Salt River Ecosystem Restoration Project

Habitat Mitigation and Monitoring Plan
Monitoring Report 2020

Finalized February 2021

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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 primarily in private ownership with City of Ferndale occupying multiple small parcels at the wastewater treatment plant.

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 will be restored to three watershed tributaries – Reas, Francis and Williams Creeks.

Across the years of 2013, 2014, 2015, 2017, 2018, and 2019 a total of 6.2 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 the remaining 1.2 miles of the Phase 2 construction will occur by 2023, completing the Salt River corridor restoration.

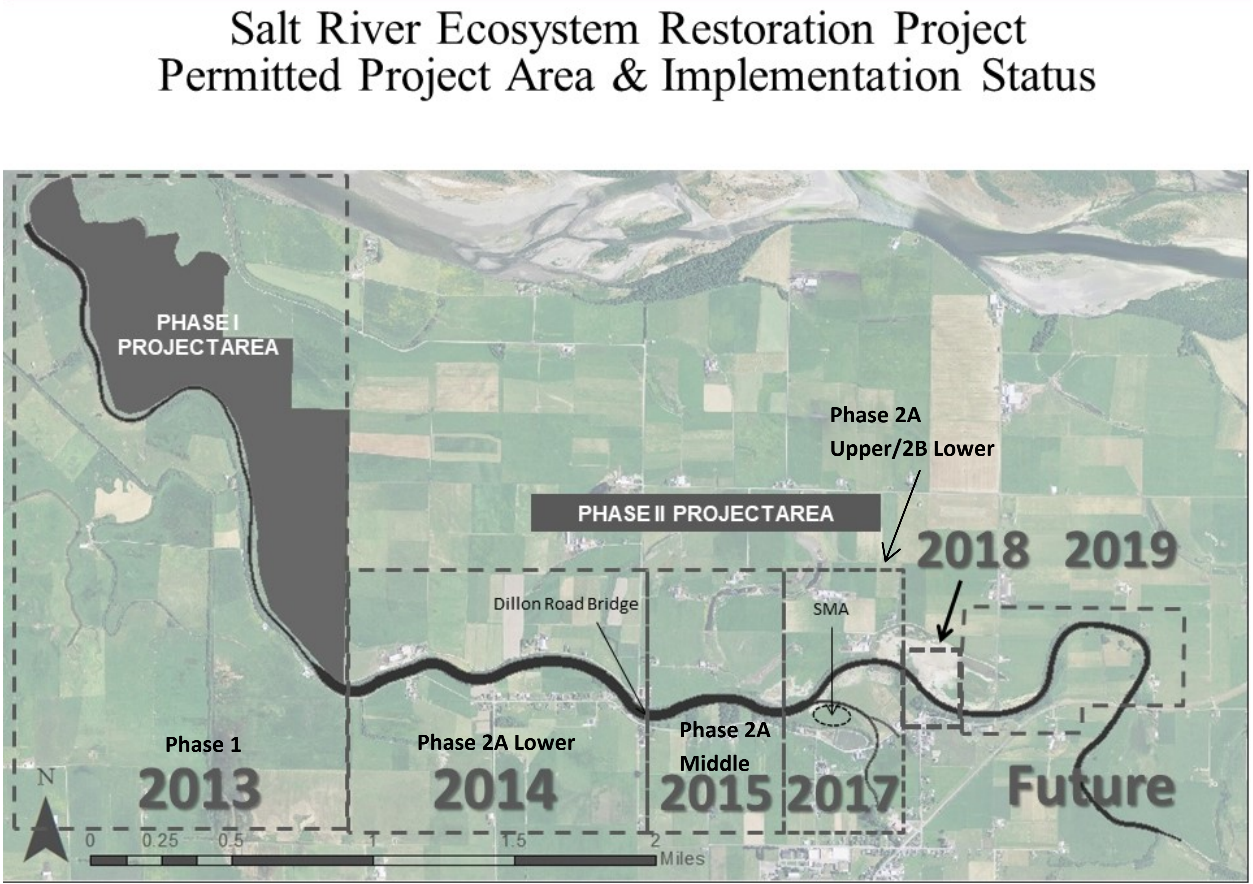

Figure 1: Salt River Ecosystem Restoration Construction Timeline as of 2020

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 HMMP of the Salt River Ecosystem Restoration Project as follows:

- Phase 1: Year 7 (post construction 2013)
- Phase 2: Year 6, Year 5, Year 3, Year 2, Year 1 (post construction 2014, 2015, 2017, 2018, and 2019 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 2020 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), 2017 (Phase 2A Upper/2B Lower), 2018 (Phase 2B Middle), and 2019 (Phase 2B Upper) 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 2019/2020 hydrologic year experienced below average rain totals. Rainfall at nearby Scotia and Eureka stations were measured at 18.1 inches and 9.8 inches below normal, respectively. Thus, the area achieved only 63% to 76% of normal rainfall levels.

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 2020, most phases reached their respective success acreage criteria, except for the tidal salt marsh in Phase 1. Tidal salt marsh was mapped to reach 94% of its success criteria and this is due to the prevalence of mudflats in the estuarine portion of the Phase 1 footprint. These mudflats appear to be converting over to tidal salt marsh as years progress.

The 2020 percent cover sampling results indicate that a majority of surveyed restored areas are achieving appropriate success criteria. However, Phase 1 has slightly fallen short for native species cover by 0.6%. Additionally, planted riparian on some sections of active berm along the Phase 2 portion of the channel corridor restoration (Phase 2B Middle and Upper) are not meeting appropriate success criteria and should be assessed to determine if further plantings are required. Most phases of the project exceed the minimum threshold for non-native non-invasive vegetation. All phases exceed invasive minimum thresholds where Spartina is severely encroaching in Phase 1, while reed canary grass and bent grass are becoming extensive in the Phase 2 channel corridor. Recommendations for addressing non-native non-invasive and invasive vegetation is stated in the 2020 vegetation monitoring report.

To determine positive growth rates, average tree diameter/basal area was estimated and compared to previous results for planted riparian areas in Phase 2A Middle (2015). A comparison between 2018 and 2020 estimated that basal area is increasing significantly in the riparian area.

Wildlife

Since 2014, annual fish sampling has occurred across the Salt River restoration footprint. However, survey methods require multiple people to perform fish sampling which violated COVID 19 restriction guidelines in 2020. Therefore, sampling was cancelled due to potential health risks.

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. Phase 1 geomorphic surveys revealed deposition and scour in anticipated areas; however, some discrete sites in the northern slough channel had deposition and excessive scour to precipitate further field assessment. Similar to Phase 1, Phase 2 is a dynamic system and scour and deposition is found throughout, though the Phase 2 system is trending toward a scour process where channel bottom elevation is decreasing overall.

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 Habitat Mitigation and 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 monitoring 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 – Riparian Acreage (Phase 1, Phase 2A Lower, and Phase 2B Middle project areas)

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 2020 monitoring effort, high marsh ecotone, Tidal Salt & Brackish Marsh, and Riparian acreages were determined on Phase 1 (2013 restoration); Brackish Marsh Wetlands, Freshwater & Seasonal Wetlands, and Riparian acreages were determined for all implemented Phase 2 areas (2014, 2015, 2017, 2018, and 2019) restoration of the Salt River Ecosystem Restoration Project

Goals:

- Achieve 43 acres of riparian acres in Phase 1 by Year 10
- Achieve 85 acres of riparian in Phase 2 by Year 10

Report: 2020 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, the most recent satellite imagery (Google Earth 2019 and National Agriculture Imagery Program [NAIP]) and were based on observations made during fieldwork performed in 2020. 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 area of the Phase 1 High Marsh Ecotone is 34.74 acres, Tidal Salt and Brackish Marsh is 303.53 acres, and Riparian habitat is 43.36 acres. The High Marsh Ecotone and Riparian habitat areas have achieved and exceed the project's final success criteria. However, the Tidal Salt and Brackish Marsh acreages fall slightly under the established success criteria as mudflats (not considered tidal salt marsh) persists (Table 1).

Implemented sections of Phase 2 include: Phase 2A Lower (2014), Phase 2A Middle (2015), Phase 2A Upper/2B Lower (2017), Phase 2B Middle (2018), and Phase 2B Upper (2019). Brackish Marsh Wetlands were mapped to occur on 3.8 acres, Freshwater & Seasonal Wetlands are 25.61 acres, Salt River Channel Wetlands are 29.41 acres, and total Riparian Habitat is 83.6 acres. All Phase 2 observed habitat acreages meet and exceed the project's final success criteria (Table 1).

Table 1. SRERP Habitats. Summary of 2020 Observed Habitat Areas & Respective Success Criteria

	Area (Acres)		
Habitat Areas	**2020 Observed**	**Final Success Criteria**	**% of Projected**
PHASE 1			
High Marsh Ecotone	34.74	≥ 11.14	281%
Tidal Salt & Brackish Marsh	303.53	≥ 289.59	94%
Riparian - Planted & Existing	43.36	≥ 39.02	111%
PHASE 2			
Brackish Marsh Wetlands	3.8	≥ 3.28	104%
Freshwater & Seasonal Wetlands	25.61	≥ 21.81	106%
Salt River Channel Wetlands	29.41	≥ 25.08	106%
Riparian - Planted & Existing			
Existing and Planted	*61.89*		
Supplemental Planting	*21.73*		
Total Riparian Habitat	83.6	≥ 69.76	108%

VEGETATION

Monitoring Task: Vegetation Percent Cover – Tidal Marsh (Phase 1), Riparian (Phase 2A Middle, Phase 2A Upper/2B Lower, Phase 2B Middle, Phase 2B Upper), Channel Wetlands (Phase 2A Middle, Phase 2A Upper/2B Lower, Phase 2B Middle, Phase 2B Upper), and Invasives in all monitored areas

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 vegetation for: tidal marsh areas in Phase 1; riparian planted areas in Phase 2A Middle, 2A Upper/2B Lower, 2B Middle, 2B Upper (2015, 2017, 2018, and 2019 restoration respectively); Channel Wetlands areas in Phase 2A Middle, Phase 2A Upper/2B Lower, Phase 2B Middle, Phase 2B Upper (2015, 2017, 2018, and 2019 restoration respectively); and native, non-native, and invasive species within all monitored areas.

Goals:

- Achieve Native Vegetation Percent Cover of: ≥50% in Phase 1 tidal marsh; ≥50% in Phase 2A Middle wetlands; ≥40% in Phase 2A Middle riparian; ≥30% in Phase 2A Upper/2B Lower wetlands; ≥30% in Phase 2A Upper/2B Lower riparian; ≥20% Phase 2B Middle wetlands; and ≥15% Phase 2B Middle riparian habitats; ≥10% Phase 2B Upper (2019) wetlands; and ≥10% in Phase 2B Upper (2019) riparian.
- Achieve 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

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Methods:

A stratified, randomized sampling approach is used to characterize the abundance, species composition, and structural composition of existing vegetation in each vegetation sampling area. A previous year power analyses of vegetation sampling data, established 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 vegetation sampling areas of specific habitat types within project phases. ArcMap® software was then used to randomly distribute 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 – 7). Once sample plots were located in the field, a 1m^2 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 is absolute cover, which is distinct from relative cover. Absolute cover quantifies the vegetative coverage of each species, or category, 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.).

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.

Results & Discussion: The sampling effort shows that the 2020 monitoring areas are both achieving and regression from the percent cover 2020 success criteria of native vegetation depending on the Phase and habitat area. The salt marsh of the Phase 1 Tidal Marsh area is just under the success criteria of ≥50% of native vegetation; likely due to the aggressive encroachment of invasive *Spartina densiflora*. The high marsh ecotone of the Phase 1 Tidal Marsh area exceeded the ≥50% of native vegetation.

Phase 2 success criteria were met in Phase 2A Middle Channel Wetlands and Riparian, Phase 2A Upper/2B Lower Riparian, Phase 2B Middle Riparian, and Phase 2B Upper Channel Wetlands. However, active benches in the Phase 2A Upper/Phase 2B Lower and Phase 2B Middle Channel Wetlands are below their respective success criteria. Additionally, the active bench in the Phase 2B Riparian is also below its success criteria. Monitoring indicates that these active benches are being encroached upon by invasive species such as *Phalaris arundinacea* (reed canary grass), *Lotus corniculatus* (bird's-foot trefoil) and *Agrostis stolonifera* (bent grass).

Non-Native Non-Invasive success criteria is <15% in all restored habitats for all years. Areas recently restored (i.e. since 2018), tend to exceed this success criteria at varying degrees. This is often typical due to recent ground disturbance.

Invasive vegetation success criteria is < 5% in all restored habitat for all years. Monitoring in 2020 surveyed habitats all indicate invasive vegetation species far exceed the success criteria. In Phase 1, Spartina densiflora is beginning to dominate in the salt marsh areas. Phase 2 is becoming infiltrated with *Phalaris arundinacea* (reed canary grass), *Lotus corniculatus* (bird's-foot trefoil) and *Agrostis stolonifera* (bent grass) and may be outcompeting native species.

Calculated percent cover for 2020 is presented in Table 2.

Recommendations include to initiate immediate efforts to reduce and/or eradicate invasive vegetation across the project area.

Table 2: Summary of 2019 SRERP Quantitative Vegetation Percent Cover Sampling Results & Respective

	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	2020 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)	**92.7** [88.5, 95.5]	49.4 [36.8, 62.2]	≥50%	**2.4** [0.8, 5.7]	<15%	**40.8** [28.7, 54.5]	<5%	**0** [N/A]
High Marsh Ecotone (n=40)	**98.8** [95.2, 100.0]	**75.4** [66.9, 81.8]	≥50%	**3.4** [1.2, 8.1]	<15%	**20.0** [14.6, 26.2]	<5%	**0** [N/A]
Phase 2 – Salt River Corridor Restoration Area								
Phase 2A (Middle) – Salt River Channel Wetlands								
Active Channel (n=32)	**95.8** [93.4, 97.3]	**79.7** [72.7, 84.6]	≥50%	**0.4** [0.04, 1.8]	<15%	**15.7** [10.7, 22.5]	<5%	**0** [N/A]
Active Bench (n=32)	**98.8** [96.0, 99.5]	**67.4** [56.9, 76.1]	≥50%	**3.0** [0.9, 7.4]	<15%	**28.3** [20.6, 37.4]	<5%	**0** [N/A]
Phase 2A (Middle) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**99.4** [97.1, 99.7]	**53.2** [43.8, 63.0]	≥40%	**3.7** [1.2, 9.0]	<15%	**42.5** [32.9, 52.3]	<5%	**0** [N/A]
Active Riparian Berm (n=32)	**99.2** [98.1, 99.5]	**78.8** [70.8, 84.0]	≥40%	**2.6** [1.2, 5.1]	<15%	**17.8** [12.7, 25.7]	<5%	**0** [N/A]
Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands								
Active Channel (n=32)	**94.4** [89.2, 96.9]	**60.9** [49.7, 70.6]	≥30%	**6.4** [3.8, 10.8]	<15%	**27.0** [19.4, 36.9]	<5%	**0.1** [0, 0.2]
Active Bench (n=35)	**99.3** [96.2, 99.9]	25.6 [18.1, 34.8]	≥30%	**15.2** [8.1, 27.5]	<15%	**58.5** [47.3, 68.3]	<5%	**0** [N/A]
Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**99.2** [97.5, 99.7]	**49.5** [38.6, 60.3]	≥30%	**14.0** [8.8, 22.6]	<15%	**35.7** [27.3, 45.1]	<5%	**0** [N/A]
Active Riparian Berm (n=32)	**98.4** [96.2, 99.4]	**32.3** [24.1, 42.3]	≥30%	**9.2** [5.3, 15.0]	<15%	**56.9** [46.9, 65.3]	<5%	**0.1** [0, 0.3]
Phase 2B (Middle) – Salt River Channel Wetlands								
Active Channel (n=32)	**92.0** [87.1, 95.3]	**40.3** [31.9, 48.9]	≥20%	**17.6** [13.0, 23.2]	<15%	**33.5** [25.6, 42.7]	<5%	**0.7** [0.07, 3.1]
Active Bench (n=32)	**96.3** [91.8, 98.4]	**8.1** [3.9, 16.1]	≥20%	**53.4** [44.6, 62.1]	<15%	**34.5** [27.5, 42.7]	<5%	**0.2** [0, 0.5]
Phase 2B (Middle) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**97.2** [93.1, 98.8]	**25.9** [15.9, 38.6]	≥15%	**33.5** [25.0, 43.0]	<15%	**36.9** [28.3, 46.8]	<5%	**1.0** [0.2, 2.6]
Active Riparian Berm (n=32)	**99.4** [96.7, 99.8]	**18.9** [12.7, 27.4]	≥15%	**27.2** [19.6, 36.8]	<15%	**52.3** [42.3, 61.4]	<5%	**1.0** [0.3, 3.4]
Phase 2B (2019) – Salt River Channel Wetlands								
Active Channel (n=32)	**60.9** [53.4, 67.7]	**25.8** [21.2, 31.3]	≥10%	**16.5** [10.8, 24.5]	<15%	**13.6** [9.9, 17.9]	<5%	**5.1** [3.2, 7.6]
Active Bench (n=44)	**87.6** [81.5, 91.9]	**21.1** [14.2, 31.1]	≥10%	**24.7** [17.4, 33.5]	<15%	**41.2** [31.2, 52.2]	<5%	**0.7** [0.3, 1.1]
Phase 2B (2019) – Riparian Planting Zones								
Replanted Riparian Forest (n=20)	**76.3** [65.5, 84.8]	**30.7** [21.5, 44.4]	≥10%	**13.8** [7.6, 22.1]	<15%	**28.4** [17.0, 43.9]	<5%	**3.4** [1.6, 5.9]
Active Riparian Berm (n=32)	**68.4** [58.7, 77.2]	**3.4** [1.9, 5.9]	≥10%	**42.3** [31.8, 53.9]	<15%	**20.2** [14.9, 28.0]	<5%	**2.6** [1.6, 4.2]

VEGETATION

Monitoring Task: Average Tree Diameter – Average Basal Area – Phase 2A 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 average tree diameter at breast height (DBH) in Phase 2A Middle (2015).

Goals:

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

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Methods: The percent cover sampling approach was used for stratifying restoration sampling areas and creating random basal area 10-meter radius 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. 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.

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.

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 x 0.005454

Resulting sampling plot measurements of both basal area and actual-plot-area were 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.

To demonstrate a “statistically significant increasing trend” in basal area a hypothesis test was conducted and p-values computed. P-values less than 0.05 indicate statistically significant change in Basal-Area-Per-Unit Area (BAPA) from 2017 to 2019. A 95% confidence interval level was used to assess the results.

Results & Discussion: Basal area in the 2020 sampling effort reflects current growth and development of replanted and naturally recruited woody riparian vegetation (Table 3). Basal area data collected in 2020 is compared to previously surveyed basal area data collected in 2018 to determine growth trends. Total Phase 2A Middle mean basal area change was in a positive direction (i.e. growth was observed) by an increase of 12.55 ft^2/acre. This growth was found to be a significant change from 2018 to 2020.

Table 3: Summary of 2020 of Planted SRERP Woody Riparian Basal Area Sampling Results.

2020 Sampling Area	Mean Change in Basal Area (ft2/acre)	P (T-test)	P (permutation test)
Phase 2A Middle			
Replanted Riparian Forest	9.28	0.0033	0.0013
Active Riparian Berm	18.43	0.01	0.0318
Total Riparian	12.55	0.0002	0.0002

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:

DUE TO COVID 19 RESTRICTIONS MONITORING FOR SALMONID AND TIDEWATER GOBY DID NOT OCCUR

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 project 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 - 2020. 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.

Five photo monitoring sites were established across Phase 1 and nine sites across the completed Phase 2 channel corridor (Figure 2). Photos were taken prior to construction and annually post construction. 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).

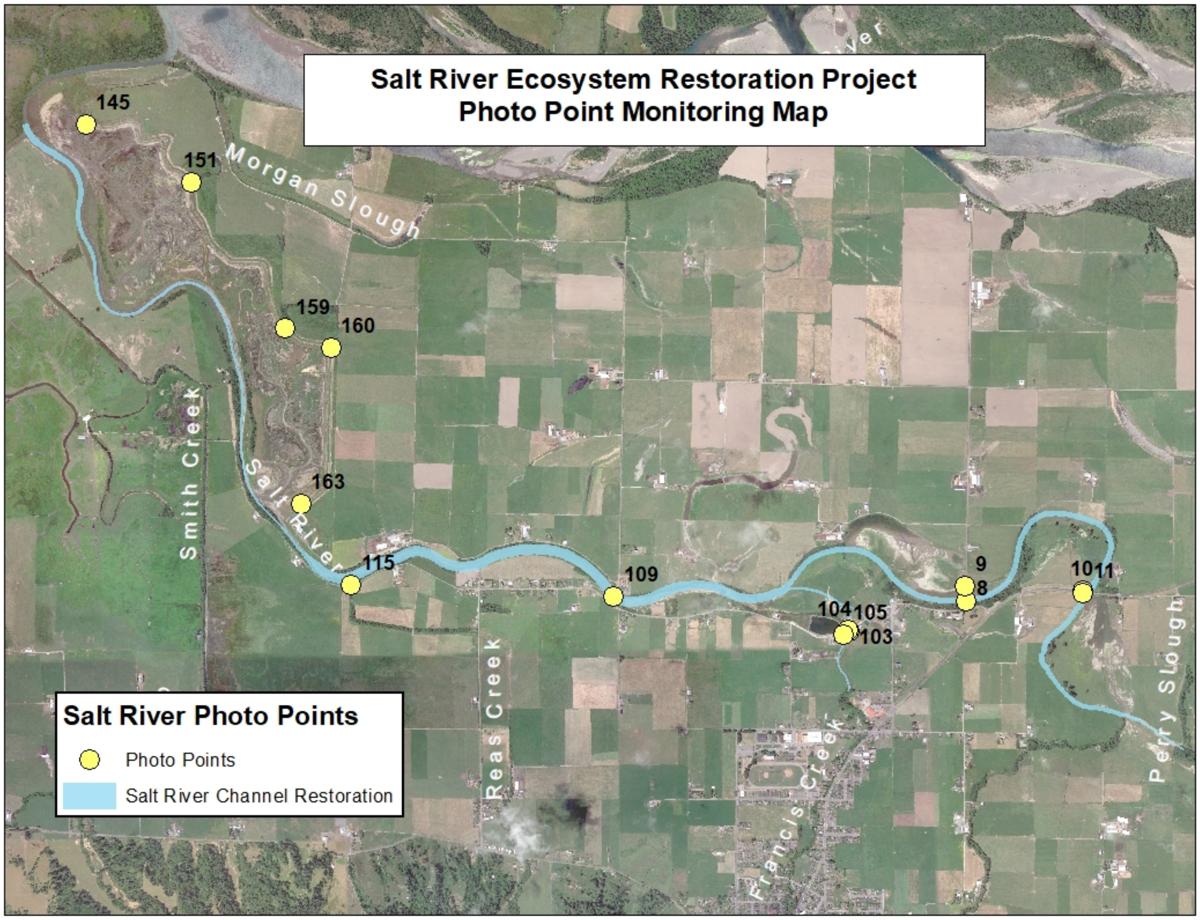

Figure 2: Photo Monitoring Points for the Constructed Footprint - 2020

Results and Discussion: A total of 14 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 – Dec 2017

PP145 – SW – Oct 2020


PP159 – SW Tidegates – Nov 2013


PP159 – SW Tidegates – Nov 2015


PP159 – SW Tidegates – Oct 2020


PP115 – Reas Ck – Jul 2011


PP115 – Reas Ck – Jan 2018


PP115 – Reas Ck – Oct 2020


PP109 – Dillon Br W – Nov 2014


PP109 – Dillon Br W – Jan 2018


PP109 – Dillon Br W – Oct 2020


PP103 – Up Strm – Apr 2017


PP103 – Up Strm – Dec 2017


PP103 – Up Strm – Oct 2020

 

PP9 – Fulmor Br E – Oct 2018   PP9 – Fulmor Br E – Oct 2020

Photo documentation indicates that vegetation continues to establish on Phase 1 and 2 where seed mixes are persisting and natural recruitment of natives, non-natives, and, in some cases, invasives are evolving. Some sites are experiencing increasing canopy cover.

GEOMORPHIC

Monitoring Task: Cross Sectional and Longitudinal Surveys – Riverside Ranch – Phase 1 - 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 at established sites on the interior northern and southern 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: Channel Profile Report: Salt River Ecosystem Restoration Project, Post-Construction Geomorphic Channel Survey Report, Phase 1, Year 7 – 2020. Prepared by Humboldt County Resource Conservation District and P. Duin, Engineer NRCS.

Methods: Data collected in 2020 were measured using a Trimble R10 RTK GPS unit. Upon completion of surveys, data were entered into Civil 3D which was used to create a surface and plot the cross sectional and longitudinal profiles. In previous years, cross-sectional and longitudinal profile data were collected using a CTS/Berger automatic level, tripod and stadia rod. For survey years 2015 through 2018, 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. Horizontal locations were determined using GPS North American Datum 1983 (NAD83) in decimal degrees.

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 16 and 32 elevation points were collected per cross section depending on the size and morphological complexity of the channel, floodplain and banks. Floodplain measurements were collected up to 200-feet on either side of the main channel when feasible. Cross sectional profiles for North and South slough channels are viewed looking downstream towards their confluence with the main-stem Salt River with the zero-point on the graph starting from the east and extending west. Main channel SR cross sectional profiles are viewed looking upstream starting from the right bank (zero-point on the graph) and extending south. 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. Figure 3 provides the location of cross-section sites and longitudinal profiles.

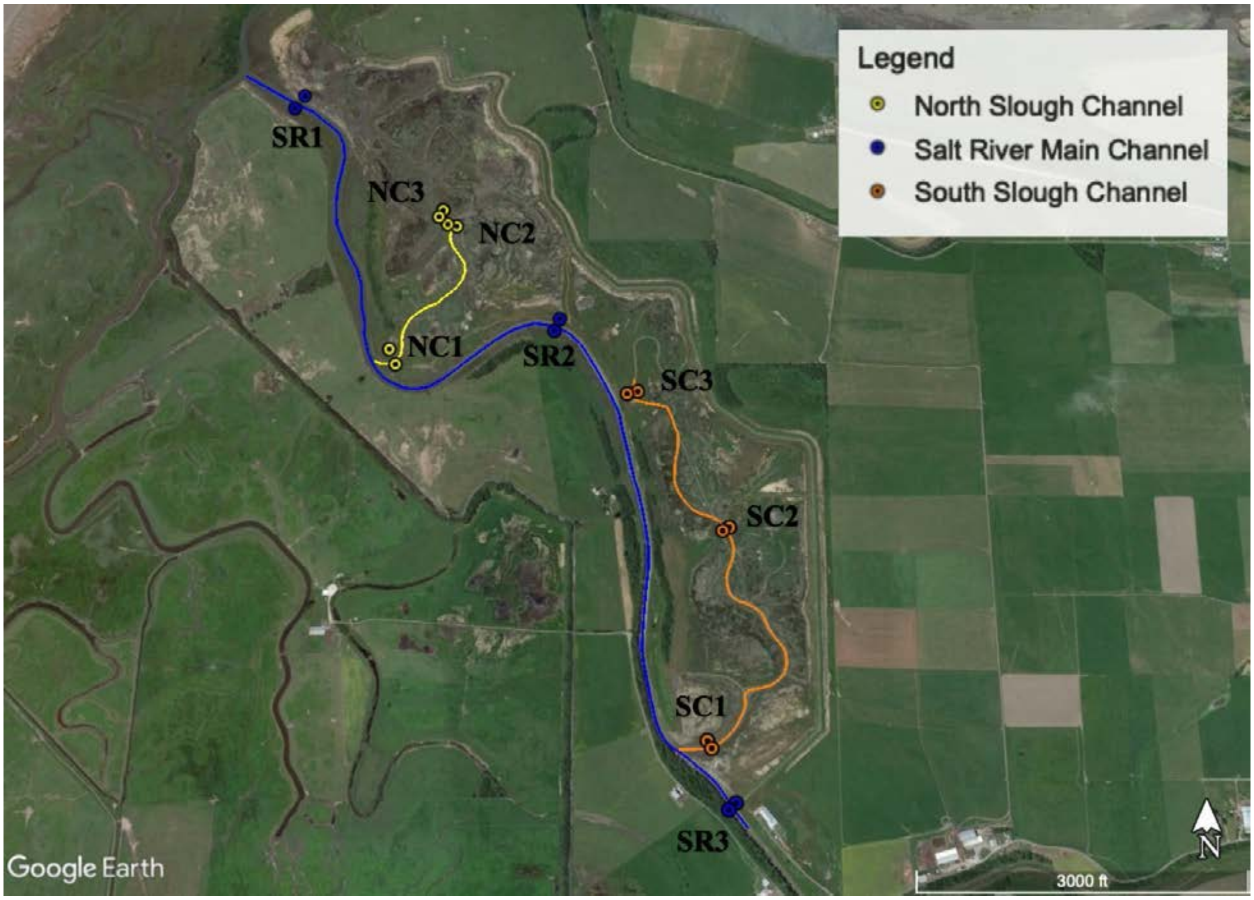

Figure 3: Locations of the cross section and longitudinal profiles for Salt River Ecosystem Restoration Survey Project, 2020. SR = Salt River main channel profiles; NC= North slough channel profiles; SC= South slough channel profiles.

Results and Discussion: Cross section profiles of the main channel indicate that the SR1 and SR2 has predominately experienced scour and deposition (Figures 4 and 5). SR2 channel capacity is estimated to have decreased by approximately 13% due to possible lateral deposition. SR3 channel shape remains relatively stable compared to recent years but experienced deposition between 0.25ft and 0.5ft throughout the channel width compared to the 2014 cross section (Figure 6).

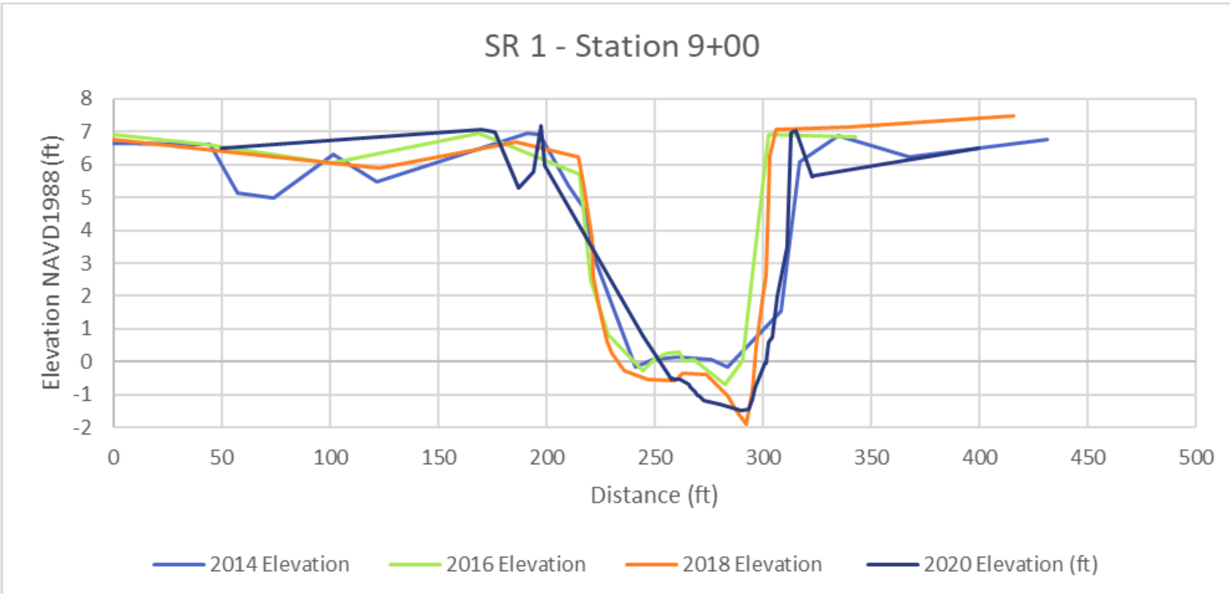

Figure 4. SR1 – Salt River main channel cross section for selected years between 2014 and 2020

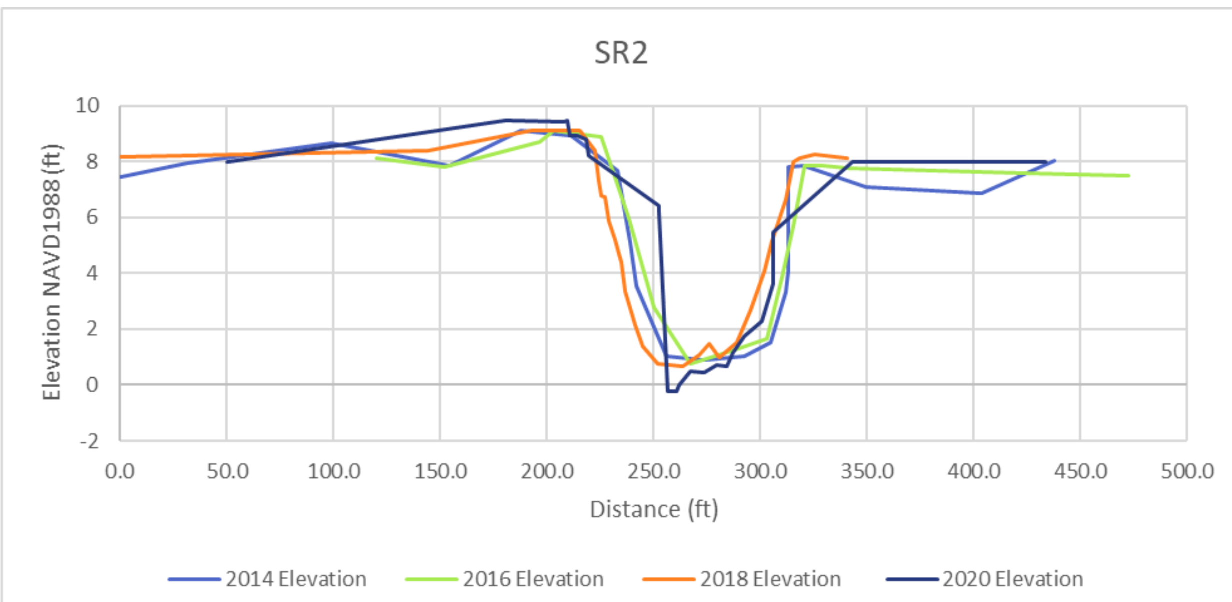

Figure 5: SR2 – Salt River main channel cross section for selected years between 2014 and 2020.

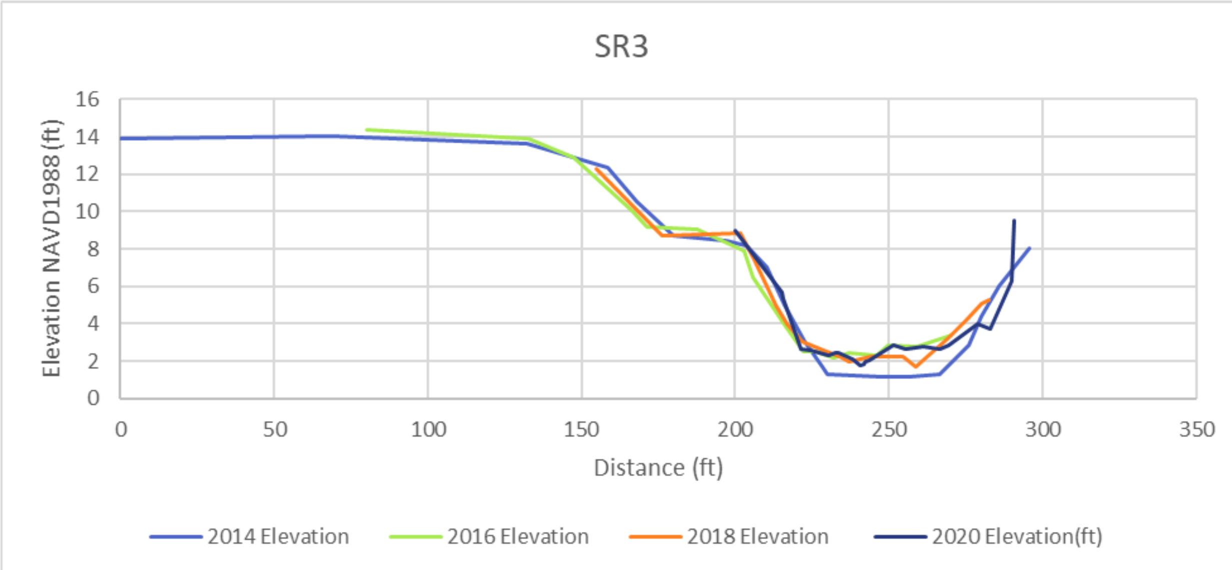

Figure 6. SR3 – Salt River main channel cross section for selected years between 2014 and 2020

The Northern slough channel cross section profiles show a general trend of deepening in the upper reaches of the slough channels and minor deposition in the lower reach. NC1 had deposition in channel bottom since 2018, however overall scour has significantly occurred since 2014 (Figure 7). NC2's capacity has significantly increased and has continued to increase since 2014. NC2 capacity has increased by 150% since 2014 and by 64% since 2018. Scour at this site is dominantly reducing elevation (deepened by 0.78ft since 2017) while widening of the channel increases at a lower rate (Figure 8). The 2020 cross section at NC3 depicts the channel as deepening and incising with deposition occurring on the sides of the channel (Figure 9).

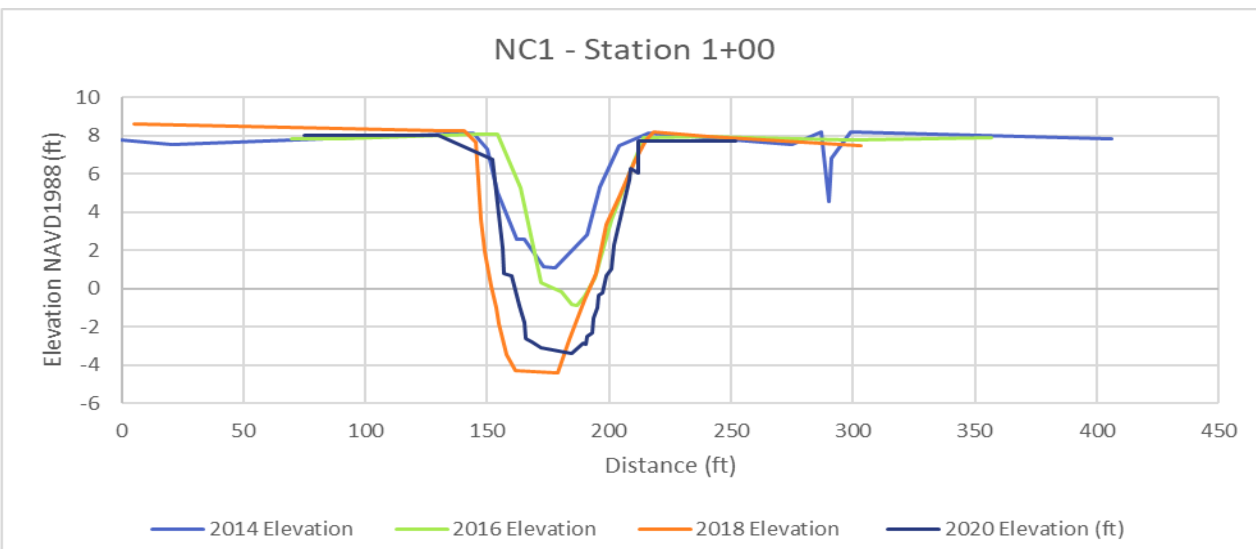

Figure 7. NC1 – Northern Slough channel cross section for selected years between 2014 and 2020

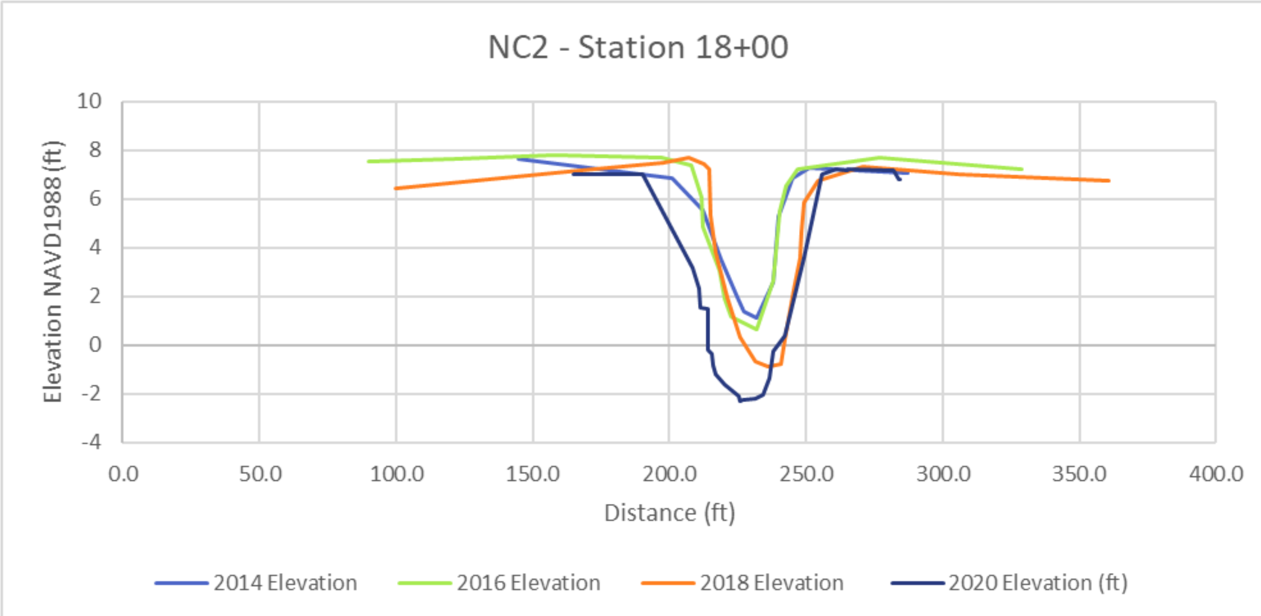

Figure 8. NC2 – Northern Slough channel cross section for selected years between 2014 and 2020

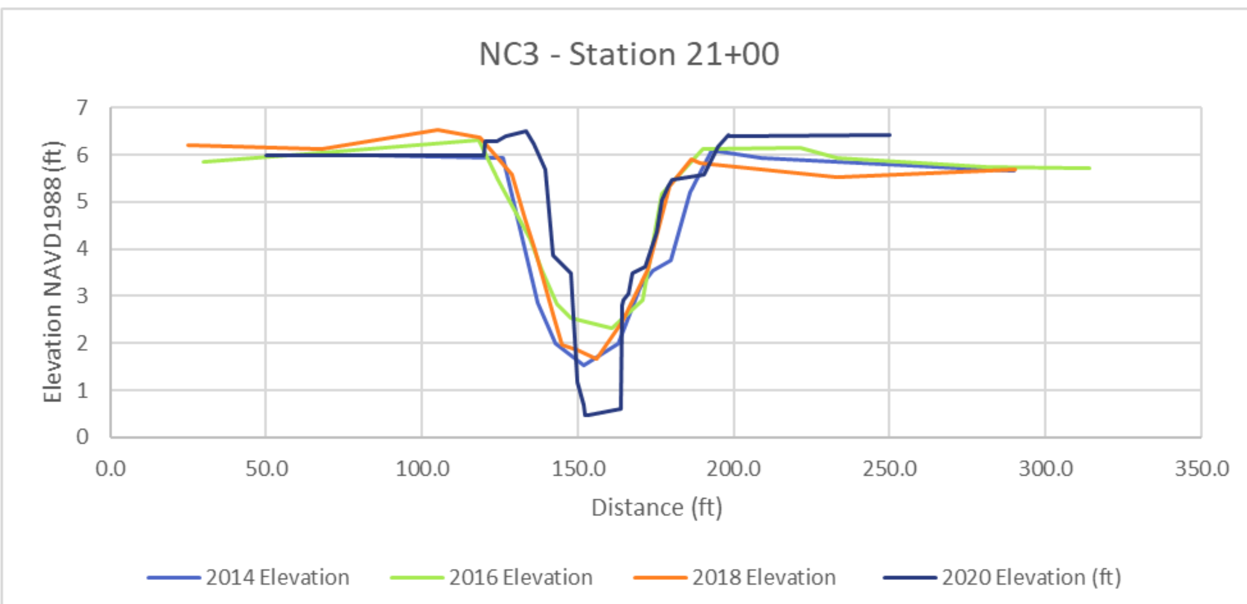

Figure 9. NC3 – Northern Slough channel cross section for selected years between 2014 and 2020

The Southern slough channel cross-sectional profiles indicate that the mid and upper portions of the project area have undergone the least morphological change while the lower reach of the slough channel experienced larger modifications by environmental factors. SC1 showed lateral migration of the right bank from 2014 and 2018 (10 to 15ft) and change in thalweg elevation of eight inches since 2014 and 1.4ft since 2018 (Figure 10). Therefore, capacity increased by approximately 15% since 2018. SC2 uniformly remained primarily unchanged from pervious years' surveys (Figure 11). SC3 experienced a decrease in capacity with approximately 0.3 ft. of aggradation along the channel bottom and 4ft of deposition along the left bank (Figure 12) equating to approximately a 25% change in capacity.

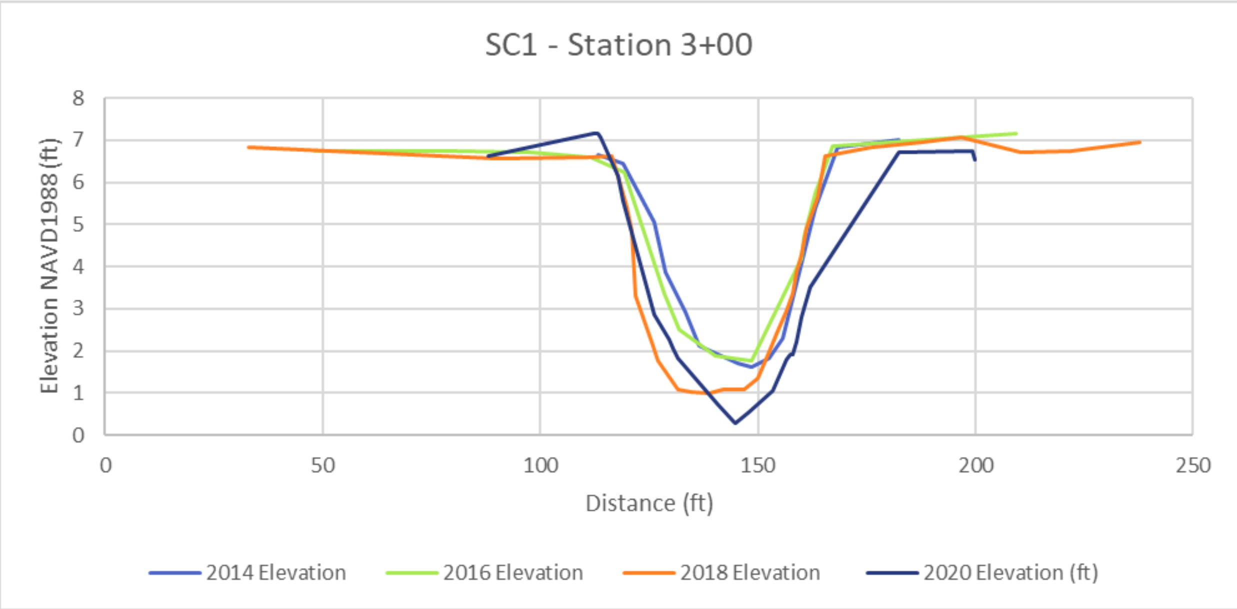

Figure 10. SC1 – Southern Slough channel cross section for selected years between 2014 and 2020

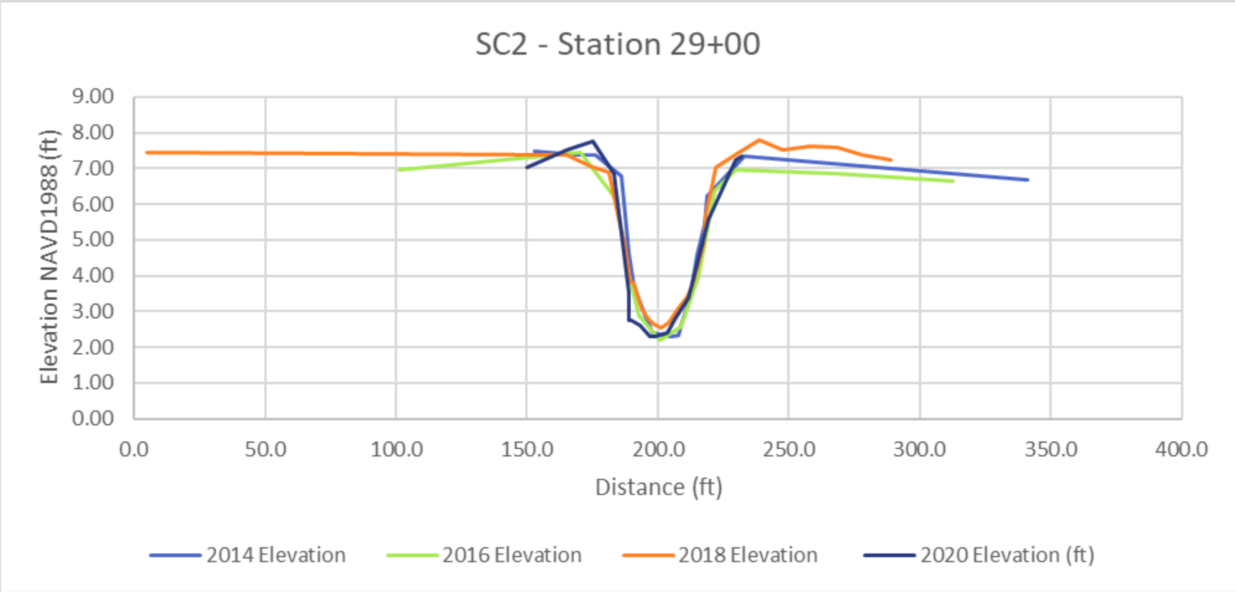

Figure 11. SC2 – Southern Slough channel cross section for selected years between 2014 and 2020

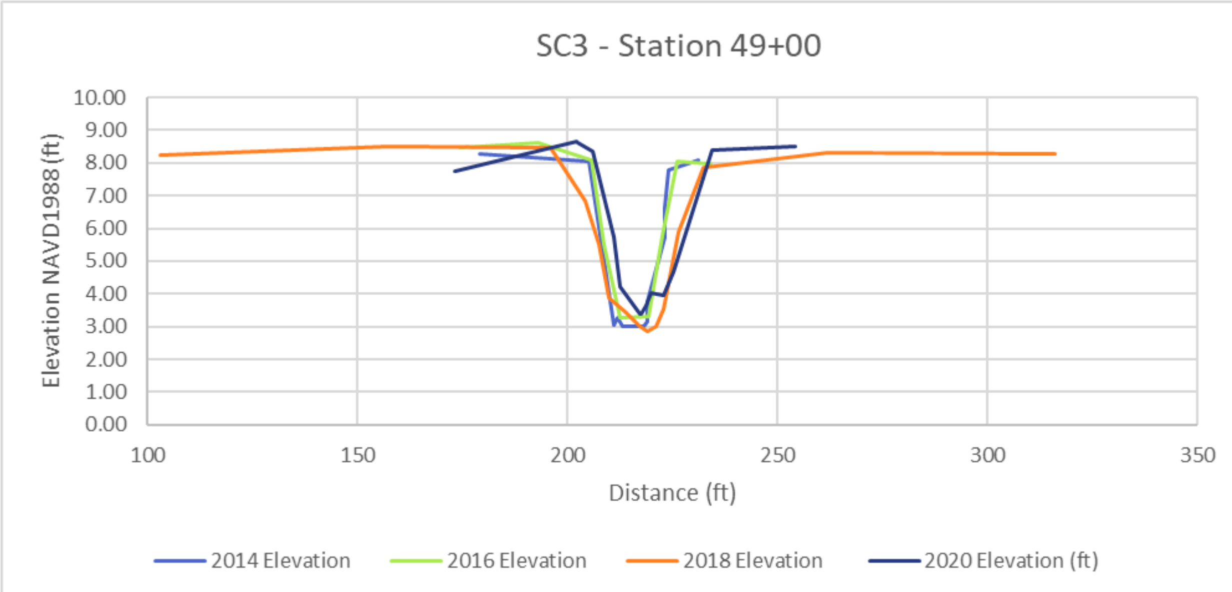

Figure 12. SC3 – Southern Slough channel cross section for selected years between 2014 and 2020

The total relief on the approximate 11,200-foot longitudinal profile section of the main Salt River channel surveyed in 2020 is 4.6 feet, yielding an average gradient of 0.41% per thousand feet, which is a 0.11% increase from 2018 (Figure 13). Compared to the 2018 survey, the dominant trend in the 2020 main channel longitudinal profile was deposition, most notably in the upper and lower reaches. However, comparing the 2020 to the 2014 and 2016 surveys, deposition occurred in the upper half of the reach and scoured in the lower half.

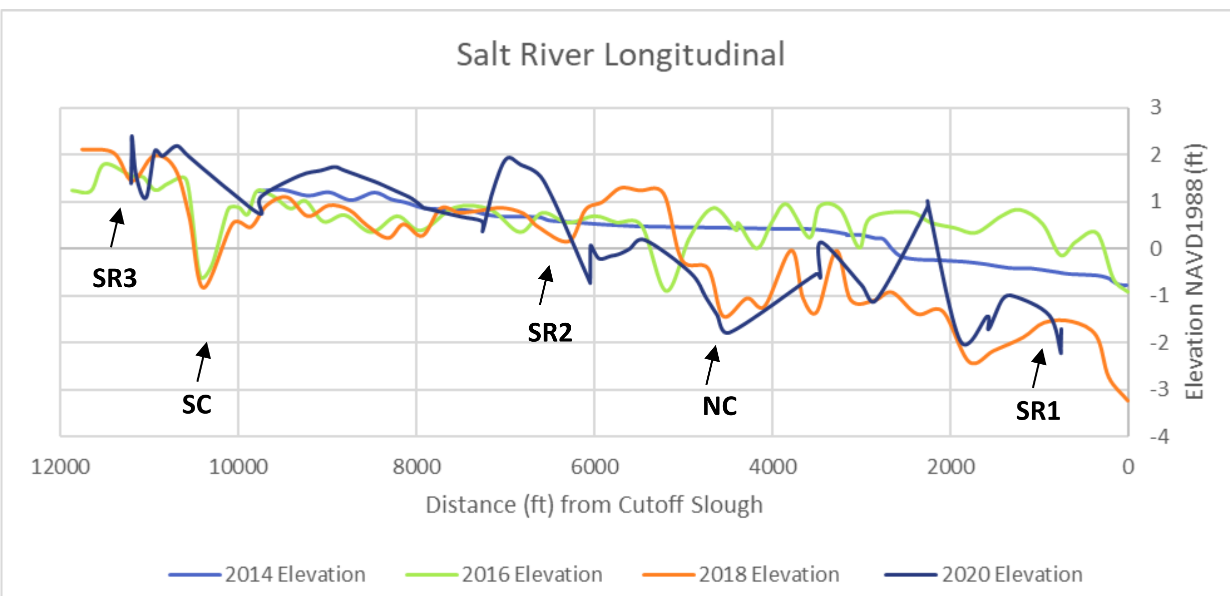

Figure 13. Salt River Longitudinal surveys for selected years between 2014 and 2020

The longitudinal profile of the NC for 2020 indicates scouring throughout almost the entirety of the channel reach with the exception of approximately one foot of deposition on either side of the cross section NC2 (Figure 14). Degradation of the channel was relatively consistent, with considerable thalweg scour occurred at the beginning of the reach (at NC1) and undercutting of the bank was observed.

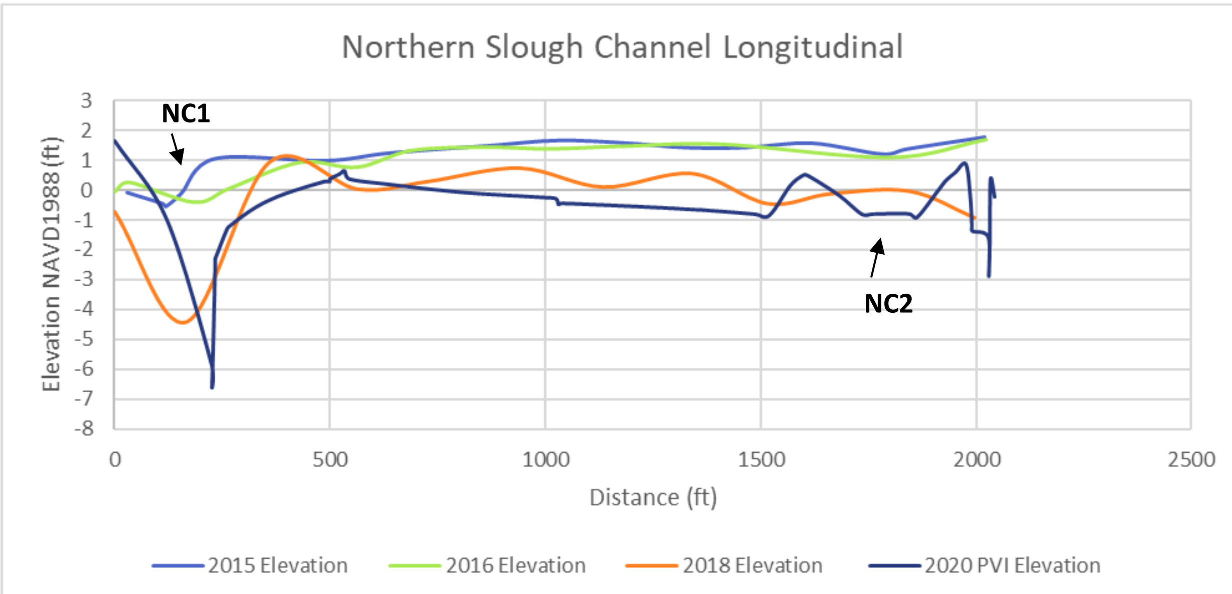

Figure 14. Northern Slough Channel Longitudinal surveys for selected years between 2014 and 2020

The 2020 longitudinal profile for the southern slough channel is relatively consistent with previous surveyed channel elevations, excluding significant deposition in the lowest (500 ft) and upper (4,500 ft) sections. These sites experienced six feet and 2.5 feet of deposition, respectively, compared to the 2018 profile (Figure 15).

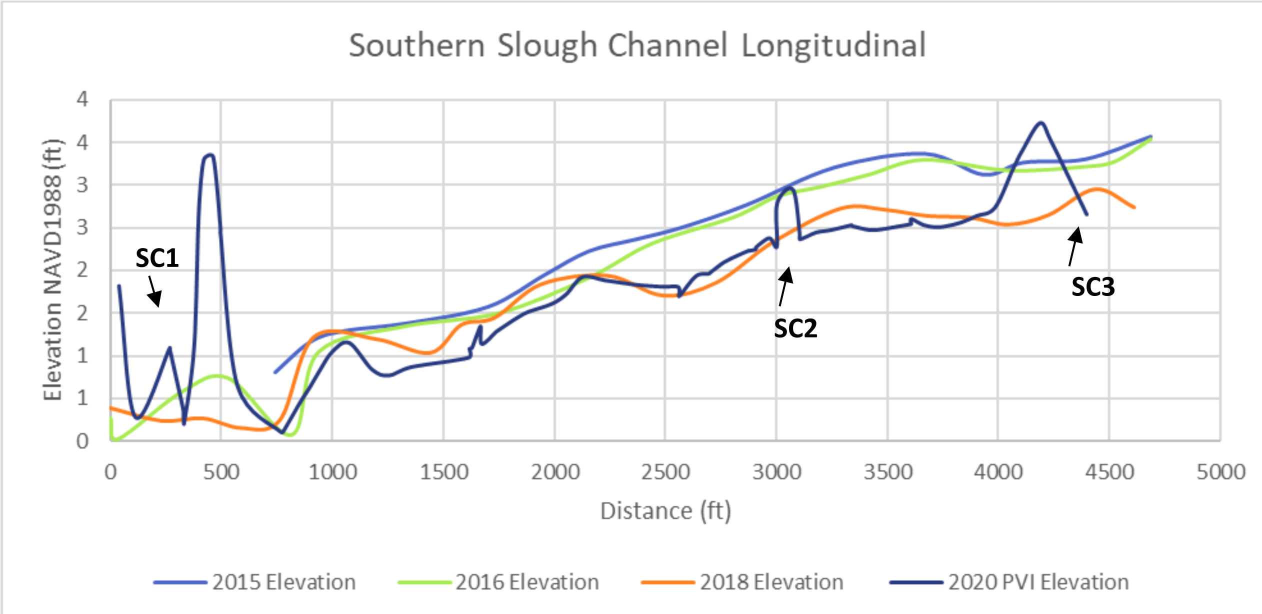

Figure 15. Southern Slough Channel Longitudinal surveys for selected years between 2014 and 2020

Though the Salt River cross-section sites did not have any dramatic changes, the longitudinal profile showed some unexpected deposition throughout 12,000 ft reach. It is highly recommended to perform a 2021 survey to determine if the confluence with the southern-slough channel has indeed filled in with sediment. The northern slough channel cross-sectional surveys indicate that approximately one foot of deposition occurred in the lower reach, while scour up to one foot is present in the upper reach. Site NC2 should be observed in the field to assess the significant scour and increase of channel capacity. The southern slough channel network appears to be mostly stable with little change from recent surveys.

GEOMORPHIC

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 Phase 2 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: Channel Profile Report: Salt River Ecosystem Restoration Project – Phase Two – Year 2020 by Doreen Hansen (Humboldt County Resource Conservation District and Peter Duin (Natural Resources Conservation Service). February 2021.

Methods: Data collected in 2020/2021 were measured using a Trimble R10 RTK GPS unit. Upon completion of surveys, data were entered into Civil 3D which was used to create a surface and plot the cross sectional and longitudinal profiles. In previous years, cross-sectional and longitudinal profile data were collected using a CTS/Berger automatic level, tripod and stadia rod. For survey years 2015 through 2018, 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. Horizontal locations were determined using GPS North American Datum 1983 (NAD83) in decimal degrees.

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 16 and 32 elevation points were collected per cross section depending on the size and morphological complexity of the channel, floodplain and banks. Cross sectional profiles are viewed looking downstream starting from the left bank (zero-point on the graph). Longitudinal profiles extended parallel to channel flow following the thalweg. The data points were collected in the thalweg at approximately 60 meter intervals where possible; though coarser resolutions where were made due to channel water level height and/or when vegetation prevented sighting of the prism. Figure 16 provides the location of cross-section sites. The longitudinal begins (distance equals zero) at the confluence of Reas Creek and extends upstream to just upstream of cross-section 10.

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Figure 16: Salt River Phase 2 Cross-Section Sites

Results and Discussion: Four cross-sections sites were surveyed in the 3.7 kilometers of the restored reaches of the Salt River (Figure 16). The following graphs (Figures 17 to 21) show cross-sections from 2020 and previous years. Excerpts and results from the Phase 2 2020 report are provided below:

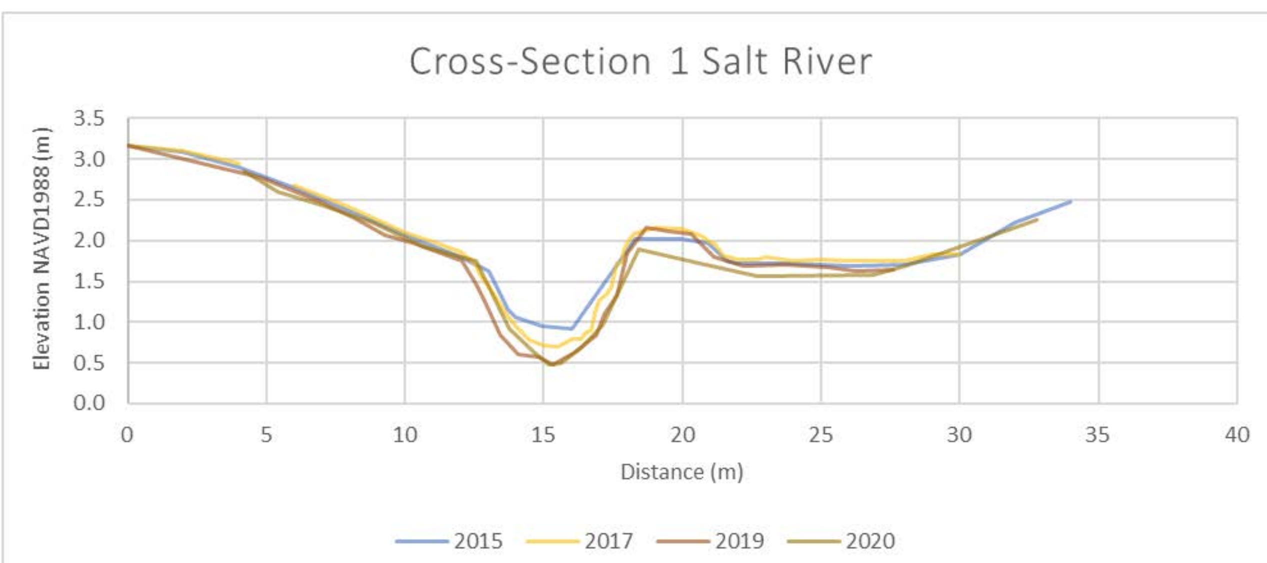

Figure 17: Cross-section one, profile for years 2015-2020.

The profile for cross-section one (figure 17) indicates some possible deposition on the left side of the channel since 2019, however is consistent with surveyed channel morphology in previous years. Channel bottom elevation is consistent with the 2019 survey. Since the original survey in 2015, the channel elevation has dropped by 0.42 meters. The coarse resolution on the active channel berm, above the right side of the channel, does not capture the relief of the feature. Possible minor scour and elevational lowering of 0.14 meters occurred on the floodplain compared to previous years.

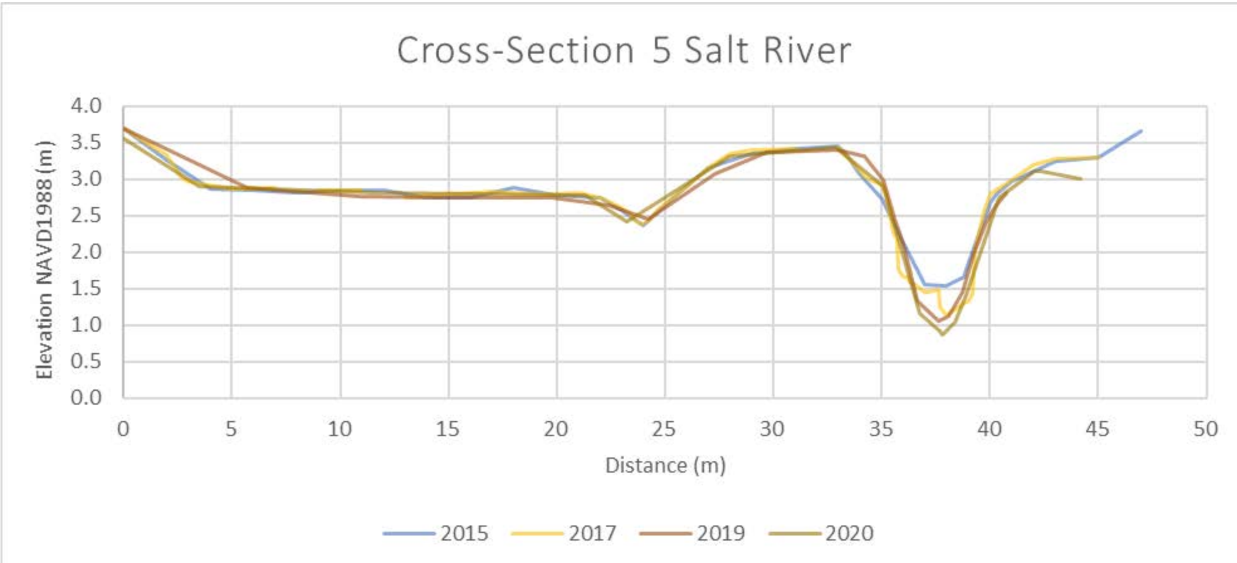

Figure 18: Cross-section five, profile for year 2015-2020.

Cross-section five closely maintained a similar configuration with 2019's survey, with a decrease in thalweg elevation of 0.19 m from the previous year (figure 18). Overall, the channel bottom has decreased by 0.57 meters since 2015. The cross-sectional profile shows floodplain elevations consistent with previous survey years.

Current and previous surveys show consistent floodplain and active berm elevations for cross-section seven (figure 19). However, the collection of the 2020 active channel data points are far too coarse to compare them to previous surveys. This may have been due to high water levels in the channel. Some deposition appears to have occurred in 2019 on the left side of the channel and scour on the right channel bottom and side, resulting in slight widening and decrease in thalweg elevation of 0.26 m compared to 2018. Channel geometry remains relatively stable with potential for more lateral migration based on visual observation in the field of slumping on the right bank.

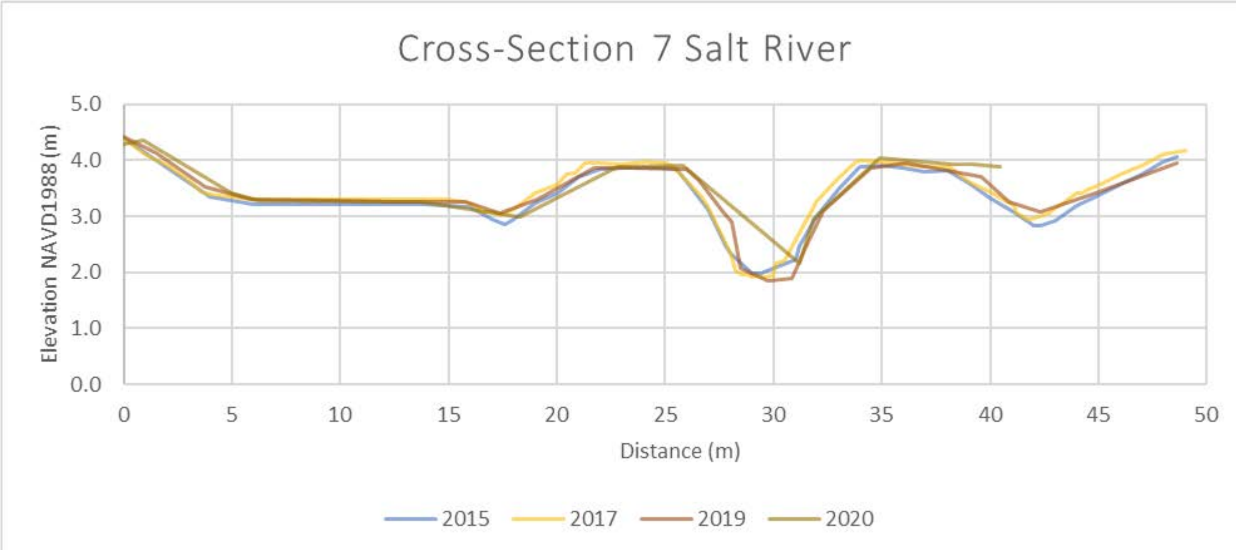

Figure 19: Cross-section seven, profile for years 2015-2020.

Cross-section ten was established in 2019 on a reach of the restored Salt River that was constructed in 2018 (figure 20). The Salt River constructed upstream of cross-section ten is not connected to a perennial water source as of 2021. Therefore, water entering the system upstream of cross-section ten is surface runoff during winter rain events. The deviations of surveyed points between years maybe due to typical surveying error, though some scour may have occurred in the channel bottom (0.19 meters). Deposition is unlikely.

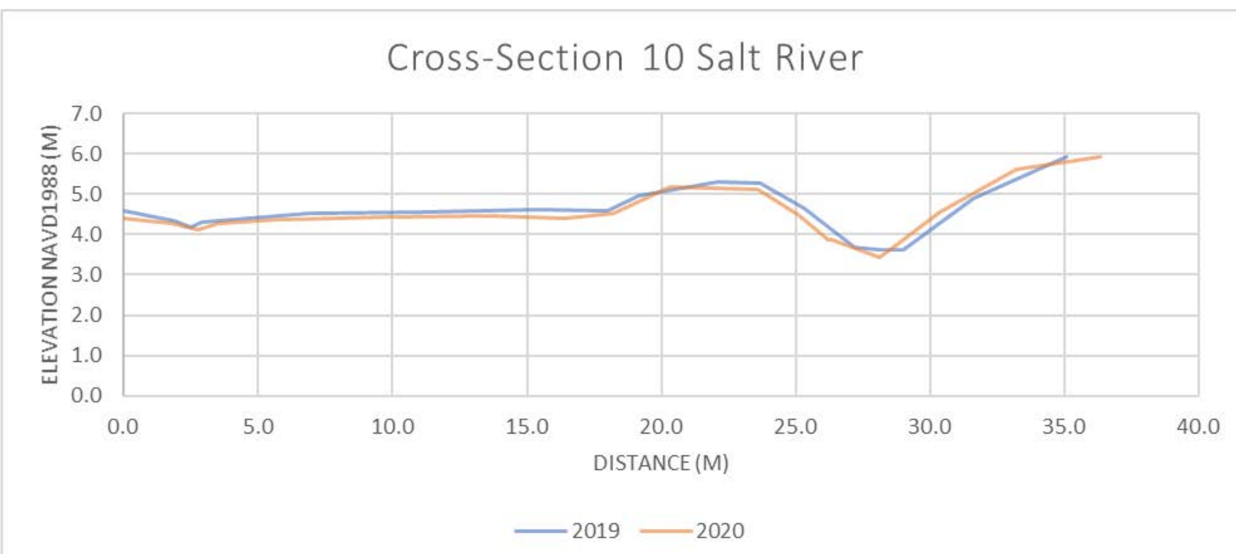

Figure 20: Cross-section ten, profile for year 2019.

Channel degradation is the dominant trend across transects; particularly in cross-sections one and five, which have decreased in thalweg elevation by approximately half a meter since 2015. The dynamic processes that cross-section one and five have experienced is likely due to the two sites being in an older constructed reach *(constructed in 2014) compared to cross-section seven (constructed in 2015). Cross-section one and five are also influenced by daily tidal cycles, where cross-section seven and ten are not. Cross-section seven shows a trend toward erosion in the channel but of less overall magnitude than the other cross-sections.*

The longitudinal profile spans a distance of 3,700 meters and is presented between years 2016 and 2020. Cross-section sites are provided to show approximate locations. The sediment management area (SMA) on Francis Creek, at the confluence of the Salt River, is also shown. Data resolution is courser in portions of the reach due to dense vegetation and excessive water depth. In agreement with cross-sectional surveys, the longitudinal profile shows a dominant trend of scouring as illustrated by reductions in elevation throughout majority of the channel. However, the 2020 survey did not capture the scour holes between 400 meters to 2,200 meters. This may be due to the increased water level heights during the time of the survey. Notably, the 2019 deposition immediately downstream of the SMA was not captured in the 2020 profile due to lack of data points taken in that reach. In-channel vegetation in that reach was thick and in late 2020 vegetation was removed in a 150-foot reach in that area. Overall, the 2020 profile was consistent with the recent 2019 survey (figure 15).

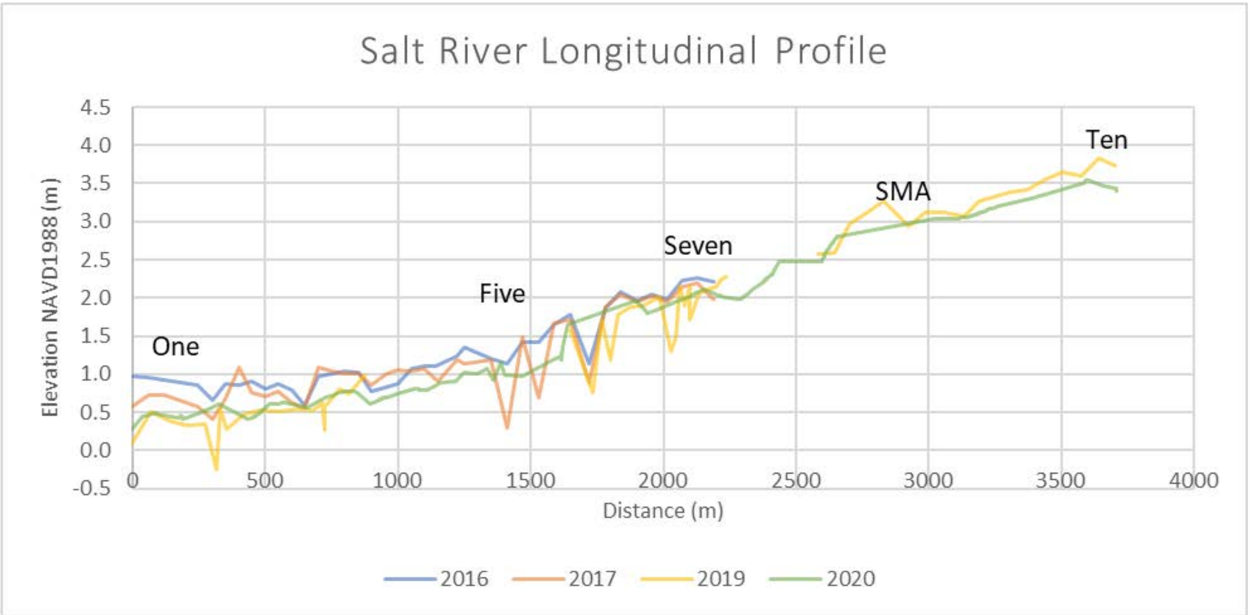

Figure 21: Phase 2 longitudinal profile

In total, the data shows trends of decreased channel bottom elevations and potential net sediment transport out of the project area, which is consistent with past survey years. Channel degradation is most prominent in the downstream portions of the river as indicated by mean bed lowering in the longitudinal profile and lower thalweg elevations in cross-sectional profiles compared to previous years. In previous years' surveys, the downstream section had relatively uniform bed lowering, whereas the upstream portion *had more variable sour patterns leading to incipient pool formation and greater morphological complexity.*

Cross-sectional profiles indicate more lateral erosion in the lowest cross-section one site compared to the upstream sites. This could partially be due to several factors; vegetation was anecdotally observed to have propagated more rapidly in the upstream portion, these reaches are also dominated by a freshwater hydrology regime towards Francis Creek and are less tidally influenced in the middle portions compared to the lower reach near Reas Creek. Increased exposure to fluvial processes, compounded by a lack of root stabilization (as lower bank vegetation is limited in these areas) could be contributing to the higher rates of lateral erosion in the downstream portion. Conversely, riparian vegetation in the upper portions may lead to greater bank stability and less lateral erosion. Additionally, dense in-channel vegetation in the upper portions was observed, potentially causing water velocity to slow and let entrained particles settling out, thus leading to less overall change in channel geometries.

Future geomorphic surveys are required. It is recommended that surveys occur in the late fall when water levels are at their lowest in order to collect sufficient points for high resolution depiction of the active channel and when tree leaf vegetation is sparse to not interfere with equipment collecting data.

LIST OF AVAILABLE REPORTS

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

Hansen, D. and Duin, P. 2021. Channel Profile Report: Salt River Ecosystem Restoration Project – Phase Two – Year 2020. Prepared for the Humboldt County Resource Conservation District. Eureka, California. January 2021.

Humboldt County Resource Conservation District. 2020. Salt River Ecosystem Restoration Project – Photo Monitoring - 2020. Eureka, California.

Humboldt County Resource Conservation District and P. Duin. 2021. Channel Profile Report: Salt River Ecosystem Restoration Project, Post- Construction Geomorphic Channel Survey Report, Phase 1, Year 7 – 2020. Prepared for Humboldt County Resource Conservation District. Eureka, California.

J.B. Lovelace & Associates. 2021. 2020 Annual Habitat Monitoring Report - Salt River Ecosystem Restoration Project, Prepared for the Humboldt County Resource Conservation District. February 2021.