Salt River Ecosystem Restoration Project

Habitat Mitigation and Monitoring Plan
Monitoring Report 2017

Finalized July 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 about 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.
- **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.

- **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.
- **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 would 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, and 2017, a total of 4.7 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 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 2018 and 2019, completing the Salt River corridor restoration.

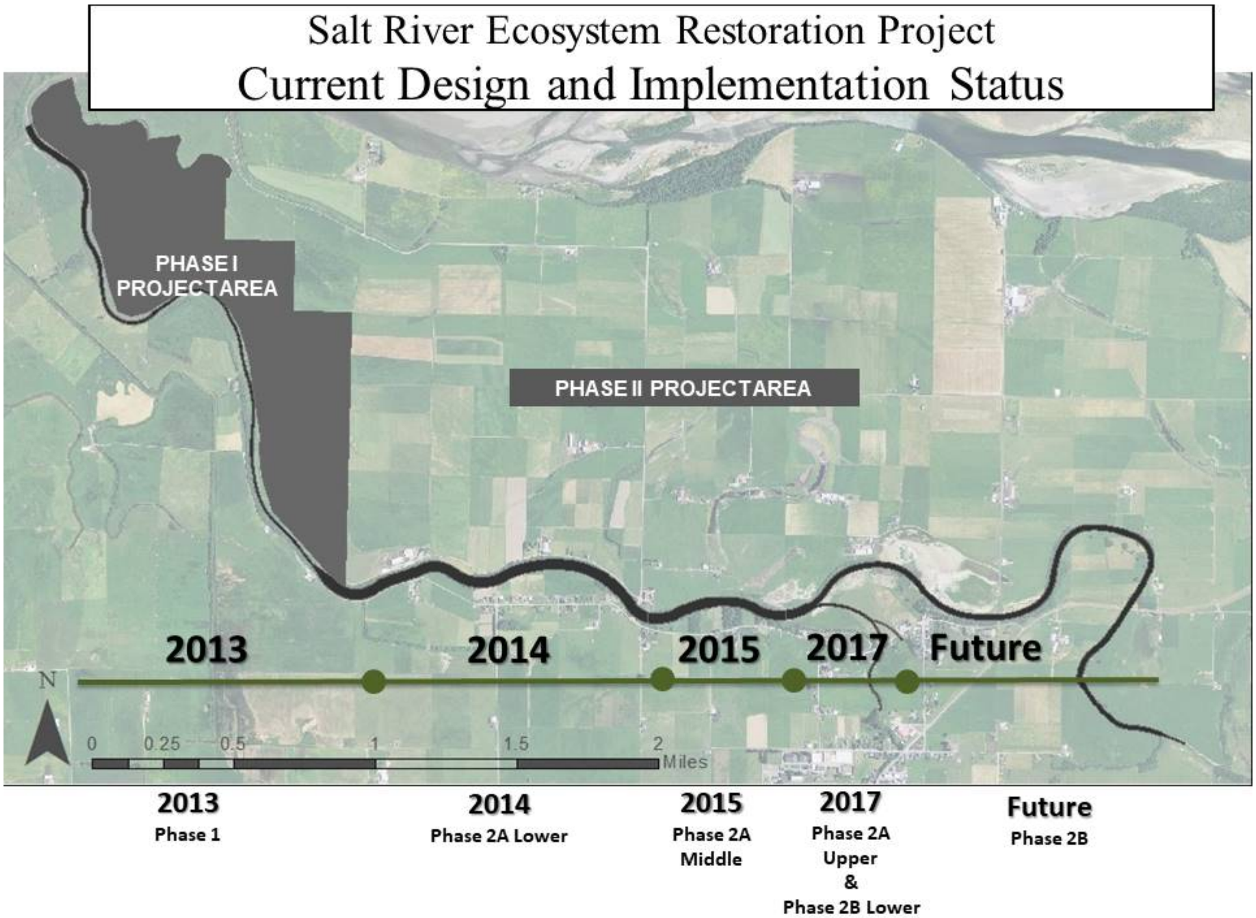

Figure 1: Salt River Ecosystem Restoration Construction Timeline as of 2017

Upon completed construction 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 4 (post construction 2013)
- Phase 2: Year 3 and Year 2 (post construction 2014 and 2015)

As discussed in the General Conclusions section of this report, monitoring results demonstrate the Project is performing successfully and largely meeting Project goals.

SUMMARY OF CONCLUSIONS

As detailed in this report, the 2017 monitoring results provide a point of reference on how the restoration activities completed in 2013 (Phase 1), 2014 (Phase 2A Lower), and 2015 (Phase 2B Middle) 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 2016/2017 hydrologic year was substantially wet. Over 60 inches of rain fell across the north coast (Eureka NOAA station) from October to April, with 17 days that experienced a one-inch or greater, rain storm. That can be compared to the relatively "normal" 2015/2016 hydrologic year where close to 47 inches of rain fell and 11 days experienced a one-inch or greater, rain storm. On average, the northern coast of Humboldt County receives approximately 40 inches of rain annually.

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

Vegetation

Phase 1 and the completed portions of Phase 2 (2A Lower and Middle) achieved all projected habitat acreages for the various habitat types, including: tidal salt marsh, high marsh ecotone, riparian, and channel wetlands.

The Project also achieved all success criteria for native species percent cover in the Phase 1 replanted riparian, Phase 2A Lower and Middle replanted riparian, and Phase 2A Lower and Middle channel wetland habitat areas. However, at nearly all monitoring sites on Phase 1 and 2, non-native non-invasive species and invasive species percent cover exceeded recommended limits. Some of these species are colonizer species and may decrease in the following years as a riparian canopy develops. Reed canary grass 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. *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 Spartina.

During this monitoring year, basal area of woody tree species was estimated for the first time in the Project area (including Phase 1 and 2A Lower) 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 fish sampling across Phase 1 and in the restored areas in Phase 2 (2A Lower and Middle). In collaboration with CDFW, NOAA/NMFS, Humboldt State University, and Ducks Unlimited, a fish sampling program has been ongoing since 2014. The 2017 sampling effort took place from March to August at 11 sites. Fifteen anadromous, freshwater, and marine species were captured in 2017. Salmonids were captured in the first 2 months of the sampling season; additionally, a separate winter sampling indicated that salmonids were present from December to February. Tidewater gobies were present in the tidally influenced reaches during the entire sampling season. The 2017 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 demonstrates 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-section 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 examining 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 demonstrate achievement of

Project goals and objectives 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.

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, and 4) 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: Riparian Habitat Mapping – Salt Marsh (Phase 1) & River Corridor (Phase 2A Lower)

Agencies/Acts: Coastal Commission

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

Description: Map the riparian acreage in the salt marsh of Phase 1 and the river corridor of Phase 2A Lower of the Salt River Ecosystem Restoration Project

Goals:

- Achieve 43 acres of riparian in the salt marsh habitat by Year 10
- Achieve approximately 17.6 acres of planted riparian in Phase 2A Lower by Year 10

Report: 2017 Annual Habitat Monitoring Report - Salt River Ecosystem Restoration Project, Prepared for the Humboldt County Resource Conservation District by J.B. Lovelace & Associates

Methods: Existing SRERP habitat GIS data, originally provided by the HCRCD and revised during the 2016 monitoring effort (J.B. Lovelace & Associates 2017), were refined where necessary in 2017 to develop updated habitat maps reflecting current site conditions. These refinements were made 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 between August 4-11, 2017. 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 riparian habitats is 43.3 acres (Figure 2), which is approximately equivalent to the 43 acres of projected riparian habitat stated in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012). No substantial changes to this habitat were observed between 2016 and 2017.

The extent of existing riparian forest and riparian planting zone habitats that occur within the Phase 2A (Lower) (Figure 3) restoration area have not changed substantially between 2016-2017. These habitats collectively total 22.01 acres, exceeding the extrapolated projected extent of this habitat (17.6 acres) by 25%.

The following Table 1 provides the results of the mapped riparian acreages for both Phase 1 and Phase 2A Lower.

Table 1. SRERP Riparian Habitats. Summary of 2017 Observed Habitat Areas & Respective Success Criteria

	Area (Acres)			
			2017	
SRERP Habitat Type	**Projected**	**Final Success Criteria**	**Observed**	**% of Projected**
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area				
Existing Riparian Forest	–	–	20.62	–
Replanted Riparian Forest	–	–	22.71	–
Phase 1 Riparian Habitat Total	**43.4**	**≥38.4**	**43.33**	**~100%**
Phase 2A (Lower) – Salt River Corridor Restoration Area				
Existing Riparian Forest	–	–	11.52	–
Riparian Planting Zones Replanted Riparian Forest	–	–	8.05	–
Active Riparian Berms	–	–	2.44	–
Phase 2A (Lower) Riparian Habitat Total	**17.6**	**≥15.8**	**22.01**	**125%**

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 2017, and all continue to exceed *final* minimum area success thresholds in this third monitoring year for Phase 1 and Phase 2A (Lower) restoration areas.

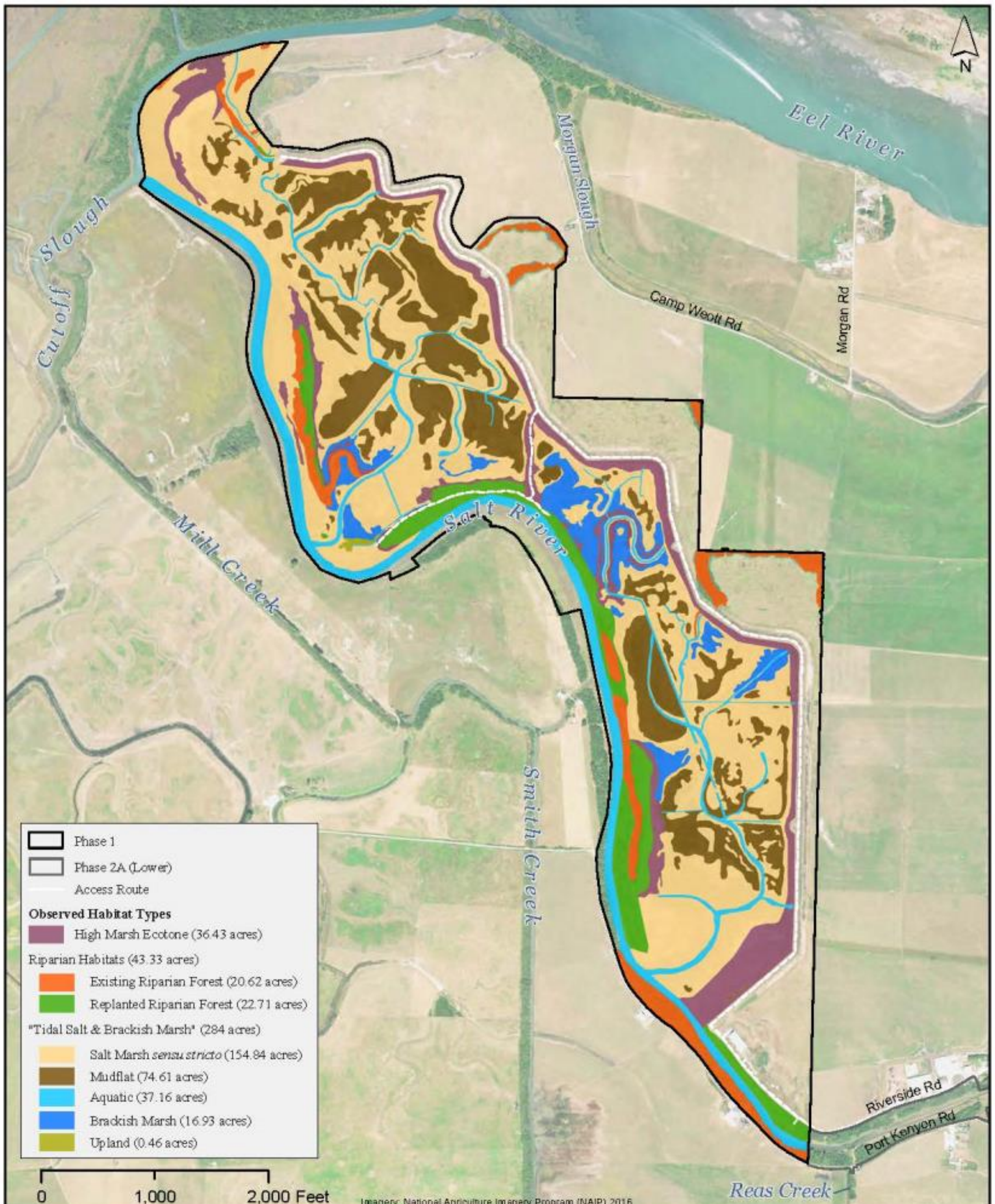

Figure 2. SRERP Phase 1 - Riverside Ranch Tidal Marsh Restoration Area Habitats
2017 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

Figure 2: Salt Marsh Habitat Acres

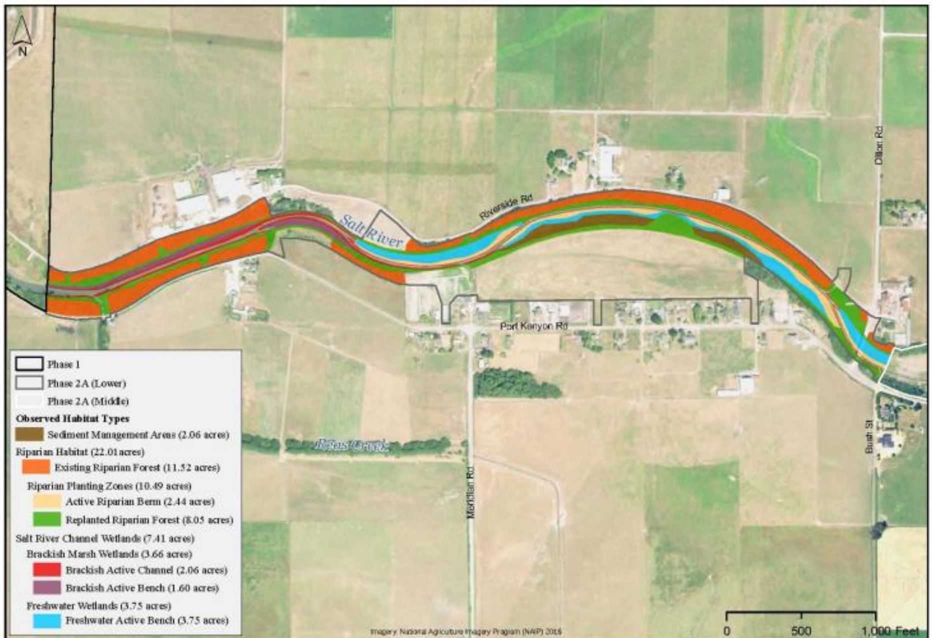

Figure 3. SRERP Phase 2A (Lower) - Salt River Corridor Restoration Area Habitats
2017 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

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

VEGETATION

Monitoring Task: Vegetation Percent Cover – Salt Marsh (Phase 1) & River Corridor (Phase 2A Lower and Middle)

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 riparian areas in the salt marsh of Phase 1 as well as wetland and riparian areas in the river corridor of Phase 2A Lower and Middle of the Salt River Ecosystem Restoration Project

Goals:

- Achieve 2017 Native Vegetation Percent Cover of: ≥30% in Phase 1 riparian habitat; ≥30% in Phase 2A Lower channel wetlands and riparian habitats; ≥20% in Phase 2A Middle channel wetlands habitats; and ≥15% in Phase 2A Middle riparian habitat.

- Achieve 2017 Non-Native Non-Invasive Vegetation Percent Cover of: <15% in all restored habitats
- Achieve 2017 Invasive Vegetation Percent Cover of: <5% in all restored habitats

Report: 2017 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 2017 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 2016 SRERP vegetation sampling data (J.B. Lovelace & Associates 2017), 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 4 – 6). 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 2017 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.

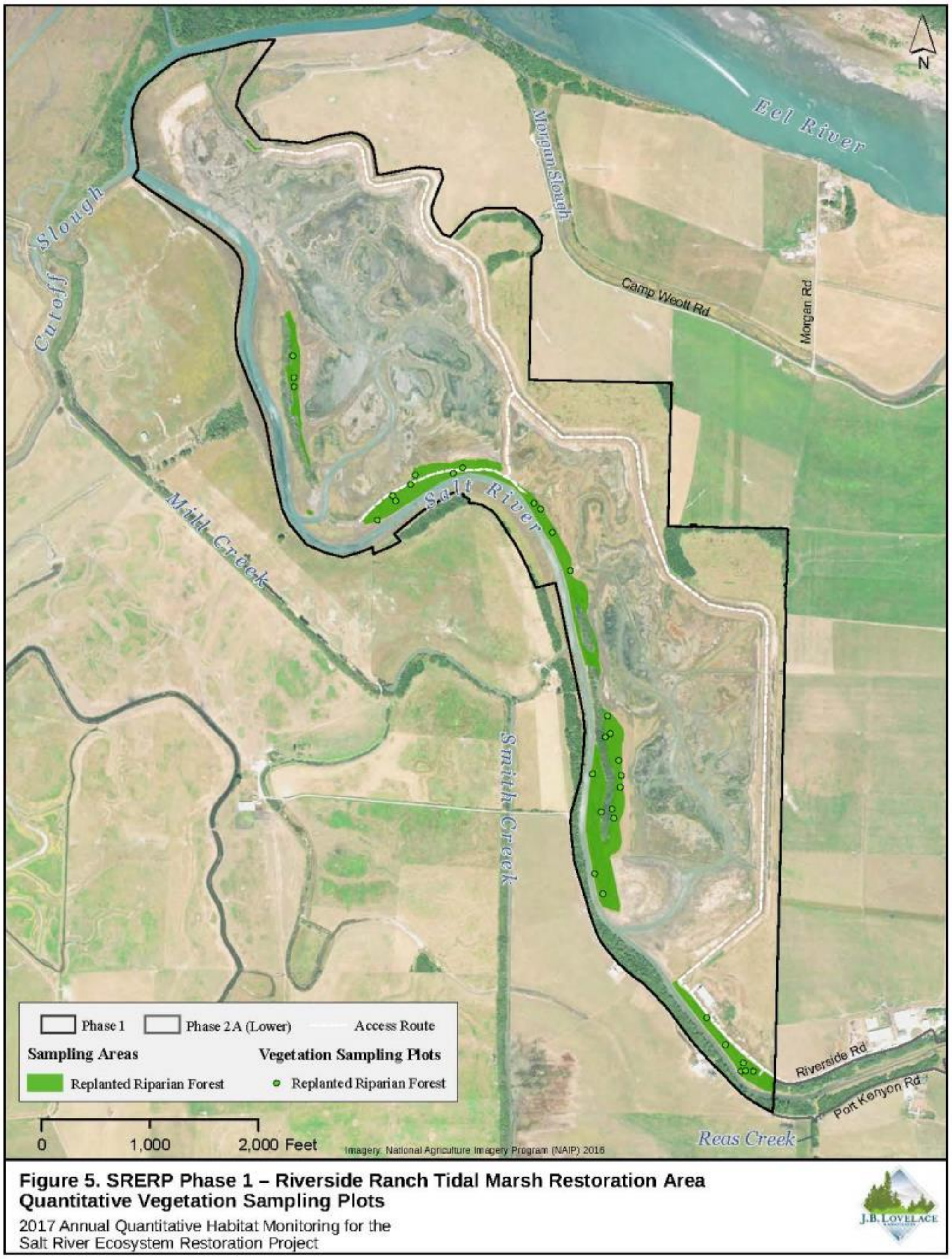

Figure 4: Phase 1 Salt Marsh Percent Cover Sampling Plots

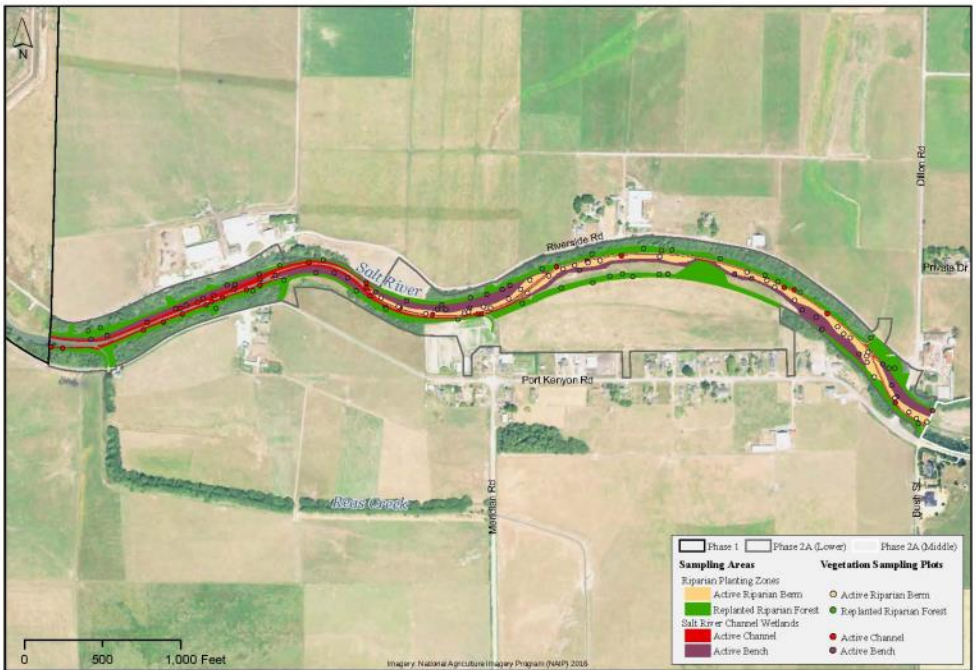

Figure 6. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Quantitiative Vegetation Sampling Plots
2017 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

Figure 5: Phase 2A Lower Percent Cover Sampling Plots

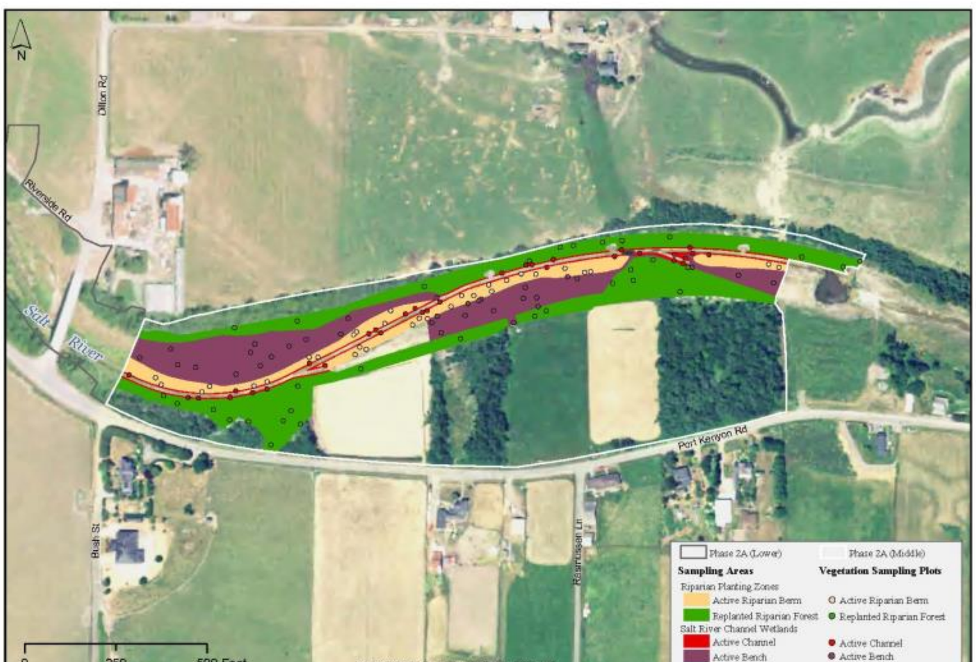

Figure 7. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Quantitative Vegetation Sampling Plots
2017 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

Figure 6: Phase 2A Middle Percent Cover Sampling Plots

Results & Discussion: The sampling effort shows that the monitoring areas are achieving the success criteria of native vegetation (Table 2). Native vegetation in the planted riparian Phase 1 areas primarily consists of *Deschampsia cespitosa* (“tufted hairgrass”), *Hordeum brachyantherum* (“meadow barley”), *Rubus ursinus* (“California blackberry”), *Lonicera involucrata* ssp. *Ledebourii* (“twinberry”), *Morella californica* (“California wax myrtle”), Salix lasiandra var. lasiandra (“Pacific Willow”) and Picea sitchensis (“Sitka spruce”). Phase 2A Lower and Middle native species include *Deschampsia cespitosa* (“tufted hairgrass”), *Salicornia pacifica* (“pickleweed”), *Grindelia stricta* var. *platyphylla* (“marsh gumplant”), *Alnus rubra* (“red alder”), *Salix lasiolepis* (“arroyo willow”), *Salix lasiandra* var. *pacifica* (“Pacific willow”), and *Salix sitchensis* (“Sitka willow”).

Success criteria for non-native non-invasive shall not exceed 15% percent cover. However, Phase 1 has exceeded that limit at 15.8%. Non-native non-invasive plant species consist of *Festuca perennis* (“rye grass”), *Plantago lanceolata* (“English plantain”), *Rumex conglomeratus* (“clustered dock”), *Trifolium fragiferum* (“strawberry clover”), and *Raphanus sativus* (“radish”). Phase 2A Lower has exceeded the non-native non-invasive limit within the channel wetlands, though not in the planted riparian area (Table 2). Phase 2A Lower channel wetlands non-native non-invasive species compositions include *Cotula coronopifolia* (“brass-buttons”), *Atriplex prostrata* (“fat-hen”), *Trifolium repens* (“white clover”), *Festuca perennis* (“rye grass”), and *Trifolium fragiferum* (“strawberry clover”). Phase 2A Middle exceeded the 15% limit within certain portions of both the channel wetlands and riparian planting areas. Non-native non-invasive species within this area primarily consist of *Trifolium repens* (“white clover”), *Atriplex prostrata* (“fathen”), and *Plantago major* (“common plantain”).

Project documents set the limit of invasive species presence below 5%. All restoration areas exceeded the invasive species limit (Table 2). Spartina densiflora is dominating the salt marsh habitat in Phase 1 and is accompanied by *Agrostis stolonifera* (“creeping bent”), *Phalaris arundinacea* (“reed canary grass”), *Polypogon monspeliensis* (“rabbitfoot grass”), and *Lotus corniculatus* (“bird’s-foot trefoil”). Both Phase 2A Lower and Middle areas also exceeded the invasive species threshold of 5%. These areas have *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”).

Table 2: Summary of 2017 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	2017 Success Criteria[2]	Observed	Final Success Criteria[3]	Observed	Final Success Criteria[3]	Observed
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area								
Replanted Riparian Forest (n=32)	**99.7** (97.8, 100.0)	**46.7** (34.3, 59.1)	≥30%	**15.8** (9.2, 26.5)	<15%	**37.2** (27.8, 47.3)	<5%	**0.0** (NA)
Phase 2 – Salt River Corridor Restoration Area								
Phase 2A (Lower) – Salt River Channel Wetlands								
Active Channel (n=32)	**78.4** (70.6, 84.2)	**40.2** (30.6, 50.4)	≥30%	**18.3** (12.2, 25.8)	<15%	**20.0** (13.3, 28.8)	<5%	**0.0** (NA)
Active Bench (n=32)	**88.8** (83.9, 92.3)	**55.9** (46.5, 65.8)	≥30%	**16.6** (10.7, 24.1)	<15%	**16.2** (9.9, 25.9)	<5%	**0.0** (NA)
Phase 2A (Lower) – Riparian Planting Zones								
Active Riparian Berm (n=32)	**96.7** (92.8, 98.4)	**64.3** (54.6, 73.0)	≥30%	**12.6** (8.0, 21.7)	<15%	**19.8** (13.7, 27.2)	<5%	**0.01** (0.0, 0.04)
Replanted Riparian Forest (n=32)	**99.4** (97.8, 99.8)	**62.1** (49.9, 72.5)	≥30%	**7.3** (4.1, 15.0)	<15%	**30.0** (21.3, 40.7)	<5%	**0.0** (NA)
Phase 2A (Middle) – Salt River Channel Wetlands								
Active Channel (n=32)	**92.8** (88.1, 95.8)	**80.3** (71.8, 86.8)	≥20%	**6.1** (2.5, 12.5)	<15%	**6.4** (3.7, 10.2)	<5%	**0.0** (NA)
Active Bench (n=32)	**87.3** (82.8, 91.3)	**59.0** (49.7, 67.8)	≥20%	**16.2** (9.8, 25.9)	<15%	**12.2** (8.4, 16.9)	<5%	**0.0** (NA)
Phase 2A (Middle) – Riparian Planting Zones								
Active Riparian Berm (n=32)	**93.6** (88.4, 96.4)	**58.3** (48.0, 68.2)	≥15%	**23.4** (16.0, 33.0)	<15%	**11.4** (6.9, 17.9)	<5%	**0.5** (0.1, 1.9)
Replanted Riparian Forest (n=32)	**95.3** (89.0, 98.1)	**42.2** (32.4, 52.8)	≥15%	13.1 (7.8, 20.8)	<15%	**40.0** (30.4, 50.4)	<5%	**0.05** (0.0, 0.15)

[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: 2017 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 2017 Annual Habitat Monitoring Report:

…The goal of this initial sampling was to establish the first baseline dataset for future comparison against results from subsequent years. This woody riparian vegetation basal area sampling effort was performed during December 5-8, 2017.

We utilized the same approach described above, for stratifying restoration sampling areas and creating random percent cover sampling plots (using ArcMap® GIS software and the Trimble GPS unit), to establish randomly-located basal area sampling plots throughout each of the three 2017 sampling areas of interest in the following quantities:

Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:

1. *Replanted Riparian Forest (n=30)*

Phase 2A (Lower) – Salt River Corridor Restoration Area:

2. *Replanted Riparian Forest (n=21)*
3. *Active Riparian Berm (n=10)*

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 ("breast height") tall. 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 = DBH2 x 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 in Section 4.0 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 2017 sampling effort reflects increasing growth and development of replanted and naturally recruited woody riparian vegetation. Approximately 11% (3.7 acres) of the total combined area (33.2 acres) of the three SRERP habitats were addressed during the 2017 endeavor. Seven tree species make up the sampled population and the projected results for each sampled habitat are provided in Table 3.

Table 3: Summary of 2017 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 2017

	(Projected*) Basal Area (ft^2)				
	Phase 1 – Riverside Ranch Tidal Marsh Restoration Area	Phase 2A (Lower) – Salt River Corridor Restoration Area			
Tree Species	Replanted Riparian Forest (22.71 acres) (n = 30)	Replanted Riparian Forest (8.05 acres) (n = 21)	Active Riparian Berm (2.44 acres) (n = 10)	Total Phase 2A (Lower) (10.49 acres)	Total[§] SRERP (33.2 acres)
Alnus rubra (red alder)	0.2194	22.2287	3.3896	25.6183	25.8377
Salix lasiolepis (arroyo willow)	8.6172	15.5159	0.0006	15.5165	24.1338
Salix hookeriana (coastal willow)	0.0056	0.4891	0	0.4891	0.4946
Salix lasiandra (Pacific willow)	0.0147	0.3816	0.0027	0.3843	0.3990
Picea sitchensis (Sitka spruce)	0.0671	0.1524	0.0261	0.1785	0.2457
Salix sitchensis (Sitka willow)	0	0.0210	0.0193	0.0403	0.0403
Pinus contorta (shore pine)	0.0171	0	0	0	0.0171
Total	**8.9411**	**38.7887**	**3.4384**	**42.2270**	**51.1682**

* Projected total basal area values were derived from basal-area-per-unit-area-sampled measurements collected during 2017 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 2017 basal area sampling effort

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 2017. 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.

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 March to August 2017 (except during July 2017 due to availability of a CDFW fisheries biologist), sites distributed across the Phase 1 and Phase 2 (Figure 7) constructed portions of the Salt River Ecosystem Restoration Project were surveyed for salmonids and tidewater gobies during low tide periods. Eleven sites on the Salt River Phase 1 and Phase 2 restoration area were selected for fish presence and distribution monitoring to represent the diversity of channel size and habitats in the main Salt River channel in the slough network. Each tidally influenced site was sampled using a 1/8th inch mesh pole seine net. Typically a single 1/8th inch mesh pole seine pass was made through each site. Sites located further up the river channel were sampled by minnow traps being 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 pike minnow were enumerated into 100 millimeter size classes by ocular estimation, and the non-native pike minnow are humanely euthanized and buried via permit requirement. A start time, end time, and air and water temperature, 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.

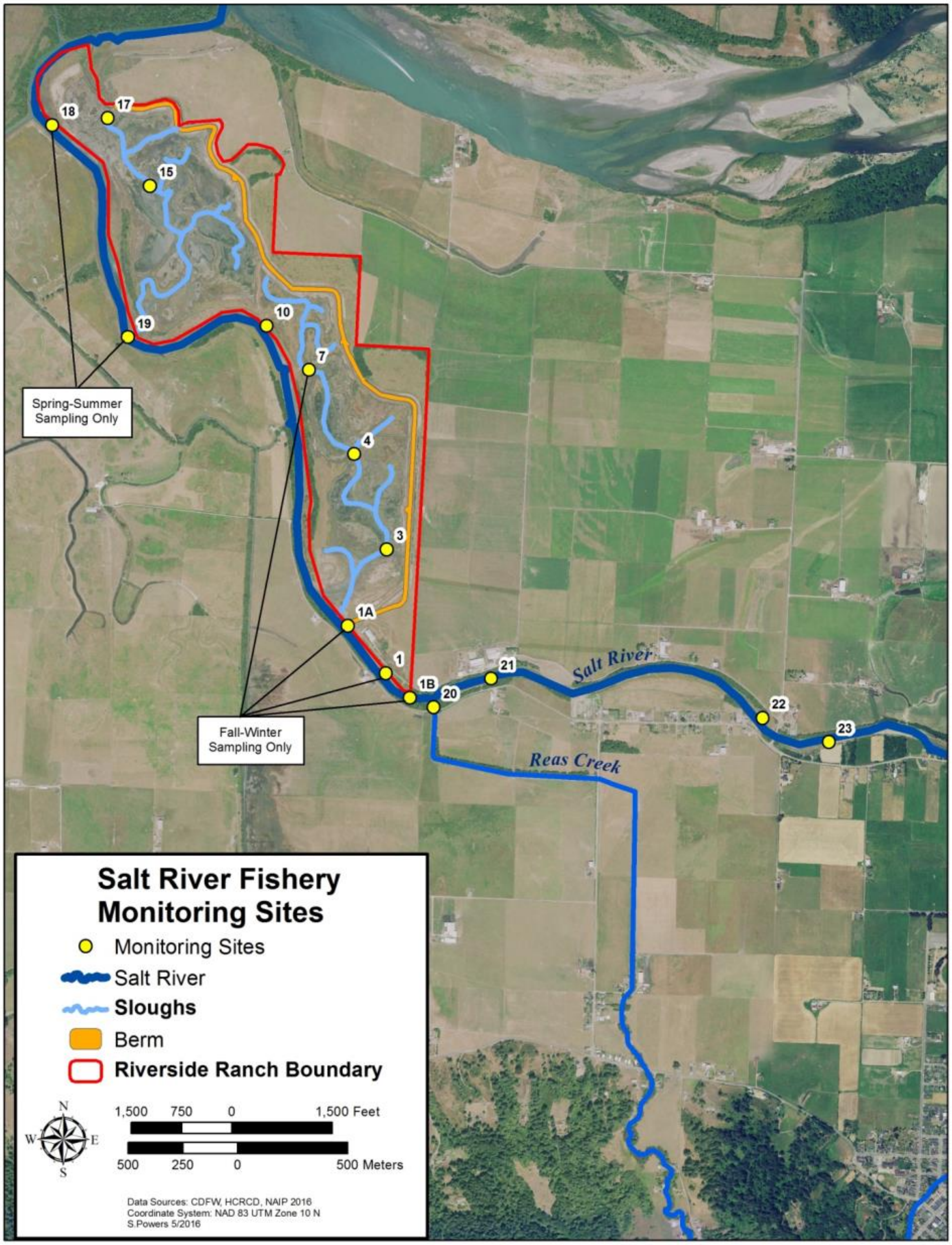

Figure 7: Fish Monitoring Sites Across Phase 1 and 2 of the Salt River Ecosystem Restoration Project (2017)

Results and Discussion: Over the five month sampling period, water temperatures ranged between a maximum of 34.7°C (August) and minimum of 12.5°C (March). Conductivity measurements were only taken in April and May, due to availability of a meter. Average conductivity ranged between a minimum of 7,185 CµS/cm and a maximum of 17,300 CµS/cm in the tidal reaches, while the freshwater reaches ranged from to 470 CµS/cm. Salinity was measured in June and August. Average salinity ranged from 20.3 to 21.8 in the estuary and 1.6 to 20.2 upstream of Reas Creek. Dissolved oxygen was also measured during the surveys and each month's average ranged between a maximum of 11.2 ppm and a minimum of 9.02 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.

Over the five month sampling period, seining and minnow trapping efforts at the 11 fisheries monitoring sites identified the presence of 15 species. Approximately 7,692 individuals were captured (approximate numbers were often made for three-spined stickleback and the lined or yellow crab). The following table (Table 4) presents the total number of fish and marine invertebrates sampled from March to August in 2017 (excluding the month of July).

Ten Coho salmon (*Oncorhynchus kisutch)* juveniles were present during the March and April sampling months as well as one Chinook salmon (*Oncorhynchus tshawytscha*). Salmonids were captured in the tidal marsh area and in the main channel Salt River.

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 (sites #8 and #9), where over a hundred individuals would be caught in one sampling period (month). In 2017, only 15 tidewater goby individuals were sampled the sampling season. 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 (sites #8, #9, and #14). These sites previously held high concentrations of tidewater goby and have now been abandoned as fish sampling sites. The 2017 captured tidewater gobies occurred at sites #3, #4, and #17.

Marine species were present in the estuary portion of the Project area. Though the internal slough channel network provides saline habitat, most marine species were captured in the main channel Salt River. Marine species include: Bay Pipefish *(Syngnthus leptorhynchus*), Pacific Herring (*Clupea pallasii*), Shiner Surfperch (*Cymatogaster aggregata*), Starry Flounder (*Platichthys stellatus*), and Top Smelt (*Atherinops affinis*).

Table 4: Number of individual fish captured by each month's fish survey efforts in 2017

	Number of Fish Captured in 2017					
	March	April	May	June	August	Total
Fish Common Name						
Tidewater Goby	3	9	0	0	3	**15**
Coho	6	4	0	0	0	**10**
Chinook	0	1	0	0	0	**1**
Three-Spined Stickleback	1,699	157	82	1,755	1,293	**4,986**
Staghorn sculpin	127	40	18	21	6	**212**
Un. ID Sculpin	2	0	1	0	0	**3**
Pike Minnow	960	49	82	44	100	**1,235**
Pacific Herring	2	0	0	0	0	**2**
Bay Pipefish	0	0	0	3	0	**3**
Top Smelt	0	0	0	0	1,105	**1,105**
Un. ID Smelt (juv)	0	0	0	10	0	**10**
Starry Flounder	0	0	0	2	1	**3**
Shiner Surf Perch	0	0	0	50	5	**55**
California Roach	37	3	0	9	0	**49**
Dungeness Crab	0	0	0	0	0	**0**
Yellow/Lined Shore Crab	0	0	0	2	1	**3**
Total	**2,836**	**263**	**183**	**1,896**	**2,514**	**7,692**

Significant numbers (212) of staghorn sculpins (*Leptocottus armatus)* were captured in 2017. This is the second year of increased staghorn sculpin numbers in the Project area. Three-Spined Stickleback continue be captured in the thousands of individuals. The number of Sacramento Pike Minnow has increased alarmingly in 2017 as compared to previous years. This may be due to the higher precipitation rate received through the winter and spring providing suitable low salinity habitat throughout a majority of Project area; whereas in previous years the region was in a drought and the marine environment stayed highly saline throughout the winter and spring. In June of 2016, a highly abundant species of shore crab (yellow or lined) was first seen in the estuary since restoration was completed in 2013 (Fig 5). For this sampling season, the crabs have reduced from numbers in the thousands in 2016 to just a few individuals in 2017.

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 – Phase 1, Photo Monitoring Year 4, 2017. Prepared by HCRCD

Salt River Ecosystem Restoration Project – Phase 2 Completed Sub-Phases, 2017. 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 8). 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).

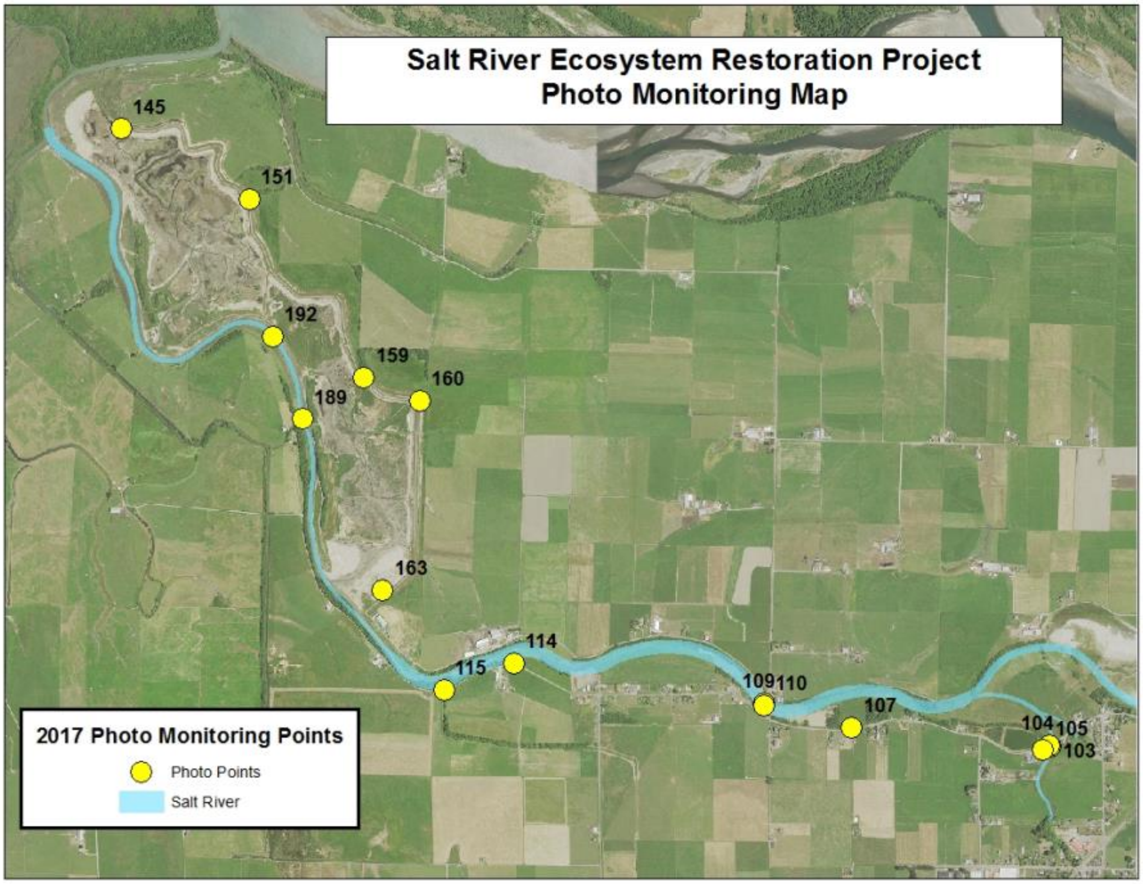

Figure 8: Photo Monitoring Points for the Constructed Footprint - 2017

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 sited above.

PP145 – SW – Nov 2013

PP145 – SW – Nov 2015

PP145 – SW – Dec 2017

PP159 – SW Pine – Nov 2013

PP159 – SW Pine – Nov 2015

PP159 – SW Pine – Dec 2017

PP115 – Reas Ck – Jul 2011

PP115 – Reas Ck – Nov 2014

PP115 – Reas Ck – Jan 2018

PP109 – Dillon Br W – Nov 2014

PP109 – Dillon Br W – Nov 2015

PP109 – Dillon Br W – Jan 2018

PP103 – Up Strm – Apr 2017

PP103 – Up Strm – Dec 2017

Vegetation continues to establish on Phase 1 and 2 where seed mixes are persisting and natural recruitment of natives and non-natives are evolving. Newly constructed areas, depicted in photo point 103, are adjusting and stabilizing through fall and winter rain events.

GEOMORPHIC

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 4 - 2017, prepared by Daniel O'Shea and Susannah Manning

Methods: The cross-sectional surveys were conducted on the main channel of the lower Salt River (SR), and of the newly excavated slough channels, in both the northern (NC) and southern (SC) regions, that were excavated during the summer and fall of 2013. A longitudinal survey was conducted of the lower main Salt River channel from Cutoff Slough to the Riverside Ranch barn. This effort concentrates on Phase 1 of the restoration Project in the Estuarine and Salt Marsh portions. All elevations are geo-referenced in feet to the 1988 North American Vertical Datum (NAVD88).

Three cross-sectional profiles of the main Salt River channel, and three cross-sections in each of the northern and southern slough channels (Figure 9), were collected using a a Nikon DTM-352 Total Station laser theodolite, tripod, prism pole and single prism along the lower, middle and upper sections of the main Salt River channel. Permanent, rebar monuments were set on both sides of the main channel and referenced to the Salt River Ecosystem Restoration Project's survey control points SR12, SR14 and SR11. The cross-sectional monuments were established using 4-foot lengths of ½"-rebar pounded into the substrate, leaving 3-inches exposed, and topped with labeled end caps. GPS (Garmin GPSMAP 62s) locations were recorded for each monument, along with photo documentation.

Elevations and distances were collected at each major break in slope, vegetation edge (dotted line), water's edge, mid-channel, and at least 2 locations on either side of mid-channel. Flood plain measurements were collected approximately 200-feet on either side of the main channel. The only exception was cross-section three (SR3), where fencing of private lands limited access.

The longitudinal profile survey of the main Salt River channel from Cutoff Slough to the Riverside Ranch barn was collected using a Nikon DTM-352 Total Station laser theodolite, tripod, stadia rod, prism pole and single prism. The prism pole was placed in the thalwag approximately every 200-feet with the total station located at one of four locations along the north bank of the main Salt River channel and geo-referenced to the project's survey control points SR11, SR14 and SR12. A total of 48 measurements were taken along 11,789 feet of the Salt River. All elevations are reported in feet using the NAVD88 vertical datum.

Map:

Figure 9: Location of the cross section and longitudinal profiles for Salt River Ecosystem Restoration Survey Project, Spring 2017.

Results and Discussion: Results are summarized from the monitoring report in the following narrative and in Figures 10 – 19. 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.

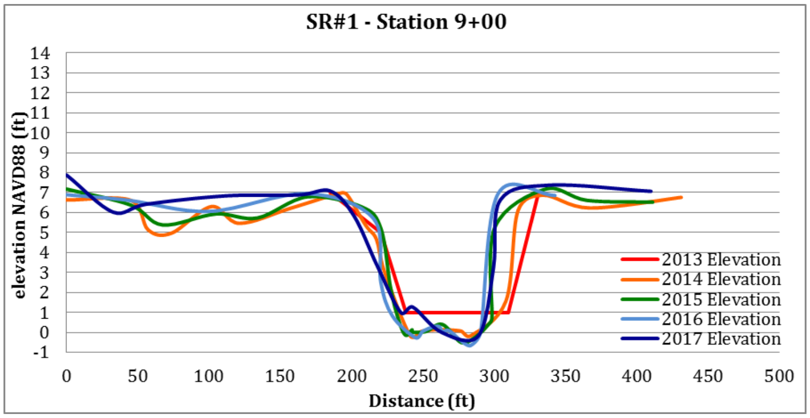

Figure 10: Salt River Cross-Section #1 (SR1)

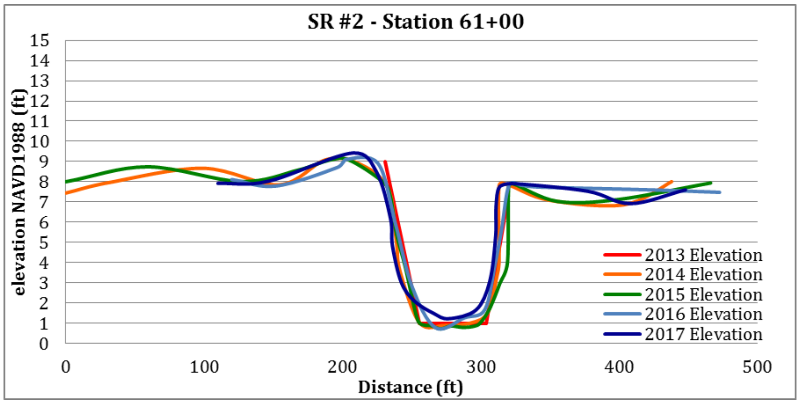

Figure 11: Salt River Cross-Section #2 (SR2)

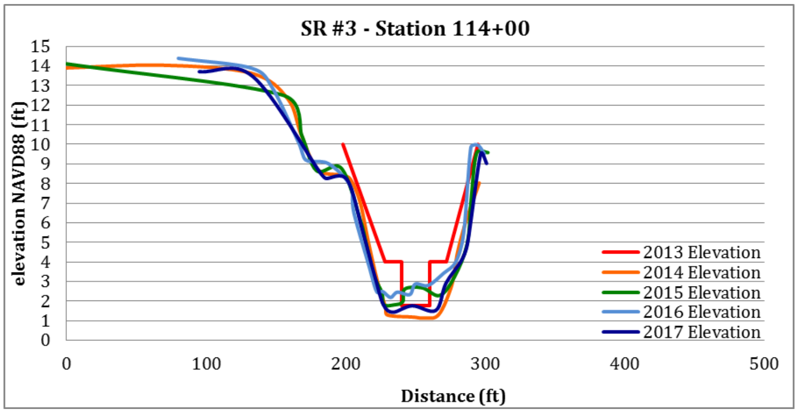

Figure 12: Salt River Cross-Section #3 (SR3)

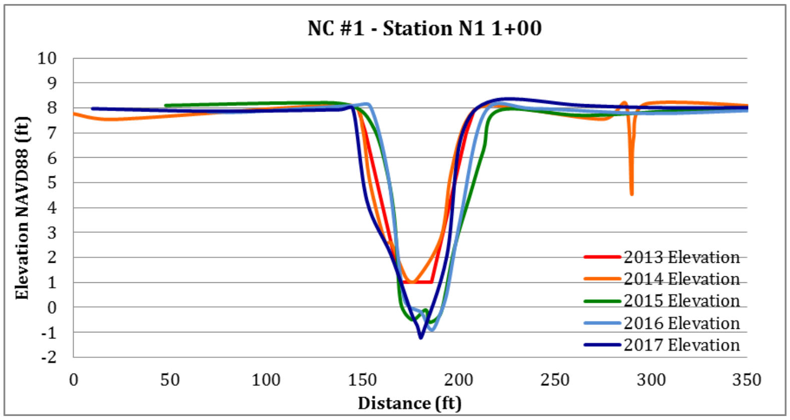

Figure 13: Slough North Channel Cross-Section #1 (NC1)

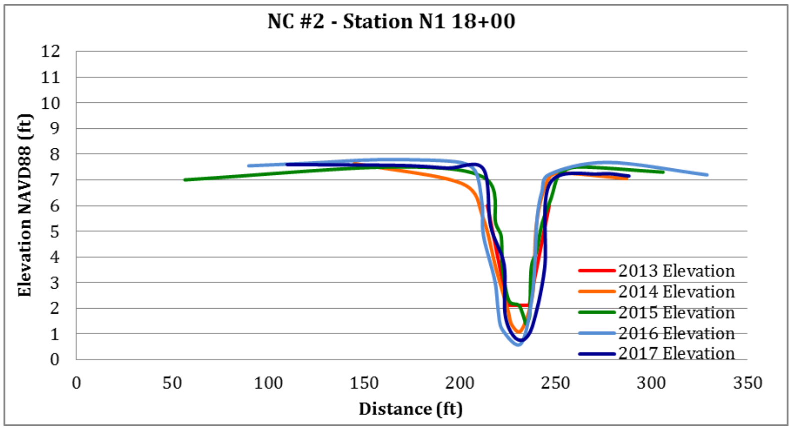

Figure 14: North Slough Channel Cross-Section #2 (NC2)

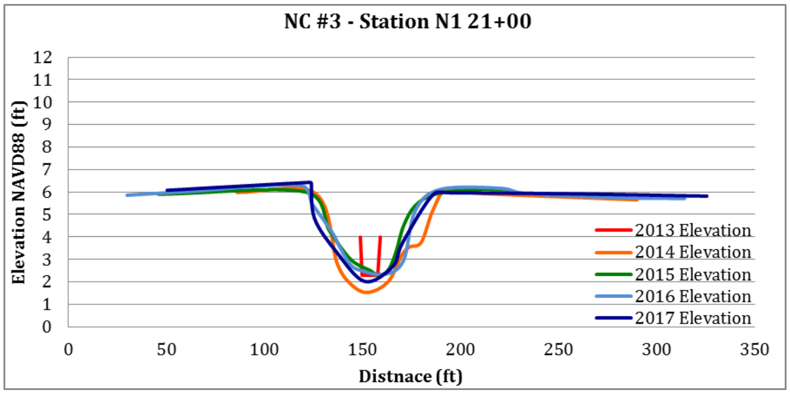

Figure 15: North Slough Channel Cross-Section #3 (NC3)

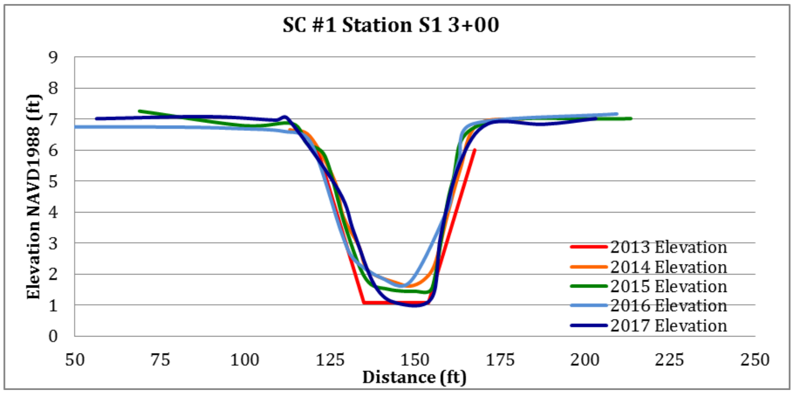

Figure 16: South Slough Channel Cross-Section #1 (SC1)

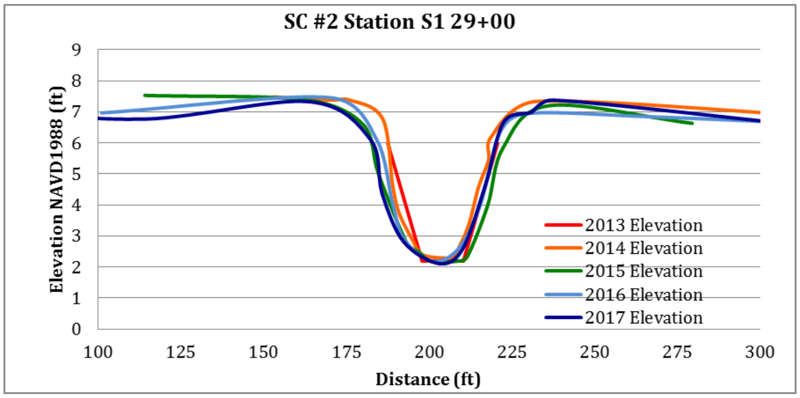

Figure 17: South Slough Channel Cross-Section #2 (SC2)

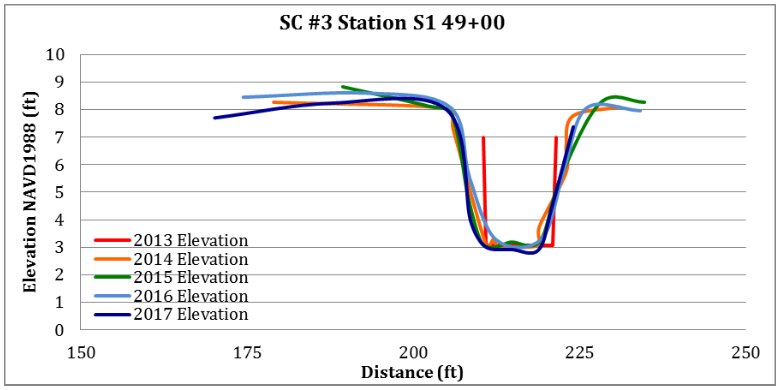

Figure 18: South Slough Channel Cross-Section #3 (SC3)

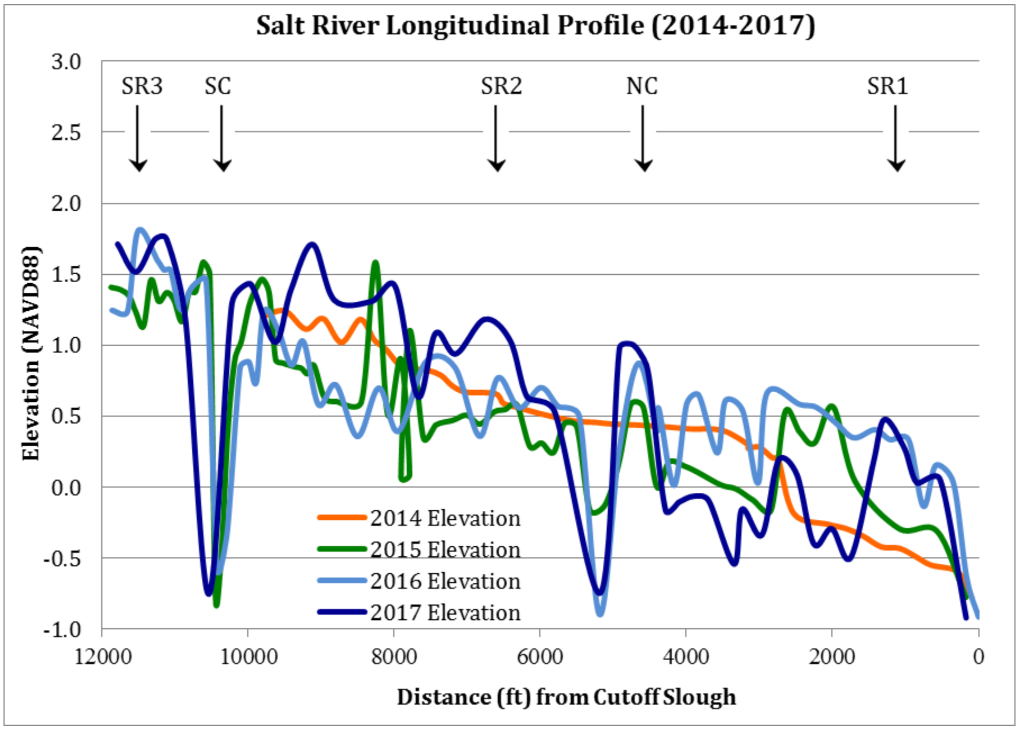

Figure 19: 2015 Salt River Longitudinal Profile - SR1, SR2 and SR3 are locations of cross sections; NC and SC are the approximate locations of the confluence with the North and South slough channels, respectively.

Patterns of erosion, transport and deposition observed in previous years continued in a similar manner in 2017. The primary difference was channel bed erosion in the lower main stem Salt River (SR), and deposition in the middle to upper sections. Bank erosion and slumping were observed throughout the project area, particularly in the downstream reaches of the SR near the confluences with Cutoff Slough (CO) and the northern slough channel (NC). Main channel bed erosion in the Salt River was observed in the lower section of the SR below NC.

The SRERP's Adaptive Management Plan identifies a 10% change in channel capacity as a trigger level for potential management actions. Seven of the nine cross-sections have experienced an increase in channel capacity since 2014 (Table 5), two of which merit discussion and further monitoring (NC1 and SC2). Two cross-sections (NC3 and SR1) have slightly decreased in capacity beyond the 10% trigger level and further monitoring is recommended. Sediment deposition in the upstream section of the Salt River channel between SR2 and SC is seen in the longitudinal profiles (Figure 19) and is likely the result of re-suspension of fine-grain sediments (e.g. silt and clay) that are transported upstream during flood tide then deposited at slack, high water. This system exhibits a net upstream transport of sediment in the Salt River main channel; however, the long-term, net-transport direction and quantity of sediment should be resolved in future channel surveys. Sediment erosion, transport and deposition, will continue in response to pending upstream restoration that will introduce more sediment inputs into the system.

The northern slough channel is experiencing channel erosion, deposition, and bank erosion (bank undercutting) throughout the network. The southern slough channels show aggradation at SR1 and show little change at others.

The longitudinal profile in the main Salt River channel indicates highly mobile sedimentation and erosion patterns. Much of the erosion and deposition are located near the confluences of the slough channel networks and at Cutoff Slough.

Table 5. Channel capacity change from 2014 to 2017

	Change in Capacity	
Cross Section	**Direction of Change**	**Percent of Change**
SR1	decrease	11%
SR2	increase	9%
SR3	increase	3%
NC1	increase	31%
NC2	increase	8%
NC3	decrease	12%
SC1	increase	5%
SC2	increase	25%
SC3	increase	2%

Though this is the third year of surveys on Phase 1, Riverside Ranch, of the Salt River Ecosystem Restoration Project, sediment erosion, transport and deposition, has 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 bring in larger volumes of water as the project connects two upstream tributaries.

<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: *Sedimentation and Erosions Patterns Within Anabranching Channels in a Lowland River Restoration Project* (2017). By Ivan Mendel. Humboldt State University Master's Thesis.

Methods: The cross-sectional and longitudinal surveys were done by a Humboldt State University graduate student for a Master's thesis under the supervision of a Salt River Project engineer from USFWS.

The cross-sectional surveys and longitudinal profile were conducted on the Salt River (SR) channel above Reas Creek to just downstream of the Francis Creek confluence using a CTS/Berger automatic level, tripod and stadia rod. This portion of the channel was constructed in 2014 and 2015. All elevations are geo-referenced in meters to the 1988 North American Vertical Datum (NAVD88) using Trimble Real Time Kinematic technology based on project survey control point SR11.

Nine cross-sectional profiles of the Salt River channel, between Reas Creek to the upstream end of the 2015 construction area, were collected in December 2015, June 2016, and May 2017 (Figure 20). Permanent, rebar monuments were set on both sides of the main channel at a minimum of three feet above bank full elevation and referenced to the Salt River Ecosystem Restoration Project's survey control points. The cross-sectional monuments were established using 4-foot lengths of ½"-rebar pounded into the substrate, leaving 12 – 16 inches exposed. Sub-meter GPS locations were recorded for each monument using a Trimble Geo-XH, along with photo documentation.

Elevations and distances were collected at a maximum resolution of every two meters and at each major break in slope, vegetation edge, water's edge, and mid-channel. Flood plain measurements were collected approximately 200-feet on either side of the main channel.

The longitudinal profile survey of the main Salt River channel from Reas Creek to the upper extent of the 2015 construction site was collected over four days in June 2016. Surveys were timed to coincide with dry weather and low tide (within intertidal reaches) conditions to allow for maximum visibility of the channel thalweg. Elevation data were collected within the thalweg at a maximum resolution of approximately every 50 meters. A total of 44 measurements were collected along the Salt River, from the upstream extent (below the Francis Creek confluence) to the downstream extent (just upstream of Reas Creek).

Figure 20: Salt River Phase 2 Cross-Section Sites

Results and Discussion: For the student's Master's thesis, nine cross-sections sites were developed and surveyed in the 1.5 miles of the 2014 and 2015 restored reach of the Salt River. 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 (freshwater); and Unit 3 contains 7, 8, and 9 (freshwater) (Figure 21).The following graphs (Figures 21 to 23) show cross-sections from each Unit from two hydrologic years.

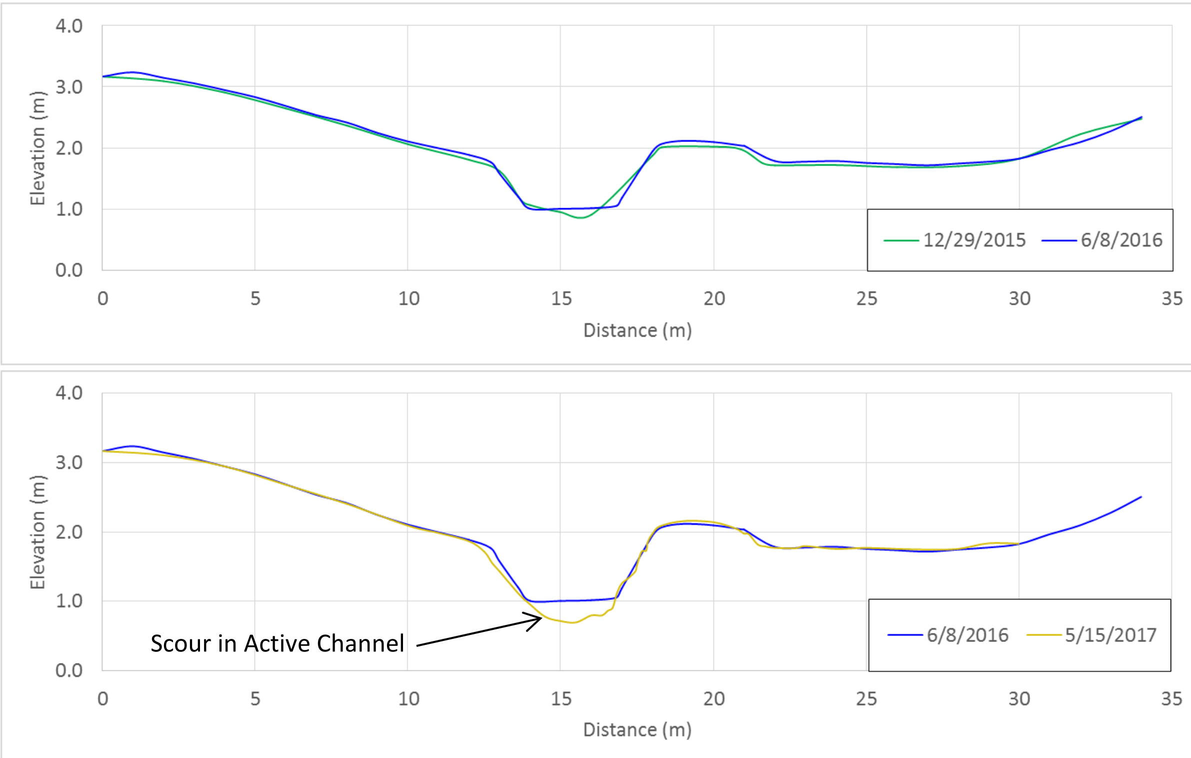

Figure 21: Unit 1 - Site 1 in 2015/16 and 2016/17

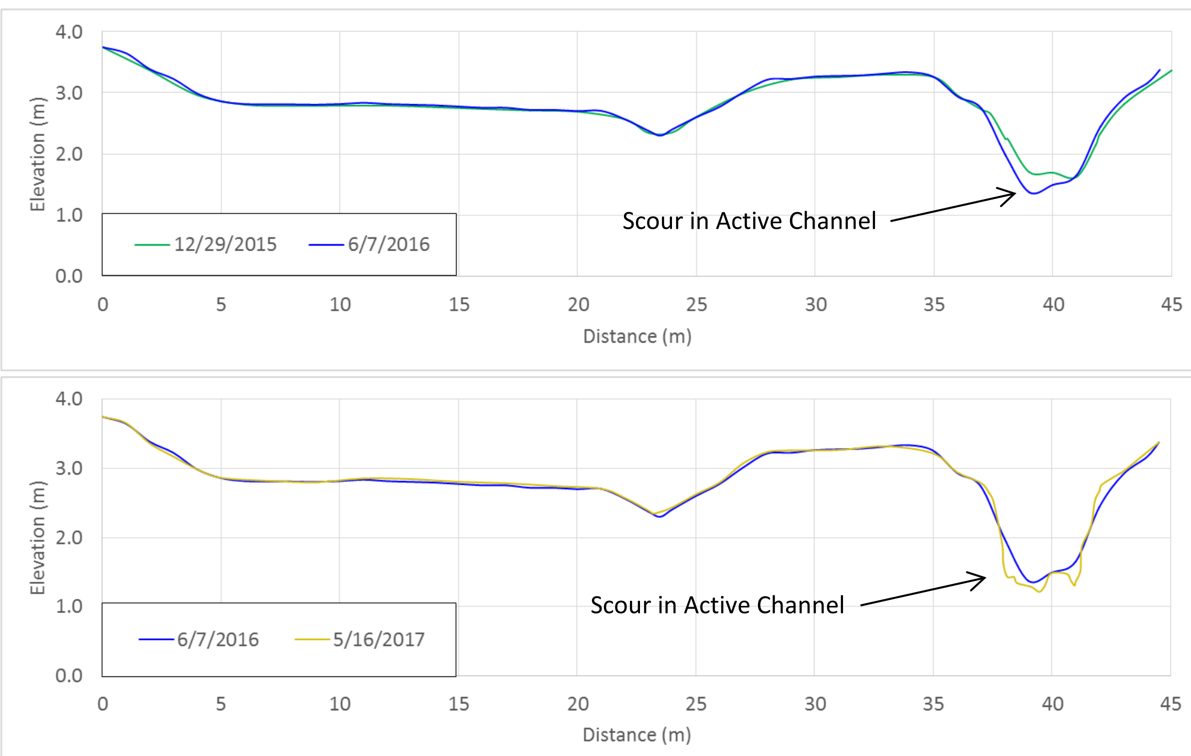

Figure 22: Unit 2 – Site 4 in 2015/16 and 2016/17

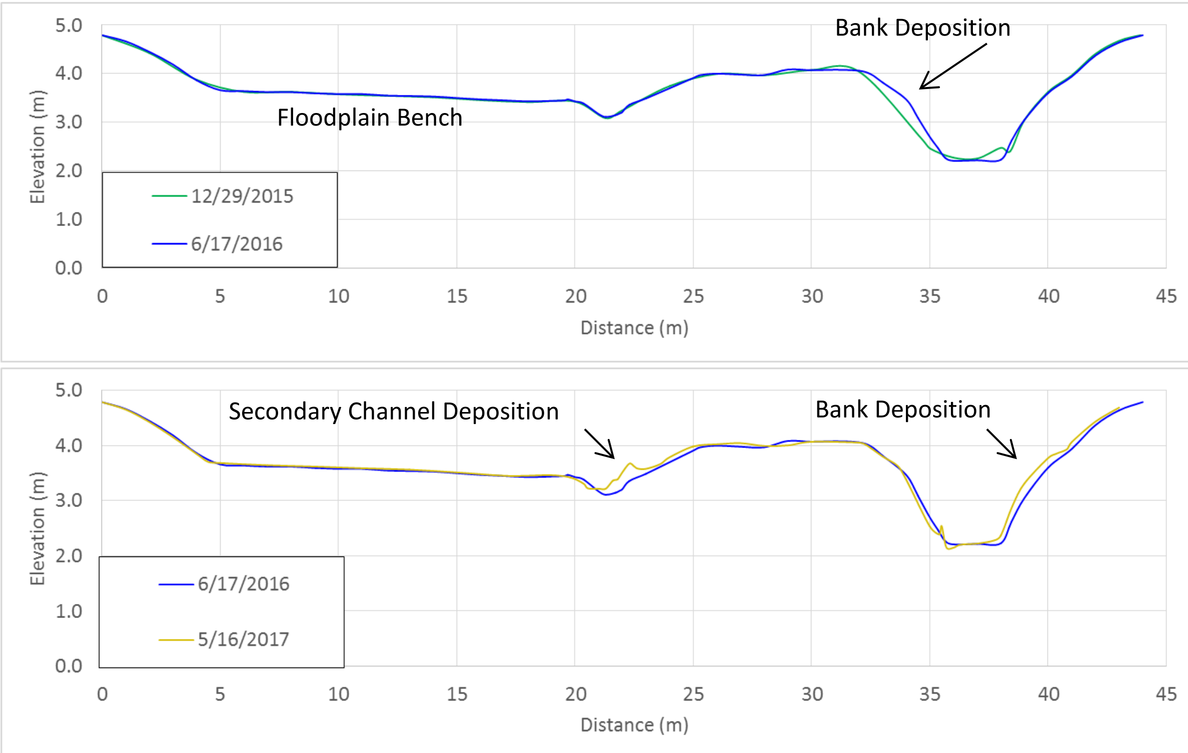

Figure 23: Unit 3 – Site 8 in 2015/16 and 2016/17

Comparing the cross-sectional graphs provides a visual indication on how the channel changed over two winter periods. The 2015/16 winter was a relatively mild, yet typical with a flood event. The 2016/17 winter was the fifth wettest winter recorded, which included multiple large flood events. Each year's cross-section is compared to the previous. In Units 1 and 2, active channel bottom elevations decreased due to channel scour in 2017. However, Unit 3 had a stable active channel elevation through both hydrologic years with deposition on either side of the bank. Looking at all the sites together, more deposition occurred in the 2015/16 winter and more scour was observed in 2016/17. In general, the active channel is primarily scouring vertically (i.e. bottom elevation is decreasing), and increasing channel capacity, which may potentially cause future bank slumping. The active channel is considered overly efficient to transport sediment out of the system at this point in time; however two large tributaries with a significant sediment loads have yet to be re-connected to the system.

Reviewing the nine cross-sections, 6 out of 9 sites decreased in capacity from 2015 to 2016; then 7 out of 9 increased in capacity from 2016 to 2017 (likely due to the wetter water year). Two cross-sections in Unit 1 and one in Unit 2 have increased in capacity beyond the 10% adaptive management trigger outlined in the AMP. These sites will be evaluated within the AMP's Project Management Team process.

High water flows from the active channel accesses the floodplain benches via the secondary channels. As sediment drops out of the sediment laden water onto the floodplain bench, the sediment will be temporarily stored until a large storm event mobilizes the particles to move downstream out of the system. The cross-sectional surveys show that the secondary channels are relatively stable, though Unit 3 has some deposition at the entrance of the floodplain bench. This is identified as an area to monitor and possibly address to make sure the entrances are unobstructed for water to enter. Further data on the cross sections indicate that the Unit 1 floodplain has more deposition downstream than upstream (likely due to tidal inundation). Units 1 and 2 appear to be stable and functioning appropriately.

A longitudinal survey was completed along the constructed Phase 2 footprint. The longitudinal profile graphs presented (Figures 24 to 26) concentrate on the three individual Units. Unit 1 shows topographic heterogeneity and a uniform channel bottom scouring from 2016 to 2017 with a pool development in the upstream section (between 1,900m and 2,000m) (Figure 24). The Unit 2 profile indicates fluctuations between scour and deposition with pool formation in the upstream section (between 700m and 800m) (Figure 25). Unit 3 is primarily stable in elevation, with some pool development in the downstream section (between 200m and 300m) (Figure 26).

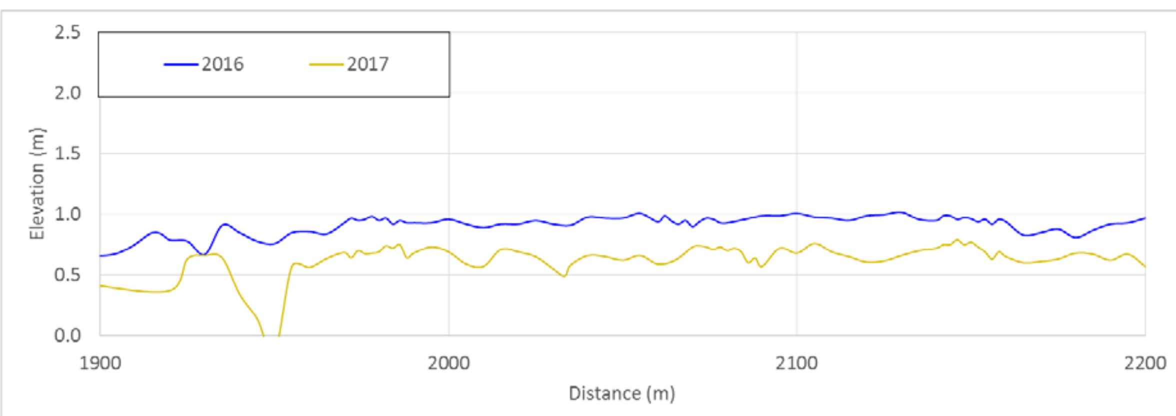

Figure 24: Unit 1 Longitudinal Profile in 2016 and 2017

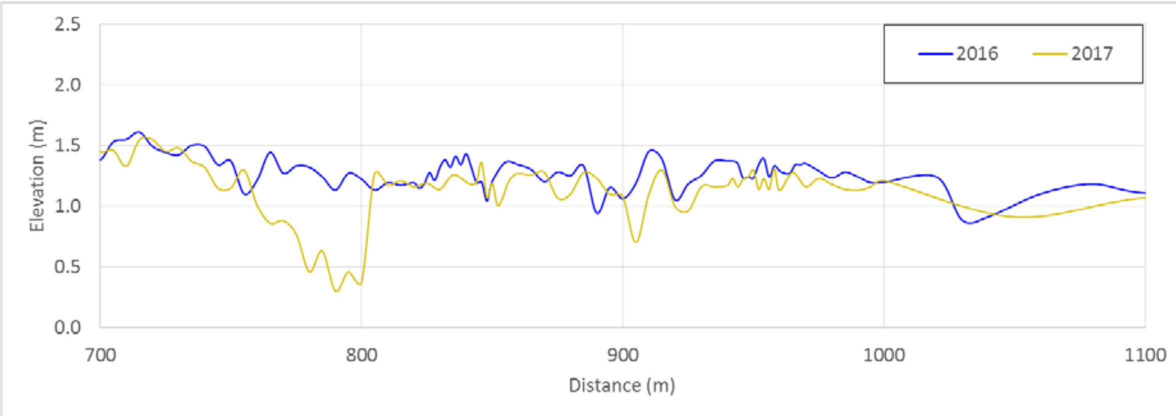

Figure 25: Unit 2 Longitudinal Profile in 2016 and 2017

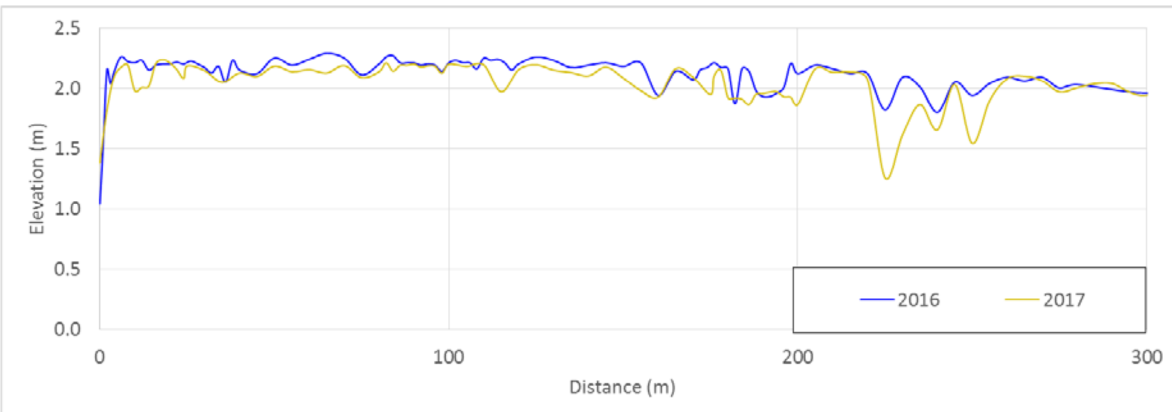

Figure 26: Unit 3 Longitudinal Profile in 2016 and 2017

Other channel considerations include a number of identified bank failures due to groundwater seepage or sand pockets. Unit 1 has a very large bank failure due to groundwater seepage. This failure occurred immediately after 2014 construction and is being monitored. Unit 2 has numerous bank failures caused by large pockets of sand composing a majority of the right bank. Much of this sand is being transported to the Unit 2 floodplain bench. Unit 3 has two bank failures that merit further monitoring. All bank failures will be assessed and determined if each will be allowed to stabilize on their own or if intervention is needed.

LIST OF AVAILABLE REPORTS

J.B. Lovelace & Associates. 2017. Annual Habitat Monitoring Report - Salt River Ecosystem Restoration Project, Prepared for the Humboldt County Resource Conservation District.

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

Mendel, Ivan. Sedimentation and Erosions Patterns Within Anabranching Channels in a Lowland River Restoration Project (2017). Humboldt State University Master's Thesis. Arcata, California.

O'Shea, Daniel and Susannah Manning. Salt River Ecosystem Restoration Project Post-Construction Geomorphic Channel Survey Report, Phase 1, Year 4 – 2017. Prepared for the Humboldt County Resource Conservation District. Eureka, California.

Salt River Ecosystem Restoration Project - Fish Monitoring Program 2017. 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 – Phase 1, Photo Monitoring Year 4, 2017. Prepared by HCRCD. Eureka, California.

Salt River Ecosystem Restoration Project – Phase 2 Completed Sub-Phases, Photo Monitoring, 2017. Prepared by HCRCD. Eureka, California.