Salt River Ecosystem Restoration Project

Habitat Mitigation and Monitoring Plan
Monitoring Report 2018

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Humboldt County
RESOURCE
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EXECUTIVE SUMMARY

The Salt River Ecosystem Restoration Project (Project) has been developed in collaboration with landowners and resource and regulatory agencies for over 30 years. The Humboldt County Resource Conservation District (HCRCD) is spearheading the Project on behalf of multiple private landowners throughout the Salt River watershed. The Salt River watershed is located in Humboldt County, California; approximately 15 miles south of the City of Eureka. The watershed surrounds the City of Ferndale and is bounded to the south by the Wildcat Mountains, to the east and north by the Eel River and to the west by the Pacific Ocean. The watershed derives its name from the Salt River that historically flowed across the Eel River delta discharging into the Eel River estuary approximately 0.2 miles from the mouth of the Eel River.

The overarching goal of the Project is to restore and improve hydrologic function and fish and wildlife habitat in the Salt River watershed. The Project area includes the main stem of the Salt River, four Salt River tributaries originating in the Wildcat Hills above the town of Ferndale (Williams Creek, Francis Creek, Reas Creek, and Smith Creek), and the approximately 400-acre Riverside Ranch, which is contiguous to the Salt River estuary. The California Department of Fish and Wildlife (CDFW) acquired Riverside Ranch in 2012 from Western Rivers Conservancy, who had purchased the property from a willing seller. CDFW is an active partner in the Project. The remainder of the Project area is in private ownership.

The Project intends to restore natural hydrologic processes to a significant portion of the watershed, promoting restoration of ecological processes and functions. The Project is presented in two primary phases to distinguish between the tidal wetland restoration (known as Phase 1) and the riverine restoration work (known as Phase 2). The Project includes work that will be accomplished over several years. Within the two phases, the Project is further broken down in to four primary components, discussed below:

- **Upslope erosion control:** Work with willing landowners to implement upslope erosion control activities in the upper portions of the Francis, Williams, and Reas Creeks watersheds to reduce the level of sediment input and delivery to the Salt River, thereby improving water quality while reducing sediment deposits in the channel.
- **Riverside Ranch tidal marsh restoration:** Restore tidal marsh in the lower Salt River. This will also increase the tidal prism exchanged through the lower river, increasing sediment transport potential, increasing scour and promoting hydraulic connectivity with the upper watershed.

- **Salt River channel excavation:** Excavate and rehabilitate approximately 7.4 miles of the historic Salt River channel to restore hydrologic connectivity within the watershed thereby improving aquatic and riparian habitat, providing fish passage to tributaries, and improve drainage in the delta.

- **Adaptive Management:** Work with the community and regulatory agencies to implement an environmentally and geomorphically acceptable adaptive maintenance and management program to maintain hydraulic and ecological function in the Project area into the future.

In 2013, restoration of Riverside Ranch (Phase 1 of the Project) restored 330 acres of pasture land back to intertidal wetland habitat, while also preserving approximately 70 acres that will be agriculturally managed to provide short-grass habitat for Aleutian cackling geese and other wetland-associated birds. Three miles of internal slough networks were excavated to create additional habitat for salmonids, tidewater goby, and other fish and aquatic species, and provide areas for the natural recruitment of eelgrass. Two miles of setback berm were constructed to create a boundary between the tidal area and the retained agricultural area, and a gravel road was installed on top of the berm to provide access for monitoring and maintenance. This component of the Project also widened and deepened approximately 2.5 miles of the tidally-influenced portion of the Salt River channel, thereby increasing tidal exchange and greatly improving fish passage and fish habitat in the lower Salt River channel.

The design of Phase 1 was intended to strike a balance between creating significant amounts of new tidal marsh habitat, retaining and enhancing some of the important existing upland and riparian features, preserving sufficient acreage to manage for short-grass habitat for Aleutian cackling geese, minimizing long-term site maintenance, and incorporating design features that accommodate sea-level rise. Earthwork on Phase 1 was balanced on site, with excavated materials all being utilized to construct a range of habitat features at varying elevations and to construct the 2-mile setback berm.

Phase 2 represents the Salt River “corridor restoration” portion of the larger project. Within Phase 2, design plans call for 4.5 miles of the Salt River channel and its adjacent floodplain to be excavated. Wetlands and riparian corridors will be re-vegetated with a diverse palette of native plants. Fish passage would be restored to three watershed tributaries – Reas, Francis and Williams Creeks.

Across the years of 2013, 2014, 2015, 2017, and 2018, a total of 5.1 miles of Salt River channel and floodplain were constructed and re-vegetated. These construction efforts also reconnected two tributaries (Reas and Francis Creek). The 2017 construction season also restored 0.5 miles of the channel and floodplain in Francis Creek (Figure 1). It is anticipated that future Phase 2 construction will occur in 2019 and 2020, completing the Salt River corridor restoration.

Salt River Ecosystem Restoration Project
Permitted Project Area & Implementation Status

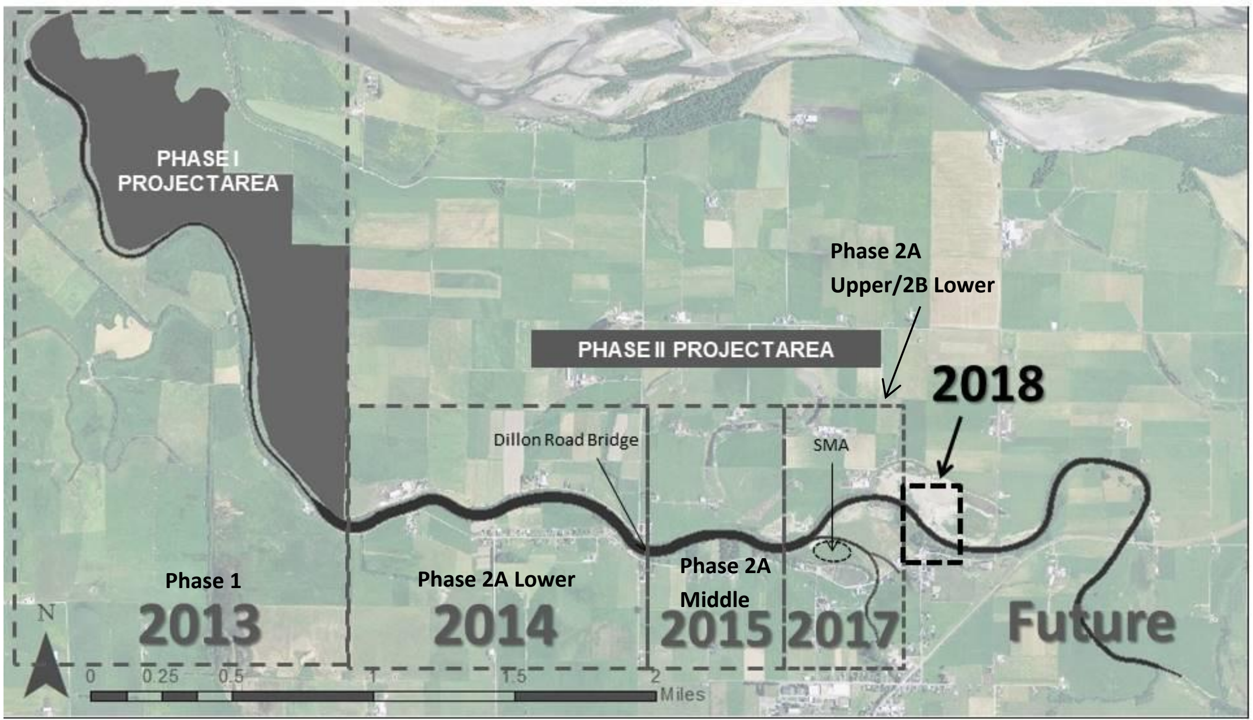


Figure 1: Salt River Ecosystem Restoration Construction Timeline as of 2018

Upon completed portions of the Project, monitoring is performed under direction of the Humboldt County Resource Conservation District and complies with requirements generated from Project documents, including the Salt River Ecosystem Restoration Project's Habitat Mitigation and Monitoring Plan (HMMP) and the Adaptive Management Plan (AMP). This report provides information on data collected for monitoring tasks pertaining to the AMP of the Salt River Ecosystem Restoration Project as follows:

- Phase 1: Year 5 (post construction 2013)
- Phase 2: Year 4, Year 3, Year 1 (post construction 2014, 2015, 2017 respectively)

As mentioned in the Summary of Conclusions section below, monitoring results demonstrate the Project is performing successfully and largely meeting Project goals.

SUMMARY OF CONCLUSIONS

As detailed in this report, the 2018 monitoring results provide a point of reference on how the restoration activities completed in 2013 (Phase 1), 2014 (Phase 2A Lower), 2015 (Phase 2A Middle), and 2017 (Phase 2A Upper/2B Lower) have responded to the area's environmental conditions during its formative years after construction. One important environmental input to consider is the previous season's amount of precipitation. The north coast of California generally experiences precipitation from October to the end of April. This period of time is referred to as a *hydrologic year*. The amount of the hydrologic year's precipitation prior to monitoring efforts can significantly affect the findings of a handful of monitoring tasks, such as riparian success and cross-sectional surveys. The 2017/2018 hydrologic year experienced a La Nina event which included greater than normal wet and dry periods. Approximately 49 inches of rain fell across the north coast (Eureka NOAA station) from October to April, with 10 days that experienced a one-inch or greater rain storm. That can be compared to an annual average of 40 inches with 8 days that exceed a 1 inch rain event on the northern coast of Humboldt County.

The following is a brief summary of the findings of the various HMMP monitoring efforts. Please reference reports listed at the end of this report for more detailed findings.

Vegetation
Phase 1 and the completed portions of Phase 2 were mapped to depict all projected habitat acreages for the various habitat types, including: tidal salt marsh, high marsh ecotone, riparian, and channel wetlands. At the culmination of 10 years (post-implementation), specific acreage goals are expected to be achieved for each habitat type. In 2018 (5 years post-implementation), the tidal and salt marsh acreage achieved 94% of its goal. In Phase 2A Lower and Middle project areas, existing and replanted riparian are achieving acreages within their respective restoration areas, however, those acres only compose 23% of the total Phase 2 project area.

Phase 1 tidal and salt marsh, Phase 2A Middle wetlands and planted riparian, and Phase 2A Upper/2B Lower areas all achieved all success criteria for native species percent cover. Phase 1 and Phase 2A Middle achieved the success criteria (<15%) for non-native and non-invasive species percent cover. However, the newly constructed Phase 2A Upper/2B Lower exceeded the maximum limit, where some of these non-native non-invasive species are colonizer species and may decrease in the following years as a riparian canopy develops. All monitoring sites on the Phase 1 and 2 areas exceeded the maximum limit for invasive species percent cover. Reed canary grass (*Phalaris arundinacea*) is present in the agricultural fields of Phase 1 and in the Phase 2 channel and accounts for a large proportion of the invasive species percent cover value. Reed canary grass is currently considered a native species by Cal-IPC and the

Humboldt Weed Management Area. However, Project documents and subsequent Project monitoring considers reed canary grass as an invasive species as it is aggressive and compromises habitat development. Dense-flowered cordgrass (*Spartina densiflora)* is an invasive species that is present on Phase 1 and is establishing upstream in Phase 2 from the tidal restoration area. HCRCD and partners continue to seek funding opportunities to control/eradicate *S. densiflora*.

During this monitoring year, basal area of woody tree species was estimated for the first time in the Phase 2A Middle project area in the planted riparian habitats to establish a baseline for future monitoring to determine if planted tree species are increasing in girth over time.

Wildlife

Wildlife monitoring consisted of avian count surveys and fish sampling across Phase 1 and in the restored areas in Phase 2 (2A Lower and Middle). Avian count surveys were initiated during pre-project construction on Phase 1. Given that approximately 300 acres of agricultural fields in the Phase 1 footprint were being converted into a more diverse tidal habitat, pre and post construction avian surveys would document any changes in species abundance and richness. In this 2018 (Year 5) avian count survey effort, the species abundance and richness are increasing and are similar to, or exceed, species abundance and richness when compared to reference sites.

In collaboration with CDFW, NOAA/NMFS, Humboldt State University, and Ducks Unlimited, a fish sampling program has been ongoing since 2014. The 2018 sampling effort took place from April to July at 13 sites. Fifteen anadromous, freshwater, and marine species were captured in 2018. Salmonids were captured in April, May, and July of the sampling season. Tidewater gobies were captured May through July in the tidally influenced reaches during the entire sampling season. With presence confirmed, the 2018 fish sampling effort, once again, proved that the Project is a success for fish species.

Geomorphic

The results of the monitoring tasks conducted under the Geomorphic heading demonstrate that the entire Project site is a dynamic system. The photo documentation not only visually records the dramatic differences between pre-construction to post-construction conditions, but records the vegetation recruitment and tidal effects. The cross-sectional surveys indicate that the Salt River channel and slough channels are adjusting to the environmental conditions where channel capacity has both increased and decreased at individual sites.

INTRODUCTION

The Salt River Ecosystem Restoration Project (SRERP) took some 30 years to develop and drew upon several studies and assessments completed during that time that examined cultural, biological, geological, aquatic, and vegetative resources as well as tidal influences in the watershed. Project proponents also developed documents to guide implementation, maintenance, and long-term monitoring. Monitoring documents include the Salt River Monitoring Plan, Habitat Mitigation and Monitoring Plan, the Adaptive Management Plan, and other specialized plans to assure the protection of sensitive wildlife habitats, landowner properties, and the hydrologic system itself.

As outlined in the Project's CEQA and the Adaptive Management Plan documents, a variety of monitoring tasks are required to be conducted to help determine if Project goals and objectives are being achieved, as well as to guide Project management and maintenance. Most of the monitoring tasks are to be completed over a period of ten years, post-implementation. Monitoring was conducted prior to beginning Project implementation to establish baseline data and/or assist in identifying and protecting resources in the Project area. Post-implementation monitoring is being conducted as required by the Project's various funders, permit requirements, and environmental compliance documents. Many of the individual reports are available from the Humboldt County Resource Conservation District upon request or can be accessed on the website (http://humboldtrcd.org/salt_river_ecosystem_restoration_project/reports_and_documents).

This report presents monitoring results under three broad categories:

1. Vegetation
2. Wildlife
3. Geomorphic

Within each category is a discussion that identifies 1) the discrete task called for, 2) the agency requiring the task, 3) the reference document, 4) a description of the task, 5) goals and objectives of the tasks, 6) the resulting monitoring report (if applicable), 7) a description of methods, and 8) a results and discussion section.

VEGETATION

Monitoring Task: Habitat Mapping – Tidal & Salt Marsh Acreage (Phase 1) and Riparian Acreages in the River Corridor (Phase 2A Middle and Phase 2A Upper/2B Lower)

Agencies/Acts: Coastal Commission

Compliance Documents: Coastal Development Permit- Special Conditions; SRERP Habitat Mitigation and Monitoring Plan and the Adaptive Management Plan

Description: For the 2018 monitoring effort, determine acreages through mapping for the tidal and salt marsh habitat acreages on Phase 1 (2013 restoration); planted and existing riparian acreage in Phase 2A Middle (2015 restoration), and planted and existing riparian in Phase 2A Upper/2B Lower (2017 restoration) of the Salt River Ecosystem Restoration Project

Goals:

- Achieve 322 acres of Tidal Salt and Brackish Marsh in Phase 1 by Year 10
- Achieve 85 acres of riparian in Phase 2 by Year 10

Report: 2018 Annual Habitat Monitoring Report - Salt River Ecosystem Restoration Project, Prepared for the Humboldt County Resource Conservation District by J.B. Lovelace & Associates

Methods: Habitat maps were created using ArcMap® (ESRI) geographic information system (GIS) desktop software and the most recent satellite imagery (Google Earth 2017 and National Agriculture Imagery Program [NAIP] 2016), and were based on observations made during fieldwork performed in 2018. Geographic field data were collected using a Trimble® Juno® global positioning system (GPS) device with ArcPad® software (ESRI). Habitat area (acreage) totals were calculated as part of this process.

Results & Discussion: The total mapped area of the Phase 1 Tidal and Salt Marsh habitats is 303.95 acres (Figure 2), which is made up of sub-habitats of salt marsh, mudflat, aquatic, brackish marsh, and uplands. This is an increase of Tidal and Salt Marsh from the 2017 assessment of 284 acres. The original goal of the project, as stated in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012), is to achieve 322 acres of tidal and salt marsh habitats, thus the project did not meet this Year 10 goal in 2018 (Year 5). This shortfall may be due to excess acreage attributed to the High Marsh Ecotone in the Phase 1 footprint, where the project intended to create 12 acres of high marsh ecotone, yet field investigations have delineated 36 acres of high marsh ecotone. This equates to 24 acres of potential tidal and salt marsh habitat being attributed to the high marsh ecotone.

The extent of existing riparian forest and riparian planting zone habitats that occur within the Phase 2A Middle (2015 restoration) were estimated at 11.53 acres (Figure 3). In the Year 1 existing riparian forest and riparian planting zone habitats of the Phase 2A

Upper/2B Lower (2017 restoration) were estimated at 8.38 acres (Figure 4). These habitats collectively total 19.91 acres, which comprise 23% of the total expected riparian acreage for the entire Phase 2 footprint.

Table 1 provides the results of the mapped tidal & salt marsh for Phase 1 and riparian acreages for both Phase 2A Middle and Phase 2A Upper/2B Lower.

Table 1. SRERP Habitats. Summary of 2018 Observed Habitat Areas & Respective Success Criteria

	Area (Acres)		
SRERP Habitat Type	**Observed**	**Projected for Entire Phase 1 or Phase 2**	**% of Projected**
Phase 1			
Tidal & Salt Marsh	**303.95**	**322**	**94**
Phase 2A Middle			
Riparian - planted	4.64		
Riparian - existing	6.89		
Total	**11.53**	**85**	**14**
Phase 2A Upper/2B Lower			
Riparian - planted	5.12		
Riparian - existing	3.26		
Total	**8.38**	**85**	**10**

Observations indicate continued development of projected habitats restored thus far, showing a positive trajectory towards meeting final success criteria. No significant changes were observed in the extent of the habitats addressed during 2018.

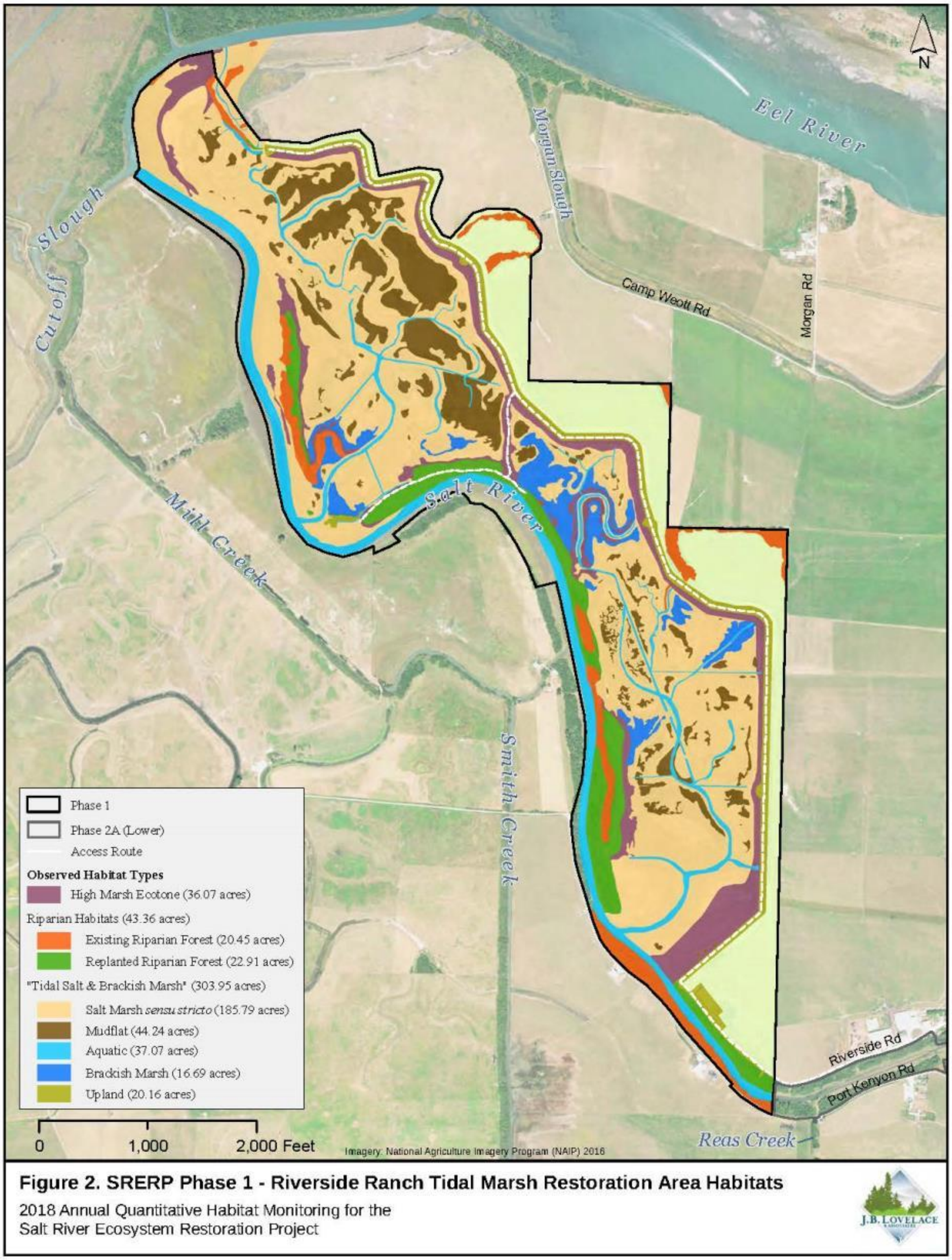


Figure 2: Tidal & Salt Marsh Habitat Acres

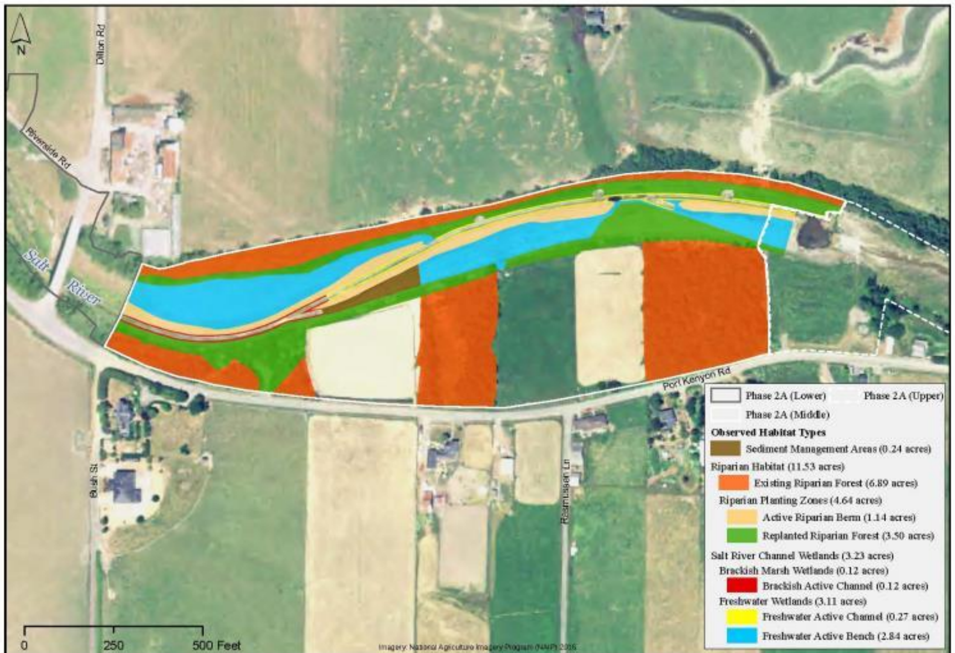


Figure 4. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Habitats
2018 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

Figure 3: Phase 2A Middle Salt River Corridor Habitat Acreage

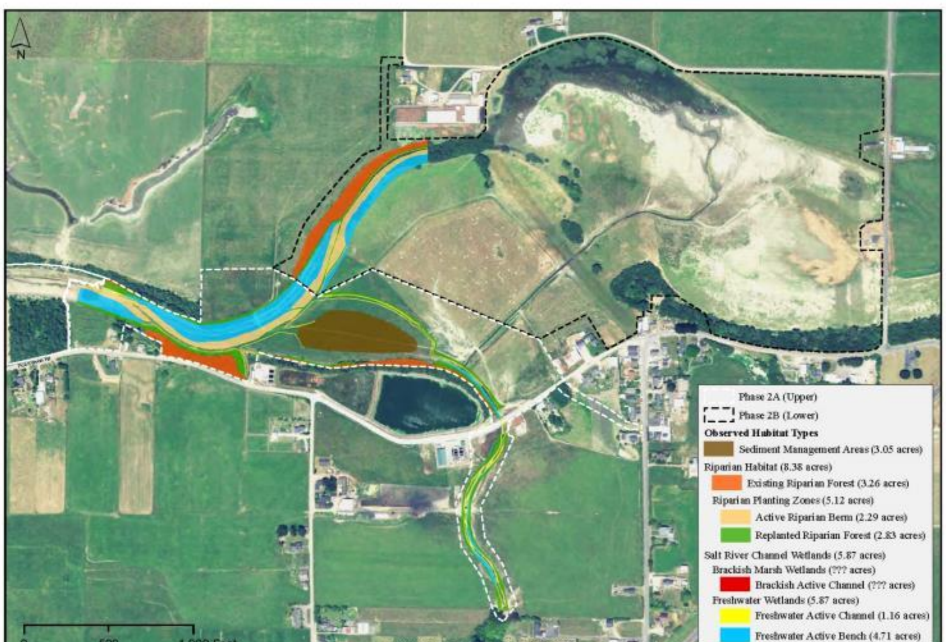


Figure 5. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Habitats
2018 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

Figure 4: Phase 2A Upper/2B Lower Salt River Corridor Habitat Acreage

VEGETATION

Monitoring Task: Vegetation Percent Cover – Tidal & Salt Marsh (Phase 1) and Riparian and Wetlands in the River Corridor (Phase 2A Middle and Phase 2A Upper/2B Lower)

Agencies/Acts: Coastal Commission

Compliance Documents: Coastal Development Permit- Special Conditions; SRERP Habitat Mitigation and Monitoring Plan and the Adaptive Management Plan

Description: Estimate percent cover of native, non-native, and invasive species within the tidal & salt marsh of Phase 1 as well as wetland and riparian areas in the river corridor of Phase 2A Middle and Phase 2A Upper/2B Lower of the Salt River Ecosystem Restoration Project

Goals:

- Achieve 2018 Native Vegetation Percent Cover of: ≥30% in Phase 1 tidal & salt marsh habitat; ≥30% in Phase 2A middle channel wetlands and riparian habitats; and ≥10% in Phase 2A Upper/2B Lower channel wetlands and riparian habitats
- Achieve 2018 Non-Native Non-Invasive Vegetation Percent Cover of: <15% in all restored habitats
- Achieve 2018 Invasive Vegetation Percent Cover of: <5% in all restored habitats

Report: 2018 Annual Habitat Monitoring Report - Salt River Ecosystem Restoration Project, Prepared for the Humboldt County Resource Conservation District by J.B. Lovelace & Associates

Methods: The following is an excerpt from the Draft 2018 Annual Habitat Monitoring Report:

We used a stratified, randomized sampling approach to characterize the abundance, species composition, and structural composition of existing vegetation in each vegetation sampling area. The goal of such a sampling approach is to sufficiently distribute the collection of vegetation data throughout sampling areas to provide the most accurate, quantitative characterization of the vegetative categories of interest throughout the site, while minimizing any preconceived bias on the part of the observer. Based on power analyses of 2017 SRERP vegetation sampling data (J.B. Lovelace & Associates 2018), we used a sample size (n=32) that was determined to be sufficient to detect a "medium" effect size of 0.5 standard deviations (following Cohen 1988) between the observed sample means and their respective success criteria using a two-sided t-test, and assuming both 95% confidence and a statistical power of 80%.

Using updated SRERP habitat GIS data and ArcMap® software, each phase and sub-phase of the restoration area was partitioned into ecologically distinct vegetation sampling areas of perceived relative homogeneity based on project reach, restoration habitat design components, revegetation prescriptions, and elevation strata. ArcMap® software was then used to randomly distribute 32 sampling plots throughout each of these sampling areas. Given that each sampling area is composed of multiple, geographically separated polygons, the 32 sample plots were randomly allocated throughout each sampling area, in quantities proportionate to the size (i.e., area) of each polygon (Figures 5 – 7). Geographic coordinates for each randomly assigned sample plot location were then appropriately corrected and uploaded to the aforementioned GPS unit for location during fieldwork. Once sample plots were located in the field, a 1m2 sampling frame, or "quadrat," constructed from ¼-inch diameter PVC was then used to visually estimate:

- *(total) percent vegetative cover, and*
- *(absolute) percent cover of each species present.*

In order to evaluate these data against the success criteria for specific vegetative parameters, each observed plant species was categorized as:

- *native,*
- *non-native non-invasive,*
- *non-native invasive, or*
- *sterile "wheatgrass" hybrid (Elymus x Triticum);*

as well as being:

- *herbaceous (an herb),*
- *arborescent (a tree), or a*
- *shrub.*

Percent cover data collected for each species reflected that species' absolute cover, which is distinct from relative cover. Absolute cover quantifies the entire aerial projection of each species (or any other vegetative category of interest) within the sample frame, regardless of any canopy overlap between different species. When measuring absolute cover, resulting cumulative cover values for sampled locations that exceed 100% for a given sample are not uncommon (Barbour et al. 1998, etc.). Absolute cover data are generally considered to allow for a broader range of analytical applications. In contrast, relative cover values always represent a proportion between 0-100%, and can be less informative due to reduced precision in addressing areas of overlapping vegetative canopy.

In an attempt to minimize any observer-related variation between monitoring efforts, the same "modified" Braun-Blanquet (1928) cover-abundance scale used in previous monitoring efforts (H.T. Harvey & Associates 2014 & 2015; J.B. Lovelace & Associates 2017) was also used during the 2018 sampling fieldwork to assign a "cover class" to the visually estimated absolute percent cover for each species observed during sampling. Median percent cover values for the range associated with each cover class were then *used in subsequent analyses. Although some precision is lost when using such a method, plant-cover abundance scales can be useful in long-term monitoring projects as they serve to reduce observer-based variation between observation periods.*

The vegetation success criteria specified in the HMMP consist of minimum percent cover thresholds for native species and maximum percent cover thresholds for both non-native non-invasive and non-native invasive species for the various combinations of habitat type and monitoring year. Although no such "percent cover" success criteria are specified for vegetative structural composition (other than related criteria for riparian habitat acreage), a characterization of the structural type of sampled vegetation in riparian planting zones was requested during a meeting with project partners and the California Coastal Commission staff (HCRCD 2016c). During this same meeting it was also determined that quantitative vegetation sampling was not required within retained existing riparian habitat areas. This does not change the requirements established in the HMMP for monitoring the extent (acreage) of this habitat throughout the duration of the monitoring period.

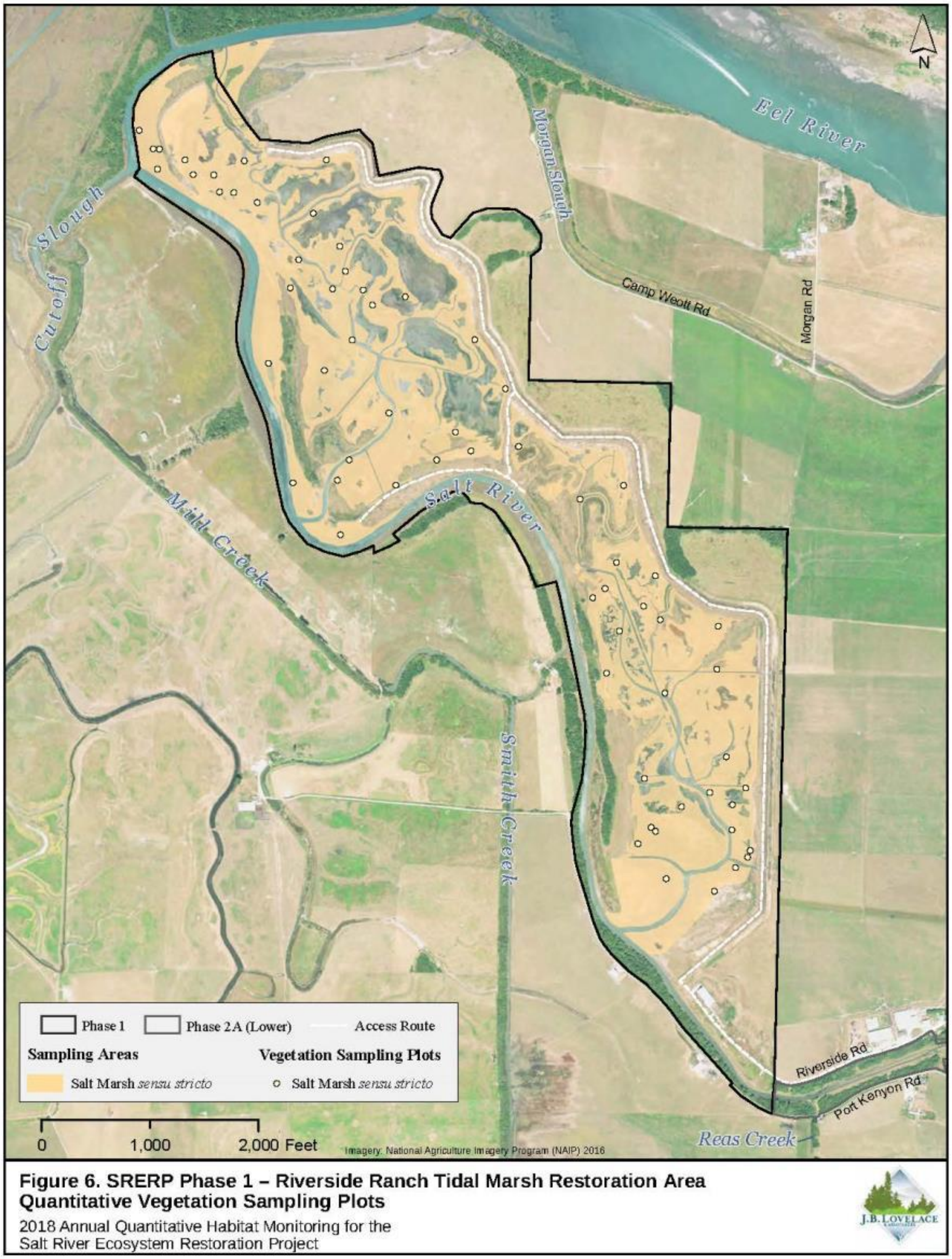


Figure 5: Phase 1 Tidal & Salt Marsh Percent Cover Sampling Plots

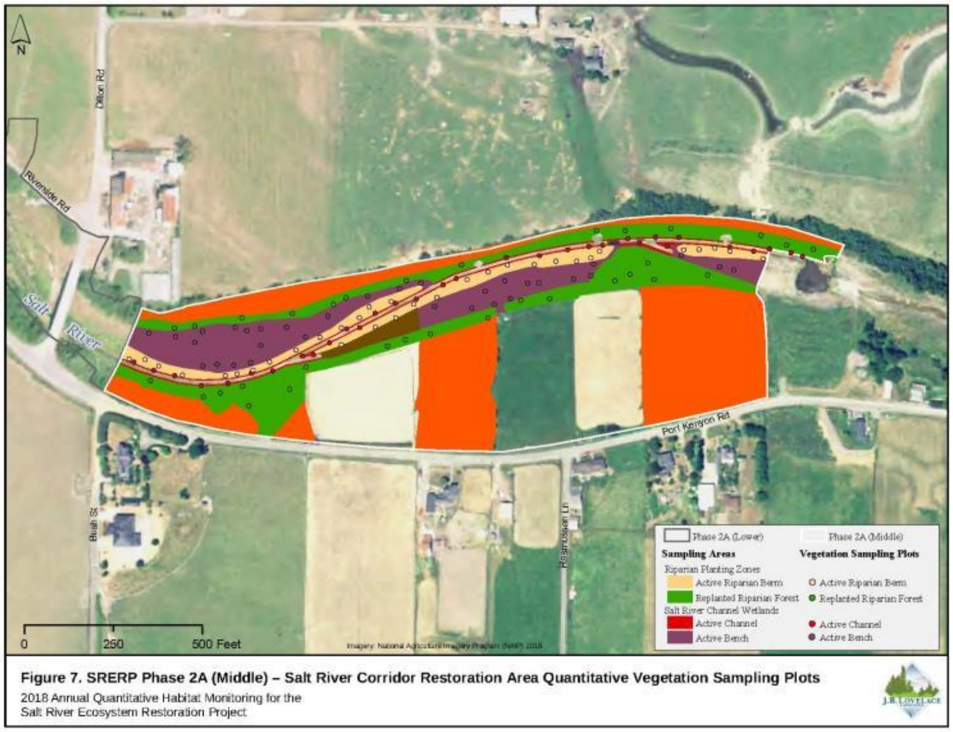


Figure 6: Phase 2A Middle Percent Cover Sampling Plots

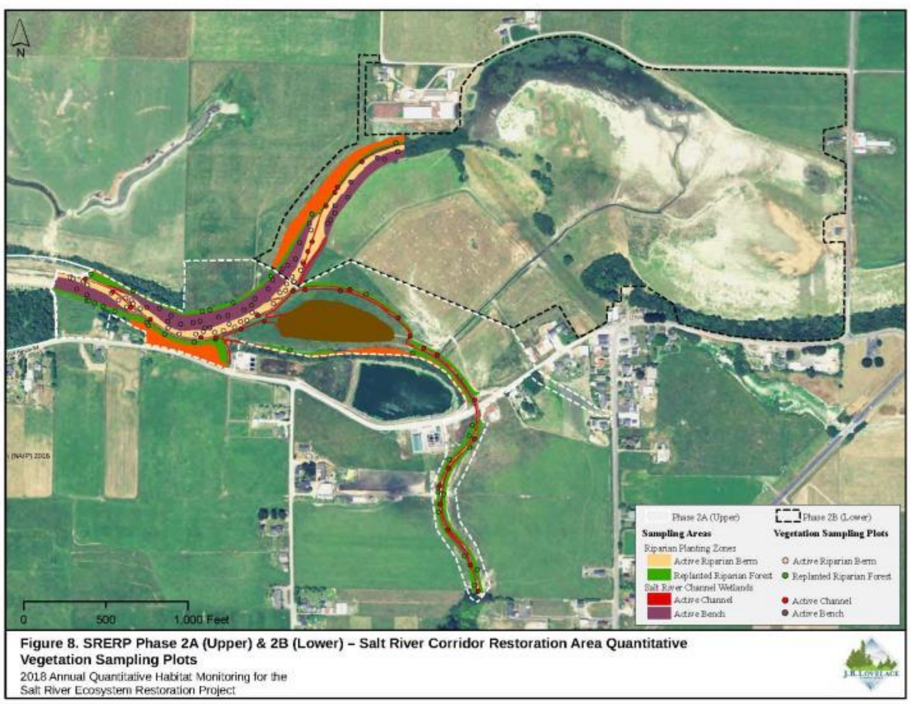


Figure 7: Phase 2A Upper/2B Lower Percent Cover Sampling Plots

Results & Discussion: The sampling effort shows that the monitoring areas are achieving the percent cover success criteria of native vegetation in all phases and habitat areas (Table 2). It is established that the final success criteria for non-native non-invasive shall not exceed 15% percent cover. The Phase 1 and Phase 2A Middle monitored habitats are all within the non-native success criteria. The most recently constructed phase, Phase 2A Upper/2B Lower in 2017, does not achieve the non-native non-invasive level of <15%. This could be attributed to colonizing vegetative species. The final success criterion for invasive vegetation is not to exceed 5% cover. Unfortunately, all phases exceed this limit considerably, except for the Phase 2A Middle active channel wetlands (only exceeded by 2.2%). *Spartina densiflora* is becoming dominant in large areas of Phase 1 and a suite of *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Ranunculus repens* ("creeping buttercup"), *Lotus corniculatus* ("bird's-foot trefoil"), *Helminthotheca echioides* ("bristly ox-tongue"), and *Cirsium vulgare* ("bull thistle") are found throughout the Phase 2 footprint. Recommendations include the continuation of monitoring and instituting a robust invasive species control program.

Table 2: Summary of 2018 SRERP Quantitative Vegetation Percent Cover Sampling Results & Respective Success Criteria. Mean percent cover estimates are in bold and associated 95% confidence intervals follow in parentheses.

	Mean Percent Cover for Vegetation Categories of Interest							
	Total Vegetation[1]	Native Vegetation		Non-Native Non-Invasive Vegetation		Invasive Vegetation		Sterile Hybrid Wheatgrass[1]
SRERP Habitat Sampling Area	**Observed**	**Observed**	**2018 Success Criteria[2]**	**Observed**	**Final Success Criteria[3]**	**Observed**	**Final Success Criteria[3]**	**Observed**
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area								
Salt Marsh *sensu stricto* (n=32)	**94.5** (92.2, 96.6)	**58.0** (49.7, 65.7)	≥30%	**8.2** (4.9, 13.7)	<15%	**28.7** (21.7, 36.7)	<5%	**0.0** (NA)
Phase 2 – Salt River Corridor Restoration Area								
Phase 2A (Middle) – Salt River Channel Wetlands								
Active Channel (n=32)	**100.0** (NA)	**90.1** (85.9, 93.6)	≥30%	**2.6** (1.1, 4.9)	<15%	**7.2** (4.3, 10.9)	<5%	**0.0** (NA)
Active Bench (n=32)	**96.3** (92.6, 98.0)	**59.7** (48.9, 69.6)	≥30%	**13.1** (7.1, 21.9)	<15%	**23.5** (16.3, 32.6)	<5%	**0.0** (NA)
Phase 2A (Middle) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**98.9** (96.7, 99.7)	**51.0** (40.5, 62.2)	≥30%	**9.1** (4.9, 17.6)	<15%	**38.8** (28.6, 50.0)	<5%	**0.0** (NA)
Active Riparian Berm (n=32)	**99.4** (96.8, 99.8)	**68.9** (59.8, 76.7)	≥30%	**8.1** (4.3, 15.5)	<15%	**22.4** (16.8, 28.9)	<5%	**0.0** (NA)
Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands								
Active Channel (n=32)	**93.0** (86.8, 96.3)	**43.0** (33.7, 52.6)	≥10%	**20.2** (14.7, 26.6)	<15%	**26.1** (20.1, 33.7)	<5%	**3.7** (2.3, 5.4)
Active Bench (n=32)	**85.0** (79.0, 89.2)	**28.5** (21.7, 36.7)	≥10%	**31.7** (24.2, 40.3)	<15%	**21.6** (16.3, 27.7)	<5%	**3.2** (1.8, 5.0)
Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**95.8** (92.5, 97.7)	**28.9** (21.1, 38.1)	≥10%	**37.3** (28.3, 46.2)	<15%	**23.6** (18.0, 31.0)	<5%	**6.0** (4.0, 9.1)
Active Riparian Berm (n=32)	**84.8** (79.0, 89.5)	**24.2** (19.6, 29.5)	≥10%	**20.1** (14.7, 26.3)	<15%	**25.0** (18.1, 34.0)	<5%	**15.5** (11.7, 21.4)

[1] No specific success criteria are indicated in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

[2] Adapted from Tables 8-10 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

[3] Must be achieved by the final monitoring year for each respective habitat sampling area (i.e., Year 5 for Salt River Channel Wetlands or Year 10 for all others) (H.T. Harvey & Associates with Winzler & Kelly 2012).

VEGETATION

Monitoring Task: Average Tree Diameter – Average Basal Area

Agencies/Acts: Coastal Commission

Compliance Documents: Coastal Development Permit- Special Conditions; SRERP Habitat Mitigation and Monitoring Plan and the Adaptive Management Plan

Description: Estimate average tree diameter at breast height (DBH) in restored habitats

Goals:

- Planted trees in restoration area will show an increasing trend of average DBH between sampling years 3, 5, and 10.

Report: 2018 Annual Habitat Monitoring Report - Salt River Ecosystem Restoration Project, Prepared for the Humboldt County Resource Conservation District by J.B. Lovelace & Associates

Methods: The goal of this initial sampling is to establish the first baseline dataset for future comparison.

The percent cover sampling approach was used for stratifying restoration sampling areas and creating random basal area sampling plots (using ArcMap® GIS software and the Trimble GPS unit), throughout Phase 2A Middle which include the active riparian berm and replanted riparian forest.

Given that no prior basal area sampling has occurred in the SRERP habitat monitoring effort, initial sample sizes were chosen somewhat arbitrarily, but were based on the perceived appropriate balance of within-habitat variability, habitat area coverage, and cost-efficiency.

Once random basal area sampling plot center coordinates were determined, ArcMap® software was then used to create circular (10-meter radius) sampling plots around each plot center. These GIS data were then appropriately corrected and uploaded to the Trimble GPS device for location in the field. Upon arriving at each basal area sampling plot, the diameter-at-breast-height (DBH) (in millimeters), species, and geographic coordinates were recorded for all trees located within the plot that were ≥4.5 feet tall. For sampling purposes, “Breast Height” is defined as 4.5 feet. Diameter measurements were obtained for all tree stems at 4.5 feet above ground level (on the uphill side, where relevant) using either metric calipers or a “diameter tape” depending on the size of the measured stem.

Following direction from HCRCD staff (Hansen pers. comm.), individual plants were considered to be a “tree” if they were a species whose vegetative “habit” is described in relevant botanical literature (e.g., Baldwin et al. 2012; etc.) as being a tree at maturity. This criterion included young flexible saplings and excluded some woody species whose habit is described as being a “shrub” at maturity (even if such woody individuals encountered were robust and tall enough to have a diameter-at-breast-height).

In instances where the circular plots extended outside of the boundaries of the targeted sampling habitats, the aforementioned data were only collected for trees within the area of overlap between the sampling plot and target habitat; all trees outside of the combined area of overlap were ignored. (This was common in the more narrow and sinuous habitat sampling areas along the riparian corridor in the Phase 2 – Salt River Corridor Restoration Area.) The actual coinciding sampled area of overlap between the sampling plot and target habitat was also calculated and recorded for each sampling plot using ArcMap® GIS software. In instances where basal area sampling plots extended into adjacent, retained “Existing Riparian Forest” habitat areas, no data were collected from trees in those retained habitats.

Data Analysis

All metric DBH measurements collected during fieldwork were subsequently converted to inches, and were then squared and multiplied by 0.005454 ("the forester's constant") to derive basal area values (measured in square-feet), otherwise expressed as:

Basal area = $DBH^2 \times 0.005454$

Resulting sampling plot measurements of both basal area and actual-plot-area sampled were then summed to derive basal-area-per-unit-area-sampled totals for each tree species in each sampled habitat. These measurements were then extrapolated to produce projected estimates of total habitat- and phase-wide basal area for each species using respective habitat areas (acreages) obtained from current SRERP GIS data. Tabulated values for the resulting projected basal area estimates are provided to characterize the current developmental status of this vegetation type in sampled habitats.

This approach was chosen to provide the perceived best method of accurately characterizing this aspect (i.e., basal area) of the development and structural complexity of woody riparian vegetation throughout the restoration area, while also facilitating future comparisons with subsequent sampling efforts throughout the duration of the SRERP monitoring period.

Results & Discussion: Basal area in the 2018 sampling effort reflects current growth and development of replanted and naturally recruited woody riparian vegetation. Eight tree species make up the sampled and projected 24.7 ft^2 of basal area in the replanted riparian forest; of which, Sitka willow (*Salix sitchensis*) and red alder (*Alnus rubra*) compose most of the woody material. Nine tree species make up the sampled and projected 1.98 ft^2 of basal area in the active riparian berm; where red alder (*Alnus rubra*) composed most of the woody material. Currently, less than 1.0% of woody material makes up the Phase 2A Middle restoration area (Table 3).

Table 3: Summary of 2018 of Planted SRERP Woody Riparian Basal Area Sampling Results. Basal area values represent projected totals for each tree species observed in each habitat sampled in 2018

	(Projected*) Basal Area (ft^2)		
	Phase 2A (Middle) – Salt River Corridor Restoration Area		
Tree Species	**Replanted Riparian Forest (3.50 acres) (n = 10)**	**Active Riparian Berm (1.12 acres) (n = 5)**	**Total§ (4.62 acres)**
Salix sitchensis (Sitka willow)	12.7061	0.4600	13.1661
Alnus rubra (red alder)	9.6257	1.4214	11.0471
Salix hookeriana (coastal willow)	2.0207	0.0024	2.0231
Populus trichocarpa (black cottonwood)	0.0714	0.0798	0.1512
Salix lasiandra var. *lasiandra* (Pacific willow)	0.1198	0.0026	0.1224
Morella californica (California wax myrtle)	0.0816	0.0052	0.0868
Sequoia sempervirens (coast redwood)	0.0159	0.0053	0.0212
Picea sitchensis (Sitka spruce)	0.0196	0	0.0196
Baccharis pilularis ssp. *consanguinea* (coyote brush)	0	0.0039	0.0039
Lonicera involucrata ssp. *ledebourii* (twinberry)	0	0.0039	0.0039
Total	**24.6608**	**1.9845**	**26.6453**

* Projected total basal area values were derived from basal-area-per-unit-area-sampled measurements collected during 2018 quantitative vegetation sampling efforts, extrapolated to habitat- and phase-wide estimates based on respective habitat areas (acreages) obtained from current SRERP GIS data.

§ All SRERP restoration areas addressed during the 2018 basal area sampling effort

<u>WILDLIFE</u>

Monitoring Task: Avian Point Count Surveys – Phase 1, Riverside Ranch

Agencies/Acts: Coastal Commission

Compliance Documents: Coastal Development Permit- Special Conditions 14; SRERP Habitat Mitigation and Monitoring Plan and the Adaptive Management Plan

Description: Survey for avian relative abundance and species richness.

Goals:

- Restored habitats at Riverside Ranch will result in increased avian species richness by Year 5 and 10.

Report: Avian Point Count Survey, Salt River Ecosystem Restoration Project, Phase 1 – Year 5. Prepared by Doreen Hansen (Humboldt County Resource Conservation District) and Sean E. McAllister (Sean E. McAllister & Associates). Eureka, California. 26 October 2018.

Methods: Census monitoring, using point count methods, followed a site-specific protocol developed in consultation with California Department of Fish & Wildlife and project biologists, which was modified from the protocol established by Ralph et al. (1993). An example of the modified protocol included survey duration where breeding bird surveys were conducted for 15 minutes, verses the traditional 3 minute point count, at each monitoring site within 4 hours of sunrise to capture the peak period of bird activity. Surveys were not conducted during rain or strong winds or after 10:30 am.

The Year 5, 2018, point count surveys were conducted at five survey sites on Phase 1 - Riverside Ranch and at two reference site locations in the vicinity of the project area to control for inter-annual variability in species abundance (Figure 8). These point count surveys occurred twice during the breeding season on June 23rd and July 26th. Data collected in the field included site location, time of detection, species detected, where the species was detected in relation to the site location (ex. < 50m, >50m, or whether the individual was flying over the site), cloud cover percentage, whether wind was present, level of precipitation, and who performed the survey.

The 2018 data was analyzed for species presence, relative abundance, and species richness. Overall 2018 average relative abundance and species richness were calculated for each survey and reference site. Average relative abundance and species richness were also calculated for each monitoring month at each monitoring site. These results are also compared to results of previous monitoring years.

Results and Discussion: In Year 5, monitoring was performed on June 23rd and July 26th of 2018. A combined total of 1,333 individual bird detections were made over the two surveys dates (a total of 14 avian point counts) and were represented by at least 54 different species. Two species, Song Sparrow (*Melospiza melodia*) and the Common Raven (*Corvus corax*) were detected at all points during at least one of the two survey days. The most prevalent species overall was the Song Sparrow, detected during all 14 point counts. The most abundant species was the Least Sandpiper (*Calidris minutilla*), with 339 combined detections, followed by Western Sandpiper (*Calidris mauri*) (211) and Semipalmated Plover (*Charadrius semipalmatus*) (101). Twelve species were represented by single birds detected only once (Table 4).

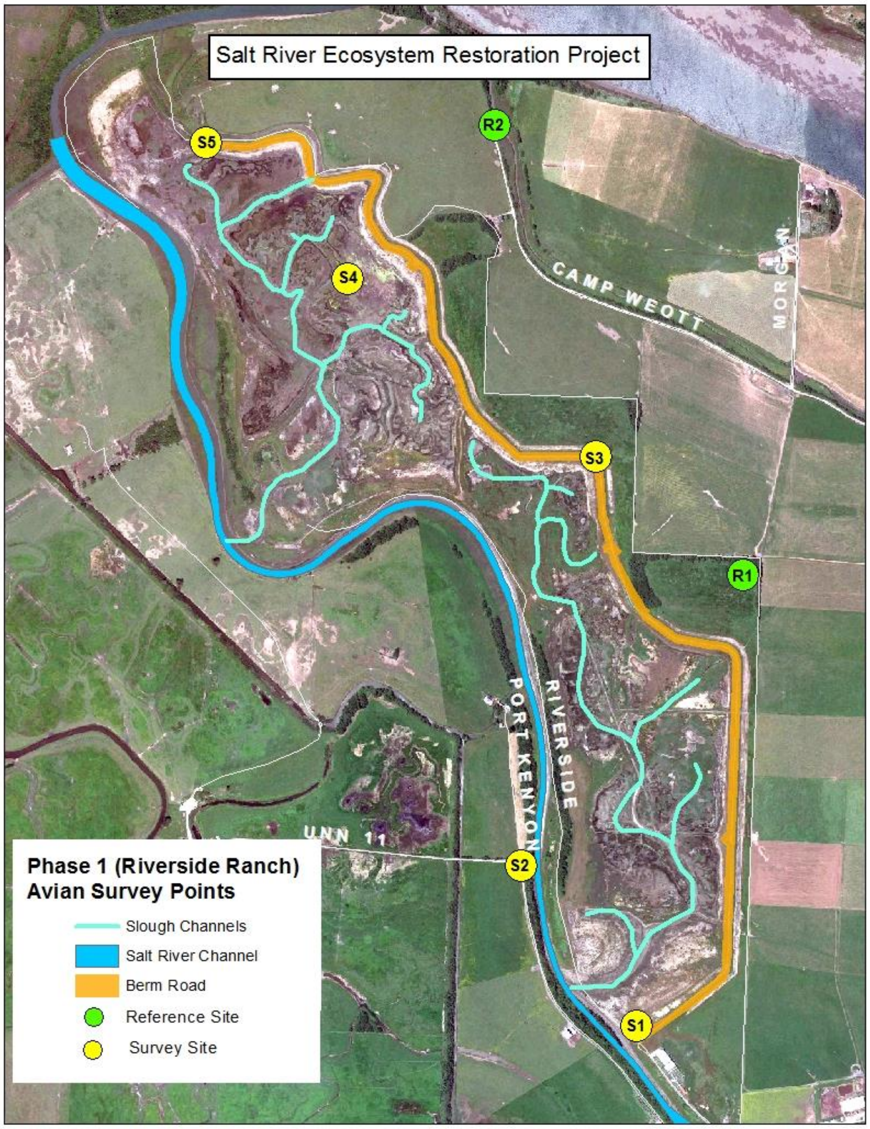


Figure 8. Avian Survey Site Location Map

Of the 54 species detected, one (1) is listed as *Species of Special Concern* (SSC) by the California Department of Fish and Wildlife or as *Threatened* (T) or *Endangered* (E) under the California Endangered Species Act. This species is underscored in Table 1, below. Two (2) of the species detected, denoted below with an asterisk (*), were only observed while flying over the project area and were not associating with the surveyed habitats. Other flyover birds were actively foraging (e.g., swallows) or hunting (raptors) while in flight over the project area.

Table 4: All Species Detected with Relative Abundance (total count) for Year 5 (2018) – Phase 1 (Riverside Ranch). Table continues on next page.

Common Name	Species Name	Relative Abundance
Allen's Hummingbird	*Selasphorus sasin*	1
American Goldfinch	*Carduelis tristis*	28
American Robin	*Turdus migratorius*	5
Anna's Hummingbird	*Calypte anna*	2
Band-tailed Pigeon	*Patagioenas fasciata*	17
Barn Swallow	*Hirundo rustica*	22
Belted Kingfisher	*Ceryle alcyon*	1
Black Phoebe	*Sayornis nigricans*	8
Black-bellied Plover	*Pluvialis squatarola*	8
Black-capped Chickadee	*Poecile atricapillus*	17
Black-headed Grosbeak	*Pheucticus melanocephalus*	3
Brewer's Blackbird	*Euphagus cyanocephalus*	10
Brown-headed Cowbird	*Molothrus ater*	27
Bullock's Oriole	*Icterus bullockii*	1
Canada Goose*	*Branta canadensis*	2
Chestnut-backed Chickadee	*Poecile rufescens*	1
Common Raven	*Corvus corax*	53
Common Yellowthroat	*Geothlypis trichas*	3
Double-crested Cormorant*	*Phalacrocorax auritus*	12
Downy Woodpecker	*Picoides pubescens*	3
Eurasian Collared-Dove	*Streptopelia decaocto*	9
European Starling	*Sturnus vulgaris*	2
Great Blue Heron	*Ardea herodias*	2
Great Egret	*Ardea alba*	14
Greater Yellowlegs	*Tringa melanoleuca*	46
House Finch	*Carpodacus mexicanus*	12
Killdeer	*Charadrius vociferus*	3
Least Sandpiper	*Calidris minutilla*	339
Long-billed Dowitcher	*Limnodromus scolopaceus*	1
Mallard	*Anas platyrhynchos*	8
Marsh Wren	*Cistothorus palustris*	21

Mourning Dove	*Zenaida macroura*	1
Northern Flicker	*Colaptes auratus*	7
Northern Harrier	*Circus cyaneus*	3
Orange-crowned Warbler	*Vermivora celata*	3
Osprey	*Pandion haliaetus*	1
Pacific-slope Flycatcher	*Empidonax difficilis*	2
Peregrine Falcon	*Falco peregrinus*	1
Red Knot	*Calidris canutus*	1
Red-tailed Hawk	*Buteo jamaicensis*	1
Bryant's Savannah Sparrow	*Passerculus sandwichensis alaudinus*	25
Semipalmated Plover	*Charadrius semipalmatus*	101
Short-billed/Long-billed Dowitcher	*Limnodromus sp.*	11
Song Sparrow	*Melospiza melodia*	65
Swainson's Thrush	*Catharus ustulatus*	10
Tree Swallow	*Tachycineta bicolor*	6
Turkey Vulture	*Cathartes aura*	33
Unidentified Hummingbird	*Trochilidae (gen, sp)*	1
Unidentified small shorebird	*#N/A*	127
Virginia Rail	*Rallus limicola*	1
Western Gull	*Larus occidentalis*	3
Western Sandpiper	*Calidris mauri*	211
White-crowned Sparrow	*Zonotrichia leucophrys*	21
White-tailed Kite	*Elanus leucurus*	6
Wilson's Warbler	*Wilsonia pusilla*	3
Wrentit	*Chamaea fasciata*	8
	TOTAL	**1,333**

* Star indicates individual species flying over monitoring sites with no association with the immediate surrounding habitat

__ Underlined species indicates a California Species of Special Concern

Fourteen point count surveys performed across seven monitoring sites in June and July of 2018 showed that species richness averaged 16.6 species per survey date across all seven sites (range 11 to 20). Species richness averaged 15 species per survey date across the two reference sites. Survey sites averaged 15.4 species per survey date across the five survey sites (Figure 9). Additional analysis of average species richness in 2018 per survey point is shown in Figure 10.

From the 14 point count surveys, relative abundance averaged 95.2 birds per site across all seven monitoring sites. Reference sites averaged lower at 55.5 birds per site while survey sites averaged significantly higher at 111.1 birds per site. A further breakdown of average relative abundance per site for each monitoring date is shown in Figure 11. This figure shows that while most monitoring sites ranged with an average of 34.5 to 65.5 of individuals detected, site S4 soars above the others with an average 373 individuals. More birds were detected across all sites in July (1,072) than in June (261).

Figure 9. Comparing Average Relative Abundance and Average Species Richness Between Reference and Survey Sites for Year 5 (2018) – Phase 1 (Riverside Ranch)

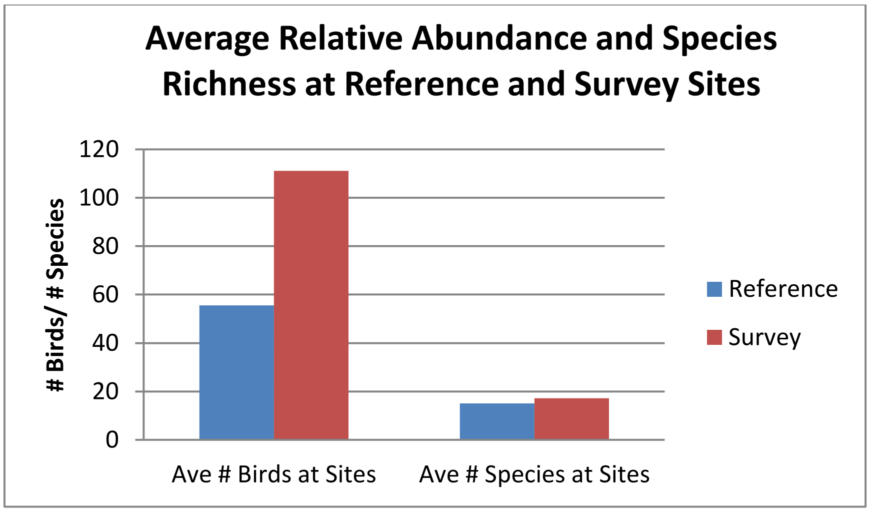


Figure 10. Average Species Richness at All Sites for Year 5 (2018) – Phase 1 (Riverside Ranch)

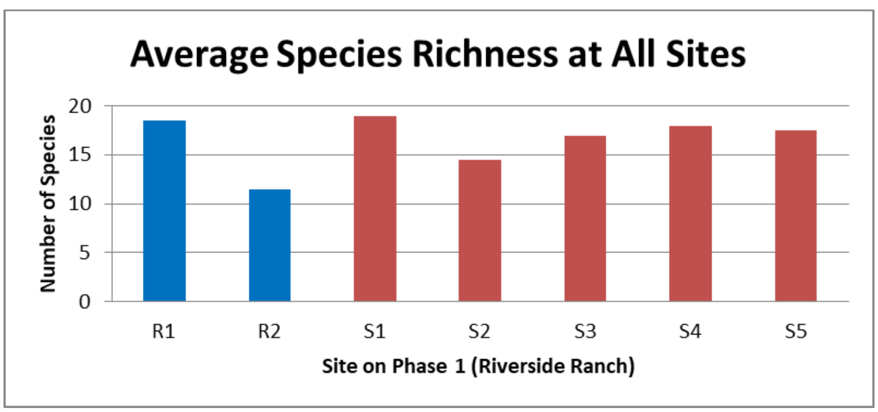
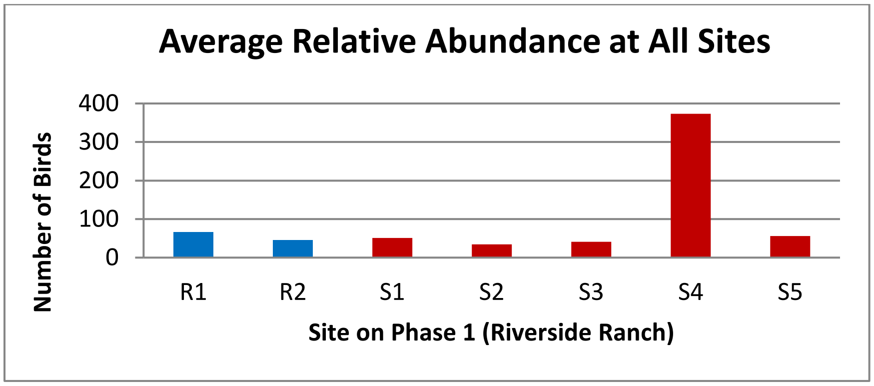


Figure 11. Average Relative Abundance at All Sites for Year 5 (2018) – Phase 1 (Riverside Ranch)



WILDLIFE

Monitoring Task: Salmonid and Tidewater Goby Monitoring

Agencies/Acts: Coastal Commission

Compliance Documents: Coastal Development Permit- Special Conditions 12, 13; SRERP Habitat Mitigation and Monitoring Plan and the Adaptive Management Plan

Description: Survey for presence of salmonids and tidewater gobies on Phase 1 in the spring through summer months.

Goals:

- Surveys will show that salmonids and tidewater gobies will utilize the restored Salt River main channel and the tidal slough networks.

Report: Salt River Ecosystem Restoration Project Fish Monitoring Program 2018. Results of fish species presence and distribution monitoring conducted from April to July, 2018 within the Salt River, Eel River Estuary, Phase 1 and 2 Project areas, Humboldt County California. Prepared By Doreen Hansen of the Humboldt County Resource Conservation District.

Methods: The California Department of Fish and Wildlife, Humboldt State University, and the Humboldt County Resource Conservation District led and/or participated in the fish monitoring program.

Once a month, from April to July 2018, sites across the restored portions of Phase 1 and Phase 2 (Figure 12) of the Salt River Ecosystem Restoration Project were surveyed for salmonids and tidewater gobies during low tide periods. Thirteen (13) sites on Phase 1 and constructed portions of the Phase 2 restoration areas were selected for fish presence and distribution monitoring. These sites represent the diversity of channel size and habitats in the main Salt River channel and in the slough networks. Each tidally influenced site was sampled using a 1/8th inch mesh pole seine net. Typically a single pass with an 1/8 inch seine was made at each site. Sites located further up the river channel were sampled by minnow traps deployed for at least an hour. These sites were not seined if it was determined ineffective due to narrow channel size.

Captured fish were held in aerated buckets, identified to species, counted, and released back into the waterway. Additionally, juvenile salmonids were measured, held in a recovery bucket, and then released back into the waterway. Captured non-native pike minnow were enumerated into 100 millimeter size classes by visual estimation, and were humanely euthanized and buried via permit requirement. A start time, end time, and air and water temperatures, measured by thermometer, were recorded for each minnow trap and seine deployment. In previous years, minnow traps were deployed at each site but results did not significantly add further information to the seining effort, thus minnow trapping has since been limited to specific sites.

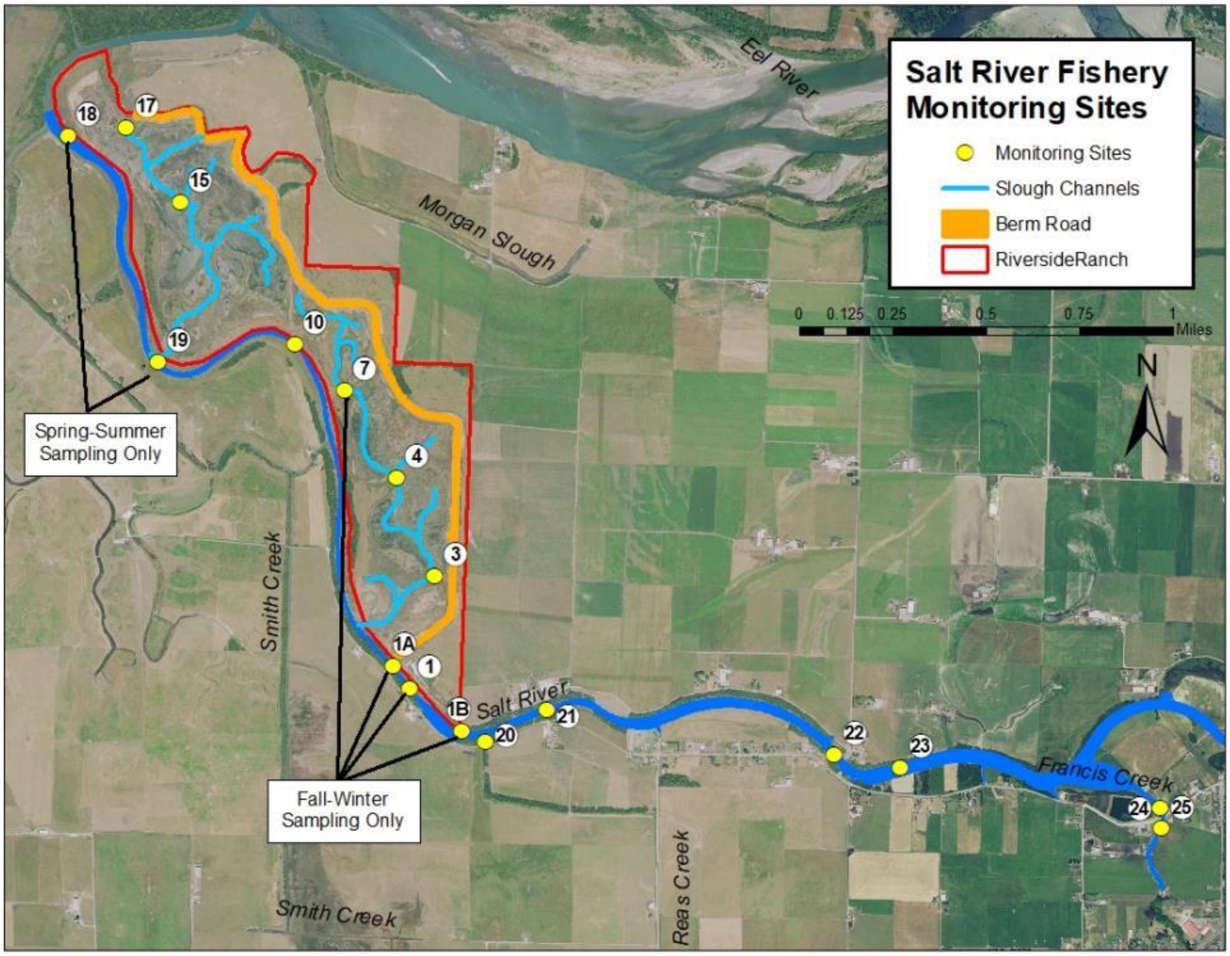


Figure 12: Fish Monitoring Sites Across Phase 1 and 2 of the Salt River Ecosystem Restoration Project (2018)

Results and Discussion: Over the five month sampling period, water temperatures ranged between a maximum of 22.8°C (June) and a minimum of 9.7°C (April). Availability of a water quality meter limited salinity measurements to June and July. Average salinity was 24.8 ppt in the estuary and 0.2 ppt upstream of Reas Creek. Dissolved oxygen was also measured during the surveys and each month's average ranged between a maximum of 14.7 ppm and a minimum of 7.0 ppm (100% oxygen saturation is 10.0 ppm). The dissolved oxygen maximum value is beyond a maximum level, though dissolved oxygen probes are notorious for reading above 10.0 ppm.

Seining and minnow trapping efforts at the 13 fisheries monitoring sites identified the presence of 15 species. Approximately 6,903 individuals were captured (approximate numbers in 2018 were often estimated during the capture of large numbers of three-spined stickleback, staghorn sculpin, topsmelt, and unidentified shrimp). The following table (Table 5) presents the total number of fish and marine invertebrates sampled from

April to July in 2018 (Ross Taylor and Associates completed the March survey and those results are presented in the fall-winter report "Fisheries Sampling in the Lower Salt River during the Fall and Winter of 2017-2018" (Taylor 2018)).

Eight Coho salmon (*Oncorhynchus kisutch)* juveniles were present during the April and July monitoring efforts and two Chinook salmon (*Oncorhynchus tshawytscha*) were captured in May. Salmonids were captured in the tidal marsh area and in the main channel Salt River. In July, a juvenile Coho salmonid was captured in a deep pool in Francis Creek.

In previous years immediately after construction of the tidal marsh in 2013, tidewater gobies (*Eucyclogobius newberryi)* were abundant at the southern slough channel terminal arms, where over a hundred individuals would be caught in one sampling period (month). In 2018, only 5 tidewater goby individuals were sampled during the sampling season (down from 15 individuals in 2017). The low numbers are likely due to degraded or loss of backwater habitat, caused by anticipated tidal regime impacts of sedimentation and/or erosion of channel features within the created slough channels at three sites. These sites previously held high concentrations of tidewater goby and have now been abandoned as fish sampling sites. The 2018 captured tidewater gobies occurred at sites 15 and 17.

Multiple marine species were present in the estuary portion of the Project area. Most marine species were captured in the estuary slough channels, both in the northern (sites 15 and 17) and southern (sites 3 and 4) slough networks. Marine species include: Bay Pipefish *(Syngnthus leptorhynchus*), Dungeness crab (*Metacarcinus magister*), English Sole (*Parophrys vetulus*), Pacific Herring (*Clupea pallasii*), Saddleback Gunnel (*Pholis ornate*), Shiner Surfperch (*Cymatogaster aggregata*), Starry Flounder (*Platichthys stellatus*), and Topsmelt (*Atherinops affinis*).

Table 5: Number of individual fish captured by each month's fish survey efforts in 2018

	2018				
Common Species Name	**April**	**May**	**June**	**July**	**TOTAL**
Tidewater Goby	0	1	1	3	**5**
Coho	7	0	0	1	**8**
Chinook	0	2	0	0	**2**
Bay Pipefish	0	0	0	1	**1**
California Roach	0	0	0	1	**1**
Dungeness Crab	0	2	0	24	**26**
English Sole	0	0	1	1	**2**
Pacific Herring	0	0	0	1	**1**
Sacramento Pikeminnow (<100mm)	49	65	0	60	**174**
Saddleback Gunnel	0	0	0	1	**1**
Shiner Surf Perch	0	0	5	2	**7**
Staghorn sculpin	95	503	38	12	**648**
Starry Flounder	0	41	15	5	**61**
Three-Spined Stickleback	57	1682	1585	1280	**4604**
Topsmelt	0	0	100	765	**865**
Unidentified Sculpin	40	0	0	0	**40**
Unidentified Flatfish	0	2	0	0	**2**
Unidentified Shore Crab	0	0	7	45	**52**
Unidentified Shrimp	0	403	0	0	**403**
TOTAL	**248**	**2701**	**1752**	**2202**	**6903**

Numbers of staghorn sculpins (*Leptocottus armatus)* continue to increase in numbers since 2014 within the Project area; zero in 2014, zero in 2015, 148 in 2016, 212 in 2017, and 648 in 2018. Three-spined stickleback (*Gasterosteus aculeatus*) continue to be captured in the thousands of individuals. The number of Sacramento pikeminnow (*Ptychocheilus grandis*) dramatically decreased from 2017 to 2018. This may be due to the lower precipitation through the winter and spring creating higher salinity habitat throughout a majority of the Project area, greatly reducing their presence in the estuary. An abundance of Starry flounder (*Platichthys stellatus*), 30 individuals, were captured at site 3 during the May survey effort.

GEOMORPHIC

Monitoring Task: Restoration Documentation Photos

Agencies/Acts: Coastal Commission

Compliance Documents: SRERP Habitat Mitigation and Monitoring Plan

Description: Perform qualitative documentation of the restoration with feature and landscape photos such as stream profile, floodplain, and riparian conditions.

Goals:

- Photo point monitoring will be used to qualitatively document pre- and post-project visual changes at restoration sites.

Report(s): Salt River Ecosystem Restoration Project – Photo Monitoring - 2018. Prepared by HCRCD

Methods: Photo monitoring was performed across the Phase 1 and the completed Phase 2 footprint by a staff member of the HCRCD.

Seven photo monitoring sites were established across Phase 1 and eight across the completed Phase 2 channel corridor (Figure 13). Photos were taken prior to construction and annually post construction. Handheld GPS units were used to navigate to photo point sites. The compass direction of the photo was recorded and aligned with previous photo elements. Post-project photos will be taken during the same season or month as pre-project photos (Fall/Winter, November/December).

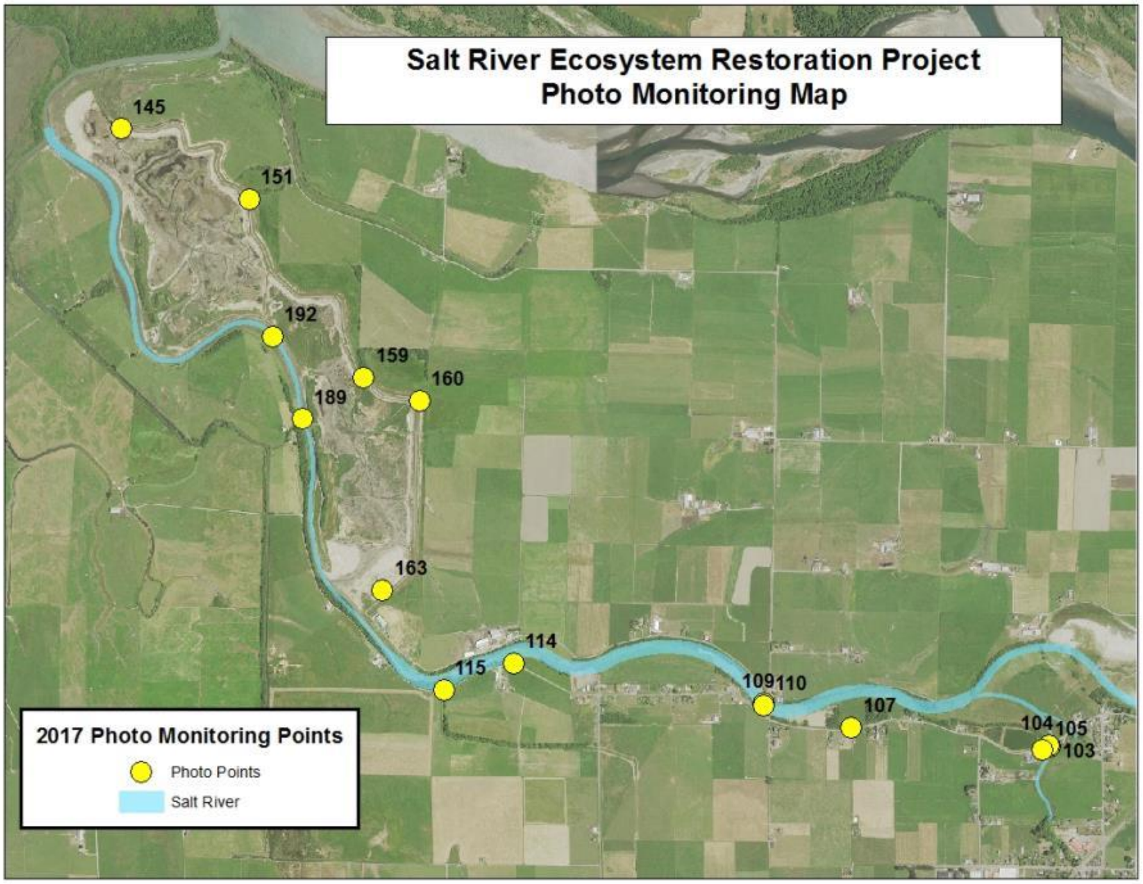


Figure 13: Photo Monitoring Points for the Constructed Footprint - 2018

Results and Discussion: A total of 15 photo point sites are established across the Phase 1 and the completed portion of the Phase 2 project area. Pre-construction and post-construction photos have been recorded. The following five photo points are a sample of the 15 sites described in the two photo monitoring reports cited above.

PP145 – SW – Nov 2013

PP145 – SW – Nov 2015

PP145 – SW – Oct 2018

PP159 – SW Pine – Nov 2013

PP159 – SW Pine – Nov 2015

PP159 – SW Pine – Oct 2018

PP115 – Reas Ck – Jul 2011

PP115 – Reas Ck – Nov 2014

PP115 – Reas Ck – Oct 2018

PP109 – Dillon Br W – Nov 2014

PP109 – Dillon Br W – Nov 2015

PP109 – Dillon Br W – Oct 2018

PP103 – Up Strm – Apr 2017

PP103 – Up Strm – Dec 2017

PP103 – Up Strm – Oct 2018

Vegetation continues to establish on Phase 1 and 2 where seed mixes are persisting and natural recruitment of natives and non-natives are evolving. Some sites are experiencing increasing canopy cover where much of the restored area is obscured.

<u>GEOMORPHIC</u>

Monitoring Task: Cross Sectional and Longitudinal Surveys- Phase 1 - Riverside Ranch Erosion and Sediment Deposition Surveys

Agencies/Acts: Coastal Commission, and California Environmental Quality Act (CEQA)

Compliance Documents: Coastal Development Permit- Special Conditions; Salt River Ecosystem Restoration Project Final Environmental Impact Report (FEIR); and Salt River Ecosystem Restoration Project Adaptive Management Plan

Description: Cross-sectional and longitudinal profile surveys are performed across and along the main channel Salt River and slough channels.

Goals:

- Cross-sectional and longitudinal surveys will describe how the channel is remaining consistent with restoration designs, or if areas are aggrading or eroding to the point of intervention.

Report: Salt River Ecosystem Restoration Project Post-Construction Geomorphic Channel Survey Report, Phase 1, Year 5 - 2018, prepared by Daniel O'Shea and Melissa Kobetsky

Methods: The following is an excerpt from the 2018 Geomorphic Channel Survey Report:

For the 2018 survey, "*…a Nikon DTM-352 Total Station laser theodolite, tripod, prism pole and single prism were used. Elevations are geo- referenced, in feet, to the 1988 North American Vertical Datum (NAVD88) based on corrected positions from survey benchmarks SR11 and SR14 (Appendix VIII). Horizontal locations were determined using GPS North American Datum 1983 (NAD83) in decimal degrees.*

A total of nine cross-section survey transects and benchmarks were established in 2014, with 3 profiles on the main stem Salt River (SR), the North slough channel (NC), and the South slough channel (SC). Data for cross-section transects has been collected annually from 2014 to 2018. All cross sections are GPS referenced (NAD83) to the survey benchmarks and original endpins (e.g. SR1, SC1, NC1, etc.) are monumented with ½" rebar and orange caps. Due to disturbance, biofouling and/or burial, several endpins were not re-occupied and transects were located using GPS coordinates and True north azimuth direction (14.5°E declination). Endpins and locations that were determined by GPS were marked with three foot wooden stakes to facilitate exact re-location in future surveys.

Cross-section elevations and distances were collected across the flood plain, channel slope, vegetation edge, water's edge, thalweg and channel- with a minimum of eight points within the channel between vegetation edges. Between 15 and 32 elevation points were collected per cross section depending on the size and morphological complexity of the channel, floodplain and banks. Flood plain measurements were collected up to 200-feet on either side of the main channel, with the exception of the south bank of SR3 due to dense vegetation and restricted access to private land. Cross section profiles are viewed from the west (or north) with the zero-point on the left-side of the graph and extending up to 400 feet toward the south (and east). The discussion refers to left bank and right bank when viewed looking downstream.

Longitudinal profiles extended parallel to channel flow following the thalweg and were conducted on the main-stem Salt River (SRL), the North slough channel (NCL), and of the South slough channel (SCL). The prism pole was placed in the thalweg approximately every 200-feet along the survey length. The SRL extended 12,000ft from cutoff slough to the Phase 1 excavation boundary near the Riverside Ranch barn. NCL and SCL profiles began at the confluence of the main-stem Salt River and extended upstream 2,000ft and 4,800ft respectively" (Figure 14).

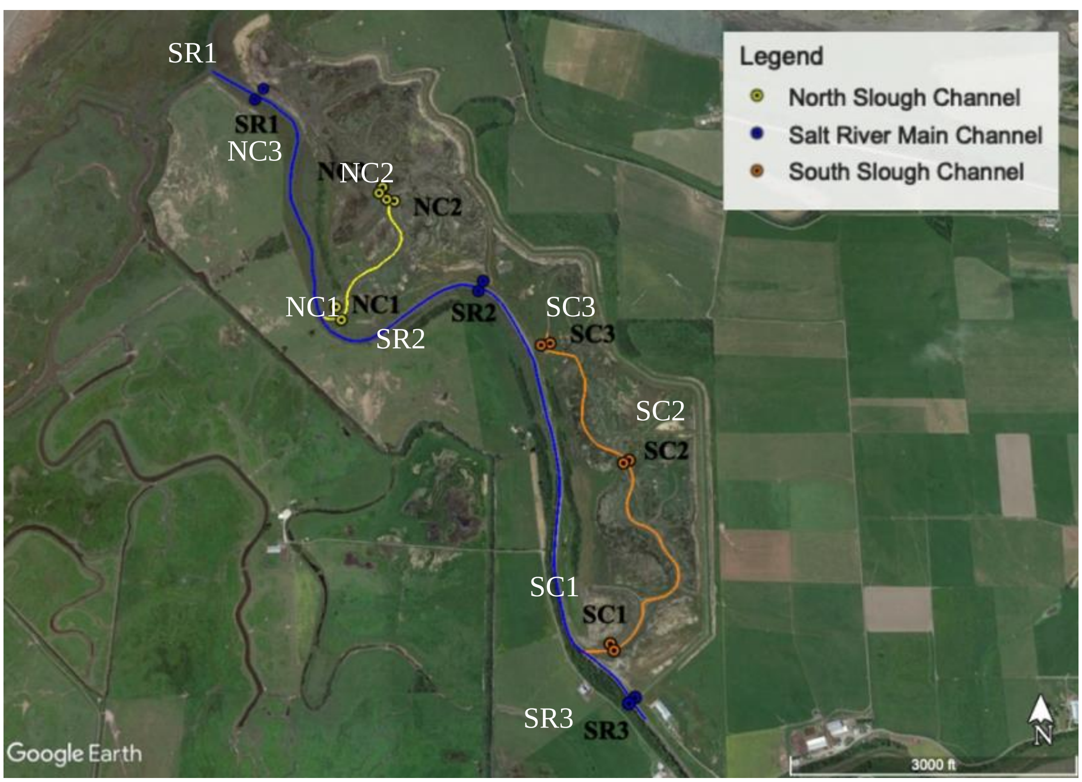


Figure 14: Location of the cross section and longitudinal profiles on Phase 1 for Salt River Ecosystem Restoration Survey Project, 2018.

Results and Discussion: Results are summarized from the monitoring report in the following narrative and in Figures 15 – 24. Cross-sections determine the width and depth of the channels. The following are the cross-sectional and longitudinal profiles for the Salt River main channel and the southern and northern slough channel network from the designed channel in 2013 to the adjusted channel profiles from 2014 to 2018.

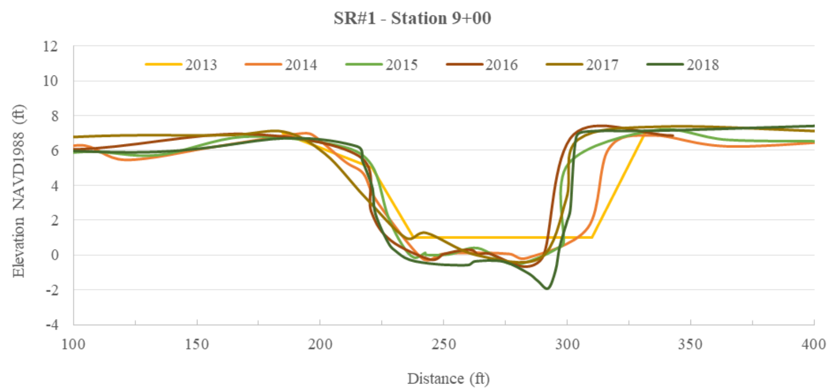


Figure 15: Salt River Cross-Section #1 (SR1)

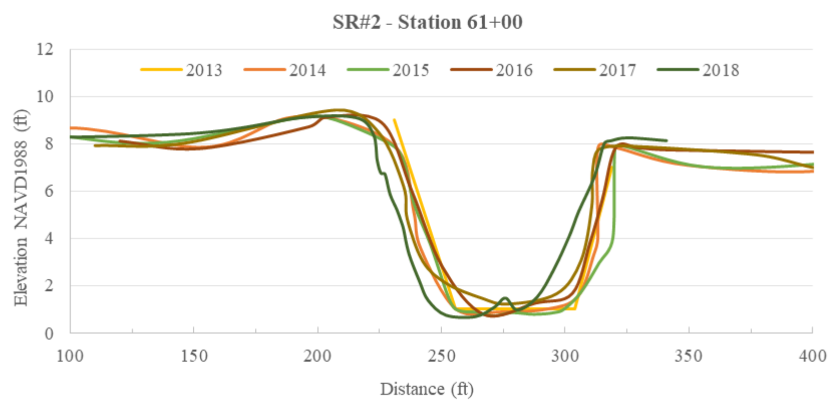


Figure 16: Salt River Cross-Section #2 (SR2)

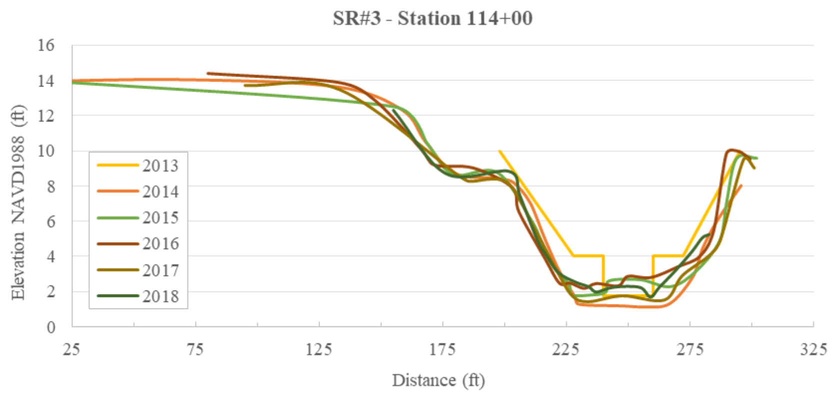


Figure 17: Salt River Cross-Section #3 (SR3)

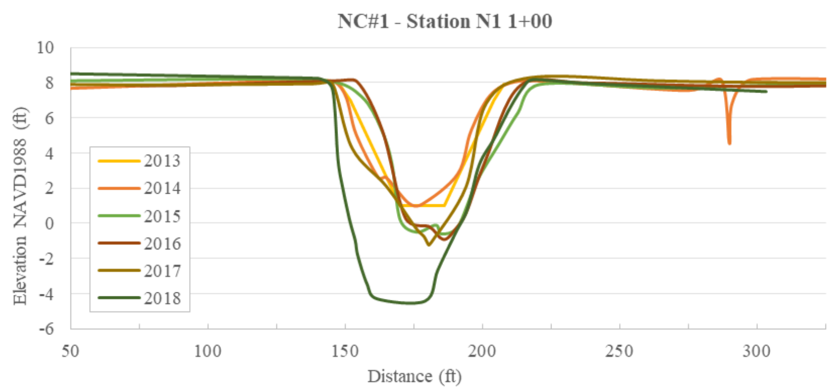


Figure 18: Slough North Channel Cross-Section #1 (NC1)

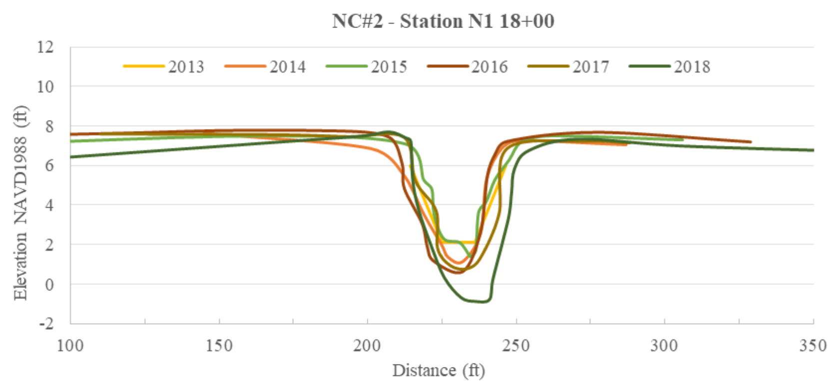


Figure 19: North Slough Channel Cross-Section #2 (NC2)

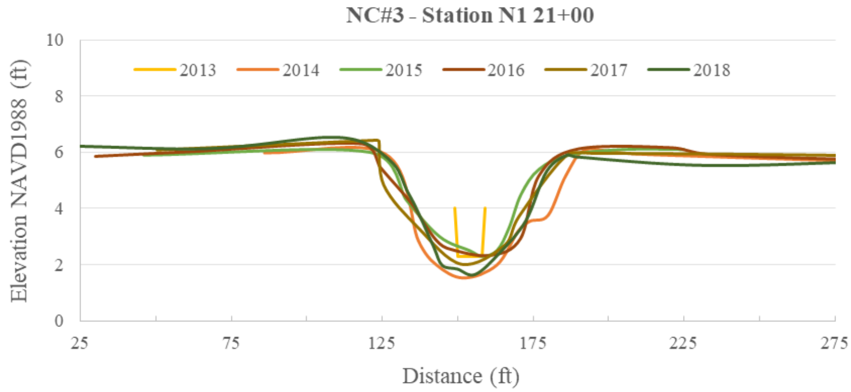


Figure 20: North Slough Channel Cross-Section #3 (NC3)

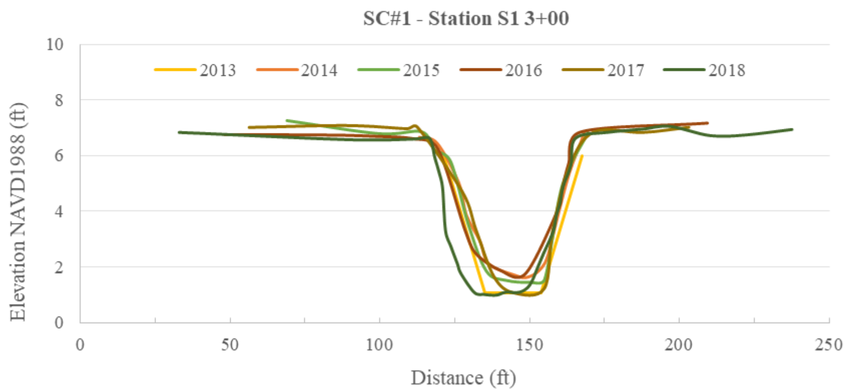


Figure 21: South Slough Channel Cross-Section #1 (SC1)

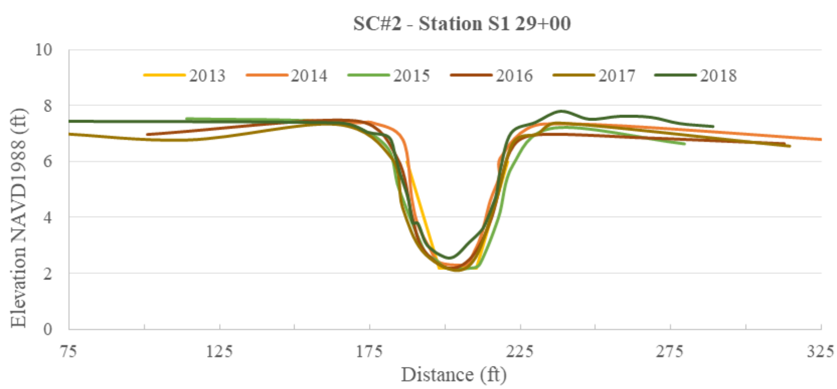


Figure 22: South Slough Channel Cross-Section #2 (SC2)

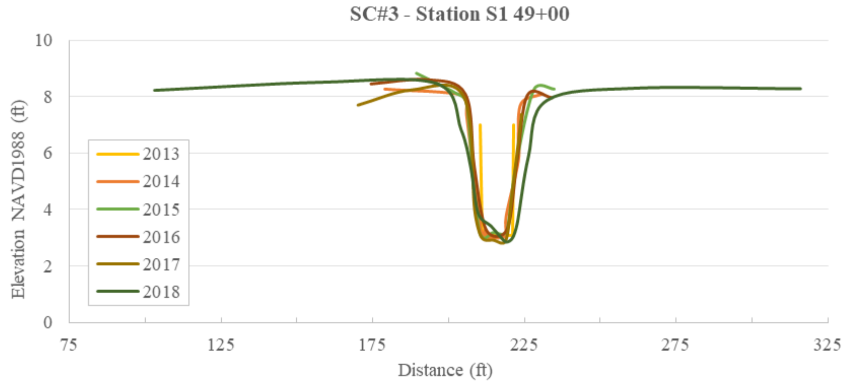


Figure 23: South Slough Channel Cross-Section #3 (SC3)

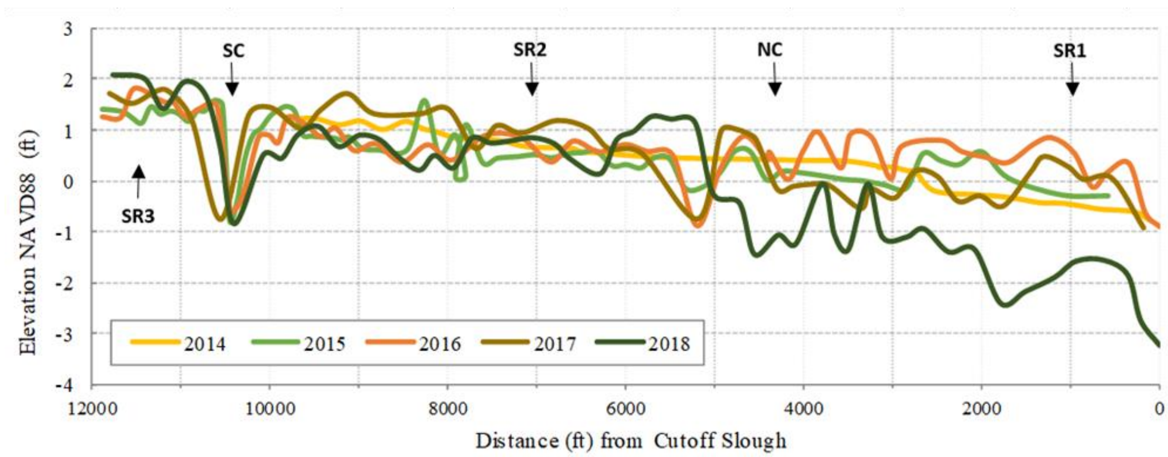


Figure 24: 2018 Salt River Longitudinal Profile - SR1, SR2 and SR3 are locations of cross sections; NC and SC are the approximate locations of the confluence with the North and South slough channels, respectively.

The 2018 cross-sectional and longitudinal surveys indicate trends of decreased channel elevation and net sediment transport out of the channel reaches, which is similar to past survey results. Results primarily indicate that channel geometries occurred vertically rather than laterally as the data show smaller variation in cross-sectional channel widths compared to channel depths.

Salt River Main Channel - Prominent channel bed erosion continues in the lower main stem Salt River (SR) below the northern slough channel (NC) confluence and immediately below the southern slough channel (SC) confluence, with up to 1.5 feet of elevation loss near Cutoff Slough. Deposition continues to occur in the upper reaches of the Salt River. All cross-sections indicate a formation of a mid-channel bar while elevations are lower near the toes of the bank. SR3 experienced an average of 4.5 inches of uniform deposition across the wetted width of the channel.

Northern Slough Channels – The downstream NC1 cross-sectional area experienced considerable channel bottom erosion as well as bank sloughing of the outside bend on river left. Bank erosion and channel deepening also occurred at NC2 with erosion around an installed log structure. NC3 had both minor erosion and deposition.

Southern Slough Channels - Scour is consistent through the southern slough channel. Average elevation loss in the longitudinal profile was 4 inches with more pronounced degradation in the upstream half of the reach. SC1 channel bottom elevation appears to be relatively stable, though lateral migration of the west bank occurred; likely due to bank slumping. SC2 had an approximate 5 inches of uniform deposition across the channel bottom while channel width and bank slope remained stable. SC3 experienced little change in channel dimension, though had an average of 2 inches of deposition from mid-channel to left bank.

Salt River Longitudinal Profile - The total relief on the 11,900-foot longitudinal profile section of the main Salt River channel surveyed in 2018 was 3.672 feet, yielding an average gradient of 0.3% per thousand feet, which is a 0.01% increase from 2017. The dominant trend in the main channel longitudinal profile was scouring, most notably between 0 and 3,000ft which had a 1.41ft lower average elevation than 2017. In contrast, an average of 1ft of deposition occurred from 5,000 to 6,000ft upstream from Cutoff Slough. Considerable channel deepening was observed at 4,500ft near the NC confluence, which has consistently scoured since the beginning of surveying in 2014.

The SRERP's Adaptive Management Plan identifies a 10% change in channel capacity as a trigger level for potential management actions. Six of the nine cross-sections have experienced over a 10% change in channel capacity as compared to the base channel geometry of 2014 (Table 6), three of which (NC1, NC2, and SC3) are over 5 times the trigger level. However, it is prudent to review past years' percent changes in channel capacity and recognize the dynamics of the system. Starting at the most downstream site, SR1, on the main channel Salt River, near the confluence of Cutoff Slough, has experienced a 13% reduction in channel capacity but has been steadily increasing its capacity to a level that is similar to 2014's capacity. The capacity of SR2 has fluctuated from an increase to a decrease of capacity from 2015 to 2018. SR3 has also fluctuated in capacity over the years, though in 2018, it experienced its largest decrease in capacity. SR3 is just downstream of Reas Creek which provides heavy sediment inputs. Francis Creek was also connected to the Salt River channel for the first time in 2017; those sediments may contribute to the deposition at this site. The majority of the lower reach in the main northern slough channel network has steadily increased in capacity, or fluctuated with an increasing trend. NC1 is significantly adjusting to a larger capacity size over the years with channel bottom scour and bank erosion on the outside channel bend. NC2 has fluctuated across the years with considerable increases and decreases in channel capacity since 2014; however, NC2 has significantly increased by 55% since

2017 with channel bottom scour and migration of the right bank. NC3 has fluctuated from a drastic decrease in channel capacity in 2015, then increased across 2016 and 2017, and again decreased slightly in 2018. In the southern slough channel network, the SC1 site has increased in capacity over the last three years, though it experienced a notable 27% increase from 2017 to 2018 with erosion of the left lower bank. This site experiences small to large fluctuations in capacity size across the years, and it doesn't seem to be dependent on the severity of the hydrologic year. The SC2 experienced a large capacity increase in 2015 and has steadily decreased in capacity since then and is nearly the same capacity as in the 2014 base year. SC3 has increased its capacity across the last 3 years, but 2018 experienced a large increase with both banks shifting laterally outward. Ultimately, the Salt River main channel appears to fluctuate mildly each year. The interior slough channels are continually adjusting yet still remain hydraulically functional, though it would be prudent to keep an eye on the northern slough channel network, especially at its confluence with the Salt River; specifically observing the south bank of the Salt River and noting if excessive erosion is occurring due to the change of the slough channel outflow.

Table 6. Change in Channel Capacity Since 2014

	Percent Change in Capacity (+/-)*			
Cross Section	**2015**	**2016**	**2017**	**2018**
SR1	- 13	- 13	- 11	- 4
SR2	+ 5	- 9	+ 9	- 4
SR3	- 8	- 9	+ 3	- 16
NC1	+ 20	+ 21	+ 31	+ 128
NC2	+ 5	+ 20	+ 8	+ 63
NC3	- 31	- 19	- 12	- 17
SC1	- 20	+ 1	+ 5	+ 32
SC2	+ 43	+ 16	+ 25	+ 5
SC3	- 7	- 1	+ 2	+ 51

* A negative (-) value denotes a decrease in channel capacity compared to the 2014 channel geometry. A positive (+) value denotes an increase in channel capacity compared to the 2014 channel geometry.

Though this is the fifth year of surveys on Phase 1, Riverside Ranch, of the Salt River Ecosystem Restoration Project, sediment erosion, transport, and deposition, have not equalized and it is likely to continue to evolve in response to the implementation of upstream restoration that will introduce more sediment inputs into the system, while at the same time bringing in larger volumes of water as the project connects the last remaining and largest upstream tributary.

<u>GEOMORPHIC</u>

Monitoring Task: Cross Sectional and Longitudinal Surveys-Salt River Channel Corridor –Phase 2 - Erosion and Sediment Deposition Surveys

Agencies/Acts: Coastal Commission, and California Environmental Quality Act (CEQA)

Compliance Documents: Coastal Development Permit- Special Conditions; Salt River Ecosystem Restoration Project Final Environmental Impact Report (FEIR); and Salt River Ecosystem Restoration Project Adaptive Management Plan

Description: Cross-sectional and longitudinal profile surveys are performed across and along the main channel Salt River.

Goals:

- Cross-sectional and longitudinal surveys will describe how the channel is remaining consistent with restoration designs, or if areas are aggrading or eroding to the point of intervention.

Report: *No report submitted. Data results were submitted to the Humboldt County Resource Conservation District. Data will be presented in a forthcoming Humboldt State University student's Master's Thesis.*

Methods:

Cross-sectional surveys in the Phase 2 portion of the SRERP on the Salt River (SR) channel span a distance of 2.2 km from upstream of Reas Creek to downstream of the sediment management area at the Francis Creek confluence. Cross-section site locations were previously determined within distinct hydraulic units that experience different flow regimes- intertidal, a combination of intertidal and supratidal, and exclusively freshwater flows (Medel 2015). Only the monument for cross-section seven was reoccupied in 2018; locations for cross-sections one and five were approximated using a handheld Garmin Global Position System (GPS) with an accuracy of ± 10 m.

Elevation points were collected using a Nikon DTM 322 Total Station, tripod, prism pole and reflector in the 1988 North American Datum (NAD88). Two temporary benchmarks were monumented at each cross-section by 2-foot wooden stakes with a 1/16-inch flathead nail pounded into the center to enable total station orientation and a closed loop traverse at each site. Horizontal and vertical benchmark locations were determined using a Trimble Model XX Real-time kinematic GPS calibrated to SRERP control point SR11.

Data for cross-sectional profiles were collected in July 2018 with measurements spanning approximately 200-feet across the channel corridor, including the main channel, with a maximum resolution of 6 meters. Higher densities were collected in the side channel, main channel, active bench and major breaks in slope in order to illustrate morphological complexity. The main channel had the highest resolution and included an elevation point for the thalweg, vegetation edge, waters' edge and at least one mid-bank elevation point in between vegetation and waters' edge, to capture slumps and/or changes in channel slope. NAD88 point cloud data was imported into ESRI ArcMap and horizontal positions were calculated in order to make data comparable to the North American Vertical Datum 1988.

Figure 25: Salt River Phase 2 Cross-Section Sites

Results and Discussion: Nine cross-sections sites were re-occupied and surveyed in the 1.5 miles of the 2014 and 2015 restored reach of the Salt River (Figure 25). The nine sites are divided into three groups or "Units", each Unit consisting of three sites. Unit 1 contains sites 1, 2, and 3 (tidally influenced); Unit 2 contains sites 4, 5, and 6 (tidally influenced); and Unit 3 contains 7, 8, and 9 (freshwater).The following graphs

(Figures 26 to 28) show cross-sections from years 2015, 2016, 2017, and 2018 of sites 1, 5, and 7.

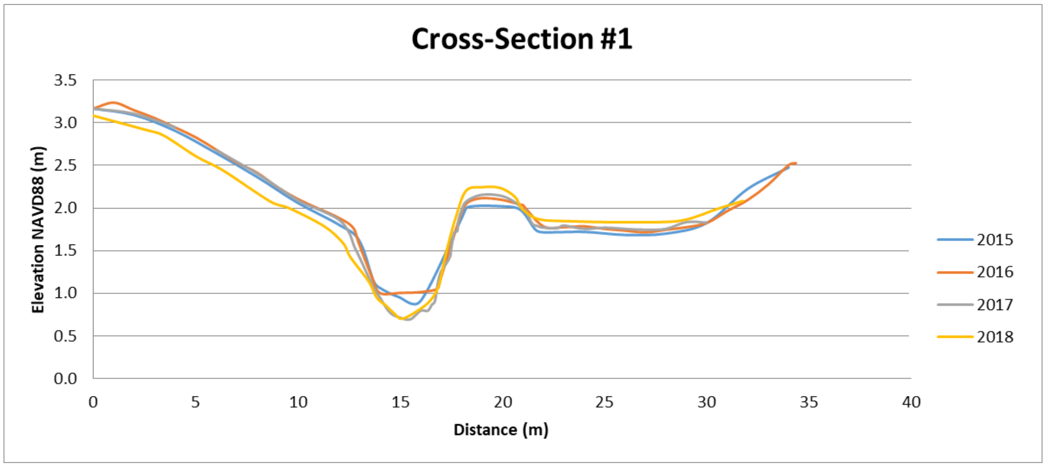


Figure 26: Unit 1 - Site 1 from 2015 to 2018

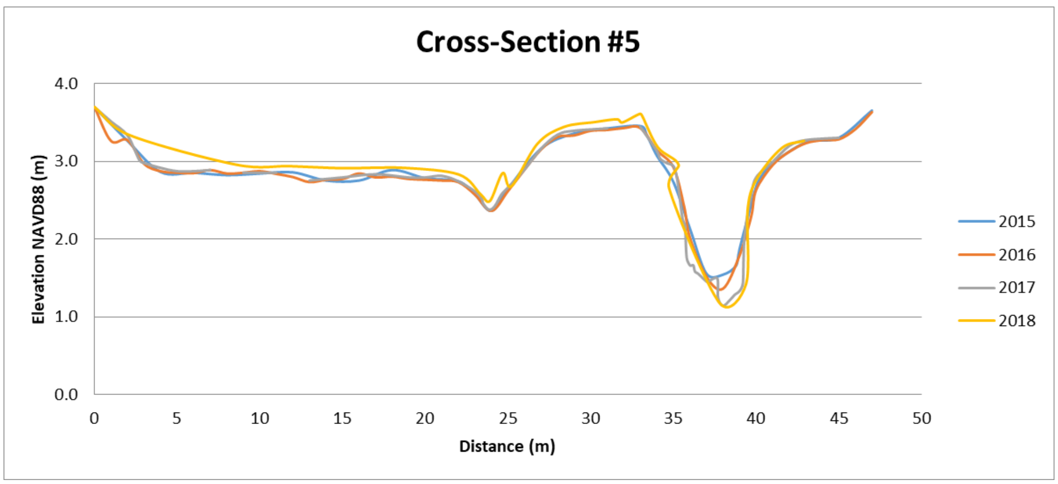


Figure 27: Unit 2 – Site 5 from 2015 to 2018

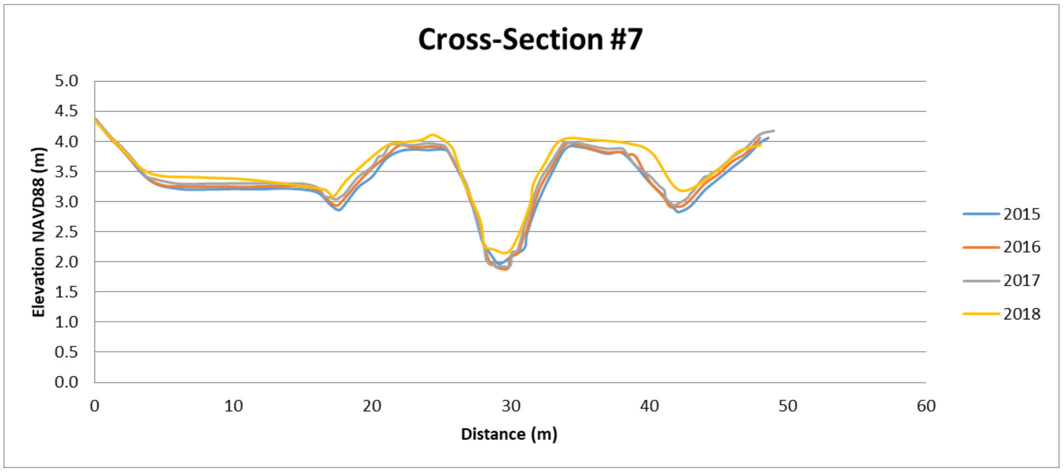


Figure 28: Unit 3 – Site 7 from 2015 to 2018

Comparing the cross-sectional graphs provides a visual indication on how the channel responds to winter periods. The 2015/16 winter was relatively mild, yet typical with a flood event. The 2016/17 winter was extremely wet winter in northern California (NOAA 2017), which included multiple large flood events. This past year's 2017/2018 winter was wetter than the average year by nine inches. In the graphs above, each year's cross-section is compared to the previous.

In the cross-sectional graphs above, elevations differences are noticeable when comparing portions of the recent 2018 cross-section to the previous years' cross-sections. This variability could have resulted from multiple factors. Heavy growth of ground vegetation in the floodplain and on the active berm played a role but measurement variability is likely the main factor. Uncertainty was more likely introduced because: (1) not all cross-section monuments were located therefore a handheld GPS was used to locate, end points which may not have been absolutely accurate; and (2) the data was collected in NAD83 and had to be converted to the vertical datum of NAVD88 that was used in previous years.

The active channel bottom elevation in cross-section site 1 (Figure 26) appears to be at the same elevation as in 2017. The measured elevation of the bank descending down from the left-hand side of the graph likely diverges from previous years' measurements due to measurement or conversion error, rather than erosion. The elevations of the active berm and floodplain on the right-hand side are likely increased due to measurement error or heavy vegetation. Capacity of the active channel has increased by approximately 26%. Though this increase is above the 10% trigger point, the increase in channel capacity appears to be stable since 2016. The recommendation is to continue monitoring, since the upper portion of channel restoration is incomplete and is still awaiting the connection of the watershed's largest tributary.

In cross-section site 5 (Figure 27), the active channel bottom elevation appears to remain at the same elevation as in 2017. The lack of measured elevational points from the thalwag up the left-hand side of the active channel bank may have inadvertently reduced the capacity of the active channel on the graph (i.e. not enough resolution in the area). Secondary channel deposition is identified in the cross-section. This deposition was not present in 2017, but a similar deposition pattern occurred in 2017 in cross-section 8 (within the same unit). The floodplain portion of the graph indicates a rise in elevation, however vegetation and minimal number of cross-section points may have factored into that variability. Capacity of the active channel has increased by approximately 1%. No action is merited given it is below the 10% trigger level, though the secondary channel in this reach of the floodplain should be inspected for deposition.

Cross-section site 7's active channel (Figure 28) appears to have experienced approximately 0.25 meters of deposition, thus increasing the channel bottom elevation. However, the limited number of measured elevational points taken within the channel bottom may have led to that increase in elevation (i.e. not enough resolution of the channel bottom). But consideration should be given to the fact that cross-section 7 is downstream and in close proximity to the confluence of Francis Creek and Salt River. Francis Creek carries a heavy sediment load and the 2017/18 winter was the first time Francis Creek entered the Salt River since monitoring began. However, much of the heavier Francis Creek sediments were captured in a sediment management area. The 2018 secondary channel elevations are also elevated indicating deposition. Capacity of the active channel has decreased by approximately 21%. Though this increase is above the 10% trigger point, the decrease in channel capacity appears to be due to the lack of channel bottom resolution. The recommendation is to verify deposition in the floodplain and continue monitoring since the upper portion of channel restoration is incomplete and is still awaiting the connection of the watershed's largest tributary.

LIST OF AVAILABLE REPORTS

Avian Point Count Survey, Salt River Ecosystem Restoration Project, Phase 1 – Year 5. Prepared by Doreen Hansen (Humboldt County Resource Conservation District) and Sean E. McAllister (Sean E. McAllister & Associates). Eureka, California. 26 October 2018.

Di Liberto, Tom. 2017. Very wet water year ends in California. National Oceanic and Atmospheric Administration (NOAA). https://www.climate.gov/news-features/featured-images/very-wet-2017-water-year-ends-california

H. T. Harvey with Winzler and Kelly. 2012. Salt River Ecosystem Restoration Project Adaptive Management Plan. Prepared for the Humboldt County Resource Conservation District. Eureka, California

H. T. Harvey with Winzler and Kelly. 2012. Salt River Ecosystem Restoration Project Habitat Mitigation and Monitoring Plan. Prepared for the Humboldt County Resource Conservation District. Eureka, California

J.B. Lovelace & Associates. 2018. Annual Habitat Monitoring Report - Salt River Ecosystem Restoration Project, Prepared for the Humboldt County Resource Conservation District.

O'Shea, Daniel and Melissa Kobetsky. Salt River Ecosystem Restoration Project Post-Construction Geomorphic Channel Survey Report, Phase 1, Year 5 – 2018. Prepared for the Humboldt County Resource Conservation District. Eureka, California.

Ross Taylor and Associates. 2018. Fisheries Sampling in the Lower Salt River during the Fall and Winter of 2017-2018. Prepared for the Humboldt County Resource Conservation District. Eureka, California.

Salt River Ecosystem Restoration Project - Fish Monitoring Program 2018. Results of fish species presence and distribution monitoring conducted from March to August, 2017 within the Salt River, Eel River Estuary, Phase 1 and 2 Project areas, Humboldt County California. Prepared By Doreen Hansen of the Humboldt County Resource Conservation District. Eureka, California.

Salt River Ecosystem Restoration Project – Photo Monitoring 2018. Prepared by Humboldt County Resource Conservation District. Eureka, California.