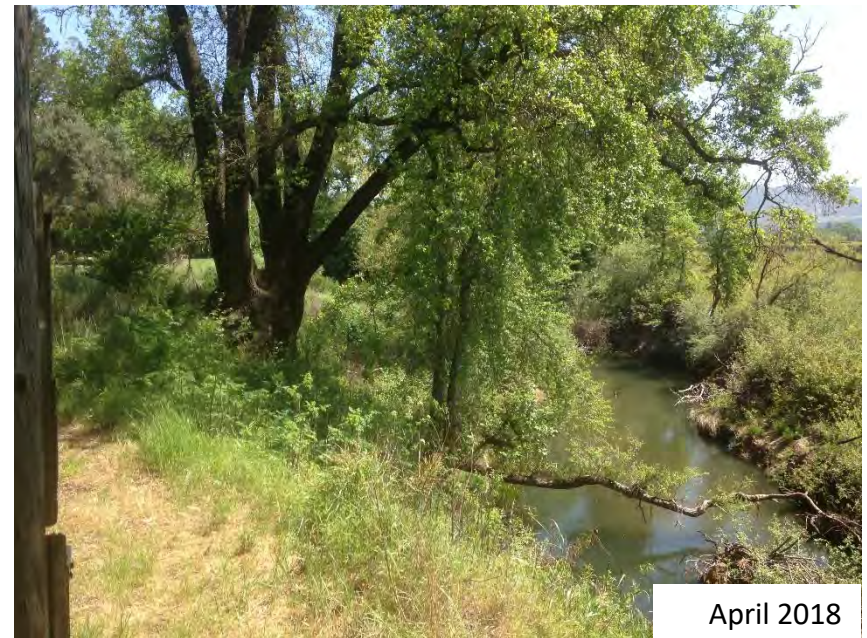
Constructed 2013

**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



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



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



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



River Station 43+00
Reach 8 South, Bank Stabilization 3: Downstream to Upstream



February 2013



December 2016



June 2015



April 2018

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



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



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



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



August 2013



March 2016



Alcove LWD Structure May 2017



April 2018

**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



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



April 2018

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



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



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



July 2014



May 2017



June 2015



April 2018

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



**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



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



July 2014



December 2016



December 2014



April 2018

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



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



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



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



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



July 2014



December 2016



June 2015



April 2018

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



July 2014



December 2016



June 2015



April 2018

Beaver Dams, Bank Repair, LWD Structures



Beaver Dam, Reach 3, 06/2018



LWD Structure, Reach 3 East Bank, 06/2018



Bank repair, Frogs Leap, Reach 4, 06/2018 - Before



10/2018 - After

Appendix C
Snorkel Survey
2018



SNapa County Resource Conservation District

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MEMORANDUM

To: Jeremy Sarrow, Napa County Flood Control and Water Conservation District
From: Jonathan Koehler, Senior Biologist
Date: May 29, 2018
Subject: Snorkel survey of the Napa River Rutherford restoration project

Introduction

This memorandum summarizes the findings of a snorkel survey conducted by the Napa County Resource Conservation District (RCD) in the Rutherford restoration reach of the Napa River in April 2018. The survey focused on installed habitat structures to document use by steelhead (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), and other native fishes.

Methods

Snorkel surveys were conducted April 23-25, 2018 by Jonathan Koehler and Paul Blank of the RCD. Surveying began at the downstream extent of the project reach and proceeded upstream. The crew wore dry-suits, diving masks, and snorkels to make underwater observations. Data were recorded with a field tablet.

All installed habitat structures located during the survey were assessed by at least one diver. Effort was made to approach each structure slowly to avoid disturbance. Fish densities within each sampling unit were visually estimated using the following scale:

- Species Not Observed
- Low Density = 1-5 fish per square meter
- Medium Density = 6-10 fish per square meter
- High Density = >10 fish per square meter

In areas of the project reach with no installed habitat structures, a random sampling approach was used to dive a minimum of every third habitat type (pool/glide, run, riffle) encountered.

Results

The survey covered a total distance of 6.6 km (4.1 miles). A total of 65 installed habitat structures (26 boulder structures and 39 wood structures) were assessed. In addition, 36 random sampling units (10 pool/glides, 9 runs, 17 riffles) outside of the immediate restoration areas were dived. Weather conditions during the survey were sunny and clear. Underwater visibility was limited to approximately 1-1.5 meters due to turbidity and a greenish tint to the water that was most apparent in low-light habitats, especially deep pools. Water temperature measured with a hand-held bulb thermometer ranged from 15-17° C. Streamflow diminished slightly over the course of the survey from approximately 38 cfs on the first day to approximately 31 cfs on the final day (provisional data, USGS Napa River streamgage site 11456000 near St. Helena).

A total of six fish species and three non-fish aquatic taxa were observed during the survey (Table 1). No Chinook salmon were observed. Steelhead were observed in just five locations; four of these observations were single fish and one observation was a group of approximately 10 fish congregating and feeding in a white-water riffle. The distribution of these observations is shown in Figures 1 and 2. Juvenile steelhead ranged in length from approximately 50 to 200mm (~2-8 inches) and were observed near installed habitat structures BC-13980-M, WD-9320-R, and WD-7520-R.

Two Pacific Lamprey carcasses were found alongside freshly-constructed spawning nests during the survey. Both carcasses had been scavenged and were half-eaten (Figure 2). Additionally, Pacific Lamprey nests were observed frequently throughout the surveyed reach, most commonly in pool tail-outs. Nest sites typically contained between 1 and 5 excavated pits, each approximately 0.5m in diameter and 0.1-0.2 m deep.

Table 1. Aquatic species observed.

Common Name	Scientific Name	Densities Observed	Notes
Steelhead	<i>Oncorhynchus mykiss</i>	Low	size classes ranged from ~50-200mm, found primarily in run/riffle habitat
Pacific Lamprey	<i>Entosphenus tridentatus</i>	Low	spawning nests relatively abundant in pool tail-outs, 2 carcasses observed
California Roach	<i>Hesperoleucus symmetricus</i>	Medium	common throughout survey
Three-spine Stickleback	<i>Gasterosteus aculeatus</i>	Medium	common throughout survey
Sacramento Sucker	<i>Catostomus occidentalis</i>	Low	common but not abundant throughout survey
Sacramento Pikeminnow	<i>Ptychocheilus grandis</i>	Low	single observation (1 school of 3-5 fish)
Bluegill	<i>Lepomis macrochirus</i>	Low	single observation
Northwestern Pond Turtle	<i>Actinemys marmorata</i>	Low	single observation
Red Swamp Crayfish	<i>Procambarus clarkii</i>	Low	
American Bullfrog (tadpole)	<i>Lithobates catesbeiana</i>	Medium	common throughout survey



Figure 1. Snorkel survey points in the southern half of the Rutherford restoration project reach.

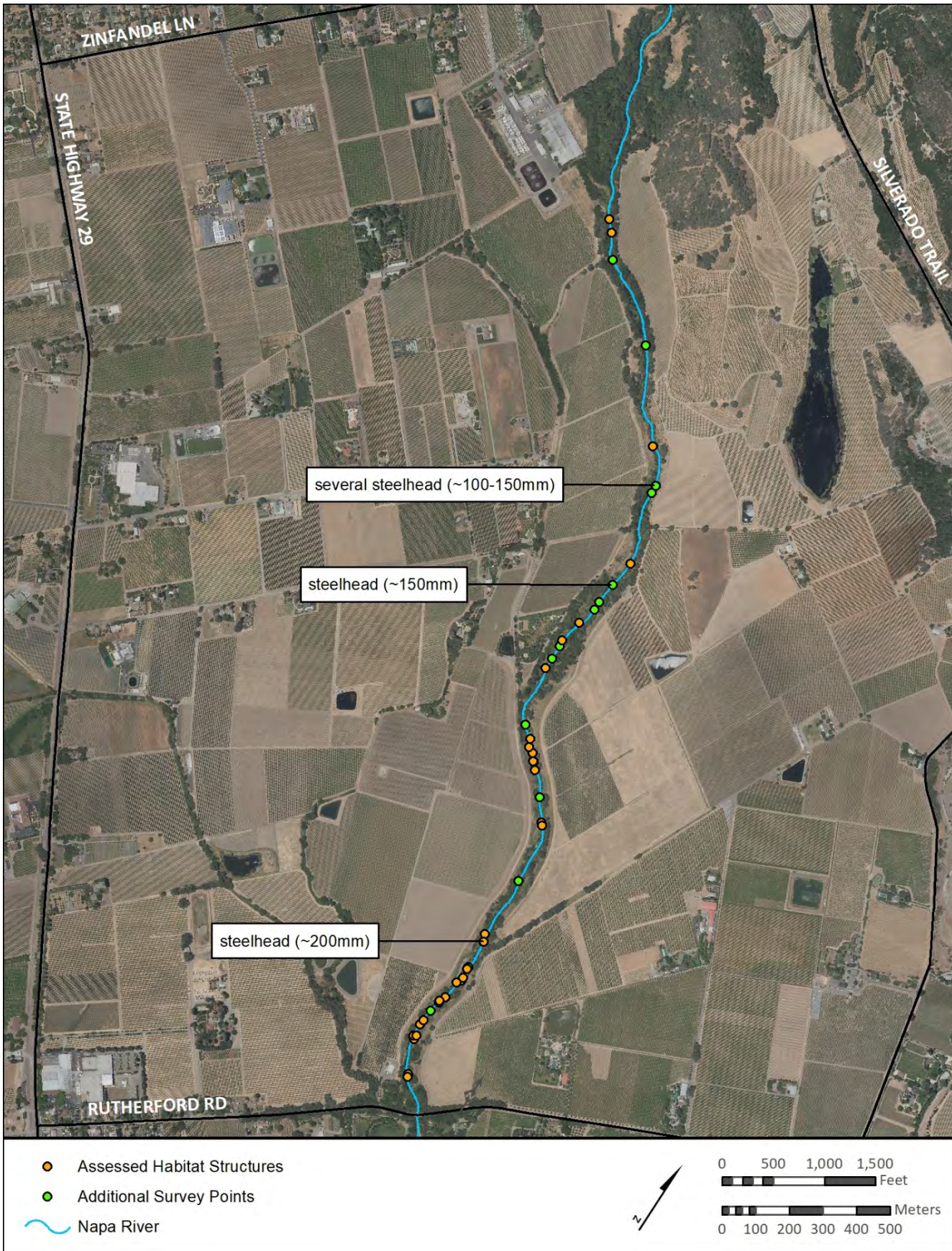


Figure 2. Snorkel survey points in the northern half of Rutherford restoration project reach.

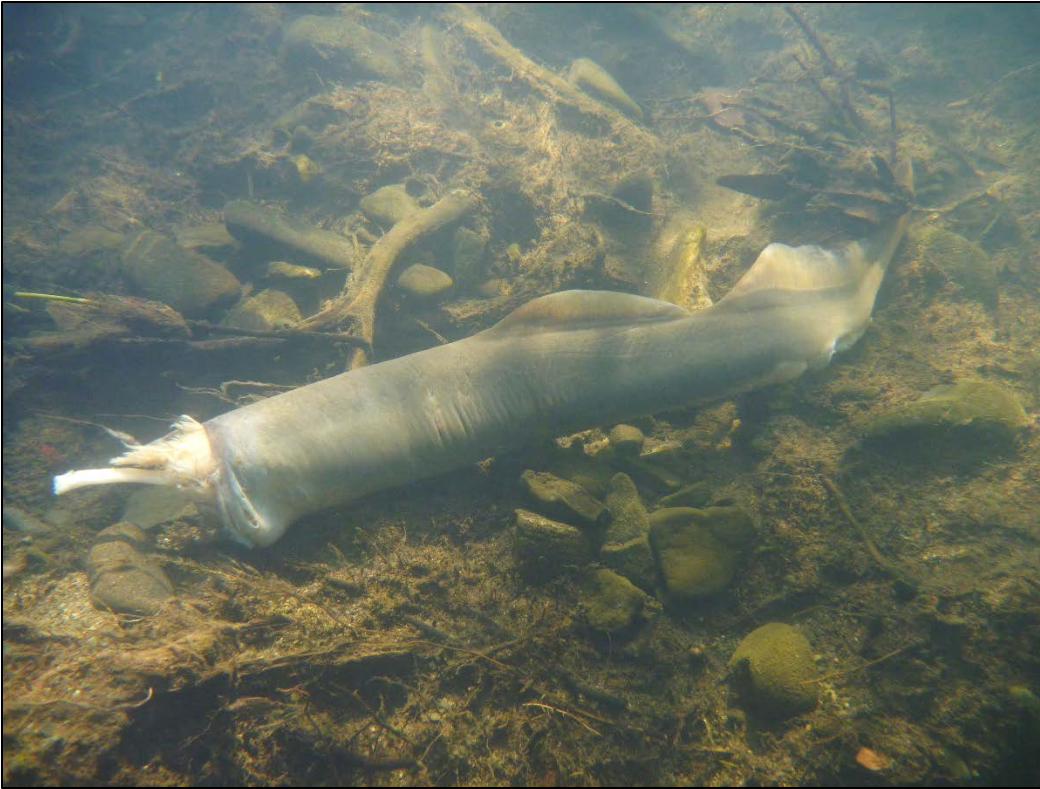


Figure 2. Scavenged Pacific Lamprey carcass.

Discussion and Conclusions

The absence of juvenile Chinook salmon was somewhat surprising given the relatively high abundance of this species captured in the Napa River rotary screw trap in spring 2018. Very little rainfall occurred during the adult spawning season (November-January), and therefore adult salmon were unable to migrate as far upstream as the Rutherford reach. RCD conducted reconnaissance surveys for spawning activity in fall/winter 2017/18 and did not observe any adult salmon upstream of Yountville. Based on the adult and snorkel surveys, it appears that Chinook did not spawn or rear in the Rutherford reach in 2018.

Steelhead abundance was notably lower than previous sampling years. An unusually wet March created favorable flow conditions for steelhead in winter/spring 2018, so the reason for this low abundance is not clear. Still, several age classes (young-of-year, 1+, 2+) of steelhead were observed during the survey, indicating that spawning and rearing occurred within the project reach.

Evidence of Pacific lamprey spawning was widespread throughout the survey. Although no quantitative counts of nests were made during this most recent survey, RCD plans to count and map lamprey spawning sites in future years to better understand their distributions and abundance through time. Based on the observations made during the most recent survey, lamprey nests were present in about a quarter to half of the riffle crests throughout the reach.

Attachments

Attachment 1 – Snorkel survey results for installed habitat structures

GIS data

Attachment 1 - Snorkel survey results for installed habitat structures

Structure ID	Structure Type	Habitat	Date	Chinook	Steelhead	Other fish	Other fish	Other fish	Notes
BC-765-M	Boulder Cluster	Pool	4/23/2018	None	None				
WD-825-L	Toe Log	Pool	4/23/2018	None	None				
WD-2020-L	Root Wad	Pool	4/23/2018	None	None				
WD-2220-L	Root Wad	Pool	4/23/2018	None	None	CARO			
WD-3252-R	Root Wad	Riffle	4/23/2018	None	None	CARO	THST		looks great
BC-3560-R	Boulder Cluster	Pool	4/23/2018	None	None	THST	CARO		
WD-3958-L	Root Wad	Pool	4/23/2018	None	None	CARO	THST	SASU	
BC-4000-L	Boulder Cluster	Run	4/23/2018	None	None	CARO			redd here
WD-4050-L	Toe Log	Run	4/23/2018	None	None	CARO			
BC-4130-L	Boulder Cluster	Run	4/23/2018	None	None	CARO			
BC-4180-L	Boulder Cluster	Run	4/23/2018	None	None				
WD-4187-L	Root Wad	Run	4/23/2018	None	None	CARO			
WD-4204-L	Root Wad	Riffle	4/23/2018	None	None	CARO			
WD-4293-R	Root Wad	Pool	4/23/2018	None	None				
BC-4560-M	Boulder Cluster	Glide	4/23/2018	None	None				no boulders visible. buried.
BC-4920-L	Boulder Cluster	Run	4/23/2018	None	None				
WD-4960-L	Root Wad	Run	4/23/2018	None	None				
BC-4980-L	Boulder Cluster	Riffle	4/23/2018	None	None	CARO			abundant roach
WD-5094-L	Root Wad	Pool	4/23/2018	None	None	CARO			
WD-5243-L	Root Wad	Pool	4/23/2018	None	None	CARO	BLUE		
WD-5344-R	Low Profile Log	Riffle	4/23/2018	None	None	CARO			
R-5770-M	Grade Control; Riffle	Riffle	4/23/2018	None	None	CARO			
BC-5875-L	Boulder Cluster	Riffle	4/23/2018	None	None	CARO			partially buried
WD-5900-L	Root Wad	Riffle	4/23/2018	None	None	CARO	THST		
WD-6100-L	Root Wad	Riffle	4/23/2018	None	None	CARO			
WD-6180-L	Root Wad	Pool	4/23/2018	None	None	CARO			
BC-6200-L	Boulder Cluster	Pool	4/23/2018	None	None				
BC-7410-R	Boulder Cluster	Pool	4/24/2018	None	None	CARO			deep turbid water

Other fish species key: CARO = California roach, SASU = Sacramento sucker, SAPI = Sacramento pikeminnow, THST = three-spine stickleback, BLUE = bluegill

Structure ID	Structure Type	Habitat	Date	Chinook	Steelhead	Other fish	Other fish	Other fish	Notes
BC-7460-M	Boulder Cluster	Pool	4/24/2018	None	None	CARO			deep turbid water
WD-7520-R	Toe Log	Pool	4/24/2018	None	Low	CARO			yoy steelhead
BC-7530-R	Boulder Cluster	Pool	4/24/2018	None	None	CARO			
WD-9320-R	Root Wad	Riffle	4/24/2018	None	Low	CARO			steelhead aprox 80mm
BC-9325-M	Boulder Cluster	Pool	4/24/2018	None	None	CARO			
BC-10380-L	Boulder Cluster	Pool	4/24/2018	None	None	CARO			buried
WD-10435-L	Root Wad	Riffle	4/24/2018	None	None	CARO			abundant roach around rootwad
BC-12400-L	Boulder Cluster	Pool	4/24/2018	None	None				
WD-12420-L	Root Wad	Pool	4/24/2018	None	None				
WD-12800-L	Root Wad	Glide	4/24/2018	None	None	CARO			
BC-12825-M	Boulder Cluster	Pool	4/24/2018	None	None				one boulder found
WD-12850-L	Low Profile Log	Pool	4/24/2018	None	None				half buried on pool bottom
BC-12950-M	Boulder Cluster	Pool	4/24/2018	None	None	CARO			
WD-12990-L	Low Profile Log	Riffle	4/24/2018	None	None				single boulder visible, rest probably buried
BC-13190-R	Boulder Cluster	Pool	4/24/2018	None	None				
WD-13210-R	Low Profile Log	Pool	4/24/2018	None	None				
WD-13290-R	Root Wad	Pool	4/24/2018	None	None				possible bass seen here
WD-13500-R	Root Wad	Run	4/24/2018	None	None	CARO			tiny fish larvae 1 cm could not id
WD-13590-L	Low Profile Log	Run	4/24/2018	None	None	CARO			8 inch fish seen but could not id
WD-13670-R	Root Wad	Riffle	4/24/2018	None	None				
BC-13980-M	Boulder Field	Riffle	4/24/2018	None	Low				approx 200mm steelhead, nice habitat
WD-14060-R	Root Wad	Pool	4/24/2018	None	None				stagnant pool in side channel
WD-15250-R	Root Wad	Pool	4/25/2018	None	None	THST			
BC-15275-R	Boulder Cluster	Pool	4/25/2018	None	None				
BC-15790-R	Boulder Cluster	Run	4/25/2018	None	None				mostly buried - no fish seen
BC-15910-R	Boulder Cluster	Run	4/25/2018	None	None	CARO			large congregation (100+) of California roach
WD-15925-R	Low Profile Log		4/25/2018	None	None				

Other fish species key: CARO = California roach, SASU = Sacramento sucker, SAPI = Sacramento pikeminnow, THST = three-spine stickleback, BLUE = bluegill

Structure ID	Structure Type	Habitat	Date	Chinook	Steelhead	Other fish	Other fish	Other fish	Notes
BC-16000-R	Boulder Cluster	Riffle	4/25/2018	None	None	CARO			
WD-16050-R	Root Wad	Glide	4/25/2018	None	None	CARO	THST		
WD-16125-L	Root Wad	Pool	4/25/2018	None	None	CARO	THST		deep pool - abundant roach
WD-16900-R	Root Wad	Pool	4/25/2018	None	None				
WD-17225-R	Root Wad	Pool	4/25/2018	None	None				
WD-17425-R	Root Wad	Pool	4/25/2018	None	None	CARO	THST		
BC-18250-M	Boulder Cluster	Pool	4/25/2018	None	None				
WD-19475-R	Toe Log	Pool	4/25/2018	None	None	CARO	THST		
WD-21670-L	Spider Log	Pool	4/25/2018	None	None	THST			red swamp crayfish
WD-21850-R	Toe Log	Pool	4/25/2018	None	None	CARO	THST	SAPI	

Other fish species key: CARO = California roach, SASU = Sacramento sucker, SAPI = Sacramento pikeminnow, THST = three-spine stickleback, BLUE = bluegill