NAPA RIVER RUTHERFORD REACH RESTORATION PROJECT ANNUAL MONITORING REPORT- 2015

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) 252-4188

Table of Contents

APPENDICIES

1. Introduction

The purpose of this document is to report on the results of surveys performed during calendar year 2015 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 the various Project permits and as defined in the monitoring plan (Hayes 2012, Sarrow, Blank, Koehler 2015) approved for the Project. The current monitoring plan (Plan) and previous annual monitoring reports from calendar years 2009 through 2014 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.

The 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 the monitoring framework and defines protocols that were utilized for collecting data and evaluating environmental parameters presented in this report.

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 and the Oakville Cross Road. 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 habitats, 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 inputs of fine sediments and to maintain the functions of 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 instream restoration features. This work is conducted under the supervision of the Napa County Flood Control and Water Conservation District (District) staff in coordination with landowners and their representatives. Maintenance reports from calendar year 2009 through 2015 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 excessive quantities of fine sediment degrading local water quality and beneficial uses. While sediment is a naturally-occurring input to the Napa River system, excessive amounts are considered a pollutant, and thus sediment load reductions mentioned in this report amount to 'pollutant reductions' in TMDL terms. The Rutherford Reach Restoration 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 responsible for TMDL development and implementation.

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 between Zinfandel Lane and the Oakville Cross Road.

For monitoring purposes, the 4.5 mile Project reach has been divided into reaches numbered from 1 to 9 starting from the Zinfandel Lane Bridge and ending at Oakville Cross Road 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 a list of construction schedules, Project reaches, 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 the 2014 monitoring report 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 a total of 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

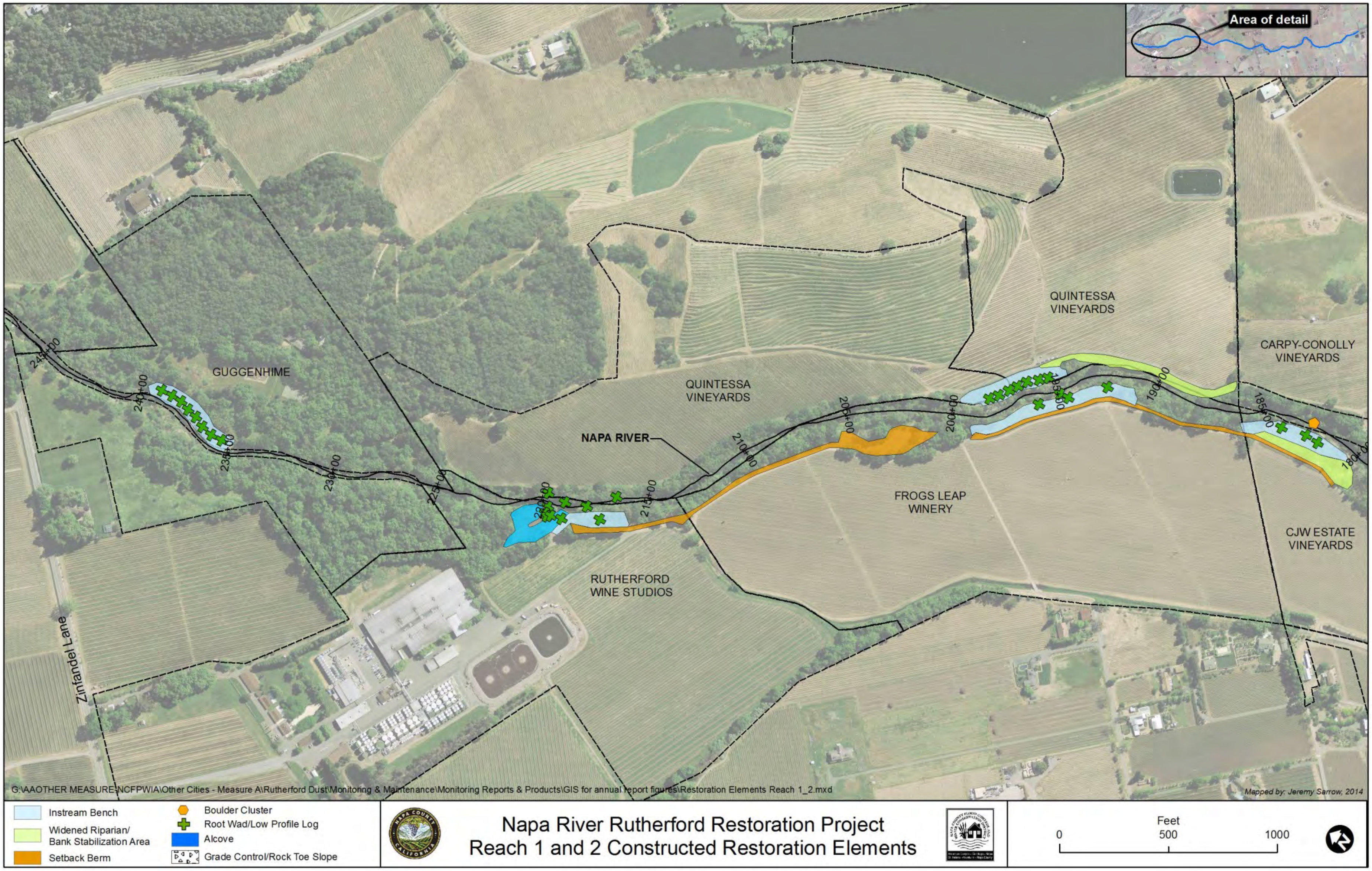


Figure 2: Constructed Restoration Elements Reaches 3 and 4

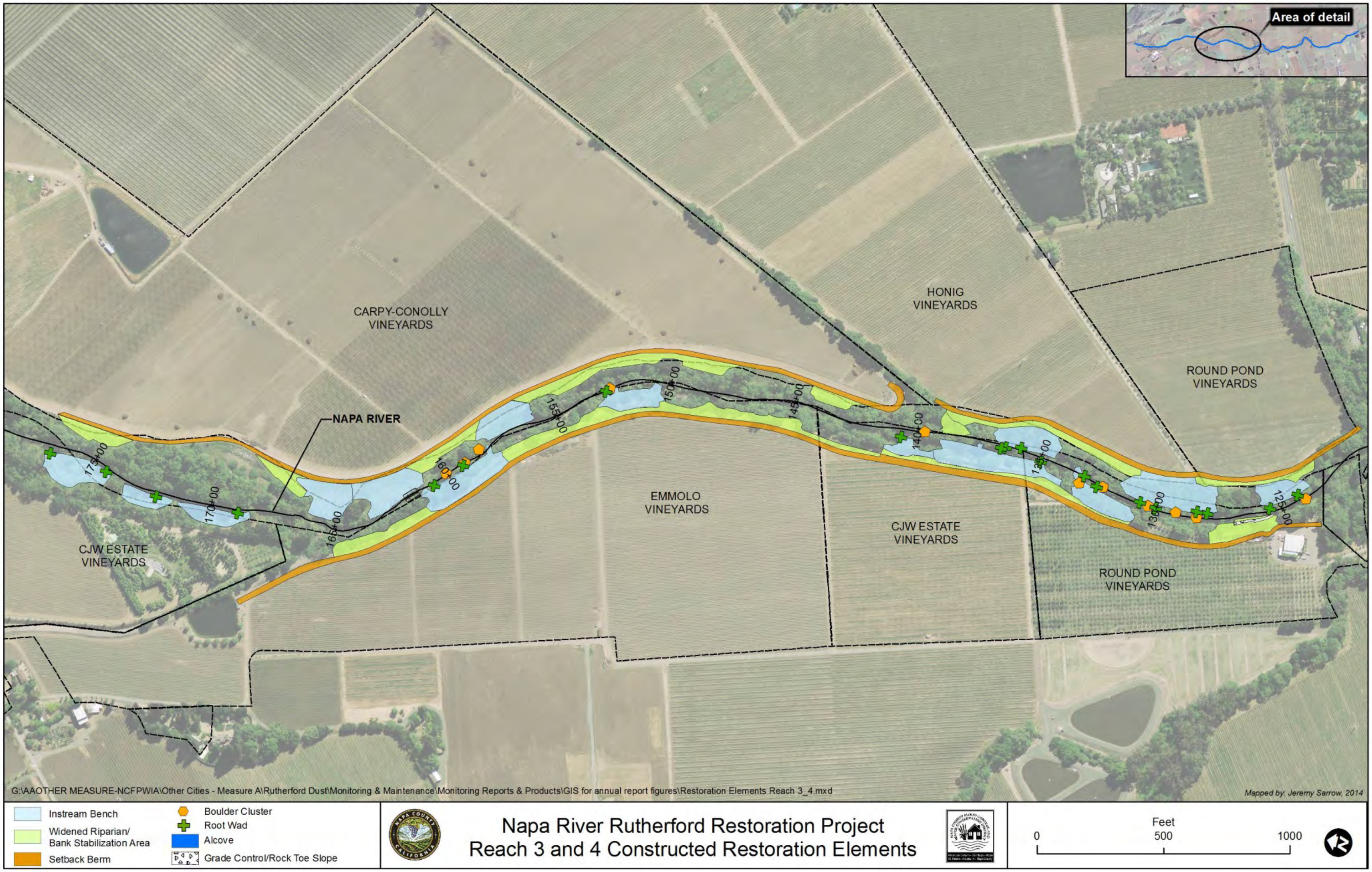


Figure 3: Constructed Restoration Elements Reach 8 North/South

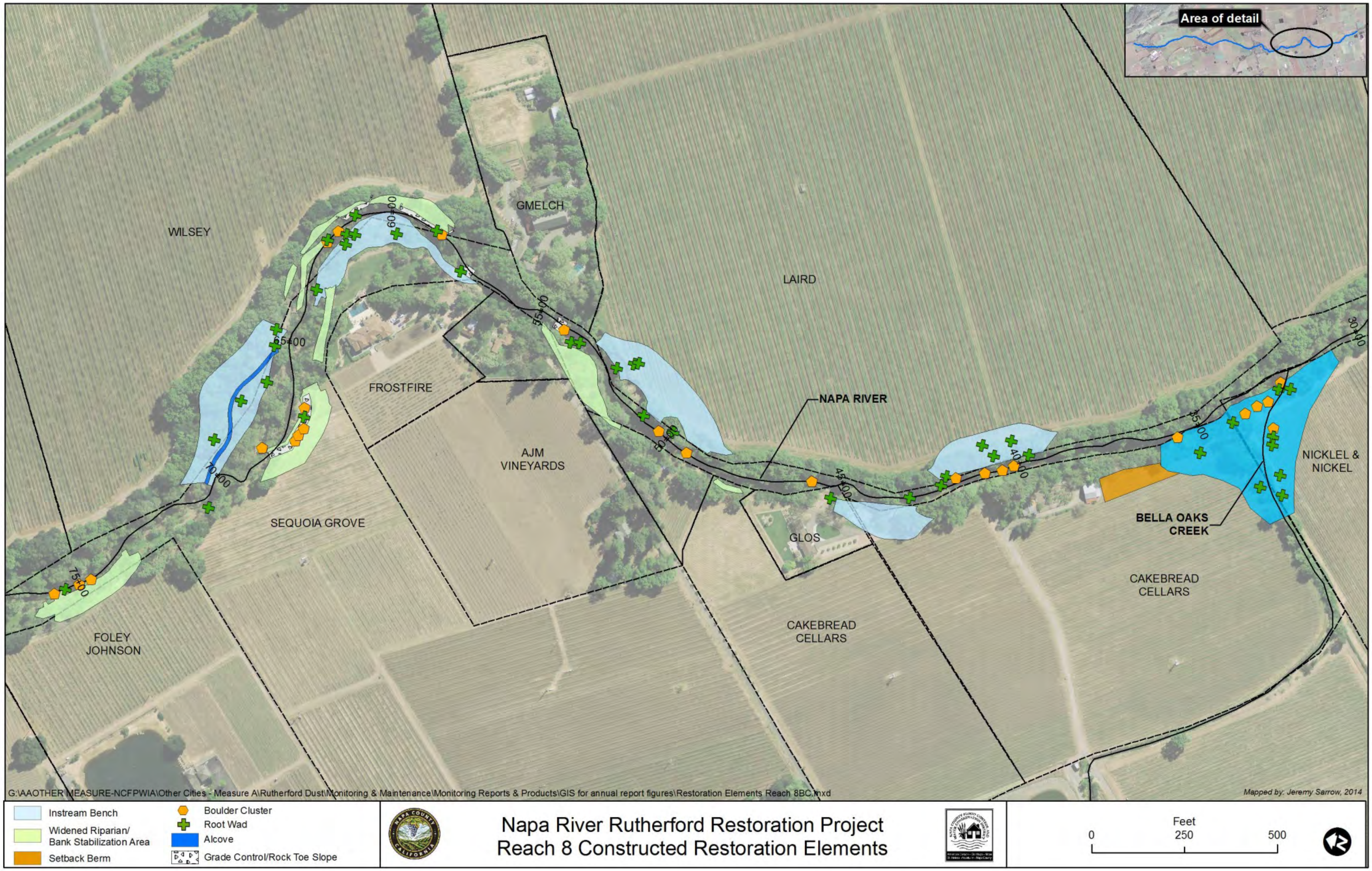
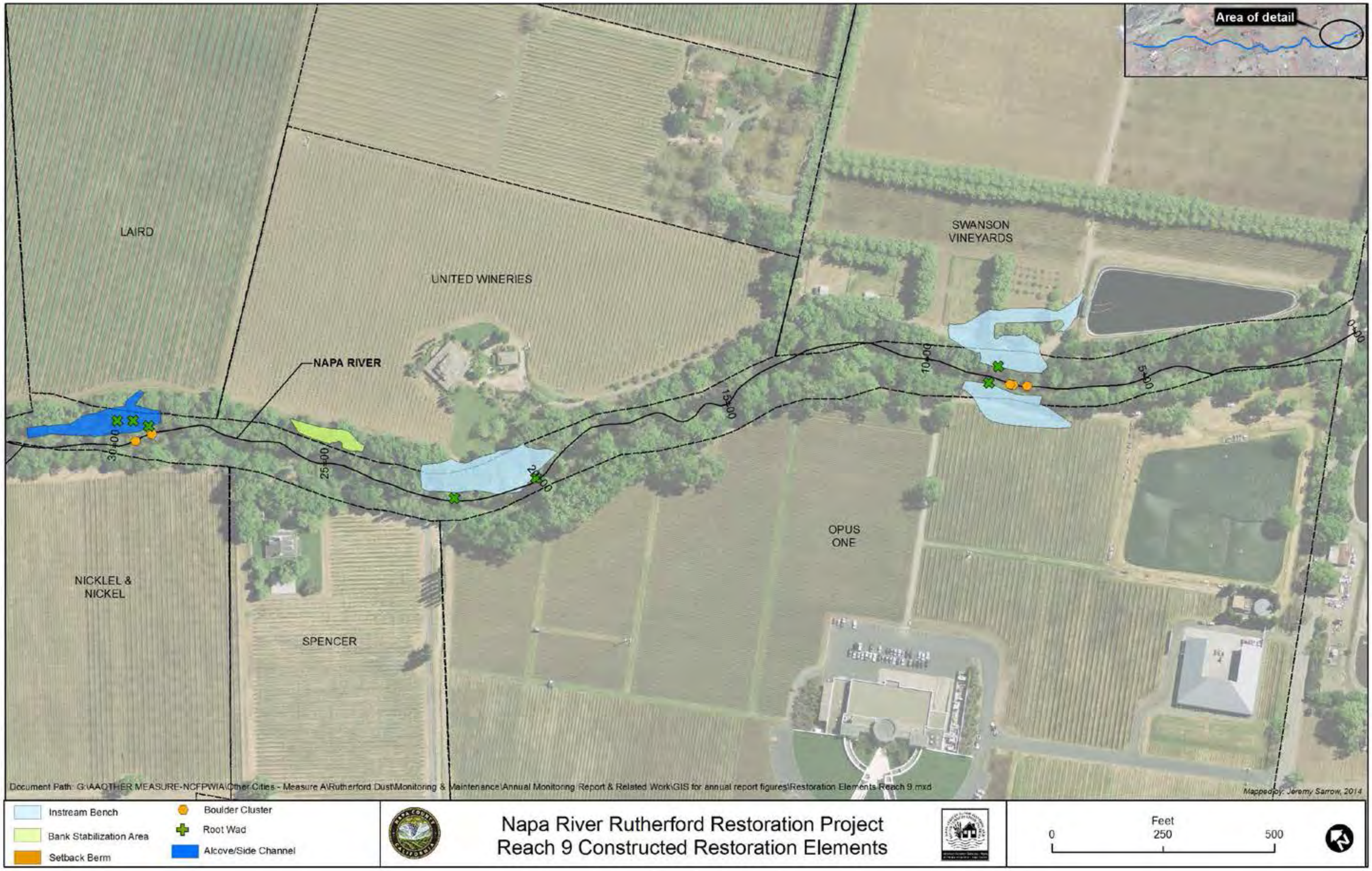


Figure 4: Constructed Restoration Elements Reaches 5, 6, and 7

Figure 5: Constructed Restoration Elements Reach 9



2.0 Restoration Goals

Restoration goals defined for the Project in the monitoring Plan and in various 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 and stabilize severely eroding banks
- 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 fewer 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 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.

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. 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 invasives 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. Detailed channel transect, longitudinal profile, and habitat typing surveys designed to characterize the long-term habitat response to changing channel conditions based on flow variation and vegetation establishment;
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 in 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	Majorityandowner 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

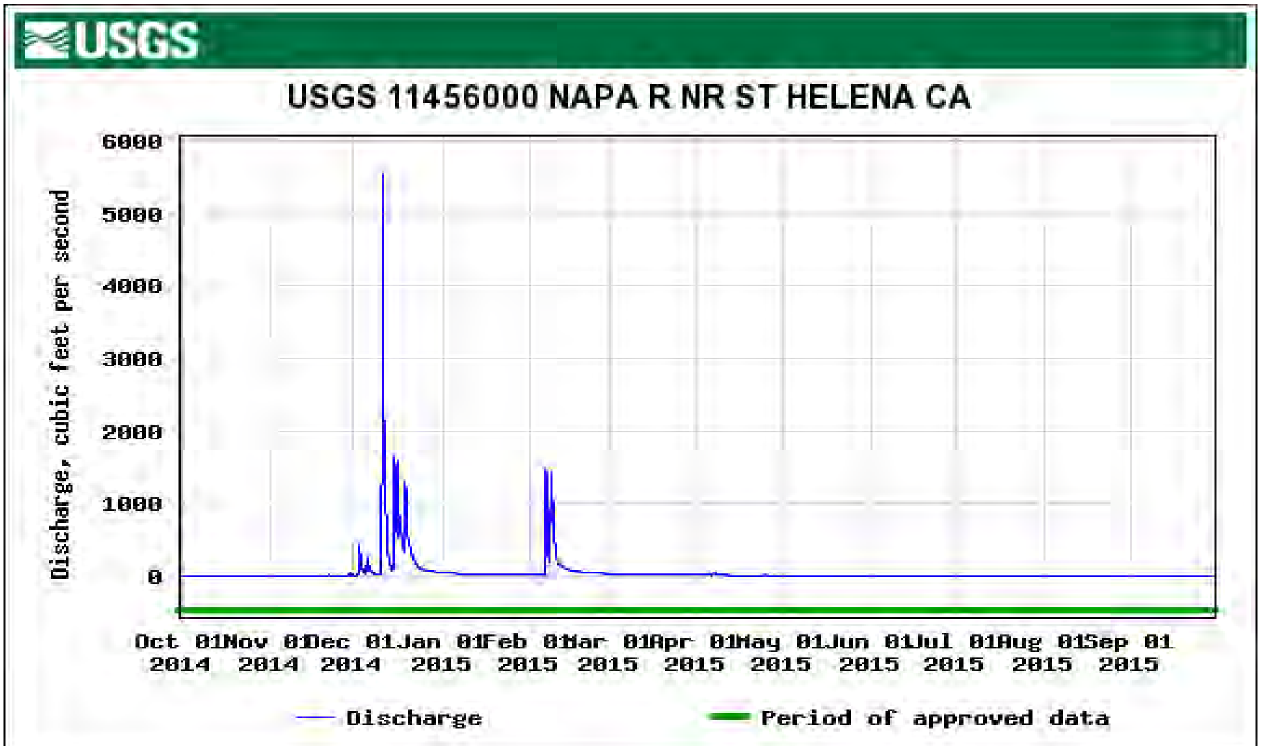
The last rare flooding event occurred on December 31, 2005, prior to construction of the project, when a peak flow of 18,300 cfs was recorded at Station 11456000, making it an approximate 50-year flood. Since that time, all peak flow events have been below 10,000 cfs, or less than 5-year recurrence interval 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

During the 2014-15 water year (October 1, 2014 through September 30, 2015), measureable streamflow began at Station 11456000 in late November and continued through early July. The peak flow of the season occurred on December 11, 2014, and was measured to be 5,540 cfs, approximately a 2-year peak flood. Following the last significant storm of the season in mid-February, flows in the river receded until the channel finally dried up in early July. A plot of streamflow measured at Station 11456000 during the 2014-15 water year is included as **Figure 6**.

Figure 6. 2014-2015 streamflow, Napa River Rutherford Restoration Reach, USGS Station 11456000.



The reporting period for this monitoring effort includes the start of the 2015-16 water year (October 1, 2015 through September 30, 2016), and measureable flows in the reach began on December 6, 2016. The peak flow to occur so far was 4,520 cfs on March 6, 2016, between a mean annual and 2-year peak flood. This event and the streamflow data for the entire 2015-16 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 subreaches 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 annual eroding stream bank survey is conducted along the entire length of the bankfull channel every year in order to evaluate the extent of any 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 the 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 eroding stream banks by grading over-steepened banks to more stable profiles and installing biotechnical bank stabilization features such as brush mats. Additional information regarding monitoring protocols and performance targets is in the *Monitoring Plan for the Rutherford Reach Restoration of the Napa River* which can be found at www.napawatersheds.org.

One performance standard for the Project 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 2015, 1,050 feet of channel banks were mapped as eroding or unstable throughout the Rutherford Reach, this is a reduction of 93% compared to the 2009 baseline. The results of the surveys from 2009-2015 are summarized in **Table 6** below. See **Appendix A** for figures depicting the location and extent of eroding stream banks mapped during the 2015 survey.

As expected, the total linear length of eroding stream banks has steadily decreased as construction of the Project has progressed. Based on the 2014 and 2015 survey results, the Project has already realized its goal of 75% reduction in active stream bank erosion throughout the entire Project reach.

Table 6. Results of eroding banks surveys, 2009-2015.

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

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.

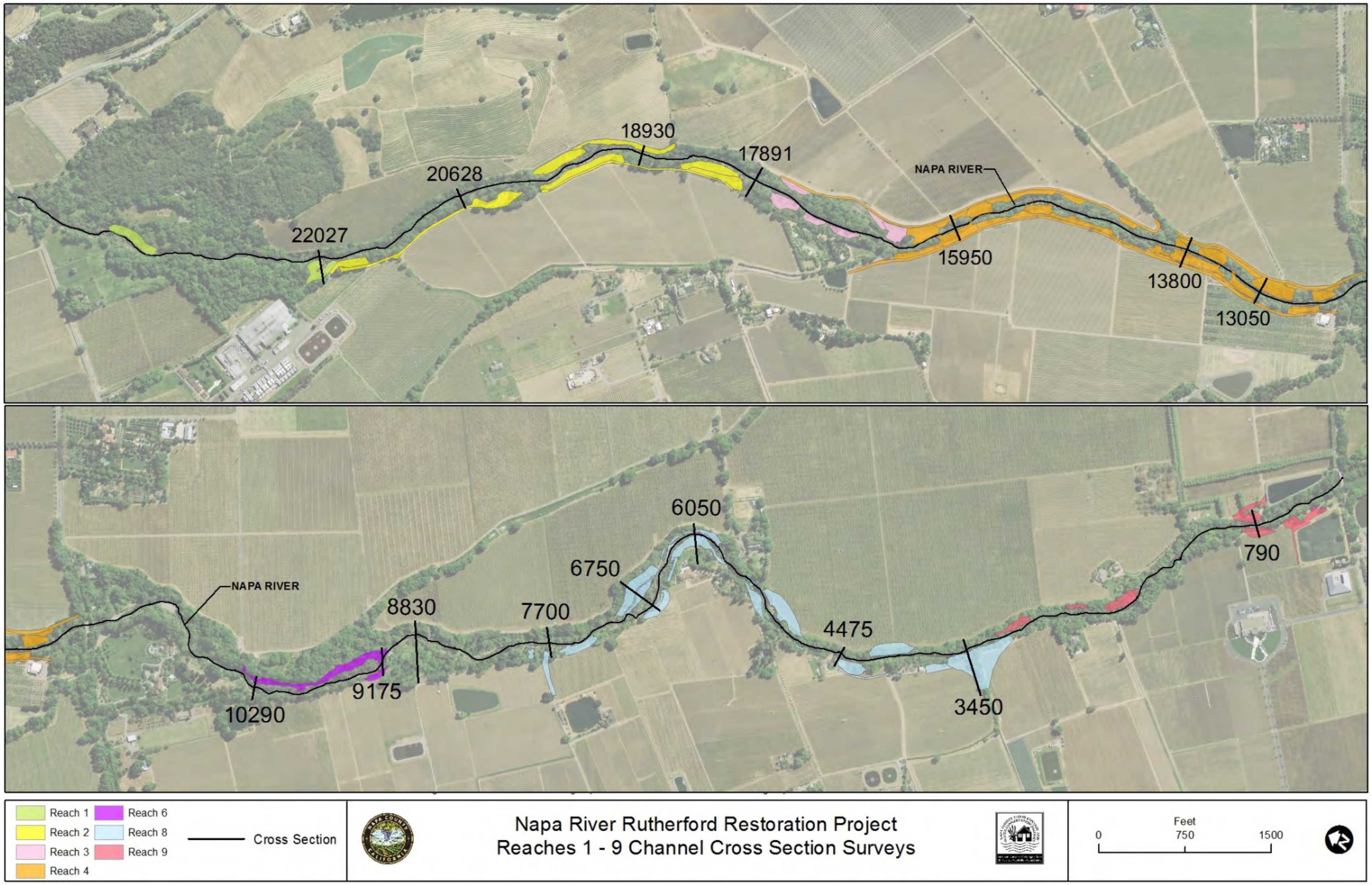
4.4 Longitudinal Profile Thalweg Surveys

Thalweg surveys were not completed in 2015; the most recent thalweg survey was completed in 2013. Thalweg surveys ae competed for the entire Project reach once every five years; therefore, the next thalweg survey is scheduled for the fall of 2018. Please refer to previous monitoring reports for details regarding the most recent thalweg survey conducted in 2013 and previous year's surveys.

4.5 Channel Cross Section Surveys

Pre-project cross sections were surveyed throughout the Project reach from 2004–2011. In October 2015, a complete set of 16 post-project cross sections were surveyed, 11 through treated areas and 5 through untreated areas; **Figure 7** below. Three of the cross sections were measured at new sites and 13 were re-occupations of previously-surveyed sites. The RCD and Flood Control District staff, often with assistance from members of the Watershed Stewardship Program of the California Conservation Corps, surveyed the cross sections by measuring lateral distance with a tightly-stretched tape across the channel, and elevation with a theodolite and stadia rod. Surveyed points along the line-of-section were selected at breaks-in-slope, and at approximately 10-foot intervals when slope was unchanging. Elevations were measured relative to four rebar monuments installed at the tops and toes of the banks. Many of these monuments were still in place from earlier surveys, and new monuments were installed when necessary. RCD returned at a later date and surveyed the left bank top-of-bank monument of each cross section to the nearest NAVD88 vertical control point, which remain scattered throughout the Project from the design and construction phases of restoration. At each surveyed point along the line-of-section, the substrate type (bedrock, cobble, gravel, sand, silt, or soil) was recorded along with the dominant vegetation. Plots of all 2015 cross sections are presented on **Figures 1-16** of **Appendix C**.

Figure 7: Location of channel cross section surveys



For each cross section, the following metrics were calculated:

- Maximum depth = difference between top-of-bank elevation and the thalweg elevation
- Top width = distance across channel at top-of-bank elevation (calculated using the Hydraulic Toolbox software developed by the Federal Highways Administration)
- Cross-sectional area = channel area at the top-of-bank elevation (calculated using Hydraulic Toolbox)
- Width-to-depth ratio = top width divided by the maximum depth
- Riparian vegetation width

In addition, the cross sections were classified to reveal the degree of channel confinement and entrenchment based on an approach developed for a neighboring reach of the Napa River by the California Land Stewardship Institute and ESA Associates and reported in the *Napa River Sediment Reduction and Habitat Enhancement Plan: Oakville to Oak Knoll*, April 2011. According to this document, gravel bar and riffle-pool formation in the Napa River begins to occur at a width-to-depth ratio of approximately 7.5. The classification categories are listed in **Table 7**. **Table 8** presents the cross section metrics and classifications for 2015 and previously-surveyed cross sections.

Table 7. Channel confinement and entrenchment classification.

Width-to-Depth Ratio	Classification
5 or Less	Deeply Entrenched
5 – 7.5	Entrenched
7.5 – 10	Approaching Functional Width
10 – 12.5	Functional Width
12.5 – 15	Wide
Greater than 15	Very Wide

Table 8. Cross section attributes and results, 2004-2015. Cross sections in treated areas are shown in yellow.

Cross Section (RS)	Survey Year	Top-of-Bank Elevation (ft NAVD88)	Thalweg Elevation (ft NAVD88)	Max depth (ft)	Cross-Sectional Area (ft^2)	Top Width (ft)	Width/Depth Ratio	Width/Depth Ratio Classification	Riparian Vegetation Width (ft)	Change in Riparian Width (%)
22027	**2005**	174.47	149.74	24.73	1,752	117.8	4.8	Deeply Entrenched	280	--
	2008	174.47	149.62	24.85	1,767	119.1	4.8	Deeply Entrenched	280	0%
	2015	174.47	150.99	23.48	3,538	245.2	10.4	Functional Width	280	0%
20628	**2004**	172.19	151.00	21.19	1,566	113.6	5.4	Entrenched	160	--
	2008	172.19	150.66	21.53	1,565	113.6	5.3	Entrenched	160	0%
	2015	172.19	151.26	20.93	1,563	114.4	5.5	Entrenched	178	+11%
18930	**2008**	172.93	144.51	28.42	1,959	126.1	4.4	Deeply Entrenched	190	--
	2015	172.93	145.06	27.87	1,939	131.2	4.7	Deeply Entrenched	212	+12%
17891	**2009**	168.27	144.80	23.47	2,896	263.3	11.2	Functional Width	325	--
	2015	168.27	144.85	23.42	2,916	282.7	12.1	Functional Width	325	0%
15950	**2004**	163.39	139.68	23.71	1,653	118.9	5.0	Deeply Entrenched	150	--
	2009	163.39	139.95	23.44	1,655	118.7	5.1	Entrenched	150	0%
	2015	163.39	141.11	22.28	2,386	160.2	7.2	Entrenched	193	+29%
13800	**2010**	159.19	132.67	26.52	1,937	144.0	5.4	Entrenched	190	--
	2015	159.19	134.52	24.67	2,725	209.7	8.5	Approaching Functional Width	222	+17%
13050	**2010**	158.06	134.14	23.92	1,663	119.3	5.0	Deeply Entrenched	180	--
	2015	158.06	134.46	23.60	2,576	179.2	7.6	Approaching Functional Width	224	+24%
10290	**2015**	150.58	130.34	20.24	3,033	203.9	10.1	Functional Width	314	--
9175	**2015**	146.69	125.82	20.87	3,908	429.4	20.6	Very Wide	478	--
8830	**2004**	146.54	126.60	19.94	3,645	428.6	21.5	Very Wide	478	--
	2009	146.54	125.23	21.31	3,621	427.3	20.1	Very Wide	478	0%
	2015	146.54	126.67	19.87	3,600	434.1	21.8	Very Wide	478	0%
7700	**2004**	145.81	122.91	22.90	2,476	219.7	9.6	Approaching Functional Width	284	--
	2009	145.81	122.34	23.47	2,445	220.6	9.4	Approaching Functional Width	284	0%
	2015	145.81	123.36	22.45	2,447	220.0	9.8	Approaching Functional Width	284	0%
6750	**2011**	143.12	120.22	22.90	2,778	222.4	9.7	Approaching Functional Width	360	--
	2015	143.12	119.29	23.83	3,675	267.0	11.2	Functional Width	406	+13%
6050	**2011**	142.71	118.04	24.67	3,372	315.7	12.8	Wide	180	--
	2015	142.71	118.22	24.49	3,720	304.3	12.4	Functional Width	187	+4%
4475	**2011**	140.20	116.12	24.08	1,981	159.0	6.6	Entrenched	160	--
	2015	140.19	116.41	23.78	1,926	155.9	6.6	Entrenched	160	0%
3450	**2011**	135.71	113.91	21.80	1,594	113.0	5.2	Entrenched	140	--
	2015	135.71	114.12	21.59	3,672	298.9	13.8	Wide	307	+119%
790	**2015**	128.78	110.90	17.88	1,940	174.6	9.8	Approaching Functional Width	257	--

The Monitoring Plan lists 3 performance standards that apply to cross section monitoring. The first is to show positive trends (increases) in channel width-to-depth ratios. The project aimed to produce increases in width-to-depth ratios by increasing top width in several areas through bank excavation, and by decreasing maximum depth through aggradation of gravel. To assess progress toward this performance standard, width-to-depth ratios for 13 pre- and post-restoration cross sections were compared.

As expected, little change was observed at the 5 cross sections in untreated areas; however, measureable improvement occurred at 4 sites (Cross Sections 20628, 8830, 7700, and 4475) due to gravel aggradation. Although a significant increase in width-to-depth ratio was measured at Cross Section 17891, the channel actually remained unchanged. The difference was due to the loss of rebar monuments and the failure to exactly reoccupy the original line-of-section.

For the 11 cross sections in treated areas, pre-project data were available at 8 sites. Comparison of width-to-depth ratios indicates favorable change at 7 of these sites, with sufficient improvement at 5 sites to jump into better classification categories. Width-to-depth ratio decreased at Cross Section 6050 due to a false decrease in top width from the failure to exactly reoccupy the original line-of-section. The top width at this site was actually unchanged and the width-to-depth ratio should have remained the same or slightly increased due to a slight decrease in maximum depth. In total, improvement was observed at 11 of 13 sites. Width-to-depth ratio classifications of "approaching functional width" or better now apply to 12 of 16 cross sections, and only 4 remain in the "entrenched" categories. Based on these results, restoration in the project reach has so far succeeded in achieving positive trends in channel width-to-depth ratios.

The next performance standard is to show increases in in-channel gravel recruitment and fine-sediment storage. To assess progress toward increased in-channel gravel recruitment, pre- and post-project maximum depths were compared for the 13 reoccupied cross sections. Decreases in maximum depth, or increases in bed elevation due to recruitment or aggradation of gravel, were observed at 12 of 13 cross section locations, with changes of greater than a foot at Cross Sections 22027, 15950, 13800, 8830, and 7700. Overall, restoration in the Project reach has so far succeeded in achieving this standard. Demonstrating progress toward increased in-channel fine-sediment storage will require multiple post-project cross section surveys to compare elevations of bench cuts, alcoves, and terraces, and will be addressed in future years. However, **Figures 1-16** in **Appendix C** show the presence of well-sorted sand on many of these features in 2015, indicating that the Project is functioning well in this regard.

The final performance standard is to show positive trends (increases) in riparian buffer width. To assess progress toward this standard, pre- and post-project riparian vegetation widths were compared for the 13 reoccupied cross sections. Restoration activities have resulted in increased riparian widths at 8 of 13 sites ranging from 4% to 119% change, with the average change in riparian width at a given cross section being 14%; width at the remaining 3 sites remained unchanged. Areas with the greatest change, such as at cross section 3450 and 15950, are due to project design/construction activities where vineyard rows were removed or berms were setback in order to accommodate greater riparian widths at a given restoration area.

4.6 Pebble Counts

Streambed gravel quality is an important measure of salmonid habitat quality. Particle sizes of spawning gravels must be small enough to be moved by the spawning fish, but large enough, and free enough of fine sediment to allow for intra-gravel flow for incubation of eggs and emergence of fry. A pebble count is a relatively quick and easy survey method that provides reproducible grain size distributions of the surface layer of the gravel. The surface layer is typically deficient in the finer components of the distribution, but it is representative of the framework grains of the gravel. Although subsurface sampling is required to assess the fine tail of the grain size distribution, fine sediments detected on the surface can be an indication of the fine sediment content of the deposit.

Pebble count surveys have been conducted at select riffle crests in the Project reach since 2004 and are available for the pre- and post-project time periods in several locations. In 2015, pebble counts were conducted at the nearest riffle crest to each of the 16 surveyed cross sections.

2015 Pebble Counts

In October 2015, RCD and Flood Control District staff, often with assistance from members of the Watershed Stewardship Program of the California Conservation Corps, conducted pebble counts by measuring the width of the actively-scoured streambed. This distance was then rounded down to the nearest 5-foot increment and two measuring tapes stretched to the rounded distance were laid out one perpendicular to, and one parallel to, the channel to create a square grid. From site to site, the grids ranged in size from 15x15 feet to 40x40 feet. In one case, the length of the riffle crest gravels was shorter than the width, and the 20x20 grid extended over some fine-grained non-target substrate. In this case, the length was compressed and the pebble count was performed on a 20x15 rectangular grid. Each grid was divided evenly by 10 along both axes to create 100 cells, from which 100 particles were randomly selected for measurement by stepping to the grid cell and blindly pointing toward the ground. The diameter of the particle first touched by the crew member was measured in millimeters (mm) along the intermediate axis (b-axis). Particles less than 2 mm in width were recorded as “<2 mm.”

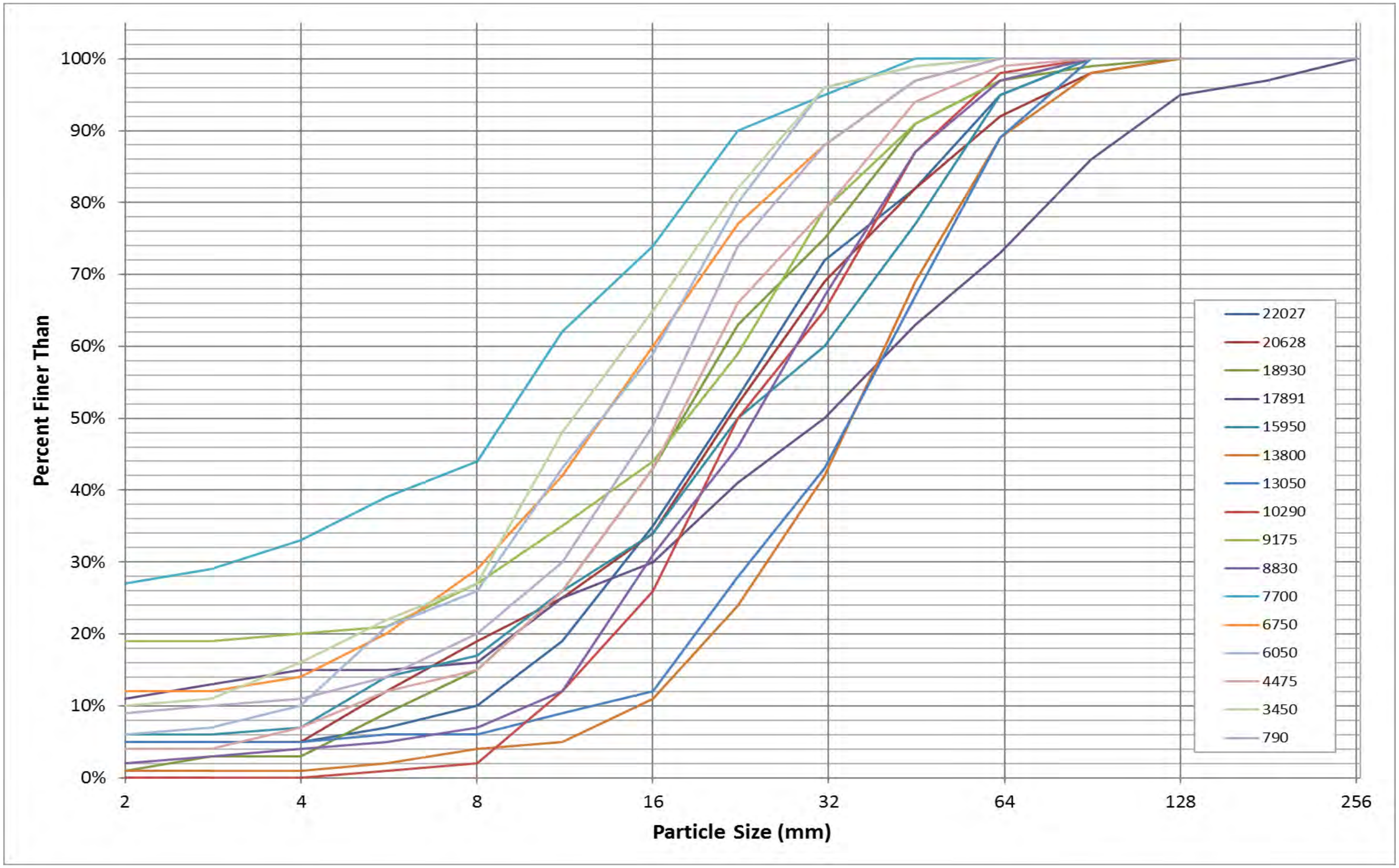
The field data were entered into a spreadsheet that tallied the values into standard sieve size classes, plotted the grain size distributions, and computed statistics. The 2015 pebble count results are listed in **Table 9**. The grain size distributions are presented on **Figure 8**.

Table 9. Results of 2015 pebble counts.

Cross Section	Date	d_{16} (mm)	d_{50} (mm)	d_{84} (mm)	Percent Fines	d_g (mm)	s_g	sk
22027	10/5/2015	10.0	21.2	47.4	5	21.8	2.2	0.04
20628	10/6/2015	6.9	21.6	48.1	5	18.2	2.6	-0.18
18930	10/7/2015	8.2	18.0	38.5	1	17.8	2.2	-0.01
17891	10/7/2015	8.0	31.5	85.2	11	26.1	3.3	-0.16
15950	10/6/2015	7.1	22.4	51.3	6	19.1	2.7	-0.16
13800	10/8/2015	18.2	35.0	57.9	1	32.5	1.8	-0.13
13050	10/8/2015	17.4	35.0	58.4	5	31.9	1.8	-0.15
10290	10/12/2015	12.4	22.4	42.9	0	23.1	1.9	0.05
9175	10/12/2015	--	18.3	36.5	19	--	--	--
8830	10/14/2015	12.1	23.9	42.7	2	22.7	1.9	-0.08
7700	10/14/2015	--	8.9	19.7	27	--	--	--
6750	10/15/2015	4.5	13.1	27.8	12	11.2	2.5	-0.18
6050	10/15/2015	4.8	13.1	24.4	6	10.8	2.3	-0.23
4475	10/16/2015	8.2	17.7	35.5	4	17.1	2.1	-0.05
3450	10/16/2015	4.0	11.7	23.5	10	9.7	2.4	-0.21
790	10/5/2015	6.3	16.2	28.6	9	13.4	2.1	-0.25

d_{16} = the grain size diameter at which 16% of the sample is finer
d_{50} = the median grain size diameter, at which 50% of the sample is finer
d_{84} = the grain size diameter at which 84% of the sample is finer
d_g = geometric mean diameter, $d_g = (d_{84} * d_{16})^{0.5}$
s_g = geometric sorting coefficient, $s_g = (d_{84}/d_{16})^{0.5}$
sk = geometric skewness coefficient, $sk = [\log_{10}(d_g/d_{50})]/[\log_{10}(s_g)]$
**the fine-grained fractions of these samples were too great to calculate d_{16}, and therefore, d_g, s_g, and sk.*

Figure 8. Grain size distributions for the 2015 pebble counts.



The fine-grained fractions of the samples collected at Cross Sections 7700 and 9175 were too great to calculate d_{16} values, and therefore d_g, s_g, and sk as well. Although Sample 9175 had a high proportion of fine-grained material, the framework particles were within the size range of the other samples. Sample 7700 had a high percentage of fine-grained material and also anomalously fine framework gravels. The site of this sample should be re-evaluated to confirm that it is a potential spawning site, and then re-sampled to confirm the results.

During redd construction, spawning salmonids can move gravels with a median diameter up to about 10% of their body length (Kondolf 2000). In the Napa River, spawning salmonids (steelhead and Chinook salmon) range in length from about 45 cm to over 1 meter. Fish at the lower end of this range would therefore be limited to constructing redds in areas with a median particle size of about 45 mm or less. The results of the 2015 pebble counts show median gravel diameters (d_{50}) ranging from 8.9 to 35 mm. This distribution suggests that gravels in the Project reach are well within the suitable size range for salmonid redd construction. However, it is important to note that although a smaller gravel size distribution may facilitate redd construction, the smaller particles are more likely to be mobilized more often throughout the year, thus increasing the potential for mortality of incubating eggs and fry.

Trends in Spawning Gravel Size

Historical pebble count data were reported in standard sieve size classes, so the 2015 data were converted to match. The d_{50} and d_{84} results were compiled and are presented in **Tables 10** and **11**. Of the 12 sites for which pre- and post-construction data are available, the change in particle size has, in general, remained the same or varied by 1 size class. The exception is the d_{50} at Cross Section 13050 which has increased by 3 size classes.

Table 10. Historical and recent d_{50} size classes for the locations of the 2015 cross sections. The dark line represents the completion of grading activities in the vicinity.

Cross Section	d_{50} Size Class (mm)								Change*
	2004	2005	2008	2009	2010	2011	2013	2015	
22027			11.2				5.6	16	+1 size class
20628	16		22.4			16	22.4	16	same
18930			22.4					16	-1 size class
17891		45		45			22.4	31.5	-1 size class
15950	16			22.4		16	22.4	22.4	+1 size class
13800							22.4	31.5	NA
13050					11.2	22.4	22.4	31.5	+3 size classes
10290								22.4	NA
9175								16	NA
8830	16			11.2		11.2	16	22.4	+1 size class
7700	8			8		16	11.2	8	same
6750						11.2	11.2	11.2	same
6050						16	22.4	11.2	-1 size class
4475						16	16	16	same
3450						16	16	11.2	-1 size class
790								16	NA

** Assessed by comparison of the 2015 result to the earliest pre-project result for the location.*

Table 11. Historical and recent d_{84} size classes for the locations of the 2015 cross sections. The dark line represents the completion of grading activities in the vicinity.

Cross Section	d_{84} Size Class (mm)								Change*
	2004	2005	2008	2009	2010	2011	2013	2015	
22027			31.5				16	45	+1 size class
20628	31.5		45			31.5	45	45	+1 size class
18930			45					31.5	-1 size class
17891		--		90			45	63	-1 size class
15950	31.5			45		31.5	45	45	+1 size class
13800							45	45	NA
13050					31.5	45	45	45	+1 size class
10290								31.5	NA
9175								31.5	NA
8830	31.5			31.5		31.5	22.4	31.5	same
7700	16			22.4		31.5	22.4	16	same
6750						31.5	31.5	22.4	-1 size class
6050						31.5	45	22.4	-1 size class
4475						31.5	31.5	31.5	same
3450						31.5	31.5	22.4	-1 size class
790								22.4	NA

** Assessed by comparison of the 2015 result to the earliest pre-project result for the location.*

The Percent Fines results were compiled and are presented in **Table 12**. Although pebble counts cannot fully assess the fine-sediment content of spawning gravels, they "…can still detect fine sediment on the surface, which may imply large quantities of fine sediment throughout the gravel deposit..." (Kondolf 1997). Of the 12 sites for which pre- and post-project data are available, 11 reveal a decrease in surface fine sediment percentage.

Table 12. Historical and recent percent fines for the locations of the 2015 cross sections. The dark line represents the completion of grading activities in the vicinity.

Cross Section	Percent Fines (<2mm)								Change* (Percentage Points)
	2004	2005	2008	2009	2010	2011	2013	2015	
22027			22				28	5	-17
20628	--		11			23	6	5	-6
18930			12					1	-11
17891		--		8			16	11	3
15950	--			15		--	4	6	-9
13800							4	1	NA
13050					30	2	12	5	-25
10290								0	NA
9175								19	NA
8830	--			21		21	8	2	-19
7700	--			39		12	13	27	-12
6750						27	18	12	-15
6050						13	10	6	-7
4475						6	8	4	-2
3450						14	15	10	-4
790								9	NA

** Assessed by comparison of the 2015 result to the earliest pre-project result for the location.*

4.7 Channel Morphology/Riffle Survey

The Project reach has experienced simplification in channel morphology due to channel incision during the past half century. This has resulted in long sections of homogenous glides and a reduction in the frequency and spatial extent of riffle habitat. Restoration efforts aim to increase riffle length and frequency through a variety of treatments as outlined in the Monitoring Plan. The performance standard for the Project is a 30% increase in riffle length or riffle frequency in treated locations.

As part of the annual channel survey, riffle crest mapping has been performed since 2011. The monitoring team identifies each riffle crest visually in the field and records its location with a GPS device. The points are then mapped and river stationing for each crest is assigned. Monitoring methods have been refined over the course of the Project, and as a result the monitoring team has determined that the results of the 2011 and 2012 riffle crest mapping efforts are not directly comparable with data collected more recently. The monitoring team has used the 2013 riffle crest survey data as a baseline for assessing performance against the standard.

For comparison purposes, a total of six distinct treated areas were identified within the greater Project reach. These six areas represent sections of the river where banks were re-contoured to promote hydraulic conditions favorable for riffle creation. Riffle crest counts from the 2013 - 2015 surveys are summarized in **Table 13** below.

Table 13. Restoration treatment areas and riffle crest counts, 2013-2015.

Treated Area	Year Completed	River Station (ft)	Riffle Crest Count			Percent Change From Baseline
			2013	2014	2015	
1	2009	23,300 –24,100	2	4	3	+50%
2	2010	21,500 – 22,200	2	3	2	0%
3	2009-2012	12,300 – 20,000	18	20	19	+6%
4	2012/13	2,800 – 7,700	20	20	11	-45%
5	2014	1,900 – 2,350	0	0	0	0%
6	2014	650 – 1,000	0	0	0	0%
	Total		42	47	35	-17%

In 2014, a 12% increase in the number of riffles was observed relative to the 2013 baseline. However, a 17% decrease in riffle frequency has was observed in restoration treatment areas during the 2015 survey. Several factors may have contributed to this decline including, 1) prolonged drought conditions and low frequency of storm flows during the monitoring period, 2) backwatering effects of beaver dams, and/or 3) inconsistent identification and characterization of riffles (i.e. lumping vs. splitting units) from one year to the next by the field crew.

Of the factors listed above, beaver activity within the reach appears to be the most likely cause of the large decline in riffles between 2014 and 2015. Within the treated areas, a total of 8 riffles were mapped in 2013 and 2014, but were not mapped in 2015. These 8 riffles were all located above beaver dams, suggesting that the topographic bedform characteristics of these riffles may still have been present during our 2015 survey, but they were “drowned out” and unable to be visually detected. Ongoing beaver activity in the Project reach is likely to confound long-term comparisons of riffle frequency in the future. Representative pictures of the some of the larger beaver dam’s encounter during the 2015 survey can be found in **Appendix E.**

4.8 Large Woody Debris and Boulder Cluster Surveys

Beginning in 2009, naturally-recruited large wood debris (LWD), as well as installed structures (boulder clusters and log features), have been monitored during the annual channel survey. Naturally-occurring LWD is being monitored in an effort to track trends in location, quantity, size, and function over time. Installed structures are being monitored to verify their persistence, functionality (summer and winter refugia), and to assess potential damage or maintenance needs.

The stated performance standard for this project is a 75% persistence rate for all installed instream structures, including both wood and boulder features. To assess whether this performance standard was being achieved, the rate was calculated as follows:

$$\textit{Persistence (\%)} = \frac{\textit{Total number of structures installed - Number of structures not found}}{\textit{Total number of structures installed}} \textit{ X 100}$$

A total of 149 habitat structures (37 boulder features and 112 wood features) were installed over the course of this project between 2009 and 2014. Of that total, 18 of the installed wood structures were not found during the 2015 field survey; all of the installed boulder structures were able to be located and assessed. Overall, this yields a persistence rate of 88%, which exceeds the performance standard of 75%, **Table 14**. It is worth noting that the actual persistence rate is likely higher than 88%, as field indicators (e.g. gravel deposition, channel morphology, etc.) observed around 10 of the "missing" structures suggested they were intact, but simply buried out of sight. The remaining 8 structures that were not found may have been buried or washed away, however there was no clear evidence of this during the field survey.

Table 14. Installed habitat structure persistence rates.

Installed Habitat Structure Type	Total Installed Structures	Total Surveyed in 2015	Persistence Rate
Wood Features[1]	112	94	84%
Boulder Features[2]	37	37	100%
Combined Total	149	131	88%

[1]Includes root wads, snags, toe logs, bench logs, log weirs, spider-logs, low-profile logs, and terrace logs
[2]Includes boulder clusters, a boulder field, and a grade-control riffle

The performance standard for instream cover states that installed structures (both wood and boulder features) will increase the amount of refugia and cover by at least 40%. To assess whether this performance standard was being achieved, the amount of cover provided by naturally-occurring LWD was compared to the amount provided by installed structures using the following calculation:

$$\textit{Change in Cover (\%)} = \frac{\textit{Number of installed structures providing cover}}{\textit{Number of pieces of naturally-occurring LWD providing cover}} \; X\ 100$$

For purposes of the survey, naturally-occurring LWD was defined as any piece of natural wood with a minimum length of 6 feet and diameter of at least 18 inches. The wood must be located in the channel below the top of bank. For each occurrence of LWD encountered, the field crew noted whether the feature was serving any of the following functions: spawning gravel recruitment, hydraulic constriction, pool scour, summer refugia, winter high-flow refugia, or bank stability.

During the 2015 survey, a total of 108 naturally-occurring LWD features were assessed, and 77 of those were found to be providing either summer low-flow or winter high-flow refugia, **Table 15**. A total of 99 of the installed structures were found to be providing this same function, yielding a 129% increase in the amount of cover provided by log and boulder features. This increase far exceeds the 40% target set by the performance standard for instream cover.

Table 15. Change in cover provided by installed structures compared to naturally-occurring LWD.

Habitat Function	Naturally-Occurring LWD	Installed Structures	Change in Cover
Summer Refugia	47	62	+ 132%
Winter Refugia	30	37	+ 123%
Combined Total	77	99	+ 129%

The 2015 survey was the seventh consecutive year of monitoring naturally-occurring LWD within the project reach; summary statistics from this ongoing effort are provided in Table 11. There are several long-term trends suggested by these data (**Table 16**):

1. The total number of LWD accumulations and jams has remained relatively stable.
2. The number of single LWD pieces has varied greatly from year to year and does not appear to correlate with large flow events.
3. The most common bed form association has consistently been pools, followed by terraces.
4. An average of about 15% of the LWD encountered in any given year was classified as "perched", meaning it was transient and not yet integrated into the channel bed or banks.
5. The average length of single LWD pieces has remained relatively stable.
6. An average of about 80% of the LWD encountered in any given year was in the 18 to 24-inch size class.
7. The most common functions provided by naturally-occurring LWD have been summer refugia and pool scour.

Table 16. Summarized statistics on naturally-occurring LWD within the overall project reach.

Survey Year	2009	2010	2011	2012	2013	2014	2015
Number of Occurrences							
Single	46	60	97	111	90	59	85
Accumulations (2-9)	23	19	19	24	20	27	21
Jams (>10)	3	3	3	1	3	1	2
Total	72	82	119	136	113	87	108
Bedform Association (%)							
Bank	---	9.8	9.2	3.7	16.8	10.3	18.5
Bar	---	15.9	12.6	13.2	9.7	12.6	---
Pool	---	36.6	37	41.9	36.3	35.6	37
Riffle	---	4.9	10.1	5.9	5.3	9.2	5.6
Terrace	---	24.4	29.4	19.1	16.8	12.6	15.7
Secondary Channel	---	1.2	1.7	0	1.8	1.1	1.9
Perched in Vegetation	---	7.3	---	16.2	13.3	18.4	21.3
Size							
Single Piece Length Range (ft)	6-80	8-100	6-95	6-80	6-60	6-80	6-90

Single Piece Length Average (ft)	30	25	25	23	23	29	28
Accumulation Length Range (ft)	10-120	10-100	8-85	8-100	10-200	10-200	10-100
Diameter Class (%)							
18-in	25	63.4	69.7	68.4	68.1	60.9	67.6
24-in	38.9	19.5	16	17.6	15	26.4	20.4
30-in	22.2	3.7	6.7	2.2	5.3	8	4.6
36-in	6.9	7.3	4.2	5.9	8	1.1	7.4
42-in	2.8	6.1	2.5	3.7	2.7	2.3	0
≥ 48-in	4.2	0	0.8	2.2	0.9	1.1	0
Function (%)							
Hydraulic Constriction	---	---	28.6	26.5	18.6	29.9	13.9
Pool Scour	---	---	33.6	28.7	28.3	29.9	25
Gravel Recruitment	---	---	---	---	10.6	1.1	6.5
Summer Refugia	---	---	41.2	44.1	42.5	48.3	45.4
High-flow Refugia	---	---	6.7	17.6	30.1	27.6	27.8
Bank Stability	---	---	28.6	23.5	22.1	5.7	9.3
Other	---	---	21	17.6	---	---	---

4.9 Pool Scour/Residual Pool Depth Surveys

Of the 149 habitat structures installed throughout this project, 39 of the root-wad and toe-log structures were specifically designed to induce pool scour and increase aquatic habitat complexity in the low-flow channel. Although not directly intended to do so, many of the installed boulder structures were also found to promote pool scour and were therefore included in this assessment.

The stated performance standard for this project is a 25% increase in residual pool depth in treated locations. In an attempt to assess whether this performance standard was being achieved, each installed structure that was designed to induce scour was assessed during the 2013, 2014, and 2015 annual surveys. If a pool was observed adjacent to an installed structure during these surveys, its maximum water depth was measured as well as the water depth of the closest downstream riffle crest. The riffle crest depths were subtracted from the maximum pool depths to yield the residual pool depths, which are independent of flow conditions and therefore provide a comparable dataset from year to year.

In 2015, a total of 64 installed habitat structures were found to be providing pool scour, including 36 wood structures and 28 boulder structures, **Table 17**. Of these, 40 were able to be accurately assessed for residual pool depths – the remaining 24 structures were omitted due to the presence of beaver dams on the downstream riffle crests, which prevented accurate water depth measurements.

Table 17. Summarized residual pool depths for installed habitat structures. Note: 2013 was the first year of measuring residual pool depths, and was therefore used as the baseline for comparison.

Year	Wood Structures			Boulder Structures		
	Structures Providing Pool Scour	Average Scour (ft)	Change From Baseline	Structures Providing Scour	Average Scour (ft)	Change From Baseline
2013	13	2.5	-	10	1.9	-
2014	26	2.5	0	23	2.4	+ 26%
2015	36	2.1	- 16%	28	2.5	+ 32%

The average residual pool depth associated with the installed wood structures decreased by 16% in 2015, while the average scour depth around boulder structures increased by approximately 4% from the previous year. It should be noted that pool scour is particularly irregular in terms of timing and magnitude, and it is strongly dependent on seasonal flow patterns. Therefore, comparisons over short time periods are limited to showing short-term outcomes. Determining whether or not the project has met the scour objective of increasing pool depths by 25% may be better assessed after several years or more. It may also be helpful to consider this objective in a slightly different way; specifically, that a total of 64 installed structures were found to be providing an average of 2+ feet of pool scour that did not exist prior to this project. Regardless of the numeric target, this appears to be a considerable achievement toward improving aquatic habitat complexity.

4.10 High/Low Flow Instream Habitat Structure Surveys

LWD structures and boulder clusters have been installed throughout the project reach to create greater heterogeneity along the streambed and improve steelhead and salmon habitat quality and quantity under a broad range of flow conditions. The locations of instream habitat structures are shown on the 2015 restoration monitoring maps, **Figures 1-5, Section 1.**

Each year, the RCD performs two assessments of installed structures: one during a winter high-flow event to evaluate graded habitat features and high-flow structures, and one during spring baseflows to evaluate LWD and boulder structures in the low-flow channel. During the high-flow assessment, RCD sketches flow patterns in graded areas and measures water velocity at select locations to evaluate whether the feature has successfully decreased velocities and created slow- and slack-water habitat. The RCD also collects photographs and surveys high-water marks. During the low-flow assessment, RCD sketches flow patterns and measures water velocity around low-flow installed structures to evaluate whether the structures are functioning as intended. Low-flow structures are also assessed on an annual basis during the maintenance survey. During this survey, the function, persistence, and condition of the structures are evaluated, and the residual pool depth is measured for structures providing pool scour.

The RCD completed the final assessment of installed in-stream restoration features in Reaches 6, 7, and 9 of the Project during December 2014 and April 2015.

Based on the high-flow assessments conducted in December 2014, all of the newly constructed benches provided extensive areas of slow- and slack-water habitat with velocities less than 6 feet-per-second, thus meeting the intended goal of improving fall and winter habitat conditions for both juvenile and adult salmonids. The Round Pond secondary channel was completely inundated and inaccessible during the initial high-flow assessment. However, under lower flow conditions on the following day, it appeared to provide reduced-velocity off-channel habitat for juvenile salmonids and potential resting habitat for adult salmonids.

Under spring flow conditions in April 2015, the RCD determined that 11 of the recently-installed habitat structures were inducing pool scour, 10 were providing summer refugia, and 3 were producing hydraulic constriction to produce feeding opportunities for juvenile salmonids. Although many individual structures failed to provide their intended functions, we found that the overall net number of features providing these functions was generally very close to or higher than the planned design. For example just 4 of the 7 recently-installed habitat structures intended to induce pool scour were found to be performing that function. However, an additional 7 structures that were not specifically designed to provide pool scour were also found to be doing so. Thus, the total number of installed structures actually producing pool scour (11) was greater than the total planned (7), creating an unexpected benefit to the project.

Most installed low-flow features appeared to be enhancing fish habitat conditions, as evidenced by the widespread presence of native fish around these features during the spring of 2015. However, steelhead densities were very low and no juvenile Chinook salmon were observed. A single Chinook spawning redd was found in the Rutherford reach in the fall of 2014 and the winter 2015 as part of the RCD's annual salmon monitoring program. See **Appendix D** for additional details including site sketches, snorkel survey results and analysis regarding the high/low flow High/Low Flow Instream Habitat Structure Surveys. Results from previous years' surveys in Reaches 1-4 can be found in prior restoration monitoring reports available at www.napawatersheds.org.

4.10 Vegetation Establishment Surveys

Vegetation establishment surveys are conducted the first three 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. The target restoration goals and success criteria for vegetation establishment include:

- Establishment of a minimum of 20 acres of riparian habitat established over the life the Project (20 years)
- A minimum of 80% of native plants installed shall survive/establish at the re-vegetation sites within 3 years after being installed, and at years 5 and 10 will be in good health
- Greater than 70% vegetative cover will exist at any given planting site over the *life* of the Project and evidence of natural recruitment will be documented after year 5 at any given re-vegetation site

As a result of completing construction for the Project in the fall of 2014, 30.5 acres of native riparian plants have been install in restored areas encompassing all 9 Project reaches, exceeding the outlined 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 through 2015, including direct count, percent vegetative cover, line intercept transect surveys and invasive plant management is presented herein and in **Appendix B**.

Direct count and photo documentation

During the fall of 2015, Flood District and contractor staff conducted annual direct count vegetation surveys of all restoration sites in Reaches 1 through 9 shown in **Figure 9** 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. All planted restoration areas were surveyed to determine percent survivorship and qualitative health of installed and naturally recruited vegetation. **Table 18** below presents the cumulative direct count and qualitative health assessments for reaches 1 through 9 for monitoring years 2010 through 2015; for additional detailed information regarding percent survivorship and health by a given species at each planted area in all restoration areas see **Tables B1** through **B5** in **Appendix B**. Re-vegetation contractors were responsible for plant establishment and monitoring in Reaches 1-3 from 2009-2012, in Reach 4 from 2012-2015, Reach 8 from 2013-2015 and Reaches 5, 6, 7 and 9 in 2015.

Survey results in 2015 for reaches 1 and 2 indicate overall survivorship for installed plants was 78% or greater, only 2% less then survivorship/establishment goals. Vegetation was initially installed in 2010/2011 in reaches 1 and 2 and irrigation was discontinued at these sites in 2014 in order to transition the native vegetation over to California's natural hydrologic cycle and have the site not depend on supplemental irrigation. As natural recruitment continues to increase, and as the sites mature, 80% survivorship is expected to be attained before or by year 10.

The 2015 survey results for reach3 indicate overall survivorship for installed plants was 55% or greater, well below the survivorship goals. The Flood District has been working to increase plant survivorship by adding mulch and hand watering vegetation in reach 3 and has had success on the west bank establishing replacement vegetation while the east bank of reach 3 continues to suffer from rodents undermining roots and water availability. Overall survivorship for Reach 4 was 83% for survey year 2015; a slight decrease from 2014's results. Irrigation for reach 4 was discontinued in 2015. Overall plant survivorship for Reach 8 in 2015 was 144% due to a significant amount of natural recruitment of cottonwoods and various species of willow, as well as herbaceous vegetation, such as Santa Barbra Sedge, throughout the restoration sites. The 2015 survey results for reaches 5, 6, 7 and 9 indicate overall survivorship for installed plants was 97% or greater, well above the 80% survivorship goal. Vegetation in reaches 5, 6, 7 and 9 was installed in the fall of 2014 and spring of 2015. Representative photos of the survey sites are shown in **Appendix B.**

Figure 9: Location of direct count and line intercept vegetation surveys

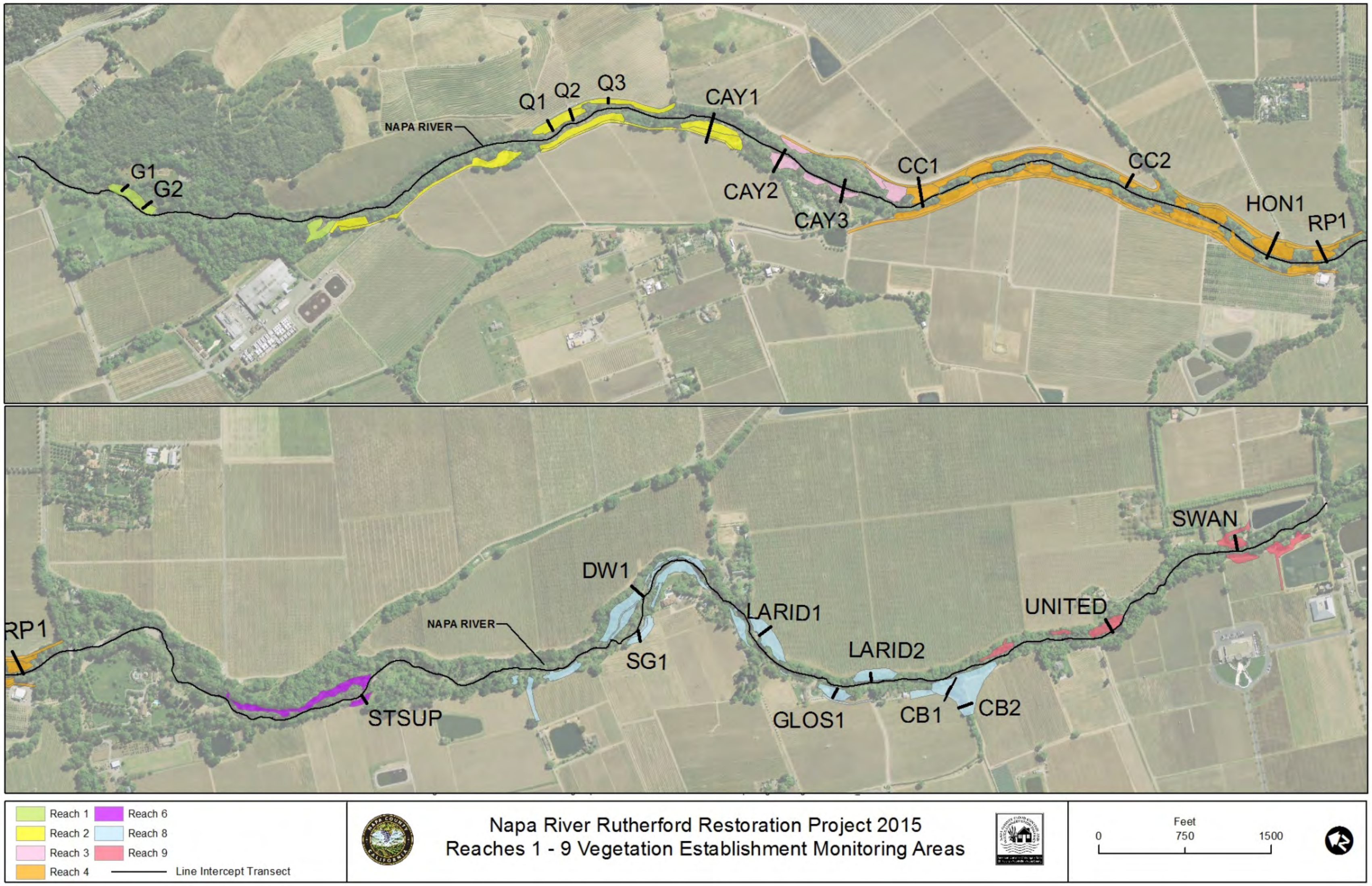


Table 18: Summary of direct count/survivorship installed vegetation surveys, Reaches 1-9

Survey Area	Year Installed	Quantity Installed	Quantity Alive 2015	% Survival 2011	% Survival 2012	% Survival 2013	% Survival 2014	% Survival 2015
Reach 1-2	2010/2011	1603	1254	86%	85%	81%	N/A	78%
Reach 3	2011/2012	1404	747	56%	52%	49%	N/A	55%*
Reach 4	2012/2013	2898	2418	N/A	N/A	86%	92%	83%
Reach 8	2013/2014	2186	3149	N/A	N/A	86%**	116%	144%***
Reach 5,6,7,9	2014/2015	1776	1723	N/A	N/A	N/A	N/A	97%^

*The Flood District is currently working to adaptively manage Reach 3 such that 80% or greater survival will be attained. **Represents vegetation installed in Reach 8A only. ***A large number of willows and cottonwoods are naturally recruiting within Reach 8 and other Reaches. ^Includes Caltrans Troutdale Creek Mitigation planting areas.

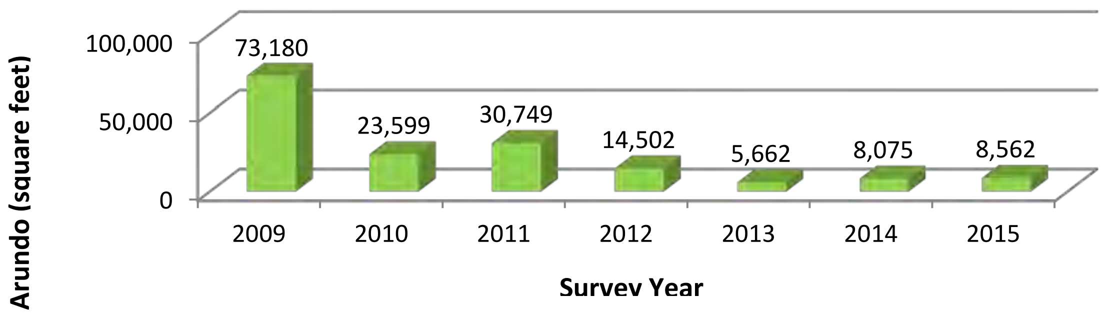
Invasive plant management

Of the 114,640 square feet (2.6 acres) of invasive and Pierce host's vegetation that was mapped during the 2015 maintenance survey, approximately 101,427 square feet (2.3 acres) were treated during the summer and fall of 2015; areas not treated were either inaccessible or outside the season of treatment and will be treated in the spring/summer of 2016. Other non-native species such as fennel, poison hemlock, etc. were observed during the June survey but not treated outside of planted areas as a result of land owners' requests to prioritize maintenance funds for treatment only of invasive plants that are considered Pierce host's species as well giant reed which is not a Pierce host. **Table 19** shows the total area of invasive and Pierce host plants treated by species since the inception of the Project in 2009 through 2015. Previous and ongoing efforts related to the Project to manage and remove giant reed (*Arundo*) have been largely successful in reducing the total amount of giant reed within the Project area. **Chart 1** below depicts the general decline of *Arundo* throughout the Project area. Currently, only small or re-sprouting patches of giant reed require re-treatment under the Maintenance Assessment District. Areas of invasive plants that were treated in 2015 that had the potential to cause streambank erosion were replanted with willow stakes and broadcast seeded with native species during the winter and spring of 2015 and 2016.

Table 19: Invasive/Pierce host plant species mapped and treated, 2009-2015

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
Total Treated to Date:							**1,038,790 (23.8 acres)**

Chart 1: Arundo mapped and treated (2009-2015)



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 vegetation cover and height class within restored areas (Harris 2005). Representative photos of the sites are shown in **Appendix B**. The transect lines range from 45 to 111 feet in length and typically span the entire width of a restoration area. **Figure 9** above shows the name and location of each transect line surveyed. **Chart 2** below presents the average relative percent native cover, by ground cover type, for all transect lines in Reaches 1- 9 for survey years 2012-2015. Results from the last four years of surveys indicate that the general trend in native ground cover is shifting from un-vegetated to herbaceous, with a gradual increase of native shrub 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 site. The slight decrease in herbaceous cover in 2014 and slight decline in shrub cover type in 2015 is likely due to the addition of several new transect sites at locations that were planted and established for less than a year prior to the 2014 and 2015 surveys. Now that Project construction is complete, and all restoration sites have been planted, the vegetation establishment monitoring dataset should stabilize and continue to show clear long term trends.

Chart 2: Average percent cover by ground cover type for line transect surveys (2012-2015)

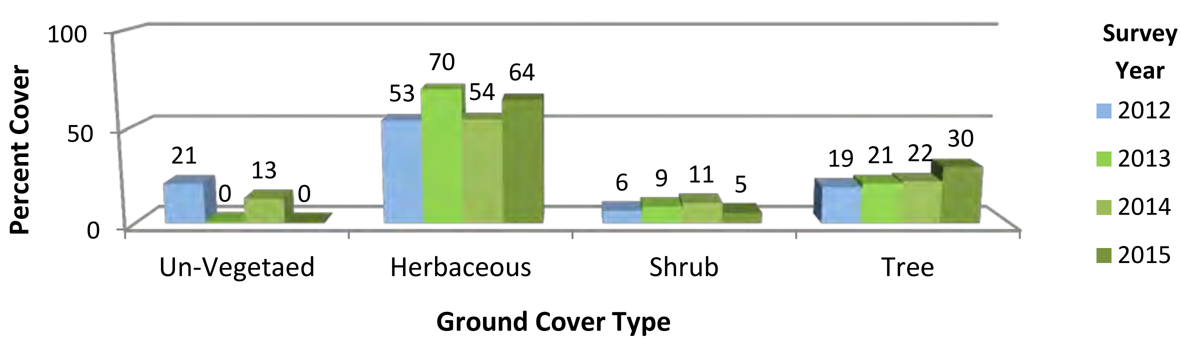
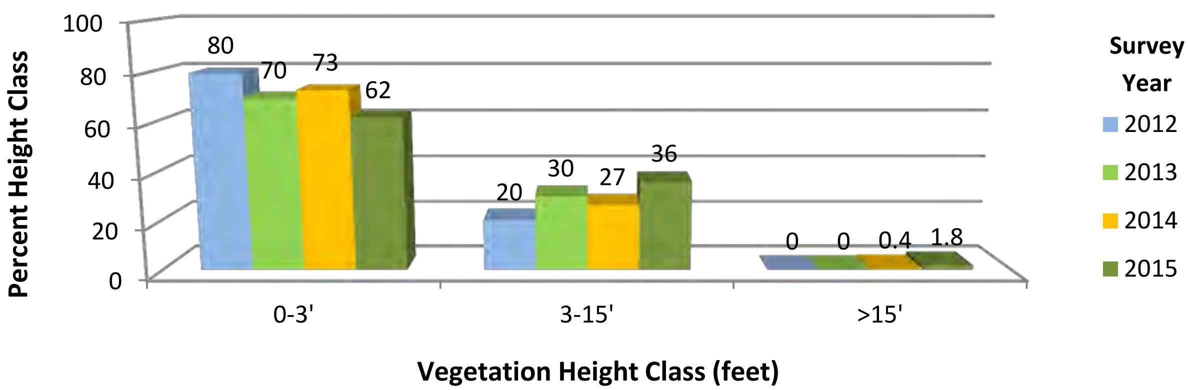


Chart 3 below represents the average height class of measured vegetation along all surveyed transect lines from 2012 through 2015. Approximately 62% of the vegetation measured in 2015 at a given

transect ranged between 0 and 3 feet tall, while approximately 36% of the vegetation measured in 2015 ranged between 3 and 15 feet in height. In 2015 several trees (cottonwoods) measured along a transects (CAY2 and DW1) in reach 3 and 8 were 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. This represents a milestone in the relative vegetative cover measured from previous survey years and is generally indicative of successful plant establishment. Representative photos of the monitoring sites are shown in **Appendix B.**

Chart 3: Average height class of herbaceous and woody vegetation for line transect surveys (2012-2015)



The results of the surveys indicate there is generally a positive trend in vegetation establishment year over year in both relative native vegetative cover and average vegetation height measured at recently constructed restoration areas. Survival of installed native woody and herbaceous vegetation in Reaches 1,2, and 4-9 ranged between 78% -144% which is generally consistent with the Project goals and performance standards for vegetation survivorship; however survivorship for Reach 3 continues to remain low (55%) despite a slightly increasing trend from 2014. The reasons for low survivorship on Reach 3 east bank are mentioned above and in previous reports. The Flood District is continuing to adaptively manage this site to the best of our ability by adding soil amendments (mycorrhizae, etc.), increasing moisture retention at planting basins through the use of mulch and increasing the watering duration so that this area will attain 80% survivorship over time.

Results from the line intercept surveys also indicate that cover at restoration sites, on average, is approximately 64% herbaceous, 5% woody shrub and 30% tree native cover types, with the remaining 1% representing either un-vegetated areas or leaf litter as cover at a given transect. Further, in 2015 approximately 62% of installed native vegetation measured between 0 feet and 3 feet in height, 36% measured 3 feet to 15 feet high, and several trees now measured above 15 feet in Reaches 3 and 8. 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 increase at natural growth rates under typical, non-drought growing conditions.

4.11 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 2015 cross section survey indicate that the width to depth ratio here has 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 in this area range between 69% -156% with an average of 144% for the site, well above the 80% or greater vegetation survivorship monitoring requirements

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 in this area ranged between 67% -100% with an average of 97% for all of the sites, well above the 80% or greater vegetation survivorship 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** and **E** for additional vegetation establishment data and photographs of the sites.

4.12 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).

From 2009 – 2011, the LAC convened three times per year. Landowners voted in 2012 to meet twice per year: once in July to review and comment on the results of the maintenance survey and work plan, and a second time in March to review and comment on work completed, the budget, and the prioritization of channel maintenance activities. Attendance at each LAC meeting has ranged between 6-15 people, representing approximately20-50% of the properties in the MAD **Table 20** below. The Napa County MAD representative is available via email and phone throughout the year and is in communication with all of the landowners in the MAD on a regular basis.

Table 20: Landowner Advisory Committee (LAC) meeting attendance

Meeting Date	Landowner Attendees	Properties Represented (of 30)	Percent of Properties Represented
6/18/2009	No Record	No Record	No Record
11/13/2009	No Record	No Record	No Record
4/10/2010	No Record	No Record	No Record
12/7/2010	No Record	No Record	No Record
4/22/2011	6	9	30%
8/2/2011	10	9	30%
12/6/2011	7	10	33%
4/12/2012	9	10	33%
7/24/2012	11	8	27%
4/9/2013	8	7	23%
7/25/2013	6	8	27%
4/10/2014	11	15	50%
7/17/2014	6	8	27%
3/24/2015	11	9	30%
7/30/2015	7	7	23%
3/31/2016	12	10	33%

4.13 Photo Monitoring

Photo monitoring is conducted concurrently with the annual stream survey and was also conducted at restoration sites' pre-construction activities. Site-specific monitoring of restoration sites creates a visual record of vegetation survival rates, 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 2015 (and in the spring of 2016 in some instances) are shown in **Appendix E.**

4.14 Complementary Monitoring

The Project team coordinates with partner agencies responsible for complementary fish, and wildlife monitoring including the RCD and others and will encourage an active exchange of data and findings.

Salmonid Monitoring

The Napa RCD conducts annual surveys to document salmonid spawning activity in the mainstem Napa River. Spawner surveys, as they are known, are typically conducted from November through January for Chinook salmon, and from January through April for steelhead. In addition, the RCD operates a salmonid smolt trap in the lowest non-tidal reach of the Napa River each spring from March through June. The results of these two monitoring efforts are used to generate abundance estimates, describe details of adult and juvenile migration timing, estimate average smolt sizes, and estimate freshwater and ocean survival rates. Over the long-term, these data can be used to gauge ecological responses to ongoing habitat restoration throughout the watershed.

2015/16 Spawner Survey Results

The Napa RCD completed three spawner surveys in the Rutherford Project reach during the 2015/16 monitoring year. Survey details and results are presented in **Table 21**. Additional details and results from this watershed-wide monitoring effort will be provided in the RCD's annual report for their Napa River Steelhead and Salmon Monitoring Program, which will be available in late 2016. Previous reports are available on the RCD and WICC websites.

Table 21. Spawner survey details and results from the 2015/16 monitoring season.

Date	**December 29, 2015**	**January 4, 2016**	**February 4, 2016**
Target Species	Chinook salmon	Chinook salmon	Steelhead
Survey Method	Wading	Kayak	Kayak
Starting Location	Rutherford Rd	Rutherford Rd	Zinfandel Ln
Ending Location	Zinfandel Ln	Yountville Crossroad	Oakville Crossroad
Distance Surveyed (mi)	2.42	5.53	4.67
Results			
# Live Fish Observed	1	0	0
# Spawning Redds Counted	6	8	0
# Carcasses Recovered	0	0	0

Database Tracking

The Natural Resource Projects Inventory (NRPI) project survey form is completed for each Phase. It can be viewed at the following link: http://www.ice.ucdavis.edu/nrpi/project.asp?ProjectPK=12386. Napa County also uploads project data to the Wetland Tracker for each Project phase at the following website: www.californiawetlands.net/tracker/. Each year, Napa County completes and submits the State Water Resources Control Board Annual Sediment Load Reduction Form, including BMPs implemented.

5.0 Achievement of Performance Standards Discussion and Conclusions

To date, monitoring results indicate that the restoration is meeting, or is on target to meet, the Project goals and performance standards. Following the completion of the Project in the fall of 2014 the cumulative amount of fine sediment reduction as a result of Project construction is 257,260 metric tons with an estimated 16,394 metric tons/year reduced each year from the Napa River watershed over the next 20 years. Further based on the 2014 and 2015 survey results, the Project has attained the performance standard of a 75% reduction in active stream bank erosion throughout the entire Project reach. Positive trends (increases) in channel width-to-depth ratios at 12 of the 16 surveyed cross sections were documented during the 2015 survey with 12 cross section sites being classified as "approaching functional width" with the remain 4 sites categorized as "entrenched." Decreases in maximum depth, or increases in bed elevation due to recruitment or aggradation of gravel, were observed at 12 of 13 cross section locations as well.

Aquatic habitat has been improved with the addition of 149 instream habitat structures with 88% of these structures remaining as "persistent" and functional (summer and winter refugia) within the river channel. Additionally, 108 naturally-occurring LWD features were assessed in 2015, and 77 of those were found to be providing either summer low-flow or winter high-flow refugia. A total of 99 of the installed structures were found to be providing this same function, yielding a 129% increase in the amount of cover provided by log and boulder features. This amount far exceeds the 40% target set by the performance standard for instream cover. In 2015, a total of 64 of the 149 installed habitat structures were found to be providing pool scour, including 36 wood structures and 28 boulder structures. The average residual pool depth associated with the installed wood structures decreased by 16% in 2015, short of the 25% increase performance standard for this metric, while the average scour depth around boulder structures increased by approximately 4% from the previous year. Comparisons for this metric over short time periods are limited to showing short-term outcomes. Determining whether or not the Project has met the scour objective of increasing pool depths by 25% may be better assessed after several more years of monitoring.

As a result of completing construction for the Project in the fall of 2014, 30.5 acres of native riparian plants were installed in restored areas in all 9 Project reaches, exceeding the outlined restoration goal for establishing a minimum of 20 acres of riparian habitat over the life of the Project. Survival of installed native woody and herbaceous vegetation in Reaches 1, 2, and 4-9 ranged between 78% -144% which is generally consistent with the performance standard of 80% for vegetation survivorship;

however survivorship for Reach 3 continues to remain low (55%) despite a slightly increasing trend from 2014. Results from the line intercept surveys also indicate that native cover, on average, is approximately 64% herbaceous, 5% woody shrub and 30% tree cover type, with the remaining 1% representing either un-vegetated areas or leaf litter as cover at a given transect. In general, the increase in relative native cover 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 aquatic and terrestrial habitats are providing important foraging and rearing for native wildlife. Within the Project reach fine sediment sources have been reduced and are expected to be reduced year to year over the life of the Project as a result of related bank stabilization and other channel enhancement activities.

6.0 References

Gerstein, J.M. (2005)Monitoring the Effectiveness of Instream Habitat Restoration. University of California, Center for Forestry, Berkeley, California. 45 pgs. http://forestry.berkeley.edu/comp_proj/DFG/Monitoring%20the%20Effectiveness%20of%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. 33 pp. http://www.cnr.berkeley.edu/forestry/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, California, 2009. http://www.napawatersheds.org/documents/view/4585

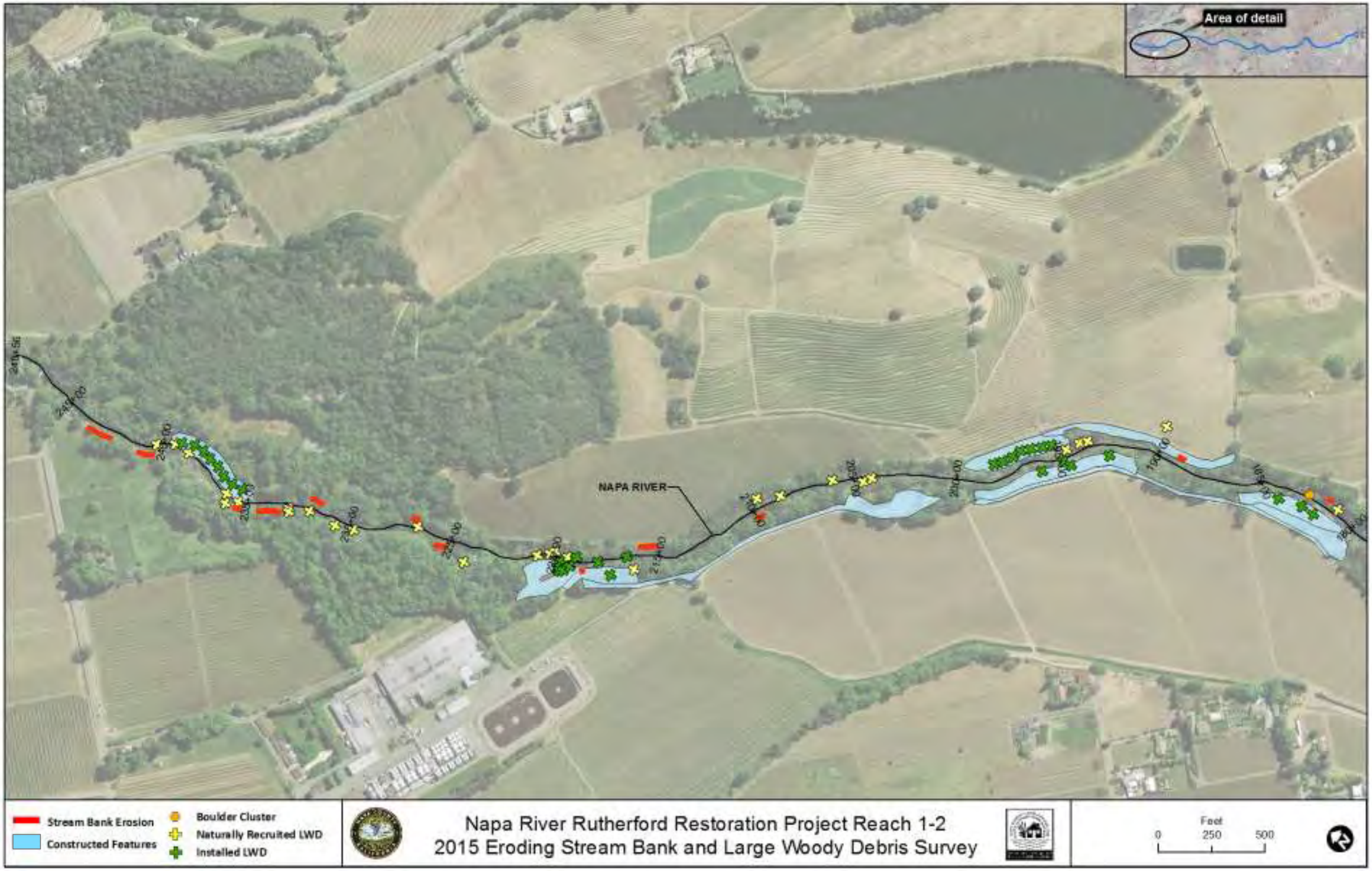
Kondolf, G. (1997) Application of the pebble count: Notes on purpose, method, and variants.

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

Sarrow, J., Blank, P., Koehler, J., (2015) Napa River Rutherford Reach Restoration Project Annual Monitoring Report 2014. http://www.napawatersheds.org/documents/view/7101

Appendix A
Eroding Stream Bank and Large Woody Debris (LWD) Survey Figures and Tables



Napa River Rutherford Restoration Project Reach 1-2
2015 Eroding Stream Bank and Large Woody Debris Survey

Stream Bank Erosion	Boulder Cluster
Constructed Features	Naturally Recruited LWD
	Installed LWD

Napa River Rutherford Restoration Project Reach 3-4
2015 Eroding Stream Bank and Large Woody Debris Survey

Feet
0 250 500

Stream Bank Erosion
Constructed Features
Boulder Cluster
Naturally Recruited LWD
Installed LWD

Napa River Rutherford Restoration Project Reach 5-7
2015 Eroding Stream Bank and Large Woody Debris Survey

Feet
0 250 500

Napa River Rutherford Restoration Project Reach 8
2015 Eroding Stream Bank and Large Woody Debris Survey

Napa River Rutherford Restoration Project Reach 9
2015 Eroding Stream Bank and Large Woody Debris Survey

Table A1: Summarized statistics on naturally-occurring LWD within the overall project reach.

Survey Year	2009	2010	2011	2012	2013	2014	2015
Number of Occurrences							
Single	46	60	97	111	90	59	85
Accumulations (2-9)	23	19	19	24	20	27	21
Jams (>10)	3	3	3	1	3	1	2
Total	72	82	119	136	113	87	108
Bedform Association (%)							
Bank	---	9.8	9.2	3.7	16.8	10.3	18.5
Bar	---	15.9	12.6	13.2	9.7	12.6	---
Pool	---	36.6	37	41.9	36.3	35.6	37
Riffle	---	4.9	10.1	5.9	5.3	9.2	5.6
Terrace	---	24.4	29.4	19.1	16.8	12.6	15.7
Secondary Channel	---	1.2	1.7	0	1.8	1.1	1.9
Perched in Vegetation	---	7.3	---	16.2	13.3	18.4	21.3
Size							
Single Piece Length Range (ft)	6-80	8-100	6-95	6-80	6-60	6-80	6-90
Single Piece Length Average (ft)	30	25	25	23	23	29	28
Accumulation Length Range (ft)	10-120	10-100	8-85	8-100	10-200	10-200	10-100
Diameter Class (%)							
18-in	25	63.4	69.7	68.4	68.1	60.9	67.6
24-in	38.9	19.5	16	17.6	15	26.4	20.4
30-in	22.2	3.7	6.7	2.2	5.3	8	4.6
36-in	6.9	7.3	4.2	5.9	8	1.1	7.4
42-in	2.8	6.1	2.5	3.7	2.7	2.3	0
≥ 48-in	4.2	0	0.8	2.2	0.9	1.1	0
Function (%)							
Hydraulic Constriction	---	---	28.6	26.5	18.6	29.9	13.9
Pool Scour	---	---	33.6	28.7	28.3	29.9	25
Gravel Recruitment	---	---	---	---	10.6	1.1	6.5
Summer Refugia	---	---	41.2	44.1	42.5	48.3	45.4
High-flow Refugia	---	---	6.7	17.6	30.1	27.6	27.8
Bank Stability	---	---	28.6	23.5	22.1	5.7	9.3
Other	---	---	21	17.6	---	---	---

Appendix B

Vegetation Establishment Survey Figures and Tables

Figure B1: Vegetation establishment direct count, transect survey and photo monitoring locations

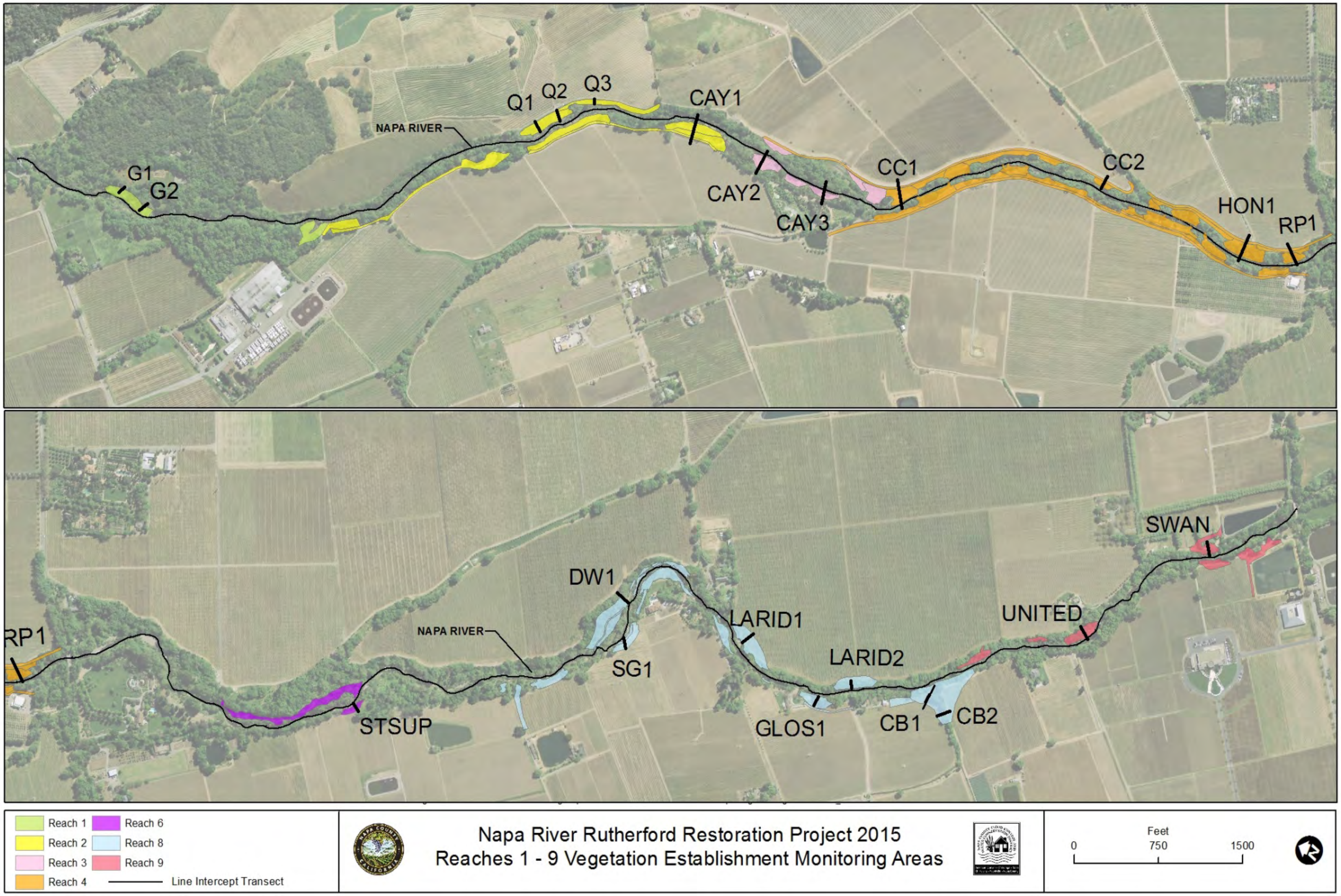


Table B1: Reach 1 and 2 Direct Count/Survivorship Survey 2015

Common Name	Total Installed	Count 2011	% Survival	Count 2012	% Survival	Count 2013	% Survival	Count 2015	% Survival	Health
White alder	30	30	100%	30	100%	30	100%	30	100%	Good
Big Leaf Maple	29	29	100%	26	90%	26	90%	26	90%	Good
California buckeye	29	8	28%	12	41%	6	21%	10	34%	Poor
Coyote Bush	60	60	100%	88	147%	170	283%	150	250%	Good
Western spice bush	241	241	100%	220	91%	183	76%	173	72%	Good
Oregon Ash	100	91	91%	88	88%	49	49%	54	54%	Poor
Toyon	9	4	44%	9	100%	18	200%	22	244%	Good
California Black Walnut	50	56	112%	55	110%	74	148%	58	116%	Good
Honeysuckle	87	64	74%	64	74%	46	53%	48	55%	Poor
Coast live oak	132	71	54%	48	36%	50	38%	65	49%	Poor
Valley oak	90	49	54%	64	71%	50	56%	86	96%	Good
Fremont's cottonwood	136	97	71%	118	87%	112	82%	98	72%	Fair
California wild rose	147	147	100%	140	95%	128	87%	96	65%	Fair
Red willow	136	142	104%	115	85%	90	66%	102	75%	Good
Arroyo willow	136	95	70%	84	62%	104	76%	79	58%	Poor
Snowberry	147	147	100%	155	105%	151	103%	148	101%	Good
California bay	44	44	100%	39	89%	6	14%	9	20%	Poor
Total	**1603**	**1375**	**86%**	**1355**	**85%**	**1293**	**81%**	**1254**	**78%**	

*Installed Fall 2010 and spring 2011, includes original planted stock and naturally recruited species.

Table B2: Reach 3 Direct Count/Survivorship Survey 2015

Common Name	Total Installed	Count 2011	% Survival	Count 2012	% Survival	Count 2013	% Survival	Count 2015	% Survival	Health
Western Redbud	82	69	84%	68	83%	24	29%	20	24%	Poor
Silver Lupine	150	83	55%	57	38%	23	15%	30	20%	Poor
Sticky Monkeyflower	57	20	35%	9	16%	12	21%	10	18%	Poor
White Alder	10	4	40%	2	20%	6	60%	15	150%	Good
Oregon Ash	44	32	73%	45	102%	28	64%	32	73%	Good
Fremont's Cottonwood	37	16	43%	32	86%	25	68%	45	122%	Good
Red Willow	24	29	121%	9	38%	28	117%	50	208%	Good
Arroyo Willow	30	8	27%	21	70%	24	80%	65	217%	Good
Yellow Willow	28	20	71%	11	39%	11	39%	0	0%	Poor
Big Leaf Maple	10	5	50%	13	130%	11	110%	8	80%	Good
Box Elder	13	11	85%	0	0%	2	15%	0	0%	Poor
California Buckeye	44	0	0%	0	0%	3	7%	12	27%	Poor
Black Walnut	65	42	65%	47	72%	46	71%	48	74%	Good
Valley Oak	128	14	11%	25	20%	38	30%	45	35%	Poor
Coast Live Oak	58	0	0%	2	3%	32	55%	32	55%	Poor
Bay Laurel	86	76	88%	52	60%	37	43%	32	37%	Poor
Blue Oak	28	0	0%	0	0%	0	0%	0	0%	Poor
California Black Oak	3	0	0%	0	0%	0	0%	0	0%	Poor
California Wild Rose	144	121	84%	122	85%	138	96%	125	87%	Good
Snowberry	100	76	76%	64	64%	65	65%	78	78%	Good
Coyote Bush	67	36	54%	44	66%	49	73%	78	116%	Good
Western Spice Bush	31	24	77%	23	74%	11	35%	11	35%	Poor
Toyon	59	29	49%	23	39%	17	29%	17	29%	Poor
Twinberry	76	67	88%	59	78%	47	62%	12	16%	Poor
Honeysuckle	30	6	20%	9	30%	6	20%	9	30%	Poor
Total	**1404**	**788**	**56%**	**737**	**52%**	**683**	**49%**	**774**	**55%****	

* Installed Spring 2011 and spring 2012, includes original planted stock and naturally recruited species.

**High mortality related to inconsistent water availability and rodent damage to root balls.

Table B3: Reach 4 Direct Count/Survivorship Survey 2015

Common Name	Total Installed	Count 2013	% Survival	Count 2014	% Survival	Count 2015	% Survival	Health
White Alder	16	15	94%	23	144%	24	150%	Good
Oregon Ash	128	134	105%	138	108%	125	98%	Good
Cottonwood	83	22	27%	38	46%	64	77%	Good
Red Willow	63	25	40%	61	97%	85	135%	Good
Arroyo Willow	58	16	28%	93	160%	93	160%	Good
Yellow Willow	9	6	67%	98	1089%	98	1089%	Good
Big Leaf Maple	30	29	97%	18	60%	18	60%	Fair
California Buckeye	126	86	68%	70	56%	55	44%	Poor
Black Walnut	201	139	69%	132	66%	98	49%	Poor
Valley Oak	196	252	129%	204	104%	190	97%	Good
Coast Live Oak	175	202	115%	190	109%	98	56%	Poor
Bay Laurel	133	109	82%	87	65%	75	56%	Poor
Blue Oak	73	37	51%	67	92%	45	62%	Fair
California Wild Rose	338	345	102%	354	105%	365	108%	Good
Snowberry	338	240	71%	258	76%	276	82%	Good
Coyote Bush	201	231	115%	251	125%	265	132%	Good
Western Spice Bush	51	53	104%	52	102%	34	67%	Fair
Toyon	100	52	52%	41	41%	41	41%	Poor
Deergrass	325	290	89%	271	83%	271	83%	Good
Honeysuckle	254	223	88%	212	83%	98	39%	Poor
Total	**2898**	**2506**	**86%**	**2658**	**92%**	**2418**	**83%**	

*Installed Spring 2012 and 2013, includes original planted stock and naturally recruited species.

Table B4: Reach 8 (Includes Ritz-Carlton Mitigation Area) Direct Count/Survivorship Surveys 2015

Common Name	Total Installed Reach 8 A + BC	*Count 2013 Reach 8 A Only*	Count 2014 Reach 8 A + BC	% Survival	Count 2015 Reach 8 A + BC	% Survival	Health
Big leaf maple	59	14	63	107%	61	103%	Good
Honeysuckle	26	8	18	69%	27	104%	Good
Snowberry	300	105	467	156%	512	171%	Good
California Wild Rose	379	108	394	104%	531	140%	Good
Spicebush	18	8	14	78%	16	89%	Good
California Buckeye	98	5	159	162%	140	143%	Good
White Alder	190	16	185	97%	275	145%	Good
Oregon ash	189	65	157	83%	178	94%	Good
Fremont's Cottonwood	116	62	238	205%	298	257%	Good
California Black Walnut	114	26	150	132%	163	143%	Good
Coyote Bush	195	23	149	76%	245	126%	Good
Valley Oak	225	60	254	113%	351	156%	Good
Bay Laurel	46	9	41	89%	41	89%	Good
Toyon	52	17	79	152%	47	90%	Good
Coats Live Oak	179	30	164	92%	264	147%	Good
Total	**2186**	**556**	**2532**	**116%**	**3149**	**144%****	

* Installed Spring 2013 and 2014, includes original planted stock and naturally recruited species.

**A large number of willows and cottonwoods are naturally recruiting within Reach 8 and other Reaches.

Table B5: Reach 5, 6, 7 and 9 (Includes CalTrans Troutdale Creek Mitigation Area) Direct Count/Survivorship Surveys 2015

Common Name	Total Installed	Count 2015	% Survival	Health
Big Leaf Maple	29	29	100%	Good
California Buckeye	54	36	67%	Fair
White Alder	29	29	100%	Good
Oregon Ash	45	45	100%	Good
California Black Walnut	65	65	100%	Good
Northern California Black Walnut *	60	60	100%	Good
Fremont's Cottonwood	72	72	100%	Good
Coast Live Oak	163	153	94%	Good
Valley Oak	238	238	100%	Good
Red Willow	106	106	100%	Good
Arroyo Willow	48	48	100%	Good
Bay Laurel	21	21	100%	Good
Deergrass	343	318	93%	Good
Coyote Bush	73	73	100%	Good
Western Spice Bush	35	35	100%	Good
Hairy Ceanothus	23	23	100%	Good
Toyon	47	47	100%	Good
Ninebark	34	34	100%	Good
California gooseberry	52	52	100%	Good
California Wild Rose	148	148	100%	Good
Snowberry	91	91	100%	Good
Total	**1776**	**1723**	**97%**	

*Installed Fall 2014 and spring 2015, includes original planted stock and naturally recruited species.

Figure B2: Representative photos of direct count and transect monitoring sites

Transect G1 (July 2015)

Transect Q2 (July 2015)

Transect CAY3 (July 2015)

Transect SG1 (July 2015)


Transect GLOS1 (July 2015)


Transect DW1- Ritz Carlton Mitigation Site (July 2015)


Transect LAIRD2 (July 2015)


Transect CB1 (July 2015)

Transect STSUP- Caltrans Mitigation Site (July 2015)

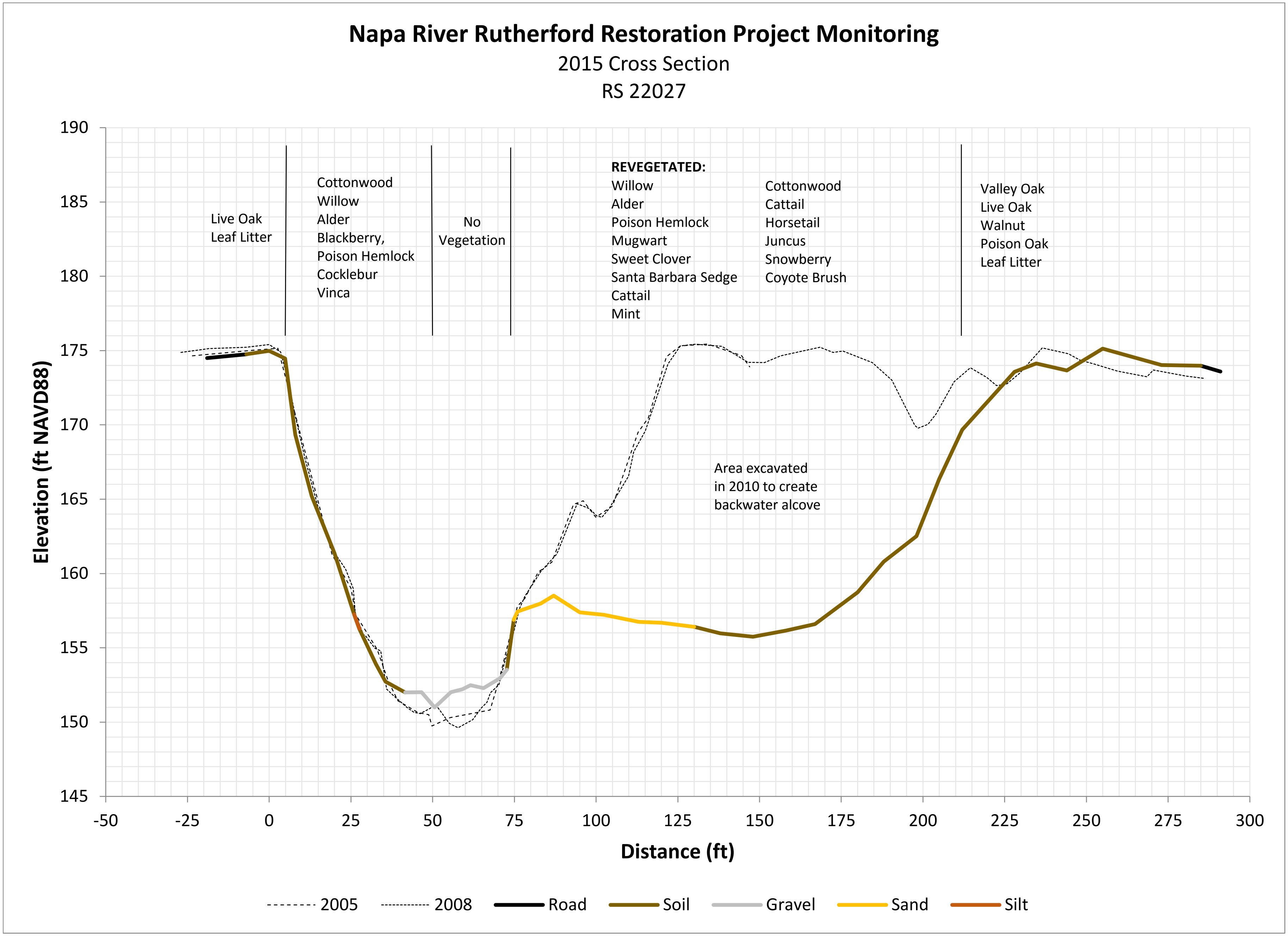
Transect UNITED- Caltrans Mitigation Site (July 2015)

Transect SWAN- Caltrans Mitigation Site (July 2015)

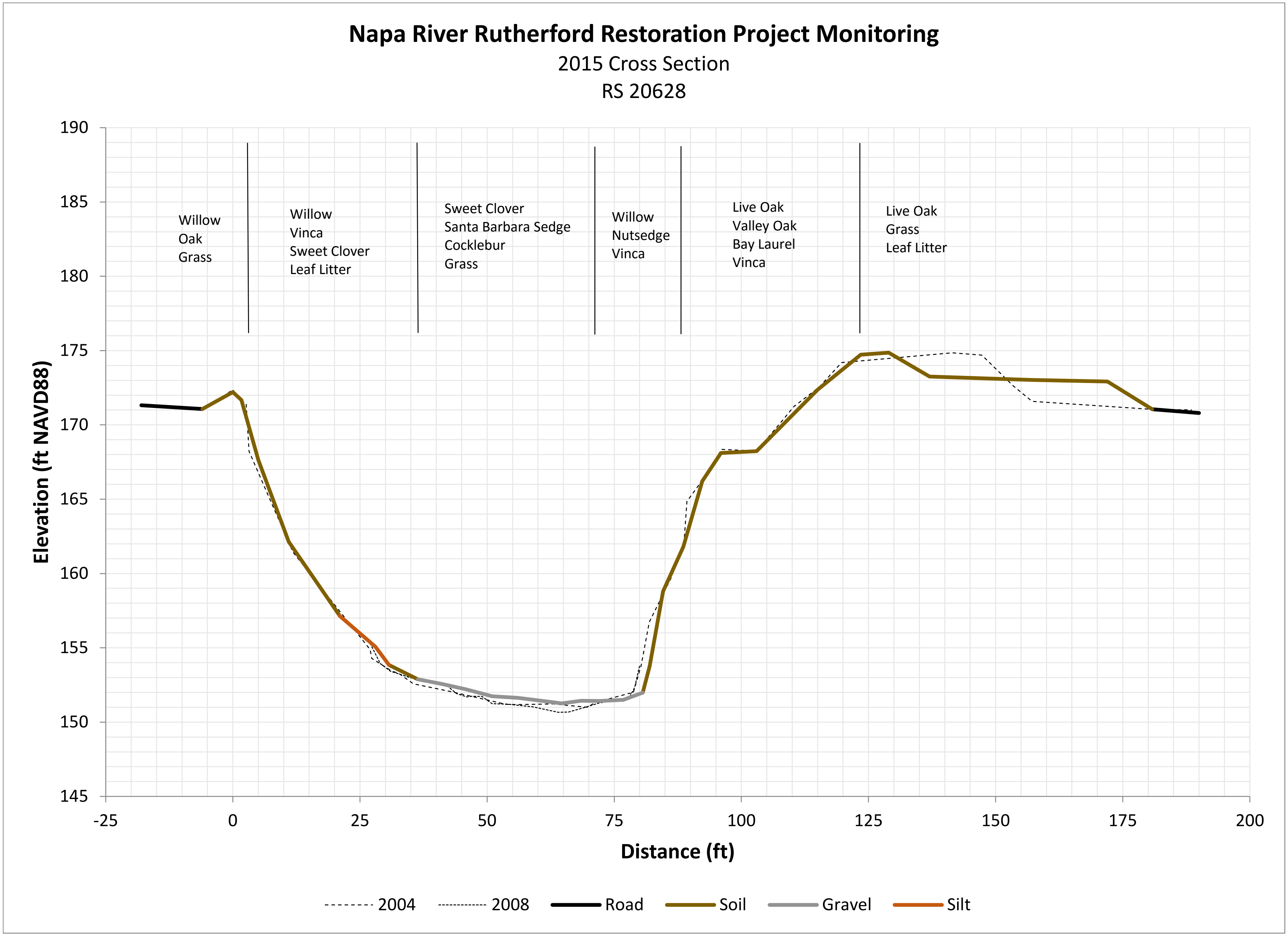
Transect SWAN- Caltrans Mitigation Site (July 2015)

Appendix C

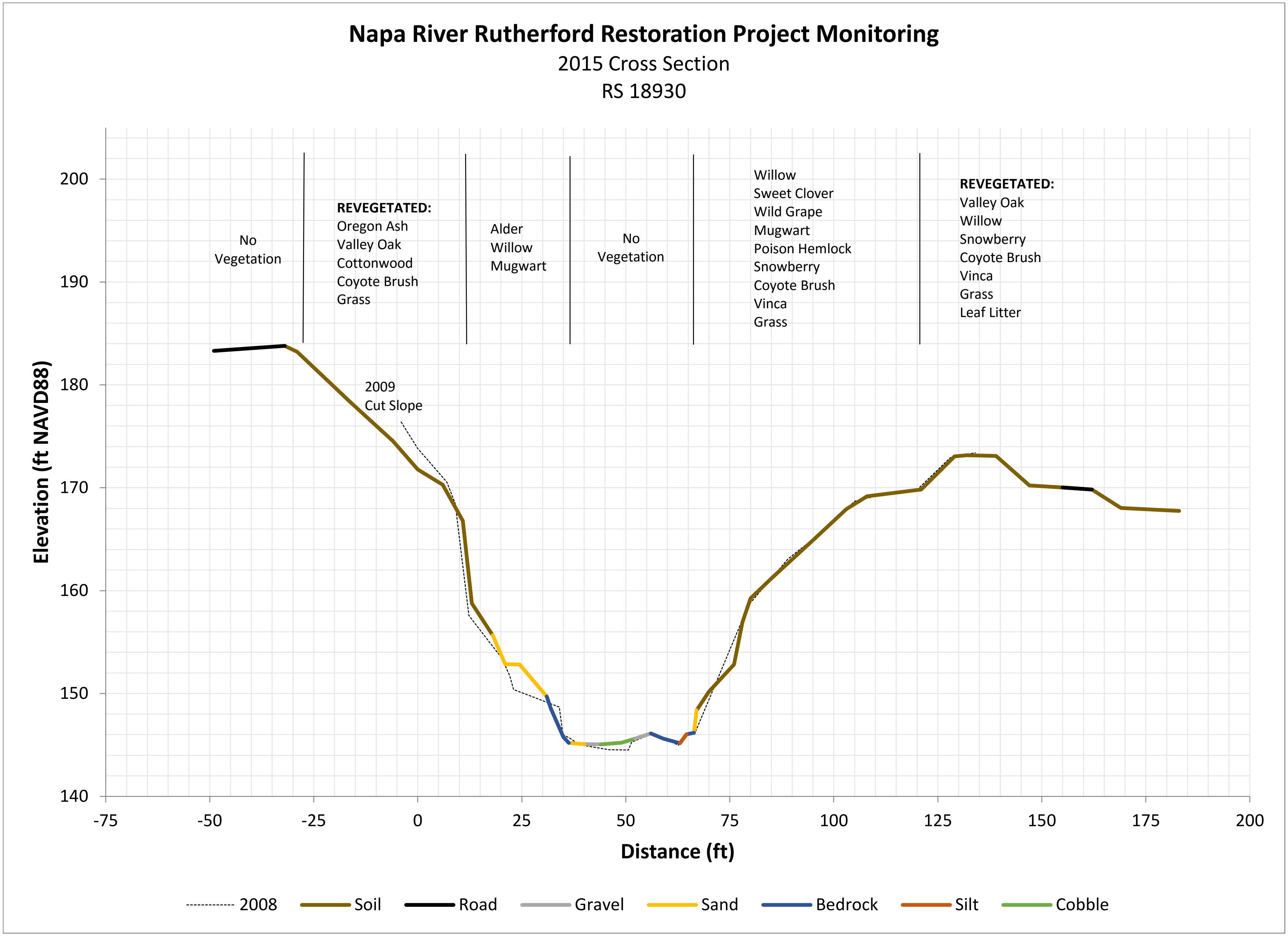
Cross Section Surveys



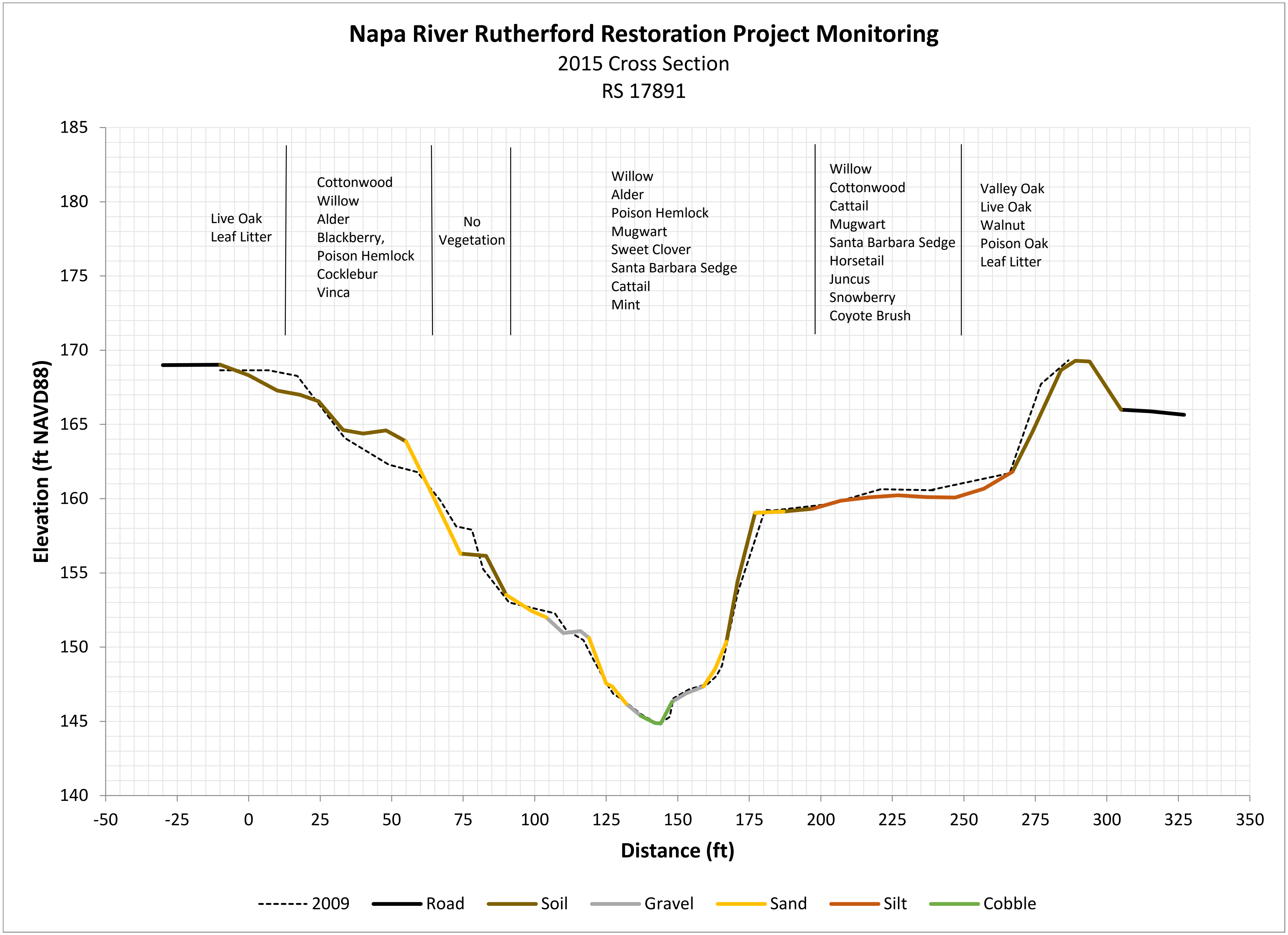
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 22027
Live Oak
Leaf Litter
Cottonwood
Willow
Alder
Blackberry,
Poison Hemlock
Cocklebur
Vinca
No
Vegetation
REVEGETATED:
Willow
Alder
Poison Hemlock
Mugwart
Sweet Clover
Santa Barbara Sedge
Cattail
Mint
Cottonwood
Cattail
Horsetail
Juncus
Snowberry
Coyote Brush
Valley Oak
Live Oak
Walnut
Poison Oak
Leaf Litter
Area excavated
in 2010 to create
backwater alcove
Elevation (ft NAVD88)
190
185
180
175
170
165
160
155
150
145
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
Distance (ft)
2005
2008
Road
Soil
Gravel
Sand
Silt



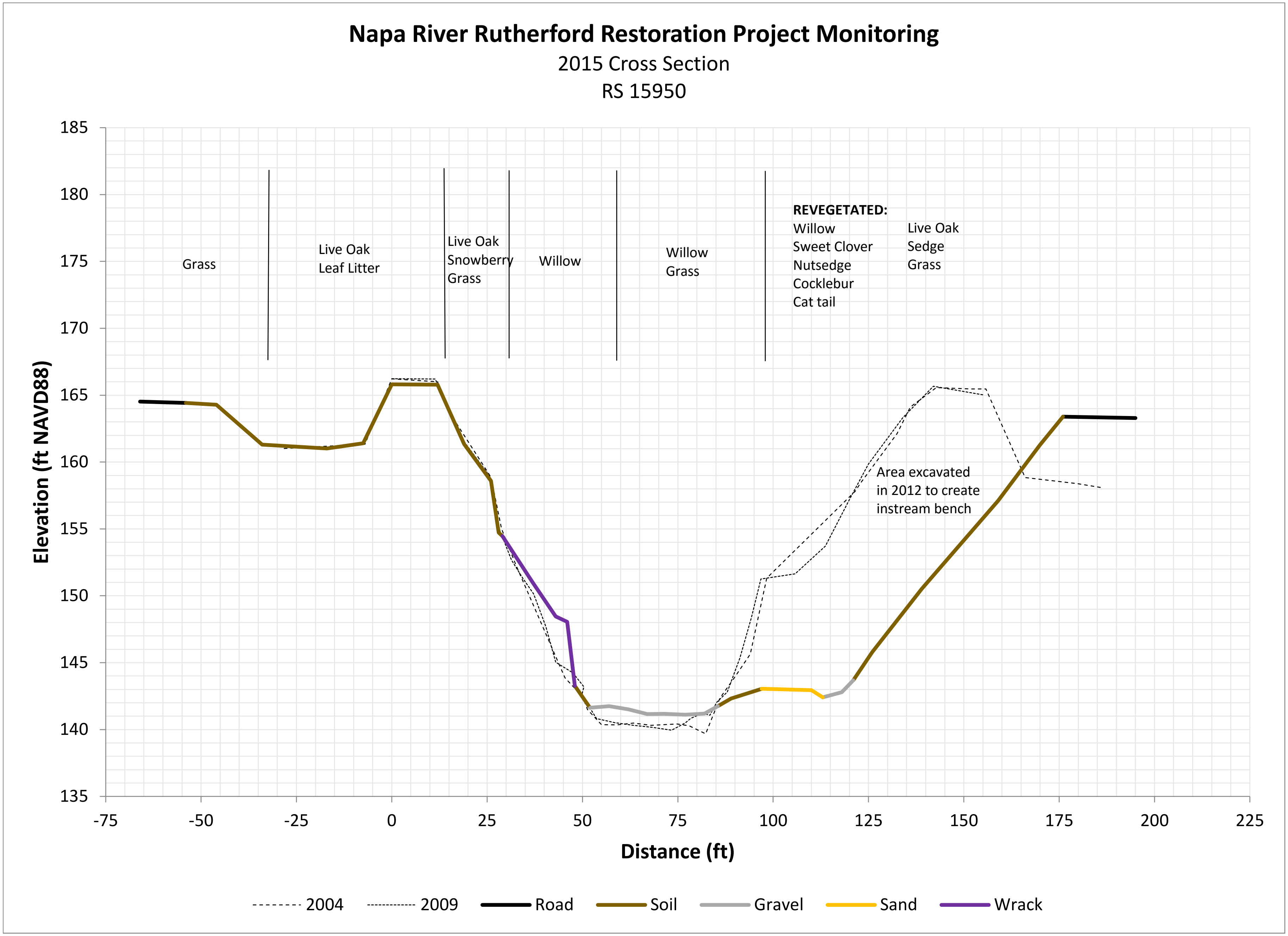
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 20628
Willow
Oak
Grass
Willow
Vinca
Sweet Clover
Leaf Litter
Sweet Clover
Santa Barbara Sedge
Cocklebur
Grass
Willow
Nutsedge
Vinca
Live Oak
Valley Oak
Bay Laurel
Vinca
Live Oak
Grass
Leaf Litter
Elevation (ft NAVD88)
190
185
180
175
170
165
160
155
150
145
-25
0
25
50
75
100
125
150
175
200
Distance (ft)
2004
2008
Road
Soil
Gravel
Silt



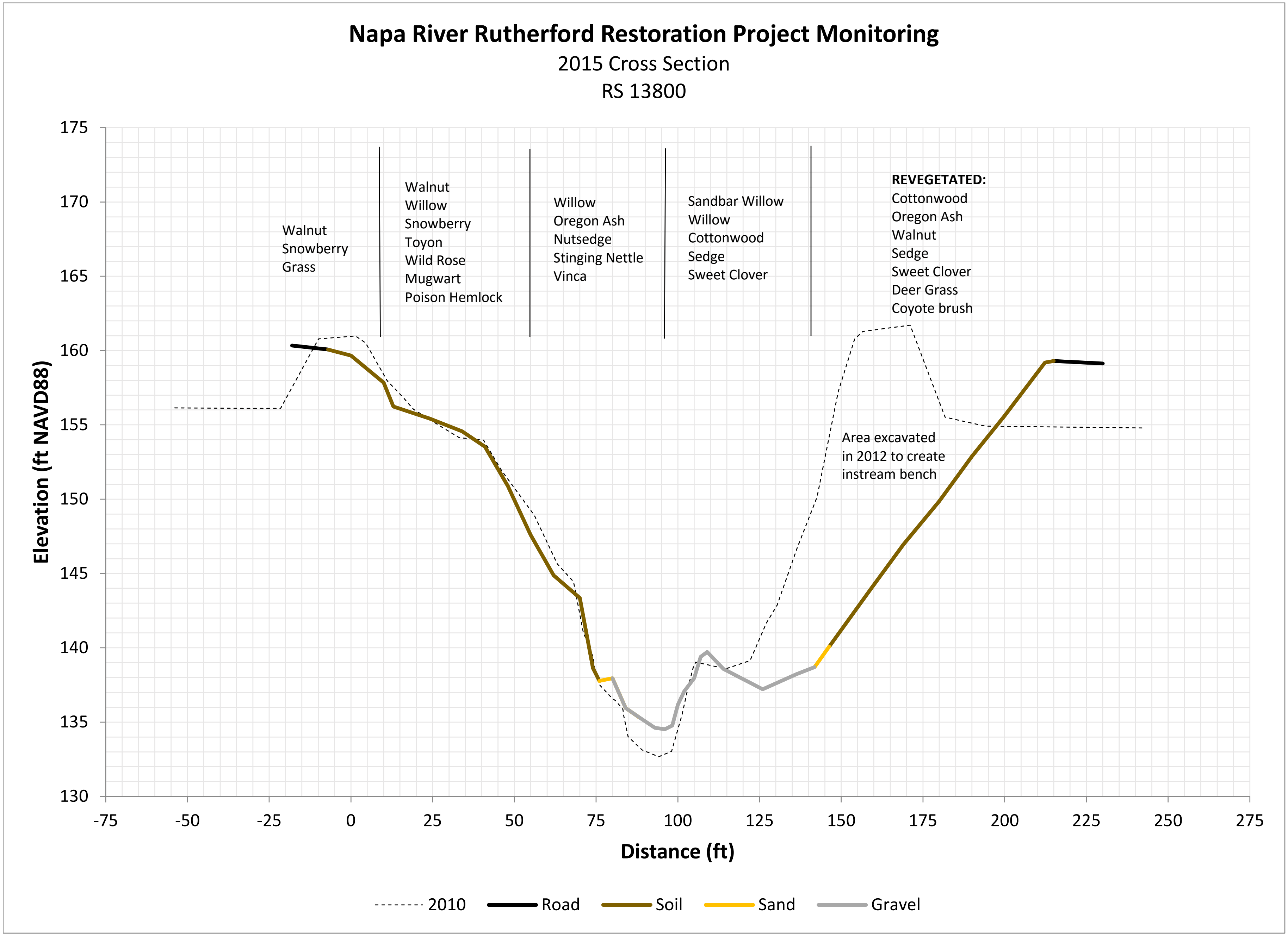
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 18930
No Vegetation
REVEGETATED:
Oregon Ash
Valley Oak
Cottonwood
Coyote Brush
Grass
Alder
Willow
Mugwart
No Vegetation
Willow
Sweet Clover
Wild Grape
Mugwart
Poison Hemlock
Snowberry
Coyote Brush
Vinca
Grass
REVEGETATED:
Valley Oak
Willow
Snowberry
Coyote Brush
Vinca
Grass
Leaf Litter
2009
Cut Slope
Elevation (ft NAVD88)
200
190
180
170
160
150
140
-75
-50
-25
0
25
50
75
100
125
150
175
200
Distance (ft)
2008
Soil
Road
Gravel
Sand
Bedrock
Silt
Cobble



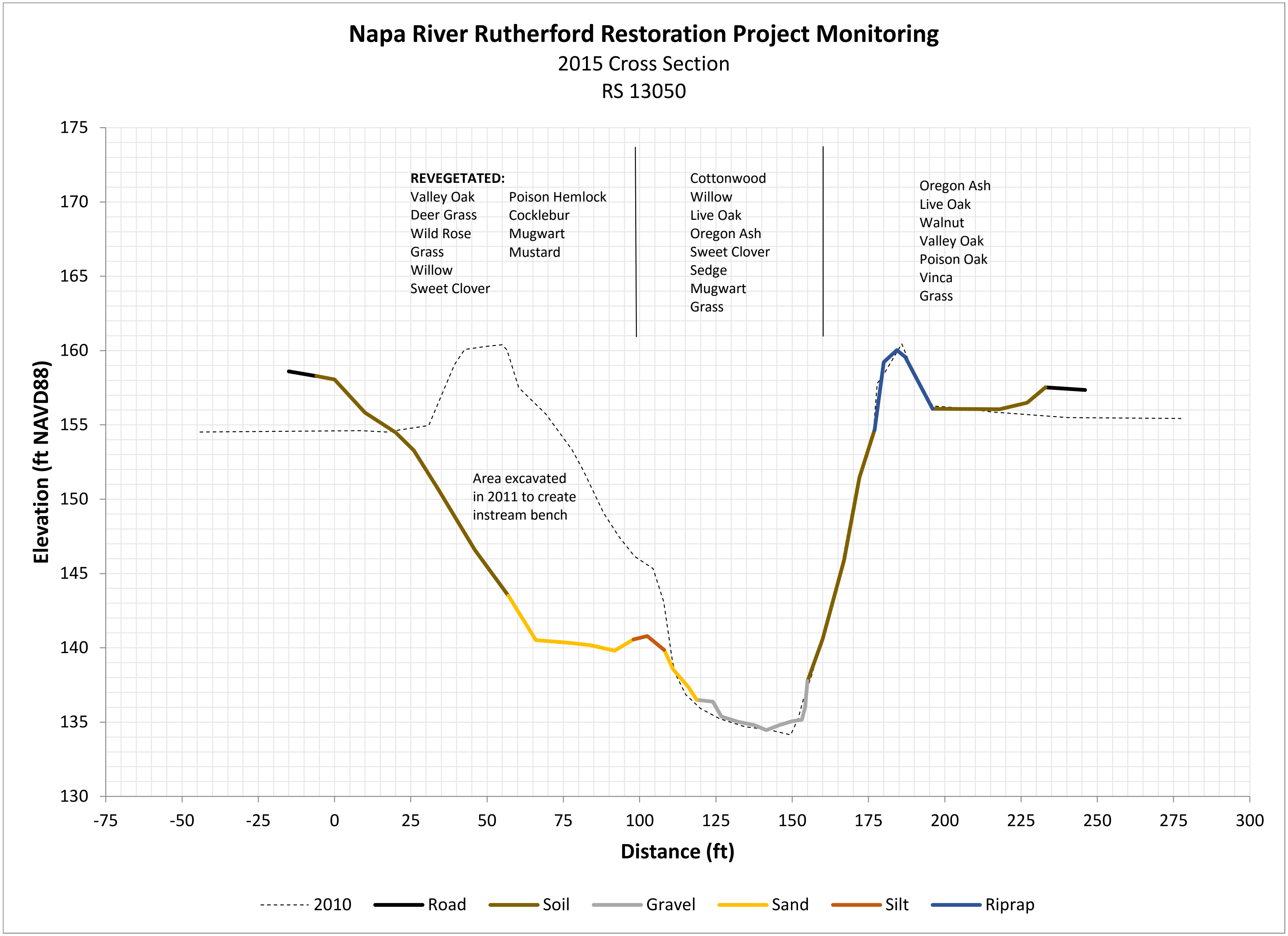
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 17891
Live Oak
Leaf Litter
Cottonwood
Willow
Alder
Blackberry,
Poison Hemlock
Cocklebur
Vinca
No
Vegetation
Willow
Alder
Poison Hemlock
Mugwart
Sweet Clover
Santa Barbara Sedge
Cattail
Mint
Willow
Cottonwood
Cattail
Mugwart
Santa Barbara Sedge
Horsetail
Juncus
Snowberry
Coyote Brush
Valley Oak
Live Oak
Walnut
Poison Oak
Leaf Litter
Elevation (ft NAVD88)
185
180
175
170
165
160
155
150
145
140
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
Distance (ft)
2009
Road
Soil
Gravel
Sand
Silt
Cobble



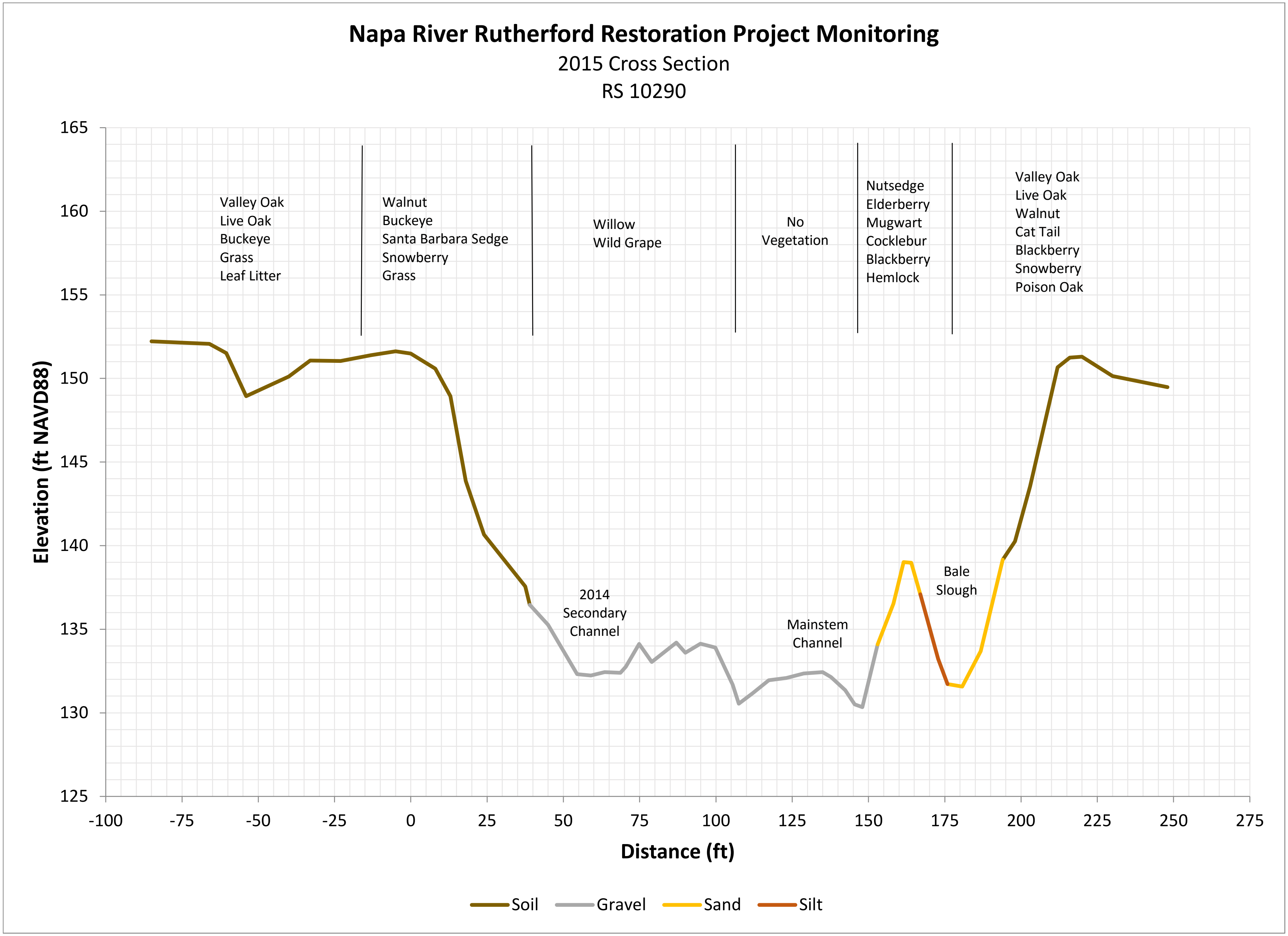
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 15950
Grass
Live Oak
Leaf Litter
Live Oak
Snowberry
Grass
Willow
Willow
Grass
REVEGETATED:
Willow
Sweet Clover
Nutsedge
Cocklebur
Cat tail
Live Oak
Sedge
Grass
Area excavated
in 2012 to create
instream bench
Elevation (ft NAVD88)
185
180
175
170
165
160
155
150
145
140
135
-75
-50
-25
0
25
50
75
100
125
150
175
200
225
Distance (ft)
2004
2009
Road
Soil
Gravel
Sand
Wrack



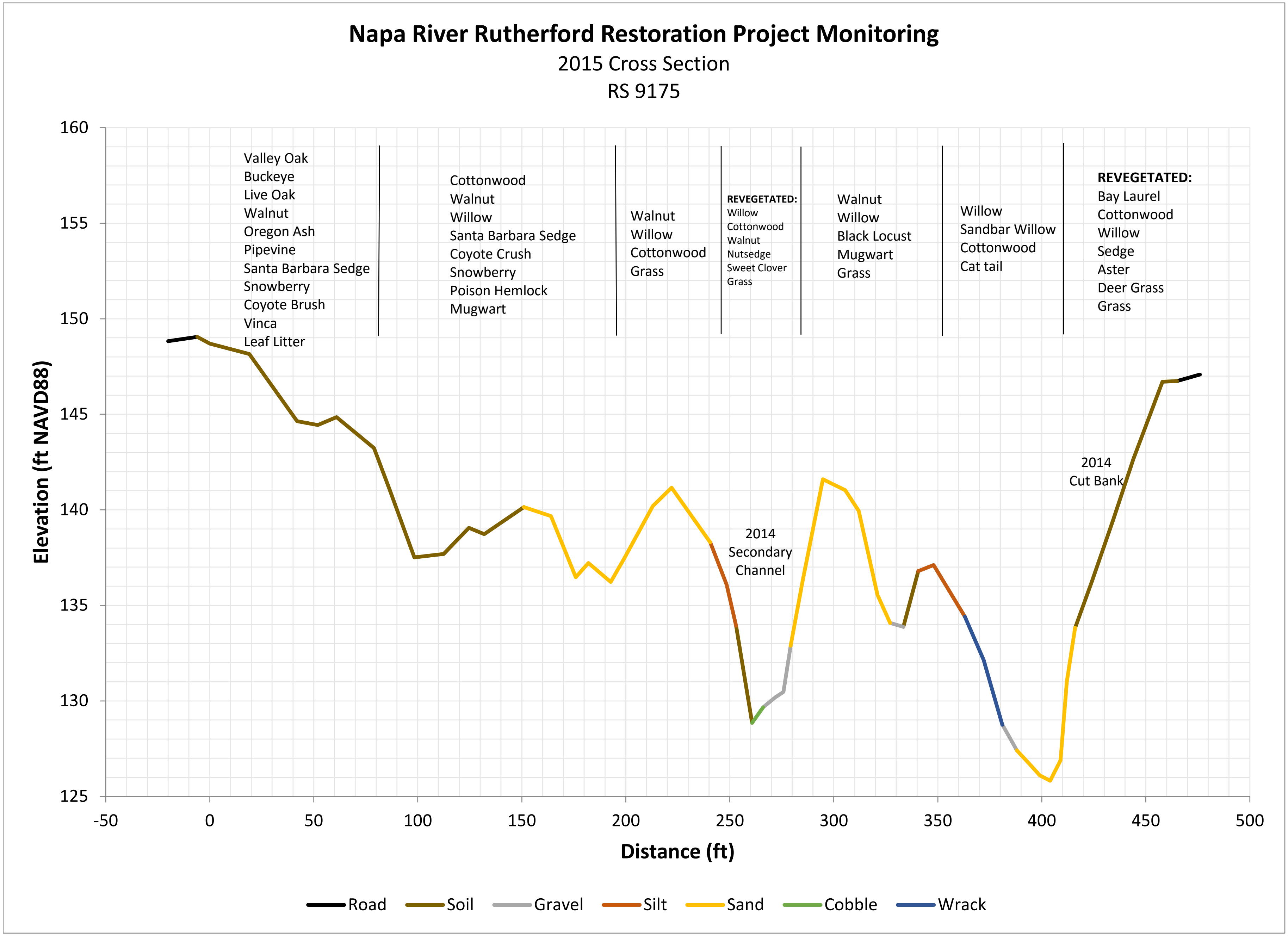
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 13800
Elevation (ft NAVD88)
Distance (ft)
175
170
165
160
155
150
145
140
135
130
-75
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
Walnut
Snowberry
Grass
Walnut
Willow
Snowberry
Toyon
Wild Rose
Mugwart
Poison Hemlock
Willow
Oregon Ash
Nutsedge
Stinging Nettle
Vinca
Sandbar Willow
Willow
Cottonwood
Sedge
Sweet Clover
REVEGETATED:
Cottonwood
Oregon Ash
Walnut
Sedge
Sweet Clover
Deer Grass
Coyote brush
Area excavated
in 2012 to create
instream bench
2010
Road
Soil
Sand
Gravel

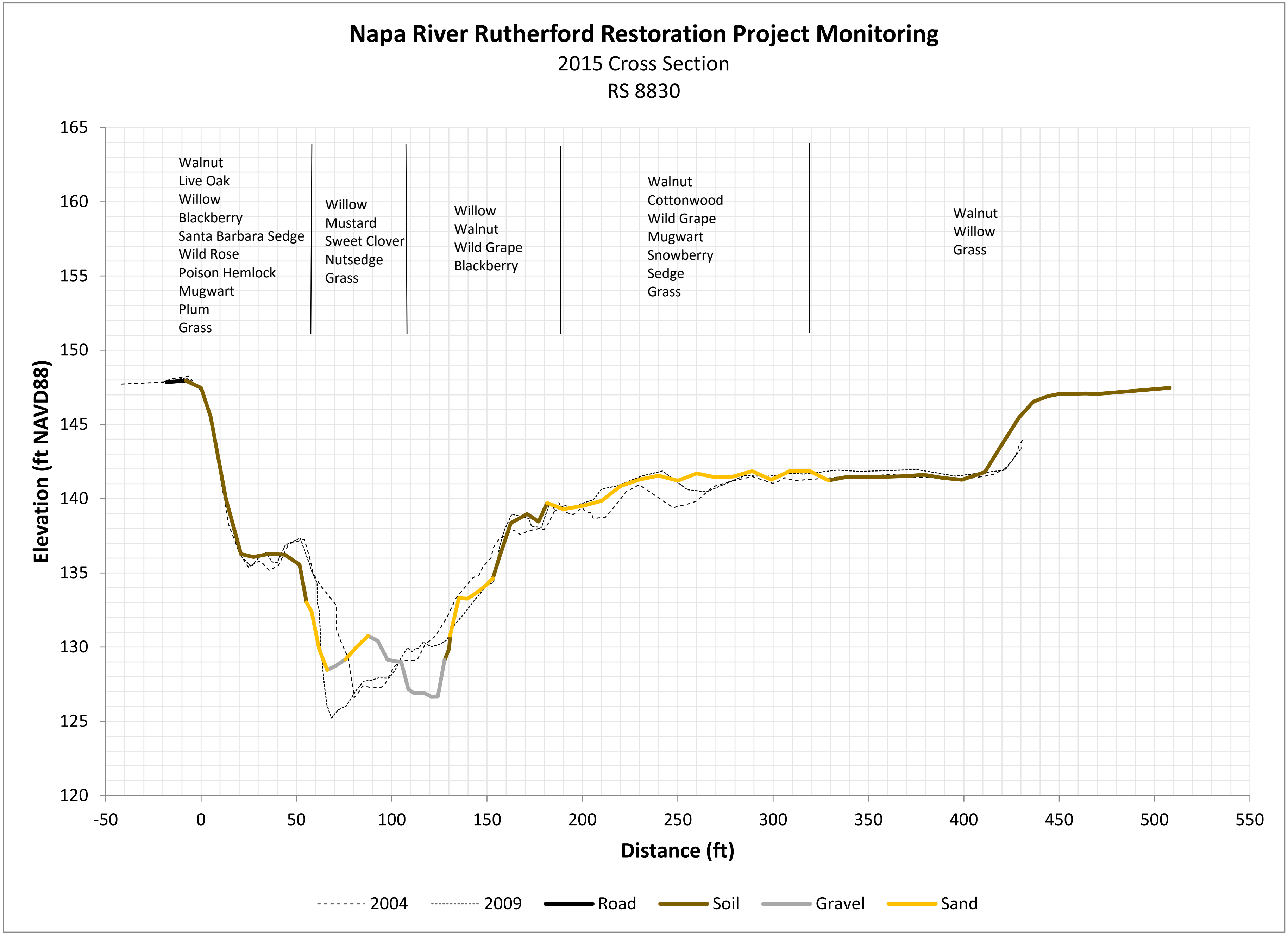


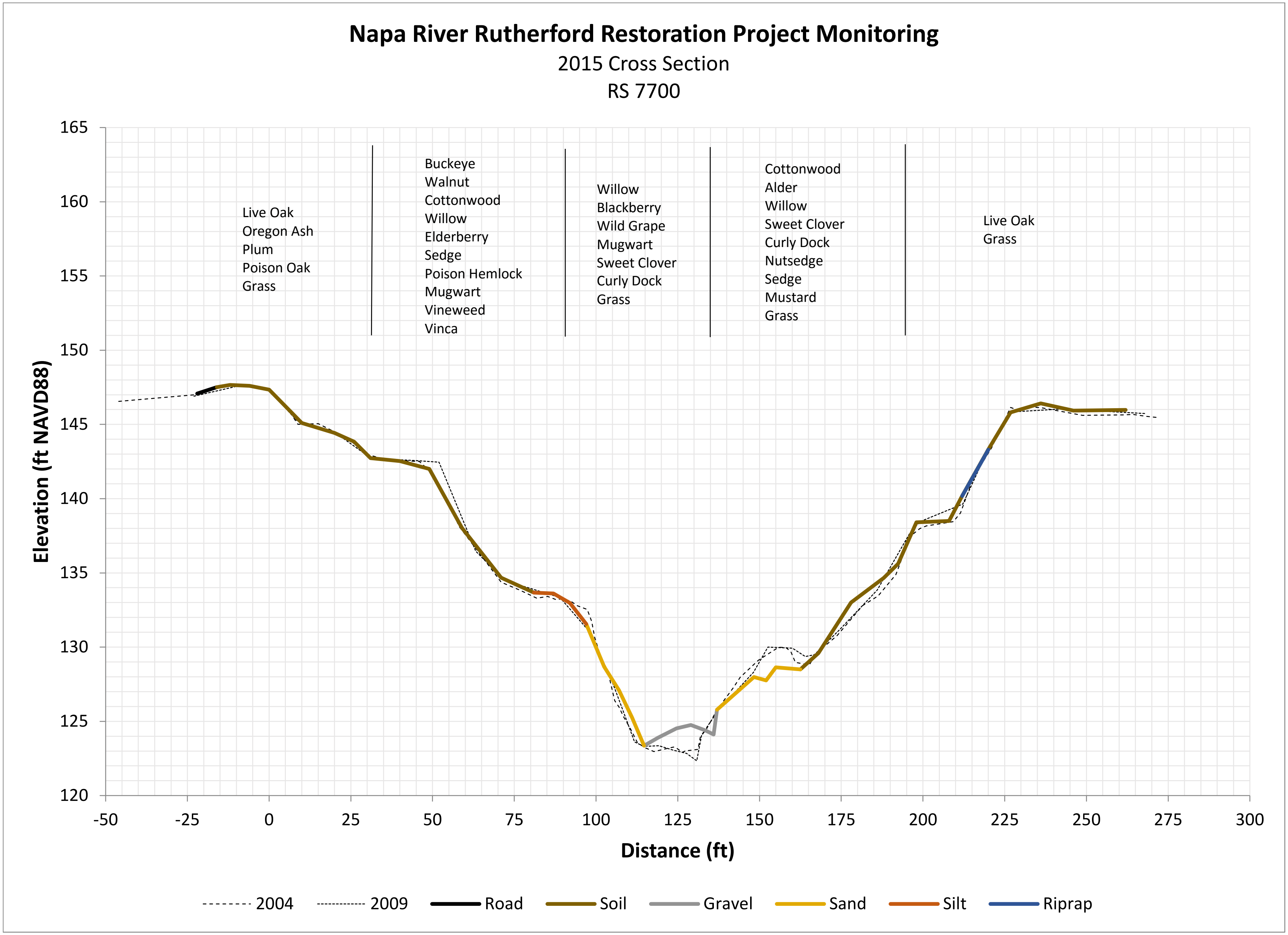
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 13050
REVEGETATED:
Valley Oak
Deer Grass
Wild Rose
Grass
Willow
Sweet Clover
Poison Hemlock
Cocklebur
Mugwart
Mustard
Cottonwood
Willow
Live Oak
Oregon Ash
Sweet Clover
Sedge
Mugwart
Grass
Oregon Ash
Live Oak
Walnut
Valley Oak
Poison Oak
Vinca
Grass
Area excavated in 2011 to create instream bench
Elevation (ft NAVD88)
175
170
165
160
155
150
145
140
135
130
-75
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
Distance (ft)
2010
Road
Soil
Gravel
Sand
Silt
Riprap



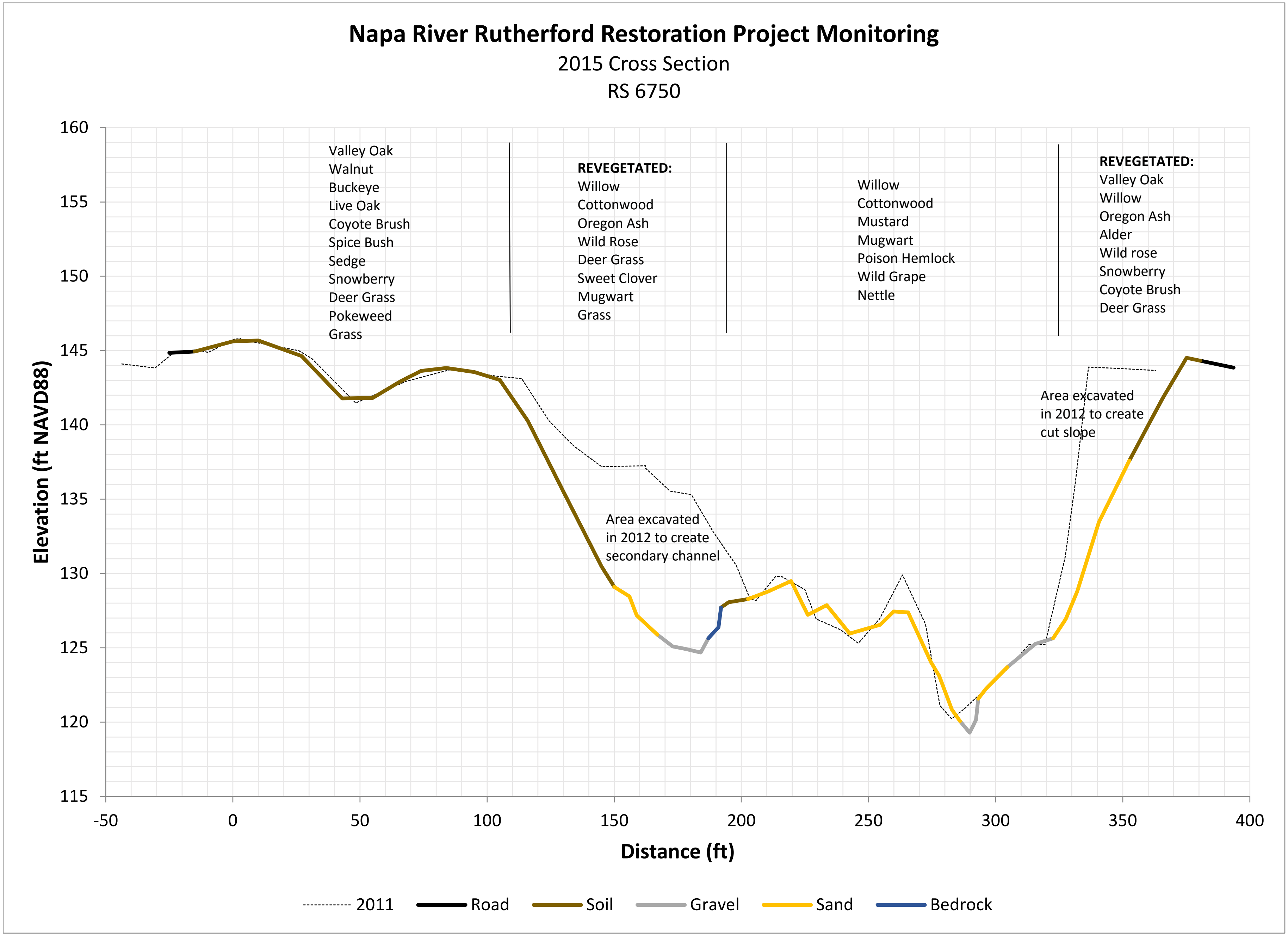
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 10290
Valley Oak
Live Oak
Buckeye
Grass
Leaf Litter
Walnut
Buckeye
Santa Barbara Sedge
Snowberry
Grass
Willow
Wild Grape
No Vegetation
Nutsedge
Elderberry
Mugwart
Cocklebur
Blackberry
Hemlock
Valley Oak
Live Oak
Walnut
Cat Tail
Blackberry
Snowberry
Poison Oak
2014 Secondary Channel
Mainstem Channel
Bale Slough
Elevation (ft NAVD88)
165
160
155
150
145
140
135
130
125
-100
-75
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
Distance (ft)
Soil
Gravel
Sand
Silt


Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 9175
Valley Oak
Buckeye
Live Oak
Walnut
Oregon Ash
Pipevine
Santa Barbara Sedge
Snowberry
Coyote Brush
Vinca
Leaf Litter
Cottonwood
Walnut
Willow
Santa Barbara Sedge
Coyote Crush
Snowberry
Poison Hemlock
Mugwart
Walnut
Willow
Cottonwood
Grass
REVEGETATED:
Willow
Cottonwood
Walnut
Nutsedge
Sweet Clover
Grass
Walnut
Willow
Black Locust
Mugwart
Grass
Willow
Sandbar Willow
Cottonwood
Cat tail
REVEGETATED:
Bay Laurel
Cottonwood
Willow
Sedge
Aster
Deer Grass
Grass
2014 Secondary Channel
2014 Cut Bank
Elevation (ft NAVD88)
160
155
150
145
140
135
130
125
-50
0
50
100
150
200
250
300
350
400
450
500
Distance (ft)
Road
Soil
Gravel
Silt
Sand
Cobble
Wrack

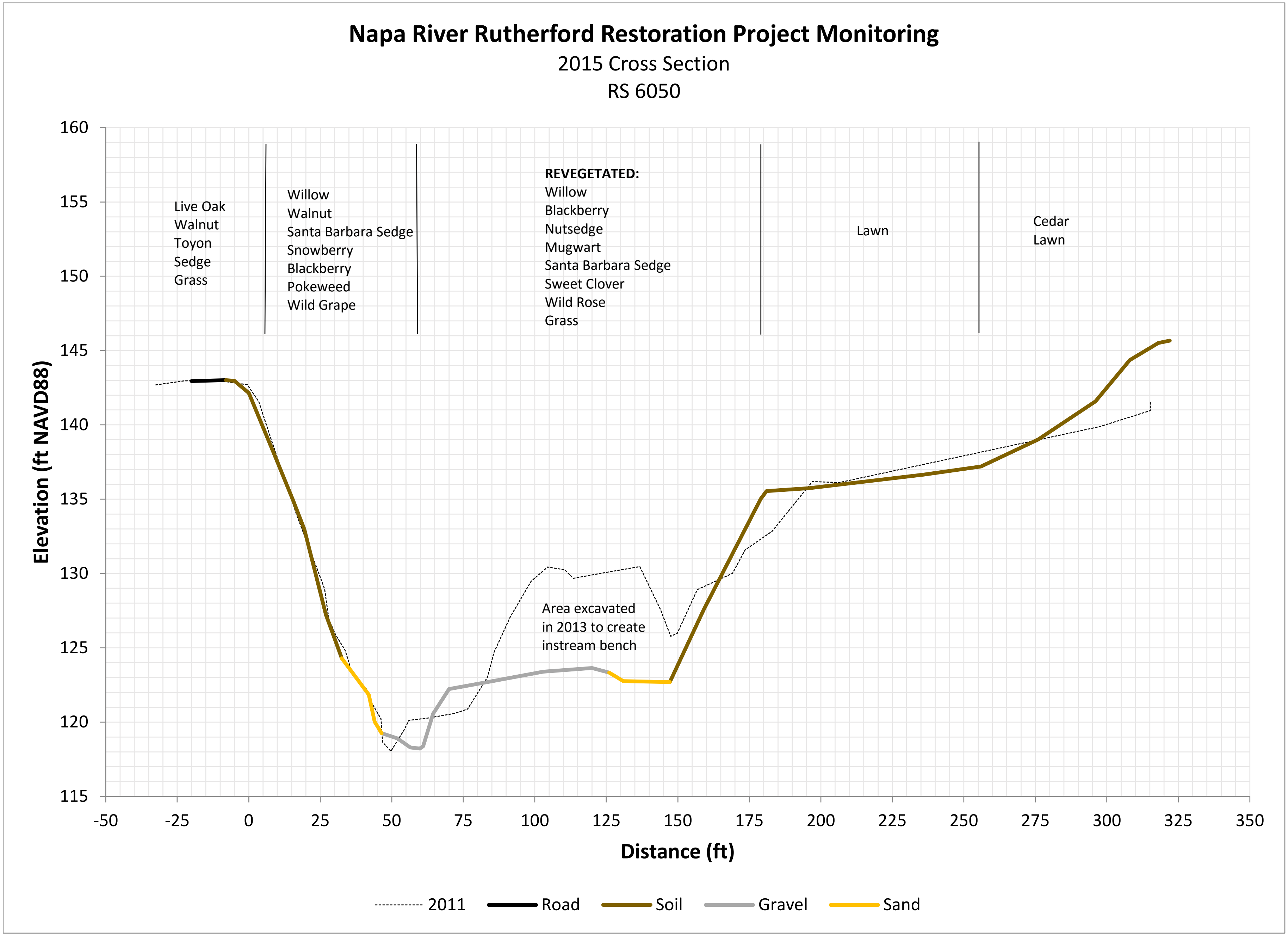

Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 8830
Walnut
Live Oak
Willow
Blackberry
Santa Barbara Sedge
Wild Rose
Poison Hemlock
Mugwart
Plum
Grass
Willow
Mustard
Sweet Clover
Nutsedge
Grass
Willow
Walnut
Wild Grape
Blackberry
Walnut
Cottonwood
Wild Grape
Mugwart
Snowberry
Sedge
Grass
Walnut
Willow
Grass
Elevation (ft NAVD88)
Distance (ft)
2004
2009
Road
Soil
Gravel
Sand

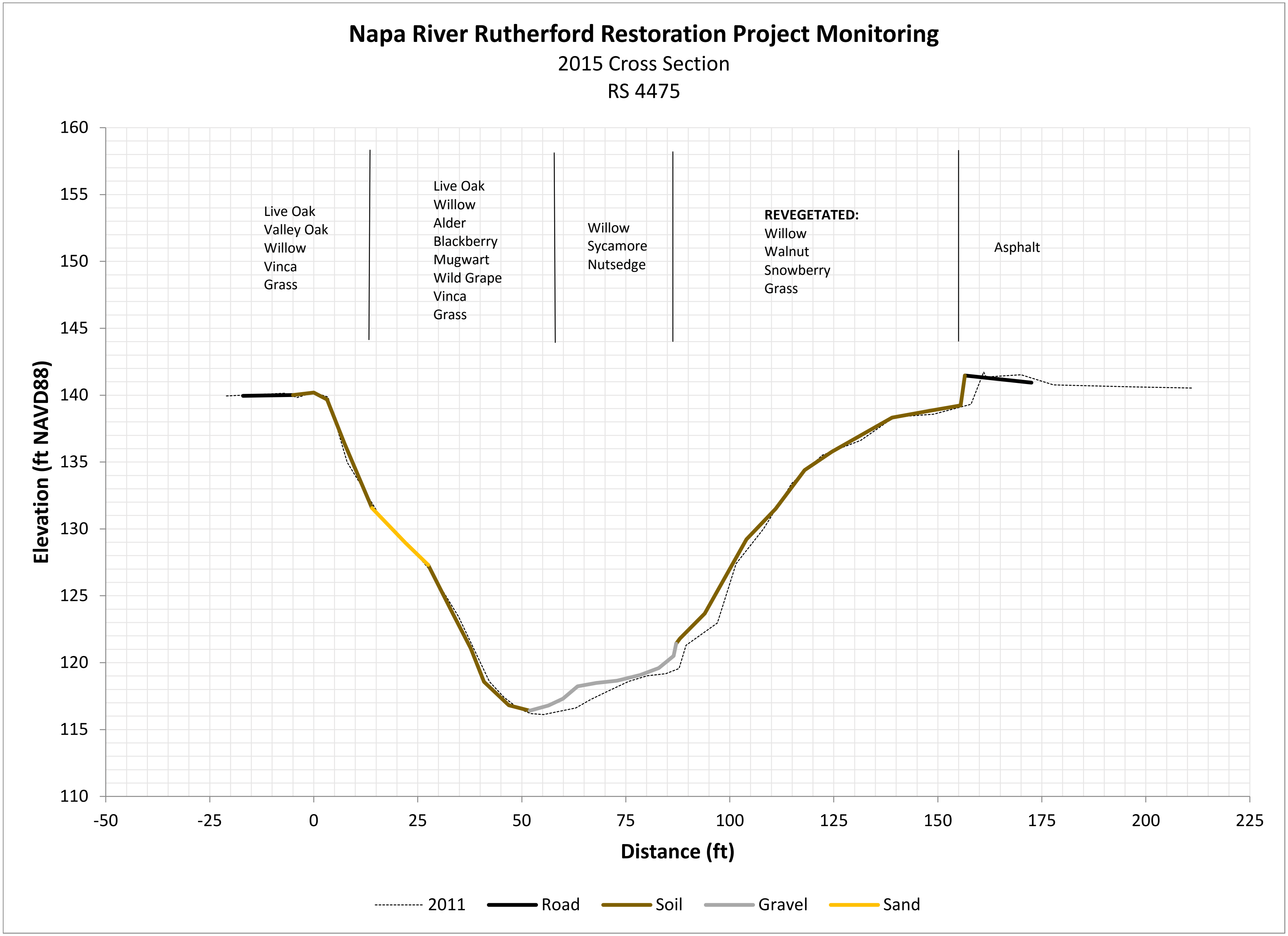


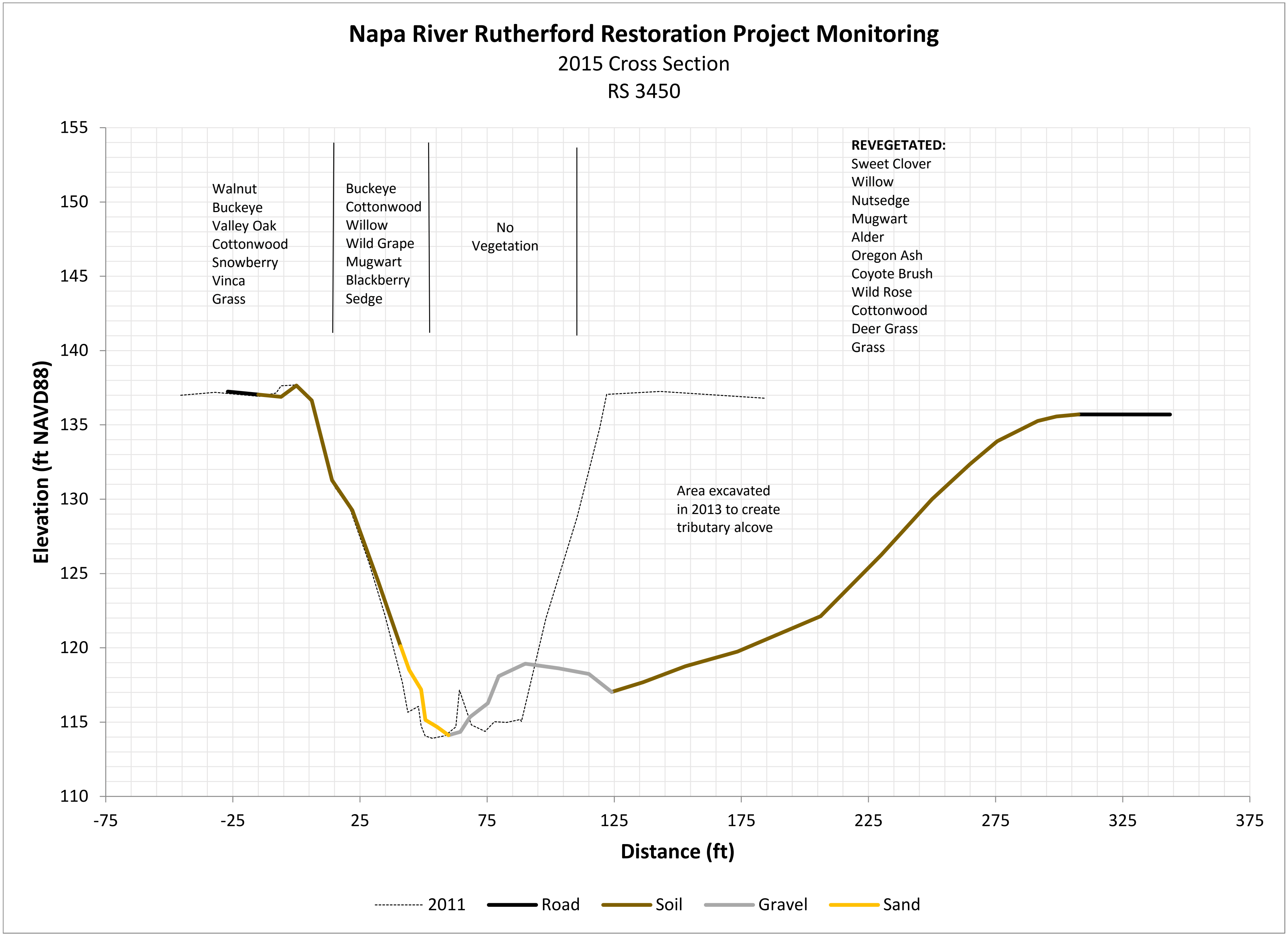
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 7700
Live Oak
Oregon Ash
Plum
Poison Oak
Grass
Buckeye
Walnut
Cottonwood
Willow
Elderberry
Sedge
Poison Hemlock
Mugwart
Vineweed
Vinca
Willow
Blackberry
Wild Grape
Mugwart
Sweet Clover
Curly Dock
Grass
Cottonwood
Alder
Willow
Sweet Clover
Curly Dock
Nutsedge
Sedge
Mustard
Grass
Live Oak
Grass
Elevation (ft NAVD88)
165
160
155
150
145
140
135
130
125
120
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
Distance (ft)
2004
2009
Road
Soil
Gravel
Sand
Silt
Riprap



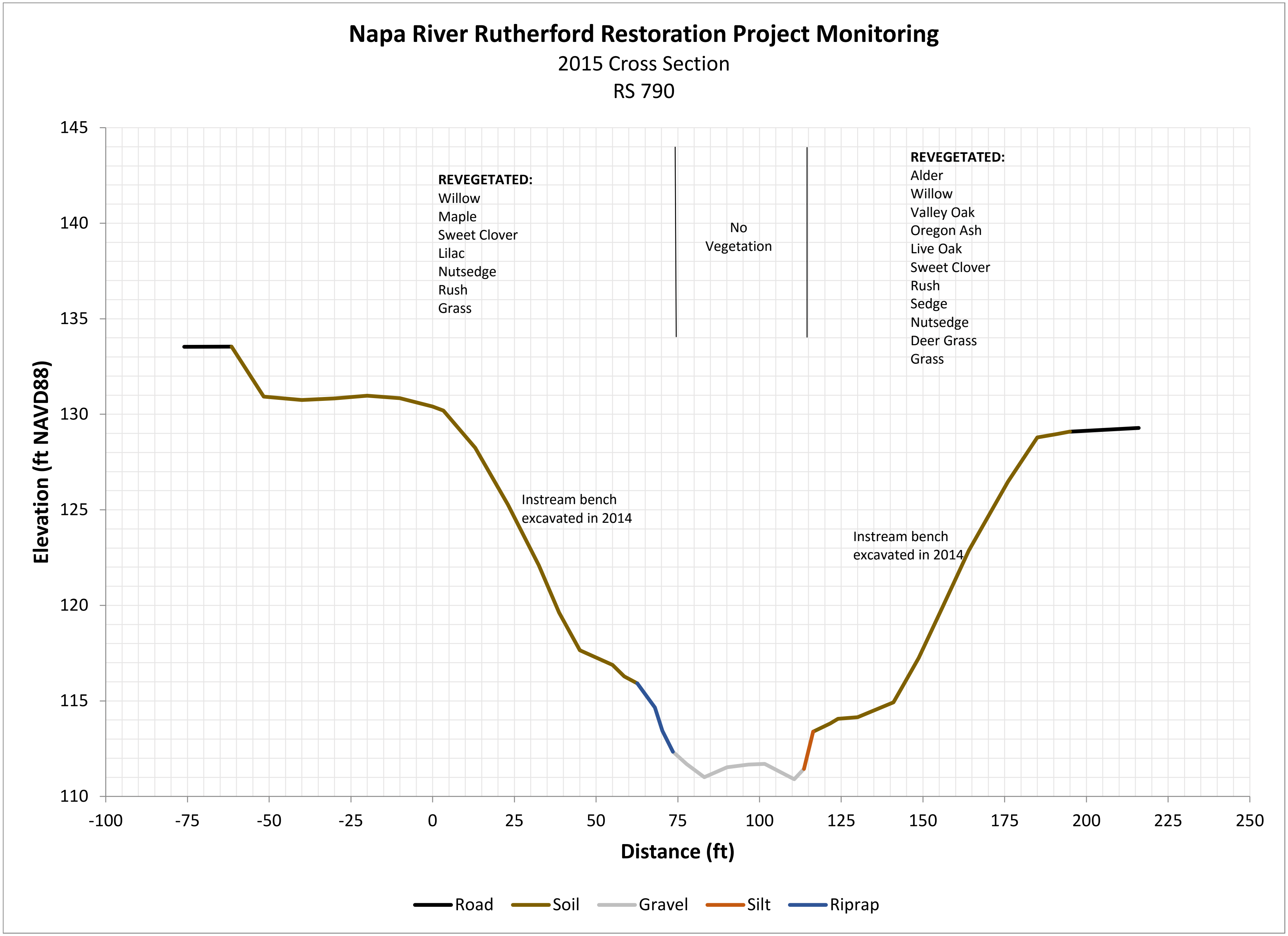
Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 6750
Valley Oak
Walnut
Buckeye
Live Oak
Coyote Brush
Spice Bush
Sedge
Snowberry
Deer Grass
Pokeweed
Grass
REVEGETATED:
Willow
Cottonwood
Oregon Ash
Wild Rose
Deer Grass
Sweet Clover
Mugwart
Grass
Willow
Cottonwood
Mustard
Mugwart
Poison Hemlock
Wild Grape
Nettle
REVEGETATED:
Valley Oak
Willow
Oregon Ash
Alder
Wild rose
Snowberry
Coyote Brush
Deer Grass
Area excavated in 2012 to create cut slope
Area excavated in 2012 to create secondary channel
Elevation (ft NAVD88)
160
155
150
145
140
135
130
125
120
115
-50
0
50
100
150
200
250
300
350
400
Distance (ft)
2011
Road
Soil
Gravel
Sand
Bedrock


Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 6050
Live Oak
Walnut
Toyon
Sedge
Grass
Willow
Walnut
Santa Barbara Sedge
Snowberry
Blackberry
Pokeweed
Wild Grape
REVEGETATED:
Willow
Blackberry
Nutsedge
Mugwart
Santa Barbara Sedge
Sweet Clover
Wild Rose
Grass
Lawn
Cedar
Lawn
Area excavated
in 2013 to create
instream bench
Elevation (ft NAVD88)
Distance (ft)
160
155
150
145
140
135
130
125
120
115
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
2011
Road
Soil
Gravel
Sand


Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 4475
Live Oak
Valley Oak
Willow
Vinca
Grass
Live Oak
Willow
Alder
Blackberry
Mugwart
Wild Grape
Vinca
Grass
Willow
Sycamore
Nutsedge
REVEGETATED:
Willow
Walnut
Snowberry
Grass
Asphalt
Elevation (ft NAVD88)
160
155
150
145
140
135
130
125
120
115
110
-50
-25
0
25
50
75
100
125
150
175
200
225
Distance (ft)
2011
Road
Soil
Gravel
Sand



Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 3450
Walnut
Buckeye
Valley Oak
Cottonwood
Snowberry
Vinca
Grass
Buckeye
Cottonwood
Willow
Wild Grape
Mugwart
Blackberry
Sedge
No Vegetation
REVEGETATED:
Sweet Clover
Willow
Nutsedge
Mugwart
Alder
Oregon Ash
Coyote Brush
Wild Rose
Cottonwood
Deer Grass
Grass
Area excavated in 2013 to create tributary alcove
Elevation (ft NAVD88)
Distance (ft)
155
150
145
140
135
130
125
120
115
110
-75
-25
25
75
125
175
225
275
325
375
2011
Road
Soil
Gravel
Sand


Napa River Rutherford Restoration Project Monitoring
2015 Cross Section
RS 790
REVEGETATED:
Willow
Maple
Sweet Clover
Lilac
Nutsedge
Rush
Grass
No
Vegetation
REVEGETATED:
Alder
Willow
Valley Oak
Oregon Ash
Live Oak
Sweet Clover
Rush
Sedge
Nutsedge
Deer Grass
Grass
Instream bench
excavated in 2014
Instream bench
excavated in 2014
Elevation (ft NAVD88)
145
140
135
130
125
120
115
110
-100
-75
-50
-25
0
25
50
75
100
125
150
175
200
225
250
Distance (ft)
Road
Soil
Gravel
Silt
Riprap

Appendix D
High/Low Flow Instream Habitat Structure Surveys

2014-15 In-Stream Fish-Habitat Structure Monitoring
Napa River Rutherford Reach Restoration Project
Reaches 6, 7, 9

Technical Memorandum

JULY 15, 2015

Prepared For:
Jeremy Sarrow
Napa County Flood Control and Water Conservation District

Prepared by:
Jonathan Koehler, Senior Biologist
Paul Blank, Senior Hydrologist
Napa County Resource Conservation District
1303 Jefferson Street, Suite 500B
Napa, California 94559
www.naparcd.org

Introduction

At the request of the Napa County Flood Control and Water Conservation District and in accordance with the *Monitoring Plan for the Rutherford Reach Restoration of the Napa River* (Monitoring Plan), Napa County Resource Conservation District (RCD) completed assessments of recently-installed in-stream restoration features in Reaches 6, 7, and 9 of the Napa River Rutherford Reach Restoration Project (Rutherford Project). Two assessments were completed: one during a winter high flow event large enough to inundate newly-graded areas, and one during low spring flow conditions to evaluate new wood and rock habitat structures. In addition, RCD conducted a snorkel survey to assess fish presence in the vicinity of recently installed structures. This technical memo describes the results of these three surveys.

High Flow Assessment

On December 11, 2015, Jonathan Koehler (RCD biologist) and Paul Blank (RCD hydrologist) visited recently-completed graded habitat features in Reaches 6, 7, and 9. According to provisional data obtained from USGS Gauging Station 11456000, located approximately 2 miles upstream of the top of the Rutherford Reach, streamflow peaked during our visit at 7,670 cubic feet per second (cfs). This event was the largest of the 2014-15 season, and falls between the 2- and 5-year peak discharges for the station.

A second visit was made on December 12, 2015 to assess the secondary channel on the Round Pond property, which was not safely accessible during peak flows.

High-flow assessment included sketching surface flow patterns, collection of photographs, flagging water surface elevations (WSELs), water velocity measurements, and evaluation of habitat function by the RCD fisheries biologist. Average water velocity was measured at select locations within the newly-installed features using a USGS Price AA current meter with a wading rod and the six-tenths depth method. RCD flagged the December 11, 2014 WSELs for surveying at a later time.

RCD returned to the reach on January 23, 2015 with a theodolite and stadia rod and surveyed the previously-flagged WSELs. Water levels were surveyed relative to existing monuments which had previously been surveyed relative to NAVD88.

Low-Flow Assessment

On April 14, 2015, Jonathan Koehler and Paul Blank visited newly-installed wood and rock habitat structures in Reaches 6, 7, and 9. According to provisional data obtained from USGS Gauging Station 11456000, streamflow was steady during our assessment at 9.8 cfs. Low-flow assessment included sketching surface flow patterns, collection of photographs, water velocity measurements, and evaluation of habitat function by the RCD fisheries biologist. Average water velocity was measured at select locations near the newly-installed features using a USGS Price Pygmy current meter with a wading rod and the six-tenths depth method.

Snorkel Survey

On May 20, 2015, Jonathan Koehler conducted a snorkel survey of Reach 9. The survey was intended to document the relative abundances of aquatic species, with an emphasis on juvenile salmonids. According to provisional data obtained from USGS Gauging Station 11456000, streamflow was steady during the survey at 3.6 cfs.

Beginning at the downstream end of each reach, the RCD fisheries biologist entered the water wearing a dry-suit, diving mask, and snorkel and swam upstream in the vicinity of each installed habitat feature. The survey progressed slowly, so as not to scare away fish before observing their locations and behaviors. Relative abundance of each observed species was visually estimated using the following scale: "*high abundance*" was used to denote that more than five organisms were observed per square meter of habitat, "*moderate abundance*" was used to denote that approximately 2-5 organisms were observed per square meter of habitat, and "*low abundance*" was used to denote areas with approximately 2 or less organisms per square meter of habitat. Photos and short video clips were taken with an underwater camera during the survey.

Results

Results of the snorkel survey are presented in Table 1. During the snorkel survey, water temperature was measured at 19° C (66° F) and underwater visibility was estimated to be approximately 4 feet.

Common Name	**Scientific Name**	**Origin**	**Relative Abundance**
Steelhead	(*Oncorhynchus mykiss*)	Native	Low
California roach	(*Lavinia symmetricus*)	Native	High
Sacramento sucker	(*Catostomus occidentalis*)	Native	Moderate
Three-spine stickleback	(*Gasterosteus aculeatus*)	Native	Moderate
Sacramento pikeminnow	(*Ptychocheilus grandis*)	Native	Low
Tule perch	(*Hysterocarpus traski*)	Native	Low
Western pond turtle	(*Actinemys marmorata*)	Native	Low
Signal crayfish	(*Pacifastacus leniusculus*)	Non-native	Low
Bullfrog (tadpoles)	(*Rana catesbeiana*)	Non-native	Moderate

Table 1. Aquatic species observed during a snorkel survey on May 20, 2015.

Juvenile steelhead ranging in length from approximately 80-150 mm (approx. 3-6 inches) were observed most commonly in swift moving water associated with riffle and run habitat types. No juvenile Chinook salmon were observed. No salmonids were observed in the immediate vicinity of any of the installed structures.

The results of the high-flow assessment are presented in Table 2. The results of the low-flow assessment are presented in Table 3. Site sketches and photographs from the high- and low-flow assessments are included in Attachments 1 and 2, respectively. Water velocity measurements, GPS locations, photo locations, habitat types, and other noteworthy features are included in the site sketches.

Graded Habitat Feature	Bank (facing ds)	River Station (ft)	Date, Time	Measured Water Velocities[1] (ft/sec)	Water Surface Elevation (ft NAVD88)	Flow at USGS Gage 11456000 (cfs)[2]	Fisheries Biologist Evaluation
Bench 1	Left	1,930 - 2,280	12/11/2014, 11:10	0.58 -1.31	130.47	7,670	This bench is functioning very well to provide off-channel refuge habitat for juvenile salmonids during high-flow events. Extensive slow and slack water areas were observed during a large winter storm event. This feature contained a favorable mix of slow resting habitat and swift feeding habitat.
Bench 2	Left	725 - 900	12/11/2014, 10:50	0.519 - 0.845	127.22	7,610	This bench is providing off-channel refuge habitat for juvenile salmonids during high-flow events. Several areas of slow and slack-water habitats were observed during a winter storm event.
Bench 3	Right	725 - 920	12/11/2015, 10:28	0.569 - 1.04	126.05	7,530	This bench is providing off-channel refuge habitat for juvenile salmonids during high-flow events. The entire feature was nearly slack during a winter storm event.
Secondary Channel	Left	9,050 - 10,400	12/12/2014, 14:50	1.67 - 3.09	not surveyed	850	This secondary channel was completely inundated and inaccessible during our initial field visit on December 11, 2015. During lower flows on the following day, it appeared to provide reduced-velocity off-channel habitat for juvenile salmonids and potentially resting habitat for adult salmonids. Water clarity during both visits prevented any observation of the bed in this feature, but subsequent visits later in the spring showed that localized scour occurred at several locations throughout the length of this channel, creating favorable topographic complexity. Portions of the secondary channel were dry with stagnant isolated pools during our low-flow assessment on April 14, 2015. The entire secondary channel was dry during subsequent visits in May; thus this feature appears to have limited value for salmonid rearing past late winter/ early spring.
Bank Stabilization 1	Right	9,200 - 9,380	not assessed	not measured	not surveyed	n/a	Bank stabilization feature not designed to provide off-channel habitat. Too steep and swift to safely collect high-flow velocity measurements.
Bank Stabilization 2	Left	2,880 - 3,200	not assessed	not measured	not surveyed	n/a	Bank stabilization feature not designed to provide off-channel habitat. Too steep and swift to safely collect high-flow velocity measurements.
Bank Stabilization 3	Left	2,430 - 2,630	not assessed	not measured	not surveyed	n/a	Bank stabilization feature not designed to provide off-channel habitat. Too steep and swift to safely collect high-flow velocity measurements.

[1]These are spot measurements and do not represent the full range of velocities present within each feature.
[2]Discharge data remain flagged as provisional by USGS at the time of this writing.

TABLE 2. High-flow assessment results, December 11, 2014, Napa River Rutherford Restoration Project, Reaches 6, 7, 9

Associated Graded Feature	Structure Label	Habitat Structure	*Biological and Geomorphic Functions*								Notes
			Summer Refugia	Winter Refugia	Hydraulic Constriction	Pool Scour	Bank Stability	Sediment Sorting	Geomorphic Diversity	Scoured gravel deposits on ds riffle	
Bench 3	**BC-730-M**	Boulder cluster	D		D			D	D		Remove from list - this structure is part of BC-765-M
	BC-765-M	Boulder cluster	D		D			D	D		One contiguous boulder cluster - not three distinct structures
	BC-800-M	Boulder cluster	D		D			D	D		Remove from list - this structure is part of BC-765-M
	WD-850-R	Live Wood Structure		D				D			Not found
	WD-870-R	Live Wood Structure	D			D		D	D	D	Live tree on bench. Structure out of water
Bench 2	**WD-825-L**	Root Wad									Structure not listed in table of constructed features, but found in field
Bench 1	**WD-2020-L**	Large Wood Structure	D			D		D	D	D	
	WD-2220-L	Large Wood Structure	D			D		D	D	D	
Bank Stabilization 2	**WD-2925-L**	Root Wad		D		D					Creating pool scour, but on bench, not low flow channel
	BC-2930-M	Boulder cluster	D		D			D	D		
	WD-2955-L	Root Wad		D		D					Creating pool scour, but on bench, not low flow channel
	BC-3150-M	Boulder cluster	D		D			D	D		Adjust river station from 2960 to 3150
	WD-3000-L	Root Wad		D		D					Creating pool scour, but on bench, not low flow channel
Stabilization 1	**WD-9320-R**	Large Wood Structure	D			D					
	BC-9325-M	Boulder Cluster	D		D			D	D		
Crossing	**BC-10380-L**	Boulder cluster									Structure not listed in table of constructed features, but found in field
	WD-10410-L	Root Wad		D			D				Remove from list - only WD-10435-L found
	WD-10435-L	Root Wad		D			D				One large root wad structure - not three separate features
	WD-10450-L	Root Wad		D			D				Remove from list - only WD-10435-L found

Key: **D** = Structure designed to perform this function

= Structure was performing function

= Structure was not performing function

= Structure not found or should be combined with other structures

TABLE 3. Low-flow assessment results, April 14, 2015, Napa River Rutherford Restoration Project, Reaches 6, 7, 9. Design functions for each structure were provided by ESA-PWA.

Discussion and Conclusions

A primary goal of the Rutherford Project is to improve salmonid habitat quality and quantity under a broad range of flow conditions. To achieve this goal, the Monitoring Plan provides a series of water velocity and depth targets that address the needs of specific lifestages (i.e. fry, juvenile, adult) with the expectation that achieving such conditions will result in higher salmonid production over time.

The Monitoring Plan states that the Rutherford Project aims to improve fall and winter habitat conditions by, *"increasing and establishing high flow (>500 cfs) low-velocity (<6 feet per second {fps}) bankfull refugia areas to increase fall and winter rearing habitat for 0-1+ steelhead and immigrating/emigrating salmonids."* Based on our high-flow assessments, all of the newly constructed benches provided extensive areas of slow- and slack-water habitat and are therefore meeting this project goal. The conditions we observed during our field visit in December 2014 represented a large winter storm flow; one that is likely to occur once every 2 to 5 years on average. Under such conditions, all of the benches we assessed had slower water velocities than the adjacent main channel. Measured water velocities along the margins of the benches ranged from 0 – 1.31 fps, which is well below the 6 fps target prescribed by the Monitoring Plan. Based on the water velocity and depth data, it is likely that both juvenile and adult salmonids (as well as other native fishes) would find conditions in these constructed benches favorable for resting and hiding during high-flow events.

During non-storm-flow conditions, the Monitoring Plan states that the Rutherford Project aims to improve habitat quality for juvenile salmonid rearing during the spring months by, *"increasing the quantity of high velocity feeding lanes, by creating relatively high velocity riffle habitat, and breaking up low velocity flat-water pool habitat."* This is to be achieved by, *"inducing local velocity accelerations and complexity and channel flow constrictions with installed habitat structures (LWD/Boulders)."* Based on our observations of the most recently installed structures, just 1 of the 4 structures installed to induce hydraulic constriction was performing this function and therefore achieving the goal of the project. We determined that 3 of the structures were not inducing hydraulic constriction; however, it is important to note that the structures that were not performing this function may provide different functions as the channel adjusts over time, and should therefore be re-assessed at some future date to get a more accurate assessment of their success. Additionally, 2 structures (WD-9320-R and BC-10380-L) that were not installed specifically to provide hydraulic constriction were found to be serving this function, thus providing an unexpected benefit to the project.

The Monitoring Plan states that the project aims to improve habitat quality for juvenile salmonids by "*enhancing pool habitat complexity, depth, and shelter/canopy cover."* Based on our observations of the most recently installed structures, 7 of the 8 structures that were intended to provide this function (summer refugia) were doing so. One structure (WD-870-R) was located on a bench out of the low-flow channel and therefore did not provide summer refugia. Additionally, 3 structures (WD-825-L, BC-10-380-L, and WD-10435-L) that were not specifically intended to provide summer refugia were found to be serving this function, again providing an unexpected benefit to the project.

Pools of sufficient depth and structure provide important rearing habitat for juvenile salmonids as well as resting and hiding areas for spawning adults. According to the Monitoring Plan, the project aims to enhance these functions by, *"increasing summer rearing habitat and cover by inducing lateral pool scour associated with installed habitat structures,"* and by, *"increasing fall and winter spawning habitat and cover by inducing lateral pool scour associated with installed habitat structures."* Based on observations of the most recently installed structures, 3 of the 7 structures installed specifically to induce pool scour were found to be clearly performing well; 4 of the structures were found without any significant amount of pool scour in their vicinity. Bed scour is particularly irregular in terms of timing and magnitude, and it is strongly dependent on seasonal flow patterns. Therefore, as stated for other project goals, these structures may provide different functions as the channel adjusts over time and should be re-assessed at some future date to get a more accurate assessment of their success. Interestingly, a total of 7 structures that were not specifically installed to create pool scour were found to be serving this function, again providing an unexpected benefit to the project.

We were unable to find just one structure (WD-850-R) during our low-flow fieldwork. This structure may have been buried or placed in a different location than originally planned. Additionally, 4 structures (BC-730-M, BC-800-M, WD-10410-L, and WD-10450-L) did not appear to be distinct from one another, and we recommend lumping them together with BC-765-M and WD-10435-L respectively. We also found 2 structures that were not listed in the table of installed structures: WD-825-L on Bench 2, and BC-10380-L just downstream of the Crossing. As shown in Table 3, both of these structures were performing multiple functions at the time of our assessment.

Most installed low-flow features appeared to enhancing fish habitat conditions, as evidenced by the widespread presence of native fish around these features during the spring of 2015. Although juvenile salmonids were not observed directly utilizing the newly-installed structures, it should be noted that the snorkel survey was conducted during a period of low summer base-flow conditions. In years when higher spring flows persist later into May and June, these structures would be likely provide more habitat value to young salmonids as they grow and emigrate to the ocean.

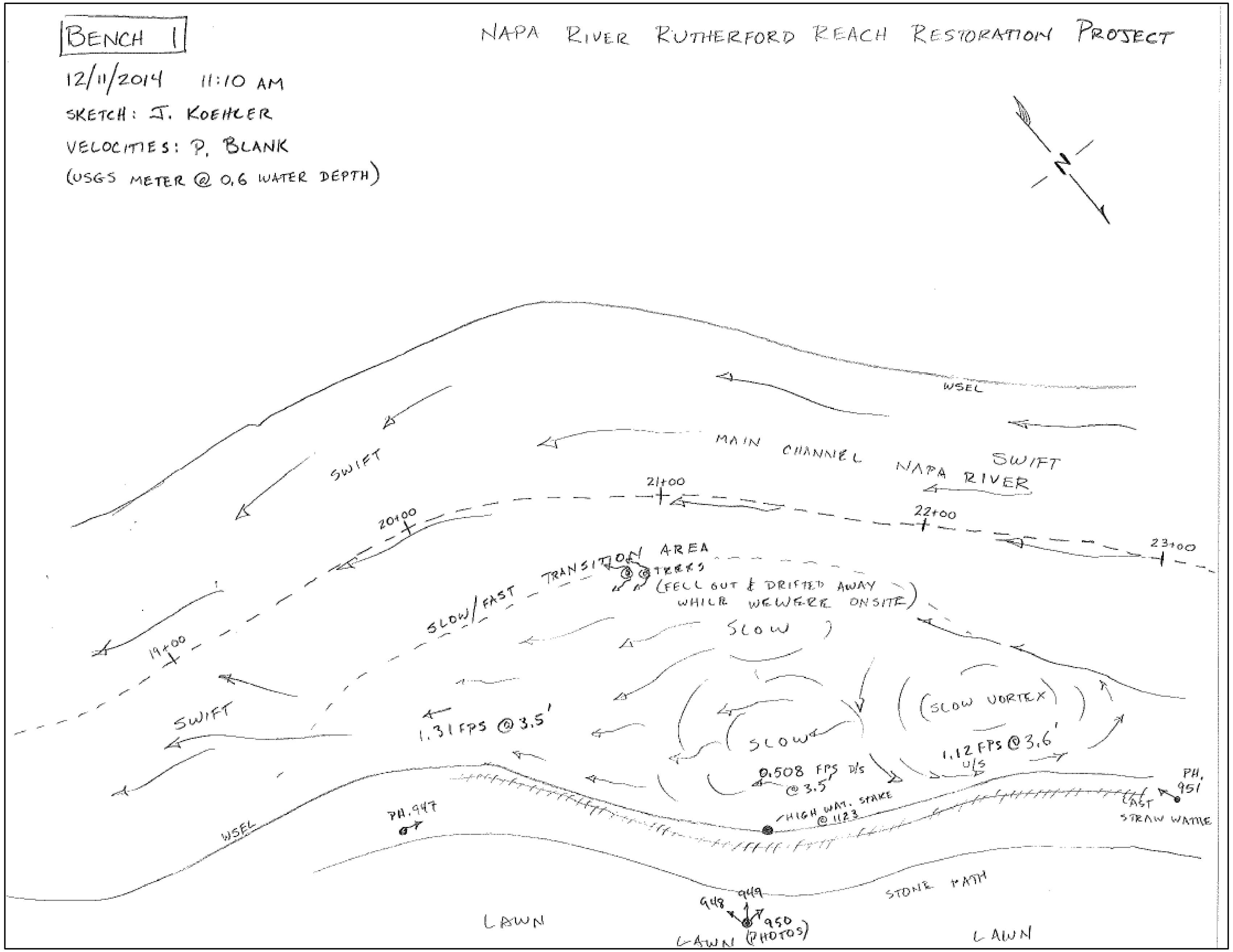
We did not observe any juvenile Chinook salmon rearing in the Rutherford reach during our snorkel survey or low-flow assessment. Also, we found only a single Chinook spawning redd in the Rutherford reach in fall 2014 and winter 2015 as part of our annual salmon monitoring program. Streamflow was extremely low in the Napa River watershed in late 2014, and the mainstem remained largely disconnected from the estuary until the December 11 storm. RCD observed Chinook salmon spawning near Calistoga in late December, so presumably salmon migrated freely through the lower parts of the river and appeared to spawn most heavily higher in the watershed. Based on the fact that RCD also captured no juvenile Chinook salmon in the Napa River rotary screw trap in 2015, it appears very few Chinook salmon spawned in the middle or lower mainstem of the Napa River during the 2014/15 spawning year.

ATTACHMENTS:

Attachment 1: Site Sketches and Photographs – High-Flow Assessment
Attachment 2: Site Sketches and Photographs – Low-Flow Assessment

ATTACHMENT 1: Site Sketches and Photographs – High-Flow Assessment

Bench 1 – United Wineries (12/11/2014)



ATTACHMENT 1: Site Sketches and Photographs – High-Flow Assessment

Bench 1 – United Wineries (12/11/2014)

Photo 947

Photo 951

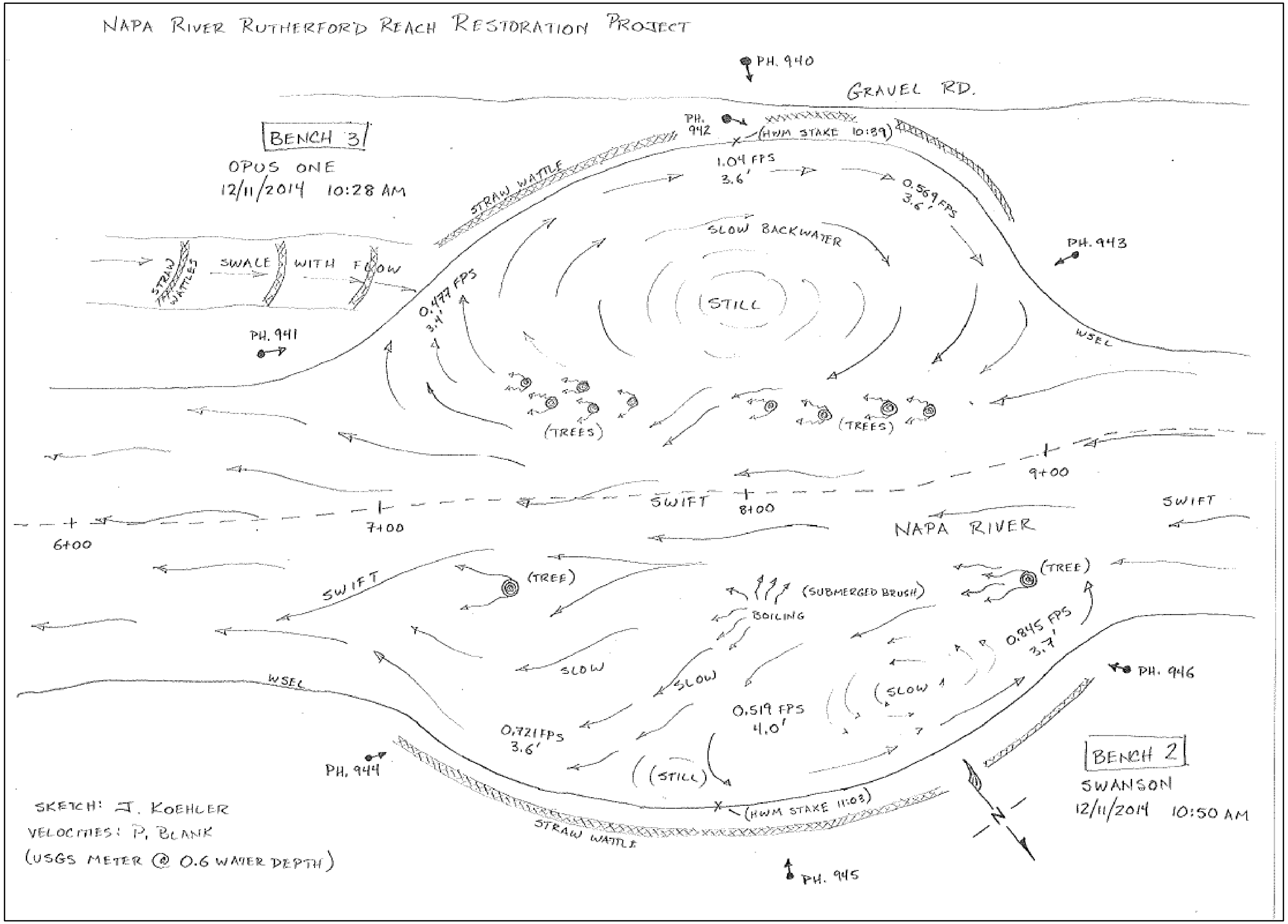
Photo 948

Photo 949

Photo 950

ATTACHMENT 1: Site Sketches and Photographs – High-Flow Assessment

Bench 2 – Swanson, and Bench 3 – Opus One (12/11/2014)



ATTACHMENT 1: Site Sketches and Photographs – High-Flow Assessment

Bench 2 – Swanson (12/11/2014)

Photo 944

Photo 945

Photo 946

Bench 3 – Opus One (12/11/2014)

Photo 941

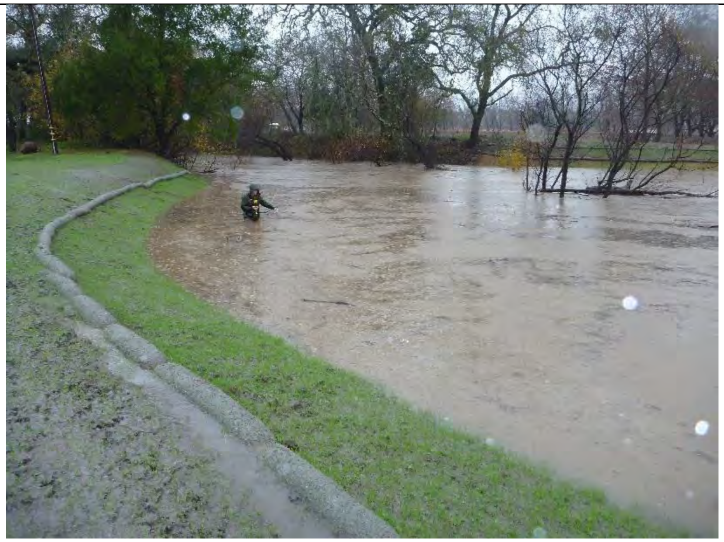
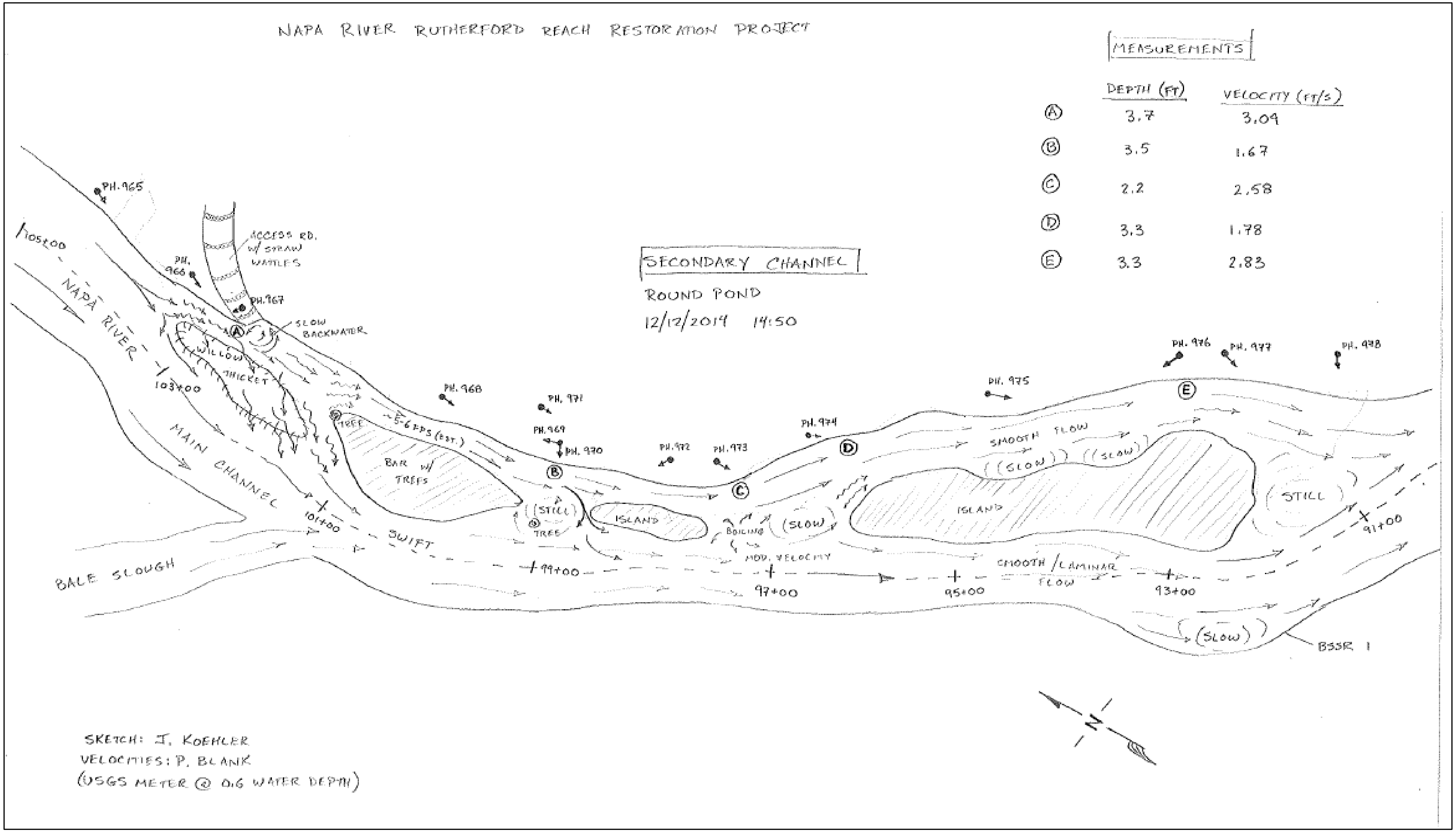


Photo 942

Photo 943

ATTACHMENT 1: Site Sketches and Photographs – High-Flow Assessment

Secondary Channel – Round Pond (12/12/2014)



Secondary Channel – Round Pond (12/12/2014)


Photo 965


Photo 966


Photo 967


Photo 968


Photo 969


Photo 970

Secondary Channel – Round Pond (12/12/2014) (cont.)


Photo 971


Photo 972


Photo 973


Photo 974


Photo 975


Photo 976

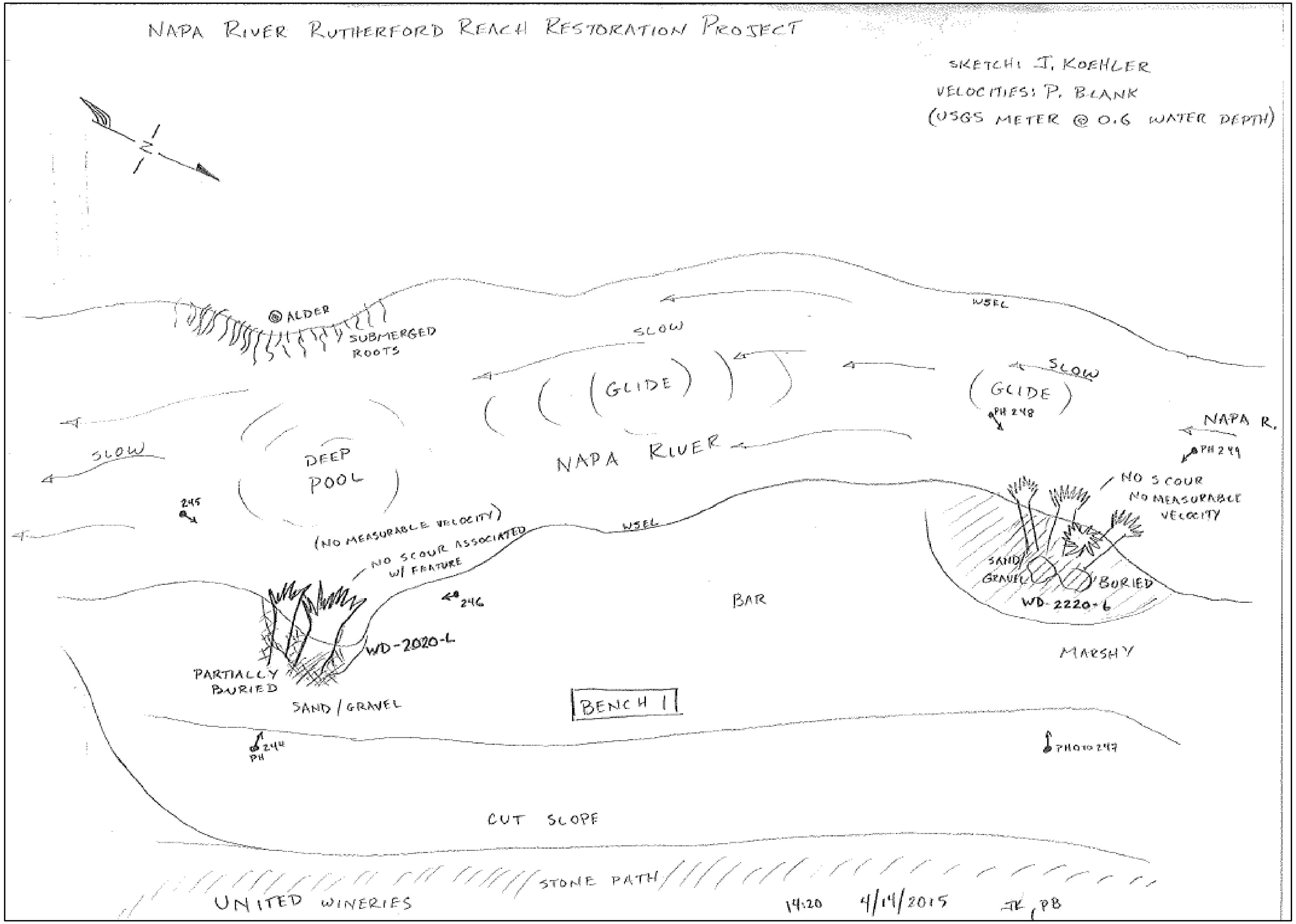
Secondary Channel – Round Pond (12/12/2014) (cont.)

Photo 977

Photo 978

ATTACHMENT 2: Site Sketches and Photographs – Low-Flow Assessment

Bench 1 – United Wineries (4/14/2015)



ATTACHMENT 2: Site Sketches and Photographs – Low-Flow Assessment

Bench 1 – United Wineries (4/14/2015)

Photo 244 (WD-2020-L)

Photo 245 (WD-2020-L)

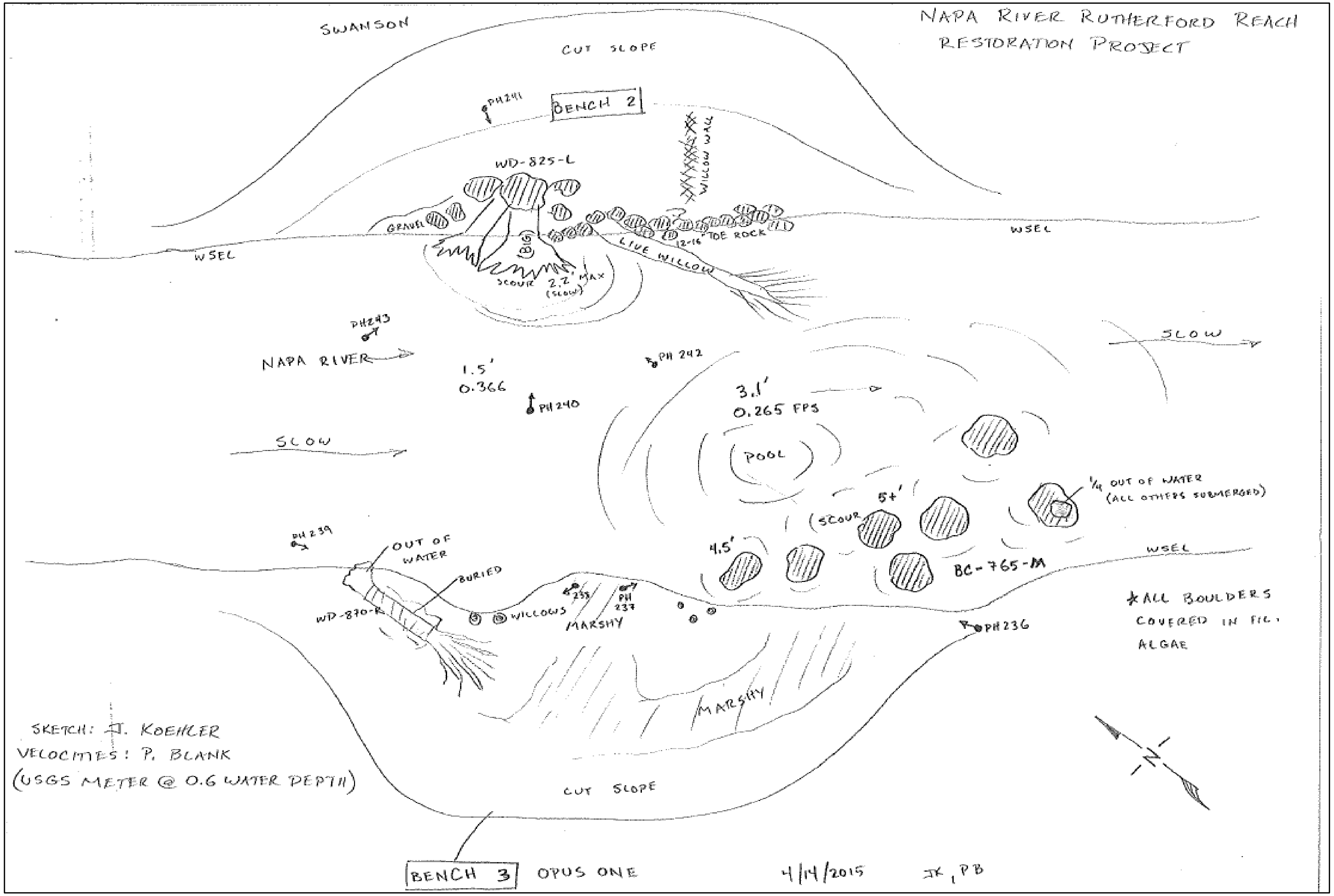
Photo 246 (WD-2020-L)

Photo 247 (WD-2220-L)

Photo 248 (WD-2220-L)

Photo 249 (WD

Bench 2 - Swanson, and Bench 3 - Opus One (4/14/2015)



Bench 2 - Swanson (4/14/2015)

Photo 240 (WD-825-L)

Photo 241 (WD-825-L)

Photo 242 (WD-825-L)

Photo 243 (WD-825-L)

Bench 3 – Opus One (4/14/2015)


Photo 236 (BC-765-M)

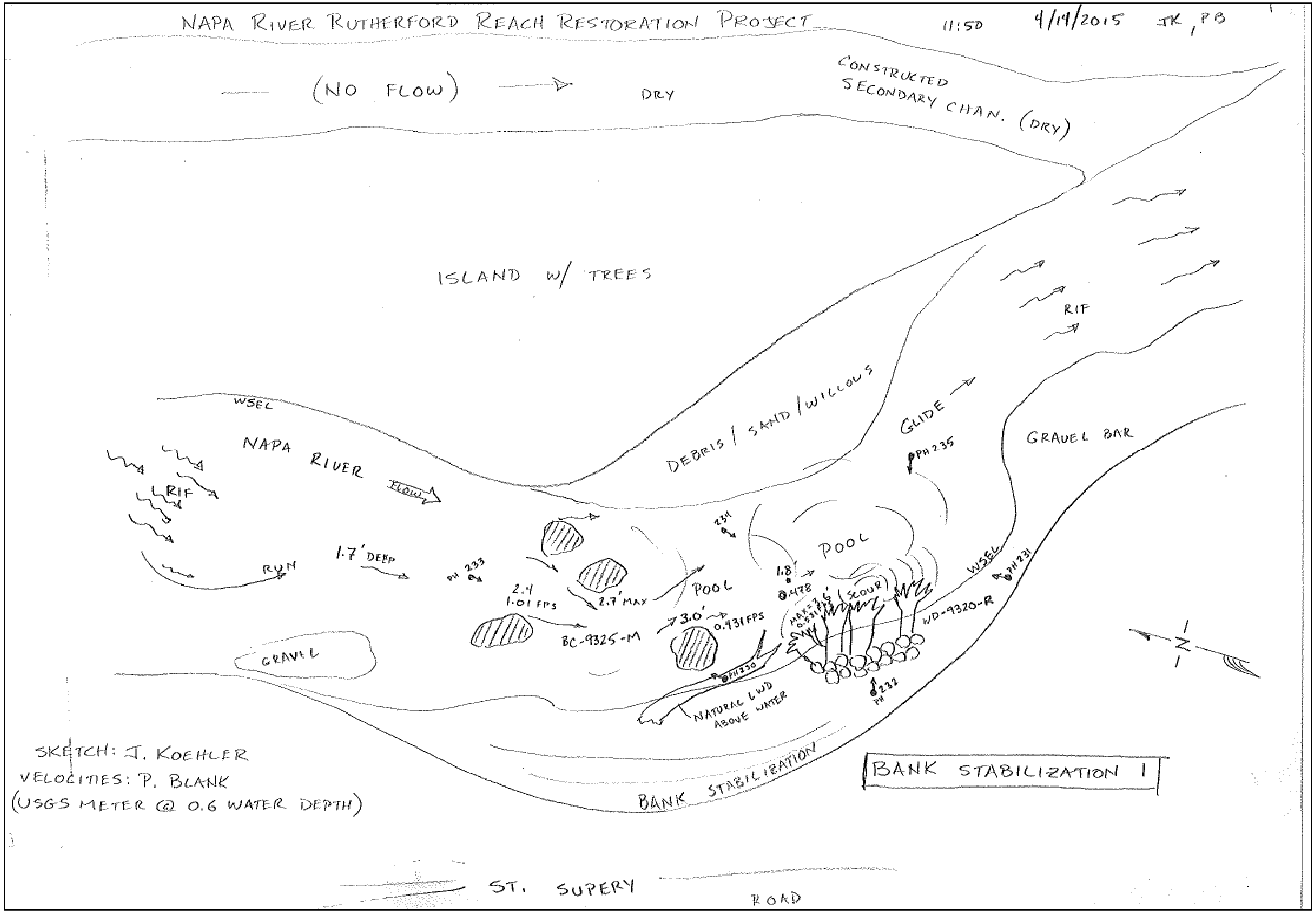

Photo 237 (BC-765-M)


Photo 238 (WD-870-R)


Photo 239 (WD-870-R)

ATTACHMENT 2: Site Sketches and Photographs – Low-Flow Assessment

Bank Stabilization 1 – St. Supery (4/14/2015)



Bank Stabilization 1 – St. Supery (4/14/2015)


Photo 230 (BC-9325-M)


Photo 233 (BC-9325-M)


Photo 231 (WD-9320-R)

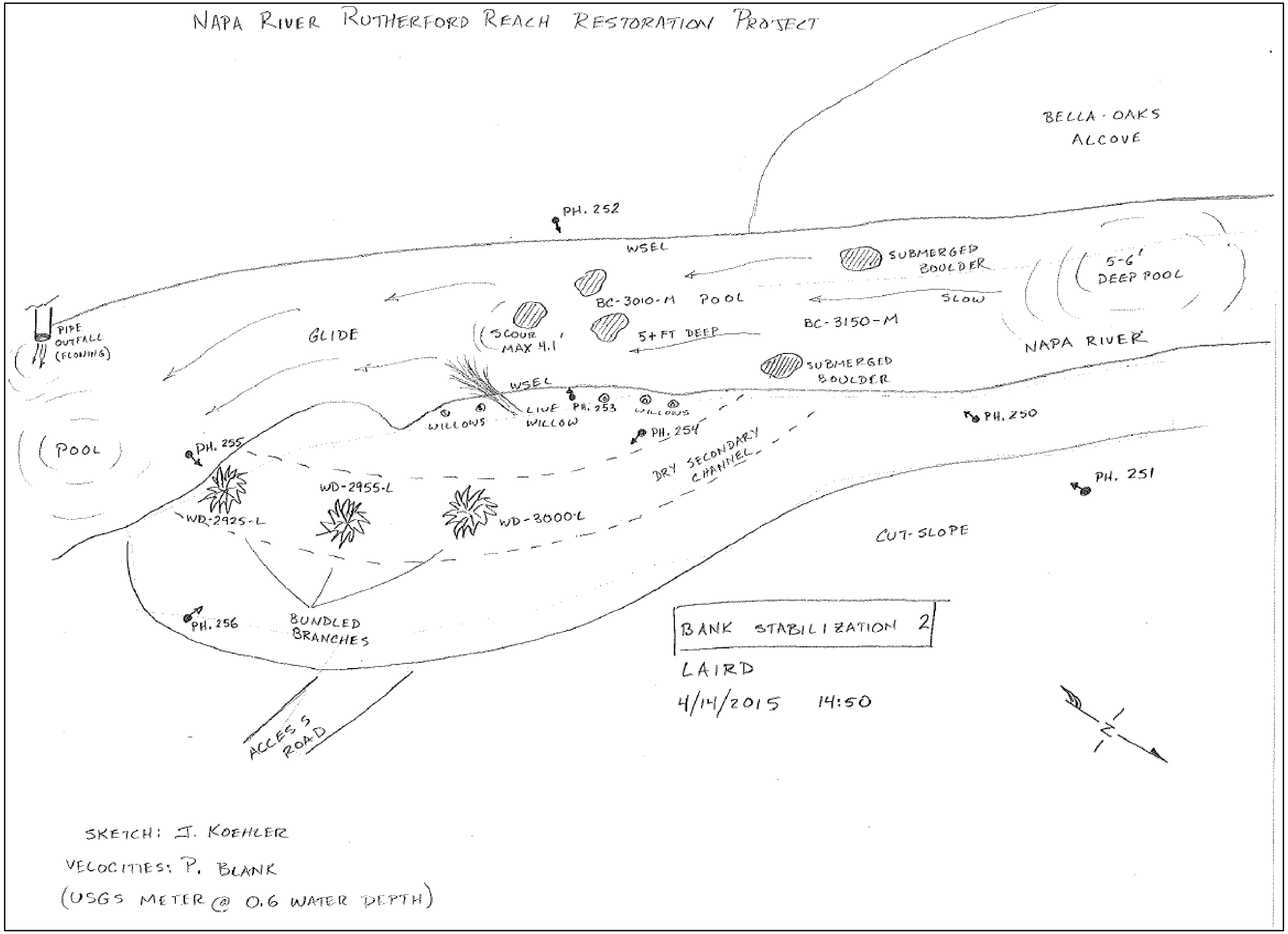

Photo 232 (WD-9320-R)


Photo 234 (WD-9320-R)


Photo 235 (WD-9320-R)

ATTACHMENT 2: Site Sketches and Photographs – Low-Flow Assessment

Bank Stabilization 2 – Laird (4/14/2015)



Bank Stabilization 2 – Laird (4/14/2015)

Photo 250 (BC-3150-M)

Photo 251 (BC-3150-M)

Photo 253 (BC-3010-M)

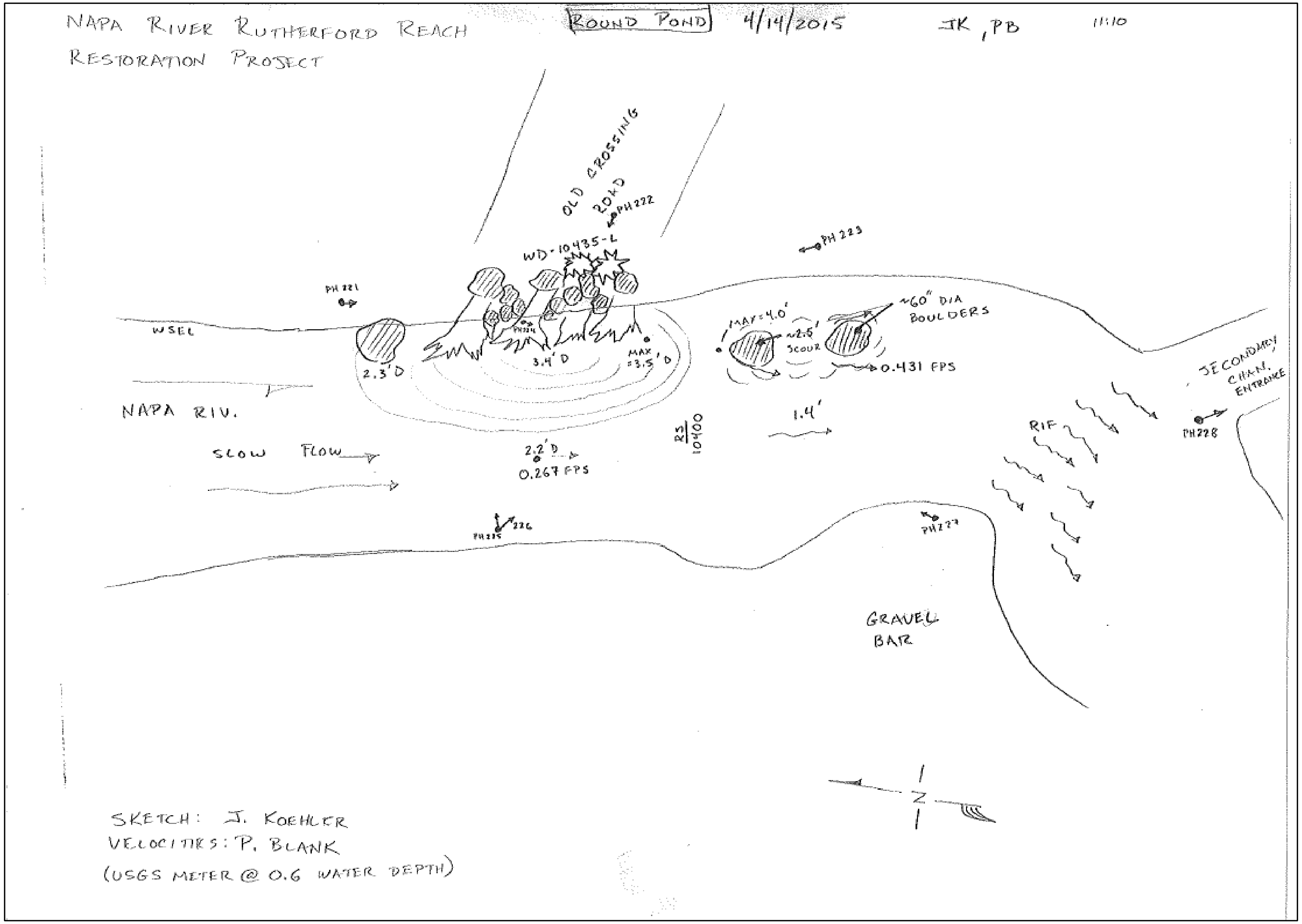
Photo 254 (WD-3000-L)

Photo 255 (WD-2925-L)

Photo 256 (WD-2925-L, WD2955-L, WD-3000-L)

ATTACHMENT 2: Site Sketches and Photographs – Low-Flow Assessment

Crossing – Round Pond (4/14/2015)



Crossing – Round Pond (4/14/2015)


Photo 221 (WD-10435-L)


Photo 222 (WD-10435-L)


Photo 223 (WD-10435-L)


Photo 225 (WD-10435-L)

Crossing – Round Pond (4/14/2015)

Photo 224 (BC-10380-L)

Photo 226 (BC-10380-L)

Photo 227 (WD-10435-L and BC-10380-L)

Photo 228 (Secondary Channel)

Appendix E
Photographic Monitoring

Reaches 1 and 2 East Bank
(Phase 1)

Constructed 2009

Guggenhime
Quintessa

River Station 235+00

Bench: Guggenhime, East Bank

June 2009

October 2009

June 2011

March 2016

River Station 195+50

Benches: Quintessa, East Bank

June 2009

March 2011

March 2016

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

September 2009

March 2016

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

March 2015

March 2011

LWD, Ranch Winery, March 2015

River Station 198+50

Bench: Frog's Leap, West Bank

August 2010

April 2011

March 2016

River Station 191+00

September 2010 | Frog's Leap Bench from Quintessa Road, East Bank | March 2016

River Station 181+00

Setback Berm: Caymus Bench, West Bank

December 2010

March 2016

Reach 3
(Phase 2)

Constructed 2010

Carpy Conolly and Caymus

River Station 176+50

Bench 1: Caymus, West Bank

September 2009


October 2010

December 2010


March 2015

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

October 2010

December 2010


March 2016

River Station 168+50

Bench 3: Caymus, Downstream to Upstream

October 2010

March 2016

River Station 164+20

Bench 4: Carpy Conolly, East Bank

September 2010

November 2011

March 2016

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

September 2010

March 2016

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

August 2011

March 2016

Reach 4 East Bank
(Phase 3)

2011

Honig
Round Pond East Bank

River Station 135+40

Bench 11: Honig, East Bank

October 2011

March 2012

March 2016

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

August 2011

March 2012

March 2016

River Station 127+50

Bench 13: Honig, East Bank to Upstream

May 2011

October 2011

March 2016

River Station 124+25

Bench 14: Round Pond, East Bank

October 2011


LWD Bench 14, March 2015


March 2016

Reach 4 West Bank
(Phase 3)

Constructed 2012

Emmolo, Caymus and Round Pond

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

May 2012

November 2012

March 2016

River Station 157+60

Bench 6: Emmolo, West Bank to Upstream

May 2012

March 2016

August 2012

River Station 152+90

Bench 8: Emmolo, West Bank to Downstream

May 2012

November 2012

March 2016

River Station 15,000

Bench 8: Emmolo, West Bank Looking Upstream

May 2012

November 2012

March 2016

River Station 139+20

Bench 10: Caymus, West Bank to Downstream

August 2012

December 2014

March 2016

River Station 135+60

Bench 10: Caymus, West Bank to Upstream

November 2012

December 2014

March 2016

River Station 133+30

Bench 12: Round Pond West, West Bank to Downstream

August 2012

March 2016

LWD, Bench 12, March 2015

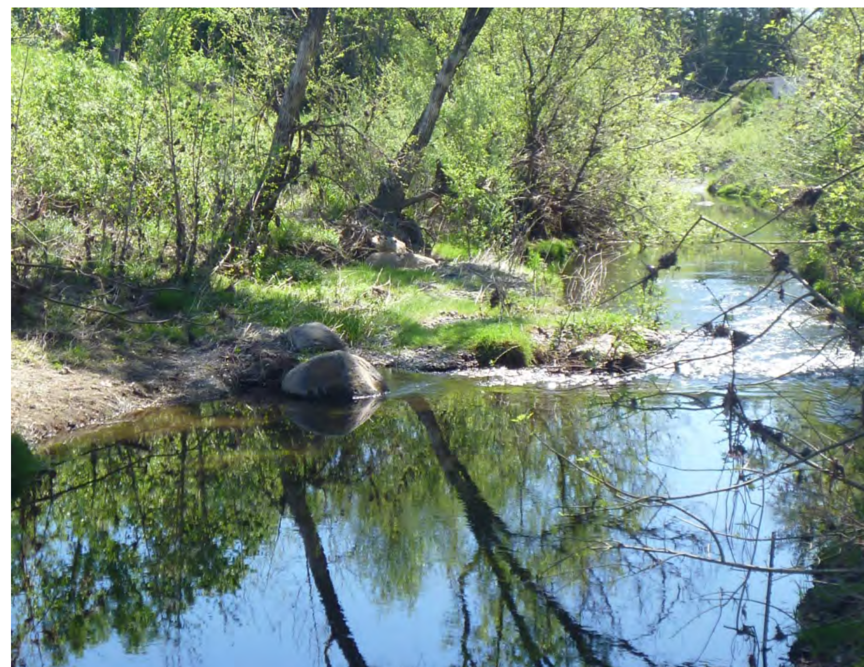
River Station 130+80

Bench 12: Round Pond West, West Bank to Upstream

November 2012

December 2014

March 2016



Boulder Cluster, Reach 4, March 2015

River Station 127+80

Bank Stabilization 3: Round Pond West Bank Looking Downstream

November 2012

December 2012

March 2016

River Station 126+00

Bank Stabilization 3: Round Pond West, West Bank to Upstream

May 2012

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

December 2014

March 2016

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 2012

March 2016

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


2011


October 2012


November 2012


March 2016

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

May 2012

December 2012

March 2016

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


March 2016


October 2012


March 2016

River Station 53+00

Reach 8 South, Bank Stabilization 1: Downstream to Upstream


August 2012


March 2016


November 2012


March 2016

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

August 2012

March 2016

November 2012

Boulder/LWD Cluster, Bench 2, March 2016

River Station 44+00

Reach 8 South, Bank Stabilization 3 to Bench 3: Upstream to Downstream

July 2010


December 2014


March 2016

River Station 43+00

Reach 8 South, Bank Stabilization 3: Downstream to Upstream

February 2013

March 2016

December 2014

River Station 42+00

Reach 8 South, Bench 3: Upstream to Downstream

August 2013

December 2014

March 2016

River Station 40+00

Reach 8 South, Bench 3: Downstream to Upstream


August 2013


December 2014


March 2016

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


August 2013


December 2014


March 2016

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

August 2013

December 2014

March 2016

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

December 2014

March 2016

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

December 2014

Boulder Cluster, BSSR 1, March 2015

March 2016

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

July 2014

December 2014

March 2015

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

December 2014

March 2015

March 2016

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

July 2014

December 2014

March 2016

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

July 2014

March 2016

December 2014

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

July 2014

December 2014

March 2016

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

July 2014

December 2014

March 2016

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 2014


March 2016

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

July 2014

March 2016

December 2014

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

July 2014

March 2016

December 2014

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

July 2014

December 2014

March 2016

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

July 2014

March 2016

December 2014

LWD, Bench 2,
March 2015

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

July 2014

December 2014

March 2016

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

July 2014

December 2014

March 2016

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

July 2014


December 2014


March 2016

Beaver Dams


Reach 2, July 2015


Reach 3, July 2015


Reach 4, July 2015


Reach 9, July 2015