Findings Report for Post-project Biological Sampling: Francis Creek

Francis Creek is a tributary to the Salt River, a tidally-influenced tributary of the lower Eel River near Ferndale, California (Figure 1). Francis Creek has a drainage area of approximately 4.6 square-miles and approximately 5.2 miles of blue-line stream channel (according to the USGS topographic maps). The Francis Creek channel includes a lower reach through dairy and agricultural lands, an urbanized middle reach through Ferndale, and a forested upper reach that has been subjected to commercial logging. In the mid-1800s the Salt River channel was sufficiently deep to support ship traffic up to Port Kenyon, however increased sediment delivered from the upper watershed and reduced tidal prism to flush sediment resulted in an aggraded channel with significantly reduced widths and depths. The frequency of flooding in Ferndale and the surrounding farmland progressively increased as the Salt River and its tributaries filled with sediment and efforts to alleviate flooding have become a persistent issue. An intensive multi-stakeholder planning process was started in 1990 with a Coastal Conservancy grant that initiated studies on sedimentation, hydrology, and aquatic and avian biology. Stakeholders have included Ferndale residents and dairy farmers, as well as tribal, city, county, state, and federal entities. The culmination of this process was a multi-phase plan to restore the hydraulic and ecological function of the Salt River. Starting in the summer 2013, Phase 1 of the multi-phase restoration project was started to meet the following objectives: 1) increase hydrologic function to the lower 2.5 miles of the Salt River, 2) provide access for re-colonization of the lower Salt River by native fish species, and 3) improve habitat for waterfowl and other avian species. Since 2013, more than four miles of the lower Salt River has been excavated and widened, along with tide gate removal and creation of slough habitats. The channel restoration project will also hydrologically reconnect Reas, Francis and Williams Creeks to the Salt River.

The channel work completed during the summer of 2017 included excavation of approximately 2,200 feet of the Salt River channel, which included reconnecting Francis Creek to the Salt River. Approximately 2,600 feet of lower Francis Creek was also excavated in 2017 (Figure 2). This portion of the project included construction of a sediment management area (SMA) in lower Francis Creek just upstream of its confluence with the Salt River, a boulder-chute transition reach between the SMA and the upstream channel, and construction of nine pools with log or boulder weirs. The upper end of the restored reach consisted of five fully-spanning boulder weirs that created a smooth transition of the channel slope between the excavated reach and the existing channel above the project reach. Cattle exclusion fencing was also installed along both banks of lower Francis Creek.

The objective of conducting pre-project biological sampling in conjunction with the channel restoration project in lower Francis Creek was to determine the composition and distribution of

fish species as influenced by the poor connectivity of Francis Creek with the Salt River. Sampling was conducted on June 13, 2017 with a 20-foot seine net and with minnow traps baited with frozen steelhead roe. The fish species caught were Sacramento Pike Minnow, Threespine Stickleback, and sculpin (species unknown, but probably Prickly Sculpin). No salmonids were caught in Francis Creek during the pre-project sampling. Baited minnow traps were also placed in two reaches of Francis Creek upstream of the project reach – just below downtown Ferndale at the Van Ness Avenue Bridge and upstream of town within Firemen's Park (only sticklebacks and sculpins were caught in these traps).

Initially we intended to conduct the post-project biological sampling only in June of 2018 so that we sampled at the same time as the pre-project sampling. However, we decided to also sample earlier in 2018 when water temperatures were cooler and also during the period when juvenile Coho Salmon might still be present in freshwater prior to out-migration. We felt that this earlier sampling would increase the likelihood of determining if juvenile salmonids recolonized Francis Creek after being reconnected to the Salt River. Thus, the post-project biological sampling occurred in both May and June of 2018.

Francis Creek Biological Sampling Methods for May 2018:

On May 10, 2018 RTA performed the first round of post-project biological sampling. Ross Taylor and Thomas Dunklin arrived at the Francis Creek crossing on Port Kenyon Road at 10:30AM. Doreen Hansen with the Humboldt County RCD also assisted with the post-project fish sampling. A 20-foot seine net with a mesh size of 1/8-inch was used to sample fish from the Salt River channel below its confluence with Francis Creek, the boulder chute reach above the SMA, and the Francis Creek channel upstream to the series of boulder weirs at the top of the restoration reach. Taylor identified captured fish and estimated lengths and age classes. Dunklin entered data into a bound field notebook and took photographs. Water temperature, dissolved oxygen, and conductivity were measured at several of the sampling locations in lower Francis Creek. All captured Sacramento Pike Minnow were humanly dispatched as required for all Salt River fisheries monitoring sampling.

On May 11, 2018, Taylor returned to Francis Creek at 7:45 AM to deploy baited minnow traps in the deeper pools where seine netting was most likely ineffective. Seven minnow traps baited with frozen steelhead roe were set in pools, starting with one trap in the deep log-formed pool downstream of Port Kenyon Road. The remaining six traps were placed in deeper pools upstream of Port Kenyon Road; four traps were placed in log-formed pools and two traps were placed in pools formed by the five boulder weirs constructed at the upper end of the restoration project. The traps were fished for approximately three hours before being checked.

Francis Creek Biological Sampling Results for May 10, 2018:

The biological sampling started in the Salt River at the waste water treatment plant inflow at 11:00AM. At this time, the water temperature was 62.7^{o}F and the dissolved oxygen was 9.8 mg/L. The conductivity was 437 µS/cm and was measured with a Milwaukee C65 conductivity meter (serial #M145947). Two passes with the 20-foot seine net were made in the rip-rapped alcove at the treatment plant inflow (Figure 3). A total of 63 juvenile Sacramento Pike Minnow, two Threespine Sticklebacks and one California Roach were captured. All of the Sacramento Pike Minnow were less than 100 mm in length.

The next seine netting pass was made in the Salt River from the treatment plant inflow, upstream to the Francis Creek confluence. This reach was shallow and lacked instream cover. A total of two juvenile Sacramento Pike Minnow and two Threespine Sticklebacks were captured. Both of the Sacramento Pike Minnow were less than 100 mm in length.

The next reach sampled was the boulder chute transition reach, which was comprised of shallow runs and several small pools formed by the boulder weirs. A total of two juvenile Chinook Salmon, 12 Threespine Sticklebacks and one California Roach were captured. The juvenile salmon were both 60-65 mm in length and silvery; photos were taken of both fish prior to their release. At 11:30AM, the water temperature at the top of the boulder chute was 61.1^{o}F and the dissolved oxygen was 11.3 mg/L. Note that the water temperature above the SMA was 1.6^{o}F cooler than the downstream channel.

Between the boulder chute and Port Kenyon Road, several shallow riffles and one deep, log-formed pool were sampled. The pool was too deep to effectively sample with the seine net. In this reach, a total of 32 Threespine Sticklebacks and one Sacramento Pike Minnow were captured.

Between Port Kenyon Road and the upstream “ag bridge”, we seine-netted several shallow riffles and attempted to net in two log-formed pools. Again, the pool sampling seemed inefficient with the 20-foot seine net. Within this reach, a total of 10 Threespine Sticklebacks, one juvenile Chinook Salmon, one Sacramento Pike Minnow, and one sculpin spp. were caught. The juvenile salmon was approximately 70 mm in length and silvery (Figure 4). We suspect that all three Chinook Salmon were non-natal to Francis Creek and had moved up the Salt River prior to smolting and out-migrating to the ocean.

The final reach sampled with the 20-foot seine net was from the ag bridge upstream through the pools formed by the five boulder weirs. No fish were captured in this reach, but the pools were difficult to sample with the seine net. At 12:45PM, the water temperature in Francis Creek

at the upper end of the project reach was 57.1°F, nearly five degrees cooler than the Salt River below the SMA.

Francis Creek Biological Sampling Results for May 11, 2018:

The baited minnow traps were deployed between 8:00 – 8:15 AM, starting downstream and ending at the uppermost pool formed by the boulder weirs.

Trap #1 set in the log-formed pool downstream of Port Kenyon Road was pulled at 11:00 AM and was empty. At a depth of 2.0 feet the water temperature was 60.4°F and dissolved oxygen equaled 11.1 mg/L.

Trap #2 set in the first log-formed pool upstream of Port Kenyon Road was pulled at 11:10 AM and one Threespine Stickleback was captured.

Trap #3 set in the second log-formed pool upstream of Port Kenyon Road was pulled at 11:15 AM and one Threespine Stickleback was captured. This pool is located approximately 75 feet downstream of the ag bridge.

Trap #4 set in the third log-formed pool upstream of Port Kenyon Road was pulled at 11:20 AM and was empty. This pool is located approximately 50 feet upstream of the ag bridge.

Trap #5 set in the fourth log-formed pool upstream of Port Kenyon Road was pulled at 11:25 AM and one sculpin spp. was captured.

Trap #6 set in the lowermost pool formed by the five boulder weirs was pulled at 11:30 AM and was empty.

Trap #7 set in the uppermost pool formed by the five boulder weirs was pulled at 11:35 AM and one Threespine Stickleback and one sculpin spp. were captured. At this time, the water temperature at a depth of 2.0 feet was 56.4°F and the dissolved oxygen equaled 10.5 mg/L.

Francis Creek Biological Sampling Methods for June 2018:

On June 21, 2018 RTA performed the second round of post-project biological sampling. Ross Taylor and Zane Taylor arrived at the Francis Creek crossing on Port Kenyon Road at 11:00AM. A 20-foot seine net with a mesh size of 1/8-inch was used to sample fish in Francis Creek, from the boulder chute reach above the SMA, upstream to the series of boulder weirs. Ross Taylor identified captured fish and estimated lengths and age classes. Zane Taylor entered data into a

bound field notebook and took photographs. Water temperature, dissolved oxygen, and conductivity were measured at several of the sampling locations in lower Francis Creek. All captured Sacramento Pike Minnow were humanly dispatched as required for all Salt River fisheries monitoring sampling.

Francis Creek Biological Sampling Results for June 21, 2018:

Prior to starting the seine net sampling, water quality measurements were taken in Francis Creek at the lower and upper ends of the SMA (which was shallow with thick mats of algae). At 11:00AM, below the SMA the water temperature was 64.7^{o}F, the dissolved oxygen was 2.5 mg/L, and the conductivity was 442 µS/cm. In the Francis Creek channel entering the SMA, the water temperature was 61.3^{o}F and the dissolved oxygen equaled 13.8 mg/L. The seine net sampling then proceeded in an upstream direction, starting within the boulder chute reach just upstream of the SMA.

One seine net pass was made in first pool within the boulder chute and a total of 13 Threespine Sticklebacks were captured. All of these fish were age-0 fish, less than 20 mm in fork length (FL).

Two seine net passes were made through the second pool within the boulder chute and a total of 598 Threespine Sticklebacks (525 age-0 fish), 15 Sacramento Pike Minnow and three California Roach were captured. All of the Sacramento Pike Minnow were less than 100 mm in FL.

One seine net pass was made in third pool within the boulder chute and a total of 30 age-0 Threespine Sticklebacks were captured.

One seine net pass was made in fourth pool within the boulder chute and a total of 79 age-0 Threespine Sticklebacks were captured. This pool was the uppermost pool within the boulder chute reach, located just downstream of the concrete diversion structure.

The next seine net pass was made in the shallow reach between the concrete diversion structure and the first log-formed pool within the Francis Creek restoration reach. A total of 32 age-0 Threespine Sticklebacks were captured.

A total of four scoops with the seine net were made in the first log-formed pool, located approximately 75 feet downstream of Port Kenyon Road. From this pool a total of four juvenile Coho Salmon, 41 Sacramento Pike Minnow and 146 Threespine Stickleback were captured. The Coho Salmon were 92, 102, and 107 mm in FL and appeared to be age-1 fish ready to out-

migrate (Figures 5 and 6). Most of the Sacramento Pike Minnow were less than 100 mm in FL, except two individuals that were approximately 120 and 130 mm in FL (Figure 7). At 12:30 PM, the surface water temperature in this pool was 65.2^{o}F and the dissolved oxygen equaled 14.5 mg/L. At the pool's maximum depth of 4.0 feet, the water temperature was 63.6^{o}F and the dissolved oxygen equaled 13.9 mg/L.

In the riffle underneath the Port Kenyon Road Bridge, a total of three Threespine Stickleback were captured. These fish were approximately 30 to 40 mm in FL.

A total of three scoops with the seine net were made in the first log-formed pool upstream of Port Kenyon Road. From this pool a total of 52 age-0 Threespine Sticklebacks and one California Roach were captured. We observed numerous Sacramento Pike Minnow in this pool, but none were captured.

A total of four scoops with the seine net were made in the second log-formed pool upstream of Port Kenyon Road. This pool is located approximately 75 feet downstream of the age bridge (Figure 8). From this pool a total of seven age-0 Threespine Sticklebacks, one juvenile Coho Salmon, one Coastal Cutthroat Trout, 13 Sacramento Pike Minnow, and one sculpin spp. were captured. The juvenile Coho Salmon was 87 mm in FL and the Coastal Cutthroat Trout was 128 mm in FL (Figure 9).

We skipped sampling the third log-formed pool (upstream of the ag bridge) because it was difficult to maneuver the seine net within this pool.

A total of three scoops with the seine net were made in the fourth log-formed pool upstream of Port Kenyon Road. From this pool a total of 14 Sacramento Pike Minnow and two sculpin spp. were captured (Figure 10).

The final five pools sampled were formed by the five boulder weirs located at the top of the Francis Creek restoration reach. These weirs create a smooth transition in channel gradient between the excavated reach and the immediate upstream existing channel.

In the first (lowermost) pool formed by the boulder weirs, two scoops with the 20-foot seine net were made. From this pool a total of four Sacramento Pike Minnow, three adult Threespine Sticklebacks and one California roach were captured.

In the second pool formed by the boulder weirs, two scoops with the 20-foot seine net were made. From this pool a total of three Sacramento Pike Minnow were captured.

In the third and fourth pools formed by the boulder weirs, two scoops with the seine net were made in each pool. No fish were caught in these pools. Both pools lacked instream cover for fish.

In the fifth (uppermost) pool formed by the boulder weirs, five scoops with the 20-foot seine net were made. From this pool a total of four Coastal Cutthroat Trout and one juvenile Coho Salmon were captured. The Coastal Cutthroat Trout were 123, 150, 156 and 212 mm in FL (Figures 11 and 12). The Coho Salmon was 88 mm in FL. At 1:35 PM, the surface water temperature in this pool was 60.2^{o}F and the dissolved oxygen equaled 11.6 mg/L. At the pool's maximum depth of 3.7 feet, the water temperature was 59.1^{o}F and the dissolved oxygen also equaled 11.6 mg/L.

Discussion – 2018 Post-Project Biological Sampling:

Although the quality of salmonid habitat in Francis Creek and its connectivity to the Salt River has been affected by a host of human induced impacts, several earlier assessments have documented the presence of salmonids in the creek. CDFW habitat typed Francis Creek in 2003 and conducted electrofishing at 20 locations. Four age classes of Coastal Cutthroat Trout were sampled in pools from Eugene Street in Ferndale to about two miles upstream. *The Salt River Watershed Assessment* report produced by CDFW in 2005 confirmed the past presence of Coastal Cutthroat Trout, juvenile Coastal Rainbow Trout and juvenile Coho Salmon in Francis Creek. The Coho Salmon were caught during fish relocation for a bank stabilization project in Firemen's Park in August 2005 – this was the first confirmation of Coho Salmon in Francis Creek in more than 20 years. Additional juvenile Coho Salmon were relocated in October of 2005. However, no records of Coho presence were available for the past 13 years.

The channel excavation work completed during the summer of 2017 restored the connectivity between Francis Creek and the Salt River. Previously, high flows and sediment from Francis Creek would spread out over pasture land or flow through a network of ditches that emptied into a large swale adjacent to the Salt River. Elevated flows during the winter of 2017-2018 were contained within the reconstructed section of Francis Creek, allowing ample opportunity for fish movement between the Salt River and Francis Creek. Salmonid habitat in the lower 2,600 feet of Francis Creek was improved by the 10 pools constructed within this reach, along with the livestock exclusion fencing and revegetation that has resulted in noticeable changes in less than one year (Figures 13 and 14).

The Chinook and Coho Salmon juveniles caught in lower Francis Creek were most likely non-natal fish that migrated down to the Eel River estuary, moved into the Salt River and eventually took up temporary residence in Francis Creek. The three juvenile Chinook Salmon were silvery

and appeared ready to out-migrate as smolts. The five juvenile Coho salmon that ranged between 87 mm and 107 mm were age-1 fish that should be undergoing the process of smolting and moving towards the ocean. The Coastal Cutthroat Trout were most likely resident fish that moved downstream into the recently constructed pools.

The water temperature measurements made on 6/21/18 documented a warming trend from the upstream end of the restoration reach (59.1^{o}F at 3.7 feet deep at 1:35 PM) and the pool just below Port Kenyon Road (63.6^{o}F at 4.0 feet deep at 12:30 PM). Earlier in the morning there was also a noticeable temperature increase of 3.4^{o}F as streamflow moving through the shallow SMA. Immediately downstream of the SMA, dissolved oxygen readings were extremely low (2.5 mg/L) and may be affected by the thick algal mats that had already formed, because immediately upstream of the SMA the dissolved oxygen was >10 mg/L.

As Francis Creek flows diminish during the summer and early fall, one would expect water quality metrics to further deteriorate for salmonids, with warmer temperatures and lower dissolved oxygen concentrations. Water temperature monitoring with two or three data loggers placed throughout the 2,600 foot restoration reach would easily provide valuable data. Periodic dissolved oxygen readings would be valuable too in evaluating the suitability of over-summering habitat for salmonids in lower Francis Creek.

The SMA was created as a wide, low-gradient area for sediment mobilized during storm flows to drop-out and accumulate. At the upper end of the boulder chute, the concrete diversion structure was constructed so Francis Creek can be diverted into a bypass channel to the Salt River so the SMA can dry out and the accumulated sediment excavated (Figure 2). The presence of juvenile anadromous salmonids within the recently reconnected reach of Francis Creek was encouraging. The presence of these fish in May and June is within the time frame one would expect these species to be ready to smolt and out-migrate; however the SMA may unintentionally be an out-migration barrier due to lack of depth and low dissolved oxygen. As previously recommended, further evaluation of water quality and fish monitoring should occur during the summer of 2018 to better manage lower Francis Creek for juvenile salmonid rearing and unimpeded movement in both upstream and downstream directions. If warranted, the practice of bypassing Francis Creek around the SMA and directly into the Salt River may provide juvenile salmonids a clearer migratory path between the two channels. Use of the bypass channel in late spring and summer may also reduce the thermal loading and biological oxygen demand that appears to be occurring to low flows passing through the SMA.

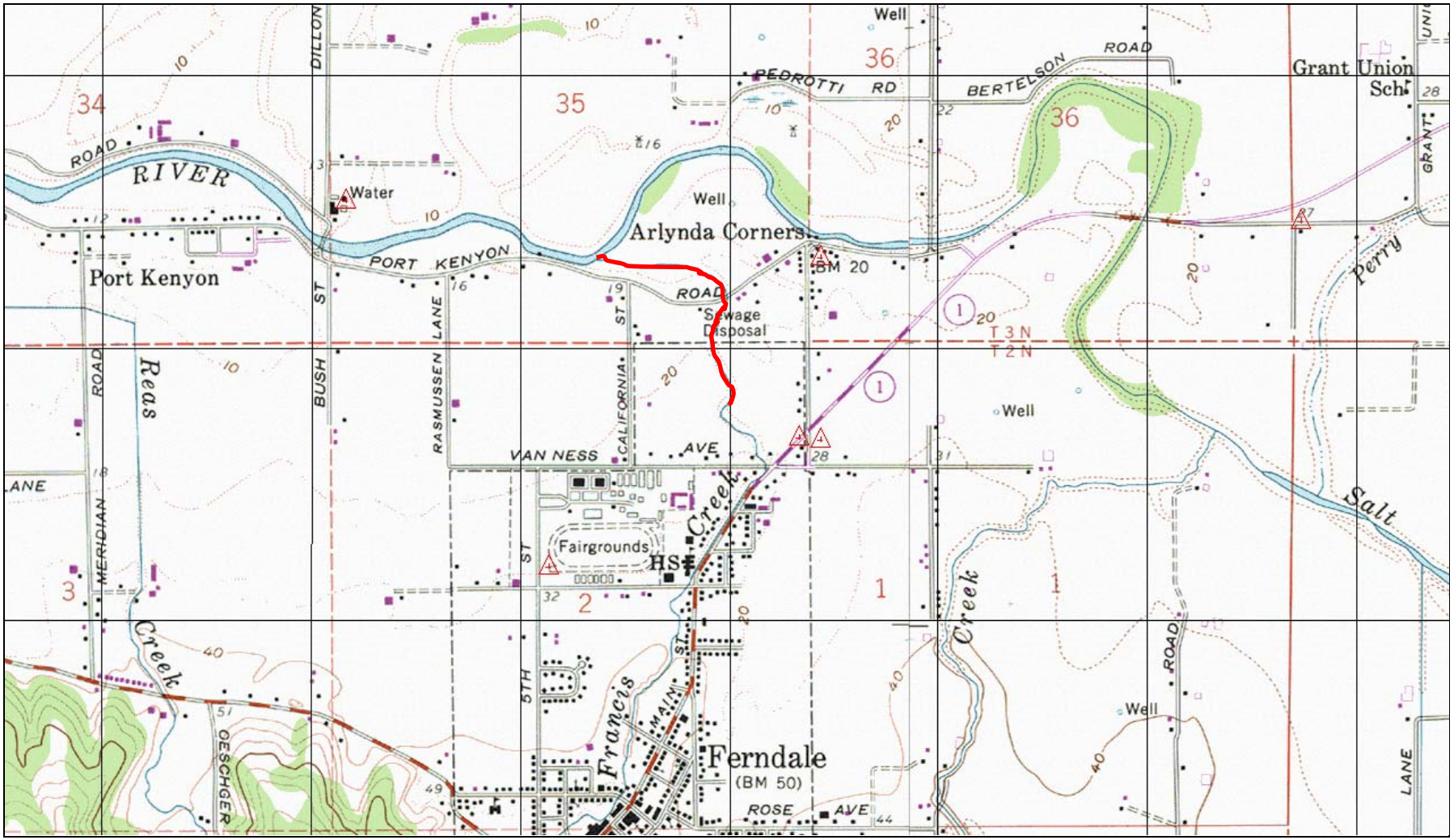

Figure 1. Location of Francis Creek post-project fish distribution sampling conducted in May and June of 2018 (red line demarks the approximate channel reach that was sampled above and below Port Kenyon Road).

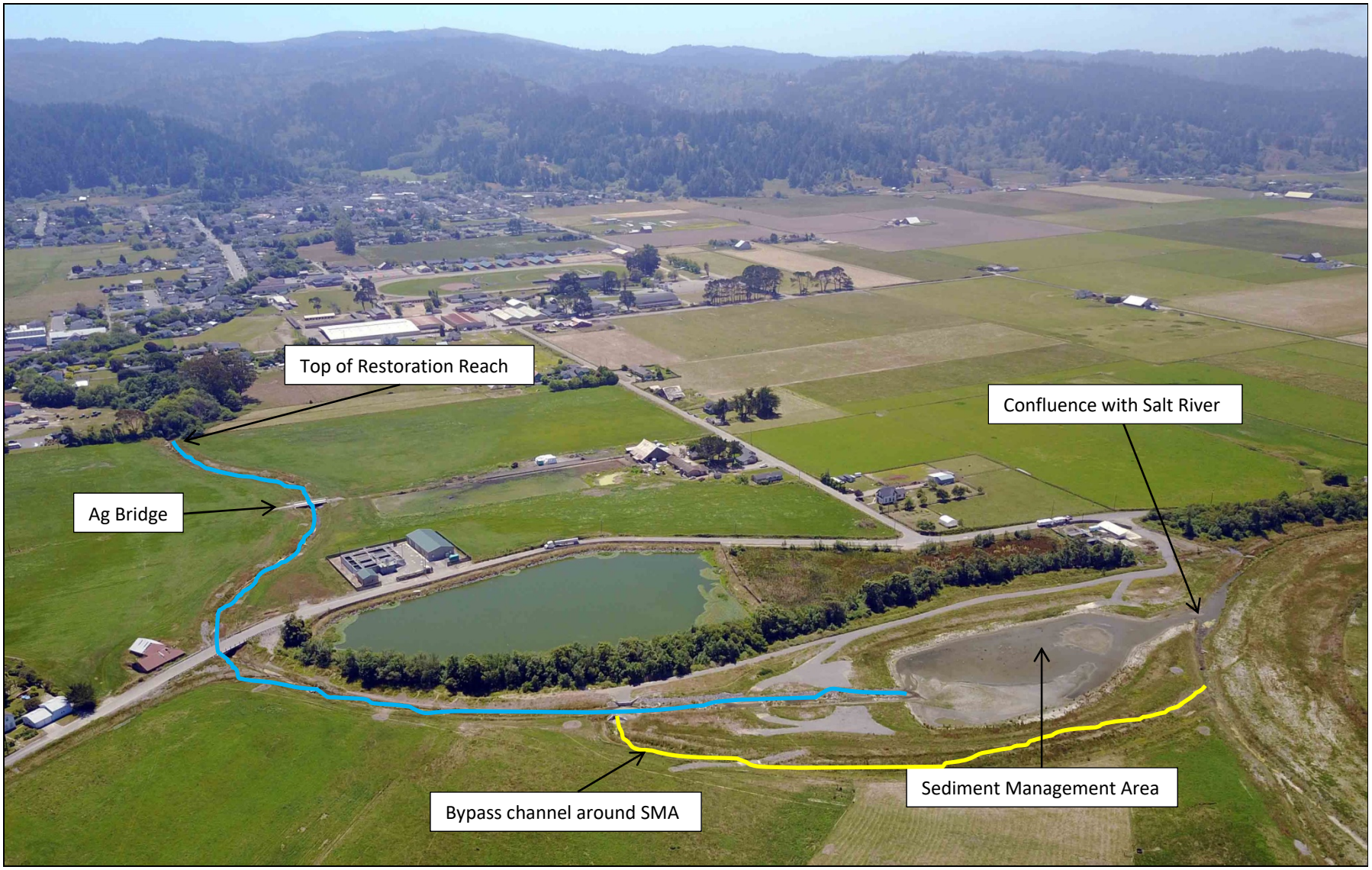

Figure 2. Aerial view of the Francis Creek restoration reach (blue line), including the sediment management area (SMA), bypass channel around SMA (yellow line) and confluence with the Salt River. Photo taken by Thomas Dunklin on 6/30/18.

Figure 3. Salt River and water treatment plant inflow on 5/10/18.

Figure 4. Chinook Salmon captured in Francis Creek on 5/10/18. FL = 70 mm.

Figure 5. Coho Salmon captured in Francis Creek on 6/21/18. FL = 107 mm.

Figure 6. Coho Salmon captured in Francis Creek on 6/21/18. FL = 92 mm.

Figure 7. Sacramento Pike Minnows captured in Francis Creek, downstream of Port Kenyon Road on 6/21/18.

Figure 8. Log-formed pool on Francis Creek, upstream of Port Kenyon Road on 6/21/18. Juvenile Coho Salmon and Coastal Cutthroat Trout were captured in this pool.

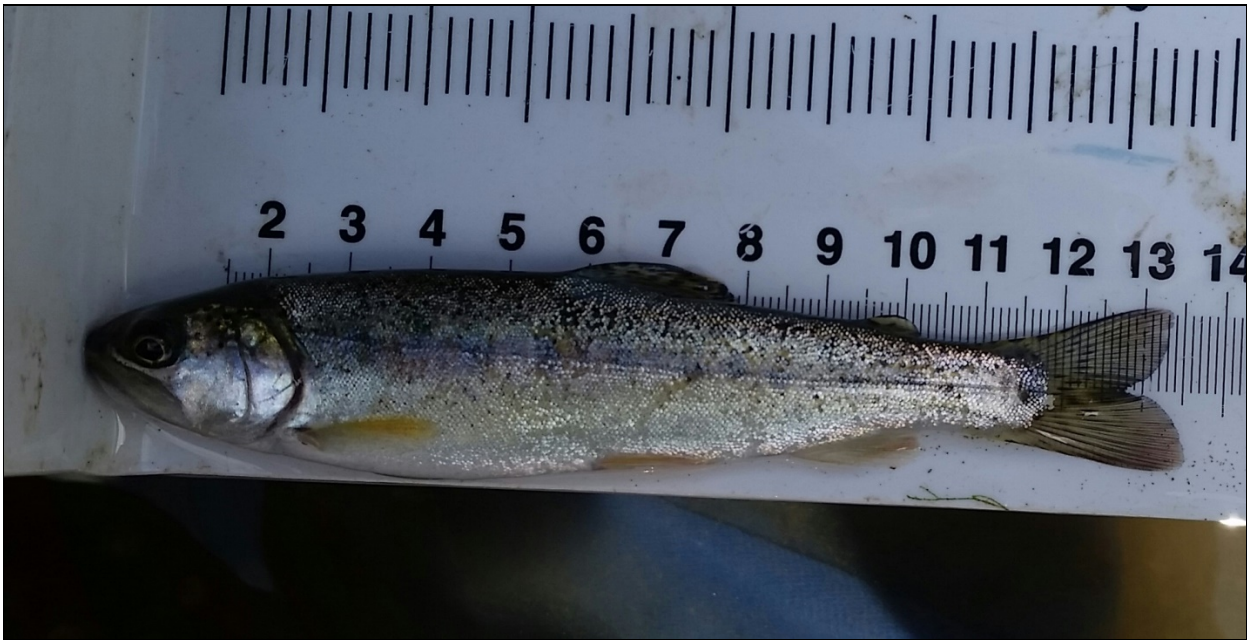

Figure 9. Coastal Cutthroat Trout captured in Francis Creek on 6/21/18. FL = 128 mm.

Figure 10. Sculpin spp. captured in Francis Creek on 6/21/18 from the fourth log-formed pool upstream of Port Kenyon Road.

Figure 11. Coastal Cutthroat Trout captured in Francis Creek on 6/21/18 from the uppermost pool in the restoration reach. FL = 123 mm.

Figure 12. Coastal Cutthroat Trout captured in Francis Creek on 6/21/18 from the uppermost pool in the restoration reach. FL = 212 mm.

Figure 13. Pre-project reach of Francis Creek upstream of Port Kenyon Road on 6/13/17.

Figure 14. Post-project reach of Francis Creek upstream of Port Kenyon Road on 6/21/18.