2022 WETLAND HABITAT AND HYDROLOGY ANNUAL MONITORING REPORT FOR THE SAN ELIJO LAGOON RESTORATION PROJECT

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ACRONYMS AND ABBREVIATIONS

AA	assessment area
AdH	Adaptive Hydraulics Modeling System
Cal-IPC	California Invasive Plant Council
CCC	California Coastal Commission
CDP	Coastal Development Permit
CI	confidence interval
cm	centimeter(s)
Corps	U.S. Army Corps of Engineers
DEM	digital elevation model
I-	Interstate
LFRR	light-footed Ridgway's rail
m	meter(s)
m^2	square-meter(s)
Monitoring Plan	Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project
NAVD88	North American Vertical Datum of 1988
OD	overdredge
PEP	plant establishment period
RTK GPS	real-time kinematic global positioning system
SELRP	San Elijo Lagoon Restoration Project
TIF	tidal inundation frequency
USFWS	U.S. Fish and Wildlife Service

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1. INTRODUCTION

1.1 PROJECT BACKGROUND

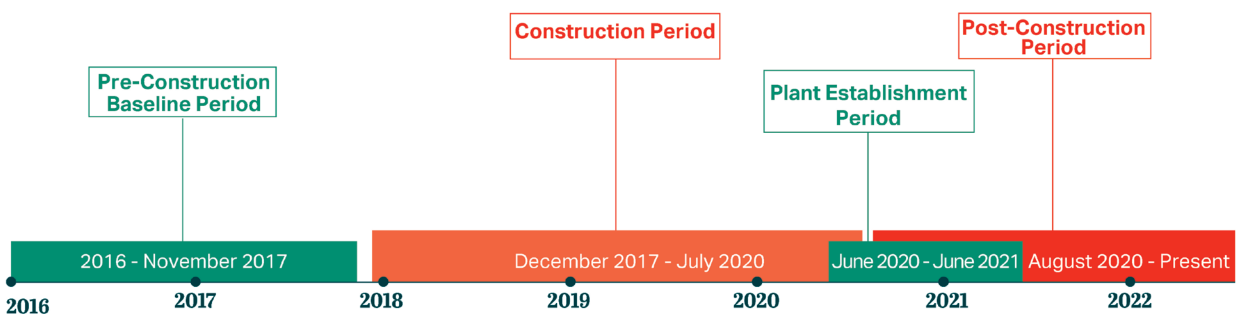
San Elijo Lagoon is a coastal wetland formed at the confluence of Escondido Creek and La Orilla Creek as they meet the Pacific Ocean. Located in the city of Encinitas, San Diego County, California, the lagoon provides habitat for sensitive, threatened, and endangered plants and animals, including resident and migratory wildlife. The San Elijo Lagoon Ecological Reserve is owned and managed by California Department of Fish and Wildlife, County of San Diego Parks and Recreation Department, and Nature Collective (formerly San Elijo Lagoon Conservancy). Lagoon functions had become compromised over time, as development and infrastructure constraints affected the ecosystem, characterized in part by changes in the gradient of habitats within the lagoon (e.g., between unvegetated and vegetated intertidal habitats). The San Elijo Lagoon Restoration Project (SELRP) has been an effort to restore lagoon functions and services to the extent practicable given the current constraints of surrounding development.

The SELRP has been implemented by Nature Collective, San Diego Association of Governments, and California Department of Transportation District 11 to enhance and restore the physical and biological functions and services of San Elijo Lagoon. These efforts included increasing hydraulic efficiency in the lagoon, improving pre-construction water quality impairments, and halting ongoing conversion of unvegetated wetland habitats (mudflat) to vegetated salt marsh with the goal of restoring a more connected gradient of balanced habitat types. Success of the restoration effort is being measured through the implementation of a monitoring program developed in coordination with various permitting and approval agencies, including California Coastal Commission (CCC), U.S. Army Corps of Engineers (Corps), U.S. Fish and Wildlife Service (USFWS), and California Regional Water Quality Control Board.

Construction for the SELRP began in December 2017 and was substantively completed in July 2020 with focused activities continuing to occur in discrete areas of the lagoon. Environmentally sensitive area fence installation and vegetation clearing occurred in the central and east basins December 2017 through early March 2018 to avoid the light-footed Ridgway's rail (*Rallus obsoletus levipes*; LFRR) breeding season. Vegetation clearing in the west basin occurred in December 2018. Throughout 2018 and 2019, the overdredge (OD) pit was dredged, followed by excavation of channel side slopes and mudflat areas and channel dredging with disposal to the OD pit. Grading of transitional areas and the nest site also occurred, along with pedestrian bridge installation, construction of the inlet revetment, trail installation, and planting and irrigation. Demobilization was initiated, with final site cleanup, staging area/access/dike removal, and demobilization completed in mid-2020; some minor remedial grading also occurred within the main channel and nest site to complete the project through late 2020. Planting within restoration areas and substantive construction activities were completed in July 2020, and the 240-working day plant establishment period (PEP) was initiated in June 2020. The 240-working day PEP was completed in June 2021 and determined successful.

To assess the responses to the construction activities and changes to the habitat in San Elijo Lagoon, monitoring and data collection are grouped into three discrete periods: the "pre-construction baseline" from 2016 through 2017, a "construction period" from 2018 through July of 2020, and a "post-construction period" starting with August 2020 (Figure 1-1). For some metrics that rely more heavily on spring data (e.g., avian species), the first year post-construction may be considered 2021. For other metrics relying on data collection during the fall (e.g., fish), 2020 may be considered the start of the post-construction period. For the purposes of this Annual Monitoring Report, a "post-construction year" follows the same dates as a calendar year. More specific information is included under the discussion for each metric. For the purposes of reporting a 4-year running average herein, construction and post-construction years have been combined into a "construction/post-construction period," which includes the years 2018 through 2021, when information is available. These data provide complementary information related to performance standards and construction/post-construction monitoring results documented as part of the monitoring program as set forth in *Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project* (Monitoring Plan) (Nature Collective 2020).

Figure 1-1. San Elijo Lagoon Restoration Project Timeline



1.2 REPORTING REQUIREMENTS

This Annual Monitoring Report summarizes the status of the SELRP post-construction in 2022 (Year 2). Metrics included in this Annual Monitoring Report are defined in the SELRP Monitoring Plan prepared for the project. The Monitoring Plan includes both relative and absolute metrics. Relative metrics are those that compare post-restoration conditions to reference wetlands in the region. Absolute standards require that the variable of interest be evaluated only within San Elijo Lagoon. Absolute standards are those that compare post-construction conditions to pre-construction conditions or project design. Absolute standards are not compared to reference wetlands. Absolute performance standards for the SELRP fall into two general categories:

- Project design absolute performance standards have been developed based on the SELRP design in order to meet project objectives. For example, topography or habitat cover variables have pre-determined goals based on the final design and restoration plans, or as-built conditions. These standards are not dependent on pre-restoration conditions.
- Pre-restoration absolute performance standards were developed based on the pre-restoration condition of the lagoon. These standards ensure the SELRP does not negatively impact pre-existing positive ecological attributes of San Elijo Lagoon. The standards are used to determine if post-restoration conditions are similar to pre-restoration conditions.

This Annual Monitoring Report documents conditions in the lagoon post-construction. It is framed to be consistent with the Monitoring Plan, *Wetland Habitat and Hydrology San Elijo Lagoon Baseline Monitoring Report* (AECOM 2020a), and anticipated Annual Monitoring Reports to facilitate reference between documents. Table 1-1 summarizes the specific resources being monitored for success of the SELRP, as well as performance standards for each of the 13 broad physical and biological variables.

Per the Monitoring Plan, Annual Monitoring Reports will be completed as needed until Year 10 post-construction, after which a final monitoring report will be prepared and submitted. Monitoring and reporting beyond 10 years post-construction for the life of the project (defined as a minimum of 50 years) will be detailed in a Long-Term Management Plan

Detailed methods including data collection, monitoring frequency, analysis, and performance standards are discussed in the Monitoring Plan, which is summarized below. Additional detail regarding the overview of past and current monitoring is included in Chapter 15.

Table 1-1. Monitoring Plan Variable Summary

Chapter	Variable	Variable Type	Final Performance Standard	Status of Monitoring
2	Topography	Project Design Absolute	Habitat areas fall within 10% of design acreage No large-scale variations from design elevations	Active; monitored in 2022
3	Bathymetry	Project Design Absolute	Habitat areas for subtidal habitat fall within 10% of design acreage No large-scale variations from design elevations	Active; monitored in 2022
4	Tidal Elevation	Project Design Absolute	Habitat areas must fall within 10% of the designed habitat area targets in response to tidal inundation frequency (TIF) Predicted seawater residence time must remain on average shorter than 7 days in the central basin and 9 days in the east basin, as estimated using a numerical	Active; monitored in 2022

Chapter	Variable	Variable Type	Final Performance Standard	Status of Monitoring
			hydrodynamic model (such as RMA) to indicate first order water quality	
5	Habitat Areas	Project Design Absolute	Habitat areas fall within 10% from final approved habitat distribution (acreage) (CCC) including 57 to 73 acres of low marsh (USFWS)	Active; monitored in 2022
6.1	Vegetative Cover	Project Design Absolute	Meet the 5- and 10-year absolute performance standards defined in the final restoration plan as detailed in Table 6-1 of the Monitoring Plan	Active; monitored in 2022
6.2	California Cordgrass *(Spartina foliosa)* Canopy Architecture	Relative	Not significantly worse than the mean value (i.e., 4-year running average of the mean proportion of stems >90 centimeters at the lowest performing reference wetland)	Active; monitored in 2022
6.3	Exotics	Project Design Absolute	No more than 0% coverage by California Invasive Plant Council “Invasive Plant Inventory” species of “high” or “moderate” threat and no more than 5% coverage by other exotic/weed species	Active; monitored in 2022
7	Water Quality	Relative	Not significantly worse than the mean value (i.e., 4-year running average of the mean number of consecutive hours with dissolved oxygen) at the lowest performing reference wetland	Active; monitored in 2022
8	Benthic Invertebrates	Relative	Not significantly worse than the mean value (i.e., 4-year running average of benthic invertebrate densities and number of species) at the lowest performing reference wetland	Active; not monitored in 2022 per Monitoring Plan schedule
9	Sediments	Not Applicable	No specific performance standard associated with this variable; collected to inform water quality and benthic invertebrate standards	Active; not monitored in 2022 per Monitoring Plan schedule
10	Fish	Relative	Not significantly worse than the mean value (i.e., 4-year running average of fish densities and number of species) at the lowest performing reference wetland	Active; monitored in 2022
11.1	Light-footed Ridgway’s Rail	Pre-Restoration Absolute	4-year running average of density and lagoon-wide abundance of light-footed Ridgway’s rail individuals are within 95% or greater of pre-construction survey data (2016, 2017)	Active; monitored in 2022
11.2	Western Snowy Plover and	Pre-Restoration Absolute	4-year running average number of western snowy plover and California least tern individuals observed per survey/month are	Active; monitored in 2022

Chapter	Variable	Variable Type	Final Performance Standard	Status of Monitoring
	California Least Tern		within 95% or greater of pre-construction survey data (2016, 2017)	
11.3	Belding's Savannah Sparrow	Pre-Restoration Absolute	4-year running average of density of Belding's savannah sparrow individuals are within 95% or greater of pre-construction survey data (2016, 2017)	Active; monitored in 2022
12	Wetland Function (CRAM)	Pre-Restoration Absolute	Post-restoration greater than or equal to Baseline CRAM Attribute Score	Active; not monitored in 2022 per the Monitoring Plan schedule
13	Eelgrass	Pre-Restoration Absolute	No permanent losses of eelgrass	Completed
14	*Caulerpa*	Pre-Restoration Absolute	*Caulerpa* absent from project site	Completed

CCC = California Coastal Commission; CRAM= California Rapid Assessment Method;
USFWS = U.S. Fish and Wildlife Service

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2. TOPOGRAPHY

2.1 PERFORMANCE STANDARD

Topography is a project design absolute monitoring variable and, as such, is not held to comparisons with reference wetlands for purposes of determining success of the SELRP. Performance standards shall be considered met if post-construction monitoring results show no large-scale variations from design elevations and habitat areas are within 10% of the design habitat distribution.

2.2 APPROACH

Per the Monitoring Plan, target elevations for low, mid-, and high salt marsh habitats, as well as wetland to upland transition zone habitat, must be met to achieve succesful restoration. The establishment and maintenance of vegetation coverage representative of these habitat types reflect that target elevations have been met. Habitat mapping within the lagoon as described in Chapter 5 is used to assess the success of this metric.

Post-construction monitoring was conducted in October 2020 to establish the post-construction topography within the site, per the Monitoring Plan Year 0 requirement. This survey established the baseline post-construction topography that will be used to identify substantial changes in the future that could affect the ability of the desired habitats to become established. Subsequent post-construction monitoring was conducted in December 2022 to assess whether the project has undergone major topographic change that could affect habitat areas. Both the 2020 and 2022 surveys were conducted using aerial imagery and were supplemented with traditional ground surveys by KDM Meridian, Coastal Frontiers Corporation, and Moffatt & Nichol. Topography in the three basins was mapped to 1-foot contours using digital aerial imagery. Elevation contours were produced in digital computer aided design (or CAD) format. A complete description of survey methodology is provided in the Monitoring Plan.

2.3 RESULTS

Target habitats to confirm if the topographic performance standard is met include low, mid-, and high salt marsh habitats, as well as wetland to upland transition zone habitat, as noted in the Monitoring Plan. Table 2-1 below identifies the target acreage for those habitat categories as presented in Chapter 5 of this Annual Monitoring Report, as well as confirmation whether the 2022 mapped acreage falls within the required range for the performance standard.

Table 2-1. Topographic Target Habitat Distribution

Habitat Type	Target Acres	Acres -/+ 10%	Acres Mapped 2022	Habitat Distribution Achieved (within -/+ 10%)
Intertidal Mudflat	32-47	28.8/35.2 - 42.3/51.7	39.7	YES
Intertidal Salt Marsh[1]	293-308	263.7/322.3 - 277.2/338.8	302	YES
Transitional[2]	7	6.3/7.7	7.1	YES

[1] Intertidal salt marsh includes low, mid-, and high salt marsh habitats. Range is due to uncertainty of converted low marsh areas within the overdredge pit.
[2] Transitional habitat acreage has been updated to reflect refinements in geographic information system information.

The topographic surveys conducted in 2020 document the topography of the lagoon immediately following construction (Figure 2-1), and reflect changes to topography that resulted as part of the construction process per project design. The topographic suveys conducted in 2022 (Figure 2-2) document whether design elevations have been maintained. The elevation differences between 2020 and 2022 are represented in Figure 2-3.

2.4 DISCUSSION

Habitat establishment determines whether target elevations for topography have been attained. The correct elevations are critical for restoration success and drive habitat establishment. As shown in Table 2-1, habitat areas for 2022 were within 10% of the planned habitat range for those habitat types used for the topographic performance standard. Areas for habitat types are discussed in more detail in Chapter 5; see Table 5-2 and Table 5-3.

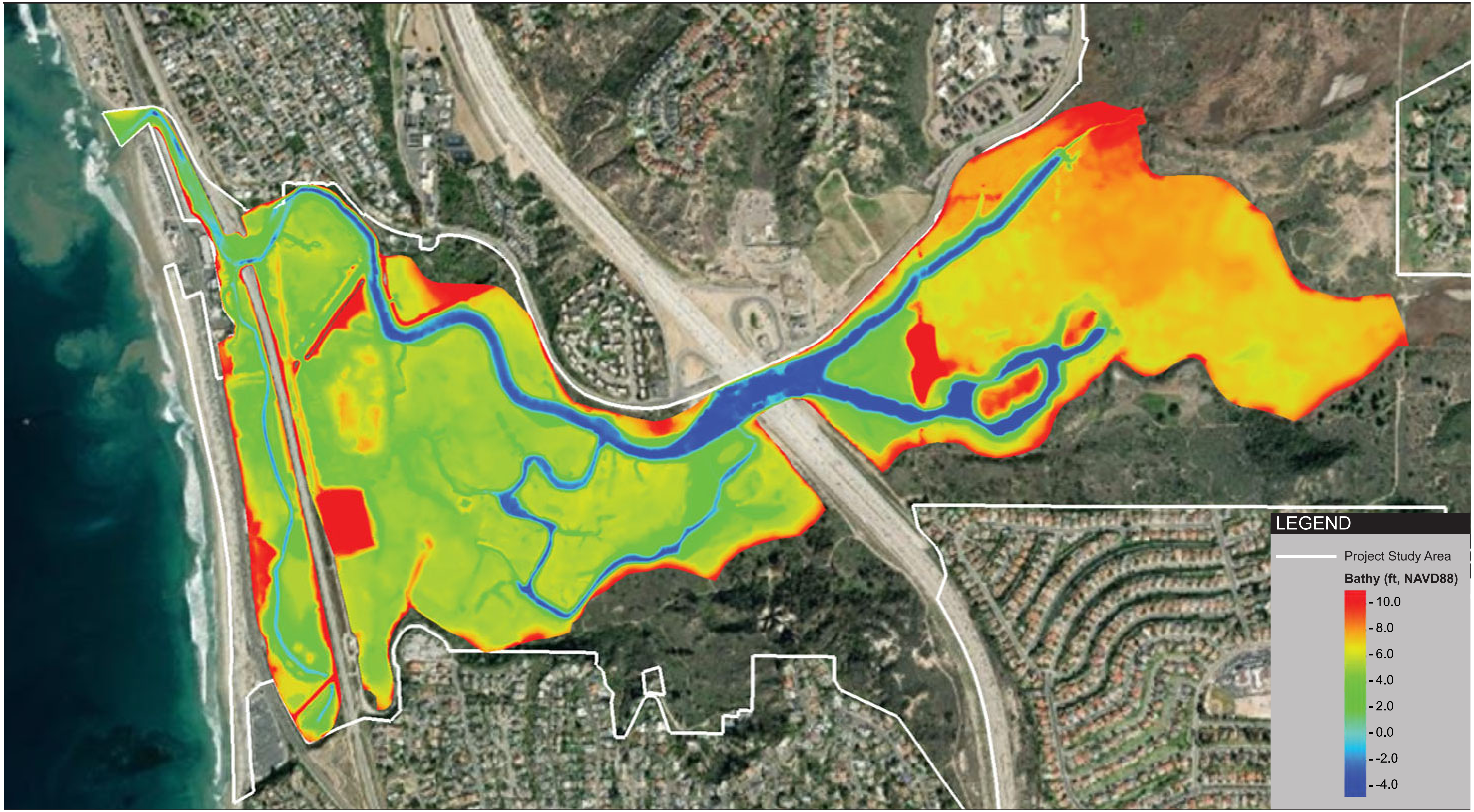
The immediate post-construction project site was quite variable in its topography (Figure 2-1), with the majority of the restoration site between +2 feet and +6 feet North American Vertical Datum of 1988 (NAVD88). Areas east of Interstate (I-)5 are higher and range from +6 feet to +10 feet NAVD88. The restoration site in 2022 (Figure 2-2) did not undergo major topographic changes across the lagoon with elevations remaining generally consistent with the 2020 design elevations. The 2022 survey showed the OD pit has settled in comparison to 2020 elevations. The final surface elevation of the OD pit will be verified in future topgraphic surveys. Future reports will address subsequent activities and whether they result in changes that affect the ability of habitat to establish as designed.

In 2022, the topographic performance standard was met as habitat areas for the metric mapped in 2022 fell within 10% of the design habitat acreage and no large-scale variations from the design elevations had occurred.

Source: Moffatt & Nichol 2022

NO SCALE

Figure 2-1
San Elijo Lagoon Post-construction 2020 Topography/Bathymetry



Source: Moffatt & Nichol 2022

NO SCALE

Figure 2-2
San Elijo Lagoon Post-construction 2022 Topography/Bathymetry

Source: Moffatt & Nichol 2022

NO SCALE

Figure 2-3
San Elijo Lagoon Elevation Differences Between 2020 and 2022 Topography/Bathymetry

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3. BATHYMETRY

3.1 PERFORMANCE STANDARD

Like topography, bathymetry is a project design absolute monitoring variable and is not subject to comparisons with reference wetlands. Performance standards shall be considered met if post-construction monitoring results show no large-scale variations from the design elevations and subtidal habitat areas are within 10% of the design acreage. Success is determined by subtidal habitat areas and their similarity to the design (i.e., within 10%).

3.2 APPROACH

Mapping of subtidal habitat area within the lagoon, as described in Chapter 5, is used to assess the success of this metric.

Post-construction monitoring was completed by Coastal Frontiers in October of 2020 to establish the post-construction bathymetry within the site, per the Monitoring Plan Year 0 requirement. This survey established the baseline post-construction bathymetry that will be used to identify substantial changes in the future that could affect the ability of desired habitats to become established within the lagoon. Subsequent post-construction monitoring was conducted in December 2022 to assess whether the project has undergone major bathymetric change that could affect channel capacity. The 2020 and 2022 bathymetric data were obtained using a survey-grade digital acoustic echosounder operated from a small boat and focused on subtidal areas. Bathymetry was obtained along pre-established channel-perpendicular transects spaced at a nominal interval of 100 feet. A real-time kinematic global positioning system (or RTK GPS) base-rover set was used to determine the horizontal position of each sounding, as well as the water surface elevation (relative to NAVD88). The soundings were merged with the topographic data described in Chapter 2 and used to develop a digital elevation model (or DEM). A complete description of survey methodology can be found in the Monitoring Plan.

3.3 RESULTS

Table 3-1 identifies the design acreage for subtidal habitat categories as presented in Chapter 5 of this Annual Monitoring Report, as well as confirmation whether the 2022 mapped acreage falls within the required range for the performance standard.

Table 3-1. Bathymetry Target Habitat Distribution

Habitat Type	Target Acres	Acres -/+ 10%	Acres Mapped 2022	Habitat Distribution Achieved (within -/+ 10%)
Tidal Channels and Basins (Subtidal)	62	55.8/68.2	61.2[1]	YES

[1] A slight increase in acreage is due to completion of the Interstate 5 bridge and removal of material at the bridge abutment.

The bathymetric survey conducted in 2020 documented the bathymetry of the lagoon immediately following construction (Figure 2-1) and reflects changes to bathymetry and channels that resulted as part of the construction process per project design. Immediately following construction, bathymetry varied throughout the site from the ocean to the east of I-5. Subtidal elevations were approximately +1.6 feet NAVD88 within the lagoon, with tidal channel depths ranging from -2 to -4 feet NAVD88. The bathymetry surveys conducted in 2022 (Figure 2-2) document whether design elevations have been maintained. The elevation differences between 2020 and 2022 are represented in Figure 2-3. At the time of the 2020 survey, the channel underneath the I-5 bridge was still under its construction-phase configuration, consisting of a narrow channel (about 44 feet wide) confined by sheet pile walls. The channel has now been widened per the proposed dimensions and the 2022 survey reflects the final configuration (Figure 2-2). Acreage does not include areas within the I-5 right-of-way; therefore, continued construction during 2020 did not affect acreage results.

3.4 DISCUSSION

Subtidal habitat area determines whether the performance standard for bathymetry has been met. The correct elevations are critical for channel capacity and lagoon function. As shown in Table 3-1, habitat areas for 2022 are within 10% of the design acreage for subtidal habitat area used for the bathymetric performance standard. Areas for habitat types are discussed in more detail in Chapter 5; see Table 5-2 and Table 5-3.

In contrast to topography, bathymetry represents areas that are inundated 100% of the time, occur at lower elevations, and are more heavily influenced by hydraulic forces in the lagoon. Bathymetry was expected to evolve beginning immediately after construction. It is expected that sediment within tidal channels becomes mobile post-construction, and scour and deposition within the tidal channel network occur as a more stable equilibrium condition establishes. In 2022 immediately following construction, the proposed main channel was deepened to -4 feet NAVD88. It was also widened from its pre-construction condition of between 50 to 100 feet wide, to between 100 and 200 feet wide in some areas as designed. The restoration site in 2022 (Figure 2-2) did not undergo major bathymetric changes across the lagoon with elevations remaining generally consistent with

2020 design elevations. Some focused shoaling occurred on the west side of the lagoon causing the channel east of the railroad bridge to infill and narrow as shown in Figure 2-3, but subtidal habitat acreages were not affected, and continued habitat establishment should not be affected with continued maintenance. However, if shoaling of the inlet is not addressed, there may be further negative effects to bathymetry in future years. Future reports will address subsequent activities and whether they result in changes that affect the ability of habitat to establish as designed.

In 2022, the bathymetry performance standard was met as subtidal habitat areas mapped in 2022 fall within 10% of the design habitat acreage and no large-scale variations from design elevations have occurred.

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4. TIDAL ELEVATIONS

4.1 PERFORMANCE STANDARD

Tidal elevation is a project design absolute monitoring variable and, therefore, is not compared to reference wetlands. Performance standards include the following metrics:

1. Habitat areas must fall within 10% of the designed habitat area targets in response to tidal inundation frequencies (TIFs); and
2. Predicted seawater residence time must remain on average shorter than 7 days in the central basin and 9 days in the east basin, as estimated using a numerical hydrodynamic model (such as RMA) to indicate first order water quality.

4.2 APPROACH

Tidal elevation data were collected during 2022 to calculate both the TIF relationship with habitat areas and the estimated tidal residence time within each lagoon basin (Appendix A). Station locations are presented in the Monitoring Plan. Two tide gauge locations within the main channel that were initially included were eliminated to avoid redundancy. These locations included one at the north end of the utility road and one south of Ocean Cove Drive. Tidal elevations are anticipated to vary over time depending on inlet condition, as well as sedimentation within channels. The performance standards were established to rely on longer-term variations in tidal elevations that could affect lagoon function and habitat establishment, rather than short-term variability that is a result of natural processes within an estuarine system.

Habitat was mapped in 2022 as discussed in Chapter 5, and both topographical and tidal elevation data were used to confirm the predicted TIF of various habitat types in the lagoon.

Modeling of tidal residence time was calculated for 2022 using the Adaptive Hydraulics Modeling System (or AdH) developed by the Corps Engineering Researach and Development Center.

4.3 RESULTS

Tidal elevation monitoring conducted in 2022 confirmed that tide range and extent in the lagoon increased after construction. Based on TIF data,habitat elevations in 2022 were within range to support design habitat distribution and habitat is still becoming established as designed (i.e., target acreages).

As discussed further in Chapter 5, habitat areas are continuing to establish within 10% of the final design habitat distribution. The tidal elevation performance standard is considered met if target habitat areas fall within 10% of the design acreage for the project and residence times remain within the durations outlined in the Monitoring Plan within each lagoon basin.

Table 4-1 identifies the target acreage for various habitat categories as presented in Chapter 5 of this Annual Monitoring Report, as well as confirmation whether the 2022 mapped acreage falls within the required range for the performance standard. As vegetation continues to establish in restored areas of the lagoon (e.g., OD pit), acreages may continue to shift until they reflect the TIF of the specific location.

Table 4-1. Target Elevation Distribution Results

Habitat Type	Target Acres	Acres -/+ 10%	Acres Mapped 2022	Habitat Distribution Achieved (within -/+ 10%)
Tidal Channels and Basins (Subtidal)	62	55.8/68.2	61.2	YES
Intertidal Mudflat[1]	32-47	28.8/35.2 - 42.3/51.7	39.7	YES
Intertidal Salt Marsh[1]	293-308	263.7/322.3 - 277.2/338.8	302	YES
Transitional[2]	7	6.3/7.7	7.1	YES
Total	**409**	**368.1/449.9**	**410**	**YES**

[1] Intertidal mudflat and salt marsh ranges are due to uncertainty of converted low marsh areas within the overdredge pit.
[2] Transitional habitat acreage has been updated to reflect refinements in geographic information system information.

The estimated residence time for 15 locations throughout the various basins of San Elijo Lagoon in 2022 is provided in Figure 4-1 and Table 4-2.

Figure 4-1. Estimated Residence Time (days) within San Elijo Lagoon for 2022

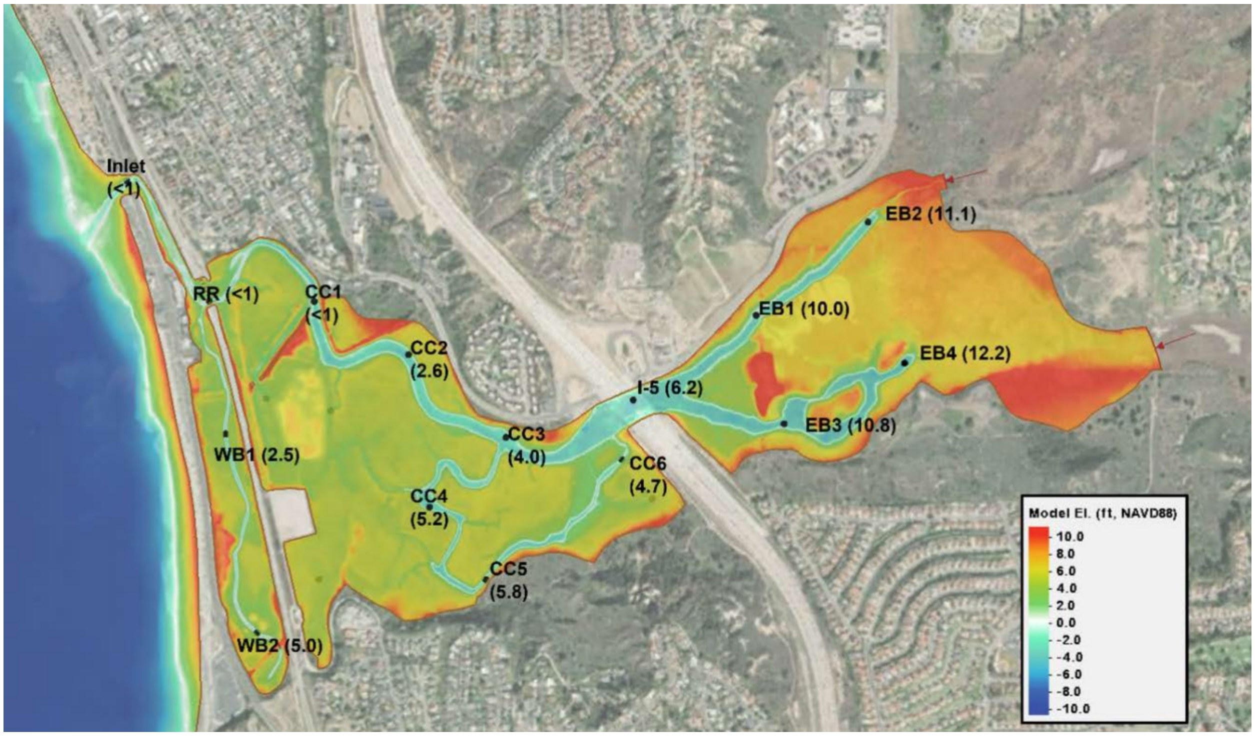

Table 4-2. Estimated Residence Time within San Elijo Lagoon for 2022

Basin	Location	Residence Time (Moving Average Days)
West Basin (WB)	Inlet	<1
	RR	<1
	WB1	2.5
	WB2	5.0
Central Basin (CC)	CC1	<1
	CC2	2.6
	CC3	4.0
	CC4	5.2
	CC5	5.8
	CC6	4.7
East Basin (EB)	I-5	6.2
	EB1	10
	EB2	11.1
	EB3	10.8
	EB4	12.2

I- = Interstate; RR = railroad

Table 4-3 summarizes the average residence time for each basin of San Elijo Lagoon in 2022 per the project performance standard. Numerical modeling analyses for seawater residence time are provided in Appendix A.

Table 4-3. Average Residence Time per Basin in San Elijo Lagoon

Basin	Average Residence Time Target	2022 Average Residence Time	Performance Standard Met
West Basin	N/A	2.1 days	N/A
Central Basin	<7 days	3.8 days	Yes
East Basin	<9 days	10.1 days	No

N/A = not applicable

4.4 DISCUSSION

Tides in the lagoon became broader in vertical tide range after construction assuming October 2020 represents the post-construction condition. Water level and velocity measurements during 2022 revealed temporal variability and indications of long-term effects of restoration on tidal amplitudes within the lagoon. Post-construction measurements of tides during 2022 showed that tidal conditions are similar throughout the lagoon. This indicates that the changes to the lagoon as a result of restoration dramatically increased tidal exchange relative to pre-restoration conditions. While the overall tidal range was smaller in 2022 than the range during 2020 due to increased tidal muting, the lagoon continued to have a higher range and extent than prior to construction.

The overall decrease in tidal range in 2022 was most likely due to natural morphological changes at the mouth of the lagoon, and because the shoals at the inlet channel were unable to be immediately dredged due to logistical constraints. The decrease in the normalized tidal ranges in the central and east basins can likely be attributed to the shoaling under the railroad bridge. The west basin was less affected by this shoal because it is located downstream. However, the tidal ranges at locations upstream of the railroad bridge appear to have been muted as a result of the increased sedimentation. The sediment built up at the bridge constricted tidal drainage at upstream gauge locations and decreased their overall tidal range.

As expected, residence time in the lagoon increased with distance from the inlet, ranging from <1 day at the inlet of the lagoon, to 12 days at the far east end of the model domain. This can be explained by the hydrodynamics and the mechanisms in which transport of constituents (e.g., the water tracer) occurs at the different regions of the lagoon. Close to the inlet, tidal current velocities are the highest, and transport primarily follows the mean tidal currents. Ebb tidal currents flush out waters and flood tidal currents bring in water from the open coast. Meanwhile, farther from the inlet, tidal current velocities have drastically reduced at the far east end of the lagoon. In this area of the lagoon, diffusion is more relevant, which is the transport given by much more smaller-scale flow processes. Residence times in the lagoon increased in 2022 except for the locations closest to the inlet. The strong incoming and outgoing tidal flows likely promoted the rapid transport and flushing of tracers out of the lagoon with small to negligible differences in time. While the west basin average remained below its threshold of 7 days, the increase in the east basin exceeded its threshold of 9 days. Despite the overall increase in residence time in the lagoon in 2022, it is noted that the estimated values are considerably smaller compared to pre-restoration residence times.

While habitat areas mapped in 2022 fall within 10% of the design habitat acreage and the average residence remained shorter than 7 days in the central basin, the tidal elevations performance standard was not met because the average residence time in the east basin was not shorter than 9 days. However, effects of construction are no longer present in the tidal series and tidal ranges have returned to ambient post-restoration conditions overall. Tidal conditions are far superior than prior to construction and lead to tidal inundation frequency conditions conducive to proposed wetland habitat establishment. Habitat is establishing within San Elijo Lagoon in response to the predicted TIF and consistent with project design. Continued monitoring of the effects of shoaling underneath the railroad bridge will take place until dredging can occur to minimize potential negative effects on the wetland ecosystem and/or hydraulic function.

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5. HABITAT AREAS

5.1 PERFORMANCE STANDARD

The attainment of predicted habitats, including subtidal, intertidal mudflats, intertidal salt marsh, and transitional areas, is an absolute monitoring variable specific to two separate permit/approval requirements, is based on design target elevations, and is not compared to reference wetlands. CCC Coastal Development Permit (CDP) conditions stipulate that areas of different habitats not vary by more than 10% from the final approved design habitat distribution for the performance standard to be met. The overall project design habitat distribution is shown in Figure 5-1. Target habitat acreages specific to the performance standard and for CCC requirements are identified in Table 5-1 and shown in

Figure 5-12.

Table 5-1. Target Habitat Distribution

Habitat Type	Target Acres
Tidal Channels and Basins (Subtidal)	62
Intertidal Mudflat[1]	32-47
Intertidal Salt Marsh[1]	293-308
Transitional[2]	7
Total	**409**

[1] Intertidal salt marsh and mudflat ranges are due to uncertainty of converted low marsh areas within the overdredge pit.
[2] Transitional habitat acreage has been updated to reflect refinements in geographic information system information.

A performance standard specific to low marsh target acreage has also been established pertinent only to USFWS requirements. For the performance standard to be met (USFWS), low marsh must total between 57 and 73 acres. Low marsh target acreage encompasses the lagoon as a whole because it is focused on species support, including planted areas, areas anticipated to convert over time, and existing low marsh.

5.2 APPROACH

Vegetation mapping was completed throughout the project area by AECOM during the summer of 2022. Habitats were classified based on the dominant and characteristic plant species, plant physiognomy, and soils in accordance with the *Draft Vegetation Communities of San Diego County* (Oberbauer et al. 2008), as described in Appendix B. Subtidal, intertidal mudflat, and intertidal salt marsh habitats were then categorized based on the criteria identified in the San Dieguito Wetlands Restoration Project (low marsh, mid-marsh, and high marsh have been combined). Areas within the project OD pit that remain unvegetated but are anticipated to ultimately convert to vegetated marsh are identified separately and will be categorized as a specific habitat type as conversion occurs. A complete description of survey methodology can be found in the Monitoring Plan.

5.3 RESULTS

Habitat mapping for 2022 is shown in Figure 5-3 and indicates a decrease of tidal mudflat and an increase of intertidal salt marsh due to the expansion of low salt marsh. The acreage of each target habitat and performance standard for each target habitat are compared in Table 5-2.

Table 5-2. Target Habitat Distribution Results

Habitat Type	Target Acres	Acres -/+ 10%	Acres Mapped 2022	Habitat Distribution Achieved (within -/+ 10%)
Tidal Channels and Basins (Subtidal)	62	55.8/68.2	61.2	YES
Intertidal Mudflat[1]	32-47	28.8/35.2 - 42.3/51.7	39.7	YES
Intertidal Salt Marsh[1]	293-308	263.7/322.3 - 277.2/338.8	302	YES
Transitional	7	6.3/7.7	7.1	YES
Total	**409**	**368.1/449.9**	**410**	**YES**

[1] Intertidal salt marsh and mudflat ranges are due to uncertainty of converted low marsh areas within the overdredge pit.

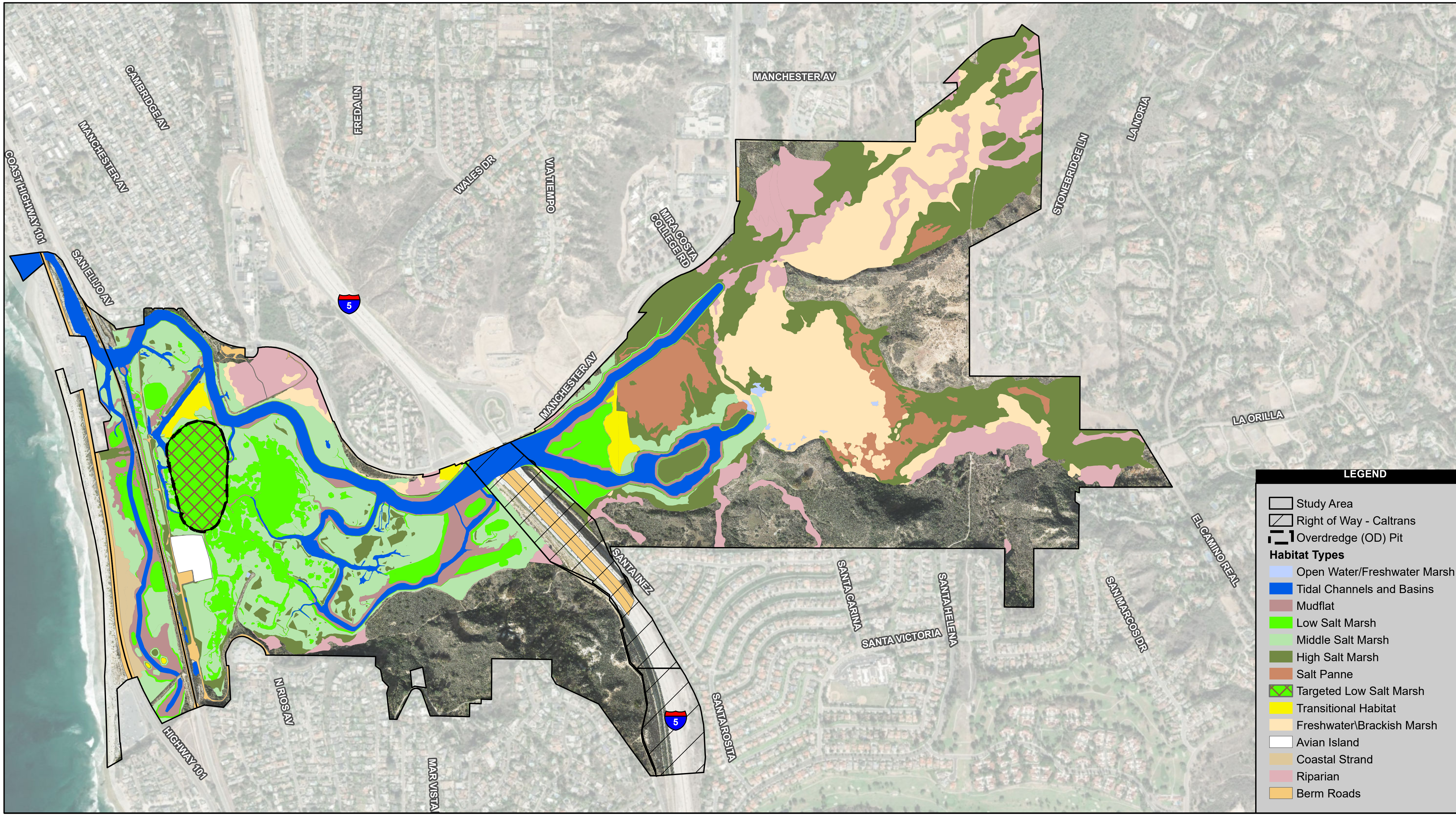
With respect to the USFWS performance standard specific to low marsh, habitat mapping conducted in 2022 resulted in a total of 66.1 acres of low salt marsh. The increase of 5.1 acres of low salt marsh from 2021 to 2022 was due to the expansion of cordgrass in areas that were previously mapped as mudflat and/or the unvegetated portion of the OD pit. The acreage of mapped low salt marsh and target acres for low salt marsh are compared in Table 5-3.

Table 5-3. Target Low Marsh Acreage Results

Habitat Type	Target Acres (Outside of the OD Pit)	Target Acres (Inside of the OD Pit)	Total Target Acres[1]	Target Acreage Achieved
Low Marsh (Performance Standard)	58	15	57–73	N/A
2022 Low Marsh	61.8	4.3	66.1	YES

N/A = not applicable

[1] Biological Opinion total target acreage requirements of low marsh is a range of 57–73 acres.



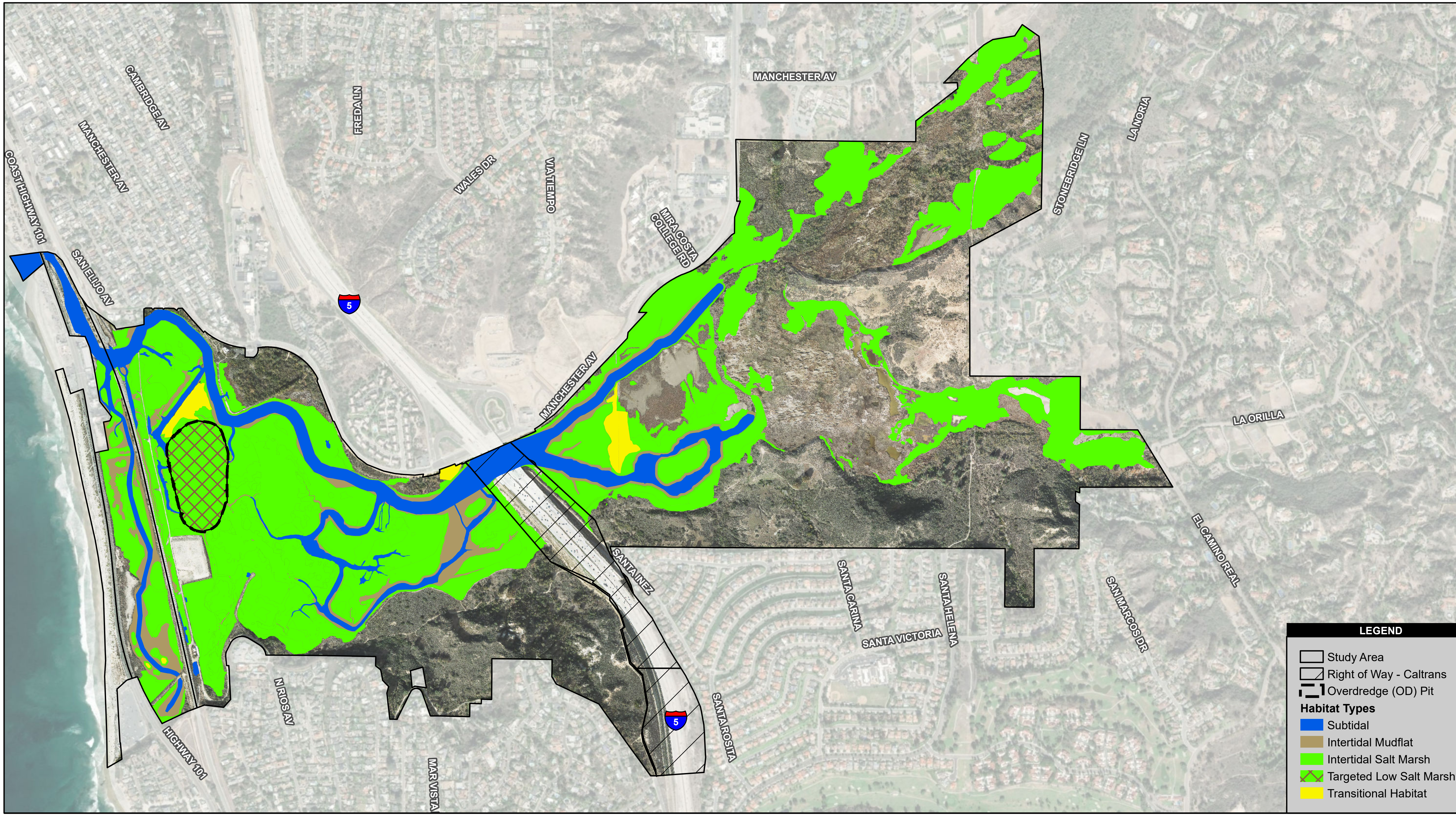
Source: SanGIS 2022; MoffattNichol 2022; AECOM.

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

Figure 5-1
Design Habitat Distribution

Path: \\na.aecomnet.com\lfs\AMER\SanDiego-USSDG1\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Annual\2022\Proposed Habitat Distribution_July2020.mxd, 8/1/2023, paul.moreno



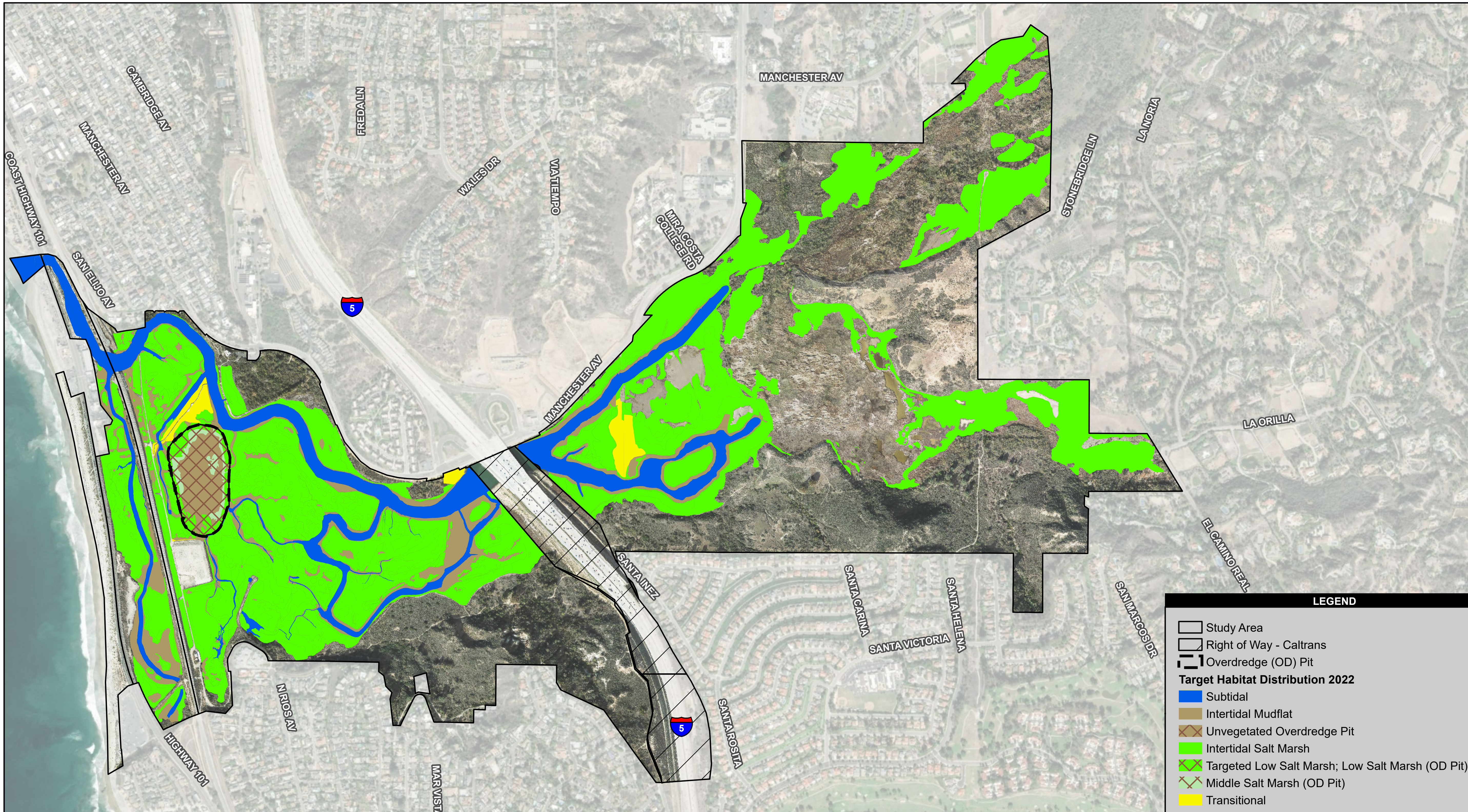
Source: SanGIS 2022; MoffattNichol 2022; AECOM.

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

Figure 5-2
Performance Standard Target Habitat Distribution

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Annual\2022\Performance Standard Target Habitat Distribution.mxd, 12/13/2023, paul.moreno



Source: SanGIS 2022; MoffattNichol 2022; AECOM.

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

Figure 5-3
Habitat Distribution 2022

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5.4 DISCUSSION

Achieving habitat goals is dependent upon achieving the target goals of topography, bathymetry, and tidal elevation, which have been directly modified as part of the SELRP to ultimately alter habitat. Accordingly, habitat distribution must be within 10% of the target acreages presented in Table 5-1. Establishment and conversion of habitat are anticipated as the lagoon reaches equilibrium after the completion of restoration, and are expected to result in shifts in acreage between intertidal salt marsh, brackish marsh, and unvegetated flats. Unvegetated areas planned as vegetated salt marsh within the OD pit have not initially been mapped as habitat and will continue to be monitored until they can be characterized as a specific habitat type once they contain approximately 30% cover or can be confidently mapped as mudflat.

In 2022, the habitat area performance standard for tidal channels and basins, mudflat, intertidal salt marsh, and transitional habitat was met as presented in Table 5-2.

In 2022, the performance standard for low marsh was met as presented in Table 5-3.

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6. VEGETATION

6.1 VEGETATIVE COVER

6.1.1 Performance Standard

Vegetation cover is a project design absolute monitoring variable and is not subject to comparisons with reference wetlands. Performance standards for vegetation cover address the post-construction 240-workday PEP, during which the contractor was responsible for maintaining plants, as well as the performance standards necessary to meet longer-term habitat goals.

The interim yearly performance standards are absolute (Table 6-1) and require the separation of low marsh from the other marsh types (mid- and high marsh). Final standards will be considered met in the year when the Year 10 cover standards have been met.

Table 6-1. 10-Year Absolute Performance Standards

Milestone	Planted Low Marsh Native Cover (absolute)	Planted Mid- and High Marsh Native Cover (absolute)	Unplanted Marsh Native Cover (absolute)[1]	Planted Transitional Habitat Native Cover (absolute)	Species Diversity	Nonnative Cover (absolute)	Container Plant Survival
240-Workday Plant Establishment Period	N/A	N/A	N/A	N/A	N/A	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	100%
Year 1	5%	10%	N/A	10%	80% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Year 2	10%	20%	N/A	20%	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Year 3	20%	30%	N/A	35%	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Year 4	35%	45%	N/A	50%	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Year 5	45%	55%	30%	70%	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)

Milestone	Planted Low Marsh Native Cover (absolute)	Planted Mid- and High Marsh Native Cover (absolute)	Unplanted Marsh Native Cover (absolute)[1]	Planted Transitional Habitat Native Cover (absolute)	Species Diversity	Nonnative Cover (absolute)	Container Plant Survival
Year 6	50%	60%	30%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed “high” or “moderate” threat species	80% (unless function has been replaced by recruitment)
Year 7	55%	65%	35%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed “high” or “moderate” threat species	80% (unless function has been replaced by recruitment)
Year 8	60%	70%	40%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed “high” or “moderate” threat species	80% (unless function has been replaced by recruitment)
Year 9	65%	75%	40%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed “high” or “moderate” threat species	80% (unless function has been replaced by recruitment)
Year 10	70%	80%	45%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed “high” or “moderate” threat species	80% (unless function has been replaced by recruitment)

Cal-IPC = California Invasive Plant Council; N/A = not applicable

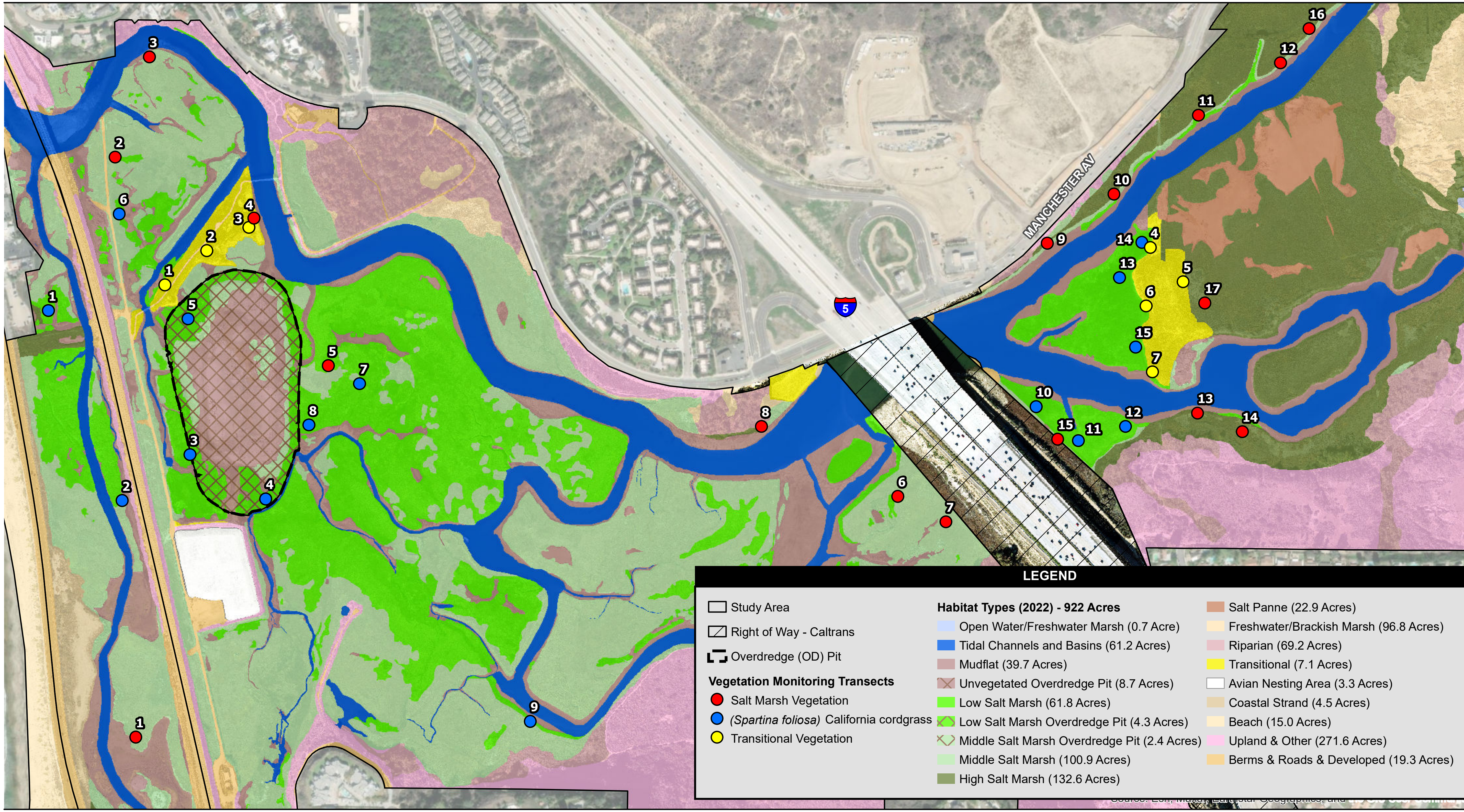
[1] Performance standards for low marsh and mid- to high marsh will be separated by planned acreage for respective habitat types.

6.1.2 Approach

Quantitative vegetation cover monitoring was conducted by biologists from AECOM and Nature Collective at the end of August in 2022 within areas impacted during dredging and grading operations where container plants were installed, as well as areas expected to convert from a pre-construction habitat type to salt marsh. Monitoring was conducted using 30-meter (m) point intercept transects, with a 2.5-m wide plant diversity belt on both sides of the transect line as described in the Monitoring Plan. During the Year 1 (2021) monitoring event, the number of transects and placement of transects were modified slightly from the Monitoring Plan to account for access issues (i.e., not accessible due to increase in channel width), ease of repeatability, and the need to decrease impacts to sensitive wildlife species. Monitoring of the same transects was repeated in Year 2 (2022). Monitoring within mid- and high salt marsh habitat included one transect in the west basin, seven transects in the central basin, and nine transects in the east basin (Figure 6-1). Monitoring within the transitional areas included three transects in the central basin and four transects in the east basin (Figure 6-1). No vegetation cover transects were placed within low marsh to monitor for cover because low marsh was monitored using transects to measure California cordgrass canopy architecture as discussed in Section 6.2. Total native cover and nonnative cover in each basin were determined by averaging the transect data within each basin. A complete description of survey methodology can be found in the Monitoring Plan.

6.1.3 Results

Transect data results from 2022 are summarized in Table 6-2 through Table 6-5. The total number of species (species richness) identified within the transects and 2.5-m wide diversity belts was 47 native species; two native species and zero nonnative species were recorded in the west basin, 37 native species and two nonnative species in the central basin, and 36 native species and five nonnative in the east basin. Zero California Invasive Plant Council (Cal-IPC) listed “high” or “moderate” threat species were recorded overall. Detailed transect results by species are included in Appendix C.



Source: SanGIS 2022; MoffattNichol 2022; AECOM (2018-2022).

500 250 0 500 Feet

Scale: 1:6,000; 1 inch = 500 feet

Figure 6-1
Vegetation Transects Points with 2022 Habitats

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Table 6-2. Mid- and High Salt Marsh Transect Combined Planted and Unplanted Areas Monitoring Results

Basin	Native Species	Nonnative Species
	Average Absolute Cover	Average Absolute Cover
West[1]	68.30%	0.00%
Central	90.60%	0.00%
East	76.00%	3.70%
All Basins	*83.20%*	*1.80%*

[1.] Planting was not conducted in the west basin; this number reflects transect data from unplanted areas.

Table 6-3. Planted Mid- and High Salt Marsh Transect Monitoring Results

Basin	Native Species	Nonnative Species
	Average Absolute Cover	Average Absolute Cover
West[1]	N/A	N/A
Central	77.90%	0.00%
East	85.60%	0.00%
All Basins	*81.20%*	*0.00%*

N/A = not applicable
[1] Planting was not conducted in the west basin.

Table 6-4. Unplanted Mid- and High Salt Marsh Transect Monitoring Results

Basin	Native Species	Nonnative Species
	Average Absolute Cover	Average Absolute Cover
West	68.30%	0.00%
Central	100.70%	0.00%
East	68.70%	7.50%
All Basins	*84.70%*	*3.00%*

Table 6-5. Transitional Transect Monitoring Results

Basin	Native Species	Nonnative Species
	Average Absolute Cover	Average Absolute Cover
Central	230.00%	0.00%
East	100.80%	0.00%
All Basins	*156.20%*	*0.00%*

6.1.4 Discussion

The vegetation cover success criterion is an absolute performance standard and success for vegetation is based on meeting the criteria identified in Table 6-1. As presented in Table 6-6, Year 10 vegetation cover performance standards have been met in Year 2. The Year 10 performance standard for low marsh native cover has been met in Year 2 with cover estimated at >70%. Within low marsh areas, approximately 66.1 acres of the targeted 57 to 73 acres has an estimated cover of at least 70%. Low marsh cover is based on the aerial mapping for habitat assessment rather than transect data. Low marsh is also assessed using the California cordgrass canopy architecture performance standard described in Section 6.2. The Year 10 performance standard for planted mid- and high marsh native cover has been met in Year 2 with cover estimated at 81.2%. The Year 10 performance standard for unplanted mid- and high marsh native cover has been met in Year 2 with cover estimated at 84.7%. The Year 10 performance standard for planted transitional native cover has been met in Year 2 with cover estimated at 156.2%. As described in the Monitoring Plan, when monitoring for absolute cover, multiple species are recorded at each point if there is overlapping canopy or there are multiple species touching the same point that is recorded within a transect. This can occur at many different points within a transect resulting in more than 100% cover. Additionally, Year 10 success critiera for species diversity, nonnative cover, and container plant survival have been met in Year 2. Zero of the nonnative species indentified were Cal-IPC listed “high” or “moderate” threat species. See Table 6-6 for a comparison to the specific vegetation performance standards.

In the 2021 Annual Monitoring Report, a brief discussion was included to support the discontinuation or reduction of vegetation cover monitoring after 2022 if the Year 10 vegetation cover performance standards had been achieved prior to Year 10. After vegetation monitoring in 2022, the SELRP team decided that an additional year of vegetation monitoring in 2023 would be conducted even though Year 10 vegetation performance standards had been achieved in Year 2. If the 2023 data are consistent with the data collected in previous years and performance standards are achieved, future vegation monitoring will be discontinued.

Table 6-6. 10-Year Absolute Performance Standards Compared to 2022 Monitoring Results

Milestone	Planted Low Marsh Native Cover (absolute)	Planted Mid- and High Marsh Native Cover (absolute)	Unplanted Marsh Native Cover (absolute)[1]	Planted Transitional Native Cover (absolute)	Species Diversity	Nonnative Cover (absolute)	Container Plant Survival
240-Workday Plant Establishment Period	N/A	N/A	N/A	N/A	N/A	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	100%
Performance Standard Status	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**Achieved**	**Achieved**
Year 1	5%	10%	N/A	10%	80% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved 30.0%**	**Achieved 78.3%**	**N/A**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 2	10%	20%	N/A	20%	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved 30.0%**	**Achieved 78.3%**	**N/A**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 3	20%	30%	N/A	35%	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved 30.0%**	**Achieved 78.3%**	**N/A**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 4	35%	45%	N/A	50%	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved >70.0%**	**Achieved 78.3%**	**N/A**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 5	45%	55%	30%	70%	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved >70.0%**	**Achieved 78.3%**	**Achieved 77.4%**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 6	50%	60%	30%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved >70.0%**	**Achieved 78.3%**	**Achieved 77.4%**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 7	55%	65%	35%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved >70.0%**	**Achieved 78.3%**	**Achieved 77.4%**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 8	60%	70%	40%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)

Milestone	Planted Low Marsh Native Cover (absolute)	Planted Mid- and High Marsh Native Cover (absolute)	Unplanted Marsh Native Cover (absolute)[1]	Planted Transitional Native Cover (absolute)	Species Diversity	Nonnative Cover (absolute)	Container Plant Survival
Performance Standard Status	**Achieved >70.0%**	**Achieved 78.3%**	**Achieved 77.4%**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 9	65%	75%	40%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved >70.0%**	**Achieved 78.3%**	**Achieved 77.4%**	**Achieved 81.3%**	**Achieved**	**Achieved**	**Achieved**
Year 10	70%	80%	45%	N/A	Natural recruitment of multiple species in habitat types and 75% of the species planted present	<5% nonnative and 0% Cal-IPC listed "high" or "moderate" threat species	80% (unless function has been replaced by recruitment)
Performance Standard Status	**Achieved >70.0%**	**Achieved 81.2%**	**Achieved 84.7%**	**Achieved 156.2%**	**Achieved**	**Achieved**	**Achieved**

Cal-IPC = California Invasive Plant Council; N/A = not applicable

6.2 CALIFORNIA CORDGRASS (*SPARTINA FOLIOSA*) CANOPY ARCHITECTURE

6.2.1 Performance Standard

California cordgrass (*Spartina foliosa*) canopy architecture is a relative standard, which is used to compare the restored San Elijo Lagoon to similar measurements taken at reference wetlands. The restored wetland areas shall have a California cordgrass canopy architecture similar to reference wetlands. The relative performance standard will be considered met if the 4-year running average of the mean proportion of stems >90 centimeters (cm) is not significantly worse than the mean value at the lowest performing reference wetland. In the 2021 Annual Monitoring Report, Tijuana Estuary was the only reference wetland used for comparison but to stay consistent with the other relative standard metrics and because more data are available, Mugu Lagoon is included in 2022.

6.2.2 Approach

In 2021, transects measuring 20 m long were established in the areas of low marsh established through construction and areas expected to convert to low marsh after construction. Transect locations are identified in Figure 6-1. In 2022, data were collected along the same 15 transects established in 2021. The transects include two transects in the west basin, seven transects in the central basin, and six transects in the east basin. The number and height of cordgrass stems were assessed in 0.1-square-meter (m^2) (circular) quadrats placed over the cordgrass every 2 m along each transect (a total of 10 points along each transect). Maximum height (excluding flowering culms) of stems present in the quadrat was recorded and the mean proportion of stems >90 cm in height was determined for each cordgrass stand. In 2022, it was recommended that the number of transects be reduced to a total of eight to reduce impacts to the overall lagoon system, including habitat and marsh birds. As a result of this recommendation, both data collected from the original 15 transects, and data from a reduced total of eight transects are presented below. The reduced eight transects presented include planted and unplanted areas in the west, central, and east basins (Figure 6-2). In addition to this change, some minor discrepanices were discovered in how different wetland mean proportional values were calculated, and data have now been standardized as follows: the proportion of stems >90 cm is calculated for each quadrat, and each transect average is calculated from those 10 quadrats. For aquadrat with zero stems, the proportion of stems >90 cm is given as 0.00 rather than undefined based on the ecological relevance of including those data as unsuitable rather than omitting them because they are mathematically undefined. Omitting those data results in artificial increases in the average proportion of stems >90 cm.

6.2.3 Results

Table 6-7 summarizes the results of the 15 California cordgrass transects monitored within San Elijo Lagoon (Appendix C includes individual transect data). In 2022, the combined density of stems in the west, central, and east basins was calculated at an average of 29.23 stems per quadrat while the average number of stems greater than 90 cm tall per 0.1 m^2 was 1.37, which resulted in the proportion of stems greater than 90 cm tall equaling 0.05. Data collected along four transects at Tijuana Estuary and Mugu Lagoon were provided for 2022, within which the proportion of stems greater than 90 cm tall per 0.1 m^2 was 0.07 for Tijuana Estuary and 0.00 for Mugu Lagoon (Table 6-7). The 2-year running average of the proportion of stems greater than 90 cm tall per 0.1 m^2 at San Elijo Lagoon (0.08) was not significantly lower than than the lowest performing wetland (Mugu Lagoon) (Table 6-8 and Figure 6-3).

Table 6-7. 2022 California Cordgrass Transect Results Using Fifteen Transects at San Elijo Lagoon

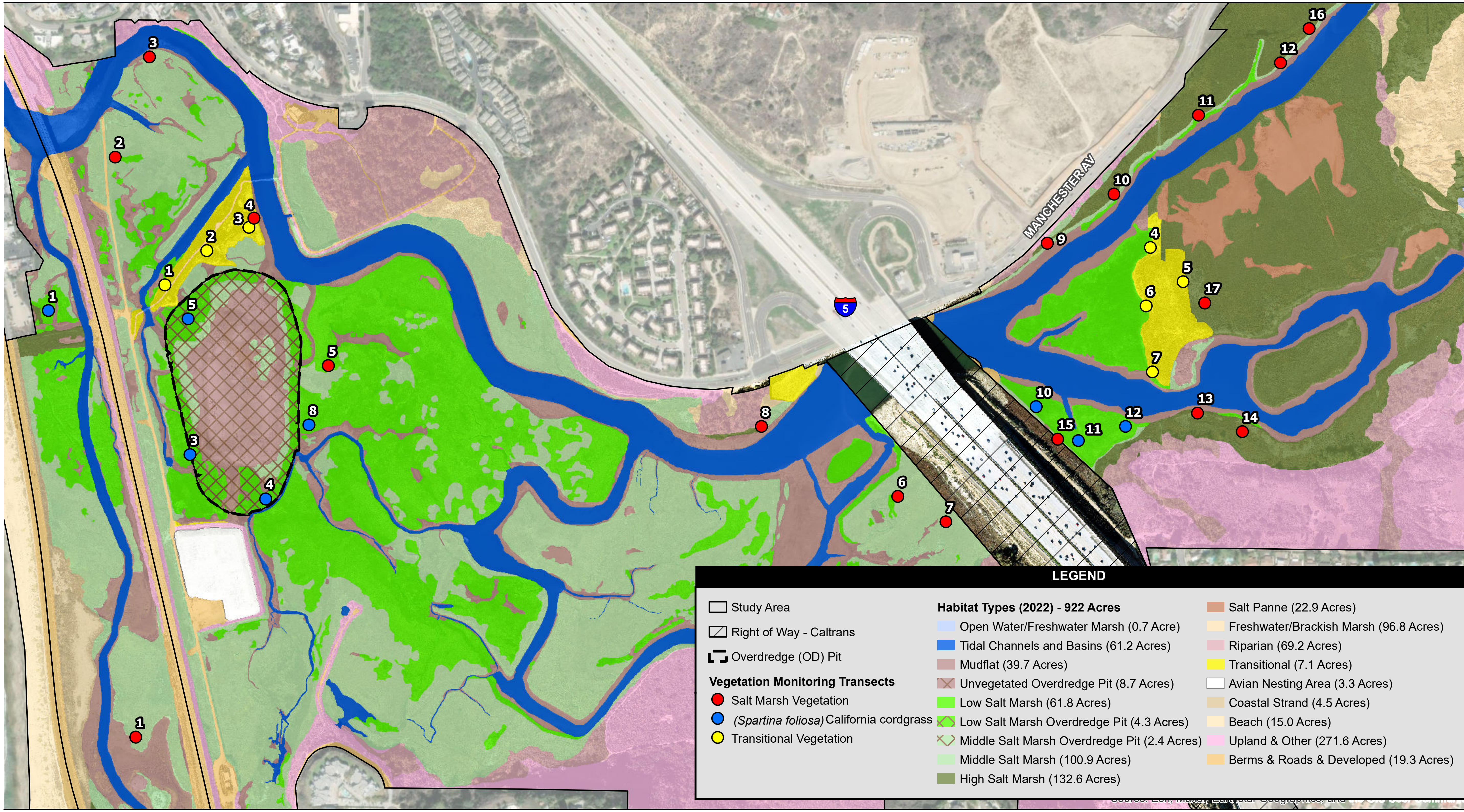
Metric	San Elijo Lagoon	Tijuana Estuary	Mugu Lagoon
Density of Stems per 0.1 m^2 (Avg)	29.23	NP	NP
Proportion of Stems >90 cm Tall per 0.1 m^2 (Avg)	0.05	0.07	0.00

cm = centimeters; m^2 = square meter; NP = not provided

Table 6-8. San Elijo Lagoon, Tijuana Estuary, and Mugu Lagoon California Cordgrass Transect Results Using Fifteen Transects at San Elijo Lagoon

End Year of Running Avg	Sampling Station	California Cordgrass Cover Post-construction Running Averages: Proportion Stems >90 cm High/0.1 m^2		
		San Elijo Lagoon	Tijuana Estuary	Mugu Lagoon
2022	California cordgrass_01	0.01	N/A	0.00
	California cordgrass_02	0.00	N/A	0.00
	California cordgrass_03	0.13	0.13	0.00
	California cordgrass_04	0.05	0.20	0.00
	California cordgrass_05	0.07	0.01	N/A
	California cordgrass_06	0.00	0.06	N/A
	California cordgrass_07	0.09	N/A	N/A
	California cordgrass_08	0.39	N/A	N/A
	California cordgrass_09	0.00	N/A	N/A
	California cordgrass_10	0.14	N/A	N/A
	California cordgrass_11	0.12	N/A	N/A
	California cordgrass_12	0.03	N/A	N/A
	California cordgrass_13	0.00	N/A	N/A
	California cordgrass_14	0.01	N/A	N/A
	California cordgrass_15	0.07	N/A	N/A
	Overall Average (SE)	**0.08 (0.03)**	**0.10 (0.04)**	**0.00 (0.00)**

cm = centimeters; m^2 = square meter; N/A = not applicable; SE = Standard Error



Source: SanGIS 2022; MoffattNichol 2022; AECOM (2018-2022).

500 250 0 500 Feet

Scale: 1:6,000; 1 inch = 500 feet

Figure 6-2
Vegetation Transects Points with 2022 Habitats

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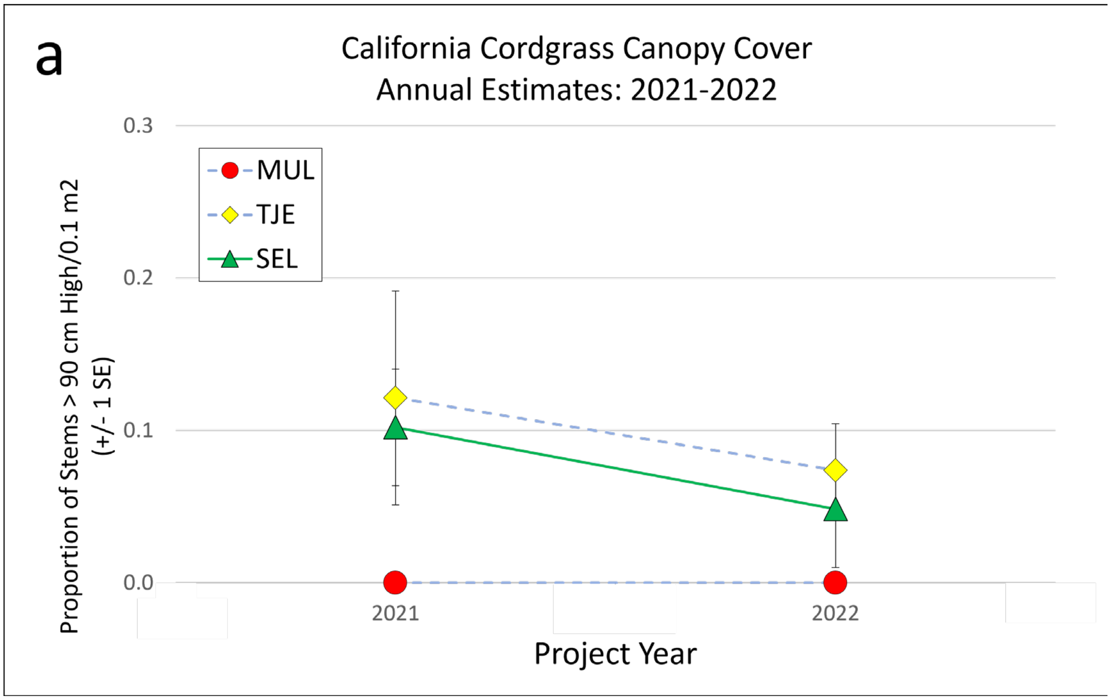
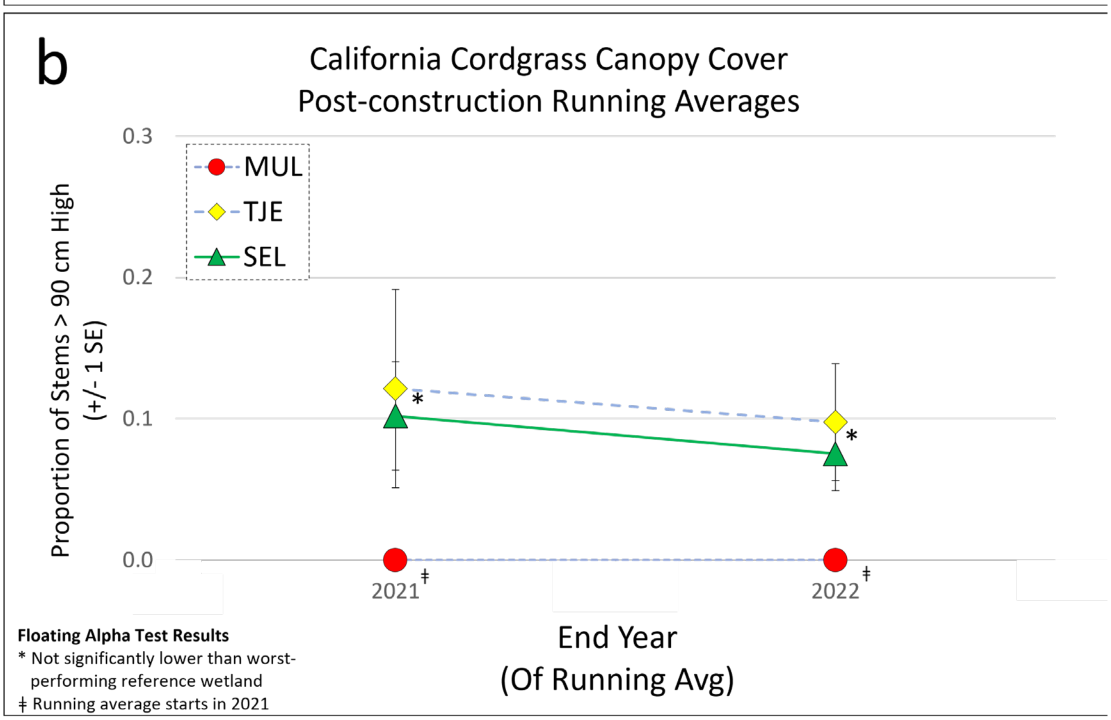
Figure 6-3. California Cordgrass Canopy Cover Comparing Fifteen Transects at San Elijo Lagoon to Two Reference Wetlands





MUL=Mugu Lagoon; TJE=Tijuana Estuary; SEL=San Elijo Lagoon

Table 6-9 summarizes the results of the eight California cordgrass transects monitored within planted and unplanted areas at San Elijo Lagoon (Transects 1, 3, 4, 5, 8, 10, 11, and 12). In 2022, the combined density of stems was calculated at an average of 28.23 stems per quadrat while the average number of stems greater than 90 cm tall per 0.1 m^2 was 2.25, which resulted in the proportion of stems greater than 90 cm tall equaling 0.08. The 2-year running average of the proportion of stems greater than 90 cm tall per 0.1 m^2 at San Elijo Lagoon (0.12) was the highest of the three wetlands, and was thus not significantly lower than the lowest performing wetland (Mugu Lagoon) (Table 6-10 and Figure 6-4).

Table 6-9. 2022 California Cordgrass Transect Results Using Eight Transects at San Elijo Lagoon

Metric	San Elijo Lagoon	Tijuana Estuary	Mugu Lagoon
Density of Stems per 0.1 m^2 (Avg)	28.23	NP	NP
Proportion of Stems >90 cm Tall per 0.1 m^2 (Avg)	0.08	0.07	0.00

cm = centimeters; m^2 = square meter; NP = not provided

Table 6-10. San Elijo Lagoon, Tijuana Estuary, and Mugu Lagoon California Cordgrass Transect Results using Eight Transects at San Elijo Lagoon

End Year of Running Average	Sampling Station	Spartina Canopy Cover Post-construction Running Averages: Proportion Stems >90 cm High/0.1 m^2		
		San Elijo Lagoon*	Tijuana Estuary	Mugu Lagoon
2022	California cordgrass_01	0.01	N/A	0
	California cordgrass_02	N/A	N/A	0
	California cordgrass_03	0.13	0.13	0
	California cordgrass_04	0.05	0.2	0
	California cordgrass_05	0.07	0.01	N/A
	California cordgrass_06	N/A	0.06	N/A
	California cordgrass_07	N/A	N/A	N/A
	California cordgrass_08	0.39	N/A	N/A
	California cordgrass_09	N/A	N/A	N/A
	California cordgrass_10	0.14	N/A	N/A
	California cordgrass_11	0.12	N/A	N/A
	California cordgrass_12	0.03	N/A	N/A
	California cordgrass_13	N/A	N/A	N/A
	California cordgrass_14	N/A	N/A	N/A

End Year of Running Average	Sampling Station	Spartina Canopy Cover Post-construction Running Averages: Proportion Stems >90 cm High/0.1 m^2		
		San Elijo Lagoon*	Tijuana Estuary	Mugu Lagoon
	California cordgrass_15	N/A	N/A	N/A
Overall Average (SE)		**0.12 (0.04)**	**0.10 (0.04)**	**0.00 (0.00)**

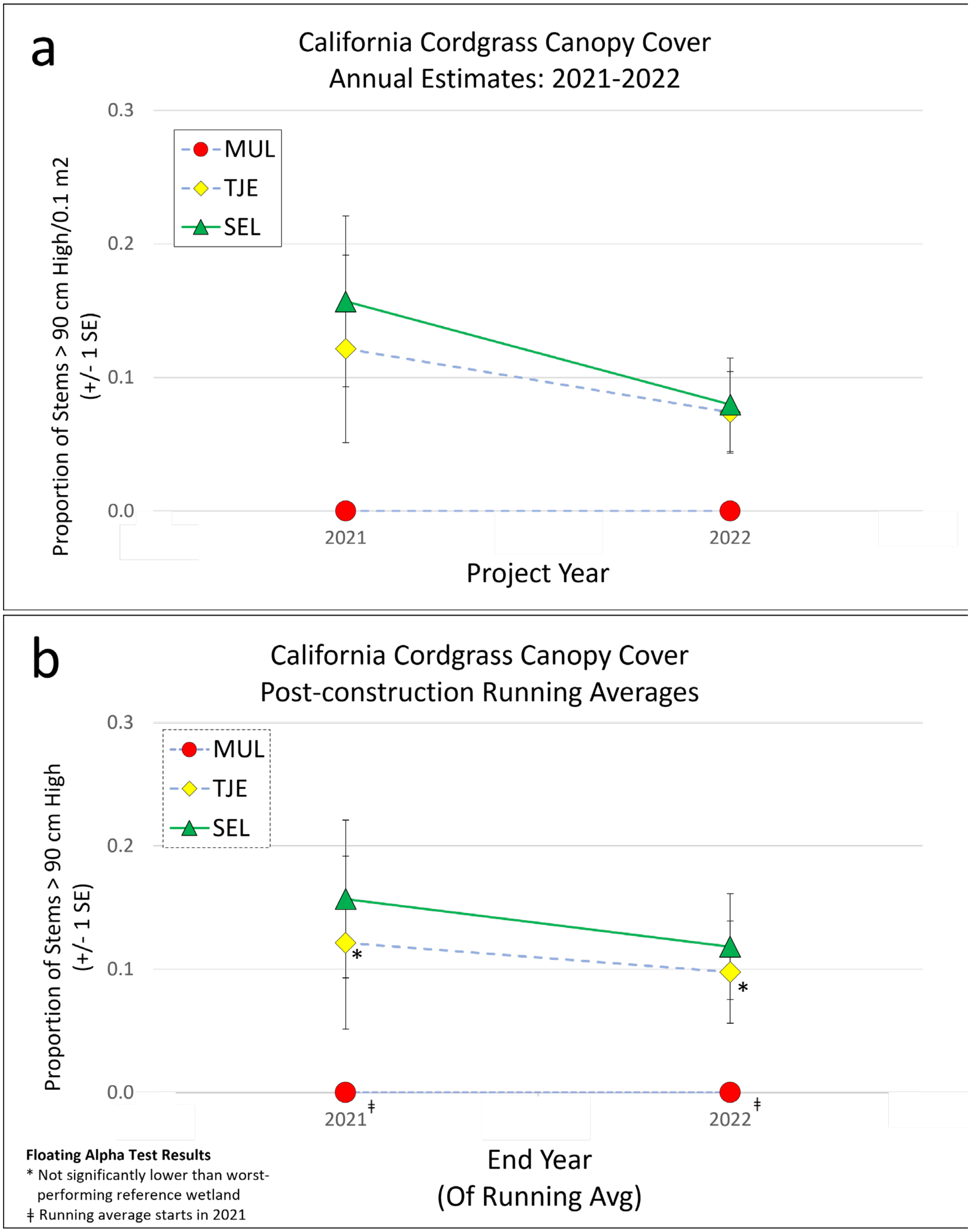
*Data for eight transects that will be sampled moving forward
cm = centimeters; m^2 = square meter; N/A = not applicable; SE = Standard Error

6.2.4 Discussion

Unlike other relative standard metrics, California cordgrass cover was compared to only California cordgrass cover values at Tijuana Estuary in 2021. However, following the 2021 Annual Monitoring Report, data collected for Mugu Lagoon were provided for both 2021 and 2022, and have been included in this report. In 2022, the 2-year running average of proportion of California cordgrass canopy cover greater than 90 cm high per 0.1 m^2 using 15 transects at San Elijo Lagoon was 0.08, which was not significantly lower than the 0.10 value at Tijuana Estuary, nor the 0.00 value at Mugu Lagoon. The 2022 San Elijo Lagoon average density of stems per quadrat using 15 transects was 29.23, which was an increase of 0.53 stems per quadrat from the 2021 average density of 28.70 stems per quadrat. This increase in stem density actually helped contribute to an overall decrease in the average proportion of stems greater than 90 cm high because most of the new stems are shorter in height. However, San Elijo Lagoon still had the highest singular proportion of stems greater than 90 cm for sampling station 08.

As discussed above, it was recommended that the number of transects be reduced to a total of eight to reduce impacts to the greater lagoon system, including habitat and marsh birds. The proposed eight transects represent areas with ease of access within the west, central, and east basins, and include planted and unplanted areas. In 2022, the 2-year running average of proportion of California cordgrass canopy cover greater than 90 cm high per 0.1 m^2 using eight transects at San Elijo Lagoon was 0.12, which was not significantly lower than the 0.10 value at Tijuana Estuary, nor the 0.00 value at Mugu Lagoon. The 2022 San Elijo Lagoon average density of stems per quadrat using eight transects was 28.23 stems per quadrat. Overall, the transects with a relatively high canopy cover at San Elijo Lagoon are located within both areas that have been converting naturally over time (Transect 8) as well as transects that have been planted as part of the restoration project (Transects 3, 10, and 11). Other transects with lower canopy cover are located in unplanted portions of the OD pit as well as areas that have been anticipated to convert over time. Transects with no cover are generally located in areas that have not historically contained California cordgrass and may not necessarily convert as anticipated if they remain characterized by a different type of habitat. Going forward, only the reduced total of eight transects (Transects 1, 3, 4, 5, 8, 10,

Figure 6-4. California Cordgrass Canopy Cover Comparing Eight Transects at San Elijo Lagoon to the Two Reference Wetlands



MUL=Mugu Lagoon; TJE=Tijuana Estuary; SEL=San Elijo Lagoon

11, and 12) will be monitored and included in future annual monitoring reports. As discussed in the 2021 Annual Monitoring Report, California cordgrass generally requires a few years to establish, and while these eight transects will continue to be monitored, the transect data from specific transects may not be used in future years. These data represent 2 years of monitoring and therefore do not meet the criteria for the 4-year running average needed for the performance standard, but are meant to provide an early barometer of California cordgrass canopy cover.

After California cordgrass canopy monitoring is conducted in 2023, the discontinuation of monitoring California cordgrass canopy may be considered for a number of reasons. California cordgrass monitoring results in collateral damage to the habitat, which is temporal but still present. This damage is from the direct impacts of trampling the cordgrass along the transects and disturbance to LFRR supported within the cordgrass areas of San Elijo Lagoon. Support of LFRR is another performance standard used to evaluate success of the project. If avian monitoring indicates that LFRR are present in these areas, or the LFRR performance standards are being achieved, the height of California cordgrass is not specifically necessary to confirm for suitability of LFRR nesting purposes. Additionally, if the required acreage of low marsh has been achieved consistent with the habitat area performance standard, then this may be sufficient to determine that LFRR have enough area to maintain populations. While some of the transects within San Elijo Lagoon are located within areas of existing cordgrass, several are in areas that may convert over time. Conversion to low marsh containing California cordgrass may never occur as some of these areas are surrounded by mid-marsh habitat and the species composition may be such that these areas continue to convert to habitat more dominated by species such as picklweed (*Salicornia pacifica*). Because other metrics reflect successful support of the key target species of LFRR, it may be prudent to eliminate monitoring within the lagoon to reduce collateral impacts to LFRR.

6.3 EXOTICS

6.3.1 Performance Standard

Exotics are a project design absolute monitoring variable and are not subject to comparisons with reference wetlands. Conditions included in the CCC CDP and the USFWS Biological Opinion state that important functions of the restored wetland shall not be impaired by exotic species, including 0% coverage by California Invasive Plant Council (Cal-IPC) “Invasive Plant Inventory” species of “high” or “moderate” threat and no more than 5% coverage by other exotic/weed species. Should such species exceed the thresholds, they will be removed.

6.3.2 Approach

While exotic plant species are not anicipated to colonize the low and mid- intertidal salt marsh areas to be restored by the SELRP, it is likely that such species could invade high salt marsh and transition areas. Surveys of vegetative cover in restored areas described in Section 6.1.2, including the 2.5-m wide diversity belt along each side of the transects for species composition, were conducted in 2022 to inform the monitoring program on the presence of exotic species. A complete description of survey methodology can be found in the Monitoring Plan.

6.3.3 Results

In the west and central basins, zero nonnative plant species occurred along the marsh transects or 2.5-m wide diversity belts. In the east basin, zero nonnative plant species occurred along the marsh transects or 2.5-m diversity belts within planted areas while the total estimate of nonnatives detected in transects and 2.5-m diversity belts within unplanted areas was 7.5%. When the marsh transects and 2.5-m diversity belts were averaged, the total estimate of nonnative species was 3.0%. In the central and east basins, zero nonnative plant species occurred along the transitional habitat transects but several nonnative plant species were identified within the 2.5-m diversity belts. The total nonnative cover recorded along transects is presented in Table 6-2 through Table 6-5. In total, eight nonnative species were identified within the marsh transects or the 2.5-m diversity belt (Table 6-11).

Table 6-11. Nonnative Species Detected within Marsh Transects

Scientific Name	Common Name	Cal-IPC Classification
Atriplex patula	fat hen	Not listed
Chenopodium album	lambs quarters	Not listed
Erigeron sumatrensis	tropical horseweed	Not listed
Euphorbia maculata	spotted spurge	Not listed
Lactuca serriola	prickly lettuce	Not listed
Melilotus albus	white sweetclover	Not listed
Melilotus indicus	annual yellow sweetclover	Not listed
Pseudognaphalium luteoalbum	Jersey cudweed	Not listed

Cal-IPC = California Invasive Plant Council

6.3.4 Discussion

Of the nonnative species identified within the transects, zero Cal-IPC listed “moderate” or “high” threat species were detected. The performance standard requires 0% coverage by Cal-IPC “Invasive Plant Inventory” species of “high” or “moderate” threat and no more than 5% coverage by other exotic/weed species. Weed species had an average cover of 1.8%, which is less than the performance standard of 5%. Therefore, the performance standard for exotics has been achieved as the cover of invasive plants with a “high” threat is 0% and the cover of other weed species is 1.8%. Monitoring for invasive species will continue, and species with “moderate” or “high” threat ratings will be removed as they are identified. Detailed species results are presented in Appendix C.

7. WATER QUALITY

7.1 PERFORMANCE STANDARD

Water quality is a relative standard, which is used to compare the restored San Elijo Lagoon to similar measurements taken at reference wetlands. The final relative performance standard will be considered met if the 4-year running average of the mean number of consecutive hours with dissolved oxygen <3 parts per million is not significantly worse than the mean value at the lowest performing reference wetland.

7.2 APPROACH

To calculate the relative performance metric for the SELRP, one continuous-monitoring data sonde was deployed near the inlet (Nature Center Sonde) to be analyzed for success following construction. A complete description of survey methodology can be found in the Monitoring Plan.

The criterion for event duration determines whether two readings are considered unique events or the same event. A 1-hour envelope was used to classify hypoxic events in proximity to each other as one event. The start and end of an event must be at least 1 hour apart to signal an event is complete. Otherwise, readings triggering the threshold value are considered the same event. Table 7-1 illustrates how events are categorized and event duration is calculated. No other filtering of the data was performed. The duration of each hypoxic event was quantified and then averaged across the total number of events (i.e., mean hypoxic duration). There are numerous events of only a single reading (15 minutes) that did not have any other hypoxic reading within an hour of that event occurring.

Table 7-1. Example Hypoxic Event Duration Calculation[1]

Reading	1	2	3	4	5	6	7	8	9	10	11	12	13		
Time (hr)	0	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3		
Examples														# Events	Duration (hr)
A	3.84	3.57	3.29	3.01	1.84	1.77	1.51	1.84	3.99	5.59	6.24	6.56	6.68	1	1
B	3.5	3.22	3.14	3.05	2.99	2.97	3.12	2.42	2.53	2.65	3.08	3.07	2.92	1	1.5
C	4.53	4.16	3.71	3.29	2.97	3.7	5.08	5.26	5.79	2.59	3.28	3.38	3.27	2	.25 (for both)

[1] Gray highlights represent hypoxic events (i.e., dissolved oxygen threshold of <3.0 milligrams per liter)

7.3 RESULTS

Post-construction mean hypoxic event duration at San Elijo Lagoon and the three reference wetlands in 2022 is provided in Figure 7-1a, and the post-construction running averages are provided in Table 7-2 and Figure 7-1b. These post-construction values represent 2 years of data at this time. In 2022, the mean hypoxic event duration running average at San Elijo Lagoon was 1.65

hours (Table 7-2), which was not signficantly longer in duration than the lowest performing reference wetland (Tijuana Estuary) (Figure 7-1b). Appendix D details water quality data collected at the Nature Center station.

Table 7-2. 2022 Mean Hypoxic Event Duration Post-construction Running Averages for San Elijo Lagoon and Reference Wetlands

Year(s)	Mean Hypoxic Event Duration Post-construction Running Averages: # Hours (+ - SE)			
2021-2022	Carpinteria Salt Marsh	Mugu Lagoon	Tijuana Estuary	San Elijo Lagoon
	3.68 (0.24)	**1.08 (0.10)**	**4.40 (0.19)**	**1.65 (0.23)**

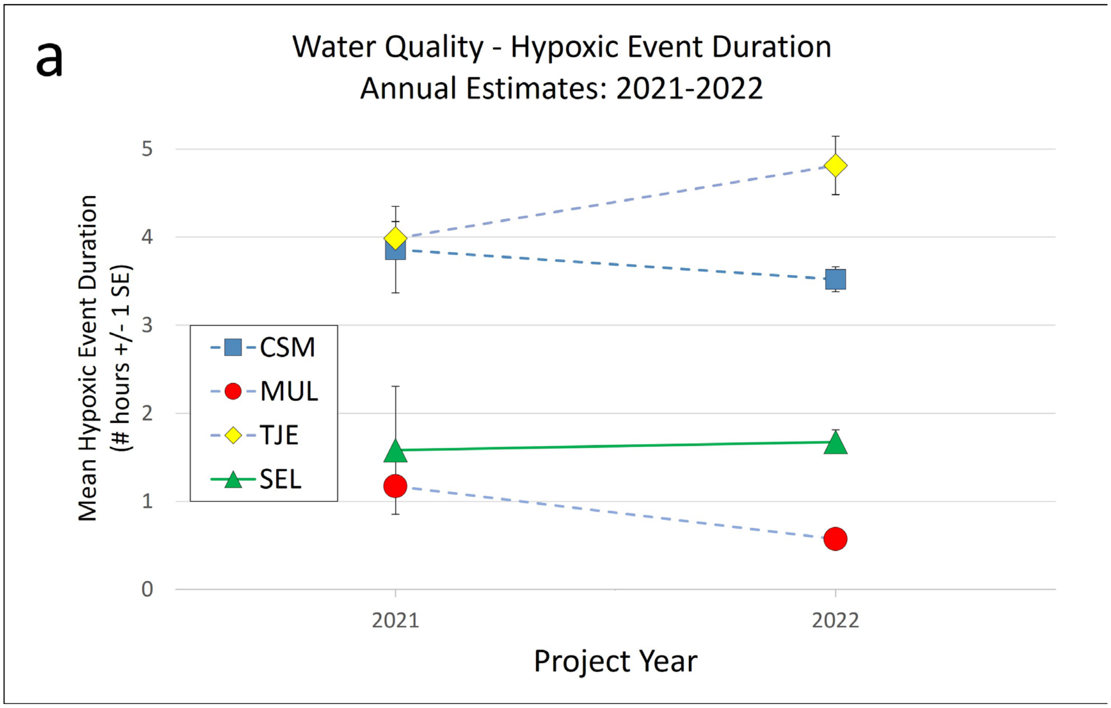
SE = Standard Error

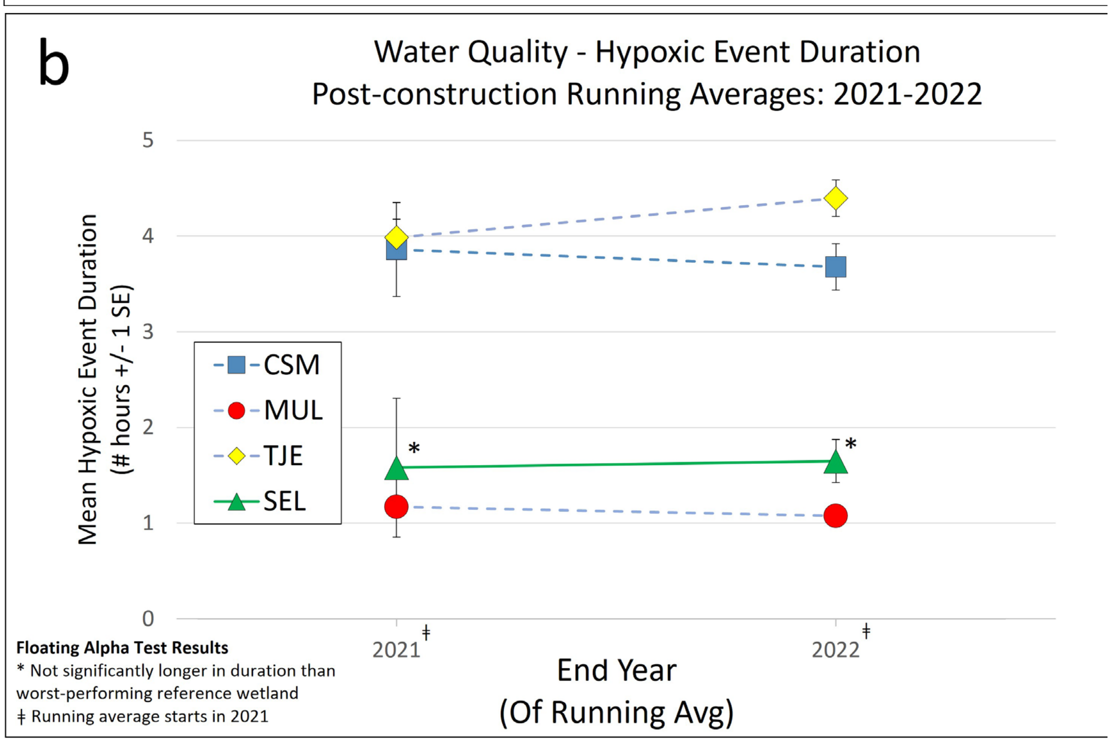
7.4 DISCUSSION

The 2022 hypoxic event duration post-construction running average at San Elijo Lagoon was 1.65 hours, which was 2.75 hours shorter than the average hypoxic event duration at Tijuana Estuary (the lowest performing reference wetland), and only 0.57 hours longer than Mugu Lagoon (the best performing reference wetland) (Table 7-2). There were a total of 216 hypoxic events at San Elijo Lagoon in 2022, with an average duration of 1.68 hours. The maximum duration for a single hypoxic event was 10.5 hours. The number of hypoxic events and the average hypoxic event duration both increased from 2021 levels (85 events and mean of 1.58 hours in 2021), which could be attributed to the decrease in tidal range from 2021 to 2022 discussed in Chapter 4.

These data represent the second year of water quality data post-construction and therefore cannot be used to evaluate the performance standards. However, the data provide an early indicator of how restoration has impacted water quality. Despite the decrease in tidal range from 2021 to 2022, tidal function and channel flow are much improved compared to pre-construction with concurrent improvements to mean hypoxic event duration. This metric will continue to be monitored, and running averages will be generated for San Elijo Lagoon and the reference wetlands to quantitatively evaluate the performance standards.

Figure 7-1. 2021-2022 Mean Hypoxic Event Duration Post-construction Running Averages for San Elijo Lagoon and Reference Wetlands





CSM=Carpinteria Salt Marsh; MUL=Mugu Lagoon; TJE=Tijuana Estuary; SEL=San Elijo Lagoon

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8. BENTHIC INVERTEBRATES

8.1 PERFORMANCE STANDARD

Benthic invertebrate community composition is a relative standard, which is used to compare the restored San Elijo Lagoon to similar measurements taken at reference wetlands. The relative performance standard will be considered met if the 4-year running average of the benthic invertebrate density and number of species at San Elijo Lagoon are not significantly worse than the mean value at the lowest performing reference wetland. Running averages are calculated for each year post-construction to provide an early barometer of San Elijo Lagoon's performance relative to the reference wetlands.

8.2 APPROACH

Benthic invertebrate populations were not sampled in 2022 (Year 2 post-construction). Per the Monitoring Plan, benthic invertebrate sampling will be conducted at Year 0, 1, and 3 after completion of restoration and then will be conducted annually beginning in Year 5.

8.3 RESULTS

Sampling results of benthic invertebrate populations will be included in the 2023 (Year 3) Annual Monitoring Report.

8.4 DISCUSSION

Benthic invertebrate communities are expected to take several years to establish following restoration. Year 0, 1, and 3 sampling is intended to provide data points to see where benthic invertebrate recovery is starting from. The post-construction benthic invertebrate populations are expected to remain relatively low due to dredging activities, at least for the short term. As tidal flow improves and vegetation returns, the habitat at San Elijo Lagoon should become more heterogeneous and should support a greater number of benthic invertebrate species. If these data points indicate benthic communities are recovering quicker than expected, annual monitoring may commence before Year 5. Benthic invertebrate sampling will resume in 2023 and the results will be published in the 2023 Annual Monitoring Report.

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9. SEDIMENTS

9.1 PERFORMANCE STANDARD

Sediment quality information is being collected for information only and does not have a specific performance standard associated with it. In the event benthic invertebrate populations or water quality performance standards are not met, sediment quality information will be used to help identify whether there is continued presence of historic high-nutrient sediments and/or whether they continue to affect metrics with performance standards. Monitoring for grain size is also supplemental to nutrients and may be referenced for adaptive management actions if nutrient levels appear improved, but benthic invertebrate populations are not establishing as anticipated.

9.2 APPROACH

Post-construction sampling for sediment quality will continue until water quality and benthic invertebrate performance standards have been met. Sediment samples were not collected in 2022. Per the Monitoring Plan, sediment monitoring is conducted in conjunction with benthic invertebrate monitoring, which will be conducted Years 0, 1, and 3.

9.3 RESULTS

Sampling results of soil and sediment quality will be included in the 2023 (Year 3) Annual Monitoring Report.

9.4 DISCUSSION

Soil and sediment quality within the lagoon is being monitored in conjunction with water quality and benthic invertebrate monitoring, with sediment nutrient levels informing potential adaptive management strategies if performance standards for water quality and/or benthic invertebrate populations are not met. Sampling of soil and sediment quality will resume in 2023 along with benthic invertebrate sampling and the results will be published in the 2023 Annual Monitoring Report.

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10. FISH

10.1 PERFORMANCE STANDARD

Fish community composition is a relative standard, which is used to compare the restored San Elijo Lagoon to similar measurements taken at reference wetlands. The relative performance standard will be considered met if the 4-year running average of fish density and number of species at San Elijo Lagoon are not significantly worse than the mean value at the lowest performing reference wetland. Running averages are calculated for each year post-construction to provide an early barometer of San Elijo Lagoon's performance relative to the reference wetlands.

10.2 APPROACH

Fish habitat established by restoration efforts was primarily composed of shallow subtidal channels. Intertidal channels are expected to evolve and can be added to the post-construction monitoring program upon their development. For the purposes of this monitoring program, fish monitoring in main channel/basins habitats was confined to shallow (-1.5 to -3.6 feet NGVD [National Geodetic Vertical Datum of 1929]) subtidal habitats. Fish measurements were collected in the fall of 2022 to avoid nesting activities of the federally endangered LFRR. Fish data were collected using two methods: seining and enclosure traps. The locations of the sampling stations are presented in the Monitoring Plan and, while changes in channel topography and sedimentation may necessitate slight adjustments to the placement of the sampling stations over time, the locations are generally consistent with the originals. Appendix E includes precise sampling locations for 2022. Of the 18 sampling stations, historical locations that were tidally influenced prior to construction activities in 2017 (i.e., main channel sampling stations 1 through 6 and tidal channel sampling stations 1 through 6) were incorporated into the overall monitoring summary and are used for performance standard evaluations. Performance standard analysis is conducted at the wetland level and is not separated by main channel or tidal channel locations. Fish data from the six main channel and six tidal channel locations were combined to calculate overall fish density and species richness values for San Elijo Lagoon and for each of the reference wetlands. Locations east of I-5 (i.e., main channel and tidal channel sampling stations 7 through 9 provided in Appendix E) are considered contingency locations and are not included in the performance metric evaluations.

Density was standardized to number of individuals per m^2 for both seining and enclosure trap data. Species richness was standardized to number of unique species per sampling location. The averages for enclosures and seines are summed to produce a combined estimate of total density (average number per m^2) for each sampling location. A complete description of survey methodology can be found in the Monitoring Plan.

10.3 RESULTS

A detailed summary of the survey results for 2022 is provided in Appendix E.

Fish Density

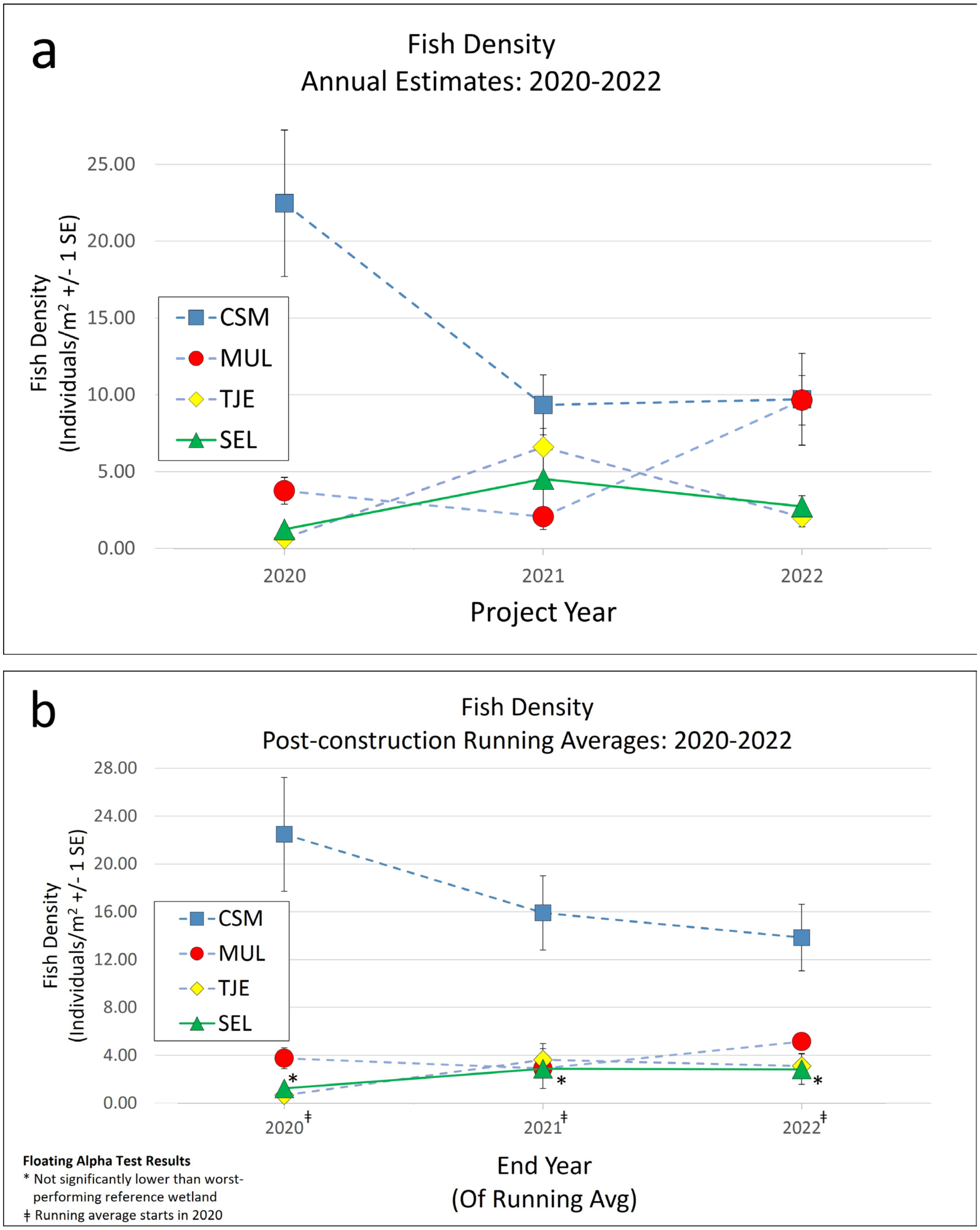
Post-construction annual estimates of fish density at San Elijo Lagoon and the three reference wetlands for 2022 are provided in Figure 10-1a. Post-construction running averages of fish density at San Elijo Lagoon and reference wetlands for 2022 are provided in Figure 10-1b and Table 10-1. In 2022, the running average of fish density at San Elijo Lagoon was not significantly lower than the lowest performing reference wetland (Figure 10-1b).

Table 10-1. 2020–2022 Fish Density Post-construction Running Averages for San Elijo Lagoon and Reference Wetlands

Year(s)	Sampling Station	Fish Density Post-construction Running Average (# Individuals/m^2)			
		Carpinteria Salt Marsh	Mugu Lagoon	Tijuana Estuary	San Elijo Lagoon
2020–2022	MC1	2.35	9.86	2.69	16.52
	MC2	6.17	1.43	2.21	3.20
	MC3	13.74	4.01	7.66	0.91
	MC4	16.14	6.13	0.95	0.93
	MC5	3.81	5.17	1.91	0.61
	MC6	11.96	1.93	1.30	0.84
	TC1	4.85	6.67	13.21	0.85
	TC2	27.20	3.57	2.20	1.86
	TC3	19.82	2.36	0.99	2.48
	TC4	6.48	8.10	0.77	3.08
	TC5	31.24	6.24	2.62	1.12
	TC6	22.34	6.32	0.66	1.54
	Overall Average (SE)	**13.84 (2.79)**	**5.15 (0.74)**	**3.10 (1.07)**	**2.83 (1.27)**

m^2 = square meter; MC = main channel; TC = tidal channel; SE = Standard Error

Figure 10-1. 2020–2022 Fish Density at San Elijo Lagoon and Reference Wetlands



SE = Standard Error

a. Annual estimates of fish density (+- SE) for San Elijo Lagoon (SEL) and reference wetlands (CSM=Carpinteria Salt Marsh; MUL=Mugu Lagoon; TJE=Tijuana Estuary). See Appendix E for complete data from 2022.

b. Running average of fish density (+- SE) for San Elijo Lagoon (SEL) and reference wetlands (CSM=Carpinteria Salt Marsh; MUL=Mugu Lagoon; TJE=Tijuana Estuary). See Appendix E for complete data from 2022.

Fish Species Richness

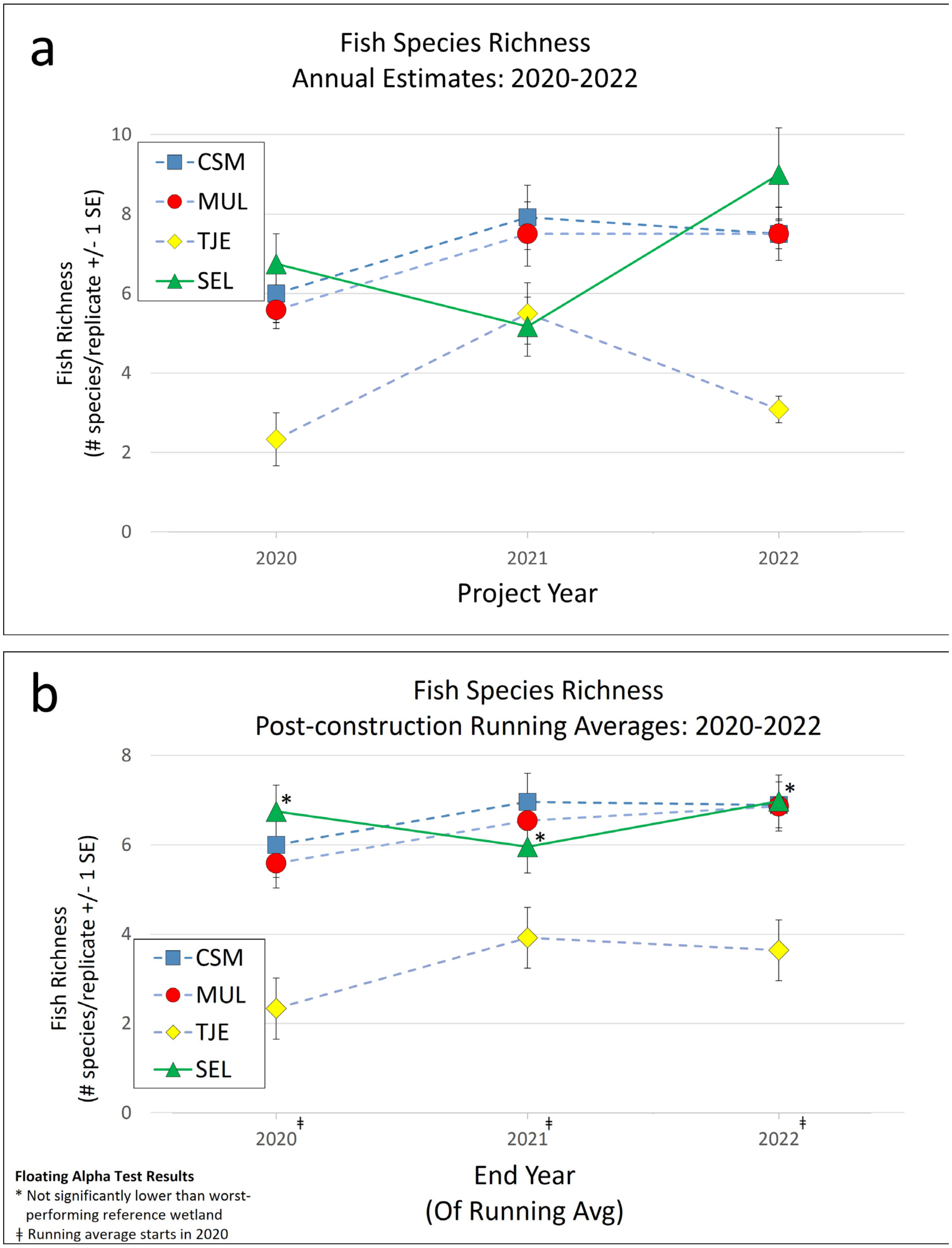
Post-construction annual estimates of fish species richness at San Elijo Lagoon and the three reference wetlands for 2022 are provided in Figure 10-2a. Post-construction running averages of fish species richness at San Elijo Lagoon and reference wetlands for 2022 are provided in Figure 10-2b and Table 10-2. In 2022, the running average of fish species richness at San Elijo Lagoon was not significantly lower than the lowest performing reference wetland (Figure 10-2b). Fish species richness annual estimates were highest at San Elijo Lagoon in 2022 compared to the reference wetlands (Figure 10-2a).

Table 10-2. 2020–2022 Fish Species Richness Post-construction Running Averages for San Elijo Lagoon and Reference Wetlands

Year(s)	Sampling Station	Fish Species Richness Post-construction Running Average (# Species/Location)			
		Carpinteria Salt Marsh	Mugu Lagoon	Tijuana Estuary	San Elijo Lagoon
2020–2022	MC1	7.67	5.33	5.67	11.33
	MC2	8.00	4.67	4.33	11.00
	MC3	6.00	9.00	3.33	6.00
	MC4	6.67	5.33	3.00	6.67
	MC5	6.33	5.67	4.00	4.67
	MC6	7.67	5.67	3.00	5.33
	TC1	7.00	7.67	8.33	4.67
	TC2	7.00	5.67	2.67	8.00
	TC3	6.00	8.33	2.00	8.33
	TC4	4.33	11.00	2.67	4.67
	TC5	11.00	7.67	2.33	5.00
	TC6	5.00	6.33	2.33	8.00
	Overall Average (SE)	**6.89 (0.49)**	**6.86 (0.55)**	**3.64 (0.52)**	**6.97 (0.69)**

MC = main channel; TC = tidal channel; SE = Standard Error

Figure 10-2. 2020–2022 Fish Species Richness at San Elijo Lagoon and Reference Wetlands



SE = Standard Error

a. Annual estimates of fish species richness (+- SE) for San Elijo Lagoon (SEL) and reference wetlands (CSM=Carpinteria Salt Marsh; MUL=Mugu Lagoon; TJE=Tijuana Estuary). See Appendix E for complete data from 2022

b. Running average of fish species richness (+- SE) for San Elijo Lagoon (SEL) and reference wetlands (CSM=Carpinteria Salt Marsh; MUL=Mugu Lagoon; TJE=Tijuana Estuary). See Appendix E for complete data from 2022.

10.4 DISCUSSION

Fish Density

The post-construction running average of fish density at San Elijo Lagoon was not signficantly lower than the lowest performing reference wetland for 2022 (Figure 10-1b). San Elijo Lagoon and Tijuana Estuary both had relatively low fish densities in 2022 that decreased slightly from 2021, whereas Carpinteria Salt Marsh and Mugu Lagoon increased from 2021 to 2022. The post-construction running average for the sampled wetlands was similar in 2022 with the exception of Carpinteria Salt Marsh, which had the highest fish density of the four wetlands (Figure 10-1b). These data represent the third year of fish data post-construction and therefore cannot be used to evaluate the 4-year running average performance standard, but the data provide an early indicator of how restoration has impacted fish density. As biotic and abiotic habitat settles and establishes at San Elijo Lagoon, and as food resources become established post-dredging, fish density may increase. Post-construction surveys will continue to monitor fish density moving forward, and running averages will be generated for San Elijo Lagoon and the reference wetlands to quantitatively evaluate the performance standards.

Fish Species Richness

The post-construction running average of fish species richness at San Elijo Lagoon was not signficantly lower than the lowest performing reference wetland for 2022 (Figure 10-2b). The fish species richness annual estimate at San Elijo Lagoon was the highest among the four wetlands in 2022, after exhibiting the lowest richness in 2021 (Figure 10-2a). Tijuana Estuary was the lowest performing wetland in 2022 for both the fish species richness annual estimate and the post-construction running average.

These data represent the third year of fish data post-construction and therefore cannot be used to evaluate the 4-year running average performance standard, but the data provide an early indicator of how restoration has impacted fish species richness. Because fish are often relatively mobile, at least some species should have been able to avoid construction-related habitat disruptions and should be able to recolonize disturbed (or colonize new) habitat relatively rapidly. Species richness depends to a degree on structural complexity and availability of different habitat types, as well as different food resources. As biotic and abiotic habitat at San Elijo Lagoon settles and establishes, and as food resources become established post-dredging, fish species richness may show increases. Post-construction surveys will continue to monitor fish species richness moving forward, and running averages will be generated for San Elijo Lagoon and the reference wetlands to quantitatively evaluate the performance standards.

11. BIRDS

11.1 BREEDING MARSH BIRDS

11.1.1 Performance Standard

The monitoring of breeding marsh birds is a "pre-restoration absolute" monitoring variable and is not compared to reference wetlands for purposes of determining success of the SELRP. Pre-construction data and construction/post-construction data metrics are compared using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan. Performance standards for LFRR are provided below.

> **Interim standard**: Construction/post-construction 4-year running average density and number of individuals 75% or greater than that of pre-construction survey data (2016, 2017) by Year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average density and number of individuals 95% or greater than that of pre-construction survey data (2016, 2017) by Year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years, as described in the Monitoring Plan. Data on five other "focal" marsh bird species are presented to provide additional insight into the health and condition of the lagoon but are not assessed as part of the performance standards.

11.1.2 Approach

Per the Monitoring Plan, six breeding marsh bird surveys were conducted between mid-March and mid-June each year (2019–2022). Construction/post-construction surveys were performed 2018 to present, but each annual report focuses on comparisons between the baseline period and the most recent 4-year running average (2019–2022). Detailed results from 2018 can be found in the 2018–2019 Avian Monitoring Report (AECOM 2020b) and the 2021 Annual Monitoring Report (AECOM 2022a). As described in the 2018–2019 Avian Monitoring Report (AECOM 2020b), survey points 9, 10, 11, and 18 were moved slightly from pre-construction points because the original locations were no longer accessible without disturbance to enhanced areas after restoration activities were completed in winter 2018–2019. Detailed information regarding the approach and the results of avian monitoring for 2022 are included in Appendix F.

11.1.2.1 Light-footed Ridgway's Rail

An independent double-observer survey approach was used for surveys, meaning two ornithologists were present for each survey (Nichols et al. 2000) and each ornithologist recorded data independently of the other ornithologist. Detection probabilities were estimated from each of the six surveys to derive LFRR estimates and abundance values. LFRR abundance and the associated 95% upper and lower confidence limits (or UCL and LCL, respectively) were calculated separately for each of the six surveys using a closed mark-recapture model (Huggins 1991). Model-averaging was used to generate LFRR estimates and confidence intervals (CIs) for 2016 through 2022 in this Annual Monitoring Report.

<u>Survey Area Density Estimates</u>

Annual LFRR survey area density estimates were calculated by dividing the model-generated estimate of LFRR abundance within the survey area by the total acreage of "preferred" habitat within the survey area for each year, as described in Appendix F.

<u>Lagoon-wide Abundance Estimates</u>

To estimate the LFRR population size for the entire lagoon (i.e., lagoon-wide abundance estimate), including both surveyed and unsurveyed areas, LFRR density estimates and associated CIs were multiplied by the total acreage of preferred habitat across the entire lagoon, as described in Appendix F.

11.1.2.2 Other Focal Marsh Bird Species

Results for five other species of marsh birds are provided as the average number of individuals detected per survey. There was an insufficient number of detections for these other species to generate modeled estimates of abundance. For this reason, raw numbers of detected individuals are presented as an index reflecting relative abundance.

11.1.3 Results

Detailed summaries of the survey dates, survey times, survey personnel, and weather conditions for 2022 are provided in Appendix F.

11.1.3.1 Light-footed Ridgway's rail

<u>Survey Area Density Estimates</u>

Locations of LFRR detections from 2022 surveys are depicted in Appendix F. Based on results from the Huggins (1991) model, LFRR survey area density estimates for each of the six surveys conducted annually in 2019–2022 are presented in Table 11-1 with associated model-generated 95% CIs. Values represent the estimated number of individuals per acre of preferred habitat within the survey area. Average pre-construction baseline period LFRR density estimates are also presented for the surveys conducted in 2016–2017, as well as the 4-year construction/post-construction average. The 4-year construction/post-construction average from 2019–2022 was 0.17 individuals/acre, which was lower than the pre-construction baseline average, and represented a decline from the previous 4-year running average by 0.04 individuals/acre (Table 11-1; Figure 11-1a and Figure 11-1b). Results from the floating alpha testing method indicated the 4-year construction/post-construction running average was not significantly lower than 75% of the pre-construction baseline mean, but was significantly lower than 95% of the pre-construction baseline mean. Thus, while both the interim and final performance standards were met for LFRR density in 2021, only the interim performance standard was met in 2022 (Figure 11-1b).

Table 11-1. Summary of Survey Area Density Estimates for the Light-Footed Ridgway's Rail

Survey Number	LFRR Survey Area Density Estimates; # Individuals/Acre					
	2016–2017 Baseline Estimate[1]	2019 Estimate (95% CI)[2]	2020 Estimate (95% CI)[2]	2021 Estimate (95% CI)[2]	2022 Estimate (95% CI)[2]	4-year Construction/ Post-construction Running Average[3]
1	0.25	0.11 (0.10-0.12)	0.33 (0.31-0.35)	0.28 (0.27-0.29)	0.18 (0.17-0.18)	0.23
2	0.22	0.19 (0.18-0.2)	0.22 (0.22-0.22)	0.29 (0.27-0.3)	0.18 (0.17-0.18)	0.22
3	0.23	0.19 (0.18-0.19)	0.22 (0.21-0.23)	0.25 (0.25-0.26)	0.08 (0.07-0.08)	0.19
4	0.21	0.14 (0.14-0.15)	0.12 (0.11-0.12)	0.17 (0.16-0.18)	0.04 (0.04-0.05)	0.12
5	0.17	0.09 (0.08-0.10)	0.12 (0.12-0.12)	0.23 (0.23-0.24)	0.05 (0.05-0.06)	0.12
6	0.18	0.07 (0.06-0.07)	0.25 (0.24-0.26)	0.27 (0.26-0.28)	0.07 (0.07-0.08)	0.17
Overall Mean (95% CI)[4]	**0.21 (0.18 – 0.23)**	**0.13 (0.09-0.17)**	**0.21 (0.14-0.28)**	**0.25 (0.22-0.28)**	**0.10 (0.05-0.15)**	**0.17 (0.14 – 0.21)**

CI = confidence interval

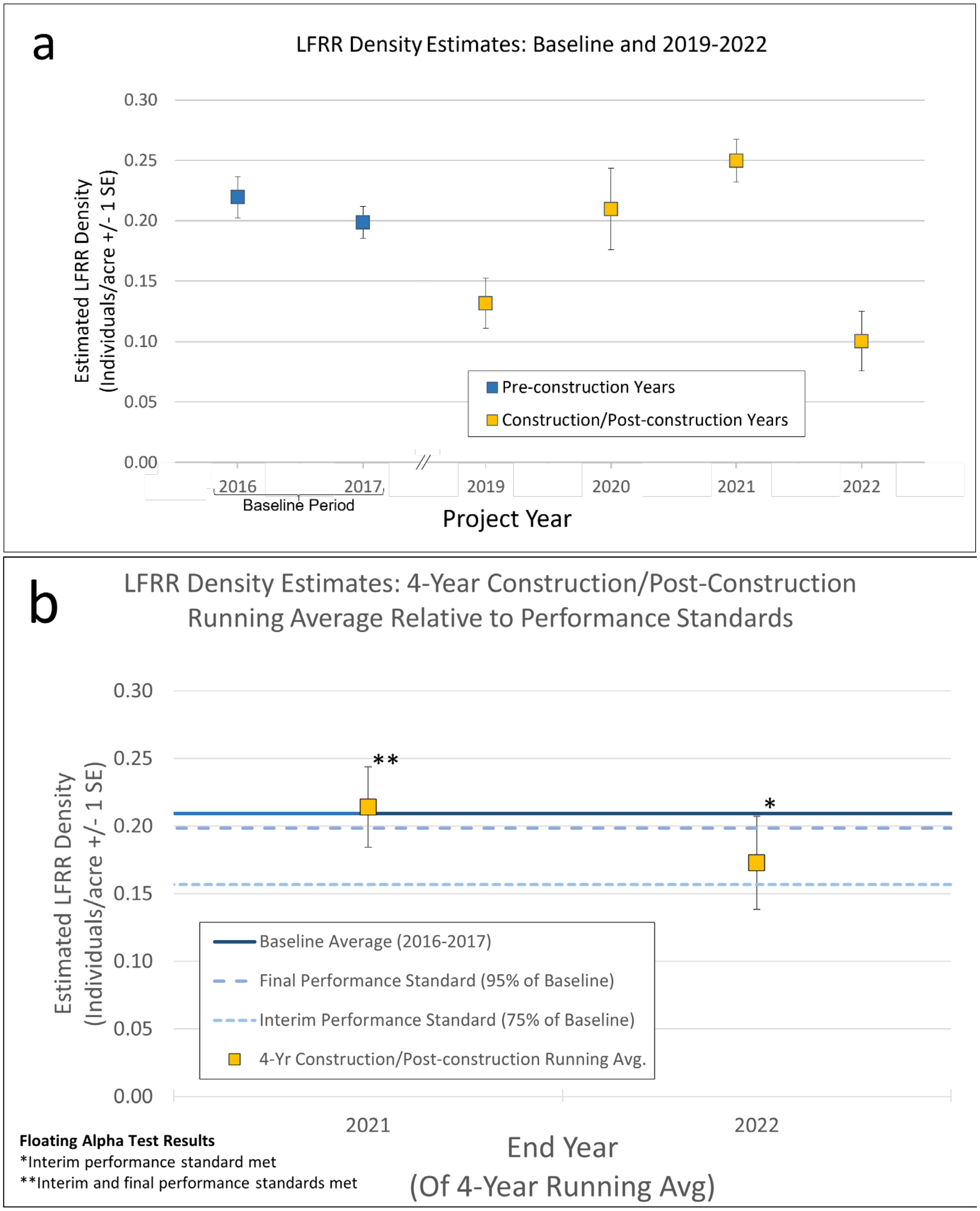
[1] 2016 and 2017 pre-construction baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a).

[2] Density estimates and 95% CIs for Surveys 1 through 6 were calculated by dividing the model-generated LFRR abundance estimates (and associated confidence limits) within the survey area by the amount of preferred habitat within the survey area (see Appendix F for acreage for each year).

[3] The six survey-specific density estimates in these columns were calculated as the mean of 2019 through 2022 density estimates and lack model-generated confidence limits.

[4] Overall Mean Estimates in this row were calculated as the mean of the six survey-specific estimates. Confidence limits for 95% CIs calculated as mean estimate +/- 1.96 x standard error of the six estimates.

Figure 11-1. LFRR Density Performance Standards Test Results



<u>Lagoon-wide Abundance Estimates</u>

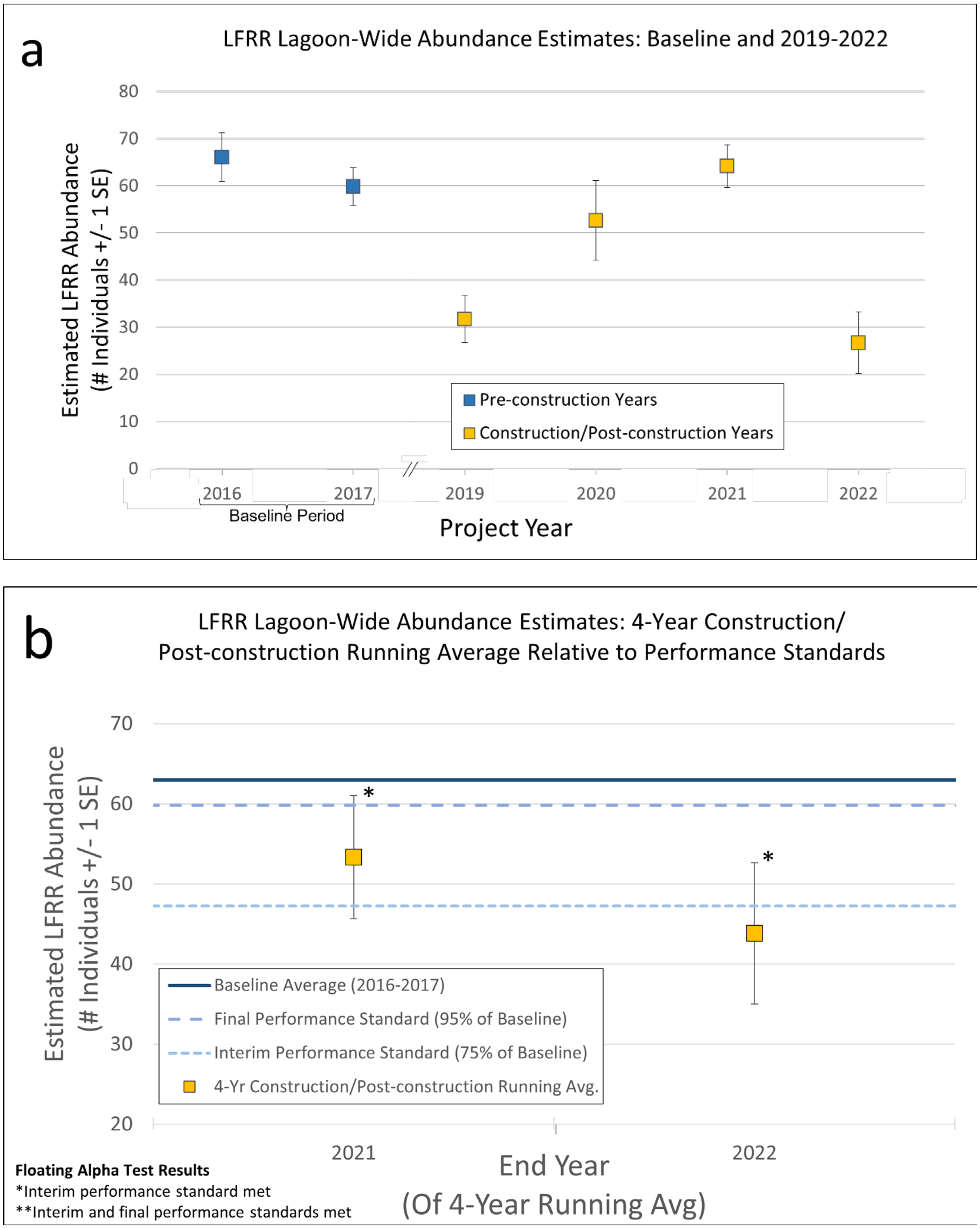
The lagoon-wide LFRR abundance estimate in 2022 was 26.70 individuals (Table 11-2). The 4-year construction/post-construction running average for lagoon-wide abundance was 44.13 individuals, which was markedly lower than the pre-construction baseline mean lagoon-wide abundance estimate of 62.98 individuals (Table 11-2; Figure 11-2a and Figure 11-2b), and a decline of approximately nine individuals from the previous 4-year running average (Figure 11-2b). Results from the floating alpha testing method indicated the 4-year lagoon-wide running average was not significantly lower than 75% of the pre-construction baseline mean, but was signficantly lower than 95% of the pre-construction baseline mean (Figure 11-2b). Therefore, as in 2021, the interim performance standard was met for this metric, but the final performance standard was not for 2022.

Table 11-2. Summary of Lagoon-wide Abundance Estimates for the Light-Footed Ridgway's Rail

Survey Number	LFRR Lagoon-wide Abundance Estimates					
	2016–2017 Baseline Estimate[1]	2019 Estimate (95% CI)[2]	2020 Estimate (95% CI)[2]	2021 Estimate (95% CI)[2]	2022 Estimate (95% CI)[2]	4-year Construction/Post-construction Running Average[3]
1	75.06	26.52 (24.98-28.07)	83.24 (78.87-87.62)	71.79 (69.44-74.15)	46.94 (44.98-48.90)	57.65
2	66.38	46.42 (44.33-48.51)	55.28 (54.32-56.25)	73.97 (70.28-77.66)	46.93 (44.98-48.88)	56.18
3	68.79	44.77 (42.71-46.82)	55.87 (53.48-58.27)	65.25 (63.04-67.47)	21.05 (19.74-22.36)	46.97
4	63.13	34.82 (33.02-36.61)	29.31 (28.44-30.18)	44.02 (42.28-45.76)	11.33 (10.40-12.26)	29.99
5	49.91	21.55 (20.17-22.93)	29.21 (28.92-29.50)	60.14 (58.41-61.88)	14.56 (13.51-15.62)	31.53
6	54.60	16.58 (15.36-17.79)	63.05 (59.56-66.54)	69.94 (68.00-71.89)	19.42 (18.19-20.65)	42.47
Overall Mean (95% CI)[4]	**62.98 (55.54 – 70.42)**	**31.77 (21.94-41.61)**	**52.66 (36.05-69.28)**	**64.19 (55.34-73.03)**	**26.70 (13.86-39.54)**	**44.13 (34.68-53.58)**

CI = confidence interval
[1] 2016 and 2017 pre-construction baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a).
[2] Lagoon-wide abundance estimates and 95% CIs for Surveys 1 through 6 were calculated by multiplying the model-generated LFRR density estimates for each year/survey (and associated confidence limits) by the amount of suitable preferred habitat across the lagoon that year (see Appendix F for acreage for each year).
[3] The six survey-specific density estimates in these columns were calculated as the mean of 2019 through 2022 density estimates and lack model-generated confidence limits.
[4] Overall Mean Estimates in this row were calculated as the mean of the six survey-specific estimates. Confidence limits for 95% CIs calculated as mean estimate +/- 1.96 x standard error of the six estimates.

Figure 11-2. LRFR Abundance Performance Standards Test Results



11.1.3.2 Other Focal Marsh Bird Species

As stated above, the focal marsh bird data represent the number of detections within the survey area and are not adjusted for the amount of suitable habitat or extrapolated to provide an estimate of the lagoon-wide abundance. Detections of focal marsh bird species recorded during survey efforts are included in Table 11-3. On average, Virginia rails were the most commonly detected of the focal marsh bird species in each year, followed by pied-billed grebes and American bitterns.

No common gallinules were detected after the pre-construction baseline period and least bitterns were rarely detected. The overall average of 9.17 individuals/survey in 2022 represented a modest rebound from the survey effort low recorded in 2021 (Table 11-3); however, overall, the focal marsh bird species average has remained relatively similar across years.

Table 11-3. Survey Detections of Other Focal Marsh Bird Species

Focal Species Common Name	Average Number Detected per Survey (Standard Error)				
	2016–2017 Baseline[1]	2019[2]	2020[2]	2021[2]	2022[1]
Virginia Rail	6.00 (1.41)	7.83 (0.54)	6.83 (1.58)	5.50 (1.82)	6.17 (2.66)
Least Bittern	0.33 (0.17)	0.17 (0.17)	0.17 (0.17)	0.00 (0.00)	0.00 (0.00)
American Bittern	0.75 (0.48)	0.33 (0.33)	2.33 (0.71)	0.83 (0.48)	0.50 (0.22)
Common Gallinule	0.08 (0.08)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Pied-billed Grebe	1.75 (0.38)	2.50 (0.72)	1.83 (0.70)	2.33 (0.42)	2.50 (1.02)
All Species[3]	**10.00 (2.49)**	**10.83 (0.79)**	**11.17 (2.80)**	**8.67 (1.65)**	**9.17 (3.38)**

[1] 2016 and 2017 pre-construction baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a)
[2] Mean and standard error for 2019–2022 averages calculated from number of individuals detected during the six surveys.
[3] Values are based on the survey-specific totals (number of individuals of all focal species) detected for surveys 1 through 6 in each year or combination of years.

11.1.4 Discussion

As marsh bird surveys continue to be conducted during the post-construction phase of the project, a running average will be calculated for the 4 most recent years of construction/post-construction surveys and compared to the pre-construction baseline abundance levels to evaluate performance standards as described in the Monitoring Plan.

11.1.4.1 Light-footed Ridgway's Rail

The 2022 LFRR data yielded the lowest survey area density estimate of the 7-year survey period at 0.10 individuals/acre, which is 0.11 individuals/acre lower than the pre-construction baseline and 0.15 individuals/acre lower than the 2021 mean. The 4-year construction/post-construction running average of 0.17 individuals/acre was 0.04 individuals/acre lower than the pre-construction baseline average, and while the interim performance standard was met, the final performance standard was not. These density estimates resulted in lagoon-wide abundance estimates of 26.70 individuals in 2022 and a 4-year construction/post-construction lagoon-wide abundance running average of 44.13 individuals, compared to 62.98 individuals for the pre-construction baseline period. The 4-year construction/post-construction lagoon-wide abundance running average dropped from 53.34 individuals in 2021 to 43.83 individuals in 2022. This steep decline can be primarily attibuted to the fact that 2 of those 4 years (2019 and 2022) represent the lowest abundance estimates of the 7-year study. Results from the floating alpha testing method indicated the 4-year construction/post-construction lagoon-wide abundance running average was not significantly lower than 75% of the pre-construction baseline value, but it was significantly lower than 95% of the pre-construction baseline value. Therefore, while the interim performance standard for LFRR abundance was met, the final performance standard was not.

The low lagoon-wide abundance estimate generated by AECOM for 2022 corroborate data collected by Zembal and Hoffman, in which they reported 49 breeding pairs in the lagoon (Zembal and Hoffman 2022). This number was a sharp decrease from the record high 78 pairs Zembal and Hoffman reported in the lagoon in 2021. Zembal and Hoffman also recorded declines across San Diego County, in which 15 subpopulations declined from 2021 to 2022 compared to only five that increased, with a net loss of 73 breeding pair detections (Zembal and Hoffman 2022).

The decrease in estimated LFRR numbers at San Elijo Lagoon and county-wide in 2022 could be a product of reduced detections (e.g., due to reduced breeding activity and less vocalizing behavior) or actual decreases in the number of individuals in the lagoon (e.g., due to normal population cycling, an increase in predator activity, or sea-level rise causing more frequent nest inundation). Continued drought conditions in 2022 may have impacted nesting substrate or food resources and caused some birds to abandon nesting activities, including territorial calling. Detections would therefore decrease without the population changing. However, there are some indications that the numbers reflect an actual decrease in the lagoon population. Zembal and Hoffman (2022) suggested that loss of habitat due to more frequent and extreme high water events was at least partly responsible for the declines in LFRR across San Diego County. In addition, data on juvenile LFRR survival at San Elijo Lagoon indicate that juvenile survival may have been relatively low in 2021 (two of 10 wild-caught juveniles and zero of 11 captive-bred juveniles all outfitted with GPS trackers were alive approximately 6 months after being tagged) and 2020 (six of 13 wild caught and two of 13 captive bred were alive for the same duration) (Sawyer et al. 2022). Low survival of juveniles often leads to low recruitment of reproductive individuals (especially for species that generally do not disperse widely), and if the LFRR population experienced low recruitment in both 2020 and 2021, that could lead to reduced population size in 2022. Predator control efforts from 2018 through 2022 have targeted potential LFRR nest-predators in the lagoon, including raccoons, Virgina opossums, and nonnative rats, among others. However, approximately 80% of juvenile LFRR mortality was attributed to raptor predation in 2020 and 2021 (Sawyer et al. 2022), indicating that raptors may play an important role after chicks have left the nest. Wild birds exhibited higher survival than captive-bred birds suggesting that wild birds are better equipped to avoid predators. It is unclear what effect, if any, the release of captive-bred LFRR has had on the population at San Elijo Lagoon, but as additional information is collected on the survival and movement of released birds, this will be incorporated into future reports.

11.1.4.2 Other Focal Marsh Bird Species

Due to the low number of detections for each of these species, survey estimates were not corrected for detection probabilities, so the reported numbers probably underestimate true abundance of focal marsh bird species. Thus, abundance estimates are not directly comparable to the modeled abundance estimates of LFRR.

The overall average of 9.17 focal marsh bird individuals/survey in 2022 was slightly lower than the 4-year construction/post-construction running average and baseline period average of 10.00 individuals/survey (for both periods). Virginia rail and pied-billed grebe both increased slightly from 2021, American bittern declined slightly from 2021, and least bittern and common gallinule were not detected. Post-construction surveys will continue to monitor numbers of these birds moving forward.

11.2 WATERBIRD SURVEYS, INCLUDING WESTERN SNOWY PLOVER AND CALIFORNIA LEAST TERN

11.2.1 Performance Standard

The monitoring of waterbird species (e.g., seabirds, waterfowl, shorebirds, wading birds) that use open water and mudflat habitats in the SELRP study area is a “pre-restoration absolute” monitoring variable. Pre-construction baseline data (defined as those data collected in 2016 and 2017, as summarized in the Baseline Monitoring Report) and construction/post-construction data metrics are compared using the “floating alpha” method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan. Other waterbird species, (i.e., birds that utilize open water, mudflat, and sand habitat, excluding western snowy plovers [*Charadrius nivosus nivosus*] and California least terns [*Sternula antillarum browni*]) are monitored to provide additional insight into the health and condition of the lagoon but are not included in the performance standards. Performance standards for western snowy plovers and California least terns are provided below.

> **Interim standard**: Construction/post-construction 4-year running average number of individuals 75% or greater than that of pre-construction survey data (2016–2017) by Year 7 post-construction

> **Final standard**: Construction/post-construction 4-year running average number of individuals 95% or greater than that of pre-construction survey data (2016–2017) by Year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan).

In addition, documentation of western snowy plover or California least tern nesting in the west, central, or east basins would be considered a success since nesting by these species has been absent or sporadic in the lagoon. In 2015, one successful nesting event was observed on Cardiff Beach; however, the beach area nesting conditions are not expected to change as a result of restoration efforts. The *Western Snowy Plover and California Least Tern Nest Monitoring and Management Plan for the San Elijo Lagoon Restoration Project* (AECOM 2017) describes actions to be taken to monitor and manage the nest area being designed as part of the SELRP.

11.2.2 Approach

Waterbird surveys focused on birds that utilize open water, mudflat, and sand habitat, including western snowy plovers and California least terns. A complete description of survey methodology for waterbird surveys can be found in the Monitoring Plan. Each survey yielded a census of waterbirds observed in the west, central, and east basins of the lagoon. Abundances of two species, western snowy plover and California least tern, were calculated as the lagoon-wide average of individuals observed per survey by month, as well as the average number observed per survey within each basin. These values were then used to calculate an overall per-survey average for each year. Observations of other waterbird species were grouped into specific taxonomic orders and summarized as both the number of individuals in each cohort observed per survey by month for each basin, and an overall per-survey average for each year. Detailed approach, as well as results such as lists of the species associated with each taxonomic order detected during surveys in 2022 are provided in Appendix F.

In the construction/post-construction period, surveys were conducted January through December with one survey conducted per month during January, February, October, November, and December, and at least two surveys conducted per month during March through September. Because California least terns overwinter in Central and South America and breed in Southern California during May and July, results for California least terns are provided for the months of April through September because the species is generally not present at the lagoon outside of these months. Construction/post-construction surveys were performed 2018 to present, but each annual report focuses on comparisons between the baseline period and the most recent 4-year running average (2019–2022).

11.2.3 Results

Detailed summaries of the survey dates, survey times, survey personnel, and weather conditions for 2022 are provided in Appendix F.

When multiple surveys were conducted in a month for a given year, the mean number of individuals detected across surveys conducted in that month was calculated. The mean number of individuals detected per survey during each month was used to evaluate temporal variation in abundance (across seasons and years), and to calculate the overall annual average abundance metrics. Survey results from 2022 are also summarized by lagoon basin in Appendix F.

11.2.3.1 Western Snowy Plover

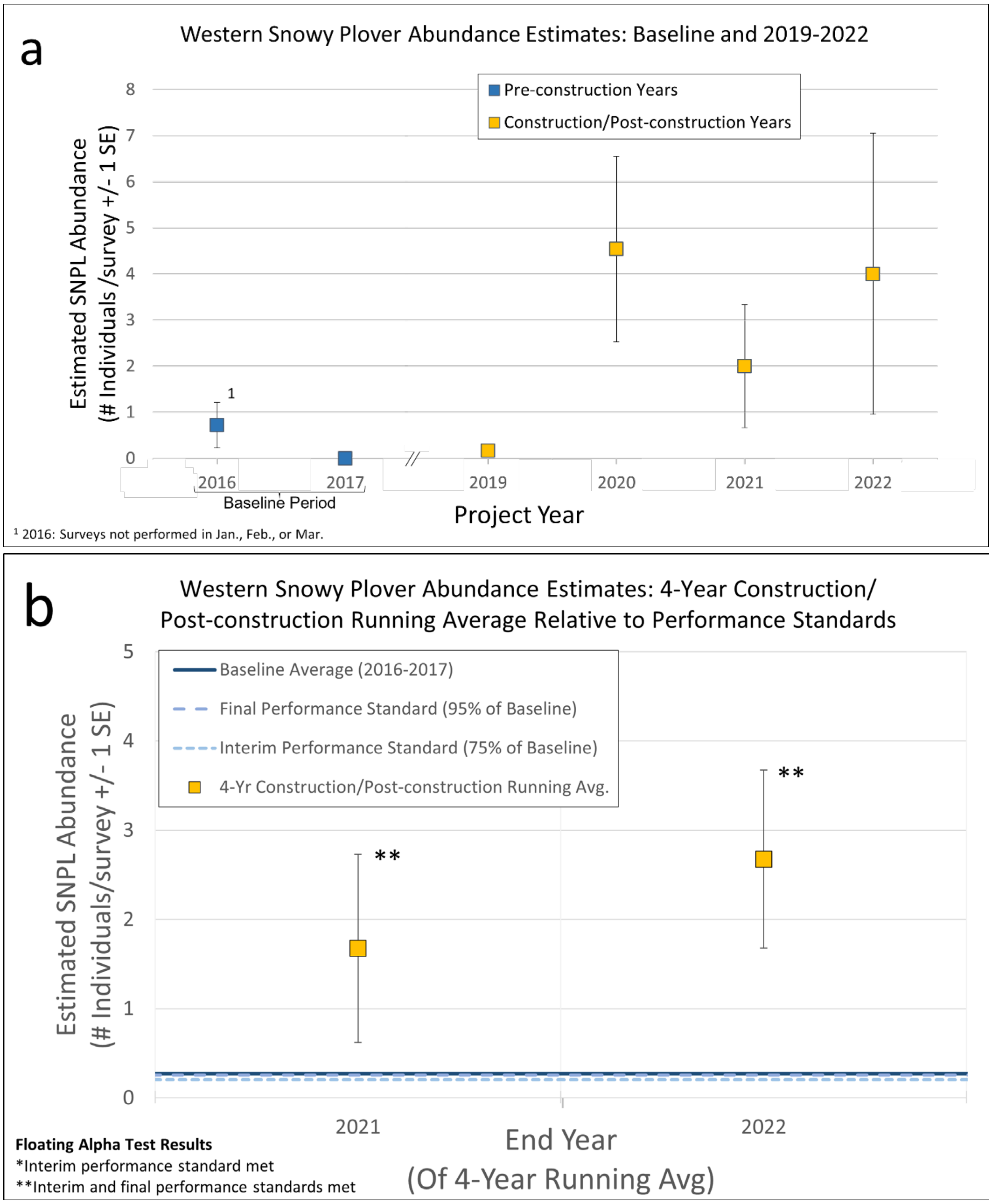
Locations of western snowy plover detections from 2022 surveys are depicted in Appendix F. Results from western snowy plover surveys from the pre-construction baseline period and 2019–2022 are summarized by month in Table 11-4. Western snowy plovers were detected in low numbers each year, with the exceptions of 2017 and 2018, during which no birds were detected. In general, no western snowy plovers were detected in the months of February through June in any year (Table 11-4). Results from the floating alpha testing method indicated the 4-year construction/post-construction average was not significantly lower than 75% of the pre-construction baseline mean, nor was it significantly lower than 95% of the pre-construction baseline mean (Table 11-4; Figure 11-3a and Figure 11-3b). Thus, both the interim and final performance standards were met for western snowy plover abundance (Figure 11-3b).

Table 11-4. Summary of Western Snowy Plover Results by Month

Monthly Averages (Mean # Individuals/Survey)						
Month	**2016–2017 Baseline**	**2019**	**2020**	**2021**	**2022**	**4-year Construction/ Post-construction Running Average[1]**
Jan	0.00	0.00	18.00	0.00	36.00	13.50
Feb	0.00	0.00	0.00	0.00	0.00	0.00
Mar	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.00	0.00	0.00	0.00	0.00	0.00
May	0.00	0.00	0.00	0.00	0.00	0.00
Jun	0.00	0.00	0.00	0.00	0.00	0.00
Jul	0.00	0.00	0.50	7.50	0.00	2.00
Aug	0.00	1.00	0.00	0.50	0.00	0.38
Sep	1.25	0.00	3.00	1.00	0.00	1.00
Oct	2.00	0.00	5.00	0.00	0.00	1.25
Nov	0.00	1.00	10.00	0.00	1.00	3.00
Dec	0.00	0.00	18.00	15.00	11.00	11.00
Overall Average (Standard Error)	**0.27 (0.19)**	**0.17 (0.11)**	**4.54 (2.01)**	**2.00 (1.33)**	**4.00 (3.05)**	**2.68 (1.33)**

[1] The 4-year construction/post-construction running average is from 2019–2022.

Figure 11-3. Western Snowy Plover Abundance Performance Standards Test Results



SNPL = Western Snowy Plover
SE = Standard Error

11.2.3.2 California Least Tern

Locations of California least tern detections from 2022 surveys are depicted in Appendix F. Results from California least tern surveys are provided only for the months of April through September because the species is generally not present on their breeding grounds outside of this date range.

Results from the pre-construction baseline period and 2019–2022 surveys are summarized by month below (Table 11-5). Lagoon-wide, California least terns were not detected during surveys conducted in the months of April, August, or September, and their numbers tended to be highest during June and July.

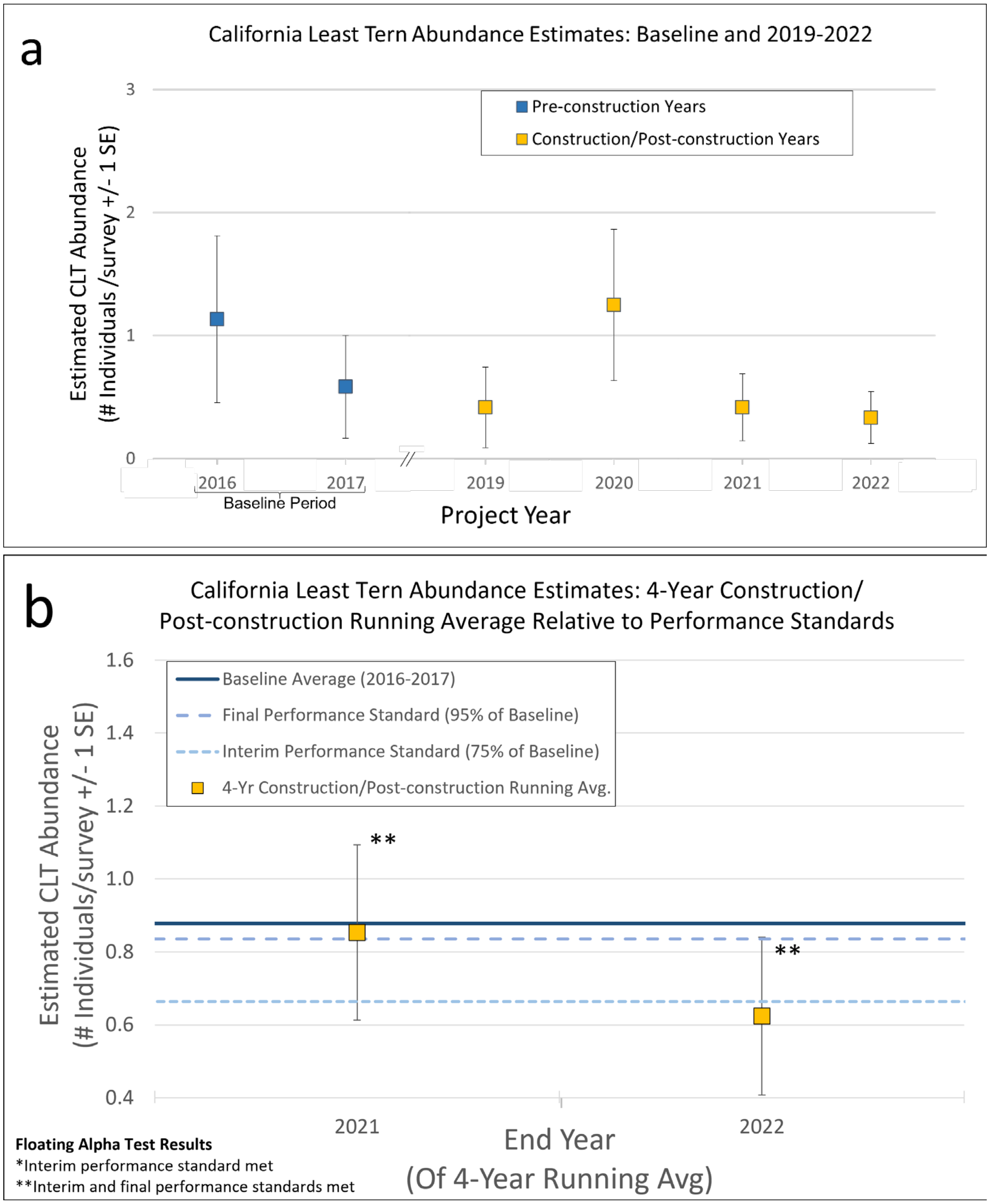
California least terns were detected in low numbers each year, with monthly averages ranging from 0.33 individuals/survey in 2022, to 1.25 individuals/survey in 2020 (Table 11-5). The 4-year construction/post-construction average was 0.60 individuals/survey, which was lower than the pre-construction baseline average of 0.86 individuals/survey (Table 11-5; Figure 11-4a and Figure 11-4b). Results from the floating alpha testing method indicated the 4-year construction/post-construction average was not significantly lower than 75% of the pre-construction baseline mean, nor was it significantly lower than 95% of the pre-construction baseline mean. Thus, both the interim and final performance standards were met for California least tern abundance (Figure 11-4b).

Table 11-5. Summary of California Least Tern Results by Month

Monthly Averages (Mean # Individuals/Survey)						
Month	**2016–2017 Baseline**	**2019**	**2020**	**2021**	**2022**	**4-year Construction/ Post-construction Running Average[1]**
Apr	0.00	0.00	0.00	0.00	0.00	0.00
May	1.40	0.50	1.50	0.00	0.00	0.50
Jun	3.35	2.00	3.50	1.00	1.00	1.88
Jul	0.40	0.00	2.50	1.50	1.00	1.25
Aug	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	0.00	0.00	0.00
Overall Average (Standard Error)	**0.86 (0.55)**	**0.42 (0.33)**	**1.25 (0.62)**	**0.42 (0.27)**	**0.33 (0.21)**	**0.60 (0.32)**

[1] The 4-year construction/post-construction running average is from 2019–2022.

Figure 11-4. California Least Tern Abundance Performance Standards Test Results



CLT = California Least Tern
SE = Standard Error

11.2.3.3 Other Waterbird Species

Results from the pre-construction baseline period and 2019–2022 surveys are summarized by month below (Table 11-6). In 2022, the lagoon-wide survey average continued to decline from the high mark of 853.71 individuals/survey in 2020, dropping another 200 individuals/survey from

2021 levels to 463.54 individuals/survey (Table 11-6). The 4-year construction/post-construction running average of 663.84 individuals/survey was very close to the previous year's 4-year running average of 661.19 individuals/survey, and approximately 85% higher than the pre-construction baseline average of 355.8 individuals/survey. Waterbird numbers tended to be lower during the months of May through August, coincident with the time that most winter migrants are away at breeding grounds farther north.

Table 11-6. Summary of Waterbird Results by Month

Monthly Averages (Mean # Individuals/Survey)					
Month	**2016–2017 Baseline**	**2019**	**2020**	**2021**	**2022**
Jan	509.5	698.0	1,275.0	1,284.0	859.0
Feb	857.0	622.0	1,310.0	1,476.0	857.0
Mar	458.5	872.0	690.0	729.5	748.0
Apr	328.8	415.5	501.0	349.5	340.0
May	181.3	212.5	412.0	143.0	119.0
Jun	148.9	225.5	258.5	88.0	78.5
Jul	154.8	383.0	595.5	316.0	163.0
Aug	262.0	399.0	424.5	446.5	196.5
Sep	286.8	526.0	621.0	471.5	368.5
Oct	186.5	796.0	868.0	821.0	268.0
Nov	549.8	1,194.0	1,717.0	692.0	888.0
Dec	682.8	1,751.0	1,572.0	1,146.0	677.0
Overall Average (Standard Error)	**355.8 (72.7)**	**647.54 (127.65)**	**853.71 (141.76)**	**663.58 (129.49)**	**463.54 (91.66)**

The two orders of birds most frequently observed during waterbird surveys were the Anseriformes (waterfowl) and Charadriiformes (shorebirds, gulls, and terns). Waterbirds belonging to these two taxonomic orders comprised more than 80% of all observations in each year.

11.2.4 Discussion

11.2.4.1 Western Snowy Plover

During 2022, western snowy plovers were observed within the lagoon in modest numbers in the west and central basins. The bulk of detections occurred in December and January, with a solitary bird in November (Table 11-4). The 4-year construction/post-construction running average of 2.68 individuals/survey was almost 10 times higher than the pre-construction baseline average of 0.27 individuals/survey, and both the interim and final performance standards were met for western snowy plover abundance (Figure 11-3a and Figure11-3b).

In 2022, western snowy plover detections were split between the central basin (33 detections) and the west basin (15 detections), with no detections in the east basin. These data continue a trend of more western snowy plover detections in the central basin compared to the west basin. Prior to 2021, western snowy plovers were detected most consistently in the west basin, with the exception of 2017 and 2018 when no western snowy plovers were detected in any basin. Construction-related dredging activities initially resulted in an increase in the amount of open mudflat suitable for foraging in the central basin (i.e., the overdredge pit), and recently this has been transitioning to drier, sandier conditions. It appears that the western snowy plovers have been utilizing that area for foraging and roosting in greater numbers. Western snowy plovers generally favor sandy substrate for foraging, but they will readily forage on mudflats and other unvegetated flats as well. Trends for western snowy plover habitat usage in the lagoon should become clearer as additional data are collected.

11.2.4.2 California Least Tern

California least terns were present in low numbers during the months of June and July in 2022. Overall, the number of California least tern detections during 2022 was 0.33 individuals/survey, which was approximately one-half of the 4-year construction/post-construction running average, and approximately 38% of the baseline average (0.60 individuals/survey and 0.86 individuals/survey, respectively). Although the 4-year construction/post-construction running average of 0.60 individuals/survey was lower than the pre-construction baseline average of 0.86 individuals/survey, results from the floating alpha testing method indicated it was not significantly lower than 95% of the pre-construction baseline value or 75% of the pre-construction baseline value from a statistical perspective. Therefore, both the interim and final performance standards were met for California least tern abundance (Figure 11-4a and Figure 11-4b).

In 2020, 15 California least terns were detected in the lagoon (AECOM 2022c), but the four detections in 2022 was very close to the five detections from 2021 (AECOM 2022b) and 2019 (AECOM 2020b). These data suggest that California least terns continue to be relatively uncommon lagoon users, and that interannual variation in survey detections may be more reflective of sampling error than actual trends in habitat usage. Data from Patton Biological LLC and eBird were examined and they corroborated the trends presented herein, although Patton and colleagues did observe numbers as high as seven individuals and they also observed some courtship behaviors. California least tern decoys, ceramic tile chick shelters, and crushed shells were added to the nesting area in April 2022 to encourage nesting activities (2022 Nest Area Monitoring and Management Plan Annual Report Memorandum [AECOM 2023]). In addition, predator control efforts at the lagoon targeted corvids (American crows and common ravens) for the first time in 2022 in an attempt to reduce the predation pressure at the nesting area. Seven American crows were removed from the lagoon, but this occurred after nesting would have begun, and the California least terns did not appear to initiate any breeding at the lagoon in 2022. Continued predator control efforts and attempts to attract California least terns to the nesting area could bolster their numbers in the lagoon moving forward.

11.2.4.3 Other Waterbird Species

Waterbird surveys were designed to assess the abundance of waterbird species (e.g., seabirds, waterfowl, shorebirds, wading birds) that use open water and mudflat habitats in San Elijo Lagoon. The 2022 survey numbers (463.54 individuals/survey) remained higher than baseline levels (355.8 individuals/survey), but for the second year exhibited a decline relative to the previous year (663.58 individuals/survey in 2021 and 853.71 individuals/survey in 2020). The 2022 average was almost exactly 200 individuals/survey lower than the 4-year construction/post-construction average (663.84 individuals/survey). Waterbirds are not included in the project's performance standards but are surveyed as additional indicators of the lagoon's condition. Post-construction surveys will continue to monitor numbers of these birds moving forward.

11.3 BELDING'S SAVANNAH SPARROW SURVEYS

11.3.1 Performance Standard

The monitoring of Belding's savannah sparrows (*Passerculus sandwichensis beldingi*) is a "pre-restoration absolute" monitoring variable and is not compared to reference wetlands for purposes of determining success of the SELRP. Pre-construction data and construction/post-construction data metrics are compared using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan. Performance standards for Belding's savannah sparrows are provided below.

> **Interim standard**: Construction/post-construction 4-year running average density 75% or greater than that of pre-construction survey data (2016–2017) by Year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average density 95% or greater than that of pre-construction survey data (2016–2017) by Year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan).

11.3.2 Approach

The focus of these surveys was to estimate density for the state endangered Belding's savannah sparrow. Per the Monitoring Plan, survey results are summarized according to four "survey periods" designed to enable grouping of survey results across four roughly equal time periods and to minimize the effects temporal variation may have on analysis results. Belding's savannah sparrow detections were recorded at all distances from the survey transects measuring 100 m long located within suitable habitat and spread throughout the lagoon, following methods described in the Monitoring Plan. Initially, there were 19 transects (i.e., transects 1 through 19), with transects 1 through 4, 6, 9, and 11 through 15 surveyed only on one side due to the lack of sufficient suitable habitat on the other side. Between 2019 and 2021, transects 16 and 17 were not surveyed due to safety issues, but those transects were surveyed again in 2022. Detailed summaries of the survey dates, survey times, survey personnel, and weather conditions for 2020 and 2021 are provided in Appendix F. Construction/post-construction surveys were performed 2018 to present, but each annual report focuses on comparisons between the baseline period and the most recent 4-year running average (2019–2022).

Survey data were analyzed using a distance sampling approach (Buckland et al. 2001), which applied the distances between the observer and each detected bird to control for differences in detectability. Based on results from the distance sampling model approach (Buckland et al. 2001) and data collected in previous years, detections beyond 75 m in perpendicular distance from the transect were omitted from the analysis. An estimate of the density of Belding's savannah sparrow individuals was calculated for each survey as the number of individuals per acre across the survey area as a whole. The modeling approach was revised following the 2020 season as described in the 2021 Annual Monitoring Report for the San Elijo Lagoon Restoration Project (AECOM 2022a) and the 2022 Avian Monitoring Report (Appendix F).

11.3.3 Results

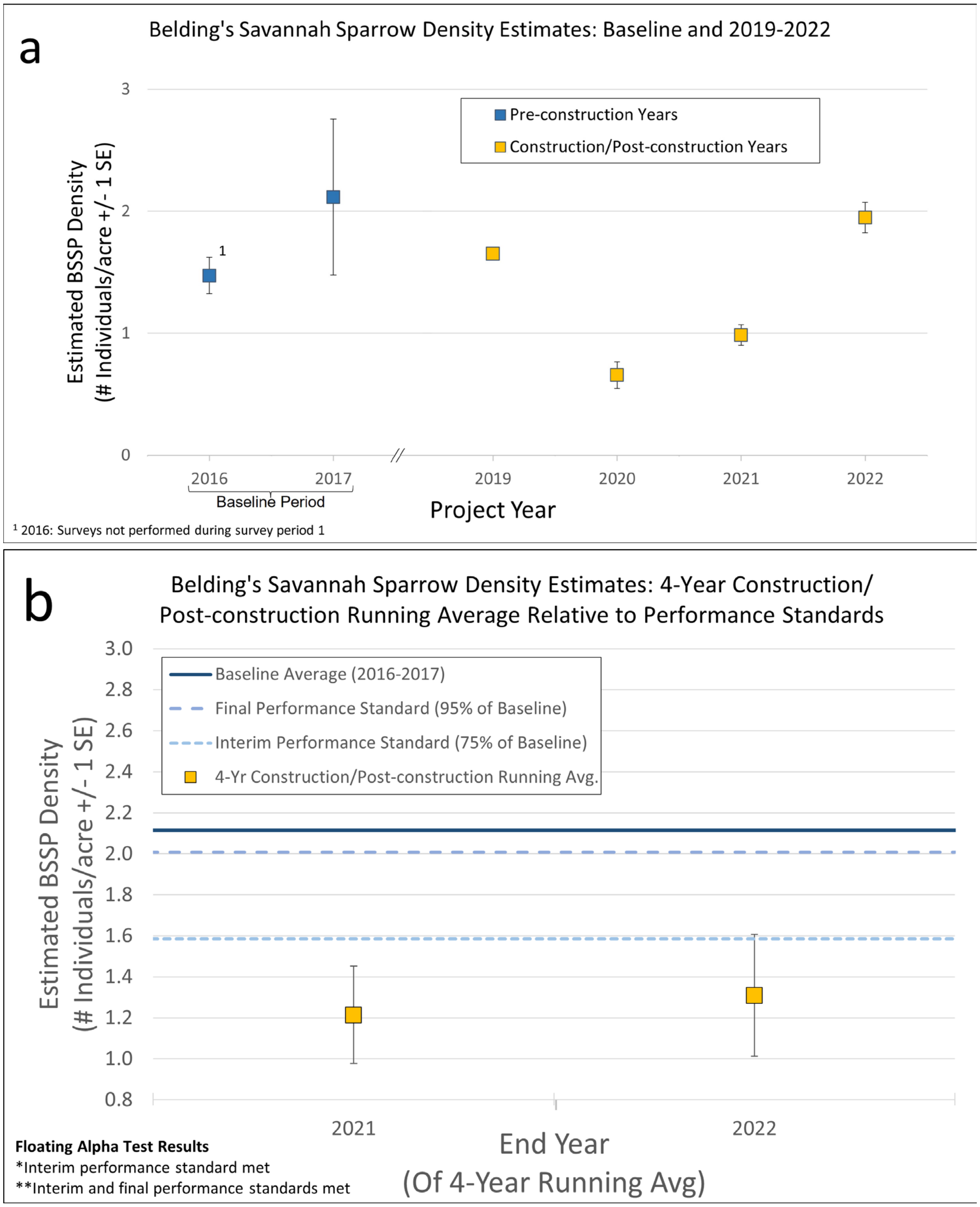
Belding's savannah sparrows were detected primarily in areas dominated by low, mid-, and high salt marsh in 2022, as shown in Appendix F. Belding's savannah sparrow density within the survey area was much higher in 2022 (1.95 individuals/acre) than the 2021 average (0.98 individuals/acre) and the 4-year construction/post-construction average from 2019–2022 (1.31 individuals/acre), but was still moderately lower than the 2016–2017 baseline average (2.11 individuals/acre) (Table 11-7). Results from the floating alpha testing method indicated the 4-year construction/post-construction running average was significantly lower than 75% of the pre-construction baseline mean and 95% of the pre-construction baseline mean (Table 11-7; Figure 11-5a and Figure 11-5b). Thus, neither the interim nor the final performance standard was met for Belding's savannah sparrow density (Figure 11-5b).

Table 11-7. Summary of Belding's Savannah Sparrow Results by Survey Period

Survey Period Averages (Density [Mean # Individuals/acre])						
Survey Period	**2016–2017 Baseline[1]**	**2019**	**2020**	**2021**	**2022**	**4-year Construction/ Post-construction Running Average[2]**
Late-Feb to Mid-Mar	4.03	1.57	0.89	1.07	1.92	1.36
Late-March to Early-Apr	1.61	1.63	0.38	1.18	2.18	1.34
Mid-Apr to Late-Apr	1.45	1.70	0.76	0.87	2.08	1.35
Early-May to Mid-May	1.36	1.70	0.59	0.82	1.61	1.18
Overall Average (Standard Error)	**2.11 (0.64)**	**1.65 (0.03)**	**0.66 (0.11)**	**0.98 (0.08)**	**1.95 (0.12)**	**1.31 (0.04)**

[1] Pre-construction Baseline values differ from those reported in previous reports due to revised model selection approach in estimating survey area densities (see Appendix F).
[2] The 4-year construction/post-construction running average is from 2019–2022.

Figure 11-5. Belding's Savannah Sparrow Density Performance Standards Test Results



BSPP = Belding's savannah sparrow
SE = Standard error

11.3.4 Discussion

The estimated Belding's savannah sparrow density within the survey area was higher in 2022 than in any year except 2017, and raised the 4-year running average from 1.21 individuals/acre to 1.31 individuals/acre. Despite the increase in 2022, the 4-year construction/post-construction running average was lower than the pre-construction baseline average, and neither the interim nor final performance standard was met for Belding's savannah sparrow abundance (Figure 11-5a and Figure 11-5b).

The Belding's savannah sparrow density estimate in the pre-construction baseline period was heavily driven by one unusually high estimate from the first survey period in 2017 (see Baseline Monitoring Report [AECOM 2020a]). That 2017 first survey period estimate (4.03 individuals/acre) is almost twice as high as any other survey from 2016 through 2022, all of which were less than 2.18 individuals/acre (Table 11-7). No surveys were performed during the first survey period in 2016, so the pre-construction baseline estimate for that survey period is based solely on the unusually high 2017 density estimate (Table 11-7; Appendix F). If the first survey period estimate that is twice as high is considered an outlier and omitted from the analysis, results from the floating alpha testing method indicate that the 4-year construction/post-construction average meets both the interim and final performance standards. This is the case whether the first survey period estimates are included in the 4-year construction/post-construction running average or omitted (to provide a balanced comparison between periods). Aside from that high count in 2017, the density estimates have generally ranged from approximately 1.00 to 2.00 individuals/acre, with the exception of 2020 in which all four survey period estimates were below 1.00 individuals/acre (2020 Avian Monitoring Report [AECOM 2022c]), and 2022 in which the density estimates were above 2.00 individuals/acre for two survey periods. The increased density estimates in 2022 are likely the result of two things: some areas of mudflat have been transitioning to low salt marsh, which is one of the habitats Belding's savannah sparrows prefer, and transects 16 and 17 were once again included in surveys. Transect 17 in particular had a large number of detections, which helped boost the density estimate, but the increased density in 2022 was not solely the product of adding transects 16 and 17 and is likely indicative of more widespread changes in the lagoon. As Belding's savannah sparrow surveys continue to be conducted during the post-construction phase of the project, running averages will continue to be calculated annually for the species' density within the survey area for the 4 most recent years of construction/post-construction surveys, and will be compared to the pre-construction baseline density levels to evaluate interim and final performance standards.

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12. WETLAND FUNCTION

12.1 PERFORMANCE STANDARD

Wetland function is an absolute monitoring variable and is not compared to reference wetlands for purposes of determining success of the SELRP. The individual assessment areas (AAs) California Rapid Assessment Method (CRAM) scores and averaged lagoon CRAM score are used to compare post-restoration conditions to pre-restoration conditions and function of the lagoon. This average score serves as the reference for determining the success of the restoration activities. Table 12-1 contains the CRAM performance standards.

Table 12-1. CRAM Performance Standards

CRAM Score	Expected Results	Performance Standard	Year
Buffer and Landscape Context Attribute	Not expected to change, mostly outside the scope of the SELRP	Post-Restoration ≥ Baseline CRAM Attribute Score	Year 5
Hydrology Attribute	Expected to increase slightly due to dredging and topography changes to increase tidal flow and flushing	Post-Restoration ≥ Baseline CRAM Attribute Score	Year 5
Physical Structure Attribute	Expected to recover to equal or exceed Baseline condition	Post-Restoration ≥ Baseline CRAM Attribute Score	Year 5
Biotic Structure Attribute	Expected to recover to equal or exceed Baseline condition	Post-Restoration ≥ Baseline CRAM Attribute Score	Year 5
Overall CRAM	**Expected to recover to equal or exceed Baseline condition**	**Post-Restoration ≥ Baseline CRAM Overall Score**	**Year 5**

CRAM = California Rapid Assessment Method; SELRP = San Elijo Lagoon Restoration Project

12.2 APPROACH

A CRAM Assessment was not conducted in Year 2 (2022). Post-construction CRAM Assessments will be conducted in Years 1, 3, and 5 per the approved Monitoring Plan. However, in accordance with Clean Water Act Section 401 Certification requirements, photographs of the lagoon were taken to document pre-restoration and post-restoration conditions (Appendix G).

12.3 RESULTS

CRAM scores will be included in the 2023 (Year 3) Annual Monitoring Report.

12.3.1.1 DISCUSSION

A CRAM assessment was not conducted in 2022. When comparing the scores for the estuarine AAs between 2016 and 2021, the scores were the same at 72 and the performance standard for CRAM was considered to be met in the 2021 Annual Monitoring Report. Future CRAM assessments will be conducted in Year 3 (2023) and included in the 2023 Annual Monitoring Report.

13. EELGRASS

13.1 PERFORMANCE STANDARD

Eelgrass is an absolute standard in which pre-restoration conditions are compared to post-restoration conditions. If, after the post-restoration surveys are completed, eelgrass has reestablished and no permanent losses are documented, the project will have met performance standards. Pre-restoration conditions are shown in Table 13-1.

Table 13-1. Eelgrass Bed Metrics for Pre-construction Eelgrass Survey – October 2017

Location	Spatial Distribution	Eelgrass Areal Extent	Vegetated Cover	Percent Cover
San Elijo Lagoon	716 m^2	19 m^2	0.9 m^2	4.7%

m^2 = square meter(s)

13.2 APPROACH

Eelgrass monitoring was not conducted in 2022, as monitoring has been discontinued because the final performance standard has been met.

13.3 RESULTS

There are no eelgrass survey results for 2022 as the final performance standard has been met and monitoring has been discontinued. The results of the 2021 Annual Monitoring Report documented that eelgrass had reestablished and there were no permanent losses. The 2021 results are presented below in Table 13-2 for reference.

Table 13-2. Eelgrass Bed Metrics for Post-construction Eelgrass Survey – September 2021

Location	Spatial Distribution	Eelgrass Areal Extent	Vegetated Cover	Percent Cover
San Elijo Lagoon	7,907 m^2	743 m^2	221 m^2	29.7 %

m^2 = square meter(s)

13.4 DISCUSSION

Eelgrass has reestablished and no permanent losses were documented according to the 2021 Annual Monitoring Report, as seen in Table 13-2; therefore, the final performance standard has been met. No further monitoring of eelgrass will be required.

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14. *CAULERPA*

14.1 PERFORMANCE STANDARD

Performance standards for *Caulerpa* are to confirm that *Caulerpa* is not present within the project site, and there would be no risk for introduction to other sites by project implementation.

14.2 APPROACH

Caulerpa surveys were not conducted in 2022 as monitoring has been discontinued because the final performance standard has been met.

14.3 RESULTS

Caulerpa was not detected during surveys within the project area in 2021, meeting the final performance standard.

14.4 DISCUSSION

As noted above, *Caulerpa* was not present within the project site in 2021; therefore, the final performance standard has been met. No further monitoring of *Caulerpa* will be required.

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15. SUMMARY OF PERFORMANCE

15.1 DETERMINING YEAR 2 SUCCESS

The status of the SELRP at the end of Year 2 (2022) is presented in Table 15-1 and Table 15-2 below. Monitoring was not conducted in 2022 for wetland function, benthic invertebrates, and sediments as consistent with the frequency outlined in the Monitoring Plan. Performance standards for topography, bathymetry, habitat areas, vegetation cover, and exotics cover were met in 2022. Final standards for eelgrass and *Caulerpa* were met in 2021 and therefore monitoring was permanently discontinued in 2021 and not conducted in 2022. Avian performance standard thresholds for breeding marsh birds with a focus on LFRR, western snowy plover, and California least tern were also met in 2022, whereas performance standards for tidal elevations and Belding's savannah sparrows were not met in 2022. Performance standards for California cordgrass, water quality, and fish could not be fully evaluated yet as additional years of data are needed to calculate the 4-year running average. Data are provided in Chapters 6.2, 7, and 10 as an early indicator of how restoration has impacted metrics to date. Overall, the relative performance standards are based on less than 4-year running averages for some metrics. The results provided cannot determine success in relation to the relative performance standards, but suggest the SELRP is on track at this time to meet the performance standards in the future.

The ecological objectives of the project are to enhance the existing physical and biological functions and services of San Elijo Lagoon. All relative metrics in this Annual Monitoring Report (Table 15-1) are equally important to the success of the project. Some relative metrics have multiple components that are evaluated for performance (i.e., density and species richness for fish and benthic invertebrates), and to ensure these metrics do not disproportionately impact the overall performance assessments, these components have been weighted 0.50 in the relative performance evaluation (Table 15-1). Each relative metric (e.g., fish, water quality, California cordgrass) therefore receives equal weight in determining project success. As noted above, benthic invertebrates were not sampled in 2022, so the values from the last year sampled (2021) were used in the ratings in Table 15-1. Removing these values does not change the outcome of the relative performance standards tables; SELRP is still better than the lowest performing wetland (Tijuana Estuary).

Table 15-1. SELRP Year 2 Post-Construction Relative Performance Standards

Relative Variable	Site Similar to Other Wetlands			
	San Elijo Lagoon	Tijuana Estuary	Mugu Lagoon	Carpinteria Salt Marsh
Water Quality[1]	Yes	No	Yes	Yes
Fish Density[2]	Yes	Yes	Yes	Yes
Fish Species Richness[2]	Yes	No	Yes	Yes
Invertebrate Density[1,3]	No	Yes	Yes	Yes
Invertebrate Species Richness[1,3]	Yes	No	Yes	Yes
California Cordgrass Canopy Architecture[1]	Yes	Yes	No	N/A[4]
Number of Standards Similar to Other Wetlands[5]	3.5	2	3	3
Weighted Prop[5]. of Standards Similar to Other Wetlands	0.88	0.50	0.75	1.00

N/A = not applicable
[1] Based on 2 years of post-construction data (final performance standard requires 4-year running average)
[2] Based on 3 years of post-construction data (final performance standard requires 4-year running average)
[3] Not sampled in 2022; value reflects data from 2020 and 2021 for all locations; will be sampled again in 2023 (see Chapter 8 for details on sampling schedule)
[4] California cordgrass survey data not available at this wetland
[5] Density and species richness are each weighted 0.50 within fish and benthic invertebrate metrics
Conclusion: San Elijo Lagoon met more standards than both Tijuana Estuary and Mugu Lagoon. Although these results are based on less than 4-year running averages, they suggest that the SELRP is on track during Year 2 post-construction to meet the relative performance standards in the future.

Table 15-2. Timeline of SELRP Overall Project Success

Permitting Agency	Variable	Year Performance Standard Met											
		0	1	2	3	4	5	6	7	8	9	10	Final Standard Met[5]
CCC	Relative Performance Standards[1]	-	Yes[4]	Yes[4]	-	-	-	-	-	-	-	-	-
CCC	*Project Design Absolute Performance Standards*												
CCC	Topography[3]	Yes	Yes	Yes	-	-	-	-	-	-	-	-	-
CCC	Bathymetry[3]	Yes	Yes	Yes	-	-	-	-	-	-	-	-	-
CCC	Tidal Elevations	-	Yes	No	-	-	-	-	-	-	-	-	-
CCC	Exotic Cover	-	Yes	Yes	-	-	-	-	-	-	-	-	-
CCC	*Pre-Restoration Absolute Performance Standards*												
CCC	Breeding Marsh Birds: Light-Footed Ridgway's Rail Density	-	Yes	Yes	-	-	-	-	-	-	-	-	-
CCC	Breeding Marsh Birds: Light-Footed Ridgway's Rail Abundance	-	Yes	Yes	-	-	-	-	-	-	-	-	-
CCC	Western Snowy Plover	-	Yes	Yes	-	-	-	-	-	-	-	-	-
CCC	California Least Tern	-	Yes	Yes	-	-	-	-	-	-	-	-	-
CCC	Belding's Savannah Sparrow	-	No	No	-	-	-	-	-	-	-	-	-
USFWS/CCC	Habitat Areas	Yes	Yes	Yes	-	-	-	-	-	-	-	-	-
USFWS/CCC	Vegetation Cover[2]	-	Yes	Yes	-	-	-	-	-	-	-	-	Yes
RWQCB	Wetland Function (CRAM)	-	Yes	-	-	-	-	-	-	-	-	-	-
Corps	Eelgrass	-	Yes	-	-	-	-	-	-	-	-	-	Yes
Corps/USFWS	*Caulerpa*	-	Yes	-	-	-	-	-	-	-	-	-	Yes

Conclusions by Year:

Year 0. Topography, bathymetry, and habitat areas standards met. Data not available for all other variables. Monitoring will continue for all variables.

Year 1. Relative performance standards, topography, bathymetry, tidal elevations, habitat areas, vegetation cover, exotic cover, breeding marsh birds with focus on light-footed Ridgway's rail, western snowy plover, California least tern, wetland function (CRAM), eelgrass, and *Caulerpa* standards met. Belding's savannah sparrow standard not met. Monitoring discontinued for eelgrass and *Caulerpa*. Monitoring will continue for all other variables.

Year 2. Topography, bathymetry, vegetation cover, exotic cover, habitat areas, breeding marsh birds with focus on light-footed Ridgway's rail, western snowy plover, and California least tern standards were met. Belding's savannah sparrow and tidal elevations standards were not met. Monitoring will discontinue for Vegetation cover. Monitoring will continue for all other variables.

CCC = California Coastal Commission; Corps = U.S. Army Corps of Engineers; CRAM = California Rapid Assessment Method; RWQCB = Regional Water Quality Control Board;
SELRP = San Elijo Lagoon Restoration Project; USFWS = U.S. Fish and Wildlife Service, - = data not available for that year.

[1] Not all required to be met in a given year.

[2] 10-Year absolute performance standards are provided in Table 6-6 (see Chapter 6) for Years 1 through 10. Year 10 vegetation cover performance standards have been met in Year 2. If the 2023 data are consistent with the data collected in previous years and performance standards are achieved, future vegetation monitoring will be discontinued.
[3] It is assumed site conditions would not change frequently enough to necessitate annual surveys or negate previous survey results for topography and bathymetry. Success of both of these absolute standards is tied to habitat, which is being monitored every year. Topography and bathymetry metrics will be considered met in the years between monitoring topography and bathymetry if the habitat performance standard is met. Therefore, if the topography and bathymetry standard was met during monitoring in Year 2 and Year 5 and the habitat standard was also met in Year 2 through Year 5, topography and bathymetry standards would be considered met during Year 2 through Year 5.
[4] Some performance standards may be evaluated based on running averages less than the required 4-year interval.
[5] Metric will no longer be monitored.

16. ADAPTIVE MANAGEMENT RECOMMENDATIONS

16.1 RECOMMENDATIONS

Adaptive management as applied to ecological restoration is a systematic decision-making process in which the results of restoration activities are consistently monitored and evaluated to identify whether the restoration program is reaching its desired results. The process for adaptive management for each of the metrics being monitored in San Elijo Lagoon is ongoing with timelines and actions depending on the individual variable, as described in the Monitoring Plan. The monitoring protocol for each metric has been established to identify specific concerns associated with each variable early enough in the post-restoration phase to enable remedial measures to be taken if necessary and as feasible to achieve project success.

These annual monitoring reports evaluate and determine if the performance standards have been met and will continue to document monitoring results within the annual reports prepared at the end of each year. If performance standards have not been met for variables and monitoring trends indicate the specific function is not heading towards achieving success, adaptive management strategies will be identified and implemented. If necessary, Nature Collective will review the data with the relevant permitting and resource agencies, or with local experts, in an effort to devise a mutually agreed upon course of action to bring the particular variable into conformance with performance standards.

Restoration was completed for the SELRP in 2020, which was the second complete year of post-construction data collection. The results discussed in this Annual Monitoring Report show the project is trending towards success. While the tidal elevations performance standard was not met due to exceedance of residence time in the east basin, water quality was not affected and habitat is establishing consistent with project design.If inlet and/or channel shoaling east of the railroad bridge is not addressed in a timeline manner, there may be negative longer-term effects to the lagoon system and additional metrics (e.g., habitat areas, tidal elevations) may fail to meet success in future years. It is recommended that dredging of the inlet shoaling take place to maintain channel capacities that could affect tidal elevations and longer term habitat establishment, as well as other metrics. Recommendations at this time also include revision of the following monitoring components after 2023 monitoring is conducted. The SELRP team decided that an additional year of vegetation monitoring in 2023 would be conducted even though vegetation performance standards had been achieved through Year 10 in 2022, which represents Year 2. If the 2023 data are consistent with the data collected in previous years and performance standards are achieved, future vegation monitoring will be discontinued, as discussed in Section 6.1.4. Additionally, the number of transects monitored for California cordgrass will be reduced to eight transects to reduce impacts to the overall lagoon system. After California cordgrass canopy monitoring is conducted in 2023, the discontinuation of monitoring this metric may also be considered to reduce impacts to sensitive species present in the lagoon as discussed in Section 6.2.4. The discontinuation of CRAM may also be considered as the AAs will only be affected by the project in the very long term and sea level rise over time. The SELRP team is also considering the potential of removing the outlier survey period from the Belding's savannah sparrow density estimate as discussed in Section 11.3.4.

16.2 ONGOING RESTORATION AND MAINTENANCE ACTIVITIES

Specified maintenance and monitoring will continue in Year 3 (2023) and through the remainder of the monitoring program. Ongoing activities include weeding and exotics removal, nest site and inlet maintenance, and predator control. Focused activities that may occur as adaptive strategies will be captured in the 2023 Annual Monitoring Report. Shoaling within the inlet channel east of the railroad is also being closely monitored and strategies to address potential impacts to the lagoon are being actively explored. Consistent monitoring continues in the lagoon for other metrics as noted above as well. Additional focused activities may occur as the year progresses.

17. LIST OF PREPARERS

Table 17-1 includes a list of persons and organizations who participated in the monitoring program and/or preparation of this Annual Monitoring Report.

Table 17-1. List of Preparers

Chapter	Variable	Lead Author	Organization
1–14	General Report Preparation	Cindy Kinkade (Project Manager)	AECOM
		Kandiss Wise	AECOM
2	Topography	Chris Webb	Moffatt & Nichol
3	Bathymetry	Chris Webb	Moffatt & Nichol
4	Tidal Elevation	Chris Webb	Moffatt & Nichol
5	Habitat Areas	Aaron Andrews	AECOM
6.1	Vegetative Cover	Aaron Andrews	AECOM
6.2	California Cordgrass Canopy Architecture	Aaron Andrews	AECOM
6.3	Exotics	Aaron Andrews	AECOM
7	Water Quality	Nature Collective	Nature Collective
8	Benthic Invertebrates	Andres Deza	Nature Collective
9	Sediments	Nature Collective	Nature Collective
10	Fish	Andres Deza	Nature Collective
11.1	Breeding marsh birds with focus on light-footed Ridgway's rail	Michael Kuehn; Loren Merrill	AECOM
11.2	Western snowy plover, California least tern, and waterbird species	Michael Kuehn; Loren Merrill	AECOM
11.3	Belding's savannah sparrow	Michael Kuehn; Loren Merrill	AECOM
12	Wetland Function (CRAM)	Aaron Andrews	AECOM
13	Eelgrass	Nature Collective	Nature Collective
14	*Caulerpa*	Nature Collective	Nature Collective

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APPENDIX A

2022 ANNUAL TIDAL WATER LEVEL AND VELOCITY MONITORING REPORT; WATER QUALITY ANALYSIS UPDATE FOR SAN ELIJO LAGOON RESTORATION PROJECT MEMORANDUM

SAN ELIJO LAGOON RESTORATION PROJECT

2022 Annual Tidal Water Level and Velocity Monitoring Report

Prepared for:
The Nature Collective

San Elijo Lagoon
RESTORATION
Reviving Your Wetlands

July 2023

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1. INTRODUCTION

This report documents the methods, results, and data analyses of a tidal water level monitoring campaign in the San Elijo Lagoon (SEL) from January through December 2022. The campaign was conducted by Moffatt & Nichol (M&N) for The Nature Collective in support of the San Elijo Lagoon Restoration Project (SELRP) and the associated 5-year post-construction monitoring requirements.

1.1 Project Background

The SEL is a 960-acre coastal wetland situated between the cities of Solana Beach and Encinitas, CA. Due to its important biological and ecological resources, SEL has been designated as a State Marine Conservation Area (SMCA) by the California Department of Fish and Wildlife (CDFW). An aerial map of the project site and boundaries is displayed in Figure 1-1.

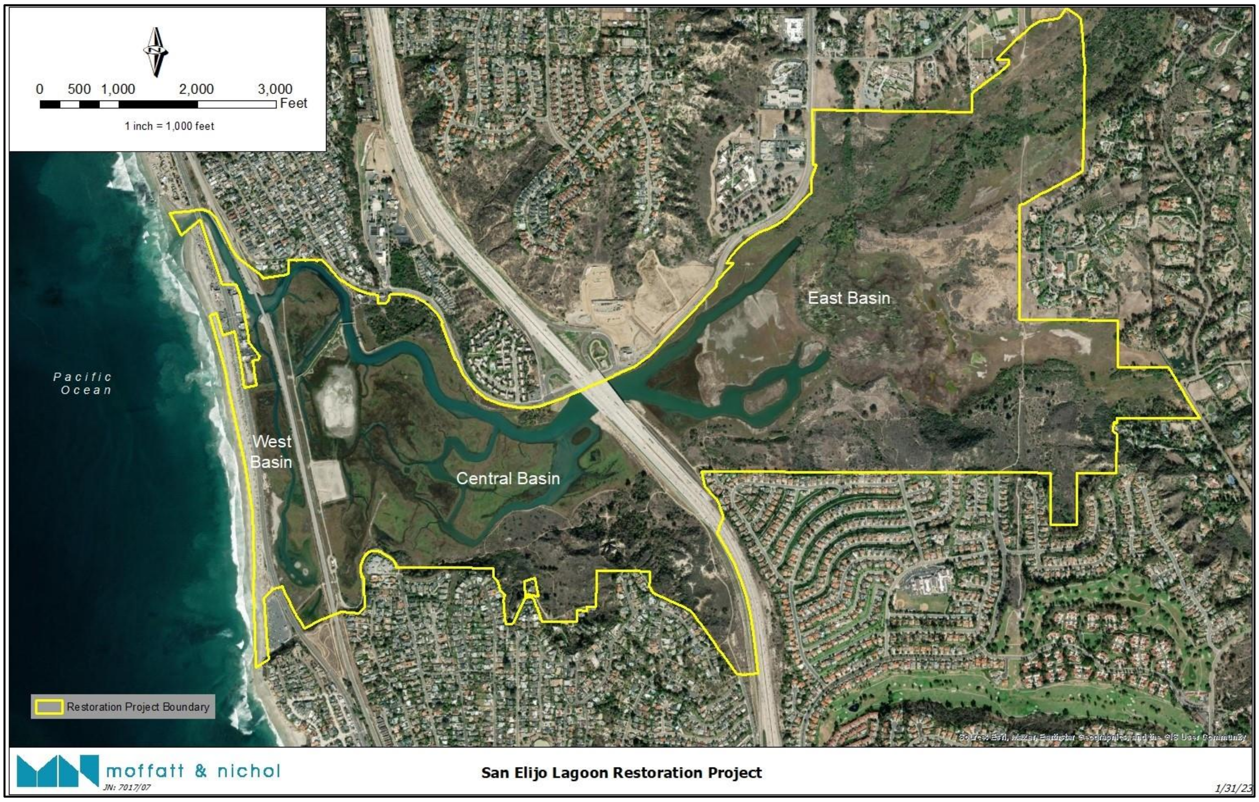


Figure 1-1: Aerial image of the San Elijo Lagoon Restoration Project boundaries.

The SELRP aims to protect, restore, and maintain the saltwater, brackish, and freshwater marsh resources, and adjacent uplands within the SEL ecosystem with the following goals:

1) Physical restoration of estuarine hydrologic functions of the lagoon,
2) Biological restoration of habitat and species within the lagoon, and
3) Management and maintenance of the lagoon to ensure the long-term viability of restoration efforts.

With respect to the physical restoration of SEL, the SELRP enhanced tidal conveyance and the tidal prism by modifying the lagoon's geometry, particularly in channels. Of specific focus are those at the Central Basin former meander, the Interstate 5 (I-5) bridge crossing, and the East Basin former dike site. These locations represented constrictions to the hydraulic capacity of SEL. The restoration increased the width of the lagoon at restrictions to enable the tide to flow more freely throughout the lagoon and into the upper reaches of the East Basin. This was also done in the effort to increase the overall tidal prism of SEL.

The primary construction phase of the SELRP was initiated in December 2017 and mostly concluded in June 2020. Additional dredging events took place during the summer of 2021 and winter of 2021/2022 to remove sandbars that had developed during a significant storm in April of 2020, and as part of a Caltrans project to replace the I-5 bridge, respectively. The construction phase of the I-5 bridge expansion concluded in April of 2022. Continued water level and tidal velocity monitoring is ongoing continuously through 2025. The objective of the monitoring effort is to observe and record the performance of the restoration efforts relative to tidal hydrology. This information is useful for detecting unanticipated changes affecting the tidal hydrology and circulation within the wetlands due to changes within the channel network (e.g., 2020 storm sandbars, I-5 chokepoint, tidal inlet sandbars, etc.).

1.2 Tidal Water Level Monitoring Campaign

A water level monitoring campaign in SEL was initiated in September 2016 with the long-term objective of documenting tidal water level conditions throughout the lagoon prior to, during, and following the construction phase of the SELRP. Water level data collected in 2016 and 2017 serve as baseline conditions for the hydraulic restoration of SEL. These baseline conditions are used in combination with data recorded during and following the construction phase to evaluate the evolution of hydrology with respect to the established project goals. They can also be used in the design of adaptive management strategies to improve lagoon functionality if certain conditions are observed that represent relatively poor or declining function.

The monitoring of water levels during project construction began with the initiation of construction efforts in SEL in December 2017. Construction and post-construction water level records reported herein span from December 2017 through December 2022. However, as discussed in the following sections, water level monitoring efforts at some of the measuring locations were temporarily paused for short periods in order to avoid conflict with construction activities taking place within the vicinity of the instrumentation. This was done to prevent potential damage to monitoring equipment.

1.3 Tidal Velocity Monitoring Campaign

A tidal water velocity monitoring campaign was added to the tide level monitoring effort in February 2020 with the long-term objective of documenting post-construction changes in tidal and stormflow velocity and tidal prism. Observed water velocities within SEL were used to calibrate the numerical model of the lagoon used to quantify tidal residence time for water quality, and to estimate the SEL tidal prism and visualize post-construction tidal circulation patterns.

2. DATA COLLECTION

2.1 Data Stations

During 2022, water levels in SEL were monitored at five locations: two within the West Basin, two within the East Basin, and one within the Central Basin. Water velocities were monitored at two locations along the main channel: one within the West Basin and one within the Central Basin. The locations of water velocity measurements roughly correspond to those of the water level monitoring stations at the Tidal Inlet Channel and the Nature Center. The geographic locations of water level monitoring stations are listed in Table 2-1 and shown in Figure 2-1. Stations shown in red were first deployed in 2017, those shown in orange were first deployed in 2018, and those shown in yellow with a grey "null" symbol were first deployed in 2019 and relocated in May 2022 to the locations indicated by the green markers. Both East Basin locations were relocated in May of 2022 so that they could be accessed more easily by footpath while still providing comparable data to previous monitoring. These changes in location are within the same general vicinity as the original instrument locations so there are no anticipated changes to measured data. The items delineated in green in Table 2-1 and Figure 2-1 indicate the relocation coordinate information and graphical locations of these two instruments, respectively.

Measured water levels in SEL were compared with water level records from the National Oceanographic and Atmospheric Administration Center for Operational Oceanographic Products and Services (NOAA CO-OPS) Station 9410230 (La Jolla, CA) to determine the relationship of tidal amplitude and range within the lagoon relative to tides on the open coast. The NOAA reference station (shown in Figure 2-1 as a light blue triangle) is located approximately 10 miles south of the mouth of SEL at Scripps Pier.

Table 2-1: Reference station and water level monitoring stations during 2022.

Longitude (East)	Latitude (North)	Station Name	Source	Initial Installation Date
-117° 16' 43.61"	33° 0' 46.19"	Tidal Inlet Channel*	M&N	12/01/2017
-117° 16' 40.05"	33° 0' 37.25"	Las Olas	M&N	12/01/2017
-117° 16' 29.04"	33° 0' 46.95"	Nature Center*†	M&N	02/01/2018
-117° 15' 35.88"	33° 0' 46.49"	East Basin North Branch (Old)	M&N	07/19/2019
-117° 15' 34.89"	33° 0' 46.35"	East Basin North Branch (Relocation)	M&N	05/23/2022
-117° 15' 18.57"	33° 0' 39.86"	East Basin South Branch (Old)	M&N	11/06/2019
-117° 15' 33.97"	33° 0' 34.13"	East Basin South Branch (Relocation)	M&N	05/23/2022
-117° 15' 24.00"	32° 52' 00.00"	La Jolla, CA (9410230)	NOAA CO-OPS	N/A

*Water velocities were also monitored at the Tidal Inlet Channel (initially installed 07/10/2020 roughly at -117° 16' 43.29" E, 33° 0' 46.88" N) and the Nature Center station (initially installed 02/19/2020 roughly at -117° 16' 29.27" E, 33° 0' 46.94" N).
†The Nature Center monitoring station referenced in this report was referred to as the Nature Center Downstream monitoring station in previous reports; it has been renamed here as Nature Center because the upstream station at the Nature Center is no longer used.

Figure 2-1: Water level monitoring stations during the 2022 deployment (red deployed in 2017; orange in 2018, and yellow/grey in 2019 and relocated in 2022 to green markers).

2.2 Instrumentation

RBR pressure gauges (RBR model: *RBRsolo D*) were used at all monitoring stations during the 2022 deployment to measure water levels in intervals of six minutes or less. These instruments, henceforth referred to as tide gauges, use built-in pressure sensors to measure the time-varying height of the water column above them (i.e., the distance from the water surface to the pressure sensor within the tide gauge). During the deployment, tide gauges were fixed to six-foot-long steel fence posts with zip-ties (see Figure 2-2). The posts were driven two-to-three feet (ft) into the lagoon bed and the gauge was positioned onto the post approximately one ft above the bed. This configuration simplified the periodic retrieval and reinstallation of the instruments, which was required for cleaning, maintenance, and data downloading procedures.

Figure 2-2: RBR Solo D tide gauge for water level measurements (left) an example of the mounting system (right) during the 2017 deployment.

Acoustic Doppler Current Profilers (ADCP's) were used to measure water velocities at the Nature Center and Tidal Inlet Channel stations throughout 2022. These instruments, henceforth referred to as "Aquadopps," use acoustic signals to measure horizontal water velocities at pre-defined depths. All instruments deployed in 2022 were programmed to measure velocities every 10 minutes in 0.25-meter (m) depth bins. Water velocities were measured by a side-looking Nortek *Aquadopp Profiler* (Figure 2-3), which was mounted on a submerged mooring close to the bottom of the lagoon bed at each of the two sampling stations. The transducers, which emit and receive acoustic signals, are the black circles on the right end of the instrument in the image.

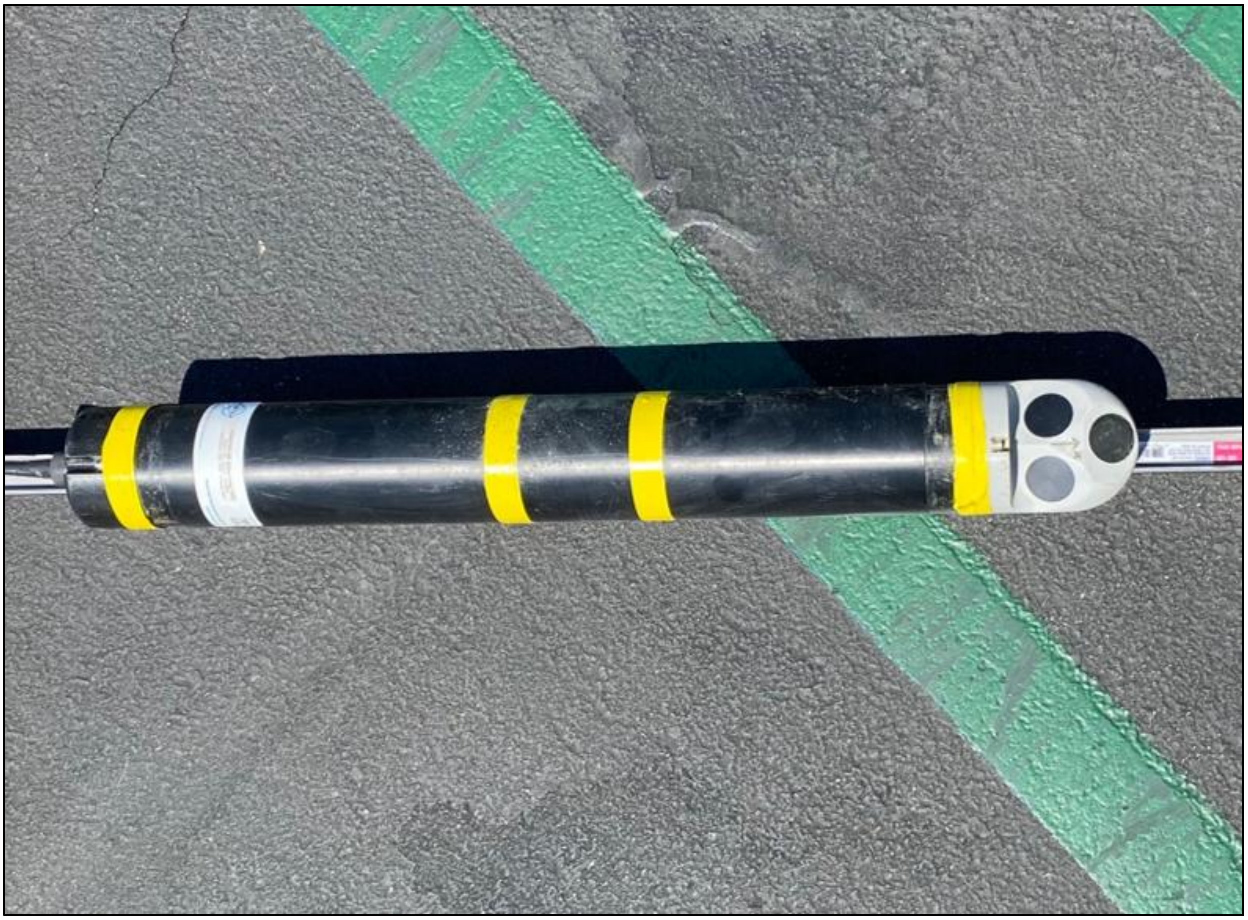


Figure 2-3: Nortek Aquadopp Profiler.

2.3 Data Processing

Data processing is an important process for producing high accuracy datasets from in-situ measurements. Standard measurement errors (such as those innate to the instrumentation, introduced by the user(s), and/or as a product of changing environmental conditions, etc.) are detected during post-processing of raw data where incorrect values are identified and either corrected or removed from the dataset. Any unexpected trends or patterns in datasets are individually investigated to determine whether they are valid measurements of natural processes or erroneous artifacts of the sampling design. This section includes descriptions of all significant modifications to the observed tidal records as well as descriptions of major anomalies and their causes.

Water depths (as measured by tide gauges) were converted to water surface elevations by surveying the water surface relative to the North American Vertical Datum of 1988 (NAVD88). On bimonthly field excursions for maintenance/data downloads during 2022, water surface elevation surveys were conducted by KDM Meridian when tide gauges were redeployed at each monitoring station (Figure 2-4).

Figure 2-4: Water surface elevation survey near the Tidal Inlet Channel station.

Similar to 2021, small (≤0.25 ft) gradual shifts in water level elevation measurements were periodically encountered at various monitoring sites in 2022. These were removed with linear corrections based on multiple water level surveys, when available. These erroneous trends may be attributed to the following factors:

- Instrument error requiring recalibration,
- Anthropogenic impacts affecting the mounting system of the instrument (e.g., being tampered with or vandalized, or being struck by construction/dredging equipment),
- Slight survey rod reading variations by the surveyor or rod-person, and/or
- Environmental influences affecting the mounting system of the instrument (e.g., kelp detritus accumulating on and pulling the mooring down towards the bed.

During 2022 bi-monthly (every other month) data downloads and instrument redeployments, water levels were surveyed either once or twice at each monitoring station: once after the tide gauge was redeployed or both just before it was retrieved *and* after redeployment. In some cases, both surveys produced varying water levels; these water level records were corrected using the most appropriate survey available based on water levels measured during prior deployments. A small degree of human-induced variability exists between measurements as survey methods rely on the manual operation of a prism pole at the water's edge to collect elevation data.

Figure 2-5 shows corrected low water levels at the Nature Center were consistently 0.1-0.2 ft higher than low water levels measured at all other monitoring stations. Similar trends were observed in portions of the 2020 and 2021 tidal monitoring campaigns. In previous years these were thought to be due to instrument/survey errors. In 2021, however, a recalibrated tide gauge replaced the previous gauge that had been in use and was in need of calibration. As such, the increased water level at this site in 2022 may be due in part to instrumentation. It is also possible that the error stems primarily from minor discrepancies in surveys and/or possible environmental factors. While the measured water levels at the Nature Center appear to be high by 1-2 inches, tidal *ranges* at the Nature Center station appear to be accurate and consistent with other lagoon data as they are not referenced to a vertical datum (Tables A-4 and A-5 in Appendix A).

During 2019, the Nature Center station showed an anomaly in water level measurements that was determined to be a result of the instrument being out of calibration. Consequently, the 2019 surveyed water levels at the Nature Center station are shown in Section 3 for illustration purposes only. However, as stated above, the tidal ranges measured at the Nature Center station are considered reliable since they are not referenced to any vertical datum.

In 2018, a trend of increasing water level measured by the gauges was identified at the Tidal Inlet Channel station from March to mid-July due to the mooring being struck by a dredge discharge line. The impact to the mooring introduced an error into the vertical datum of the water level measurements. The surveyed water levels provided in Appendix A. Water Level Data: Table A-2 and plotted in section 3 display this error. Similar to other years, the tide ranges are considered reliable since their measured values are not referenced to any vertical datum.

Water levels are also measured by ADCPs and can be used to generally verify water levels measured by tide gauges. As a result of comparing the data between the two instruments, water levels at the tide gauge were systematically shifted vertically using a linear best-fit regression between the tide gauge water level and ADCP record.

ADCP data were also checked for erroneous velocity reading measurements, which are generally due to interferences in the acoustic signals used to estimate velocity values. These typically manifest as unusually high water velocity anomalies that do not follow general measurement trends. In many cases, the directionality of current velocity data associated with these spikes does not match the general directional trends at the observation site as well. Velocity measurements deemed as erroneous per these characteristics were also removed from the final dataset.

2.4 Data Inventory

Table 2-2 provides an inventory of surveyed water level and velocity records within SEL during 2022. The gaps in water velocity and water level data coverage at the Nature Center, Las Olas, and Tidal Inlet Channel locations during the beginning of January are due to scheduled instrument removal to avoid conflict with planned dredging activities. In addition, both water velocity and water level data were unavailable for the Nature Center location from February to mid-May due to dredging equipment unexpectedly impacting the instrumentation and moorings at the site. The Aquadopp at this location was recovered but found damaged and subsequently needed to be shipped to the manufacturer for repair. The tide gauge at the site was dislodged and not able to be recovered; it required replacement with another unit in its place.

A six-day data gap in water velocity for both the Nature Center and Tidal Inlet Channel locations in August was due to unanticipated faulty power supply issues experienced by the instruments. The period from the end of October to December without water velocity data at the Tidal Inlet Channel site was caused by instrument burial due to accelerated sedimentation within the vicinity around the north end of the railroad bridge that intensified throughout the year during 2022. This instrument was recovered intact without damage, but the frame was degraded beyond repair and a new one had to be fabricated for subsequent redeployment. It was redeployed on December 7th and data were successfully collected for the remainder of the year.

Tide gauge measurements were not taken from mid-May to August at the Las Olas site and from October to December at the East Basin North Channel site due to malfunction of the instruments requiring shipment to the manufacturer for necessary repair and maintenance.

Table 2-2: Monthly percentages of data coverage in SEL from January through December 2022.

Month	Tidal Inlet Channel		Las Olas (West Basin)	Nature Center (Central Basin)		East Basin North	East Basin South
	WL	Vel*	WL	WL	Vel*	WL	WL
Jan	55%**	53%**	55%**	45%**	55%**	100%	100%
Feb	100%	95%	100%	0%	28%	100%	100%
Mar	100%	92%	100%	0%	0%	100%	100%
Apr	100%	88%	100%	57%	0%	100%	100%
May	100%	72%***	74%	100%	45%	100%	100%
Jun	100%	44%***	0%	100%	100%	100%	100%
Jul	100%	45%***	0%	100%	100%	100%	100%
Aug	100%	61%***	64%	100%	81%	100%	100%
Sep	100%	97%	100%	100%	100%	100%	100%
Oct	100%	70%	100%	100%	100%	77%	100%
Nov	100%	0%	100%	100%	100%	0%	100%
Dec	100%	74%	94%	100%	100%	70%	100%

WL = water level data coverage
Vel = water velocity data coverage
*Velocity data coverage of >75% indicates that the instrument was actively deployed, but data loss occurred due to extraneous velocity measurements (environmental error).
**Instruments temporarily removed due to dredging activities.
*** Aquadopp relocated in too shallow of water due to previous burial of the instrument in the main channel.

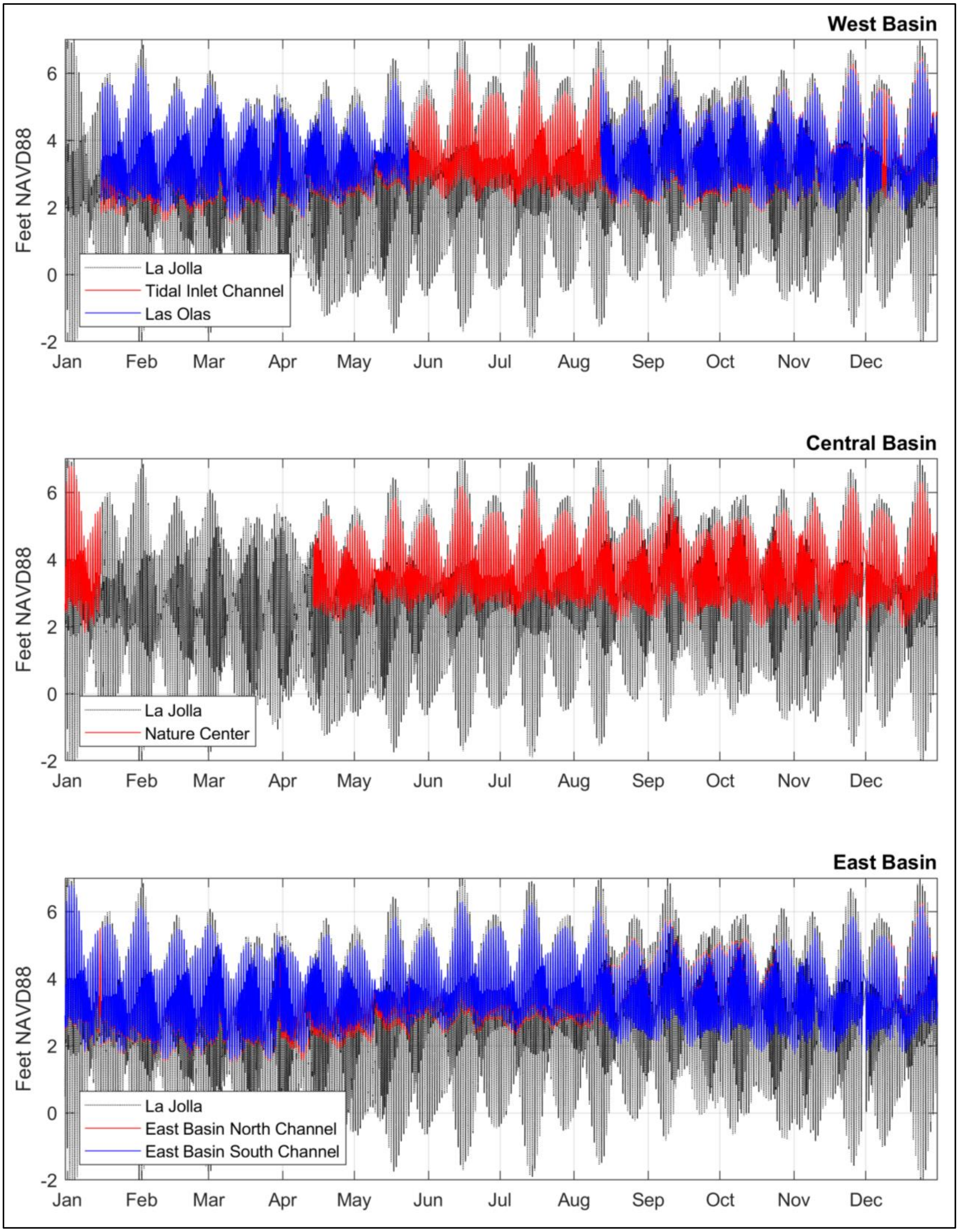


Figure 2-5: Water level measurements within SEL in 2022.

3. RESULTS

Water level and velocity measurements during 2022 revealed temporal variability and indications of the long-term effects of restoration construction on tidal amplitudes within the lagoon.

Post-construction measurements during 2020-2022 have shown that tidal conditions are similar throughout SEL (Figure 2-5). This indicates that the changes to the lagoon from the SELRP dramatically increased tidal exchange relative to pre-restoration conditions. During 2020, low tides were muted throughout the lagoon, while high tides showed little to no muting compared to open coast conditions (i.e., in comparison to the La Jolla gauge). In 2021, the measured tidal ranges for all the stations throughout the lagoon were similar to each other. However, the overall tidal range was smaller than the range during 2020 due to increased tidal muting, likely from sandbar shoaling. This trend continued in 2022 where tidal range was similar throughout the lagoon, but the overall range was smaller than what was observed in 2021.This may have been caused by changes closer to the inlet of the lagoon, such as increased shoaling at the railroad bridge discussed below.

Maximum depth-averaged tidal velocities measured in 2022 varied between the Tidal Inlet Channel and the Nature Center. As can be seen in Figure 3-1, maximum velocities at the Tidal Inlet Channel station were roughly 3 feet per second (ft/s) during spring tides and 1.5 ft/s during neap tides whereas maximum velocities at the Nature Center station were roughly 2 ft/s during spring tides and 1 ft/s during neap tides. Similar to 2021, depth-averaged velocities in 2022 at the Tidal Inlet Channel station were generally higher during ebb tides while depth-averaged velocities at the Nature Center were generally higher during flood tides (Figure 3-1). In addition to variability between each station, variability was also noted within each station. This variation was both temporal (from 2021 to 2022) and spatial (slightly different redeployment locations).

A brief summary of changes in tidal variability as a result of the increased shoaling in 2022 is provided below. These relatively rapid changes are placed in context with an examination of the ongoing effects of the restoration project on tidal water velocity and water level in following sections. The overarching conclusions from the project to-date are provided in Section 4.

3.1 2022 Shoaling at the Railroad Bridge

The June 2021 dredging event that took place along the channel leading to the mouth of SEL (seaward of the Tidal Inlet Channel monitoring station) substantially increased tidal water level variability throughout the lagoon. Following dredging completion and the removal of sandbars, an increase in tidal variability (higher high tide elevations and lower low tide elevations) and increases in along-channel tidal velocity was observed across all basins. This suggests that dredging was an effective method to increase the efficiency of tidal transport into and out of the lagoon.

Increasing the tidal range and water velocities entering and exiting the lagoon also increased the transfer of suspended sediment between the lagoon and the coastal environment. Previously, sedimentation occurred along the inlet channel just south of the lagoon mouth. Due to increased flood (incoming) tidal velocities through this area from dredging, in 2022 the sedimentation shifted further upstream where the inlet channel takes a sharp turn eastward under the railroad bridge. This resulted in the formation of a large shoal on the eastern side of the railroad bridge that constricted tidal transfer from the West Basin to the Central and East Basins of the lagoon. In May 2022, Coastal Frontiers Corporation conducted an extensive bathymetric survey of the shoal, shown in Figure 3-2. It should be noted that the survey from this effort may not reflect the current conditions of the shoal as the bathymetry in this area is highly dynamic. This was demonstrated by the wide variability of accretion and erosion observed in this zone throughout 2022.

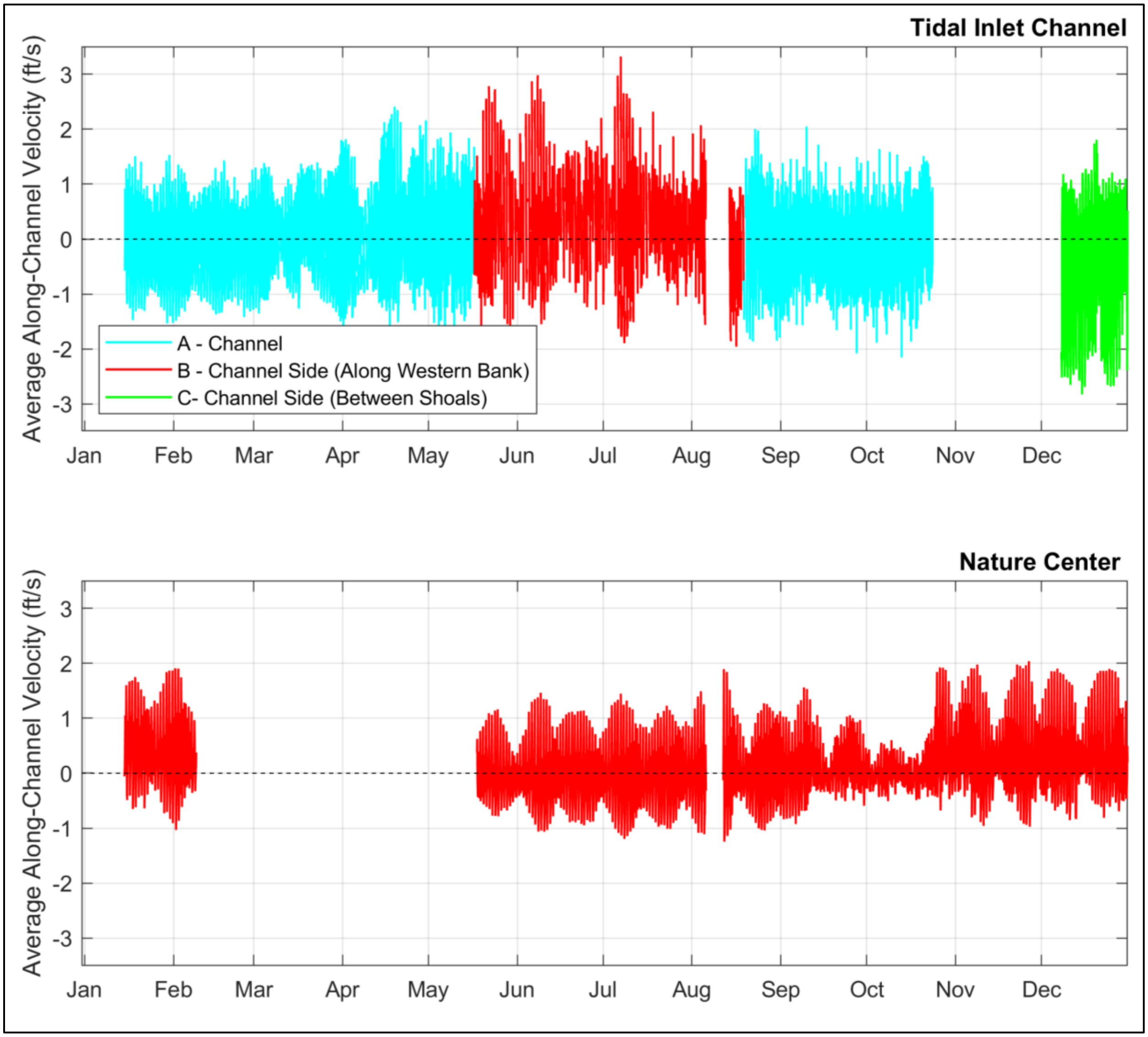


Figure 3-1: Water velocity measurements within SEL during 2022; positive values are landward (into the lagoon) and negative values are seaward (out of the lagoon).

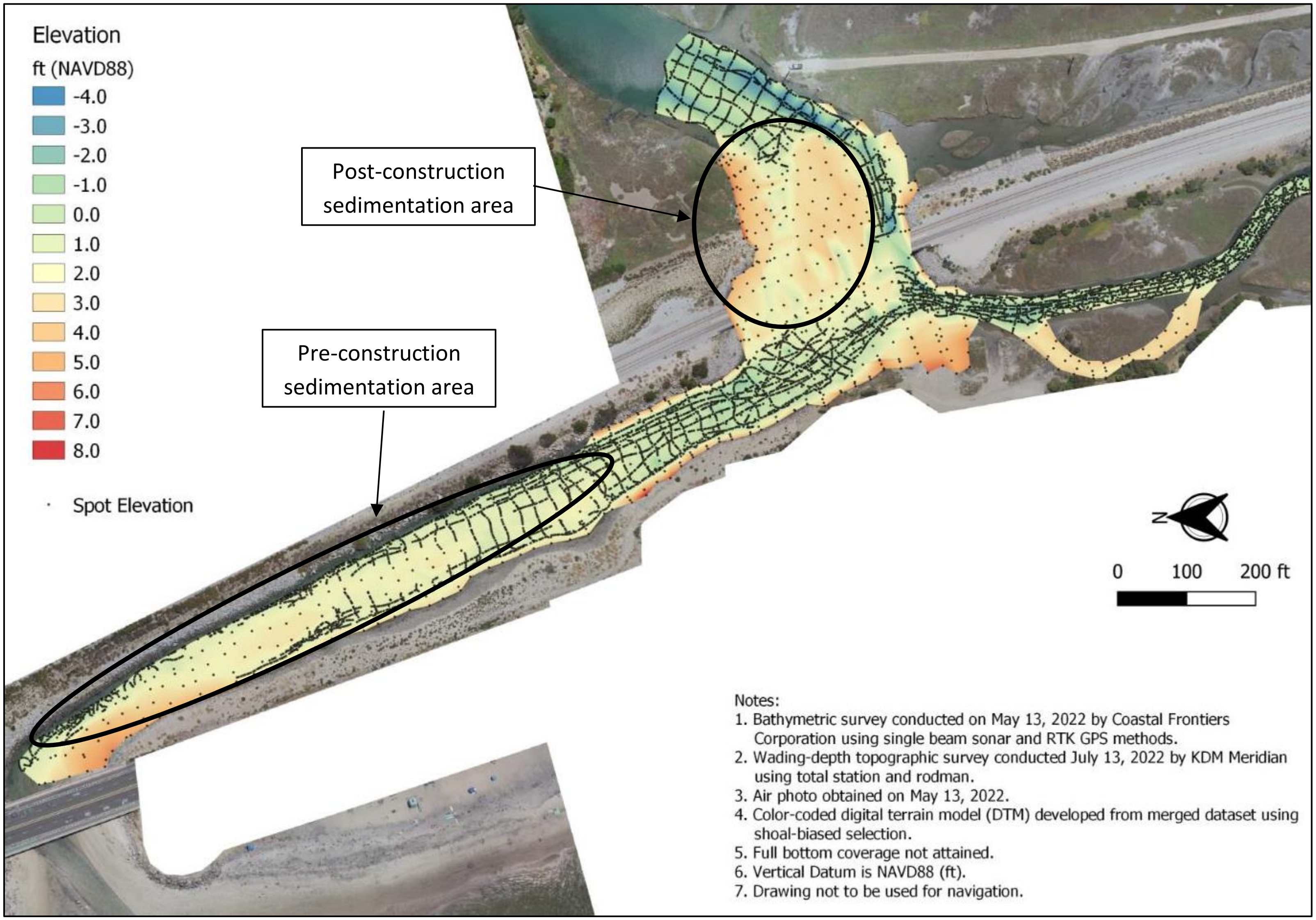


Figure 3-2: Combined May 2022 bathymetric and July 2022 topographic surveys of the tidal inlet channel and railroad bridge shoal areas.

3.1.1 Existing Conditions of Tidal Hydrology Due to Shoaling

Tide data were analyzed statistically to quantify changes in low tide elevations over time and any changes to the tidal inundation frequency for low marsh. This was done to ascertain if there may be any significant impacts to habitat and water quality due to tidal muting.

(1) Changes to Tidal Inundation Frequency

Tidal inundation frequency (TIF) is an indicator of the time period that a site is under seawater. Habitat forms at elevations with percentages of time inundated. Low marsh (cordgrass) establishes at elevations where the TIF is between 20% and 40% of the time. The design elevation range within the lagoon that corresponds to this TIF was between 3.4 ft and 4.1 ft NAVD88. Cordgrass colonized these elevations prior to restoration and occurred slightly higher than 4.1 ft in many areas (e.g., up to 4.5 ft in certain patches within the Central Basin as determined through habitat and topographic mapping).

Figure 3-3: Tidal inundation frequency range for low marsh over time post-restoration in the SEL Central Basin. shows the range of elevations within the suitable TIF condition for cordgrass. It has varied over time since restoration but straddled the target elevation of 4.1 ft NAVD88. There is no sign of it changing significantly over time. Further monitoring will continue, and resultant data will be evaluated to discern any trends in habitat elevation shifts in the future.

More comprehensive TIF data are presented in the following section of this report.

(2) Changes in Low Tide Elevations

The tidal record shows that muting of the low tide has occurred over time, has been variable, and is dependent on shoaling and maintenance dredging. Figure 3-4: Low tide elevation over time post-restoration in the SEL Central Basin. shows that since restoration was completed in June of 2020 that the average low tide at the Nature Center in the Central Basin has varied from roughly 1.6 ft to 3.1 ft NAVD88. It reflects a pattern of initially being on the low end of the range, and then progressively rising to the higher end until maintenance dredging occurred (in mid-2020 and mid-2021). From there, it markedly dropped in elevation again before being followed by another trend of rising elevations towards present day. The low tide elevation remained relatively stable in 2022 and then rose toward the end of the year. This may be an artifact of the sandbar, but it may also be a result of the effects of wet weather and associated pulses of increased freshwater input into the lagoon. Storm flow runoff events through the lagoon recorded by the gauge may have slightly biased the water level record to show a slightly higher average low tide elevation. The sandbar upstream of the railroad bridge had been in place for most of 2022 and had not significantly grown in elevation or footprint throughout the year, so the most recent data may also reflect higher lagoon water surface elevation levels from runoff.

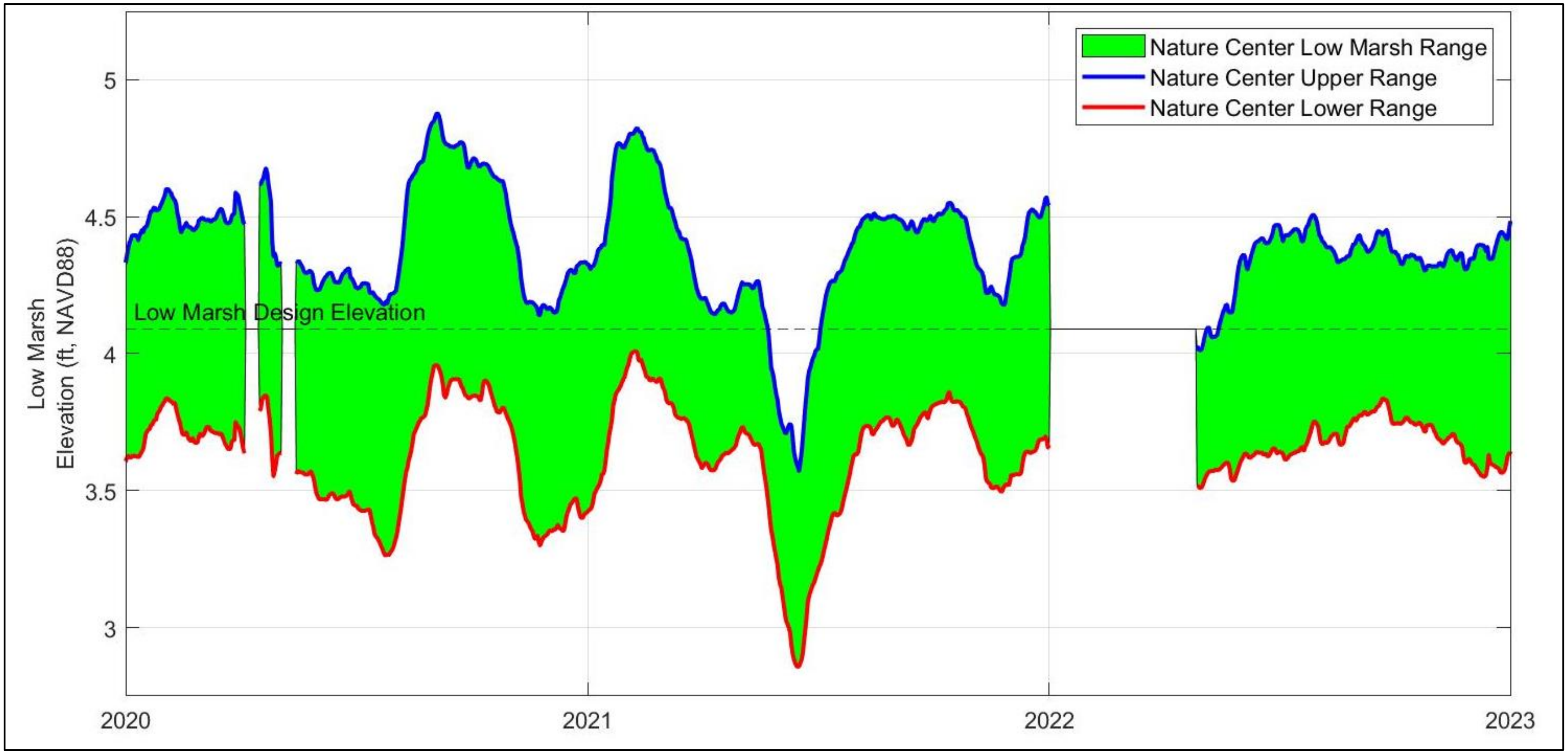


Figure 3-3: Tidal inundation frequency range for low marsh over time post-restoration in the SEL Central Basin.

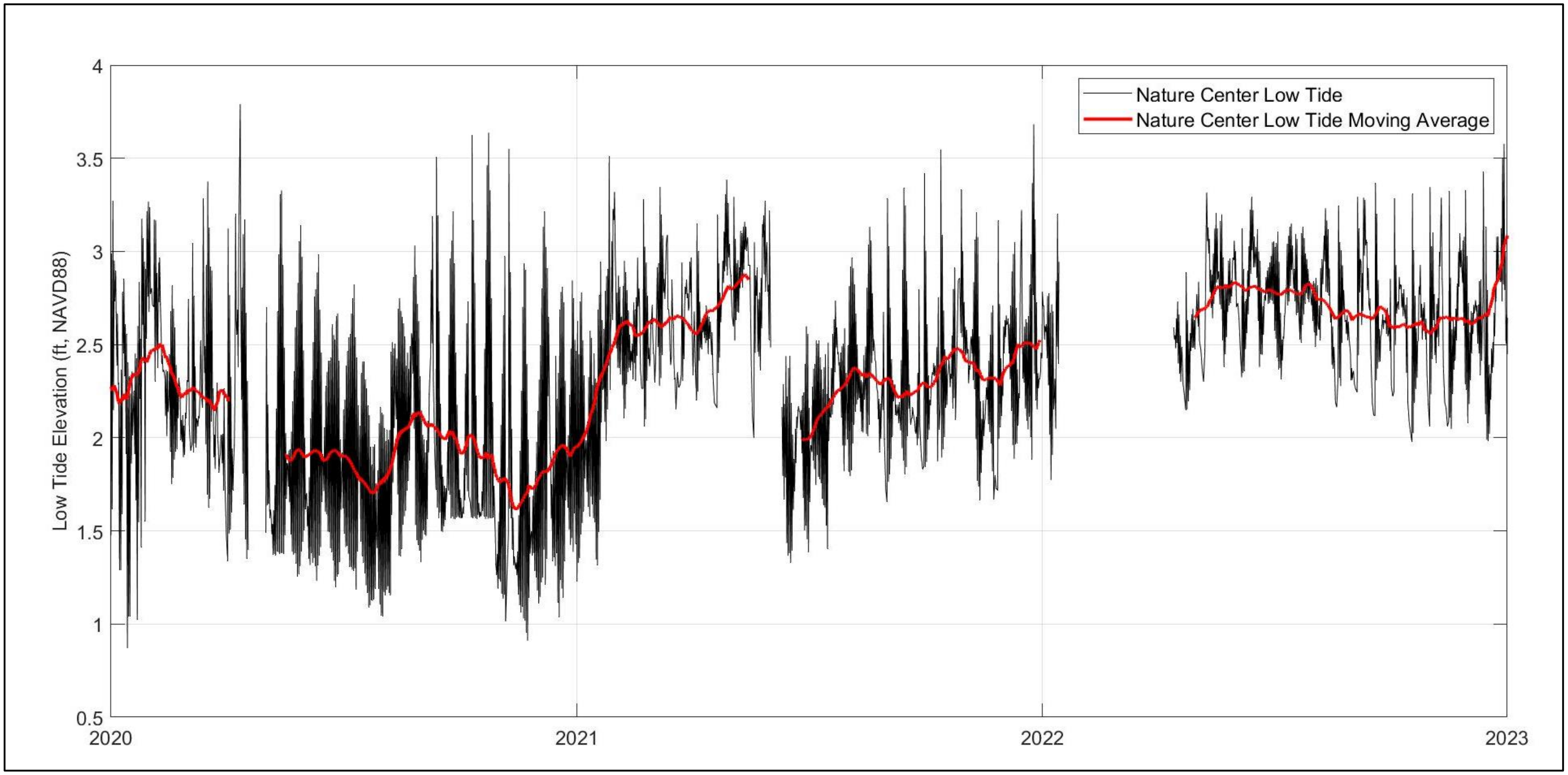


Figure 3-4: Low tide elevation over time post-restoration in the SEL Central Basin.

3.2 Water Velocity Variability Due to SELRP Construction

The Aquadopp utilized at the Tidal Inlet Channel was repositioned within the same general vicinity three times in 2022 as shown in Figure 3-5. "Channel" refers to the relative location of the Aquadopp when it was situated in the approximate center of the channel feature at this monitoring site. "Channel Side" refers to the location of the Aquadopp when it was moved further west towards the seaward bank of the channel, closer to the tide gauge fence post. Figure 3-5 provides the average along-channel velocity measurements throughout the year and specifies the different time periods that correspond with each Aquadopp location. A detailed explanation of Aquadopp relocations is provided in the following paragraphs.

Figure 3-5: Map of 2022 Aquadopp deployment locations at the Tidal Inlet Channel.

A potential influence on conditions monitored and recorded in 2022 were the dredging activities in 2021 that affected tidal velocities recorded at the Tidal Inlet Channel station location. Maximum depth-averaged tidal velocities were roughly 1.5 ft/s during spring tides and 0.5 ft/s during neap tides, with velocities before dredging activities being significantly less. A second dredging event occurred in the Central Basin underneath the I-5 bridge from December 2021 through April 2022. Most instruments downstream of the dredging event, including both Aquadopps, were removed from the water for a portion of the event when dredged material was pumped through a large discharge pipeline from the wetlands onto the adjacent Cardiff State Beach. Instruments were redeployed in mid-January 2022 upon the removal of the pipeline as transportation of material to the beach shifted to truck haul methods. At the Tidal Inlet Channel station, the Aquadopp was redeployed roughly in the center of the channel after these events concluded (see area “A" in Figure 3-5).

Ebb and flood tide velocity magnitudes recorded at the Tidal Inlet Channel station in early 2022 were roughly equal ranging from 1.5-2 ft/s (Figure 3-1), which is slightly higher than tidal velocities recorded in 2021. The increased values of flood tide velocities may be attributed to the more centralized placement of the instrument within the channel at this monitoring site. Beginning in May 2022, the Aquadopp at the Tidal Inlet Channel was moved into a shallower portion of the channel closer to the western bank (Point B in Figure 3-5) to avoid periodic burial by sand. Data availability was slightly more limited as a higher percentage of raw data needed to be filtered out during post-processing (less water above the instrument implied a greater number of measurements were affected by this limitation and needed to be removed from the dataset). When the instrument was in this location, more extreme tidal velocity measurements were recorded. Maximum tidal velocity measurements increased to 3 ft/s during flood tides and 2 ft/s during ebb tides. This increase is most likely due to tidal flow being redirected and bottlenecked to a smaller subsection of the western bank from the localized shoaling and channel reconfiguration nearby via natural processes. Similar to 2021, in 2022 depth-averaged velocities at the Tidal Inlet Channel station were generally higher during ebb tides while depth-averaged velocities at the Nature Center station were generally higher during flood tides (Figure 3-1).

In August, the Aquadopp at the Tidal Inlet Channel was moved back into the center of the channel. Subsequent data collected by the instrument showed that the measured velocities decreased and mirrored the values that were observed in early 2022. This provides further indication that the velocity measurement variability recorded at this site is likely due to the instrument’s position in the channel. In late December of 2022, the instrument was moved further downstream adjacent to the western bank (Point C in Figure 3-5) into a deeper portion of the channel. This was done to avoid burial by sand accretion in the channel center from shoaling while also providing sufficient water depth for more complete measurement datasets. Maximum tidal velocities at this position location were 1.5 ft/s for flood tide and 3 ft/s for ebb tide. Similar to 2021, maximum ebb velocity values were roughly double that of flood velocities. However, both ebb and flood velocity magnitudes recorded in 2022 were double that of what was observed in 2021 at the Tidal Inlet Channel. This amplification of the data is likely a result of the increased shoaling that prevailed throughout 2022. During outgoing tides, water is forced into a narrower portion of the channel (with reduced cross-sectional area) and therefore the tidal flow velocity increases when passing through this constriction. The Aquadopp was placed in an area where this phenomenon could be measured and observed in the dataset. Flood tides are expected to be less variable as they are less affected by shoaling. This is because incoming tides raise the water level and increase the cross-sectional area of the channel, thus reducing the hydraulic restriction.

At the Nature Center station, depth-averaged tidal velocities are higher during flooding tides rather than ebbing tides, which is reversed from the expected pattern typical of tidal lagoons. There may be multiple reasons for this condition, but it is not critically important relative to determining restoration success. Both flood and ebb tidal velocities remained relatively constant throughout the year. The decrease in velocity readings from mid-September to mid-October is attributed to an instrumentation error in which the Aquadopp inaccurately measured velocity direction. A cross sectional graphic displaying typical water velocity profiles measured by the ADCPs in SEL during 2022 is provided in Figure 3-6.

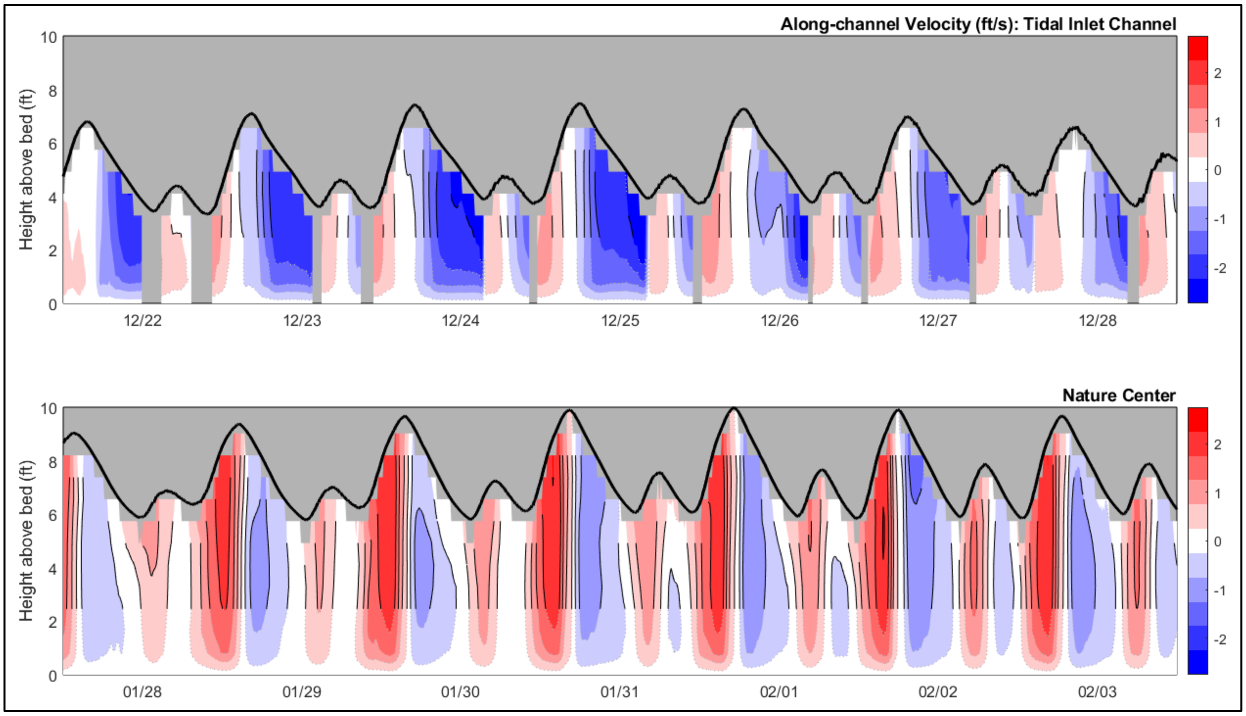


Figure 3-6: Vignette of select 1-week periods of channel velocities at the Tidal Inlet Channel and Nature Center stations in 2022.

3.3 Water Level Variability Due to SELRP Construction

One of the goals of the SELRP was to increase tidal exchange between the lagoon and the ocean as observed through changes in tidal amplitude and range. To document changes associated with the construction of the SELRP, water level measurements during the 2022 deployment were compared with those from 2017-2021. A 30-day period within each yearly deployment when all stations have continuous and undisturbed water level records were used for comparisons. These were selected to include the 28 days of a full range of spring and neap tides. Consequently, these periods are referred to as “tidal months.” Each of these representative tidal months were selected to have similar spring and neap tide ranges for comparison. Measurements in 2017 represent pre-construction water level variability, those during 2018 and 2019 represent water level variability during construction, and those during 2020, 2021, and 2022 represent post-construction water level variability.

It should be noted that some of the differences between tidal months (from year to year at the same location) are related to lunar orbital dynamics that inherently fluctuate on annual and/or longer time scales and *not* to any of the basin modifications to SEL from the SELRP. Figure 3-7 illustrates this natural tidal variability by comparing recorded water levels at La Jolla during each of the tidal months used for year-to-year comparisons of the monitoring locations. Overall, tidal water levels on the open coast are highest in 2022 and are lowest during 2018. During the spring tides in late July 2017 and mid-September 2022, water levels at high tide reached roughly 7.0 ft NAVD88. As a comparison, maximum high tide water levels during 2018 reached roughly 6.0 ft NAVD88 and those in 2019-2021 reached roughly 6.5 ft NAVD88. Tidal datums at each monitoring station for each tidal month are provided in Appendix A. Water Level Data.

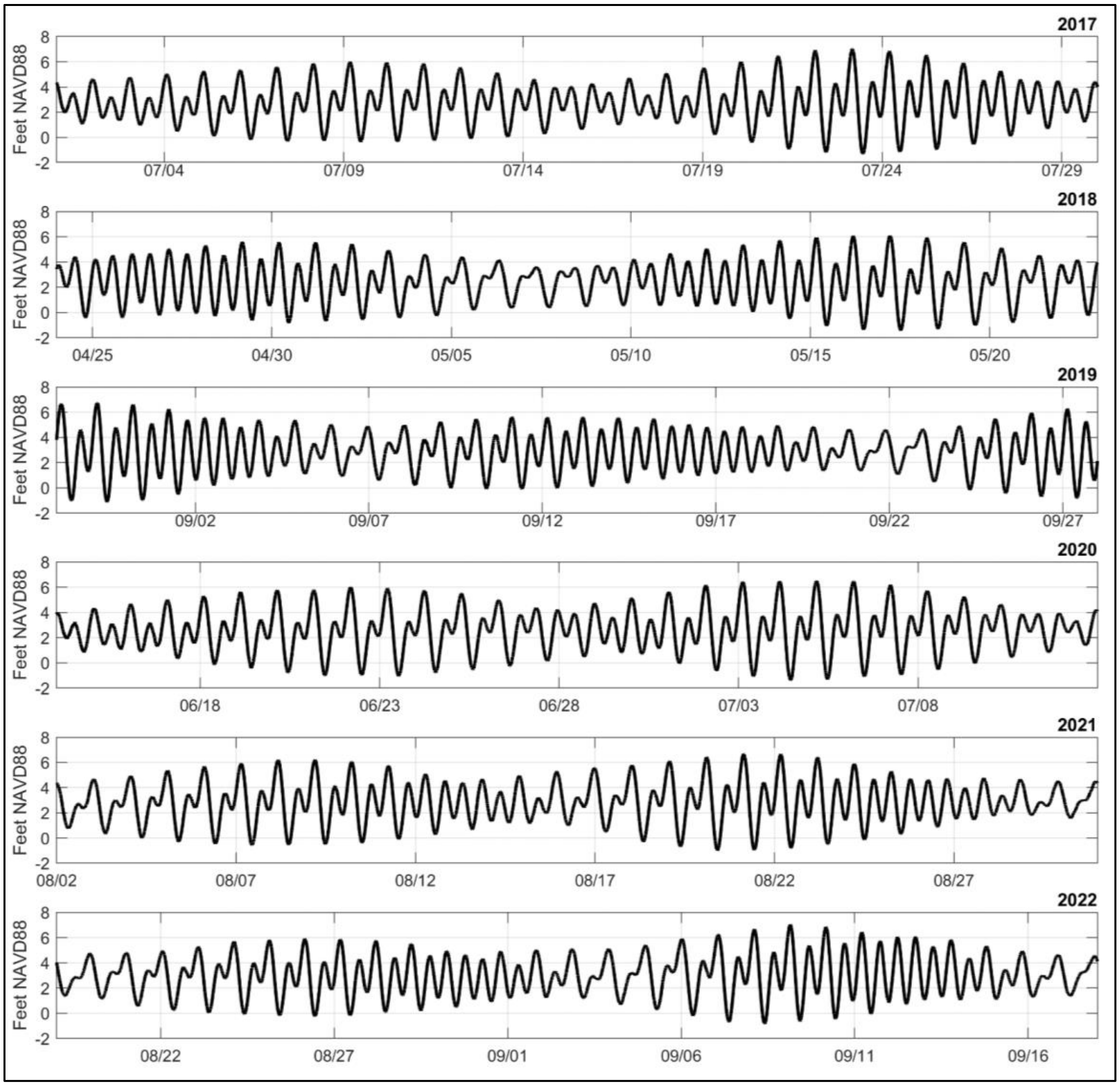


Figure 3-7: Measured water levels at La Jolla during selected 2017-2022 tidal months.

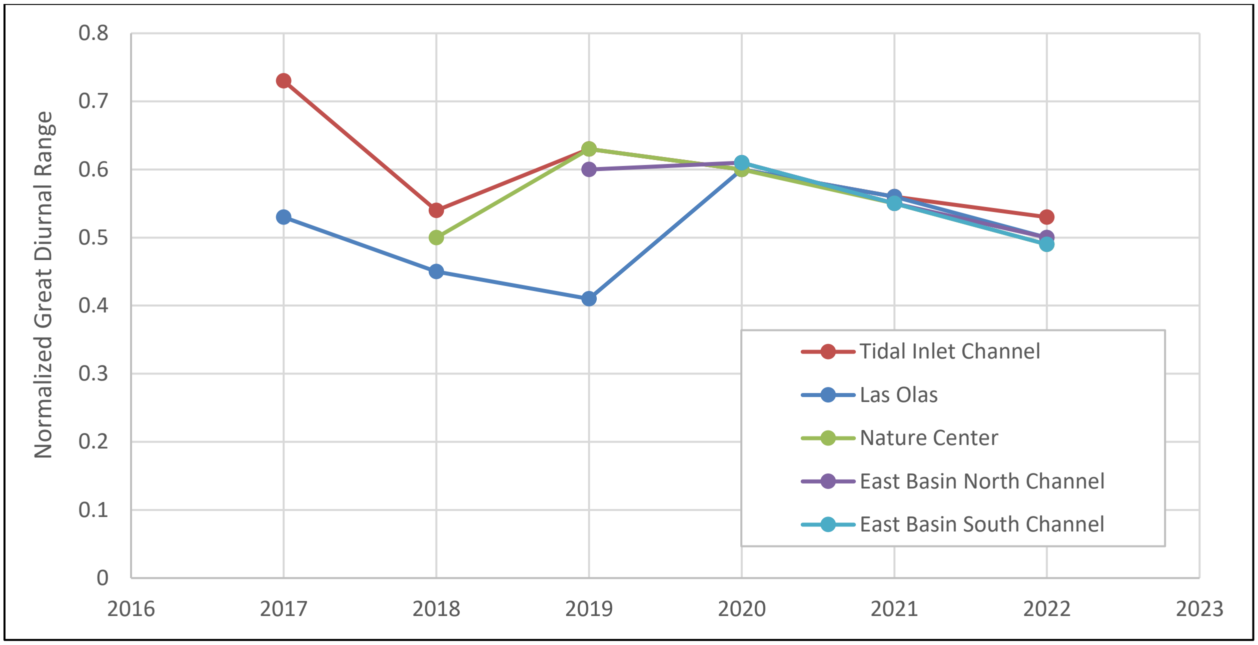
To examine changes in SEL tidal water levels from 2017-2022 that are due to construction activities, tidal ranges within SEL were normalized to the tidal range along the open coast (i.e., those experienced at the La Jolla tidal station). The normalized tide range for a given station is defined as follows:

$$\text{Normalized Tidal Range} = \frac{\text{Tidal Range at station}}{\text{Tidal Range at La Jolla}}$$

Therefore, the normalized tidal range in La Jolla always has a value of 1. Values for all stations are given in Table 3-1 and plotted in Figure 3-8. The “Great Diurnal Range” is estimated as the average difference between the daily higher-high and lower-low tides over the course of the selected tidal month. The “Spring Tide Range” is estimated as the difference between the highest high and lowest low tide of the selected tidal month. See Appendix A. Water Level Data for more information on these ranges.

Table 3-1: Normalized Great Diurnal and Spring Tide Ranges for 2017-2021 tidal months.

Station	Great Diurnal Range						Spring Tide Range					
	2017	2018	2019	2020	2021	2022	2017	2018	2019	2020	2021	2022
La Jolla	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Tidal Inlet Channel	0.73	0.54	0.63	0.60	0.56	0.53	0.54	0.45	0.61	0.64	0.51	0.44
Las Olas	0.53	0.45	0.41	0.60	0.56	0.50	0.49	0.41	0.36	0.65	0.51	0.43
Nature Center	-	0.50	0.63	0.60	0.55	0.49	-	0.42	0.60	0.64	0.50	0.40
East Basin North Channel	-	-	0.60	0.61	0.55	0.50	-	-	0.55	0.65	0.51	0.40
East Basin South Channel	-	-	-	0.61	0.55	0.49	-	-	-	0.65	0.51	0.40



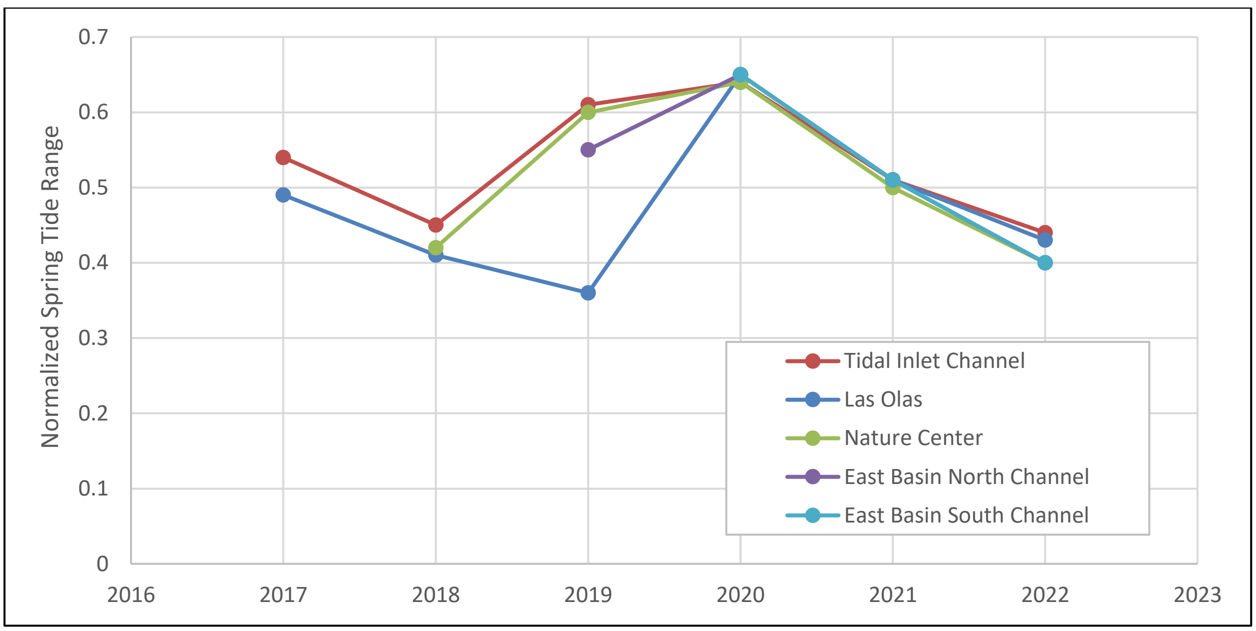


Figure 3-8: Normalized Great Diurnal (top) and Spring Tide (bottom) Ranges for all gauge locations from 2017-2022.

For all years prior to 2020, the tidal range decreased as one moves upstream away from the mouth of the SEL towards the East Basin (Table 3-1). This is expected as tidal ranges generally become increasingly smaller moving farther inland and away from the mouth of a given estuary. This is due to the effects of friction caused by flow over vegetation, distance, elevation gradients, and/or flow through constrictions. Construction activities during 2018 and 2019, such as channel dredging, served to increase the tidal ranges at stations farther upstream from the mouth. Widening and/or deepening channels throughout the lagoon decreased the constraint of water flowing in and out. As a result, tidal ranges throughout the lagoon were more similar to those at the mouth when the construction phase was completed in 2020. Since 2020, the normalized tidal ranges at all instrument locations have slightly decreased, with the locations further upstream generally decreasing the greatest. This may be due to the combined effects of friction and distance, plus sandbar growth creating channel constrictions near the inlet and railroad bridge within the lagoon as it approaches post-restoration equilibrium.

The overall decrease in tidal range in 2022 was most likely due to natural morphological changes at the mouth of the lagoon and because the shoals at the inlet channel were unable to be dredged. The further decrease in the normalized tidal ranges in the Central and East Basins can likely be attributed to the shoaling under the railroad bridge. The West Basin was less affected by this shoal because it is located downstream. However, the tidal ranges at all locations upstream of the railroad bridge appear to have been muted as a result of the increased sedimentation. The sediment built up at the bridge constricts tidal drainage at upstream gauge locations and decreases their overall tidal range.

3.3.1 Tidal Inlet Channel

Water level measurement data at the Tidal Inlet Channel contain more noise, or small and short oscillations in the water level records, than measurements at other monitoring stations in SEL. This typically indicates agitation of the water surface. The periods of noise at this station often coincide with periods of noise in the water level records at La Jolla and are consequently attributed to water surface agitation during high wind and/or wave events.

As depicted in Figure 3-9, lower tides at the Tidal Inlet Channel station during the 2017 tidal month were consistently at higher relative elevations than those at the La Jolla station, whereas higher tides at the Tidal Inlet were similar or slightly higher in elevation than those at La Jolla (see Appendix A. Water Level Data: Table A-1). This indicates muting of lower tides in the SEL inlet channel during pre-construction conditions. Similar muting of low tides is evident during all subsequent tidal months other than when the normalized tidal range dropped briefly during 2018 before rebounding back to pre-construction ranges. Starting in 2021, higher tides were observed to be slightly lower in amplitude than respective recordings at the La Jolla station, indicating an increase of higher tidal level muting. This trend continued into 2022. These fluctuations in tidal range and elevation exemplify the variable and complex effects of the restoration project construction on estuarine dynamics.

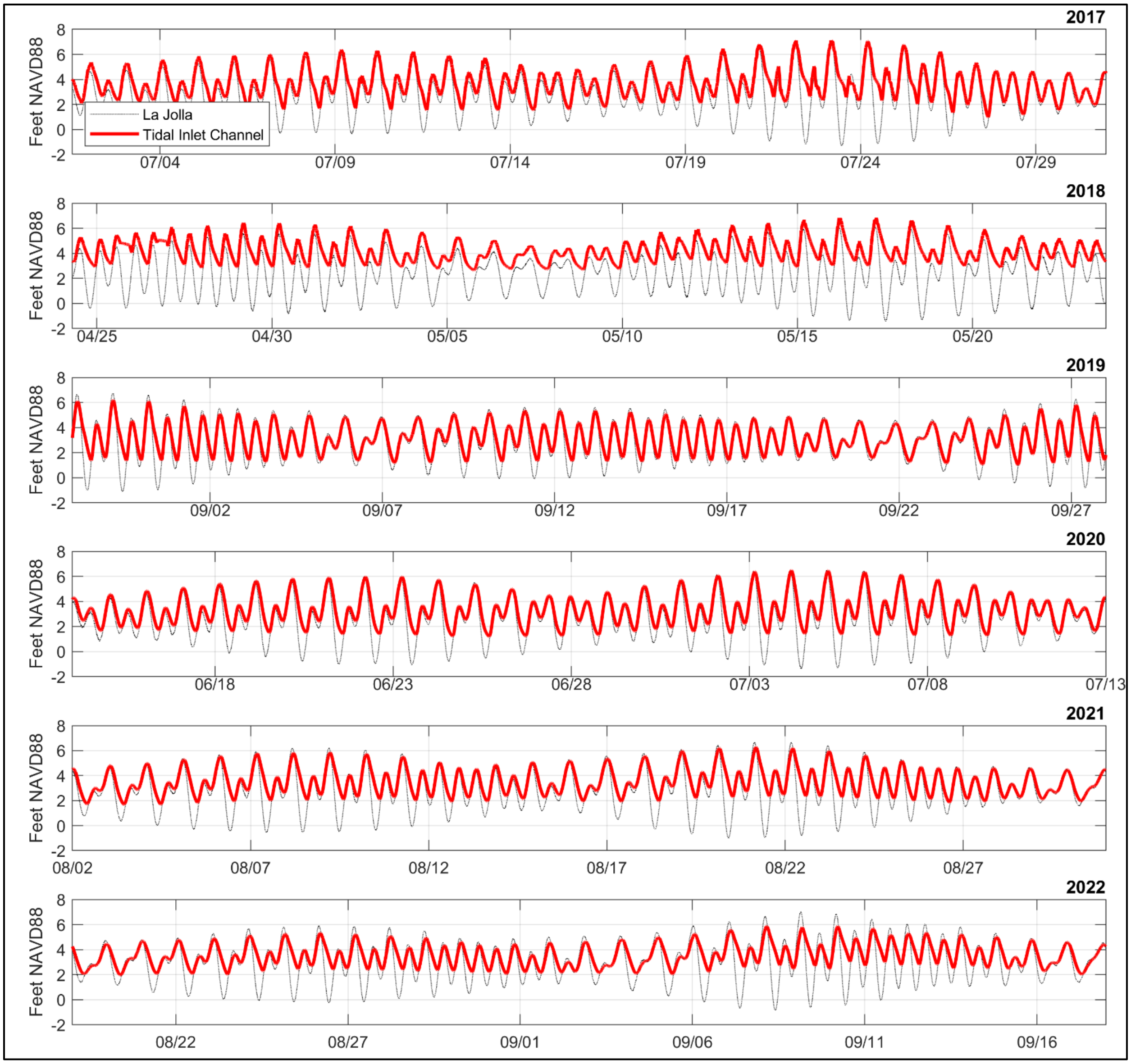


Figure 3-9: Measured water levels at the Tidal Inlet Channel station during selected 2017-2022 tidal months.

The tidal range at the Tidal Inlet Channel in 2018 was previously noted as being smaller than the tidal range at this monitoring station in 2017 (Moffatt & Nichol, 2021). Between 2017 and 2018, the normalized Great Diurnal Range decreased from 0.73 to 0.54, and the normalized Spring Tide Range decreased from 0.54 to 0.45. This can likely be attributed to dredging within the Central Basin of SEL and the temporary installation of Dikes 2A and 2B across the channel near the Nature Center and Pole Road, respectively. As a result, the dredging increased the wetted surface area of the lagoon while the volume of water entering and exiting the lagoon with tides (i.e., the tidal prism) remained constant.

The excavation of the inlet channel in the spring of 2019 served to increase the normalized tidal range at the Tidal Inlet Channel station during that year in comparison to 2018 (Table 3-1). This occurred as the larger cross-section from the excavation allowed more tidal exchange into and out of the lagoon. As a result, the tidal range at this station during neap tides from 2019-2020 was nearly equivalent to that of the open coast tidal range at La Jolla.

The normalized tidal range at the Tidal Inlet Channel slowly decreased from 2019 through 2021, though this trend was also observed further upstream at the Nature Center as well. The reduction in tidal ranges since 2020 was relatively consistent across all sampling stations. This suggests that the change in tidal ranges was likely due to changes in the lagoon mouth configuration associated with dredging events and/or larger interannual tidal variability. It should be noted that the channel has been dredged annually (except for 2022) to deepen the inlet channel and reduce constrictions to tidal flow. This may be one reason that the tidal range at the Tidal Inlet Channel continued to decrease in 2022, as the dredging activities were unable to be completed due to logistical constraints.

3.3.2 Las Olas

Measured water levels at the Las Olas monitoring station for 2017-2022 tidal months are shown in Figure 3-10. Tidal muting at this location during 2017 and 2018 was negligible at high tides but pronounced at low tides, similar to what was observed at the Tidal Inlet Channel. However, low tides at Las Olas were consistently *more* muted than low tides at the Tidal Inlet Channel (see Appendix A. Water Level Data: Table A-1 and Table A-2). Low tide muting was similar for 2019. The difference in low tide water level elevations can likely be attributed to the shallow bathymetry in the southern portion of the West Basin and the channel constriction associated with Dike 5 placed at the mouth of the channel. After the removal of Dike 5 in January 2020 from upstream of both the Las Olas and Tidal Inlet Channel station locations, the tidal range between these two stations became consistently similar. In 2022, due to the fact that the sedimentation under the railroad bridge was also upstream of both locations, tidal range values at these sites remained similar. This suggests that the restoration project was successful in increasing the tidal exchange within the West Basin. However, beginning in 2022 tidal muting increased upstream of the railroad bridge shoaling in the Central and Eastern basins.

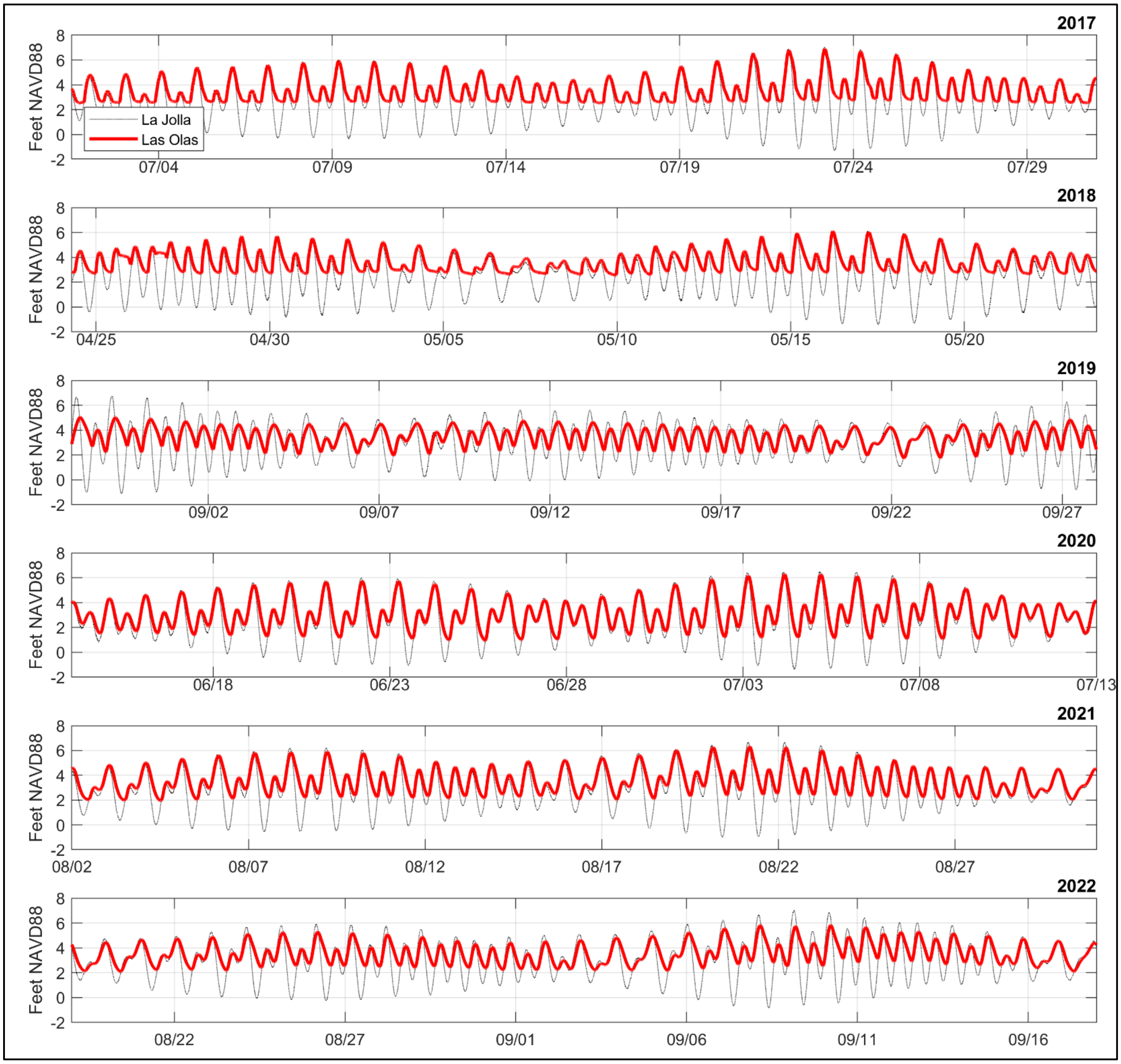


Figure 3-10: Measured water levels at the Las Olas station during selected 2017-2022 tidal months.

3.3.3 Nature Center

Water levels at the Nature Center station during 2018-2022 tidal months are shown in Figure 3-11. Low tides at the Nature Center are muted during all tidal months, similar to the Tidal Inlet Channel and Las Olas station locations. However, unlike these other two stations, high tides at the Nature Center station are also muted during 2018 and 2022. This muting is most pronounced during spring tides. As shown in Table 3-1, the Great Diurnal Range at the Nature Center station during 2018 was 50% (0.50) of the tidal range along the open coast, whereas the Spring Tide Range was 42% (0.42) of that along the open coast. The normalized tidal range increased to roughly 60% (0.60) in 2019 and has since slowly dropped to 49% (0.49) in 2022. For the selected tidal months from 2018-2021 the normalized tidal range at the Nature Center station was nearly identical to that at the Tidal Inlet Channel station location. In 2022 the tidal range at the Nature Center decreased to a value that was less than the range observed at the Tidal Inlet Channel.

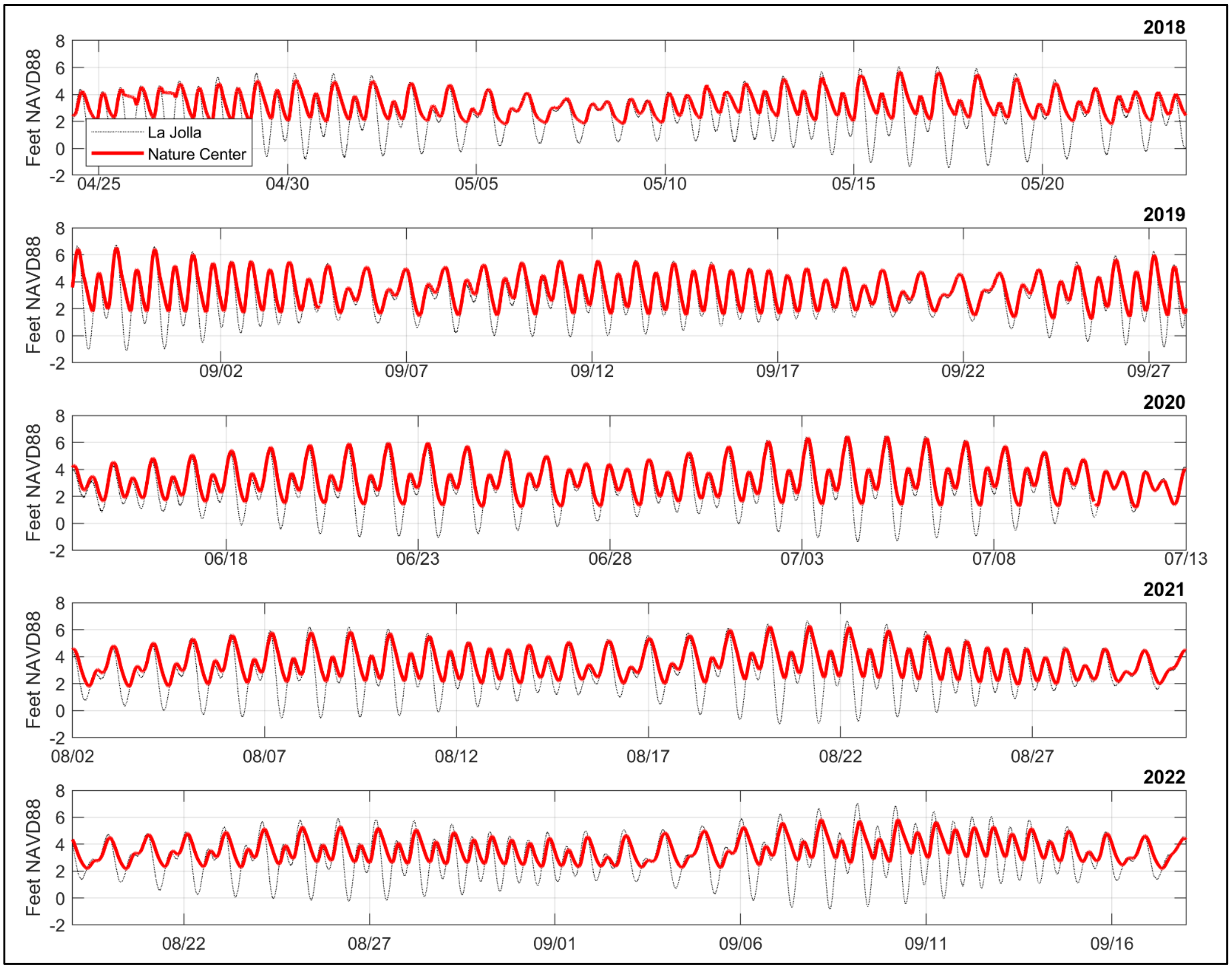


Figure 3-11: Measured water levels at the Nature Center station during selected 2018-2022 tidal months.

The change in the tidal characteristics at the Nature Center station from 2018-2019 may be attributed to the excavation of the channel between the railroad bridge and the Nature Center station location during these years. The larger cross-section at the site since 2018 may have resulted in less restricted water flow throughout the lagoon, making the tidal range at the Nature Center more similar to that at the mouth of the lagoon. The sedimentation occurring under the railroad bridge in 2022 caused the tidal flow to become more constricted upstream and therefore probably acted to decrease the tidal range at the Nature Center station location.

3.3.4 East Basin North Channel

Water levels at the East Basin North Channel station during 2019-2022 tidal months are shown in Figure 3-12. Low tides in the East Basin North Channel were muted during all tidal months in a similar fashion to all other downstream stations. High tides were also muted in the East Basin North Channel. The greatest degree of high tide muting was observed during 2022 when compared to previous years. This too can most likely be attributable to the shoaling under the railroad bridge during this year. As a result, the tidal ranges observed at the East Basin North Channel station in 2022 were similar to those measured at the Nature

Center station. There was also a slight high tide muting observed in 2019. This may be attributed to the presence of Dike 2A located upstream of the Nature Center station throughout 2019. The dike was removed in early February 2020.

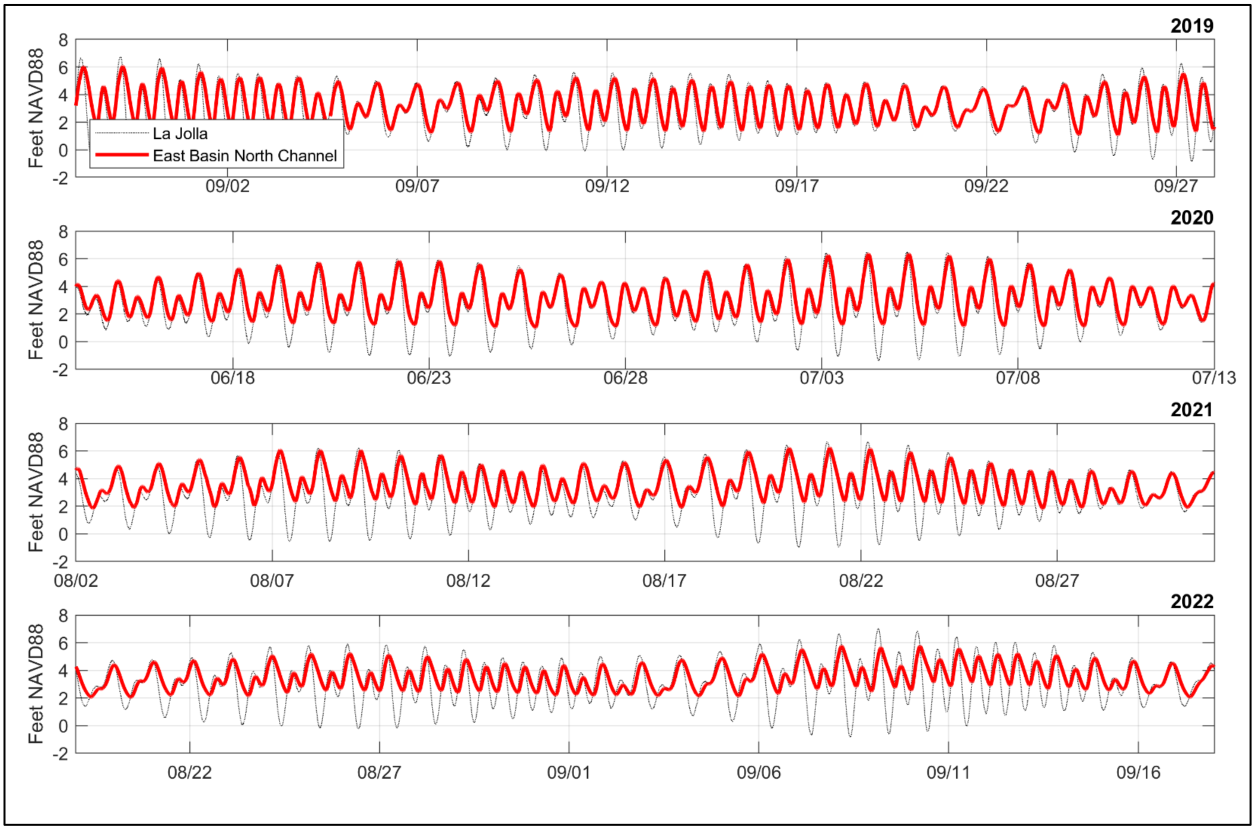


Figure 3-12: Measured water levels at the East Basin North Channel station during selected 2019-2022 tidal months.

3.3.5 East Basin South Channel

Water levels at the East Basin South Channel station during the 2020-2022 tidal months are shown in Figure 3-13 and are very similar to conditions recorded in the East Basin North Channel. Tidal variability in 2020-2021 at this station was similar to that observed at all other stations in the same timeframe; low tides were muted, while high tides were similar in elevation to high tides along the open coast measured at La Jolla. This was particularly the case during 2020 tidal observations. The tidal range showed a slight decrease from 2020 to 2021; however, this trend was consistent across all water level monitoring stations in SEL as well. There was a further decrease in the tidal range in 2022, where both high and low tidal muting was observed. This was consistent with the other Central and East Basin gauge locations (i.e., Nature Center & East Basin North Channel) and is likely due to both the lack of dredging that year and the continued shoaling under the railroad bridge.

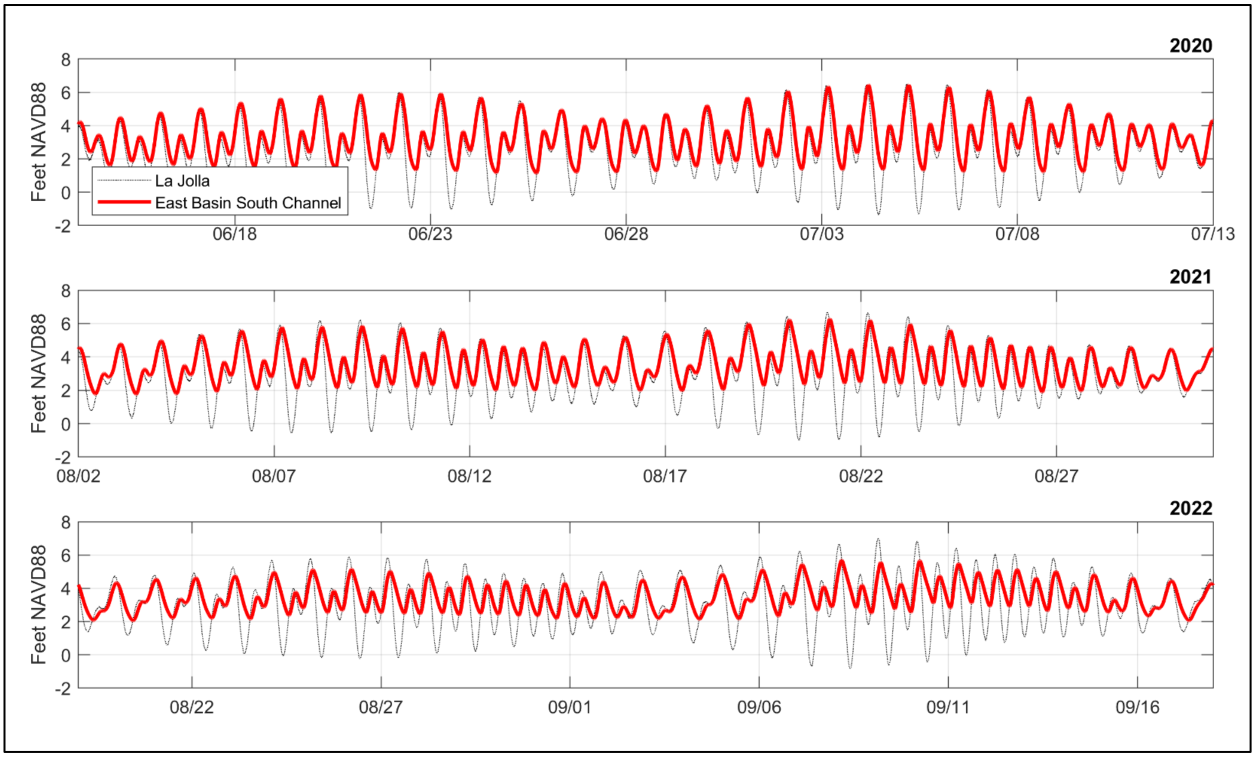


Figure 3-13: Measured water levels at the East Basin South Channel station during selected 2020-2022 tidal months.

3.4 Tidal Inundation Frequency (TIF)

The tidal inundation frequency analysis provides the frequency of inundation statistics over specific elevation thresholds at a given location. This analysis is an extremely beneficial tool for planning marsh restoration activities and habitat designs. The inundation frequency determines the elevations at which specific marsh habitats will be established and the area and distribution of specified wetland habitats within the watershed. Figure 3-14 presents the measured inundation frequencies from all tide gauge data in 2022. There are only slight variations between the inundation curves at each gauge location, but all show significant low tide muting when compared to the open coast NOAA tide gauge at La Jolla. There are four inundation percentage breaks, 0%, 4%, 20%, and 40%, which demarcate the habitat range limits for high marsh, mid-marsh, and low marsh, respectively. Measured and modeled tidal elevations can be used for target design elevations of these habitats when restoring a wetland area, such as within SEL. The slight rightward shift of the Nature Center data when compared to the remaining stations may be partially caused by the slightly increased water level elevations and other potential factors at the site.

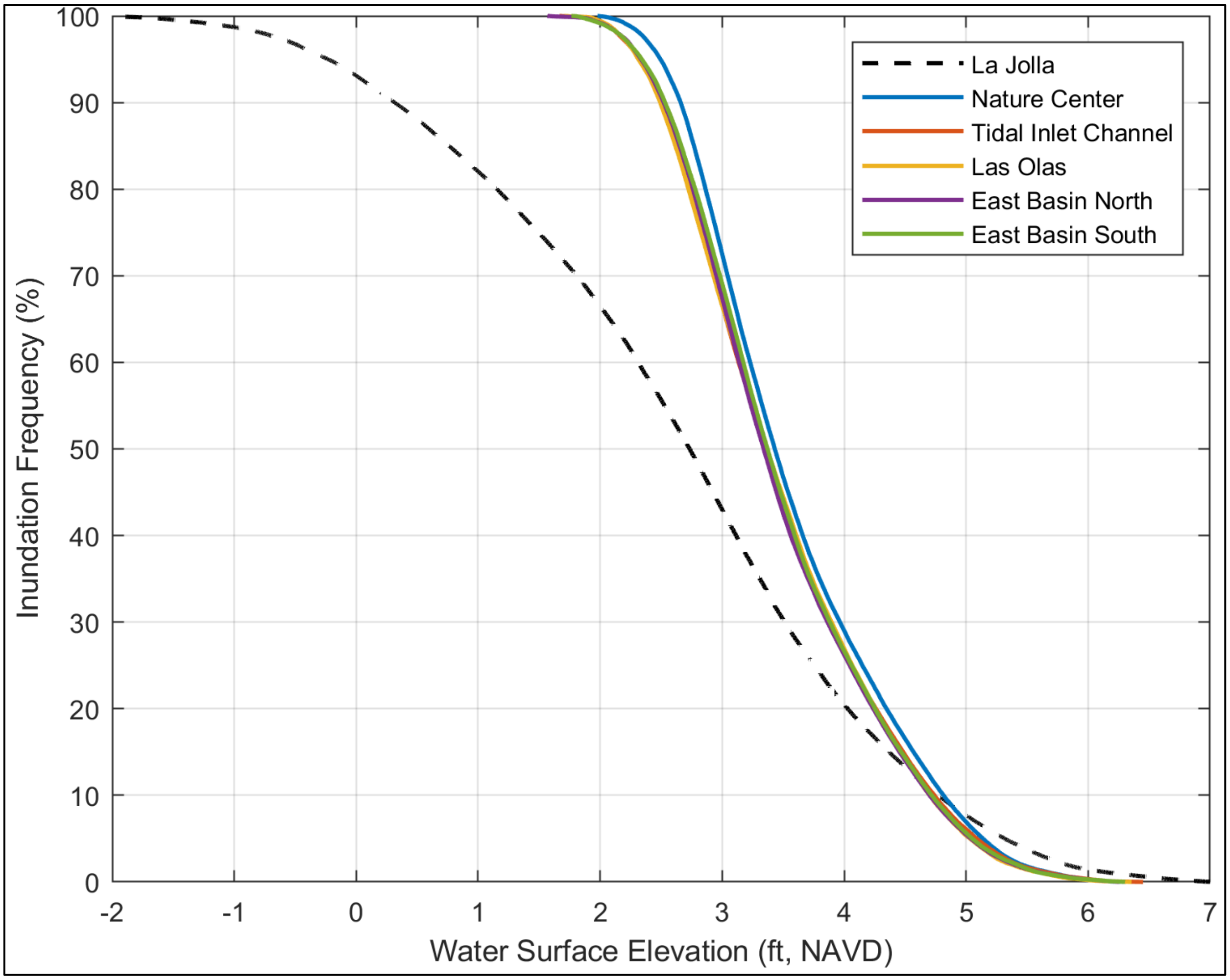


Figure 3-14: 2022 San Elijo Lagoon tidal inundation frequency curves.

Table 3-2 lists the habitat break elevations at each tide gauge location for 2022. The habitat break elevations are very similar to one another across all monitoring stations. Table 3-3 compares designed target elevations for SEL alongside habitat break elevations measured pre-construction (2017), in 2021, and in 2022 at the Nature Center station location. Based on tidal inundation frequency data, all habitat elevations in 2021 and almost all habitat elevations in 2022 were within design ranges targeted for salt marsh habitat. An exception in 2022 occurs for the subtidal habitat elevation in which all sites slightly exceeded the design target of 1.6 ft NAVD88. This is most likely due to an increase in tidal muting from 2021 to 2022, probably as a result of the shoaling in the vicinity of the railroad bridge. However, even with increased muting, habitat elevation ranges for mudflat, low marsh, mid marsh, high marsh, transitional and supra-tidal zones all fell within their respective design target elevations.

Table 3-2: 2022 Habitat elevation breaks in SEL.

Habitat Type	Freq. (%)	Habitat Breaks (WL, ft, NAVD88)				
		Nature Center	Tidal Inlet Channel	Las Olas	East Basin North	East Basin South
Mudflat	100%	1.98	1.67	1.71	1.57	1.76
Low Marsh	40%	3.66	3.58	3.61	3.56	3.60
Mid Marsh	20%	4.35	4.26	4.25	4.24	4.25
High Marsh	4%	5.22	5.18	5.12	5.13	5.14
Transitional	0%	6.31	6.45	6.36	6.25	6.30

Table 3-3: Habitat elevation ranges at the Nature Center pre-construction, in 2021, and in 2022 compared with designed target elevations of the SELRP (ft, NAVD88).

	Pre-Construction Measured Conditions	2021 Conditions	2022 Conditions	*Designed Target Elevations*
Subtidal	2.11	Below 1.23	Below 1.98	*Below 1.60*
Mudflat	2.11 to 3.40	1.23 to 3.62	1.98 to 3.66	*2.44*
Low Marsh	3.40 to 4.10	3.62 to 4.37	3.66 to 4.35	*3.73 (raised to 4.09 for contingency)*
Mid & High Marsh	4.10 to 5.80	4.37 to 6.75	4.35 to 6.31	*5.31*
Transitional	5.80 and 7.80	6.75 to 8.75	6.31 to 8.31	*Between 5.81 and 7.81*
Supratidal	Above 7.80	Above 8.75	Above 8.31	*Above 6.30*

Figure 3-15 shows the habitat elevations breaks over time for all tide gauge locations for the entire dataset. These values are calculated using the same methodology used for the TIF curve shown in Figure 3-14 except the time window used to calculate the habitat breaks is one tidal month instead of the entire year. This ensures that spring and neap tide characteristics are captured within the habitat break values, but they may not necessarily reflect interannual variability in tidal cycles. It should also be noted that a continuous month-long period of data is required for this calculation so when that is not available for a given gauge location no habitat elevation values are calculated. Since data prior to 2020 is somewhat sparse, much of the habitat elevations were unable to be calculated for that timeframe. Figure 3-15 gives a broad overview of how habitat elevations have changed in comparison to the target design elevations since lagoon restoration. It can be seen that all habitat elevations have remained relatively constant from 2020-2022 and each is equal to or below the target design elevation. Subtidal habitat is the only elevation break that has consistently increased since restoration but is still not above the target elevation. Subtidal is the habitat area which has an inundation frequency of 100%, meaning that it is always lower than the water surface level. Therefore, the increase in mudflat habitat elevation may be directly related to low tide muting within the lagoon.

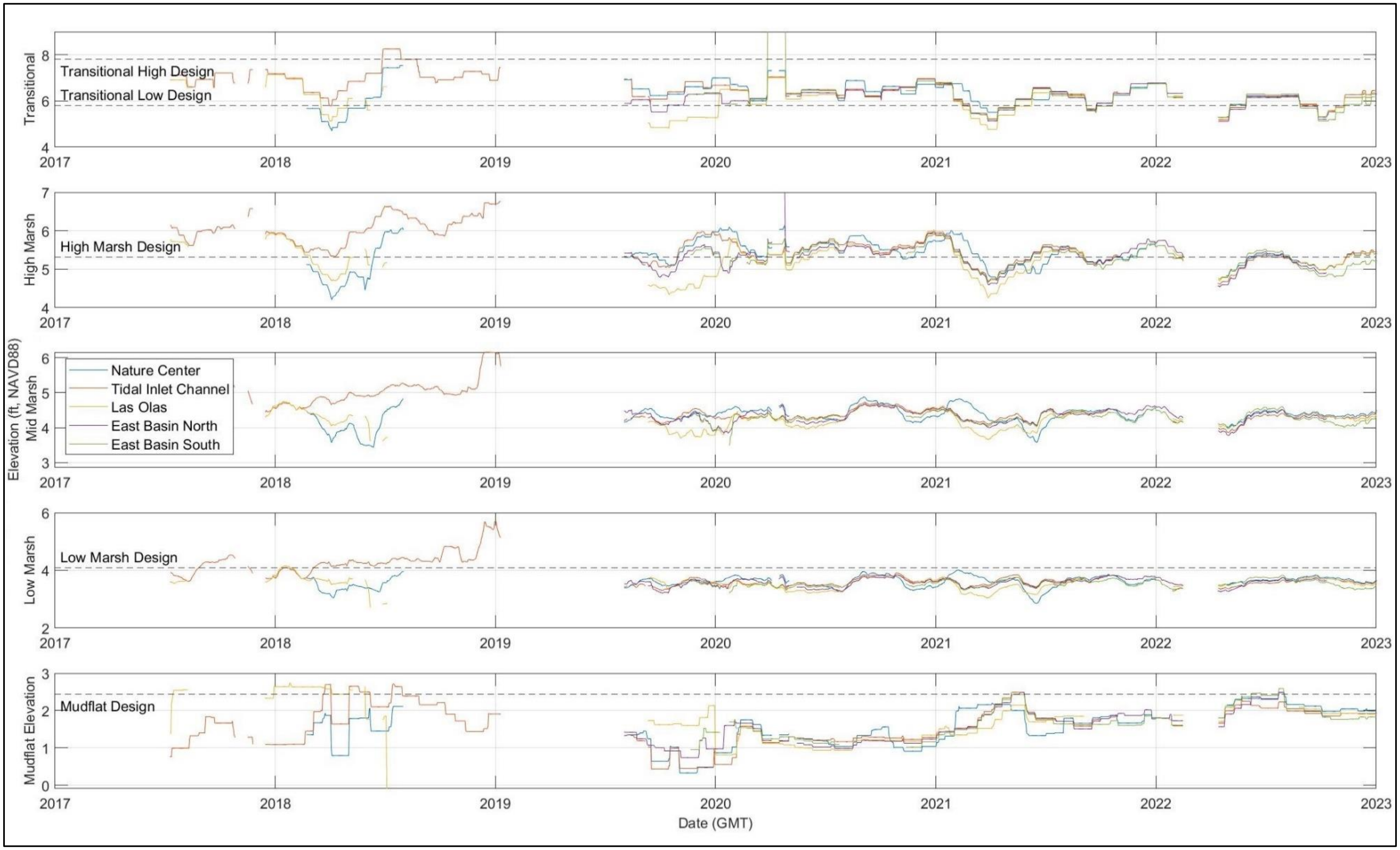


Figure 3-15: San Elijo Lagoon habitat elevation breaks over time for all tide gauge station locations.

4. SUMMARY/NEXT STEPS

This report documents methods and results of the tidal water level monitoring campaign conducted in San Elijo Lagoon during 2022 in support of the San Elijo Lagoon Restoration Project. Main findings from the campaign are summarized below.

1. Similar to 2020, effects of construction are no longer present in the tidal series and tidal ranges have returned to an ambient post-restoration condition. Tidal ranges showed a slight overall decline from 2021 values, likely due to natural interannual variability, lack of dredging in 2022, and shoaling at the railroad bridge near the Tidal Inlet Channel station.
2. Tidal ranges are nearly constant throughout the lagoon, suggesting that the depth and width of the mouth of the lagoon are controlling tidal characteristics within the lagoon.
3. Similar tidal ranges on the eastern and western sides of I-5 construction continue to indicate that the effects of the construction on tidal propagation were positive in providing a high-functioning hydraulic connection.
4. Tides successfully reach the upstream ends of the lagoon in the East Basin with amplitudes similar to downstream locations, and the timing shows very little lag. Tidal hydraulics appear to be efficient throughout the lagoon. There was a slight increase in phase lag between the West Basin and the Central and East Basins, likely as a result of shoaling underneath the railroad bridge. However, this increase was small when compared to that of preconstruction values.
5. June 2021 dredging operations to widen and deepen areas near the mouth of SEL led to increases in the tidal range throughout SEL once completed. However, since that event tidal muting of both low and high tides has slowly increased. This trend was observed at all tide gauge stations in 2022.
6. Data gaps in the West and Central Basins that were observed in early January were due to removal of instruments during dredging activities. Other data gaps in the Central Basin in February to mid-May and in the West Basin in October to December were the result of environmental and/or anthropogenic influences on the instrumentation that required removal for maintenance. Lastly, the small data gap in water velocity observed in August and the data gaps at Las Olas from mid-May to August and East Basin North Channel from October to December were the result of instrument malfunction.
7. Based on tidal inundation frequency data, habitat elevations in 2022 were similar to what was designed and expected and within the ranges specified in permits and engineering plans and specifications. Therefore, the various habitat types are expected to occur within the lagoon at locations predicted in the pre-restoration documents.
8. Continued monitoring of water levels throughout the lagoon is necessary to document local changes in tidal amplitudes and ranges in the post-construction phase of the SELRP.
9. Continued monitoring of the effects of shoaling underneath the railroad bridge should take place until dredging can occur to minimize any negative effects on the wetland ecosystem and/or hydraulic function.
10. To minimize interruptions in the water level records associated with instrumentation, inspection of the tide gauges should continue to be conducted approximately every two months. These inspections should include, but are not limited to, the following activities (as appropriate and feasible): replacing batteries, downloading data, removing biofouling from and cleaning instrumentation, ensuring a stable mounting system, checking the calibration status, clearing kelp and debris that may have collected on the mooring, and surveying the water level after redeploying the instrument.

5. REFERENCES

Moffatt & Nichol. (2018). *San Elijo Lagoon Restoration Project. 2017 Tidal Monitoring Report prepared for the San Elijo Lagoon Conservancy.* Long Beach, CA: Moffatt & Nichol.

Moffatt & Nichol. (2021). *San Elijo Lagoon Restoration Project. 2020 Tidal Monitoring Report prepared for the San Elijo Lagoon Conservancy.* Long Beach, CA: Moffatt & Nichol.

NOAA. (2019). *La Jolla, CA - Station ID: 9410230*. Retrieved from Tides & Currents: https://tidesandcurrents.noaa.gov/stationhome.html?id=9410230

APPENDIX A. WATER LEVEL DATA

Water level data over the entire monitoring period are provided herein. Descriptions of each data table are below.

- Following previous water level reports (e.g., Moffatt & Nichol, 2018), water level records from July 1 through 30, 2017, were selected to represent baseline (pre-construction) conditions.
- Records from April 24 through May 23, 2018, were selected to represent tidal conditions roughly 4 months into construction.
- Records from August 29 through September 28, 2019, were selected to characterize tidal conditions following substantial dredging throughout SEL.
- Records from June 14 through July 13, 2020, were selected to characterize initial post-construction tidal conditions.
- Records from August 2 through 31, 2021, were selected to characterize continued post-construction tidal conditions roughly two months after a tidal inlet dredging event.
- Records from August 19 through November 18, 2022, were selected to characterize later post-construction tidal conditions after an increase of shoaling in the West Basin underneath the railroad bridge.

Table A-1 provides tidal characteristics at La Jolla and the SEL monitoring stations during the 2017 tidal month; the same metrics are provided in Table A-2 for the 2018 tidal month, Table A-3 for the 2019 tidal month, Table A-4 for the 2020 tidal month, Table A-5 for the 2021 tidal month, and Table A-6 for the 2022 tidal month. The tidal metrics shown in these tables are accurate within ±0.1 ft and are defined as follows:

- MHHW: The average of the daily higher-high water levels within the 30-day record.
- MLLW: The average of the daily lower-low water levels within the 30-day record.
- Great Diurnal Range: The difference in height between MHHW and MLLW.
- Diurnal Tide Muting: The difference between the Great Diurnal Range at the La Jolla reference station and each of the SEL monitoring stations.
- Spring High Tide: The highest spring high tide within the 30-day record.
- Spring Low Tide: The spring low tide that follows the highest of the spring high tides within the 30-day record.
- Spring Tide Range: The difference in height between Spring High Tide and Spring Low Tide.
- Spring Tide Muting: The difference between the Spring Tide Range at the La Jolla reference station and each of the SEL monitoring stations.

The definitions of the MHHW and MLLW datums used in this report are statistical derivations from measured tidal data differing from those used by NOAA, which are estimated over a period of approximately 19 years (i.e., one tidal epoch). Water levels for MHHW, MLLW, Spring High Tide and Spring Low Tide at the Nature Center station(s) were corrected for long-term measurement drifts with linear trends. However, the accuracy of the corrected values (shown in the tables below) is unknown due to inconsistencies in survey data provided for this site.

Table A-1: Tidal datums and ranges from July 1 through 30, 2017.

Station	MHHW (ft, NAVD88)	MLLW (ft, NAVD88)	Great Diurnal Range (ft)	Diurnal Tide Muting (ft)	Spring High Tide (ft, NAVD88)	Spring Low Tide (ft, NAVD88)	Spring Tide Range (ft)	Spring Tide Muting (ft)
La Jolla, CA	5.41	0.03	5.38	N/A	7.03	-1.29	8.31	N/A
Tidal Inlet Channel	5.75	1.84	3.91	1.47	7.08	2.57	4.52	3.79
Las Olas	5.45	2.62	2.83	2.55	6.91	2.85	4.06	4.25

Table A-2: Tidal datums and ranges from April 24 through May 23, 2018.

Station	MHHW (ft, NAVD88)	MLLW (ft, NAVD88)	Great Diurnal Range (ft)	Diurnal Tide Muting (ft)	Spring High Tide (ft, NAVD88)	Spring Low Tide (ft, NAVD88)	Spring Tide Range (ft)	Spring Tide Muting (ft)
La Jolla, CA	4.77	-0.42	5.19	N/A	6.09	-1.44	7.53	N/A
Tidal Inlet Channel	5.76	2.96	2.80	2.39	6.69	3.32	3.37	4.16
Las Olas	5.07	2.73	2.34	2.84	6.02	2.90	3.12	4.41
Nature Center	4.71	2.09	2.62	2.57	5.62	2.47	3.15	4.38

Table A-3: Tidal datums and ranges from August 29 through September 28, 2019.

Station	MHHW (ft, NAVD88)	MLLW (ft, NAVD88)	Great Diurnal Range (ft)	Diurnal Tide Muting (ft)	Spring High Tide (ft, NAVD88)	Spring Low Tide (ft, NAVD88)	Spring Tide Range (ft)	Spring Tide Muting (ft)
La Jolla, CA	5.68	-0.36	6.04	N/A	6.72	-1.12	7.84	N/A
Tidal Inlet Channel	5.14	1.32	3.82	2.22	6.19	1.37	4.81	3.03
Las Olas	4.59	2.14	2.45	3.59	5.05	2.23	2.82	5.02
Nature Center Downstream	5.68	1.89	3.78	2.26	6.52	1.80	4.72	3.12
Nature Center Upstream	5.09	1.46	3.63	2.41	6.00	1.70	4.30	3.54
East Basin North Channel	5.08	1.42	3.66	2.38	6.06	1.71	4.35	3.49

Table A-4: Tidal datums and ranges from June 14 through July 13, 2020.

Station	MHHW (ft, NAVD88)	MLLW (ft, NAVD88)	Great Diurnal Range (ft)	Diurnal Tide Muting (ft)	Spring High Tide (ft, NAVD88)	Spring Low Tide (ft, NAVD88)	Spring Tide Range (ft)	Spring Tide Muting (ft)
La Jolla, CA	5.91	-0.74	6.65	N/A	6.50	-1.37	7.87	N/A
Tidal Inlet Channel	5.43	1.44	3.99	2.66	6.49	1.44	5.05	2.82
Las Olas	5.20	1.20	4.00	2.65	6.28	1.20	5.08	2.79
Nature Center Downstream	5.50	1.51	3.99	2.66	6.50	1.47	5.03	2.84
East Basin North Channel	5.29	1.25	4.04	2.61	6.35	1.25	5.10	2.77
East Basin South Channel	5.39	1.36	4.04	2.61	6.45	1.35	5.10	2.77

Table A-5: Tidal datums and ranges from August 2-31, 2021.

Station	MHHW (ft, NAVD88)	MLLW (ft, NAVD88)	Great Diurnal Range (ft)	Diurnal Tide Muting (ft)	Spring High Tide (ft, NAVD88)	Spring Low Tide (ft, NAVD88)	Spring Tide Range (ft)	Spring Tide Muting (ft)
La Jolla, CA	6.02	0.07	5.95	N/A	6.68	-1.00	7.68	N/A
Tidal Inlet Channel	5.33	2.02	3.32	2.63	6.29	2.36	3.93	3.75
Las Olas	5.29	2.07	3.22	2.73	6.25	2.38	3.88	3.80
Nature Center	5.34	2.09†	3.25	2.70	6.29	2.47	3.82	3.86
East Basin North Channel	5.26	1.98	3.27	2.68	6.14	2.28	3.87	3.81
East Basin South Channel	5.25	1.97	3.28	2.67	6.21	2.35	3.86	3.82

Table A-6: Tidal datums and ranges from August 19 through September 18, 2022.

Station	MHHW (ft, NAVD88)	MLLW (ft, NAVD88)	Great Diurnal Range (ft)	Diurnal Tide Muting (ft)	Spring High Tide (ft, NAVD88)	Spring Low Tide (ft, NAVD88)	Spring Tide Range (ft)	Spring Tide Muting (ft)
La Jolla, CA	5.49	0.39	5.09	N/A	7.04	-0.64	7.68	N/A
Tidal Inlet Channel	5.00	2.32	2.68	2.41	5.87	2.48	3.39	4.29
Las Olas	4.99	2.42	2.56	2.53	5.83	2.56	3.27	4.41
Nature Center	5.01	2.52	2.49	2.60	5.84	2.78	3.06	4.62
East Basin North Channel	4.92	2.40	2.52	2.57	5.76	2.66	3.10	4.58
East Basin South Channel	4.84	2.38	2.47	2.62	5.69	2.66	3.03	4.65

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MEMORANDUM

To:	Doug Gibson, The Nature Collective
CC:	Bradley Nussbaum, The Nature Collective
From:	Chris Webb, Astrid Vargas, Chris O'Day, Moffatt & Nichol
Date:	July 14, 2023
Subject:	2023 Water Quality Analysis Update for the San Elijo Lagoon Restoration Project
M&N Job No.:	7017/07

Introduction

As part of the post-construction monitoring efforts for the San Elijo Lagoon Restoration Project (SELRP), Moffatt & Nichol (M&N) updated their hydrodynamic model of San Elijo Lagoon (SEL) to reflect lagoon elevations as surveyed by KDM Meridian (KDM) and Coastal Frontiers Corporation (CFC) in December 2022. The topographic and bathymetric surveys capture the morphologic evolution 2 years following completion of construction of SELRP.

Numerical modeling analyses were conducted to provide new estimates of seawater residence times corresponding to the 2-year post construction state of SEL. A summary of the analyses and results is provided herein.

Per the water quality relative standard established in the SEL Monitoring Plan, if the residence time is estimated to be longer than 7 days in any location within the lagoon, water quality conditions will need to be more closely monitored within that particular area to determine potential degradation.

This memorandum provides an update to our previous Water Quality Analysis Memorandum (M&N, 2022), which provided estimates of water residence time following construction of SELRP (December 2020).

2022 Model Bathymetry

The Adaptive Hydraulics (AdH) model of SEL was updated to various elevation datasets. East of the Highway 101 Bridge, KDM and CFC topobathy surveys constitute the main data sources for the model elevations. These surveys do not cover the seaward side of the SEL inlet (i.e., the area between the 101 bridge and the ocean). Morphologically speaking, this is a highly dynamic area which can influence hydrodynamics within the lagoon. For this reason, additional datasets were used, including a LiDAR dataset from Scripps Institution of Oceanography (2023) and a synthetic elevation dataset of the subtidal areas within that reach (M&N, 2023). The full list of datasets and sources used to update the model bathymetry is provided in Table 1.

Table 1: Datasets and Sources Used to Update the SEL Numerical Model

No	Dataset	Source	Coverage	Elevation Range (ft., NAVD88)
1	SELRP. Full Basin Survey. Single-Beam Bathymetry and RTK GPS Spot Elevations. December 2-15, 2022.	CFC, 2023	Subtidal and tidally influenced extents of SEL east of 101 Bridge.	-6.9 to 4.9
2	SELRP. Vicinity of I-5. Single Beam Bathymetry Survey. January 26, 2023.	CFC, 2023	Subtidal and tidally influenced areas underneath I-5 Bridge.	-5.5 to +1.7
3	KDM Topomap. Aerial Survey. December 17, 2022.	KDM, 2023	Tidally influenced and upland areas within SEL.	2.5 to <300
4	2023-0526 WB Topobathy End Channel.	KDM, 2023	Tidal channel at southern end of SEL West Basin.	-2.5 to 2.8
5	Scripps LiDAR of Inlet. December 7th, 2022.	Scripps, 2023	Subaerial low tide beach elevations surrounding inlet of SEL.	-1 to 40
6	Synthetic SEL Inlet Elevations based on December 2022 LiDAR Beach Elevations.	M&N, 2023	Subtidal areas between 101 bridge and the open coast.	-2 to 1
7	San Elijo Lagoon RMA-2 Model Bathymetry.	USACE, 2006	Ocean bathymetry.	-1 to -90

Figure 1 illustrates the 2022 SEL model bathymetry. Elevation changes between 2020 and 2022 are mostly focused within the West Basin of the lagoon between the SEL inlet and the railroad bridge. As a reference, Figure 2 provides a comparison of the 2020 and 2022 model bathymetries in this area. While a more defined tidal channel is observed in the 2020 bathymetry (bottom elevations down to -5 ft, Mean Lower Low Water (MLLW), the 2022 bathymetry reflects a narrower and shallower channel (with bottom elevations of about -2 ft., MLLW).

Additionally, the area underneath the I-5 Bridge, which consisted of a 44-foot-wide tidal channel confined by sheet pile walls during the 2020 topobathy survey, was constructed to its final configuration between September 2021 and February 2022 and consists of a tidal channel that is about ~300 feet wide. This configuration is captured in the 2022 model bathymetry of SEL as depicted in Figure 1.

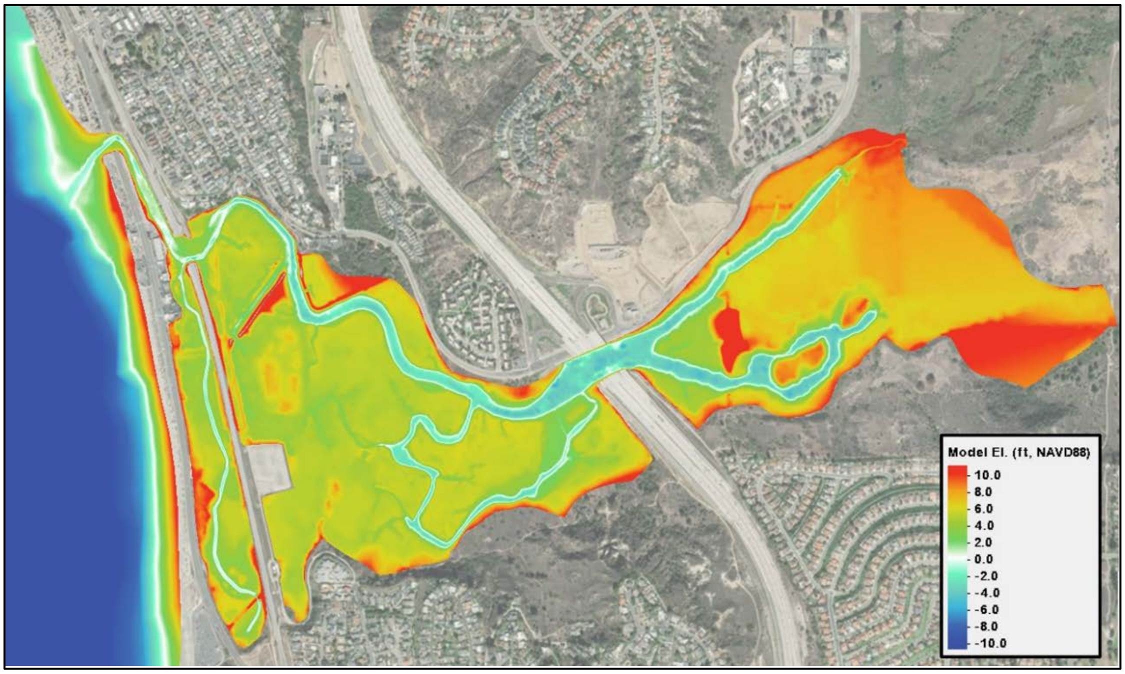

Figure 1: 2022 Model Bathymetry

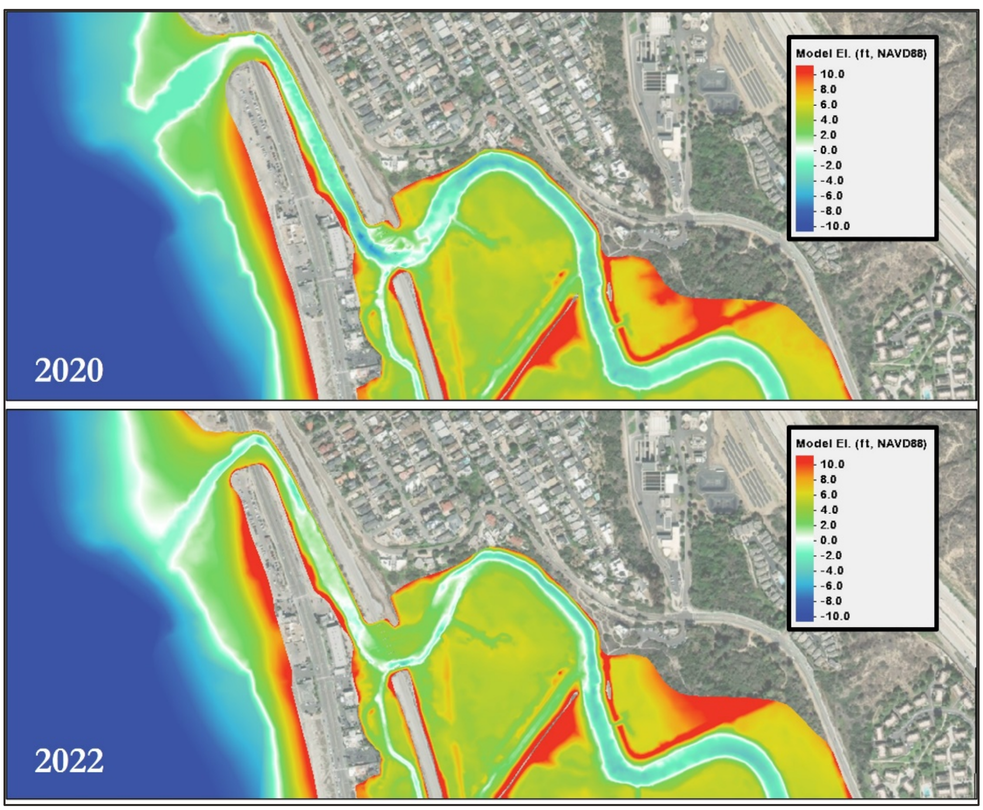

Figure 2: Comparison of 2020 and 2022 Model Bathymetry Near SEL Inlet

Model Validation

Calibration of the AdH model of SEL was conducted during previous water quality modeling efforts (M&N, 2022). However, in order to ensure that the updated bathymetry did not affect the overall model performance, a validation simulation was conducted to compare measured and modeled water levels and current velocities in the lagoon.

A 15-day simulation encompassing the spring-neap tidal cycle from December 15 through 30, 2022, was conducted. The hydrodynamic model was forced by imposing measured water levels from the National Oceanographic and Atmospheric Administration Center for Operational Oceanographic Products and Services (NOAA CO-OPS) monitoring station at La Jolla, CA (Station 941030) at the offshore boundary of the SEL model.

Figure 3 and Figure 4 provide a comparison between measured water levels at the five monitoring stations in SEL. Figure 5 compares measured and modeled depth averaged current velocities at the Nature Center Station. Agreement of measured and modeled data is limited by the lack of bathymetry data at the inlet during December 2022; however, these figures show that the model does well in capturing the range and phase of water levels and current velocities.

Additionally, the agreement between measured and modeled data was quantified with the use of four statistical parameters, defined as follows:

Root Mean Squared Error (ft.) $\varepsilon_{RMS} = \sqrt{\overline{(x-y)^2}}$ (1)

Mean Absolute Error (ft.) $MAE = \overline{|x-y|}$ (2)

Correlation Coefficient (R) $MAE = \overline{|x-y|}$ (3)

Model Prediction Capability Index (d) $d = 1 - \frac{\overline{(x-y)^2}}{\overline{(|x-\bar{x}|-|y-\bar{x}|)^2}}$ (4)

Where x and y represent the measured and modeled data, respectively. Results for water levels are provided in Table 2 and for current velocities in Table 3. While a better agreement is found for water levels than for current velocities, the statistical agreement between measured and modeled variables remains similar to the agreement during previous modeling efforts (M&N, 2022) where the achieved model calibration was deemed accurate for evaluating water quality in the lagoon. With the relatively wet winter of 2022-2023, the measured water levels in the lagoon may have been higher than predicted due to runoff from the watershed that was not considered in the modeling.

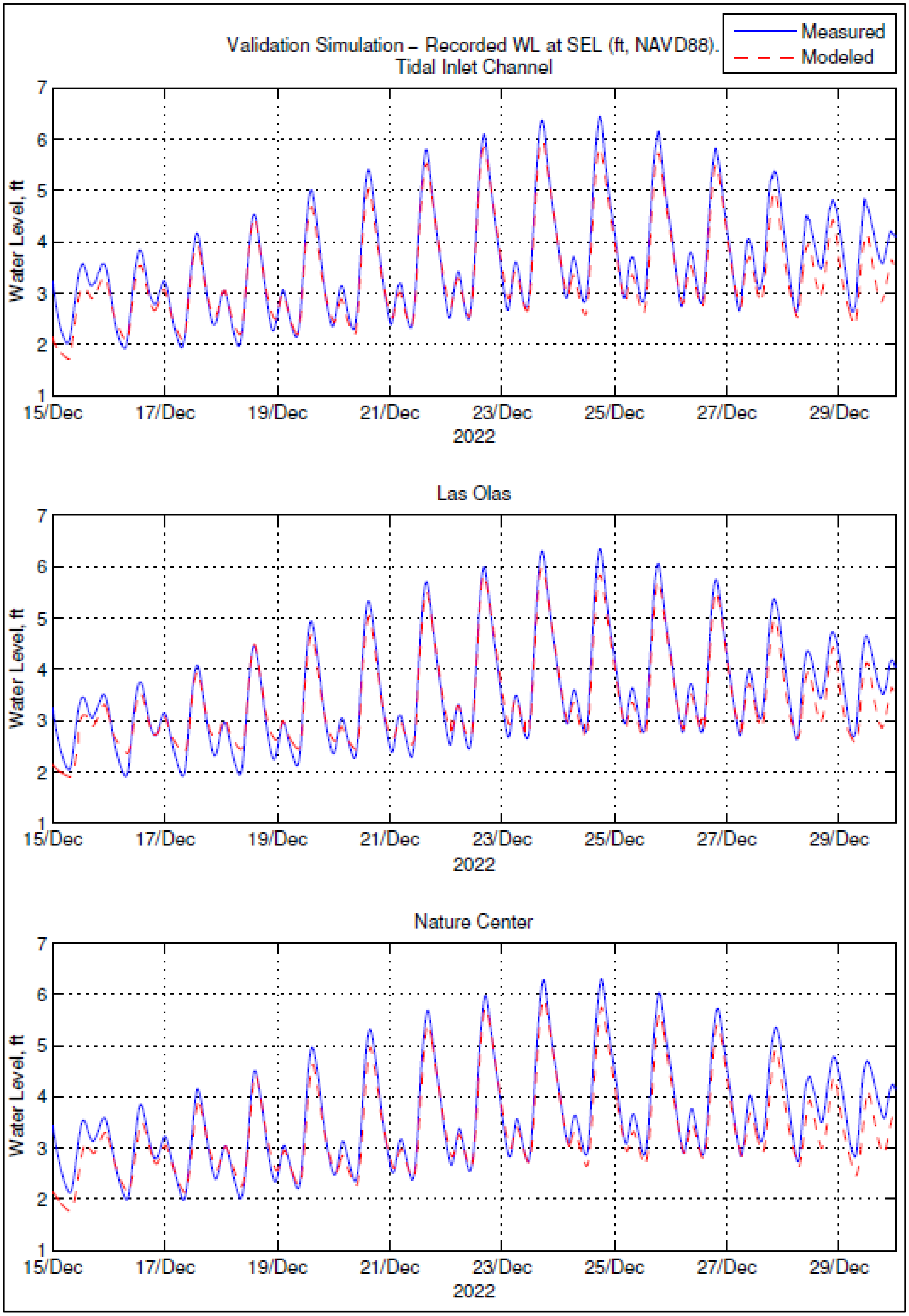

Figure 3: Measured vs. Modeled Water Levels in SEL: West and Central Basin Monitoring Stations

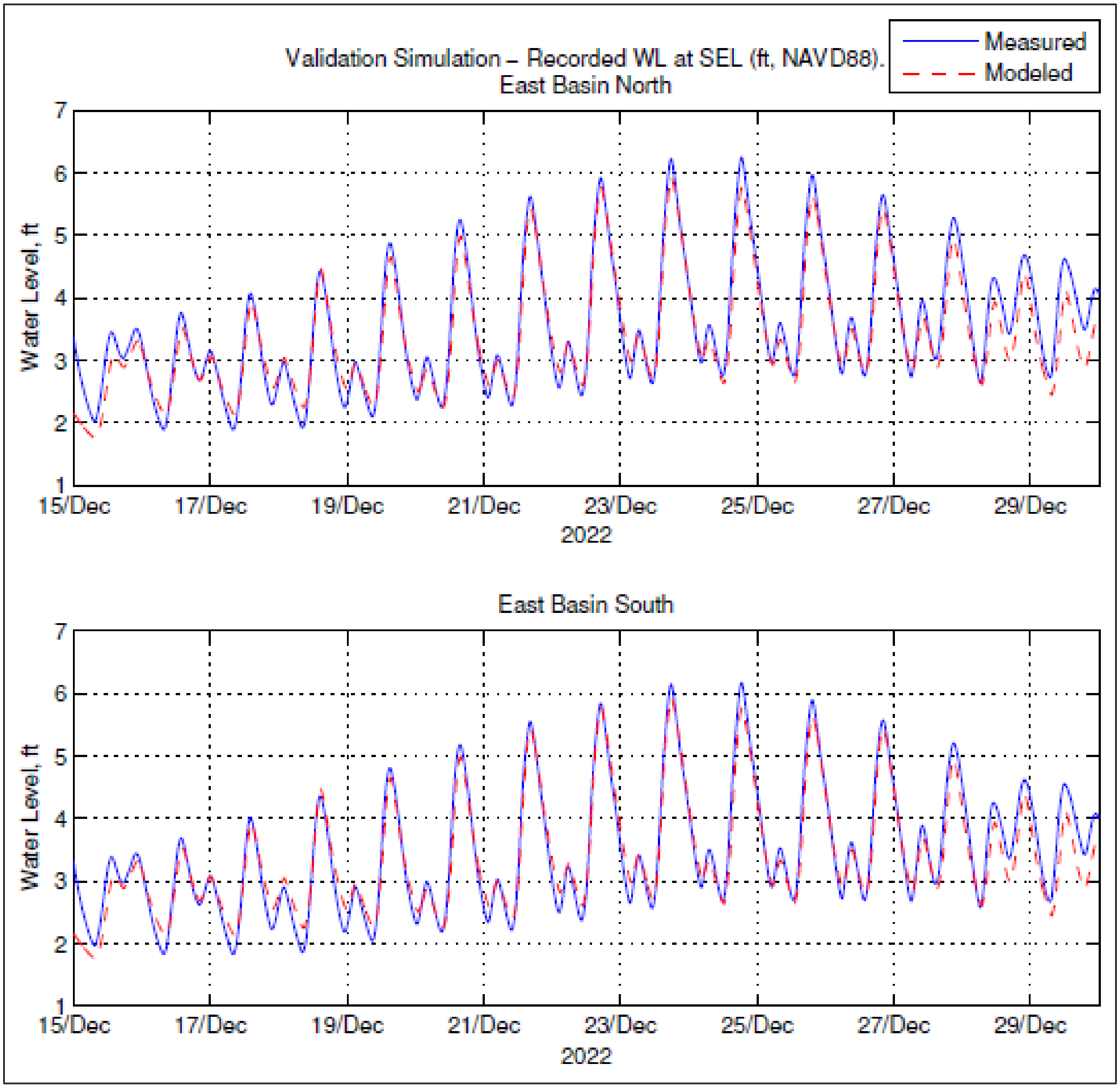

Figure 4: Measured vs. Modeled Depth Averaged Water Levels in SEL: East Basin Monitoring Stations

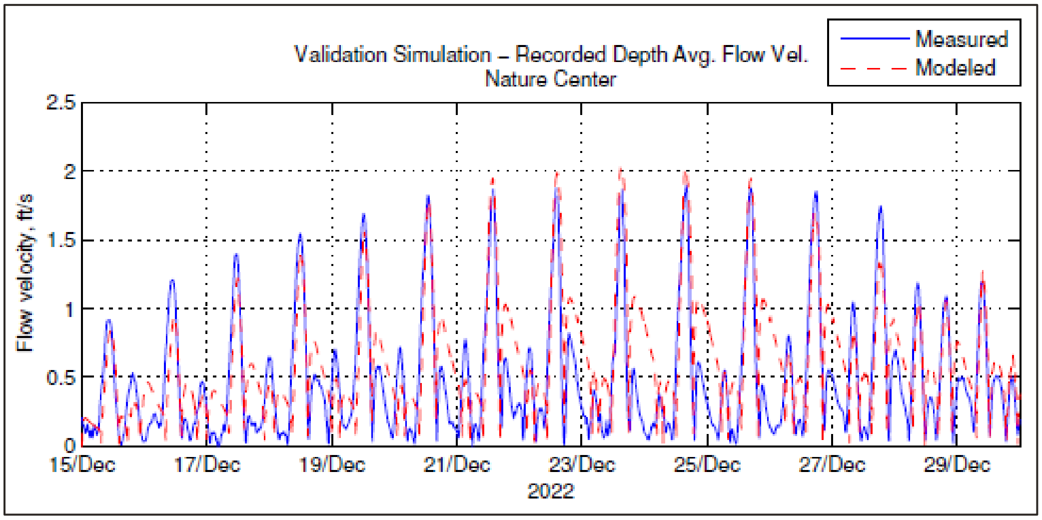

Figure 5: Measured vs. Modeled Depth Averaged Current Velocity at the Nature Center Monitoring Station

Table 2: Statistical Calibration Parameters for Water Level

Parameter	Tidal Inlet Channel	Las Olas	Nature Center	East Basin North	East Basin South
RMSE (ft.)*	0.23	0.26	0.25	0.26	0.26
MAE (ft.)*	0.19	0.20	0.20	0.21	0.21
R (-)	0.98	0.97	0.97	0.97	0.97
D (-)*	0.99	0.98	0.98	0.98	0.98

* Based on demeaned Measured and Modeled Data.

Table 3: Statistical Calibration Parameters for Depth Averaged Current Velocity Magnitude

Parameter	Nature Center
RMSE (ft./s)*	0.30
MAE (ft./s)*	0.25
R (-)	0.76
D (-)*	0.87

* Based on demeaned Measured and Modeled Data.

Residence Time Analysis

Residence time can be defined as the average time a particle resides within a hydraulic system. Similar to our previous water quality assessment (M&N, 2022), residence time was evaluated with a tracer study, in which the hydrodynamic model of SEL was used to simulate transport of a water tracer. Constituent concentrations through time were assessed at various locations in the lagoon, and residence time was computed per Fischer et al. (1979) as follows:

Considering the reduction of a tracer concentration in a tidal embayment due to flushing after being released, in which C_0 is initial concentration, K is a reduction coefficient and $C(t)$ is the concentration at time t.

$$C(t) = C_0 e^{-Kt} \tag{5}$$

The residence time of the tracer in the embayment is determined from:

$$T_r = \frac{\int_0^{\infty} t\, C(t)\, dt}{\int_0^{\infty} C(t)\, dt} = \frac{1}{K}. \tag{6}$$

Since the concentration at $t = T_r$ is

$$C(T_r) = C_0 e^{-1} = \frac{C_0}{e} \tag{7}$$

And the initial tracer concentration is the lagoon C_0 is specified as 1,

$$C(T_r) = \frac{1}{e} = 0.37 \tag{8}$$

T_r, as defined above, can be found from the tracer concentration time series computed by the hydrodynamic model of SEL.

Based on the above methodology, the general procedure of computing the residence times throughout SEL is as follows:

1. Assign an initial tracer concentration, C_0=1 over the entire area corresponding to the lagoon in the modeling domain, and C_0=0 over the open water areas and offshore boundaries to simulate a single instantaneous release of a water tracer into the lagoon.
2. Run the numerical model to simulate tidal hydrodynamics in SEL until constituent concentrations throughout the lagoon have substantially decreased.
3. Extract modeled constituent concentrations data at locations of interest in the lagoon.
4. Find the residence times for the locations of interest from the distribution curves according to Equations 5 through 8.

Model Setup

Water Level Boundary Condition

As described in (M&N, 2022), the hydrodynamic forcing for the residence time analysis simulations corresponds to a 15-day record of measured water levels at CO-OPS station at La Jolla (station 9410230), in which tidal amplitudes were representative of long-term average tidal conditions at La Jolla. In this way, the estimated residence times would also be representative of the long-term average hydrodynamic conditions in the lagoon (during dry weather conditions).

Figure 6 plots the imposed water level boundary condition time series, which encompasses the spring-neap tidal cycle between June 26 and July 14, 2020. As a reference, the average monthly maximum, minimum, and average water levels, as well as the Mean Higher High Water (MHHW), MLLW, and Mean Sea Level (MSL) datums, are also plotted in the figure.

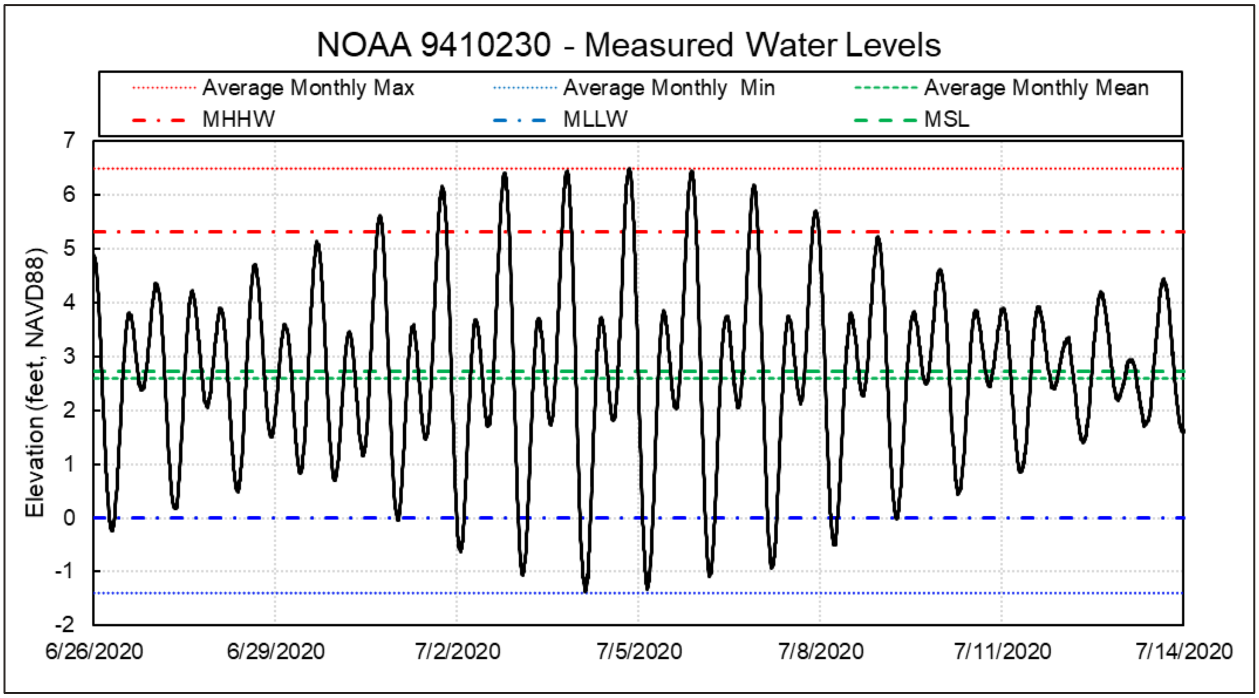

Figure 6: Water Level Boundary Condition for Residence Time Analysis Simulation

Fresh Water Inflows

The conducted Residence Time Analysis is representative of dry weather conditions. Consequently, no freshwater inflows were specified at the upstream boundaries of the SEL model.

Tracer Concentrations: Boundary and Initial Conditions

To simulate a single and instantaneous release of water tracers, no tracer concentrations were specified at the offshore boundary of the model. Meanwhile, initial tracer concentrations for the lagoon and open water areas were specified as C_0=1, and C_0=0, respectively. Figure 7 depicts the initial tracer concentration for the simulation.

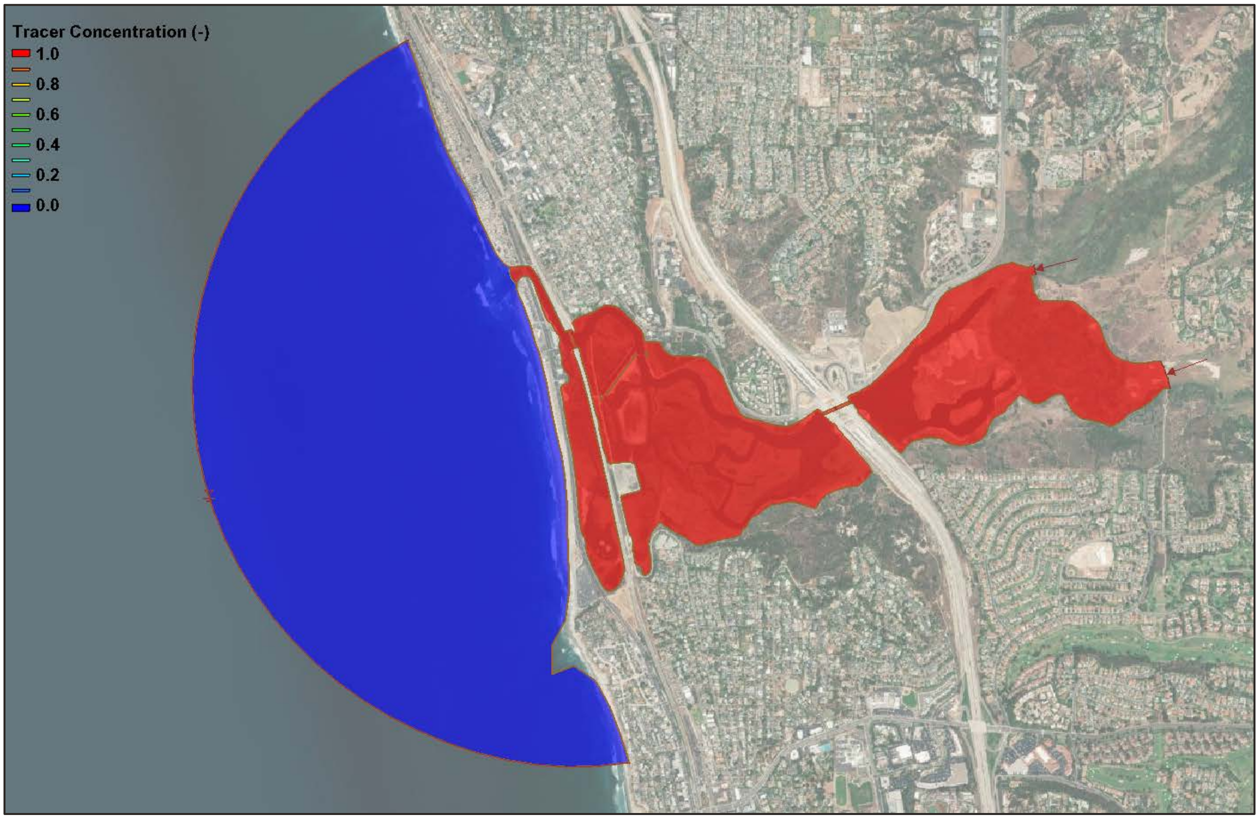

Figure 7: Initial Tracer Concentrations for the Residence Time Analysis Simulation

Diffusion Rates

The diffusion setup for the AdH model is provided and discussed in M&N (2022). No changes to diffusion/dispersion coefficients were made for this round of modeling.

Model Results: Residence Time Estimates

Modeled tracer concentrations were extracted at 16 locations in SEL. A 24-hour moving average (MA) of the modeled concentrations was computed in order to smooth out large fluctuations (within that period) in the concentrations that could yield misleading estimates of residence time. Subsequently, residence times were estimated with the moving average (MA) of the modeled tracer concentrations as defined in Equation 8 above.

Figure 8 provides an example of modeled tracer concentrations (blue curve), the computed 24-hour concentration MA (dashed black curve), and the resulting residence time (red marker) for which the CC4 location is 5.2 days (125 hours; see Figure 9 for location).

The estimated residence times for the 16 locations of interest within SEL are provided in Figure 9. Overall, residence times increase with the distance from the inlet, ranging from <1 to 5 days in the West and Central Basins and from 6 to 12 days in the East Basin. Closer to the inlet, the stronger tidal currents flush out waters with high tracer concentrations during ebb and bring in waters from the open coast with low tracer concentrations. As a result, tracer concentrations rapidly decrease with the incoming and outgoing tides.

On the other hand, tidal currents are much more subtle in the back areas of the lagoon (i.e., the East Basin), and transport of tracers is dominated by considerably smaller scale processes (advection). This results in a slower decrease of tracer concentrations through time.

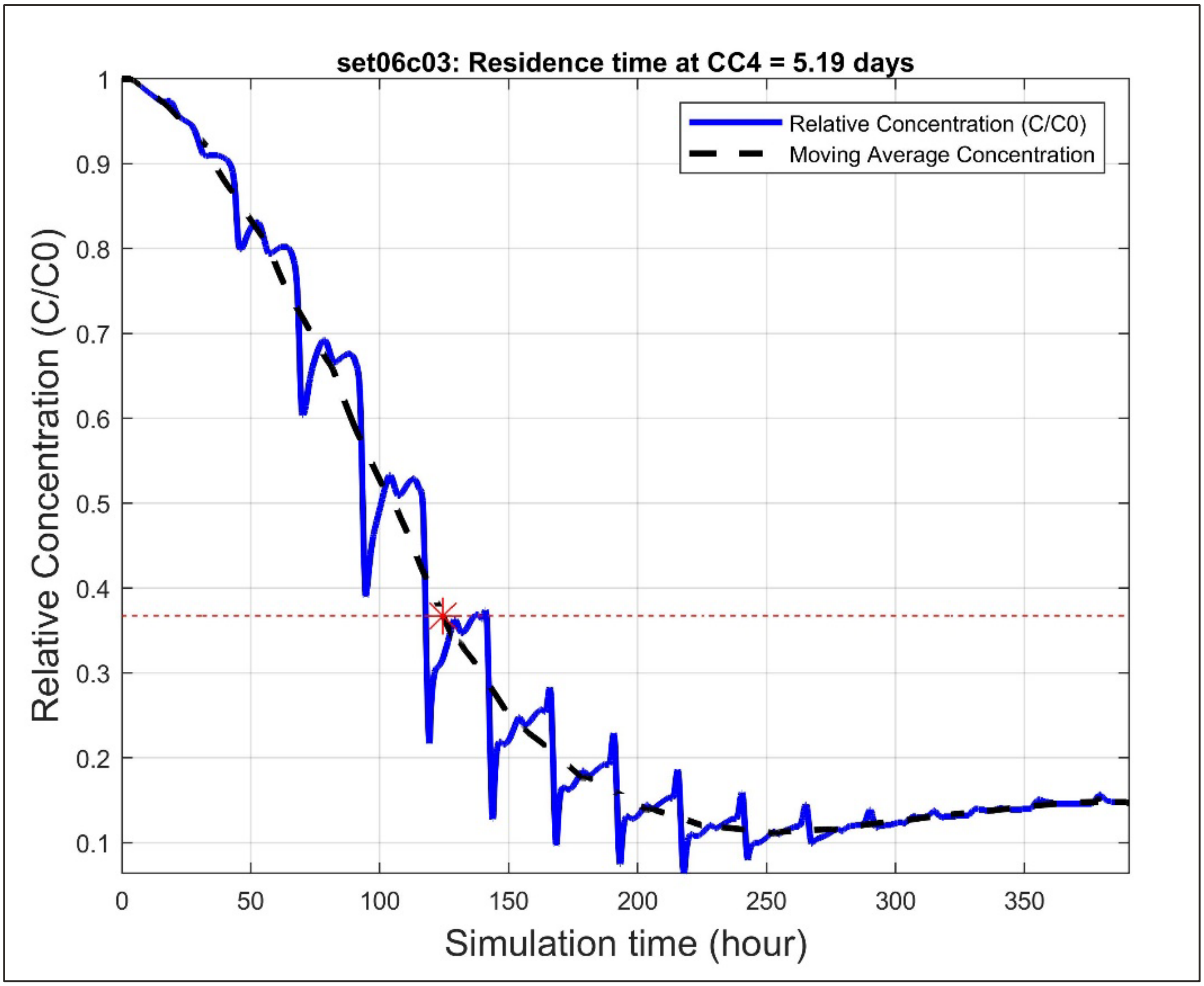

Figure 8: Relative Tracer Concentration and Residence Time at CC4, Located in the Central Basin of SEL

Table 4 compares residence time estimates from the previous modeling effort (M&N, 2022) reflecting lagoon conditions during December 2020 and those provided in Figure 9 (reflecting lagoon conditions during December 2022). The percentage increase in residence time (defined in Equation 9 below) is also provided.

$$RT\ percentage\ increase = \frac{(MA\ Residence\ Time\ 2022 - MA\ Residence\ Time\ 2020)}{MA\ Residence\ Time\ \ 2020} \times 100 \tag{9}$$

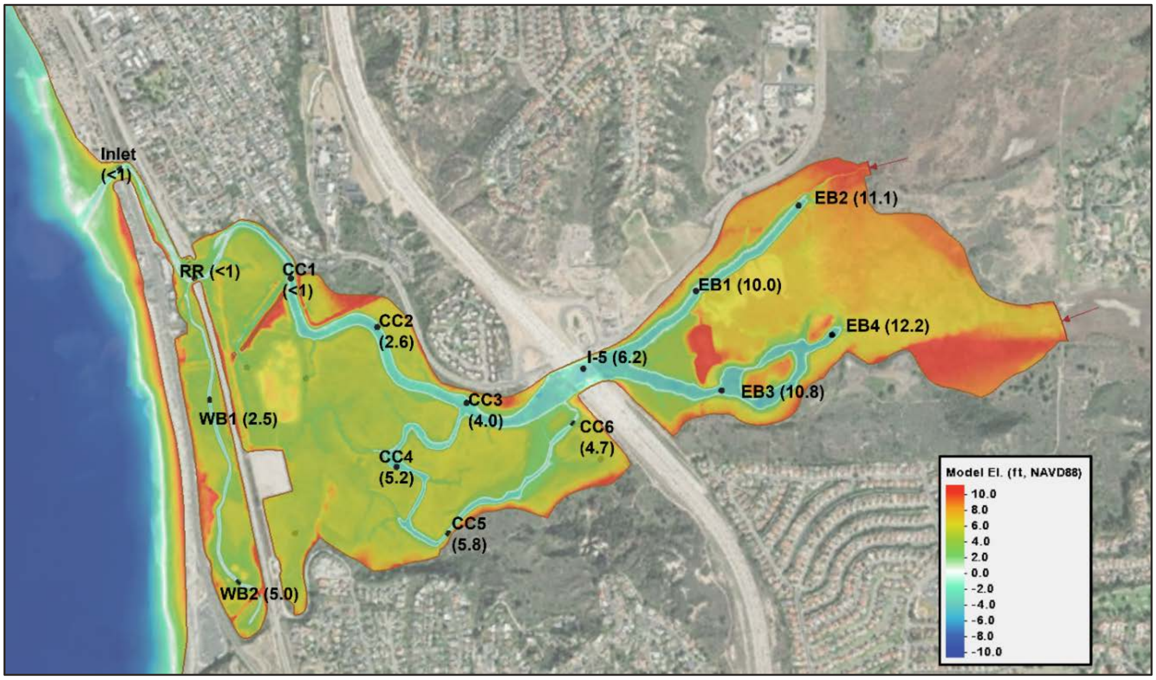

Figure 9: Estimated Residence Time (Days) at Various Locations Within SEL

Table 4: Moving Average (MA) Residence Times for 2020 and 2022 in SEL

Basin	Location	Residence Time (MA, Days) 2020	Residence Time (MA, Days) 2022	Percentage Increase (%)
West Basin	Inlet	< 1	< 1	0
	RR	< 1	< 1	0
	WB1	1.0	2.5	150
	WB2	3.3	5.0	53
Central Basin	CC1	< 1	< 1	0
	CC2	< 1 (0.9)	2.6	175
	CC3	1.9	4.0	104
	CC4	3.8	5.2	50
	CC5	4.4	5.8	38
	CC6	3.1	4.7	34
East Basin	I-5	4.0	6.2	56
	EB1	6.6	10	52
	EB2	7.9	11.1	41
	EB3	6.7	10.8	62
	EB4	8.0	12.2	52
Average Residence Time Increase (%)				60

Residence times in the lagoon are estimated to have increased in 2022 compared to 2020 except for the locations that are closest to the inlet: Inlet, RR, and CC1. At these three locations, the strong incoming and outgoing tidal flows likely promote the rapid transport and flushing of tracers out of the lagoon with small to negligible differences in time.

Meanwhile, the largest increases in estimated residence times (based on the computed percentage increases) correspond to locations in the West and Central Basins that remain relatively close to the inlet but are situated further from the accelerating currents. These are: WB1, increasing from 1 to 2.5 days (150% increase); CC2, increasing from 0.9 to 2.6 days (175% increase); and CC3, increasing from 1.9 to 4 days (104% increase). Without the localized effect of accelerating tidal flows, residence times in these locations respond primarily to the changes in morphology at the inlet. Where a shallower and narrower channel exists, smaller tidal exchange rates are present that subsequently results in longer times for tracers to be flushed out of the lagoon. It is noted that even though an increase of up to 175% is observed, residence times are still estimated to be relatively short and remain below 4 days in these locations.

For the remaining locations, residence times are estimated to increase roughly between 40% to 60%, also as a result of changing inlet morphology. At the locations in the far East Basin (EB1, EB2, EB3, and EB4), this increase results in an exceedance of the residence time threshold of 7 days established in the SEL Monitoring Plan. Exceedance of this threshold does not necessarily mean a decline in the lagoon’s water quality below acceptable limits. The recommendation is made to review water quality data obtained by the Nature Collective (dissolved oxygen, temperature, etc.) as part of the SELRP post-construction monitoring efforts to identify any trend that would indicate a decrease in water quality as a result of changes in the lagoon morphology. It is possible that no changes or minor changes to water quality will occur even though the model suggests that circulation is longer in duration now than in the past.

Despite the overall estimated increase in water residence time in SEL from 2020 to 2022 (60% increase, as indicated in Table 4), it is noted that the estimated values are considerably smaller compared to pre-restoration residence times. An excerpt from the 2017 Water Quality Report (M&N, 2017) is provided in Figure 10, which depicts estimated residence times in the lagoon prior to construction of the SELRP. Three locations are highlighted in Figure 10. For WB2 and I-5, residence times were estimated roughly to be 16 days (compared to 5 and 6 days in 2022, respectively), while for the far East Basin locations (EB1 to EB4), no residence time was provided as there would be no tidal influence in the area prior to restoration. The model is useful for planning and relative comparisons but may or may not accurately predict residence times with great precision to compare with the 7-day criterion.

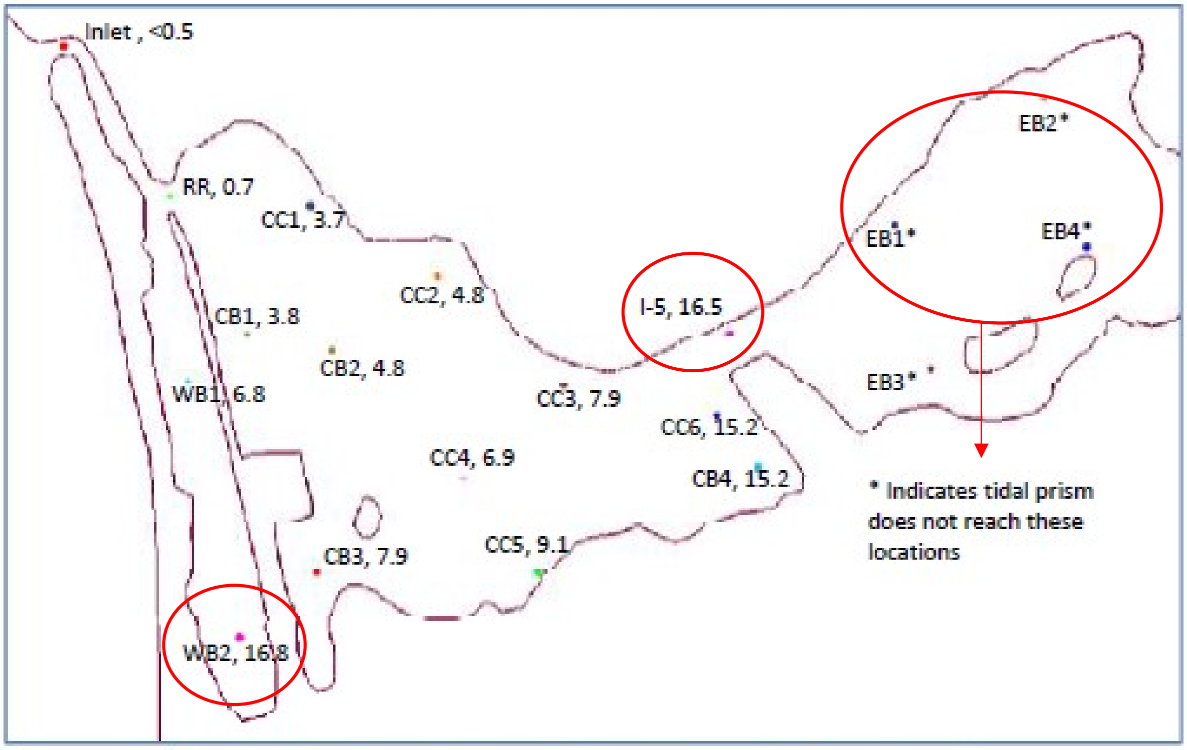

Figure 10: Water Residence Times in SEL Prior to Construction of SELRP (M&N, 2017)

Summary

Table 5 summarizes the results of this analysis by providing the average residence time for each basin of SEL based on the computed residence time for locations in Table 4.

Table 5: Average Residence Time Per Basin in SEL

West Basin	West Basin	Central Basin	East Basin
2020	1.3 days	2.4 days	6.6 days
2022	2.1 days	3.8 days	10.1 days
Increase	60%	60%	50%

The following conclusions can be drawn from this analysis:

1. An overall increase in water residence times in SEL was estimated to occur from 2020 to 2022.
2. This increase may be attributable to morphological changes at the inlet of the lagoon that occurred between 2020 and 2022 or be artifacts of imperfections in the modeling.
3. Locations with the highest increase in residence times are estimated to occur in the West and Central Basins. Despite the estimated increase, residence times may remain below 4 days for these locations.
4. Residence times in the far East locations of SEL are estimated to have increased roughly between 40% to 60% yielding values that exceed the 7-day threshold established in the 2017 SEL Monitoring Plan. Potential for declining water quality in the area should be considered by the lagoon manager with a review of water quality data collected by the Nature Collective as part of the SELRP post-construction monitoring efforts.

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APPENDIX B

HABITAT MAPPING 2022 MEMORANDUM

Memorandum

Prepared by Nature Collective,
Moffatt & Nichol, AECOM, Merkel & Associates,
and Nordby Biological Consulting

San Elijo Lagoon RESTORATION Reviving Your Wetlands

To	Doug Gibson and Tito Marchant, Nature Collective
Subject	San Elijo Lagoon Restoration Project Habitat Mapping – 2022
From	Cindy Kinkade, AECOM
Date	August 2023

Introduction

The San Elijo Lagoon Restoration Project has been implemented by Nature Collective, San Diego Association of Governments, and California Department of Transportation (Caltrans) District 11 to enhance and restore the physical and biological functions and services of San Elijo Lagoon. These efforts included increasing hydraulic efficiency in the lagoon, improving pre-construction water quality impairments, and halting ongoing conversion of unvegetated wetland habitats (mudflat) to vegetated salt marsh with the goal of restoring a more connected gradient of balanced habitat types. Success of the restoration effort is being measured through the implementation of a monitoring program developed in coordination with various permitting and approval agencies, including California Coastal Commission, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and California Regional Water Quality Control Board.

This memorandum documents the results of habitat mapping completed throughout the project area in 2022. The data below will provide information related to the habitat areas as part of the monitoring program as defined in *Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project* (Monitoring Plan) (Nature Collective 2020).

Approach

Acreages associated with the refined habitat distribution are considered the final "Design" acreages (Table 1-1 and Figure 1-1). Vegetation mapping was completed throughout the project area by AECOM in 2022. Habitats were classified based on the dominant and characteristic plant species, plant physiognomy, and soils in accordance with *Draft Vegetation Communities of San Diego County* (Oberbauer et al. 2008). Areas within the project OD pit that remain unvegetated but are anticipated to ultimately convert to vegetated marsh are identified separately and will be categorized as a specific habitat type as conversion occurs.

Results

During the mapping process for the post-construction final design habitat distribution, the following habitat types were merged together for consistency

- Subtidal Habitat and Eelgrass; Tidal Channels and Basins were combined into Tidal Channels and Basins, and
- Berms and Roads were combined with Developed as Berms and Roads.

Vegetation communities mapped within San Elijo Lagoon during 2022 are presented in Table 1, and Figure 1-2.

Table 1-1. Habitat Distribution within San Elijo Lagoon

Habitat Type[1]	Design Habitat Distribution (acres)	2022 Habitat Distribution (acres)
Open Water/Freshwater Marsh	0.7	0.7
Tidal Channels and Basins[2,3]	62.0	61.2
Mudflat[2]	32.0	39.7
Unvegetated (inside of OD pit)[4]	N/A	8.7
Salt Marsh (Subtotal of low, mid-, and high salt marsh)[3]	308.0	302
Low Salt Marsh	*58.0*	*61.8*
Low Salt Marsh (inside of OD pit)	*15.0*	*4.3*
Mid- Salt Marsh	*110.0*	*103.3*
High Salt Marsh	*125.0*	*132.6*
Salt Panne	32.0	22.9
Freshwater/Brackish Marsh	97.2	96.8
Riparian	69.2	69.2
Transitional[3]	7.1	7.1
Avian Nesting Area	3.3	3.3
Coastal Strand	4.5	4.5
Beach	15.0	15.0
Upland & Other	271.6	271.6
Berms & Roads & Developed	19.4	19.3
Total	**922.0**	**922.0**

1 Habitat descriptions are provided in Attachment 1.
2 Tidal Channels and Basins has combined 2015 Subtidal Habitat and Tidal Channels and Basins. Up to 0.1 acre may occur within the overdredge (OD) pit to provide connection to other existing tidal channels.
3 Habitats defined based on criteria identified in the San Dieguito Wetlands Restoration Project and tracked per California Coastal Commission requirements.
4 Unvegetated area within the OD pit was not actively planted but is anticipated to convert over time per the Monitoring Plan; therefore, it is identified separately from other unvegetated flats within the lagoon (e.g. mudflat).

Discussion

The establishment and conversion of habitat are anticipated as the lagoon reaches equilibrium after the completion of restoration, and are expected to result in shifts in acreage between intertidal salt marsh, brackish marsh, and unvegetated flats. Unvegetated areas planned as vegetated salt marsh within the OD pit have not initially been mapped as habitat and will continue to be monitored until they can be characterized as a specific habitat type once they contain approximately 30% cover or can be confidently mapped as mudflat. Future mapping will continue to monitor habitat establishment and conversion within the lagoon.

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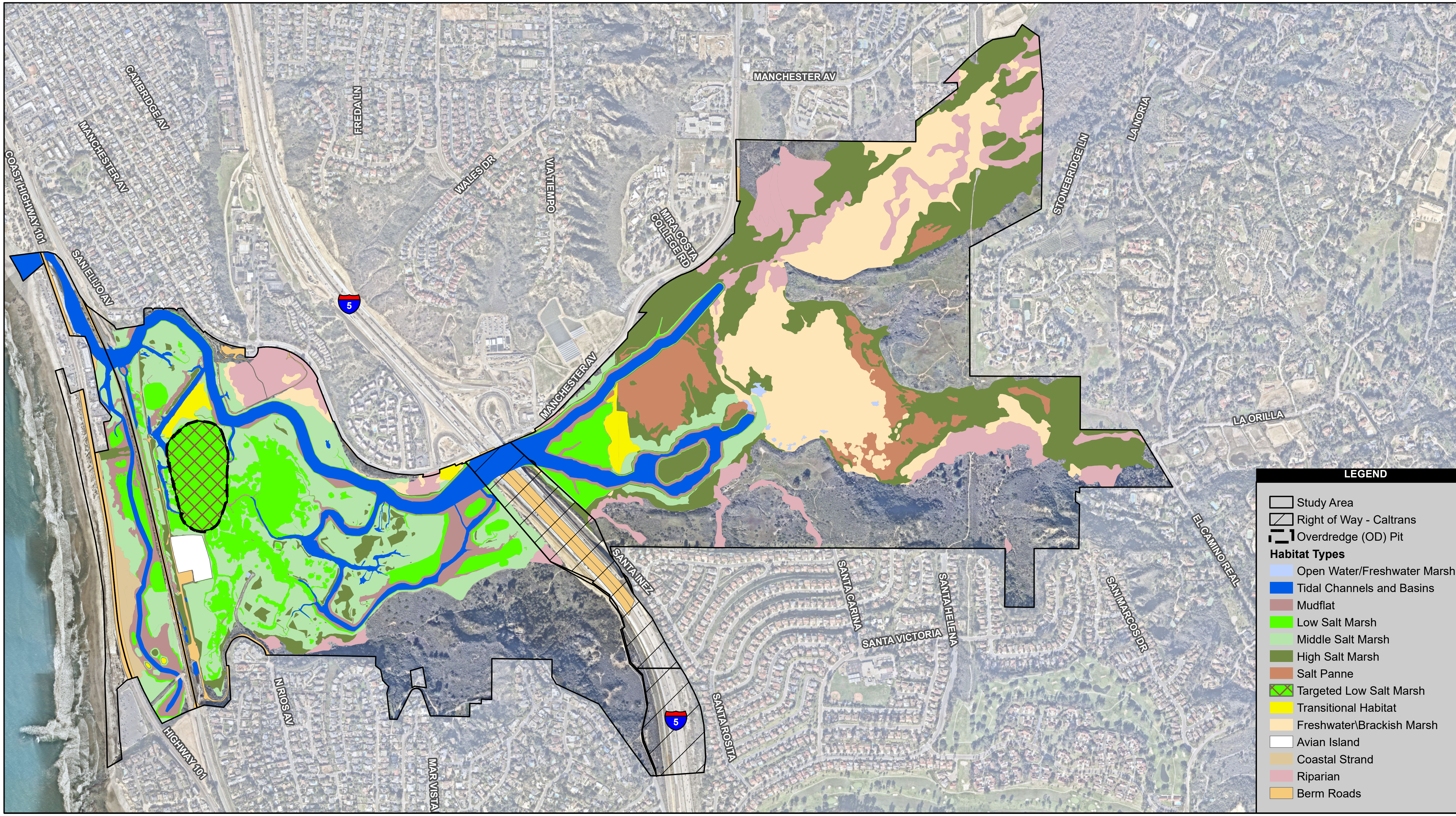
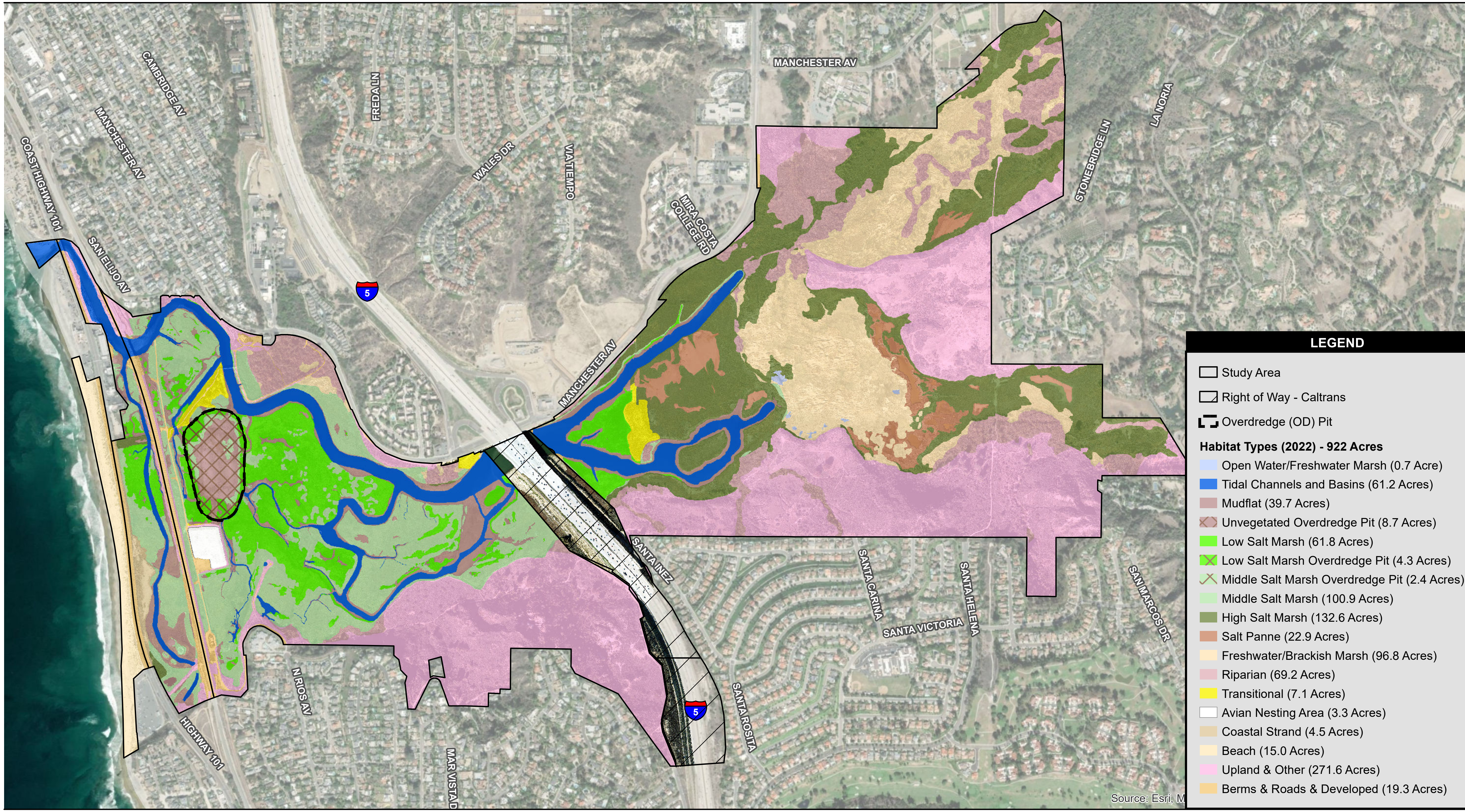


Source: SANDAG 2012; MoffattNichol 2020; AECOM.

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

Figure 1-1
Design Habitat Distribution



Source: SanGIS 2022; MoffattNichol 2022; AECOM (2018-2022).

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

Figure 1-2
SELRP Habitats 2022

Attachment 1

Habitat Descriptions

Habitat Descriptions based on Holland and Oberbauer

Habitats descriptions based on the dominant and characteristic plant species, plant physiognomy, and soils in accordance with the Draft Vegetation Communities of San Diego County (Oberbauer et al. 2008), based on the Preliminary Descriptions of the Terrestrial Natural Communities of California (Holland 1986).

Tidal Mudflat

Tidal mudflats are coastal wetlands that form when mud is deposited by tides or rivers. Most of the sediment within a mudflat is within the intertidal zone, and thus the flat is submerged and exposed approximately twice daily. Mudflats are typically important regions for wildlife, including invertebrates and migratory birds.

Coastal Salt Marsh (Low, Mid-, and High Salt Marsh)

Southern coastal salt marsh is an association of herbaceous and suffrutescent, salt-tolerant hydrophytes that form a moderate to dense cover and can reach a height of 1 m (3 feet). Most species are active in summer and dormant in winter (Holland 1986). Coastal salt marsh plants are distributed along distinct zones depending upon such environmental factors as frequency and length of tidal inundation, salinity levels, and nutrient status (MacDonald 1977). In the higher littoral zone, there is much less tidal inflow, resulting in lower salinity levels, while soil salinity in the lower littoral zone is fairly constant due to everyday annual tidal flow (Adam 1990).

Within the different littoral zones, species can be segregated with California cordgrass (*Spartina foliosa*) nearest the open water in the low-littoral zone (low salt marsh); Pacific pickleweed and saltwort (*Batis maritima*) in the mid-littoral zones (middle salt marsh); and a richer mixture of species, including alkali-heath and Parish’s pickleweed, in the higher littoral zone (high salt marsh) (Holland 1986). Other characteristic species include coastal saltgrass (*Distichlis spicata*), alkali weed (*Cressa truxillensis*), and salty susan.

Transitional

Supratidal transition zone habitat occurs between the range of the highest high tides and non-tidal supratidal uplands, from approximately +4.2 ft to + 5.2 ft NGVD in 2015. These areas represent a transition from the highest salt marsh plant species to upland plant species with both plant assemblages occurring within this relatively narrow elevation band. High soil salinities prevent upland species from invading the lower transition zone while upland species out compete salt tolerant species at the higher transition zone elevations.

Transition zone habitat is very rare in southern California coastal wetlands where development has encroached upon the edges of tidal lagoons and estuaries. As a result, this habitat is perhaps the least understood of all wetland-associated habitats. What is known is that these habitats provide refugia for salt marsh species, such as the light-footed Ridgway's rail, during extreme weather and tides, as well as additional foraging habitat. It has been postulated that important plant pollinators, such as ground dwelling bees, occur in the transition zone.

The transition zone is also important in terms of climate change and predicted sea level rise. Should sea level rise as predicted, areas of low and mid-high salt marsh will be inundated more frequently and by increasingly deeper water, ultimately converting to subtidal habitat. Under this scenario, transition zone will convert to intertidal salt marsh. Thus, inclusion of transition zone in restoration alternatives provides a potential mechanism for maintaining the biological diversity of the lagoon in the future.

Saltpan

Saltpans are unvegetated to sparsely vegetated flat, alkaline areas near the coast that are subject to tidal influence. In coastal areas, saltpans are most often associated with salt marsh habitat. While saltpans can cover relatively large areas, they often occur in a mosaic pattern with more densely vegetated areas within the salt marsh. The paucity of vegetation on saltpans is apparently due to seasonally high soil salinity levels that prevent colonization by perennial salt marsh species. However, the open substrate associated with saltpans is available for colonization by short-lived annual species after winter rains temporarily reduce salinity levels (Ferren et al. 1987).

Coastal Brackish Marsh (Freshwater/Brackish Marsh)

Coastal brackish marsh is dominated by perennial, emergent, herbaceous monocots to 2 m tall (6 feet). Coastal brackish marsh is similar to both freshwater marsh and salt marsh, with some plants characteristic of each. Salinity may vary considerably and may increase at high tide or during seasons of low freshwater runoff or both (Holland 1986).

Dominant plants within this community include California bulrush (*Schoenoplectus californicus*) and Olney's bulrush (*Schoenoplectus americanus*), with these species forming pure stands more characteristic of freshwater marsh in some areas. However, salt marsh species, such as Pacific pickleweed (*Sarcocornia pacifica*), alkali-heath (*Frankenia salina*), Parish's pickleweed (*Arthrocnemum subterminale*), and salty susan (*Jaumea carnosa*) are dispersed throughout the coastal brackish marsh in varying degrees of abundance.

Open Water (Tidal Channels and Basins)

This habitat type consists of any open water body including lakes, reservoirs, bays, flowing water within a river channel, and small ponds along stream courses. Open water bodies provide important habitat for a variety of aquatic organisms and waterfowl.

Riparian (Disturbed Wetland, Sandbar Willow Scrub, and Southern Willow Scrub)

Disturbed wetlands are communities dominated by exotic wetland species. These species have invaded sites that had been previously disturbed or are periodically disturbed.

Sandbar Willow Scrub relate to areas being colonized by sandbar (= thin-leaved) willow (*Salix exigua*) and arroyo willow (*Salix lasiolepis*). Left unaltered, this community may eventually mature into southern willow scrub.

Southern willow scrub is a densely vegetated riparian thicket, dominated by several willow species (*Salix* spp.), with scattered emergent western cottonwood (*Populus fremontii* ssp. *fremontii*) and western sycamore (*Platanus racemosa*). This community is generally greater than 6 m (20 feet) high and occupies drainages and floodplains supporting perennially wet streams. Understory species such as mulefat (*Baccharis salicifolia*), Douglas mugwort (*Artemisia douglasiana*), and hoary nettle (*Urtica dioica* ssp. *holosericea*), may also be present (Holland 1986).

Coastal Strand

Coastal strand is an area of loose to partially stabilized sand that forms near the shore above the high tide line. The plants found in this community are able to tolerate harsh conditions, such as high winds, salt, and a low nutrient supply. Many of the plants in this community have deep taproots and/or a prostrate growth form to help stabilize them in the loose sand. Dominant plants within the coastal strand community include arrow weed (*Pluchea sericea*), beach evening-primrose (*Camissonia cheiranthifolia* ssp. *suffruticosa*), beach sand-verbena (*Abronia umbellata* var. *umbellata*), Nuttall's lotus (*Lotus nuttallianus*), and coast woolly-heads (*Nemacaulis denudata* var. *denudata*).

Upland and Others (Coyote Brush Scrub, Diegan Coastal Sage Scrub-Coastal Form, Diegan Coastal Sage Scrub/Chaparral, Eucalyptus Woodland, Nonnative Grassland)

Coyote brush scrub is typically found on disturbed sites or those with nutrient-poor soils (Oberbauer 2008).

Diegan coastal sage scrub may be dominated by a variety of different species depending upon site-specific topographic, geographic, and edaphic conditions. California sagebrush (*Artemisia californica*) is more dominant in coastal forms (Oberbauer 2008), but it often occurs with various codominant species. There are several recognized subassociations of Diegan coastal sage scrub based upon the dominant species. Typical Diegan coastal sage scrub dominants include California sagebrush, California buckwheat (*Eriogonum fasciculatum*), laurel sumac (*Malosma laurina*), black sage (*Salvia mellifera*), lemonadeberry (*Rhus integrifolia*), and California encelia (*Encelia californica*).

Diegan coastal sage scrub/chaparral is a mix of chaparral and sage scrub species. Chamise (*Adenostoma fasciculata*) and coastal sagebrush are dominant and relatively equal in cover. Generally, laurel sumac, black sage, and lemonadeberry are more common in coastal sage scrub, while lilac (*Ceanothus* spp.), scrub oak (*Quercus* spp.), and mission manzanita (*Xylococcus bicolor*) are more common in chaparrals (Oberbauer 2008).

Eucalyptus woodland is dominated by several species of eucalyptus (*Eucalyptus* spp.). These introduced species produce large amounts of leaf and bark litter, the chemical composition of which may inhibit the establishment and growth of other species, especially natives, in the understory. Generally, these species were planted for aesthetic and horticultural purposes, but many species of eucalyptus have become naturalized and have been quite successful in invading riparian areas.

Nonnative grassland generally occurs on fine-textured loam or clay soils that are moist or even waterlogged during the winter rainy season and very dry during the summer and fall. It is characterized by a dense to sparse cover of annual grasses, often with native and nonnative annual forbs (Holland 1986). Typical grasses within the region include ripgut grass (*Bromus diandrus*), red brome (*Bromus madritensis* ssp. *rubens*), soft chess (*Bromus hordeaceus*), wild oats (*Avena* spp.), and fescue (*Vulpia myuros*). Nonnative disturbance-related annuals, such as red stem filaree (*Erodium cicutarium*) and horseweed (*Conyza canadensis*), are common to this community. Though named as a nonnative community, nonnative grassland often has significant biological value since it typically supports native grassland species, such as tarweed (*Deinandra* spp.), common goldfields (*Lasthenia gracilis*), blue dicks (*Dichelostemma capitatum* ssp. *capitatum*), and purple owl's-clover (*Castilleja exserta* ssp. *exserta*); provides foraging habitat for raptors; and often supports sensitive wildlife species.

Beach

Beach habitat is the flat, sandy area along the immediate coastline that occurs between mean tide and the foredune, or to the farthest inland reach of storm waves. This habitat is characterized by high exposure to salt spray and sand blast, and sandy substrate with a low organic content and water-holding capacity (Barbour and Johnson 1977). The lower portions of beaches are unvegetated, while the upper beach sometimes supports a sparse herbaceous cover, especially in areas where foredunes are present.

Berms and Roads and Developed

Berms and roads and developed habitats include areas that have been constructed upon or otherwise physically altered to an extent that native vegetation is no longer supported. Developed land is characterized by permanent or semi-permanent structures, pavement or hardscape, and landscaped areas that often require irrigation. Typically unvegetated or landscaped with a variety of ornamental (usually non-native) plants.

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APPENDIX C

DETAILED TRANSECT AND QUADRAT RESULTS

Appendix C
Detailed Transect Data

Table C-1. Vegetation Cover Table

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_01	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	08_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	09_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	10_5m	BG	*Bare ground*	-	-	-
Marsh Veg_01	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	16_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	17_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_01	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	27_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_01	5m_belt	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	01_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	01_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	02_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	02_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	03_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	04_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	04_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	05_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	05_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	06_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	06_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	07_0m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_02	07_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	09_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	10_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	12_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	13_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	13_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	14_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	14_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	15_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	16_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	16_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	16_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	17_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	17_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	17_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_02	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	18_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	18_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	19_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	19_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	20_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	20_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	21_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	21_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	22_0m	BAMA	*Batis maritima*	yes	perennial	shrub

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_02	22_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_02	23_0m	BG	*Bare ground*	-	-	-
Marsh Veg_02	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	27_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_02	5m_belt	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_02	5m_belt	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_03	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_03	5m_belt	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_03	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	01_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	01_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	02_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	02_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	03_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	04_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_03	04_5m	OW	*Open water*	-	-	-
Marsh Veg_03	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_03	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	08_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	09_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	16_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	17_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	22_0m	WK	*Wrack*	-	-	-
Marsh Veg_03	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	23_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_03	24_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_03	24_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_03	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	25_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_03	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_03	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	27_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_03	5m_belt	-				
Marsh Veg_04	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_04	00_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	01_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_04	01_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_04	02_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	02_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_04	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_04	03_5m	BG	*Bare ground*	-	-	-
Marsh Veg_04	04_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_04	04_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_04	05_0m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Marsh Veg_04	05_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_04	05_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_04	06_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_04	06_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	07_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	07_5m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Marsh Veg_04	08_0m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Marsh Veg_04	08_5m	BG	*Bare ground*	-	-	-
Marsh Veg_04	09_0m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Marsh Veg_04	09_5m	BG	*Bare ground*	-	-	-
Marsh Veg_04	10_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	10_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_04	11_5m	BG	*Bare ground*	-	-	-
Marsh Veg_04	12_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	12_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_04	13_5m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Marsh Veg_04	14_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	14_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	15_0m	WK	*Wrack*	-	-	-

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_04	15_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	16_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	16_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	17_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	17_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	18_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	18_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	19_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	19_5m	BG	*Bare ground*	-	-	-
Marsh Veg_04	20_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	20_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	21_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	21_5m	BG	*Bare ground*	-	-	-
Marsh Veg_04	22_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	22_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	23_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	23_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	24_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	24_5m	BG	*Bare ground*	-	-	-
Marsh Veg_04	24_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	25_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	25_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	26_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	26_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	27_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	27_5m	WK	*Wrack*	-	-	-
Marsh Veg_04	28_0m	WK	*Wrack*	-	-	-
Marsh Veg_04	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_04	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_04	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_04	30_0m	BG	*Bare ground*	-	-	-
Marsh Veg_04	5m_belt	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_04	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_05	5m_belt	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	5m_belt	LICA	*Limonium californicum*	yes	perennial	herb
Marsh Veg_06	5m_belt	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	01_0m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_05	01_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	02_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	02_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	03_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	04_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	04_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	05_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	05_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	06_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	06_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	07_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	07_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	08_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	09_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	09_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	10_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	12_5m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_05	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	13_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	13_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	13_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	14_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	14_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	14_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	15_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	15_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	16_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	16_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	16_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	17_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	17_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	17_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	18_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	18_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	19_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	19_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	20_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	20_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	21_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	21_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	22_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	22_5m	SPFO	*Spartina foliosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_05	23_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	23_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	23_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	23_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	24_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	24_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	24_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	25_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	25_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_05	26_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	26_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	27_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	28_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	28_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	29_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	29_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_05	30_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_05	5m_belt	-				
Marsh Veg_06	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	01_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	01_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	02_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	02_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	03_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_06	04_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	04_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	05_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	05_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	06_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	06_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	07_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	07_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	09_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	09_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	10_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	12_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	13_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	13_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	14_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	14_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	15_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	16_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	16_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	16_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	17_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	17_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	17_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	18_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	18_5m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_06	19_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	19_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	20_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	20_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	21_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	21_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	22_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	22_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	23_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	23_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	24_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	24_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	25_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	25_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	26_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	26_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	27_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	28_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	28_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_06	29_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	29_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	30_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_06	5m_belt	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_06	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_07	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	01_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	01_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_07	02_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	02_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	03_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	04_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	04_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	05_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	05_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	06_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	06_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	07_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	07_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	08_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	09_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	10_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	12_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	13_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	13_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_07	13_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	14_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	14_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	15_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	16_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	16_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	17_0m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_07	17_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	18_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	18_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	19_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	19_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	20_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	20_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	21_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	21_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	22_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	22_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	23_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	23_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	24_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	24_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	25_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_07	25_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	26_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	26_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	27_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	28_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	28_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	29_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	29_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	30_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_07	5m_belt	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_08	00_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	00_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	01_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	01_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	02_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	02_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	03_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	03_5m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_08	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	04_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	04_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	04_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	04_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	05_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	05_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	06_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	06_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	07_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	07_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	09_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	09_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	09_5m	SUTA	*Suaeda taxifolia*	yes	perennial	shrub
Marsh Veg_08	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	10_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	11_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	11_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	12_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	13_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	13_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	13_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	13_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	14_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	14_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_08	15_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	15_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_08	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	16_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	16_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	16_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	17_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	17_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	18_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	18_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	18_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	18_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	19_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	19_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	19_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	19_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	20_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	20_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	20_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	21_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	21_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	21_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	21_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	22_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	22_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	22_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	22_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	23_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	23_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	23_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	23_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	24_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	24_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	24_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	25_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	25_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	25_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	25_5m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_08	26_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	26_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	26_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_08	26_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	27_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	27_0m	SUTA	*Suaeda taxifolia*	yes	perennial	shrub
Marsh Veg_08	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	27_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_08	28_0m	CYSP	*Cyperus* sp.	yes	annual	herb
Marsh Veg_08	28_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	28_5m	CYSP	*Cyperus* sp.	yes	annual	herb
Marsh Veg_08	28_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	29_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	29_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_08	30_0m	CYSP	*Cyperus* sp.	yes	annual	herb
Marsh Veg_08	30_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_08	5m_belt	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_08	5m_belt	DSLI	*Distichlis littoralis*	yes	perennial	herb
Marsh Veg_09	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_09	5m_belt	LICA	*Limonium californicum*	yes	perennial	herb
Marsh Veg_09	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	01_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	01_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	01_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_09	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	01_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	01_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_09	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	02_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	02_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	03_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_09	03_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	04_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	04_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	05_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	05_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	06_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	06_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	06_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_09	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	07_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	07_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_09	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	07_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	07_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_09	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	08_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_09	08_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	09_0m	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_09	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	09_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	09_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	10_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	10_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	10_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	11_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	11_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	12_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_09	12_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	12_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	13_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	13_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	13_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	13_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	14_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	14_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	14_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	14_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	15_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	15_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	15_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	16_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	16_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	16_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	16_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	17_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	17_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	17_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	18_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	18_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	18_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	18_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	19_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	19_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	19_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	19_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	20_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	21_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	21_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	21_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	22_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	22_5m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_09	22_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	23_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	23_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_09	23_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	23_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	24_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	24_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	24_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	25_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	25_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_09	25_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	25_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	26_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	26_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	27_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	27_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_09	28_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	28_5m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_09	28_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	29_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_09	29_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	29_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_09	30_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_09	30_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_09	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_09	5m_belt	SUES	*Suaeda esteroa*	yes	perennial	herb
Marsh Veg_09	5m_belt	SCCA	*Schoenoplectus californicus*	yes	perennial	herb
Marsh Veg_10	00_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	00_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	01_0m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Marsh Veg_10	01_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	01_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	01_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	01_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_10	02_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	02_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	02_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_10	02_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	03_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	03_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	03_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	04_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	04_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	04_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	05_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	06_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	07_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	08_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	08_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	08_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	09_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	09_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	10_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	10_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	11_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	11_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	12_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_10	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	12_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	12_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	13_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	13_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	14_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	14_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	14_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	15_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	15_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	16_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	16_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	16_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_10	17_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	17_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	18_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	18_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	18_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	19_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	19_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	20_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	20_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	20_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	21_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_10	21_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	21_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	22_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	22_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	22_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_10	23_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	23_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	24_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	24_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	25_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	25_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	25_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_10	25_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	26_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	26_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	26_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	26_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	27_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	27_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	27_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	28_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	28_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	28_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	28_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	29_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	29_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	29_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	30_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_10	30_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_10	5m_belt	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_10	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_10	5m_belt	ISME	*Isocoma menziesii*	yes	perennial	shrub
Marsh Veg_10	5m_belt	LICA	*Limonium californicum*	yes	perennial	herb
Marsh Veg_10	5m_belt	SUES	*Suaeda esteroa*	yes	perennial	herb
Marsh Veg_11	00_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	01_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_11	01_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	02_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	02_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	03_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	03_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	04_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	04_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	05_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	06_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	07_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	07_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_11	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	07_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	08_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_11	08_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	08_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	09_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	09_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	10_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	10_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	11_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	11_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	12_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_11	12_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	13_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	13_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	14_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	14_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	14_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	15_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	15_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	15_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	16_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	16_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	16_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	17_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	17_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	17_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	17_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	18_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	18_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	18_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	18_5m	LICA	*Limonium californicum*	yes	perennial	herb
Marsh Veg_11	19_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	19_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	19_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	20_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	20_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	21_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	21_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	21_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	22_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	23_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	23_5m	SPFO	*Spartina foliosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_11	24_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_11	24_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	24_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_11	24_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	25_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_11	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	26_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	26_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	26_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	27_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	28_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	28_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	28_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	28_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	29_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	29_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	29_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	29_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	30_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_11	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_11	30_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_11	5m_belt	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_11	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_11	5m_belt	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_11	5m_belt	SUES	*Suaeda esteroa*	yes	perennial	herb
Marsh Veg_12	00_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	00_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	01_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	01_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	01_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	01_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_12	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_12	02_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_12	02_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_12	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	03_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	03_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	03_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	03_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	04_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	05_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	07_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	07_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	08_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	08_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	09_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	09_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	10_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	10_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	11_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	11_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	12_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	12_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	13_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_12	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_12	13_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	14_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	14_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	15_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	15_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	16_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	16_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	17_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	17_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	18_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	18_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	19_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	19_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	20_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	21_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	21_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	22_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	22_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	22_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	22_5m	LICA	*Limonium californicum*	yes	perennial	herb
Marsh Veg_12	22_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	23_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	23_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	23_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	23_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	23_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	23_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	24_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	24_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	24_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_12	24_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_12	24_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	25_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_12	25_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	25_5m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_12	25_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	26_0m	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_12	26_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	26_5m	SPFO	*Spartina foliosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_12	27_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	27_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_12	27_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	28_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	28_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_12	29_0m	BG	*Bare ground*	-	-	-
Marsh Veg_12	29_5m	BG	*Bare ground*	-	-	-
Marsh Veg_12	30_0m	BG	*Bare ground*	-	-	-
Marsh Veg_12	5m_belt	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_12	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_12	5m_belt	PLOD	*Pluchea odorata*	yes	annual	herb
Marsh Veg_12	5m_belt	SUES	*Suaeda esteroa*	yes	perennial	herb
Marsh Veg_13	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	03_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	04_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	05_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	05_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	06_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	07_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	07_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	08_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	09_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	09_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	10_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	10_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	11_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	11_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	12_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_13	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	14_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	16_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	17_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	17_5m	WK	*Wrack*	-	-	-
Marsh Veg_13	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	22_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	27_0m	WK	*Wrack*	-	-	-
Marsh Veg_13	27_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_13	5m_belt	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_13	5m_belt	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_13	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_13	5m_belt	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_13	5m_belt	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_13	5m_belt	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_13	5m_belt	SUES	*Suaeda esteroa*	yes	perennial	herb
Marsh Veg_14	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_14	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	08_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	09_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	14_5m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_14	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	16_0m	WK	*Wrack*	-	-	-
Marsh Veg_14	16_5m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_14	17_0m	WK	*Wrack*	-	-	-
Marsh Veg_14	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_14	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	25_5m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_14	26_0m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_14	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	27_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_14	5m_belt	SUES	*Suaeda esteroa*	yes	perennial	herb
Marsh Veg_15	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	08_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	09_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_15	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	16_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	17_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	17_5m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_15	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	18_0m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_15	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	19_0m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_15	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	20_0m	ATPR	*Atriplex prostrata*	yes	annual	herb
Marsh Veg_15	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	27_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_15	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_15	5m_belt	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_15	5m_belt	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	00_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	00_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	01_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	01_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	02_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	02_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	02_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	02_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	03_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	03_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	03_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	03_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	04_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	04_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	04_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	04_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	04_5m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	05_0m	SPFO	*Spartina foliosa*	yes	perennial	herb
Marsh Veg_16	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	07_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	08_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	08_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	09_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	09_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	09_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	10_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_16	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	10_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	11_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	11_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	12_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	12_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	12_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	13_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	13_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	13_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	13_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	14_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	14_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	15_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	15_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	15_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	15_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	16_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	16_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	17_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	17_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	18_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	18_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	19_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	19_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	19_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_16	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	20_5m	BG	*Bare ground*	-	-	-
Marsh Veg_16	21_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_16	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	21_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	22_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	22_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	23_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	23_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	24_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	24_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	25_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	25_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	26_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	26_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	27_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	27_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	27_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	28_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	28_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	28_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	29_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	29_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	29_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	29_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_16	30_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Marsh Veg_16	30_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Marsh Veg_16	30_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Marsh Veg_16	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_16	5m_belt	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Marsh Veg_16	5m_belt	BAMA	*Batis maritima*	yes	perennial	shrub
Marsh Veg_16	5m_belt	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_16	5m_belt	ISME	*Isocoma menziesii*	yes	perennial	shrub
Marsh Veg_16	5m_belt	LICA	*Limonium californicum*	yes	perennial	herb
Marsh Veg_16	5m_belt	PLOD	*Pluchea odorata*	yes	annual	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_17	00_0m	BG	*Bare ground*	-	-	-
Marsh Veg_17	00_5m	BG	*Bare ground*	-	-	-
Marsh Veg_17	01_0m	BG	*Bare ground*	-	-	-
Marsh Veg_17	01_5m	BG	*Bare ground*	-	-	-
Marsh Veg_17	02_0m	BG	*Bare ground*	-	-	-
Marsh Veg_17	02_5m	BG	*Bare ground*	-	-	-
Marsh Veg_17	03_0m	BG	*Bare ground*	-	-	-
Marsh Veg_17	03_5m	BG	*Bare ground*	-	-	-
Marsh Veg_17	04_0m	BG	*Bare ground*	-	-	-
Marsh Veg_17	04_5m	BG	*Bare ground*	-	-	-
Marsh Veg_17	05_0m	BG	*Bare ground*	-	-	-
Marsh Veg_17	05_5m	BG	*Bare ground*	-	-	-
Marsh Veg_17	06_0m	BG	*Bare ground*	-	-	-
Marsh Veg_17	06_5m	BG	*Bare ground*	-	-	-
Marsh Veg_17	07_0m	BG	*Bare ground*	-	-	-
Marsh Veg_17	07_5m	BG	*Bare ground*	-	-	-
Marsh Veg_17	08_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	08_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	09_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	09_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	10_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	10_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	11_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	11_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	12_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	12_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	13_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	13_5m	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_17	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	14_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	14_5m	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_17	14_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	15_0m	CUSA	*Cuscuta salina*	yes	annual	herb
Marsh Veg_17	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	15_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	16_0m	FASA	*Frankenia salina*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_17	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	16_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	17_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	17_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	18_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	18_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	19_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	19_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	20_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	20_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	21_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	21_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	22_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	23_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	23_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	24_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	24_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	25_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	25_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	26_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	26_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	27_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	27_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	28_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	29_0m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	29_5m	FASA	*Frankenia salina*	yes	perennial	herb
Marsh Veg_17	30_0m	FASA	*Frankenia salina*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Marsh Veg_17	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Marsh Veg_17	5m_belt	BRMA	*Bromus madritensis*	no	annual	herb
Marsh Veg_17	5m_belt	BRDI	*Bromus diandrus*	no	annual	herb
Marsh Veg_17	5m_belt	BRNI	*Brassica nigra*	no	annual	herb
Marsh Veg_17	5m_belt	ATPR	*Atriplex prostrata*	yes	annual	herb
Transitional Veg_01	00_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	00_0m	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_01	00_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	00_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	00_5m	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_01	01_0m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_01	01_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	01_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	01_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	01_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	02_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	02_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	02_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	02_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	02_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	02_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	02_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	02_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	03_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	03_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	03_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	03_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	03_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	04_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	04_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	04_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	04_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	04_5m	ERFA	*Eriogonum fasciculatum*	yes	perennial	shrub
Transitional Veg_01	05_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	05_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	06_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	06_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	06_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_01	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	06_5m	ACGL	*Acmispon glaber*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_01	06_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	06_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	07_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	07_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	07_0m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_01	07_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	07_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	07_5m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_01	08_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_01	08_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	08_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	09_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	09_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	09_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_01	09_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	09_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	09_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_01	10_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	10_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	10_0m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_01	10_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	10_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	11_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	11_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	11_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	11_5m	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_01	11_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	12_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_01	12_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	12_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	12_5m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_01	12_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	13_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	13_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	13_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	14_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	14_0m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_01	14_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	14_5m	ACGL	*Acmispon glaber*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_01	14_5m	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_01	14_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	15_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	15_0m	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_01	15_0m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_01	15_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	15_5m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_01	15_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_01	15_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	16_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	16_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	16_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	16_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	17_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	17_0m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_01	17_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	17_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	17_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	17_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	18_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	18_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	18_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	18_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	19_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	19_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_01	19_0m	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_01	19_5m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_01	19_5m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_01	19_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	20_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	20_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_01	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	20_0m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_01	20_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	20_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	21_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	21_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_01	21_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	21_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	21_5m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_01	21_5m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_01	22_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	22_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	22_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	22_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	22_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	23_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	23_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	23_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	23_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	23_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	24_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	24_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	24_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	24_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	24_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	24_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	24_5m	ERFA	*Eriogonum fasciculatum*	yes	perennial	shrub
Transitional Veg_01	25_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	25_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	25_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	25_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	25_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	25_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	26_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	26_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_01	26_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	26_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	26_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	27_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	27_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	27_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	27_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	27_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	27_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	27_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	27_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	28_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	28_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	28_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	28_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	28_5m	ACGL	*Acmispon glaber*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_01	28_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	28_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_01	28_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	29_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	29_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	29_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	29_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	29_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	29_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_01	29_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_01	29_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	30_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_01	30_0m	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_01	30_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_01	5m_belt	ACMI	*Achillea millefolium*	yes	perennial	herb
Transitional Veg_01	5m_belt	CASP	*Carex* sp.	yes	perennial	herb
Transitional Veg_01	5m_belt	ERSP	*Eriogonum* sp.	yes	perennial	shrub
Transitional Veg_01	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_01	5m_belt	BRCA	*Bromus sitchensis var. carinatus*	yes	annual	herb
Transitional Veg_01	5m_belt	BASA	*Baccharis salicifolia*	yes	perennial	shrub
Transitional Veg_01	5m_belt	SOSP	*Solanum* sp.	no	perennial	herb
Transitional Veg_01	5m_belt	PLOD	*Pluchea odorata*	yes	annual	herb
Transitional Veg_01	5m_belt	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_01	5m_belt	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_02	00_0m	ERFA	*Eriogonum fasciculatum*	yes	perennial	shrub
Transitional Veg_02	00_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	00_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	01_0m	BG	*Bare ground*	-	-	-
Transitional Veg_02	01_5m	BG	*Bare ground*	-	-	-
Transitional Veg_02	02_0m	BG	*Bare ground*	-	-	-
Transitional Veg_02	02_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	03_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	03_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	04_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	04_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	04_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	07_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_02	07_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	07_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_02	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	08_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	08_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	08_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	08_0m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_02	08_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	08_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_02	09_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	09_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	09_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	09_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	10_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	10_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_02	10_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	10_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	11_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	11_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	12_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	12_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_02	12_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	12_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_02	13_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_02	13_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	13_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	14_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	14_0m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_02	14_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	14_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	15_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	15_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	15_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	16_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	16_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	16_0m	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_02	16_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	16_5m	ISME	*Isocoma menziesii*	yes	perennial	shrub
Transitional Veg_02	17_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	17_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	17_0m	ENCA	*Encelia californica*	yes	perennial	shrub

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_02	17_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	17_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	18_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	18_0m	ISME	*Isocoma menziesii*	yes	perennial	shrub
Transitional Veg_02	18_5m	ERFA	*Eriogonum fasciculatum*	yes	perennial	shrub
Transitional Veg_02	19_0m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_02	19_5m	ACMI	*Achillea millefolium*	yes	perennial	herb
Transitional Veg_02	19_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_02	19_5m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_02	19_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_02	20_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	20_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	21_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	21_0m	ACMI	*Achillea millefolium*	yes	perennial	herb
Transitional Veg_02	21_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	21_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	21_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	21_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_02	21_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	22_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	22_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	22_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	22_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	23_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	23_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	23_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	23_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	23_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_02	24_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	24_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	24_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	24_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_02	25_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	25_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	25_5m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_02	26_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	26_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	26_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	27_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	27_0m	ARCA	*Artemisia californica*	yes	perennial	shrub

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_02	27_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	27_5m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_02	28_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_02	28_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	28_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	29_0m	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_02	29_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	29_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_02	30_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_02	5m_belt	ADCA	*Adolphia californica*	yes	perennial	shrub
Transitional Veg_02	5m_belt	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_02	5m_belt	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_02	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_02	5m_belt	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_03	00_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	00_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_03	00_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_03	01_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	01_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	02_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	02_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_03	02_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	02_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_03	03_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	03_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_03	03_5m	BG	*Bare ground*	-	-	-
Transitional Veg_03	04_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_03	04_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_03	04_5m	BG	*Bare ground*	-	-	-
Transitional Veg_03	05_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	05_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	06_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	06_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_03	06_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	07_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	07_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_03	07_5m	ISME	*Isocoma menziesii*	yes	perennial	shrub
Transitional Veg_03	07_5m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_03	08_0m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_03	08_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_03	09_0m	ACGL	*Acmispon glaber*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_03	09_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	10_0m	BG	*Bare ground*	-	-	-
Transitional Veg_03	10_5m	BG	*Bare ground*	-	-	-
Transitional Veg_03	11_0m	PSCA	*Pseudognaphalium californicum*	yes	annual	herb
Transitional Veg_03	11_5m	BG	*Bare ground*	-	-	-
Transitional Veg_03	12_0m	BG	*Bare ground*	-	-	-
Transitional Veg_03	12_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	13_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_03	13_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	13_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_03	14_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	14_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	14_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	15_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	15_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	16_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	16_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_03	17_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	17_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_03	17_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	17_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	18_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	18_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	19_0m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_03	19_5m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_03	20_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	20_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	20_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_03	21_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	21_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_03	21_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	22_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	22_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	22_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_03	23_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	23_0m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_03	23_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	24_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	24_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	24_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	24_5m	ARCA	*Artemisia californica*	yes	perennial	shrub

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_03	25_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	25_0m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_03	25_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	26_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_03	26_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	26_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_03	26_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_03	26_5m	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_03	27_0m	BG	*Bare ground*	-	-	-
Transitional Veg_03	27_5m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_03	28_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_03	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_03	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_03	29_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_03	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_03	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_03	5m_belt	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Transitional Veg_03	5m_belt	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_03	5m_belt	ERFA	*Eriogonum fasciculatum*	yes	perennial	shrub
Transitional Veg_03	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_03	5m_belt	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_03	5m_belt	LICA	*Limonium californicum*	yes	perennial	herb
Transitional Veg_03	5m_belt	PLOD	*Pluchea odorata*	yes	annual	herb
Transitional Veg_03	5m_belt	PSST	*Pseudognaphalium stramineum*	yes	perennial	herb
Transitional Veg_03	5m_belt	EUMA	*Euphorbia maculata*	no	annual	herb
Transitional Veg_03	5m_belt	SAAP	*Salvia apiana*	yes	perennial	shrub
Transitional Veg_03	5m_belt	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_04	00_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_04	00_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_04	01_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	01_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_04	02_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_04	02_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_04	02_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	03_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	03_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	04_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_04	04_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_04	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_04	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_04	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_04	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_04	07_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_04	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	08_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	08_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_04	09_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	09_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	10_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	10_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	11_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_04	11_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	12_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	13_0m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Transitional Veg_04	13_5m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Transitional Veg_04	14_0m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Transitional Veg_04	14_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	15_0m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Transitional Veg_04	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	16_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	16_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	17_0m	SUES	*Suaeda esteroa*	yes	perennial	herb
Transitional Veg_04	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	18_0m	SUES	*Suaeda esteroa*	yes	perennial	herb
Transitional Veg_04	18_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_04	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	19_0m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_04	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	19_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_04	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	20_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_04	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	22_0m	BG	*Bare ground*	-	-	-
Transitional Veg_04	22_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_04	23_0m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_04	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_04	24_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_04	24_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_04	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	25_0m	SUES	*Suaeda esteroa*	yes	perennial	herb
Transitional Veg_04	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	26_5m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Transitional Veg_04	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	27_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	27_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	28_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	29_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_04	29_5m	BG	*Bare ground*	-	-	-
Transitional Veg_04	30_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_04	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_04	5m_belt	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_04	5m_belt	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_04	5m_belt	CRTR	*Cressa truxillensis*	yes	perennial	herb
Transitional Veg_04	5m_belt	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_04	5m_belt	ERFA	*Eriogonum fasciculatum*	yes	perennial	shrub
Transitional Veg_04	5m_belt	ISME	*Isocoma menziesii*	yes	perennial	shrub
Transitional Veg_04	5m_belt	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_04	5m_belt	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_04	5m_belt	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_04	5m_belt	LICA	*Limonium californicum*	yes	perennial	herb
Transitional Veg_04	5m_belt	SPFO	*Spartina foliosa*	yes	perennial	herb
Transitional Veg_05	00_0m	BG	*Bare ground*	-	-	-
Transitional Veg_05	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	01_0m	BG	*Bare ground*	-	-	-
Transitional Veg_05	01_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_05	02_0m	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_05	02_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_05	03_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_05	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	03_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_05	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	04_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_05	04_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_05	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	06_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_05	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	07_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	08_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	08_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	09_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	09_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	10_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	10_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_05	10_5m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_05	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	11_0m	BG	*Bare ground*	-	-	-
Transitional Veg_05	11_5m	BG	*Bare ground*	-	-	-
Transitional Veg_05	12_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	12_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	12_5m	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_05	13_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	13_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	14_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	14_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	15_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	15_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	16_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	16_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	16_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	17_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	17_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	18_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	18_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	18_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	19_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	19_5m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_05	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	22_5m	BG	*Bare ground*	-	-	-
Transitional Veg_05	23_0m	BG	*Bare ground*	-	-	-
Transitional Veg_05	23_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_05	24_0m	BG	*Bare ground*	-	-	-
Transitional Veg_05	24_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	25_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	25_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_05	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	26_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_05	26_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	27_0m	BG	*Bare ground*	-	-	-
Transitional Veg_05	27_5m	BG	*Bare ground*	-	-	-
Transitional Veg_05	28_0m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_05	28_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_05	28_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	29_0m	BG	*Bare ground*	-	-	-
Transitional Veg_05	29_5m	BG	*Bare ground*	-	-	-
Transitional Veg_05	30_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_05	5m_belt	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Transitional Veg_05	5m_belt	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_05	5m_belt	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_05	5m_belt	ISME	*Isocoma menziesii*	yes	perennial	shrub
Transitional Veg_05	5m_belt	SAME	*Salvia mellifera*	yes	perennial	shrub
Transitional Veg_06	00_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	00_0m	JUAC	*Juncus acutus* ssp. *leopoldii*	yes	perennial	herb
Transitional Veg_06	00_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	01_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_06	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	01_5m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_06	01_5m	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_06	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	02_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	02_0m	JACA	*Jaumea carnosa*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_06	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	02_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	02_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	02_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	03_0m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_06	03_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_06	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	03_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	04_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	04_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	04_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	05_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	05_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	06_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	06_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	07_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	07_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	08_0m	ARSU	*Arthrocnemum subterminale*	yes	perennial	herb
Transitional Veg_06	08_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	08_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	08_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	08_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	09_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	09_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	09_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	09_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	10_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	10_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	10_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	10_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_06	11_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	11_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_06	11_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	11_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	11_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	12_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	12_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	12_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_06	12_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	13_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	13_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	14_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	15_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	15_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	16_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	16_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	17_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	17_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	18_0m	BG	*Bare ground*	-	-	-
Transitional Veg_06	18_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	19_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	19_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	20_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	20_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	21_0m	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_06	21_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	21_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	22_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	22_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	23_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	23_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	24_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_06	24_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	24_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	25_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	25_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_06	25_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	26_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_06	26_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	26_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_06	26_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_06	27_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_06	27_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_06	27_5m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_06	27_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	28_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_06	28_5m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	29_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_06	29_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_06	29_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_06	29_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_06	29_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_06	29_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_06	30_0m	ISME	*Isocoma menziesii*	yes	perennial	shrub
Transitional Veg_06	5m_belt	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_06	5m_belt	SPFO	*Spartina foliosa*	yes	perennial	herb
Transitional Veg_07	00_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	00_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	00_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	00_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	01_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	01_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	01_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	01_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	02_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	02_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	02_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	03_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	03_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	03_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	03_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	04_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_07	04_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	04_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	05_0m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_07	05_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	05_5m	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_07	05_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	06_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_07	06_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	06_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	06_5m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_07	07_0m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_07	07_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	07_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	08_0m	BG	*Bare ground*	-	-	-
Transitional Veg_07	08_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	09_0m	JACA	*Jaumea carnosa*	yes	perennial	herb
Transitional Veg_07	09_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	09_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	09_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	10_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	10_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	11_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	11_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	11_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	12_0m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_07	12_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	12_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	12_5m	DSLI	*Distichlis littoralis*	yes	perennial	herb
Transitional Veg_07	13_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	13_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	14_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	14_0m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	14_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	14_5m	SAPA	*Salicornia pacifica*	yes	perennial	herb
Transitional Veg_07	15_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	15_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	15_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	16_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	16_0m	STSP	*Stipa* sp.	yes	perennial	herb
Transitional Veg_07	16_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	16_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	17_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	17_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	18_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	18_0m	IVHA	*Iva hayesiana*	yes	perennial	herb
Transitional Veg_07	18_5m	BG	*Bare ground*	-	-	-
Transitional Veg_07	19_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	19_0m	DSSP	*Distichlis spicata*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_07	19_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	19_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	20_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	20_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	20_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	20_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	21_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	21_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_07	21_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	21_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	21_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	22_0m	BAPI	*Baccharis pilularis*	yes	perennial	shrub
Transitional Veg_07	22_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	22_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	22_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	22_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	23_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	23_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	23_0m	ISME	*Isocoma menziesii*	yes	perennial	shrub
Transitional Veg_07	23_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	24_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	24_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	24_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	25_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	25_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	25_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	25_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	26_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	26_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	26_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	26_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	26_5m	ARTR	*Artemisia tridentata*	yes	perennial	shrub
Transitional Veg_07	26_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	27_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	27_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	27_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	27_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	27_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	28_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	28_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	28_5m	ACGL	*Acmispon glaber*	yes	perennial	herb

Transect	Meter	Species	Species Name	Native	Duration	Type
Transitional Veg_07	28_5m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	28_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	29_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	29_0m	ARCA	*Artemisia californica*	yes	perennial	shrub
Transitional Veg_07	29_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	29_5m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	29_5m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	30_0m	ACGL	*Acmispon glaber*	yes	perennial	herb
Transitional Veg_07	30_0m	DSSP	*Distichlis spicata*	yes	perennial	herb
Transitional Veg_07	30_0m	ISME	*Isocoma menziesii*	yes	perennial	shrub
Transitional Veg_07	5m_belt	DIAU	*Diplacus aurantiacus*	yes	perennial	shrub
Transitional Veg_07	5m_belt	ENCA	*Encelia californica*	yes	perennial	shrub
Transitional Veg_07	5m_belt	FASA	*Frankenia salina*	yes	perennial	herb
Transitional Veg_07	5m_belt	SAME	*Salvia mellifera*	yes	perennial	shrub

Table C-2. Spartina Data Table

Transect	Quadrat	No. of Stems	No. of Stems > 90 cm	Average Height (cm)	Individual Stem Height (cm)																																																		
					H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18	H19	H20	H21	H22	H23	H24	H25	H26	H27	H28	H29	H30	H31	H32	H33	H34	H35	H36	H37	H38	H39	H40	H41	H42	H43	H44	H45	H46	H47	H48	H49	H50	H51-H63
Spartina_01	01	34	0	46.74	64	55	47	28	32	56	44	60	64	61	46	54	49	56	48	26	56	61	5	52	45	58	34	71	64	45	43	57	47	60	56	27	9	9																
Spartina_01	02	35	0	47.86	40	68	52	68	65	66	56	37	6	7	9	18	15	41	71	63	65	57	43	55	50	57	54	56	41	50	64	60	68	72	57	41	70	23	10															
Spartina_01	03	29	0	50.62	63	62	57	36	64	59	54	45	42	34	54	56	51	57	48	60	55	34	48	34	51	32	68	57	63	23	51	48	62																					
Spartina_01	04	31	0	46.00	72	7	7	13	49	53	27	5	61	36	41	69	59	61	67	43	69	15	10	41	47	75	61	45	51	59	44	61	59	57	62																			
Spartina_01	05	22	0	56.45	58	8	75	60	77	67	73	54	58	54	64	64	70	52	73	64	68	62	58	68	10	5																												
Spartina_01	06	38	0	54.47	62	70	72	64	70	57	54	57	52	56	54	51	58	55	71	57	70	30	70	59	62	60	12	15	10	7	51	68	61	68	48	64	64	74	61	52	45	59												
Spartina_01	07	38	0	51.08	59	52	59	60	63	53	57	57	64	60	10	5	6	3	5	68	72	64	49	65	58	40	66	73	64	50	42	59	68	65	66	30	56	64	50	35	60	64												
Spartina_01	08	41	0	41.68	67	8	52	65	41	40	41	27	26	49	61	55	56	46	62	60	40	28	17	48	33	51	64	65	48	8	5	6	64	60	3	10	8	52	44	44	45	57	44	60	49									
Spartina_01	09	29	1	55.21	45	68	68	35	15	34	42	71	55	111	54	35	46	70	65	67	78	63	41	45	57	58	49	31	46	51	88	56	57																					
Spartina_01	10	29	0	52.86	89	88	53	68	70	60	82	52	51	56	27	18	42	10	24	34	26	11	90	87	70	55	66	79	50	37	67	54	17																					
Spartina_02	01	42	0	37.21	50	47	26	36	39	58	10	8	61	53	52	48	45	40	43	52	43	39	36	49	32	44	53	57	33	28	47	59	22	12	50	49	45	56	53	48	6	8	10	8	5	3								
Spartina_02	02	39	0	44.95	61	40	46	59	33	47	49	46	52	60	40	33	59	50	63	50	52	51	53	49	45	51	54	65	59	64	63	64	50	45	55	66	12	10	8	9	6	14	20											
Spartina_02	03	47	0	45.68	54	61	51	52	74	49	37	53	57	26	36	60	50	69	54	48	42	34	57	63	63	26	54	56	55	52	39	55	50	58	25	55	60	50	57	62	58	52	45	53	54	8	3	7	9	4	10			
Spartina_02	04	25	0	49.52	16	17	25	55	48	47	54	51	53	57	59	61	48	47	61	46	56	48	53	57	54	61	52	52	60																									
Spartina_02	05	32	0	42.00	7	10	11	15	8	10	12	55	57	59	54	47	55	52	47	53	59	55	62	56	69	55	35	7	50	53	40	58	59	53	51	30																		
Spartina_02	06	29	0	40.34	53	51	58	43	60	66	20	48	62	53	55	62	62	51	69	53	61	65	59	60	6	7	10	5	11	8	3	4	5																					
Spartina_02	07	33	0	53.48	60	58	60	59	61	60	78	71	77	68	63	72	60	82	63	53	61	53	80	59	65	84	54	45	24	17	48	19	21	16	17	45	12																	
Spartina_02	08	41	0	50.00	68	67	82	78	61	86	64	83	47	70	61	79	35	37	18	19	13	10	16	14	13	66	51	54	70	85	83	62	45	35	48	46	74	45	62	61	29	56	31	6	20									
Spartina_02	09	39	0	47.08	45	74	87	62	56	82	54	57	42	50	53	42	45	38	22	18	23	19	19	11	14	64	74	45	68	54	68	52	72	73	52	77	61	90	47	6	5	10	5											
Spartina_02	10	33	0	43.67	76	58	74	50	53	49	55	55	58	48	51	79	40	54	48	68	42	24	10	7	15	8	12	53	22	71	85	41	51	49	10	6	19																	
Spartina_03	01	35	3	59.89	77	86	15	76	91	85	88	10	32	68	87	9	82	69	76	16	11	78	93	70	84	77	70	55	90	13	70	63	56	5	12	67	78	40	97															
Spartina_03	02	34	13	70.91	84	79	40	26	84	80	98	101	68	70	71	71	92	13	44	94	91	91	90	95	91	46	100	107	10	11	8	8	90	92	89	81	101	95																
Spartina_03	03	25	3	70.76	39	79	72	77	81	40	69	47	88	79	91	93	60	86	69	61	70	76	15	93	76	63	82	80	83																									
Spartina_03	04	32	3	61.97	77	16	17	87	61	62	58	70	15	91	97	61	70	60	82	33	81	64	9	33	40	81	62	11	89	76	92	75	75	87	82	69																		
Spartina_03	05	50	4	60.20	70	86	90	81	5	15	11	73	66	78	40	43	57	54	84	102	10	7	71	83	72	10	91	4	4	10	97	61	68	75	79	55	78	80	80	92	61	68	12	12	83	85	76	49	85	81	71	76	84	85	
Spartina_03	06	32	8	75.16	51	85	52	70	69	67	75	92	78	77	87	93	89	82	77	94	101	76	77	78	72	95	75	92	91	81	90	84	109	20	12	14																		
Spartina_03	07	19	1	67.00	91	79	69	64	45	39	87	80	84	62	65	57	56	48	73	72	64	75	63																															
Spartina_03	08	26	0	66.38	43	75	73	52	43	59	53	62	66	77	59	67	65	84	71	69	71	74	58	80	89	81	80	48	61	66																								
Spartina_03	09	34	18	86.97	18	99	96	80	91	81	87	80	95	97	97	95	101	100	75	88	72	87	93	92	74	94	92	103	71	95	89	97	87	73	91	89	85	93																
Spartina_03	10	32	6	68.25	40	8	14	7	54	70	61	65	92	67	81	70	83	70	68	62	75	60	96	71	69	72	73	64	75	106	101	99	96	72	70	73																		
Spartina_04	01	41	3	56.98	53	76	8	65	85	9	85	45	28	91	73	83	59	57	63	14	39	53	17	70	15	80	64	82	68	81	82	6	78	80	10	83	19	12	94	12	87	67	67	81	95									
Spartina_04	02	34	0	47.38	42	69	76	67	41	15	75	72	44	16	45	79	81	62	59	52	3	61	74	49	14	10	11	10	76	51	75	46	5	27	30	63	32	79																
Spartina_04	03	35	2	60.94	60	63	10	52	55	67	67	88	50	82	78	70	63	93	12	83	87	33	89	85	75	71	25	20	26	37	60	80	77	26	65	96	27	79	82															
Spartina_04	04	32	2	57.72	23	49	76	78	78	31	71	47	20	67	70	107	70	53	39	73	85	31	68	84	78	82	68	95	28	16	62	13	15	43	46	81																		
Spartina_04	05	39	7	58.77	54	49	92	94	100	58	35	21	22	30	23	86	100	79	51	80	78	84	46	41	45	46	59	97	72	85	97	25	69	68	95	23	40	60	70	14	23	67	14											
Spartina_04	06	43	10	70.53	76	80	61	91	92	53	80	81	95	6	86	79	40	77	93	63	3	60	51	79	65	92	80	87	52	74	66	85	76	63	93	93	99	10	8	78	90	95	80	62	57	90	92							
Spartina_04	07	29	0	65.41	83	74	40	84	75	82	63	76	10	70	64	72	79	30	56	60	57	81	2	72	65	84	90	86	76	70	66	60	70																					

Transect	Quadrat	No. of Stems	No. of Stems > 90 cm	Average Height (cm)	Individual Stem Height (cm)																																																		
					H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18	H19	H20	H21	H22	H23	H24	H25	H26	H27	H28	H29	H30	H31	H32	H33	H34	H35	H36	H37	H38	H39	H40	H41	H42	H43	H44	H45	H46	H47	H48	H49	H50	H51-H63
Spartina_04	08	25	3	62.48	86	64	58	59	91	14	6	8	52	55	62	55	71	91	66	68	92	80	75	64	60	70	74	71	70																										
Spartina_04	09	13	0	62.69	70	52	69	70	71	78	61	66	53	40	66	80	39																																						
Spartina_04	10	19	0	59.42	52	60	70	60	63	65	58	54	44	33	64	62	63	67	66	70	71	40	67																																
Spartina_05	01	41	2	47.37	80	69	90	72	92	65	81	84	91	87	84	89	21	22	20	47	51	50	68	63	70	14	27	30	21	19	60	40	17	44	33	5	10	40	52	61	18	6	27	9	13										
Spartina_05	02	44	3	55.68	83	89	87	94	81	77	69	81	79	68	65	70	66	73	80	91	95	80	81	74	76	69	40	39	45	44	48	25	51	59	36	31	17	47	37	22	28	12	30	24	23	33	15	16							
Spartina_05	03	40	7	59.80	97	84	94	87	86	98	97	95	84	83	101	92	81	65	75	66	54	55	79	76	82	74	30	50	35	53	56	36	52	34	66	24	18	15	25	12	17	22	31	11											
Spartina_05	04	36	0	50.81	73	81	87	85	76	82	77	77	69	71	79	75	66	70	71	62	78	82	84	57	28	10	8	30	6	48	45	16	32	14	15	39	8	10	6	12															
Spartina_05	05	31	1	49.29	95	77	64	73	73	74	71	74	86	74	82	69	70	75	51	40	56	53	58	27	28	19	22	11	10	5	26	17	15	17	16																				
Spartina_05	06	34	1	56.15	85	73	93	74	72	82	73	56	78	69	57	75	61	74	69	72	74	59	77	82	84	65	50	57	26	10	9	17	36	25	15	22	19	19																	
Spartina_05	07	35	3	52.51	89	71	75	93	92	70	82	78	82	91	65	68	79	89	75	49	47	29	34	50	60	45	39	37	4	20	12	17	25	17	33	10	15	54	42																
Spartina_05	08	42	10	63.36	91	82	114	97	102	93	65	74	68	86	90	89	86	87	66	90	65	95	82	96	73	65	66	54	84	69	75	93	92	95	26	9	19	13	14	11	13	8	6	29	15	14									
Spartina_05	09	34	9	64.41	93	94	112	107	111	81	90	97	66	82	103	70	68	80	81	76	90	84	76	95	67	63	66	96	17	6	9	19	11	8	10	15	14	33																	
Spartina_05	10	37	7	62.41	100	104	80	88	92	99	86	75	74	90	81	93	84	68	65	81	48	101	88	85	76	98	80	81	60	30	28	10	13	23	17	11	5	19	11	30	35														
Spartina_06	01	23	1	47.78	34	70	7	7	10	25	33	50	82	56	10	79	91	75	16	85	73	53	72	74	77	17	3																												
Spartina_06	02	13	0	54.00	15	69	60	56	82	61	76	71	56	89	58	5	4																																						
Spartina_06	03	17	0	51.53	71	38	28	81	68	37	64	17	40	70	60	20	49	69	60	61	43																																		
Spartina_06	04	24	0	38.33	9	7	5	49	43	38	29	53	63	49	16	57	59	20	50	53	11	66	4	71	64	16	41	47																											
Spartina_06	05	20	0	43.45	60	31	25	54	69	61	53	38	61	57	64	33	67	44	13	10	12	32	40	45																															
Spartina_06	06	20	0	44.30	57	27	21	36	58	41	24	62	45	16	56	7	56	55	57	61	60	58	44	45																															
Spartina_06	07	26	0	45.54	23	54	51	49	44	57	55	55	53	56	47	20	34	41	46	42	52	51	50	47	9	58	51	52	44	43																									
Spartina_06	08	31	0	47.94	8	68	46	53	61	79	6	62	52	58	51	53	53	54	53	48	10	66	55	52	61	53	57	14	39	26	55	65	51	44	33																				
Spartina_06	09	27	0	46.96	65	48	47	53	48	50	21	61	42	53	59	21	41	47	49	47	41	39	46	15	49	57	43	48	61	59	58																								
Spartina_06	10	21	0	43.43	53	44	57	61	51	55	29	33	47	56	60	58	34	43	56	62	6	4	3	48	52																														
Spartina_07	01	31	4	59.26	72	93	73	60	99	70	83	73	94	69	107	68	74	72	67	83	74	65	57	55	85	61	74	14	15	13	14	5	18	16	14																				
Spartina_07	02	27	0	53.59	75	57	79	70	51	55	60	61	86	79	43	74	76	62	65	27	71	59	73	61	53	63	9	10	15	8	5																								
Spartina_07	03	27	0	66.63	74	62	66	63	81	70	68	69	63	68	76	70	55	70	81	64	50	75	71	64	67	48	79	80	69	66	30																								
Spartina_07	04	29	0	53.21	60	47	73	69	74	68	68	67	70	60	74	62	72	53	45	78	53	51	67	61	82	64	64	16	7	5	13	15	5																						
Spartina_07	05	19	0	61.21	84	72	52	51	63	75	40	55	47	77	89	70	88	80	60	72	50	10	28																																
Spartina_07	06	11	1	55.73	78	75	78	79	76	78	92	15	17	17	8																																								
Spartina_07	07	29	0	58.79	68	78	80	75	80	72	77	65	61	66	82	64	72	76	74	81	57	51	57	83	59	87	87	16	6	10	8	3	10																						
Spartina_07	08	13	0	63.77	80	64	80	66	75	74	24	64	73	68	68	66	27																																						
Spartina_07	09	21	1	72.90	77	82	69	85	43	54	50	73	70	85	59	80	84	77	92	75	68	85	73	77	73																														
Spartina_07	10	33	2	52.33	67	70	59	73	70	67	90	90	43	82	74	62	85	75	67	95	85	75	72	78	94	76	7	4	8	7	5	6	22	10	3	3	3																		
Spartina_08	01	22	3	50.09	76	76	81	93	81	100	87	106	83	85	17	6	15	8	8	22	26	19	20	42	25	26																													
Spartina_08	02	29	7	51.90	96	76	65	104	91	102	77	72	60	102	86	82	83	101	70	102	24	15	5	12	17	6	5	8	9	11	9	11	4																						
Spartina_08	03	13	8	77.77	64	95	94	97	86	103	91	92	71	93	92	15	18																																						
Spartina_08	04	22	8	66.18	87	96	60	103	99	100	90	93	97	95	98	85	90	87	89	7	5	17	9	24	20	5																													
Spartina_08	05	8	2	68.63	86	91	83	82	103	34	57	13																																											
Spartina_08	06	23	13	81.96	104	91	93	89	87	57	96	100	61	105	100	95	98	95	95	99	89	84	81	102	21	15	28																												

Transect	Quadrat	No. of Stems	No. of Stems > 90 cm	Average Height (cm)	Individual Stem Height (cm)																																																		
					H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18	H19	H20	H21	H22	H23	H24	H25	H26	H27	H28	H29	H30	H31	H32	H33	H34	H35	H36	H37	H38	H39	H40	H41	H42	H43	H44	H45	H46	H47	H48	H49	H50	H51-H63
Spartina_08	07	23	1	47.43	54	89	100	84	78	75	75	88	82	81	66	35	58	15	8	24	8	24	3	12	8	6	18																												
Spartina_08	08	18	1	52.72	76	86	73	38	71	45	17	93	86	89	88	58	49	28	5	10	21	16																																	
Spartina_08	09	10	1	73.50	77	70	65	52	68	92	78	65	83	85																																									
Spartina_08	10	15	4	58.80	88	92	99	108	94	74	54	74	72	59	19	8	14	15	12																																				
Spartina_09	01	28	1	40.46	95	60	45	78	67	69	61	63	62	68	52	45	39	62	60	71	9	10	9	10	7	21	10	9	8	6	9	28																							
Spartina_09	02	31	1	38.32	65	96	48	51	58	60	68	64	76	64	73	70	66	67	68	43	66	5	6	6	6	10	10	3	4	5	6	4	8	5	7																				
Spartina_09	03	43	0	45.28	67	51	54	40	24	46	67	37	48	68	83	57	41	49	52	52	67	49	41	45	64	71	50	40	59	70	12	44	60	10	55	14	53	9	8	10	3	77	70	73	27	19	11								
Spartina_09	04	26	0	33.04	72	51	60	22	10	32	6	29	64	38	41	58	59	70	50	48	68	31	6	8	9	9	4	6	5	3																									
Spartina_09	05	23	0	47.48	52	59	48	38	60	67	41	60	44	56	57	52	66	41	63	56	51	59	42	38	14	6	22																												
Spartina_09	06	33	0	42.67	55	65	39	71	75	68	58	61	56	73	41	30	69	59	49	72	67	64	55	65	39	40	55	6	5	12	9	3	22	6	5	9	5																		
Spartina_09	07	61	0	35.10	74	60	74	63	56	45	51	68	61	66	59	73	73	78	67	70	70	62	70	63	78	80	61	56	62	60	76	60	59	63	13	6	8	5	7	5	5	11	3	8	3	3	3	9	5	2	3	4	2	4	2,4,2,7,6,3,6,10,12,17,5
Spartina_09	08	24	0	38.79	72	59	69	73	75	71	65	58	36	71	56	65	74	8	4	2	13	4	17	9	11	6	8	5																										
Spartina_09	09	37	0	36.27	74	41	83	64	40	61	38	69	78	36	79	74	70	78	64	53	62	65	27	41	25	10	5	3	10	7	4	3	11	12	12	3	8	8	6	12	6														
Spartina_09	10	22	0	40.73	37	36	61	55	58	63	80	58	68	47	34	57	58	50	56	14	9	9	7	10	14	15																													
Spartina_10	01	46	0	36.61	60	73	70	53	55	54	49	76	64	47	42	67	28	30	41	64	35	20	30	32	65	33	55	78	48	54	74	39	35	36	14	24	22	7	10	6	11	12	14	7	3	3	15	4	12	13					
Spartina_10	02	25	0	30.16	77	50	54	34	44	42	68	63	54	32	18	18	14	11	19	16	7	17	12	18	27	13	14	23	9																									
Spartina_10	03	25	0	36.24	62	76	66	65	80	63	73	86	23	22	11	19	12	10	40	10	26	27	33	24	14	12	10	25	17																									
Spartina_10	04	43	0	42.23	81	78	79	88	55	41	81	46	71	80	74	72	83	86	59	78	71	53	82	60	40	77	52	10	3	3	7	17	14	16	22	11	4	8	13	6	3	3	18	24	20	22	5								
Spartina_10	05	14	0	66.00	70	33	36	67	79	80	75	67	83	63	84	83	78	26																																				
Spartina_10	06	21	0	50.33	78	53	52	59	83	54	60	74	57	63	57	61	80	30	59	70	12	17	24	4	10																													
Spartina_10	07	32	0	44.94	74	63	45	70	32	86	50	53	53	69	82	61	55	66	86	43	41	34	83	47	10	17	12	9	18	17	11	24	32	17	28	50																		
Spartina_10	08	20	0	54.95	82	64	89	49	85	50	53	86	70	42	76	39	41	32	75	63	80	8	10	5																														
Spartina_10	09	34	1	55.74	71	81	51	87	74	89	52	81	90	67	74	85	40	79	54	37	32	34	79	79	37	91	72	80	68	71	68	8	10	20	8	6	6	14																
Spartina_10	10	31	0	52.42	78	78	74	70	57	59	81	62	85	61	83	67	61	78	76	79	85	74	74	64	24	30	8	9	14	6	24	22	8	22	12																			
Spartina_11	01	11	0	49.36	83	60	70	47	48	50	40	32	34	33	46																																							
Spartina_11	02	21	0	49.24	73	63	72	57	62	75	64	69	60	63	47	45	42	41	43	43	21	22	32	23	17																													
Spartina_11	03	21	0	50.71	66	71	72	70	68	51	40	49	70	81	46	53	71	73	50	52	32	13	17	11	9																													
Spartina_11	04	26	0	52.58	77	74	79	74	62	73	75	33	43	44	54	40	41	29	72	53	73	53	62	37	68	57	57	12	16	9																									
Spartina_11	05	25	0	51.24	77	7	68	64	72	73	61	56	30	35	14	9	8	10	56	57	88	68	74	81	63	60	60	14	76																									
Spartina_11	06	12	0	40.17	74	75	55	57	28	16	28	47	52	15	28	7																																						
Spartina_11	07	16	0	27.69	7	11	8	29	20	26	14	15	15	64	28	32	70	57	14	33																																		
Spartina_11	08	24	0	45.25	34	70	67	58	81	25	36	28	28	49	53	37	41	32	50	60	37	38	40	41	45	71	29	36																										
Spartina_11	09	13	0	39.15	67	48	30	46	13	12	53	23	64	51	48	12	42																																					
Spartina_11	10	17	0	39.47	51	50	48	33	40	41	34	35	19	26	54	67	46	44	44	13	26																																	
Spartina_12	01	37	0	48.19	41	58	66	50	25	39	20	49	53	78	50	47	83	78	39	49	58	22	23	65	71	64	27	26	47	23	33	47	73	56	13	44	30	84	58	29	65														
Spartina_12	02	23	0	50.30	85	45	63	56	54	55	21	70	60	37	65	33	64	36	26	34	53	52	50	79	61	52	6																												
Spartina_12	03	27	0	45.19	12	42	41	8	25	24	9	30	53	66	85	33	75	42	42	46	53	77	82	69	24	39	24	54	35	57	73																								
Spartina_12	04	17	0	43.88	51	44	69	22	9	44	46	78	62	79	11	5	73	67	69	10	7																																	
Spartina_12	05	26	0	47.12	78	57	54	78	67	57	38	29	13	10	53	43	46	58	10	41	37	60	88	22	68	64	22	17	46	69																									

Transect	Quadrat	No. of Stems	No. of Stems > 90 cm	Average Height (cm)	Individual Stem Height (cm)																																																		
					H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18	H19	H20	H21	H22	H23	H24	H25	H26	H27	H28	H29	H30	H31	H32	H33	H34	H35	H36	H37	H38	H39	H40	H41	H42	H43	H44	H45	H46	H47	H48	H49	H50	H51-H63
Spartina_12	06	15	0	37.47	37	47	56	58	43	29	48	8	8	37	46	77	47	17	4																																			
Spartina_12	07	34	0	47.32	17	63	66	49	77	79	29	45	20	50	61	40	10	57	79	50	58	8	68	82	22	53	39	11	30	71	48	32	50	75	79	43	25	23																
Spartina_12	08	33	1	44.18	47	64	64	77	53	77	78	66	26	9	18	92	53	66	60	53	73	24	24	80	8	10	32	33	19	36	37	45	73	5	5	8	43																	
Spartina_12	09	38	0	35.42	54	36	55	33	33	38	41	23	24	59	59	38	67	38	6	68	71	26	16	32	31	12	10	74	50	35	30	7	24	50	34	5	10	35	12	20	33	57												
Spartina_12	10	19	0	29.47	53	28	39	34	8	26	36	57	18	11	12	67	27	35	41	22	31	12	3																															
Spartina_13	01	35	0	42.71	68	43	46	66	53	67	60	62	81	64	47	62	60	83	61	65	87	68	61	46	59	26	15	27	20	18	11	7	24	10	4	5	8	7	4															
Spartina_13	02	23	0	37.83	84	52	60	66	18	7	12	4	47	23	21	75	66	55	66	26	15	14	14	8	61	59	17																											
Spartina_13	03	30	0	34.17	79	60	24	28	14	66	59	37	19	10	7	62	83	59	27	7	49	11	24	20	37	20	12	28	6	28	60	21	12	56																				
Spartina_13	04	37	0	48.86	75	64	60	68	86	50	27	77	72	20	30	48	9	9	17	15	15	53	59	52	57	67	12	12	13	85	51	46	71	67	59	30	79	81	63	76	33													
Spartina_13	05	63	0	36.02	86	21	52	38	65	80	56	71	42	75	12	20	4	18	18	5	18	5	8	15	31	28	54	71	78	59	63	63	80	66	79	72	43	76	51	87	75	71	67	61	11	32	10	28	17	17	31	10	9	10	7,10,8,9,8,13,4,3,13,10,10,10,5
Spartina_13	06	47	0	36.68	50	74	20	22	37	65	72	73	39	47	55	67	74	65	59	5	20	8	16	7	14	5	58	60	36	24	49	55	63	64	58	41	32	37	28	53	70	49	5	4	6	7	8	3	13	4	3			
Spartina_13	07	40	0	42.58	88	59	53	43	32	35	13	85	78	50	63	56	36	29	75	33	52	19	74	59	61	60	68	17	9	4	22	35	56	79	12	38	55	59	61	10	13	3	2	7										
Spartina_13	08	46	2	42.20	89	64	27	8	11	14	32	63	16	64	25	40	60	19	86	34	44	30	88	40	22	17	103	94	77	79	24	19	27	12	81	71	73	61	59	62	25	22	4	9	9	7	39	37	40	14				
Spartina_13	09	40	0	43.88	70	68	74	69	51	77	79	87	88	70	76	25	18	15	10	22	15	9	14	25	5	60	84	74	75	83	85	36	69	64	13	18	24	18	8	25	9	23	10	10										
Spartina_13	10	48	0	36.69	83	65	57	65	82	56	67	33	74	18	6	10	2	2	3	3	10	12	9	6	10	6	57	50	77	61	66	43	63	62	62	61	84	78	87	87	12	14	12	7	28	17	10	13	10	6	12	3		
Spartina_14	01	34	0	57.44	21	78	75	82	77	70	84	68	78	75	74	21	77	23	17	4	6	6	89	78	17	61	74	74	90	32	83	83	21	19	85	61	74	76																
Spartina_14	02	20	1	71.00	70	81	74	89	78	56	90	85	82	31	73	71	76	8	39	85	83	93	81	75																														
Spartina_14	03	42	0	47.55	8	5	14	11	12	48	73	64	67	61	59	59	50	65	72	41	10	68	64	69	63	62	63	6	26	45	51	23	69	70	67	63	8	6	52	71	59	71	74	12	55	61								
Spartina_14	04	22	0	40.86	7	31	56	49	59	26	45	71	72	59	43	6	72	47	7	5	30	16	67	3	65	63																												
Spartina_14	05	32	0	51.59	50	64	10	7	15	86	76	77	72	15	3	8	68	72	48	31	66	10	66	62	81	62	43	73	75	79	62	74	78	57	58	3																		
Spartina_14	06	32	0	45.53	63	72	60	76	65	64	64	74	74	43	74	65	63	61	67	66	64	68	49	62	23	12	4	10	25	15	13	6	12	27	3	13																		
Spartina_14	07	37	8	56.30	82	78	99	82	89	92	93	80	95	43	74	87	93	94	87	95	92	78	83	85	90	74	56	82	10	4	6	5	6	6	8	16	2	2	9	3	3													
Spartina_14	08	33	0	35.67	59	52	62	57	50	51	49	63	69	37	60	45	58	49	78	66	64	27	62	11	9	6	5	4	8	13	2	3	5	7	20	13	13																	
Spartina_14	09	30	0	31.43	55	29	40	50	61	66	37	75	72	23	52	37	61	68	38	46	46	7	3	12	2	6	3	10	5	21	3	7	6	2																				
Spartina_14	10	35	0	41.11	63	63	56	43	54	61	65	44	52	44	74	33	50	57	69	58	66	73	53	52	63	66	63	5	12	5	20	2	10	15	19	16	7	2	4															
Spartina_15	01	24	0	40.83	26	16	75	24	26	40	52	42	25	21	11	22	25	53	56	69	70	51	81	64	73	23	30	5																										
Spartina_15	02	22	1	54.95	87	31	40	74	98	27	49	11	68	73	19	61	41	63	74	84	65	47	78	67	47	5																												
Spartina_15	03	21	0	43.38	17	28	33	87	17	33	32	45	38	69	85	51	67	83	38	64	30	39	31	9	15																													
Spartina_15	04	28	1	49.11	41	78	18	49	59	37	80	83	48	86	26	42	59	10	8	27	60	77	30	83	22	71	17	98	75	57	19	15																						
Spartina_15	05	41	1	48.66	101	54	66	73	76	41	21	28	47	65	44	78	61	14	20	5	30	26	78	19	45	42	65	39	22	21	45	89	86	8	4	85	80	68	80	70	64	27	38	16	54									
Spartina_15	06	16	0	37.06	26	38	11	25	66	29	19	54	27	17	27	39	54	51	84	26																																		
Spartina_15	07	19	0	42.47	18	50	62	68	11	22	51	57	8	70	32	77	40	19	81	19	7	41	74																															
Spartina_15	08	33	0	50.52	46	45	40	79	48	62	42	33	56	83	73	60	4	89	34	26	46	23	40	60	78	11	31	29	19	14	68	54	84	89	63	76	62																	
Spartina_15	09	19	0	57.00	78	14	20	32	54	55	70	82	38	79	70	53	30	79	60	47	83	79	60																															
Spartina_15	10	28	0	46.39	35	69	23	77	52	73	15	31	74	59	48	71	41	41	47	40	69	24	39	3	27	47	58	29	60	38	52	57																						

APPENDIX D

WATER QUALITY DATA

Appendix D
2022 Water Quality Data: Hypoxic Event Duration at San Elijo Lagoon and Reference Wetlands

This appendix documents the 2022 water quality data for the San Elijo Lagoon Restoration Project. The water quality performance standard is evaluated by comparing the mean length in hours of continuous hypoxia between the restored San Elijo Lagoon and the reference wetlands. A dissolved oxygen concentration below 3 parts per million is considered hypoxic, and sustained concentrations below this value may be detrimental to estuarine biota (Ecological Society of America 2012). The approach to assessing dissolved oxygen is to assess the length of time continuously spent below this concentration. The criterion for event duration determines whether two readings are considered unique events or the same event. A 1-hour envelope was used to classify hypoxic events in proximity to each other as one event. The start and end of an event must be at least 1 hour apart to signal an event is complete. Otherwise, readings triggering the threshold value are considered the same event. The reference wetlands included in the table below are Mugu Lagoon (MUL), Tijuana Estuary (TJE), and Carpinteria Salt Marsh (CSM).

Table D-1. Post-construction Hypoxic Event Timing and Duration at San Elijo Lagoon and Reference Wetlands.

Year	Wetland	Hypoxic Event Start Time	Hypoxic Event Duration (h)
2022	SEL	5/4/22 8:18	0.75
2022	SEL	5/4/22 14:18	0.25
2022	SEL	5/4/22 16:18	2
2022	SEL	5/5/22 9:33	2.75
2022	SEL	5/5/22 14:48	0.25
2022	SEL	5/5/22 16:33	1.75
2022	SEL	5/6/22 13:48	0.25
2022	SEL	5/6/22 15:18	0.25
2022	SEL	5/9/22 5:48	5
2022	SEL	5/10/22 1:18	9
2022	SEL	5/11/22 4:03	2.75
2022	SEL	5/11/22 8:18	1.75
2022	SEL	5/12/22 1:33	0.25
2022	SEL	5/12/22 5:03	0.25
2022	SEL	5/12/22 6:33	0.25
2022	SEL	5/13/22 5:33	0.25
2022	SEL	5/14/22 6:33	0.25
2022	SEL	5/15/22 6:18	1
2022	SEL	5/16/22 7:48	0.5
2022	SEL	5/17/22 8:33	1.5

Year	Wetland	Hypoxic Event Start Time	Hypoxic Event Duration (h)
2022	SEL	5/17/22 17:03	0.5
2022	SEL	5/18/22 8:48	6.75
2022	SEL	5/18/22 17:03	1.5
2022	SEL	5/19/22 10:18	9.75
2022	SEL	5/20/22 10:33	2
2022	SEL	5/20/22 19:03	1
2022	SEL	5/21/22 12:48	1.25
2022	SEL	5/21/22 21:33	1
2022	SEL	5/22/22 9:48	0.25
2022	SEL	5/22/22 11:18	2.25
2022	SEL	5/23/22 12:18	2.25
2022	SEL	5/24/22 2:48	0.5
2022	SEL	5/24/22 11:03	0.75
2022	SEL	5/24/22 13:33	1.25
2022	SEL	5/25/22 3:48	0.25
2022	SEL	5/26/22 4:48	0.5
2022	SEL	5/27/22 5:03	2.5
2022	SEL	5/27/22 15:33	0.25
2022	SEL	5/28/22 5:48	2.75
2022	SEL	5/29/22 7:03	0.75
2022	SEL	5/29/22 15:18	0.25
2022	SEL	5/30/22 7:18	1.5
2022	SEL	5/30/22 13:03	1.25
2022	SEL	5/31/22 7:18	4.5
2022	SEL	5/31/22 13:03	4
2022	SEL	6/1/22 8:18	9.25
2022	SEL	6/2/22 7:33	3.75
2022	SEL	6/2/22 14:48	3.25
2022	SEL	6/3/22 9:33	2.25
2022	SEL	6/3/22 16:03	2
2022	SEL	6/4/22 9:03	0.25
2022	SEL	6/4/22 10:33	2
2022	SEL	6/5/22 8:33	0.25
2022	SEL	6/5/22 10:03	2.25
2022	SEL	6/6/22 7:33	0.25
2022	SEL	7/7/22 12:46	0.25
2022	SEL	7/8/22 6:16	1.25
2022	SEL	7/9/22 5:46	0.25
2022	SEL	7/9/22 7:46	1.75
2022	SEL	7/9/22 12:46	0.5
2022	SEL	7/10/22 6:01	0.75

Year	Wetland	Hypoxic Event Start Time	Hypoxic Event Duration (h)
2022	SEL	7/10/22 8:01	0.25
2022	SEL	7/10/22 13:46	0.5
2022	SEL	7/11/22 6:46	2
2022	SEL	7/12/22 10:01	0.25
2022	SEL	7/20/22 6:31	0.25
2022	SEL	7/21/22 5:16	5.5
2022	SEL	7/22/22 3:31	0.5
2022	SEL	7/22/22 5:16	5.5
2022	SEL	7/23/22 7:31	0.25
2022	SEL	7/24/22 6:46	1.5
2022	SEL	7/25/22 6:16	2.75
2022	SEL	7/26/22 7:01	2.5
2022	SEL	7/27/22 7:31	0.75
2022	SEL	7/27/22 9:46	0.25
2022	SEL	7/28/22 10:16	0.25
2022	SEL	7/29/22 10:46	0.25
2022	SEL	7/31/22 9:31	0.25
2022	SEL	8/1/22 9:46	0.25
2022	SEL	8/3/22 10:01	0.25
2022	SEL	8/4/22 9:16	1.25
2022	SEL	8/4/22 11:46	0.25
2022	SEL	8/5/22 3:31	3
2022	SEL	8/5/22 8:16	0.25
2022	SEL	8/5/22 9:31	3
2022	SEL	8/6/22 5:31	3.5
2022	SEL	8/6/22 11:01	0.5
2022	SEL	8/6/22 12:46	0.5
2022	SEL	8/7/22 3:31	3
2022	SEL	8/8/22 5:31	1.25
2022	SEL	8/9/22 6:46	0.75
2022	SEL	8/10/22 7:31	0.25
2022	SEL	8/10/22 8:46	0.25
2022	SEL	8/11/22 8:31	1
2022	SEL	8/11/22 17:46	0.5
2022	SEL	8/12/22 8:46	1
2022	SEL	8/12/22 19:16	0.25
2022	SEL	8/13/22 9:01	1.25
2022	SEL	8/13/22 20:16	0.25
2022	SEL	8/14/22 10:31	0.25
2022	SEL	8/14/22 21:16	0.25
2022	SEL	8/15/22 9:31	1.25

Year	Wetland	Hypoxic Event Start Time	Hypoxic Event Duration (h)
2022	SEL	8/15/22 22:16	0.25
2022	SEL	8/16/22 9:31	1.5
2022	SEL	8/16/22 23:16	1.25
2022	SEL	8/17/22 10:16	1
2022	SEL	8/18/22 1:16	10.5
2022	SEL	8/19/22 3:31	8.5
2022	SEL	8/20/22 4:46	1.75
2022	SEL	8/21/22 6:01	1.5
2022	SEL	8/22/22 4:46	3
2022	SEL	8/23/22 6:01	0.25
2022	SEL	8/23/22 7:31	0.5
2022	SEL	8/24/22 6:31	1.75
2022	SEL	8/25/22 8:31	0.25
2022	SEL	8/26/22 8:46	0.25
2022	SEL	8/27/22 9:01	0.25
2022	SEL	8/28/22 8:01	1.5
2022	SEL	8/29/22 8:01	1.25
2022	SEL	9/1/22 8:46	1.25
2022	SEL	9/2/22 0:16	1.25
2022	SEL	9/2/22 8:16	2.25
2022	SEL	9/3/22 2:16	9
2022	SEL	9/4/22 4:16	2
2022	SEL	9/4/22 8:01	3
2022	SEL	9/5/22 4:01	2.25
2022	SEL	9/6/22 5:46	1.25
2022	SEL	9/6/22 13:46	1.5
2022	SEL	9/7/22 6:16	1.25
2022	SEL	9/7/22 15:01	1
2022	SEL	9/8/22 6:46	1
2022	SEL	9/8/22 16:01	0.5
2022	SEL	9/9/22 7:16	1
2022	SEL	9/10/22 7:31	1.25
2022	SEL	9/11/22 8:46	0.25
2022	SEL	9/12/22 7:46	1.25
2022	SEL	9/13/22 7:46	1.25
2022	SEL	9/14/22 7:31	1.75
2022	SEL	9/15/22 7:01	2.75
2022	SEL	9/16/22 2:16	0.75
2022	SEL	9/16/22 6:31	1.25
2022	SEL	9/16/22 9:01	0.25
2022	SEL	9/17/22 4:01	0.75

Year	Wetland	Hypoxic Event Start Time	Hypoxic Event Duration (h)
2022	SEL	9/18/22 5:01	0.5
2022	SEL	9/19/22 5:46	0.5
2022	SEL	9/21/22 7:01	0.25
2022	SEL	9/24/22 7:31	0.25
2022	SEL	9/25/22 7:31	0.5
2022	SEL	9/26/22 7:46	0.25
2022	SEL	9/27/22 7:16	0.75
2022	SEL	9/27/22 20:31	0.75
2022	SEL	9/28/22 7:01	1.25
2022	SEL	9/28/22 22:01	0.75
2022	SEL	9/29/22 6:46	2
2022	SEL	9/29/22 23:31	0.75
2022	SEL	9/30/22 5:01	3.75
2022	SEL	10/1/22 0:31	2
2022	SEL	10/1/22 4:16	5
2022	SEL	10/2/22 2:16	2
2022	SEL	10/3/22 2:46	2.25
2022	SEL	10/4/22 2:31	3
2022	SEL	10/5/22 4:16	1.75
2022	SEL	10/6/22 5:16	1.25
2022	SEL	10/6/22 15:31	0.25
2022	SEL	10/7/22 5:16	1.5
2022	SEL	10/8/22 7:01	0.25
2022	SEL	10/10/22 6:16	0.75
2022	SEL	10/11/22 6:31	0.75
2022	SEL	10/12/22 6:31	1.5
2022	SEL	10/12/22 23:46	0.25
2022	SEL	10/13/22 6:16	2
2022	SEL	10/13/22 22:31	0.25
2022	SEL	10/14/22 0:16	1
2022	SEL	10/14/22 6:31	0.5
2022	SEL	10/14/22 23:46	2.75
2022	SEL	10/15/22 23:31	4.25
2022	SEL	10/16/22 22:46	5.75
2022	SEL	10/18/22 1:31	0.75
2022	SEL	10/18/22 3:46	1.25
2022	SEL	10/19/22 0:01	0.25
2022	SEL	10/19/22 1:31	1.75
2022	SEL	10/19/22 4:46	0.75
2022	SEL	10/21/22 4:01	0.5
2022	SEL	10/22/22 4:46	0.25

Year	Wetland	Hypoxic Event Start Time	Hypoxic Event Duration (h)
2022	SEL	10/26/22 5:46	0.25
2022	SEL	10/29/22 5:04	0.75
2022	SEL	11/9/22 22:34	1.5
2022	SEL	11/10/22 6:19	1.5
2022	SEL	11/10/22 22:34	8.75
2022	SEL	11/11/22 23:04	1.75
2022	SEL	11/12/22 6:34	0.75
2022	SEL	11/12/22 23:34	0.25
2022	SEL	11/13/22 0:49	1.25
2022	SEL	11/14/22 1:19	1.75
2022	SEL	11/15/22 2:04	1.5
2022	SEL	11/16/22 1:49	2.25
2022	SEL	11/17/22 2:04	2.5
2022	SEL	11/18/22 3:19	0.5
2022	SEL	12/13/22 1:34	0.25
2022	SEL	12/13/22 8:19	1.75
2022	SEL	12/13/22 22:49	3.5
2022	SEL	12/14/22 10:34	0.75
2022	SEL	12/14/22 19:49	6.5
2022	SEL	12/15/22 16:19	1.75
2022	SEL	12/15/22 19:49	7
2022	SEL	12/16/22 17:04	0.25
2022	SEL	12/16/22 18:49	1.25
2022	SEL	12/16/22 22:04	5
2022	SEL	12/17/22 22:04	0.25
2022	SEL	12/18/22 0:49	2
2022	SEL	12/19/22 1:19	1.5
2022	SEL	12/25/22 3:49	0.25
2022	SEL	12/29/22 23:34	2.5
2022	SEL	12/30/22 17:19	9.25
2022	SEL	12/31/22 17:19	0.75
2022	SEL	12/31/22 22:04	1.75

[1]Wetland names: MUL= Mugu Lagoon; TJE= Tijuana Estuary; SEL= San Elijo Lagoon; CSM= Carpinteria Salt Marsh

References

Ecological Society of America. 2012. Online at https://www.esa.org/esa/wp-content/uploads/2012/12/hypoxia.pdf. Accessed December 19, 2018.

APPENDIX E

SAN ELIJO LAGOON RESTORATION PROJECT POST-CONSTRUCTION FISH ASSESSMENT

SAN ELIJO LAGOON RESTORATION PROJECT

Post-Construction Fish Assessment

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Prepared for:
California Department of Transportation
California Coastal Commission
Nature Collective
San Diego Association of Governments

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SAN ELIJO LAGOON RESTORATION PROJECT

1. Introduction

This document reports the activities and findings from the post-construction monitoring surveys of San Elijo Lagoon (SEL) in Cardiff by the Sea, CA. Contracted by Nature Collective, AZED Environmental LLC performed independent post-construction fish density and richness surveys within SEL for the California Coastal Commission. Surveys took place in the fall of 2022 (late September to mid-October) after the construction activities associated with the restoration effort were completed. These data will be compared to pre-construction monitoring data collected by AZED Environmental LLC as a way to measure the performance of the San Elijo Lagoon Restoration Project (SELRP) now that construction efforts have been completed.

2. Site Background

The San Elijo Lagoon Restoration Plan seeks to restore lagoon functions and services to the extent practicable following degradation associated with urbanization of the lagoon's watershed. Urbanization has accelerated freshwater storm flows, generated year-round urban run-off and increased chemical and nutrient levels within the lagoon. Hydraulic efficiency within the channels and tidal inlet of the lagoon has been reduced due to infrastructure that obstructs water flow, including Coast Highway 101, the North County Transit District railroad, Interstate 5 and a weir in the eastern lagoon basin. Subsequently, a degradation of water quality including elevated bacterial levels have led to beach closures during moderate to large storm events.

The SELRP seeks to restore tidal influence to the lagoon and enhance freshwater fluvial flows out of the lagoon. This would, in turn, restore the physical (soils and hydrology) and biological (biogeochemical/water quality and habitat) functions that have been degraded over the years.

The SELRP proposes to modify the channels and habitats throughout the entire 960-acre lagoon. These modifications are expected to improve lagoon habitats that support sensitive coastal wetland plant and animal species. Restoration is expected to take approximately three years with the restoration of each of the three lagoon basins conducted in sequence, beginning with the Central Basin, followed by the Eastern Basin and finally the Western Basin. Upon completion of restoration construction, a minimum of 10 years of post-construction biological monitoring will be initiated for all wetland habitats. A minimum of five years of monitoring will be initiated for all restored upland habitats. In addition, long-term monitoring of selected parameters will be conducted for the life of the project, defined as 50 years post-construction.

3. Survey Methods

3.1 Fish Assemblage Surveys

Fish community assessment consists of two relative standards: average total fish densities and average number of fish species per location surveyed. The fish community within the restored areas of the San Elijo Lagoon will be compared to reference wetlands and pre-restoration conditions. Sampling methods at SEL and reference wetlands were based on those of the long-standing SONGS San Dieguito Wetland restoration program (Page et al, 2022).

Fish habitat created by restoration was primarily comprised of shallow subtidal channels. Intertidal channels are expected to develop and can be added to the post-construction monitoring program upon their development. However, for the purposes of this monitoring program, fish monitoring in main channel / basins habitats were confined to shallow (-1.5 to -3.6 ft. NGVD) subtidal habitats. Eighteen (18) sampling stations were located in tidally influenced areas throughout the lagoon with nine (9) stations located in main channels and nine (9) stations located in tidal creeks (Figure 1). Of the 18 sampling stations, only historical locations that were tidally influenced prior to construction activities (2017) were incorporated into the overall monitoring summary; therefore, locations located east of the I-5 freeway are considered to be contingency locations. Fish measurements were collected in the fall of 2022 in order to avoid nesting activities of the federally endangered Ridgeway Rail (formerly the Light-footed Clapper Rail). These methods are summarized below:

- **Seines:** Seining at each fish sampling station was conducted by blocking each end of an approximately 7-m long channel/creek segment using blocking nets. Blocking nets consist of bagless seines approximately 15.2 m x 1.8 m with 3.2 mm mesh. Small seines (approximately 7.6 x 1.8 m with 3.2-mm mesh) were used to sample the 7-m long area blocked by the blocking nets. The small seine was hauled across the blocked area (perpendicular to the long axis of the channel) to collect the fish trapped by the blocking nets (Figure 2a). Five replicate hauls were made at each station (18 stations total) and each station was visited on 3 distinct days. Additionally, all blocking nets were examined for fish that may have become trapped in small areas that are not covered by the smaller seine net. All organisms were processed in the field to the extent possible. Fish were identified to species, counted and returned to the water immediately, whenever possible. Fish abundance was expressed in terms of density (number per m^2) for each seining event and then averaged across 3 days of seining at any given sampling station. Species richness was standardized to the number unique species per replicate (given that 3 days of seining at a given location is equal to one replicate).

- **Enclosures:** Enclosures were employed to sample demersal, burrowing fish. An enclosure trap was used to sample primarily gobies (family Gobiidae), small, burrowing fishes that are often poorly sampled by other methods. The enclosure trap is composed of a polypropylene sheet fixed as a 1-m-tall cylinder with a 0.43 m^2 sampling area (Figure 2b). The trap is thrown away from the sampler in an attempt to minimize the startling of any fish nearby. A BINCKE net is then swept inside the trap and fish are identified by species, counted, and released. This is repeated until no fish are caught a total of 3 times. Enclosure trapping was conducted at 5 substations (similar to invertebrate methods) located at each of the 18 sampling stations. Thus, a total of 90 enclosure samples will be collected during each monitoring effort. Density was expressed in terms of number of individuals per m^2 for each enclosure and then averaged across enclosures at a given sampling station. Species richness of demersal, burrowing fish was standardized to number of unique species per sampling station.

- **Metrics:** Density of a given station consists of the combination of all methods outlined above. For each community, density was standardized to number of individuals per m^2 for each seine/enclosure station and results from each method where then summed for each given sampling station in order to obtain the overall density of fish per station. Species richness was standardized to the number of unique species per sampling location (i.e. seines and enclosures combined).

4. Results

4.1 Fish Assemblage Surveys

A comprehensive list of all fish identified to the species level within SEL in 2022 are listed in Table 1. Additionally, the values for fish density and species richness within main channel and tidal channel habitats are summarized in Table 2. Fish densities within the individual tidal channel stations were highly variable with TC2 and TC4 exhibiting the highest values of the historical sampling stations (TC 1 – 6). Fish densities within the main channel stations were also highly variable with the highest overall fish densities found in MC1. This highly elevated value can be attributed to significantly high densities of juvenile silversides during the period of monitoring. The overall average of fish density within the historical main channel stations (MC 1 – 6) was similar to than that of the tidal channels (TC 1 – 6).

Overall, average fish species richness within the historical main channel stations (MC 1 – 6) was similar to than that of the tidal channels (TC 1 – 6). Location of station appears to impact richness with main channel and tidal channel stations closest to the mouth of the lagoon substantially higher than locations further to the east, with the exception of TC6 which happen to be the furthest historical sampling location east of the SEL restoration project.

5. Discussion

The post-construction monitoring was conducted in order to compare fish densities and species richness to pre-construction values, which served as a baseline to help track trends in how the biota have responded to the restoration efforts. Post-construction data is also compared to three reference wetlands in order to assess the success of these population metrics. The reference wetlands are: Carpinteria Salt Marsh (CSM), Point Mugu Lagoon (MUL) and the Tijuana Estuary (TJE). Should metrics fail to achieve success, comparison of standards to post-restoration data and to baseline data will be useful in determining if or when adaptive management measures should be implemented.

The density and species richness of fish of SEL in 2022 are summarized in Figures 3 and 4, while Figure 5 lists the top 5 fish species observed in SEL. Overall, the values for fish density and fish species richness seem to be within the range of either pre-restoration values of SEL or the range of values seen at the three-reference wetlands. However, further statistical analysis is needed to validate this statement.

Appendix A – FIGURES

Figure 1: Map depicting sampling locations where fish and invertebrate surveys took place in fall of 2022

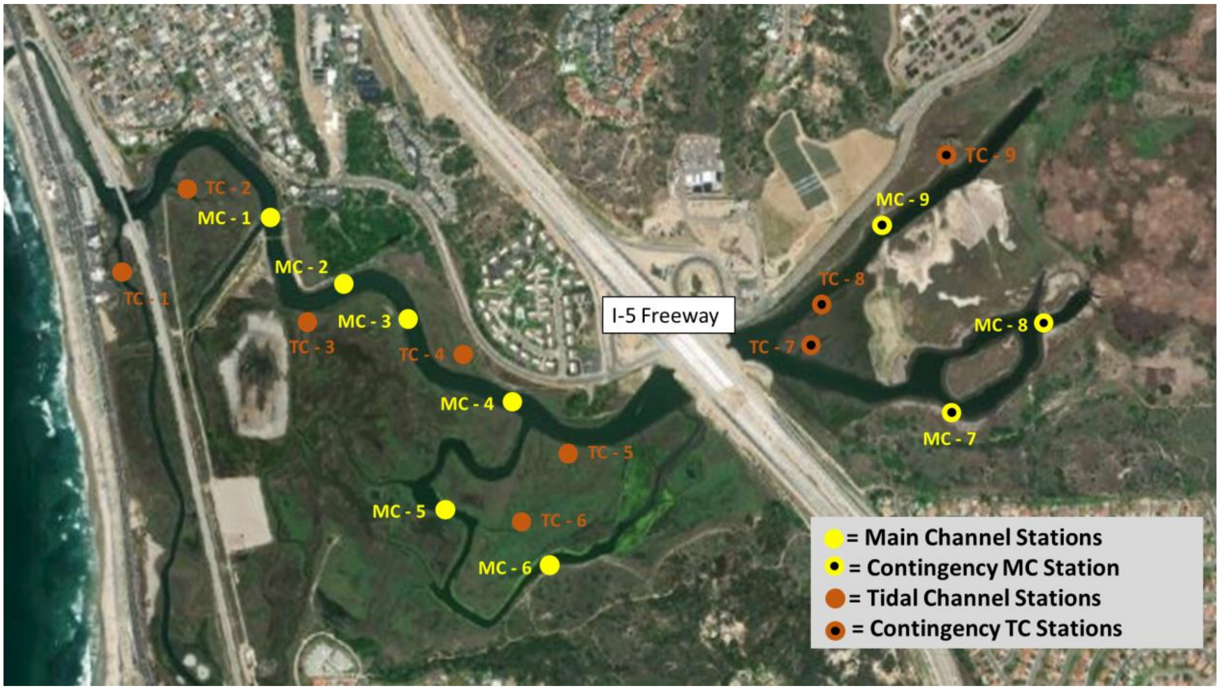

Figure 2a: (Top) Scientists using a combination of blocking nets and beach seine in order to assess fish assemblages

Figure 2b: (Bottom) Project personnel conducting enclosure trap with BINCKE net

Figure 3: Summary of fish density data within the San Elijo Lagoon in 2022
(Combined average of main channel stations (1 – 6) & tidal channel stations (1 – 6))

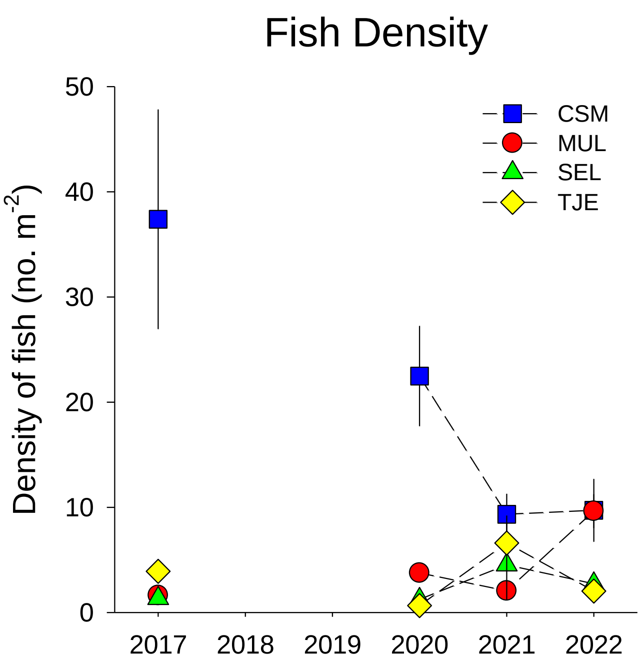

Figure 4: Summary of fish species richness data within the San Elijo Lagoon in 2022
(Combined average of main channel stations (1 – 6) & tidal channel stations (1 – 6))

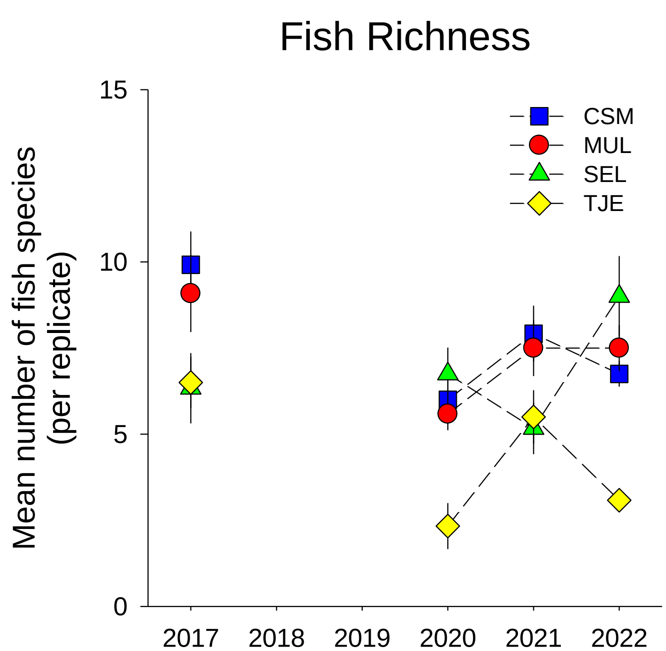

Figure 5: Summary of the top five fish species present in San Elijo Lagoon in 2022
(These calculations exclude the six contingency sites visited during the 2022 sampling season)

Appendix B – TABLES

Table 1: Fish species present during post-construction assessment of 2022

GENUS NAME	SPECIES NAME	COMMON NAME (IF AVAILABLE)
Acanthogobius	*flavimanus*	Yellowfin Goby
Anchoa	*compressa*	Deepbody Anchovy
Anisotremus	*davidsoni*	Sargo
Atherinops	*affinis*	Topsmelt
Clevelandia	*ios*	Arrow Goby
Cosmocampus	*arctus*	Snubnose Pipefish
Cymatogaster	*aggregata*	Shiner Surfperch
Fundulus	*parvipinnis*	California Killifish
Gambusia	*affinis*	Mosquitofish
Gillichthys	*mirabilis*	Longjaw Mudsucker
Girella	*nigricans*	Opaleye
Gymnura	*marmorata*	Butterfly Ray
Hypsoblennius	*gentilis*	Bay Blenny
Hypsopsetta	*guttulata*	Diamond Turbot
Paralabrax	*clathratus*	Kelp Bass
Paralabrax	*maculatofasciatus*	Spotted Sand Bass
Paralabrax	*nebulifer*	Barred Sand Bass
Paralichthys	*californicus*	California Halibut
Pleuronichthys	*ritteri*	Specklefin Midshipman
Quietula	*y_cauda*	Shadow Goby
Sardinops	*sagax*	Pacific Sardine
Strongylura	*exilis*	California Needlefish
Syngnathus	*auliscus*	Barred Pipefish
Syngnathus	*leptorhynchus*	Bay Pipefish
Urolophus	*halleri*	Round Stingray

Table 2: Summary of post-construction fish densities and species richness for each sampling station surveyed within the San Elijo Lagoon in 2022

Sampling Station	**Fish Density (# per m^2)**	**Fish Richness (# of species per replicate)**
Tidal Channel		
TC1	0.01	2
TC2	5.23	14
TC3	3.21	12
TC4	5.82	5
TC5	1.61	6
TC6	0.98	10
TC7*	1.73	8
TC8*	1.55	3
TC9*	0.07	5
Average TC (1 – 6)	2.63	8.17
Main Channel		
MC1	7.42	14
MC2	4.46	14
MC3	1.14	10
MC4	0.96	9
MC5	0.14	7
MC6	1.68	5
MC7*	4.45	4
MC8*	1.94	6
MC9*	1.61	7
Average MC (1 – 6)	2.81	9.83
MC's (1 – 6) & TC's (1 – 6) Combined Average**	2.72	9.00

*Denotes contingency sites added in 2020, which are not included in the performance metric evaluations
**Denotes overall metric used to assess performance

Appendix C – REFERENCES

Page, M., S. Schroeter, and D. Reed. 2022. 2021 Annual Report of the Status of Condition A: Wetland Mitigation. San Onofre Nuclear Generating Station (SONGS) mitigation program. Submitted to the California Coastal Commission July 2022. https://marinemitigation.msi.ucsb.edu/library/2021-annual-report-wetland-mitigation

Page, M., S. Schroeter, D. Reed, and M. Steele. 2022. Monitoring Plan for the SONGS' Wetland Mitigation Project. Report to the California Coastal Commission. https://marinemitigation.msi.ucsb.edu/library/songs-wetland-mitigation-monitoring-plan-updated-may-2022

APPENDIX F

2022 AVIAN MONITORING REPORT FOR THE SAN ELIJO LAGOON RESTORATION PROJECT

2022 AVIAN MONITORING REPORT FOR THE SAN ELIJO LAGOON RESTORATION PROJECT

Prepared for:

Nature Collective

Prepared by:

AECOM
and
Moffatt & Nichol

August 2023

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LIST OF ACRONYMS AND ABBREVIATIONS

AOU	American Ornithologists' Union
CDFW	California Department of Fish and Wildlife
CI	confidence interval
GPS	Global Positioning System
LCL	lower confidence limit
LFRR	light-footed Ridgway's rail
SELRP	San Elijo Lagoon Restoration Project
UCL	upper confidence limit
USFWS	U.S. Fish and Wildlife Service

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1. INTRODUCTION

1.1 PROJECT BACKGROUND

San Elijo Lagoon is a coastal wetland formed at the drainage of the Escondido and La Orilla Creeks into the Pacific Ocean and is located in Encinitas, San Diego County, California. The lagoon provides habitat for sensitive, threatened, and endangered plants and animals, including resident and migratory wildlife. The San Elijo Lagoon Ecological Reserve is owned and managed by the California Department of Fish and Wildlife (CDFW), County of San Diego Parks and Recreation Department, and the Nature Collective (formerly the San Elijo Lagoon Conservancy). Lagoon functions became compromised over time as development and infrastructure constraints affected the ecosystem and the gradient of habitats within the lagoon (e.g., between unvegetated and vegetated intertidal habitats). The San Elijo Lagoon Restoration Project (SELRP) was an effort to restore lagoon functions and services to the extent practicable given the current constraints of surrounding development and activities.

The SELRP was implemented by the Nature Collective, San Diego Association of Governments, and California Department of Transportation to enhance and restore the physical and biological functions and services of San Elijo Lagoon by increasing hydraulic efficiency in the lagoon, addressing existing water quality impairments, and halting ongoing conversion of unvegetated wetland habitats to support a more connected gradient of balanced habitat types. Success of the restoration effort is being measured through the implementation of a monitoring program developed in coordination with various permitting and approval agencies, including the California Coastal Commission, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service (USFWS), and Regional Water Quality Control Board.

Construction for the SELRP began in December 2017 and was substantively completed in July 2020 with focused activities continuing to occur in discrete areas of the lagoon. Figure 1-1 shows the final design habitat distribution for the lagoon. Data collection was designed to assess the responses of select avian taxa to the construction activities and associated changes to the habitat in San Elijo Lagoon. Specifically, data collection periods for avian monitoring were grouped into the following three discrete periods: the “baseline” or “pre-construction period” from 2016 through 2017, a “construction period” from 2018 through July of 2020, and a “post-construction period” starting with August 2020. Because much of the avian monitoring occurs in the spring and was conducted prior to completion of the construction activities in 2020, 2021 represented the first year post-construction for the avian metrics and 2022 the second year. For the purposes of reporting a 4-year running average herein, the construction and post-construction years have been combined into a “construction/post-construction period” that includes the years 2019 through 2022. These data provide complementary information related to performance standards and construction/post-construction monitoring results documented as part of the monitoring program as defined in

Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project (Monitoring Plan) (Nature Collective 2020). Results from the performance standards analyses are presented in the annual reports (e.g., 2021 Annual Monitoring Report for the San Elijo Lagoon Restoration Project [AECOM 2022a]). Table 1-1 provides a summary of each report associated with work conducted for the SELRP.

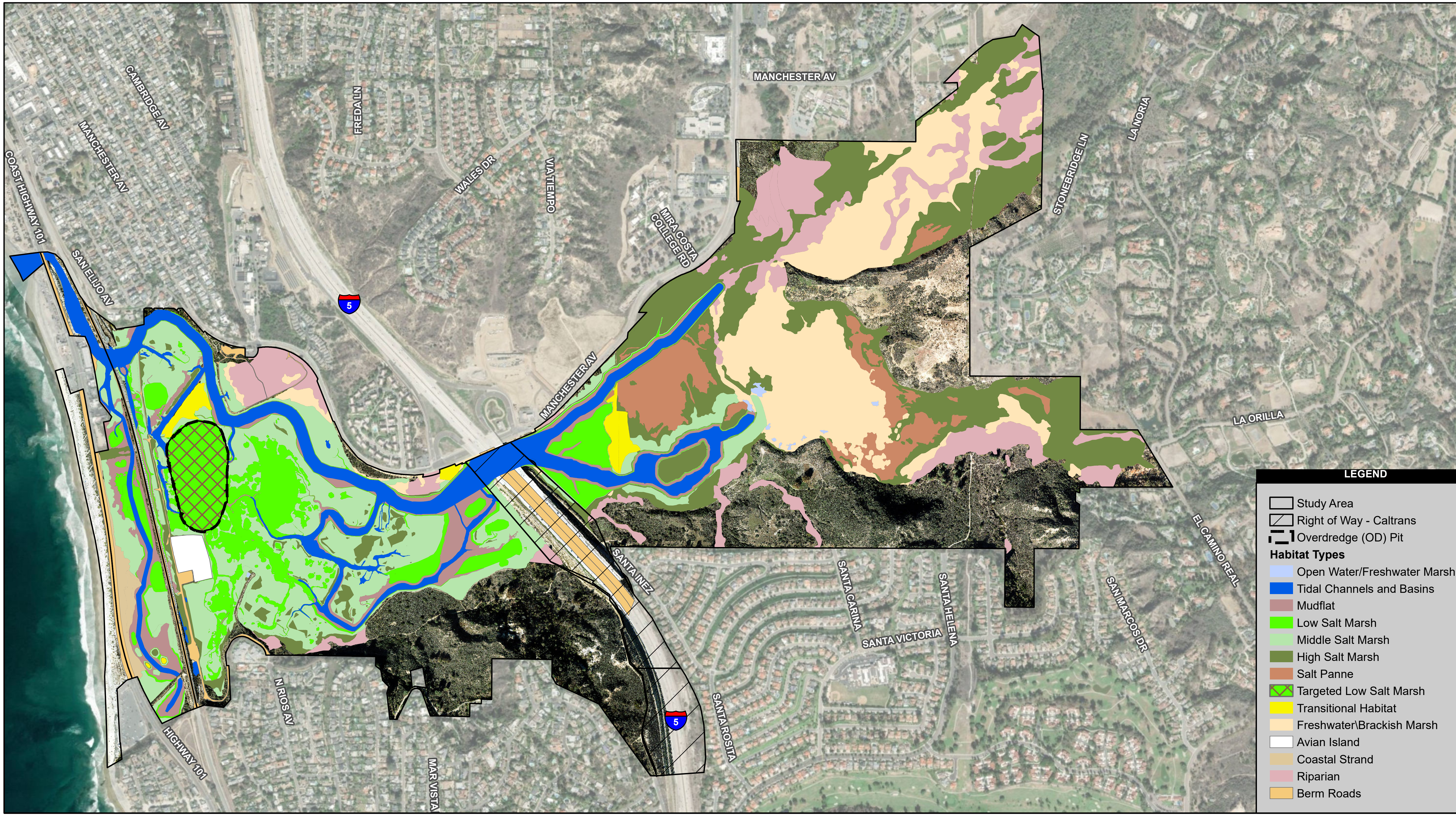
Table 1-1. Summary of SELRP Reports

Report	Description of Report
Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project (Monitoring Plan)	Overarching document that establishes the criteria for determining success (performance standards) of the restoration project for the biological and physical parameters being evaluated.
Wetland Habitat and Hydrology Baseline Monitoring Report for the San Elijo Lagoon Restoration Project (Baseline Monitoring Report)	Document that summarizes data collected during the pre-construction (baseline) period (2016–2017) against which absolute performance standard metrics will be compared.
2018-2019 Avian Monitoring Report for the San Elijo Lagoon Restoration Project (2018-2019 Avian Monitoring Report)	Document that summarizes the avian data collected during the 2018–2019 construction period.
2020 Construction Monitoring Report for the San Elijo Lagoon Restoration Project (2020 Construction Monitoring Report)	Document that summarizes data collected during 2020 and across the 3 construction phase years of 2018–2020.
Annual Reports	Documents that summarize the data collected in each year post-construction, beginning in 2021.

1.2 REPORTING REQUIREMENTS

This report documents the results of avian surveys for the year 2022, which is the second year of data collection for the post-construction period. Data for these annual reports provide a useful reference point for avian survey results relative to the baseline levels reported in the SELRP Baseline Monitoring Report (AECOM 2020a). Results from the construction and early post-construction years may be informative for adaptive management decisions should the trajectory of avian numbers not be trending towards achieving performance standards, as defined in the Monitoring Plan (Nature Collective 2020).

This 2022 Avian Monitoring Report is based on the framework set forth in Chapter 11 of the SELRP Baseline Monitoring Report (AECOM 2020a). Post-construction annual monitoring includes results for these avian survey metrics; the results identify whether the key variables have met performance standards and whether the project is on a trajectory to meet success requirements. Reports are submitted to agencies as required and also identify recommendations for remedial activities or adaptive management strategies that may be required over the year following the reporting period.



Source: SanGIS 2022; MoffattNichol 2022; AECOM 2022.

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

Figure 1-1
Design Habitat Distribution

Path: \\na.aecomnet.com\lfs\AMER\SanDiego-USSDG1\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Annual\Habitat_Mapping_Memo\Design_Habitat_Distribution_HMM.mxd, 8/21/2023, paul.moreno

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This report is framed to be consistent with the Monitoring Plan (Nature Collective 2020) to facilitate reference between documents, including future annual reports. Table 1-2 summarizes the specific variables discussed in this report and the corresponding performance standards for each variable. Per the Monitoring Plan (Nature Collective 2020), annual reports will be completed as needed until year 10 post-construction, after which a final monitoring report will be prepared and submitted. Monitoring and reporting beyond 10 years post-construction for the life of the project (defined as a minimum of 50 years) will be detailed in a Long-Term Management Plan. Detailed methods, including data collection, monitoring frequency, analysis, and performance standards, are discussed in the Monitoring Plan (Nature Collective 2020); specifically, Chapter 12 of that document includes information as it pertains to avian species.

Table 1-2. Avian Variable Summary

Chapter	Variable	Variable Type	Final Performance Standard
2.1	Light-footed Ridgway's Rail	Pre-Restoration Absolute	4-year running average of density and lagoon-wide abundance within 95% or greater of pre-construction survey data (2016–2017)
2.2	Western Snowy Plover and California Least Tern	Pre-Restoration Absolute	4-year running average of individuals/survey within 95% or greater of pre-construction survey data (2016–2017)
2.3	Belding's Savannah Sparrow	Pre-Restoration Absolute	4-year running average of density within 95% or greater of pre-construction survey data (2016–2017)

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2. BIRDS

2.1 BREEDING MARSH BIRDS

The monitoring of breeding marsh birds is a "pre-restoration absolute" monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. Additionally, the specialized surveys required to adequately estimate abundance of secretive marsh bird species are not being conducted at reference wetlands, thereby making comparison impossible. A standardized monitoring protocol (Conway 2011) recommends focused monitoring for the following secretive marsh bird species: light-footed Ridgway's rail (LFRR; federally and state endangered), Virginia rail (*Rallus limicola*), least bittern (*Ixobrychus exilis*) (CDFW Species of Special Concern), American bittern (*Botaurus lentiginosus*), common gallinule (*Gallinula galeata*), and pied-billed grebe (*Podilymbus podiceps*).

2.1.1 Performance Standards

Success for breeding marsh birds, specifically LFRR, is measured by comparing project-specific pre-construction data ("baseline data" herein defined as those data collected in 2016 and 2017, as summarized in the SELRP Baseline Monitoring Report [AECOM 2020a]) and construction (herein defined as data collected in 2018–2020)/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Data on five other "focal" marsh bird species are presented to provide additional insight into the health and condition of the lagoon but are not assessed as part of the performance standards. Performance standards for LFRR are included below.

> **Interim standard**: Construction/post-construction 4-year running average density and number of individuals 75% or greater than that of pre-construction survey data (2016–2017) by year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average density and number of individuals 95% or greater than that of pre-construction survey data (2016–2017) by year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan).

2.1.2 Approach

The focus of these surveys is to estimate density and abundance for the federally and state endangered LFRR. The objective of the LFRR surveys is to provide a replicable survey method that can act as a reliable abundance index to monitor for changes in the LFRR population size within San Elijo Lagoon over time. An additional five "focal" marsh bird species that are generally considered wetland specialists were also recorded, if present: Virginia rail, least bittern, American bittern, common gallinule, and pied-billed grebe. The focal bird species results are intended to provide an index of relative abundance of key marsh bird species other than LFRR. These other focal bird species have utility as indicator species for assessing wetland ecosystem quality (Conway 2011) and even though they are not included in the performance standards, their continued presence will be another gauge of project success.

Breeding marsh bird surveys were conducted from March 15 through June 8, 2022. LFRR data were collected within a 200-meter radius of survey points using independent double-observer methods (Nichols et al. 2000). As described in the 2018-2019 Avian Monitoring Report (AECOM 2020b), survey points 9, 10, 11, and 18 were moved slightly because the original locations were no longer accessible without disturbance to enhanced areas after restoration activities were completed in winter 2018–2019. Configuration of the proposed habitat distribution (Figure 1-1) was also slightly modified because the survey points were established in 2016, which further necessitated some minor relocation of survey points. These changes are reflected in figures in this report and in calculations regarding suitable LFRR habitat within the survey area.

2.1.2.1 Light-footed Ridgway's Rail

An independent double-observer survey approach was used for surveys, meaning two ornithologists were present for each survey (Nichols et al. 2000) and the two ornithologists recorded data independently of each other. The double-observer approach allows for estimation of detection probabilities between observers and improves overall detection probabilities to yield more precise estimates of abundance than if a single observer were used. Detection probabilities were estimated from each of the six surveys conducted from mid-March through early June in 2022 to derive LFRR estimates and abundance values. LFRR abundance and the associated 95% upper and lower confidence limits (UCL and LCL, respectively) were calculated separately for each of the six surveys using a closed mark-recapture model (Huggins 1991). Model-averaging was used to generate LFRR estimates and confidence intervals (CIs) for 2016 through 2022 in this report.

Survey Area Density Estimates

Annual LFRR survey area density estimates were calculated by dividing the model-generated estimate of LFRR abundance within the survey area by the total acreage of "preferred" habitat within the survey area for each year. For this analysis, LFRR preferred habitat was considered freshwater/brackish marsh (formerly Coastal Brackish Marsh), low salt marsh (formerly Coastal Salt Marsh – Low), and middle salt marsh (formerly Coastal Salt Marsh – Mid), based on habitat types described by Oberbauer et al. (2008). These three habitat types most closely resemble the breeding habitat of LFRR as described by Massey et al. (1984) and coincide with habitat types most consistently associated with LFRR presence during surveys. Observations of LFRR in other habitat types (e.g., mudflats, salt pannes) were generally restricted to areas immediately adjacent to one of the preferred habitat types, and represent habitats in which LFRR frequently forage. Prior to construction, there were approximately 192.5 acres of preferred habitat within the survey area in 2016 and 2017 (baseline levels). As a result of construction activities, that amount of LFRR preferred habitat within the survey area declined to 149.4 acres in 2018 and to 147.5 acres in 2019. The amount of LFRR preferred habitat within the survey area increased to 154.8 acres in 2020, 159.3 acres in 2021, and 166.5 acres in 2022.

Lagoon-wide Abundance Estimates

To estimate the LFRR population size for the entire lagoon (i.e., lagoon-wide abundance estimate), including both surveyed and unsurveyed areas, LFRR density estimates and associated CIs were multiplied by the total acreage of preferred habitat across the entire lagoon. Total preferred habitat acreages are as follows for each respective year: 301.2 acres during the baseline period (2016-2017), 244.1 acres in 2018, 241.2 acres in 2019, 251.1 acres in 2020, 257.1 acres in 2021, and 266.2 acres in 2022. It is important to note that because the LFRR density estimates are based on all six surveys, including those with reduced LFRR detections from periods when birds are less vocal, the lagoon-wide abundance estimate is an inherently conservative extrapolated value of LFRR abundance across the lagoon. This value is meant to integrate the per acre LFRR density estimates with total acreage of preferred habitat in the lagoon to showcase how changes in preferred habitat are expected to impact the lagoon-wide population. The value generated provides a tangible metric to use for within-lagoon comparisons across years rather than as a maximum estimate of the total number of LFRR within the lagoon.

2.1.2.2 Other Focal Marsh Bird Species

In addition to LFRR, results for five other species of marsh birds are provided as the average number of individuals detected per survey. There was an insufficient number of detections for these other species to generate modeled estimates of abundance. For this reason, raw numbers of detected individuals are presented as an index reflecting relative abundance.

2.1.3 <u>Results</u>

A detailed summary of the survey dates, survey times, survey personnel, and weather conditions is provided in Appendix A.

2.1.3.1 Light-footed Ridgway's Rail

Survey Area Density Estimates

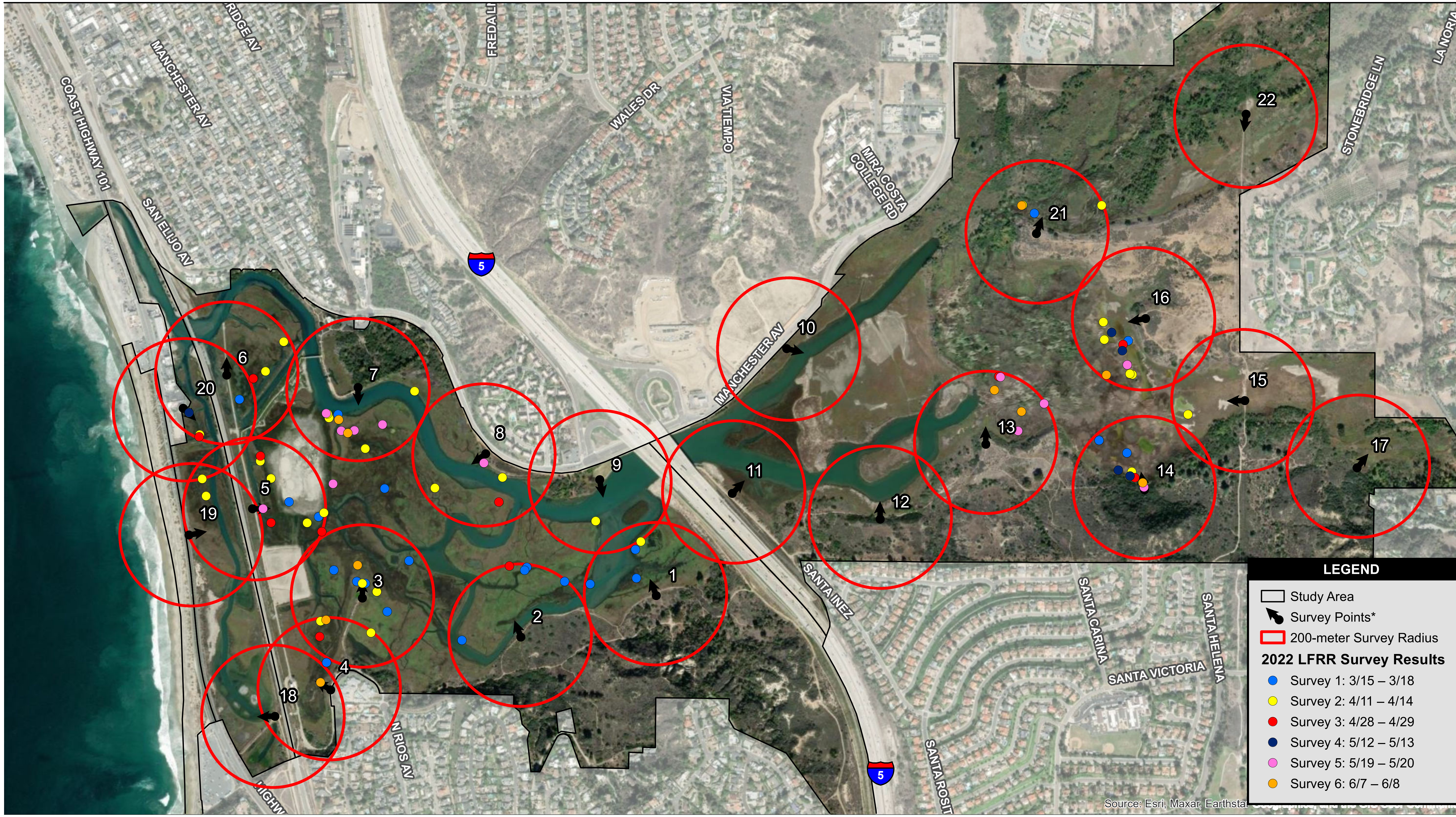
Locations of LFRR detections from 2022 surveys are depicted in Figure 2-1. Based on results from the Huggins (1991) model, LFRR survey area density estimates for each of the six surveys conducted in 2022 are presented in Table 2-1 with associated model-generated 95% CIs. Values represent the estimated number of individuals per acre of preferred habitat within the survey area. LFRR density estimates are presented for 2022, a 4-year running average of the construction/post-construction period (2019–2022), as well as the baseline period (2016–2017).

Table 2-1. Summary of Survey Area Density Estimates for the Light-Footed Ridgway's Rail

Survey Number	LFRR Survey Area Density Estimates; # Individuals/Acre		
	2022 Estimate (95% CI)[1]	2019–2022 Construction/Post-construction Estimate[2]	2016–2017 Baseline Estimate[3]
1	0.18 (0.17-0.18)	0.23	0.25
2	0.18 (0.17-0.18)	0.22	0.22
3	0.08 (0.07-0.08)	0.19	0.23
4	0.04 (0.04-0.05)	0.12	0.21
5	0.05 (0.05-0.06)	0.12	0.17
6	0.07 (0.07-0.08)	0.17	0.18
Overall Mean (95% CI)[4]	**0.10 (0.05-0.15)**	**0.17 (0.14 – 0.21)**	**0.21 (0.18 – 0.23)**

[1] Density estimates and 95% confidence intervals (CIs) for Surveys 1 through 6 in 2022 were calculated by dividing the model-generated LFRR abundance estimates (and associated confidence limits) within the survey area by the amount of preferred habitat within the survey area (166.5 acres in 2022).
[2] The six survey-specific density estimates in these columns were calculated as the mean of 2019 through 2022 density estimates and lack model-generated confidence limits.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a).
[4] Overall Mean Estimates in this row for 2022, 2019–2022 combined, and the baseline data were calculated as the mean of the six survey-specific estimates. Confidence limits for 95% CIs calculated as mean estimate +/- 1.96 x standard error of the six estimates.

Survey area density estimates varied considerably among the six surveys conducted in 2022 (Table 2-1), ranging from a low of 0.04 individuals/acre during Survey 4, to a high of 0.18 individuals/acre during Surveys 1 and 2 (overall mean=0.10 individuals/acre). LFRR density estimates were highest in the first two surveys, and then dropped during the middle surveys before exhibiting a modest recovery later in the season. This pattern has occurred in each of the past 3 years (Figure 2-2), while prior years (2016–2019) generally showed a decline across the survey period (Baseline Monitoring Report [AECOM 2020a], Figure 2-2). The inter-survey variation in 2022 was significant in many cases, with non-overlapping 95% CIs for most estimates from the different surveys. The overall mean for 2022 of 0.10 individuals/acre was 0.07 individuals/acre lower than the 4-year construction/post-construction running average, and 0.11 individuals/acre lower than the baseline period average (Table 2-1).



Source: SanGIS 2022; MoffattNichol 2022; AECOM 2022

900 450 0 900 Feet

Scale: 1:10,800; 1 inch = 900 feet

* arrows depict direction of broadcast call

Figure 2-1
2022 Light-footed Ridgway's Rail Observations

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\2022_Avian_Report\LFRR_Species_Survey_Overview_2022.mxd, 8/18/2023, paul.moreno

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Figure 2-2. Survey Area Estimates of Light-footed Ridgway's Rail Density 2019-2022

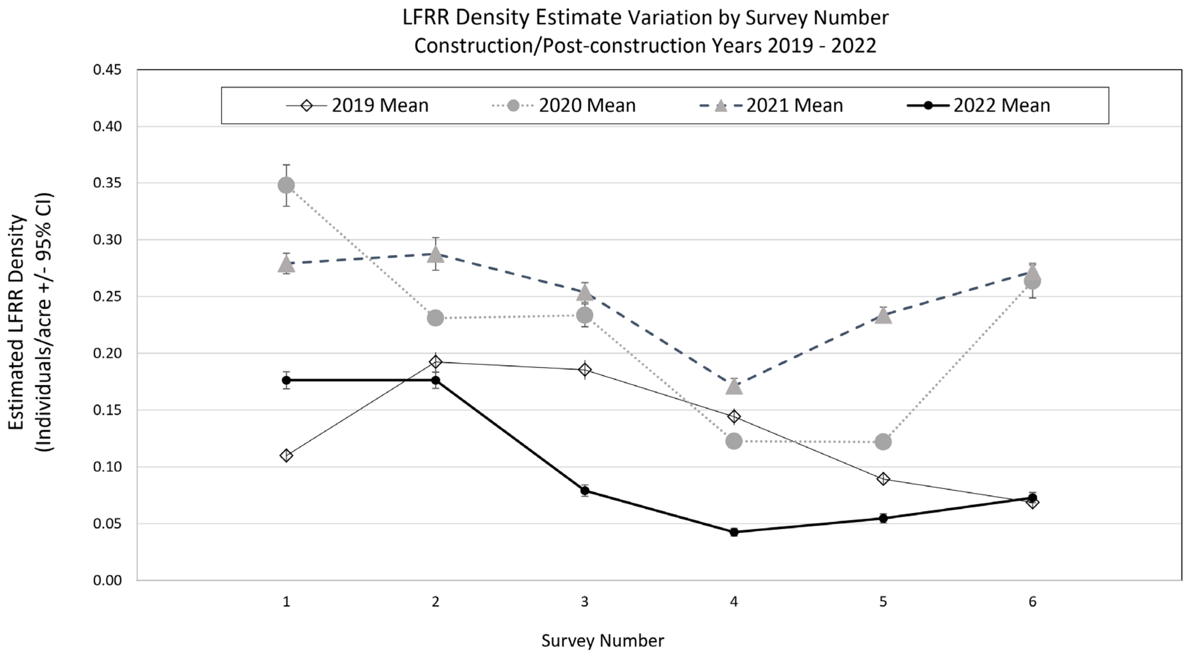


Figure 2-2: Data from 2019–2022, which represent the 4-year construction/post-construction running average. Model-generated lower and upper 95% confidence limits (LCL and UCL, respectively) are indicated by vertical lines.

Lagoon-wide Abundance Estimates

The lagoon-wide LFRR abundance estimate in 2022 was 26.70 individuals (95% CI: 13.86–39.54), which was markedly lower than both the 4-year construction/post-construction running average of 43.83 individuals (95% CI: 34.52–53.15) and the baseline average of 62.98 individuals (95% CI: 55.54–70.42) (Table 2-2). The 2022 lagoon-wide abundance estimate was the lowest single year estimate of the 7-year project, eclipsing the previous low mark of 31.77 individuals in 2019 by more than 5 individuals (Figure 2-3).

Table 2-2. Summary of Lagoon-wide Abundance Estimates for the Light-Footed Ridgway's Rail

Survey Number	LFRR Lagoon-wide Abundance Estimates		
	2022 Estimate (95% CI)[1]	2019–2022 Construction/Post-construction Estimate[2]	2016–2017 Baseline Estimate[3]
1	46.94 (44.98-48.90)	57.65	75.06
2	46.93 (44.98-48.88)	56.18	66.38
3	21.05 (19.74-22.36)	46.97	68.79
4	11.33 (10.40-12.26)	29.99	63.13
5	14.56 (13.51-15.62)	31.53	49.91
6	19.42 (18.19-20.65)	42.47	54.60
Overall Mean (95% CI)[4]	**26.70 (13.86-39.54)**	**44.13 (34.68-53.58)**	**62.98 (55.54-70.42)**

[1] Lagoon-wide abundance estimates and 95% confidence intervals (CIs) for Surveys 1 through 6 were calculated by multiplying the model-generated LFRR density estimates for each year/survey (and associated confidence limits) by the amount of suitable preferred habitat across the lagoon that year (see Section 2.1.2.1 for acreage for each year).
[2] The six survey-specific density estimates in these columns were calculated as the mean of 2019 through 2022 density estimates and lack model-generated confidence limits.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a).
[4] Overall Mean Estimates in this row were calculated as the mean of the six survey-specific estimates. Confidence limits for 95% CIs calculated as mean estimate +/- 1.96 x standard error of the six estimates.

Figure 2-3. Lagoon-wide Abundance Estimates of Light-footed Ridgway's Rails 2016–2022

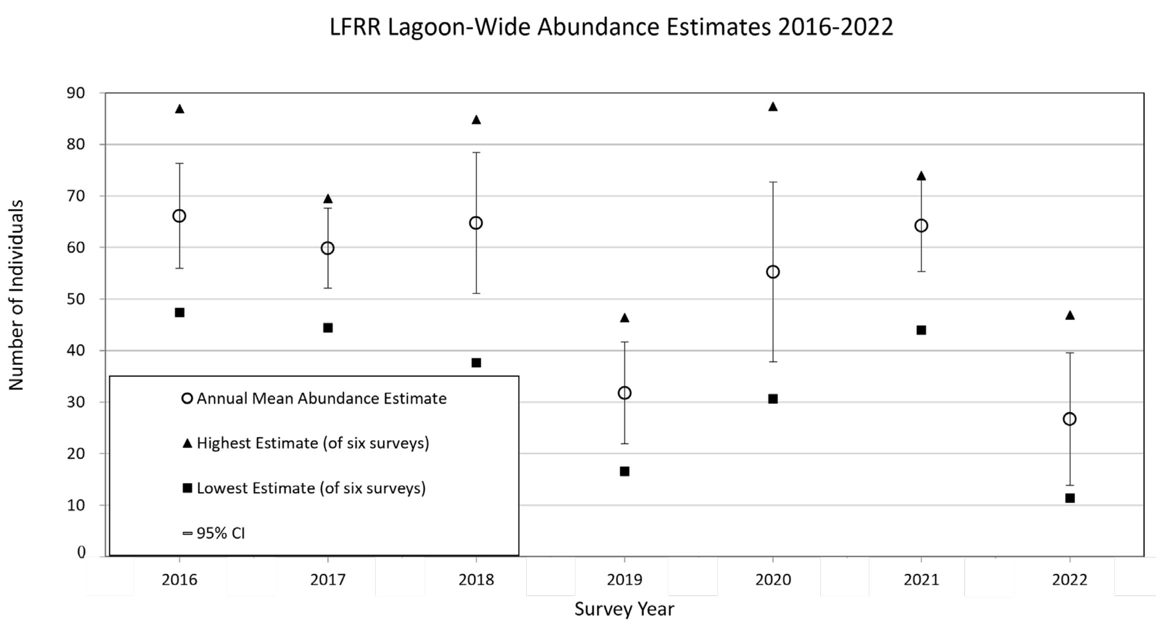


Figure 2-3: Mean abundance estimate for the number of LFRR across the lagoon by year. The first 2 years (2016 and 2017) represent the baseline period and the subsequent 5 years (2018 through 2022) represent the first 5 years of the construction/post-construction period. Lower and upper confidence limits (LCL and UCL, respectively) are indicated by vertical bars. Triangles and squares reflect mean highest (triangle) and lowest (square) estimates for a survey period.

2.1.3.2 Other Focal Marsh Bird Species

As stated above, the focal marsh bird data represent the number of detections within the survey area and are not adjusted for the amount of suitable habitat or extrapolated to provide an estimate of the lagoon-wide abundance. Detections of focal marsh bird species recorded during survey efforts are included in Table 2-3. On average, Virginia rails were the most commonly detected of the focal marsh bird species during the 2022 surveys, whereas no common gallinules or least bitterns were detected. Other focal marsh bird species exhibited inter-annual variation, but the numbers were relatively consistent over time. The overall 2022 average of 9.17 individuals/survey is slightly lower than both the 4-year construction/post-construction period running average and baseline period average of 10.00 individuals/survey (Table 2-3).

Table 2-3. Survey Detections of Other Focal Marsh Bird Species

Focal Species		Average Number Detected per Survey (Standard Error)		
Common Name	**Scientific Name**	**2022[1]**	**2019–2022 Construction/ Post-construction[2]**	**2016–2017 Baseline[3]**
Virginia Rail	*Rallus limicola*	6.17 (2.66)	6.58 (1.33)	6.00 (1.41)
Least Bittern	*Ixobrychus exilis*	0.00 (0.00)	0.08 (0.05)	0.33 (0.17)
American Bittern	*Botaurus lentiginosus*	0.50 (0.22)	1.00 (0.21)	0.75 (0.48)
Common Gallinule	*Gallinula galeata*	0.00 (0.00)	0.00 (0.00)	0.08 (0.08)
Pied-billed Grebe	*Podilymbus podiceps*	2.50 (1.02)	2.29 (0.41)	1.75 (0.38)
All Species[4]	**-----**	**9.17 (3.38)**	**10.00 (1.65)**	**10.00 (2.49)**

[1] Mean and standard error for 2022 averages calculated from number of individuals detected during the six surveys.
[2] Averages and standard error values calculated from the 4-year construction/post-construction running average (2019–2022) number of individuals detected during each of the six surveys each year.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a)
[4] Values are based on the survey-specific totals (number of individuals of all focal species) detected for surveys 1 through 6 in each year or combination of years.

2.1.4 Discussion

As marsh bird surveys continue to be conducted during the post-construction phase of the project, new running averages for LFRR will be calculated annually for the 4 most recent years of construction/post-construction surveys and compared to the baseline levels to evaluate interim and final performance standards as described in the Monitoring Plan (Nature Collective 2020). Statistical comparisons between the baseline and construction/post-construction LFRR results presented above will be presented in the annual SELRP monitoring reports.

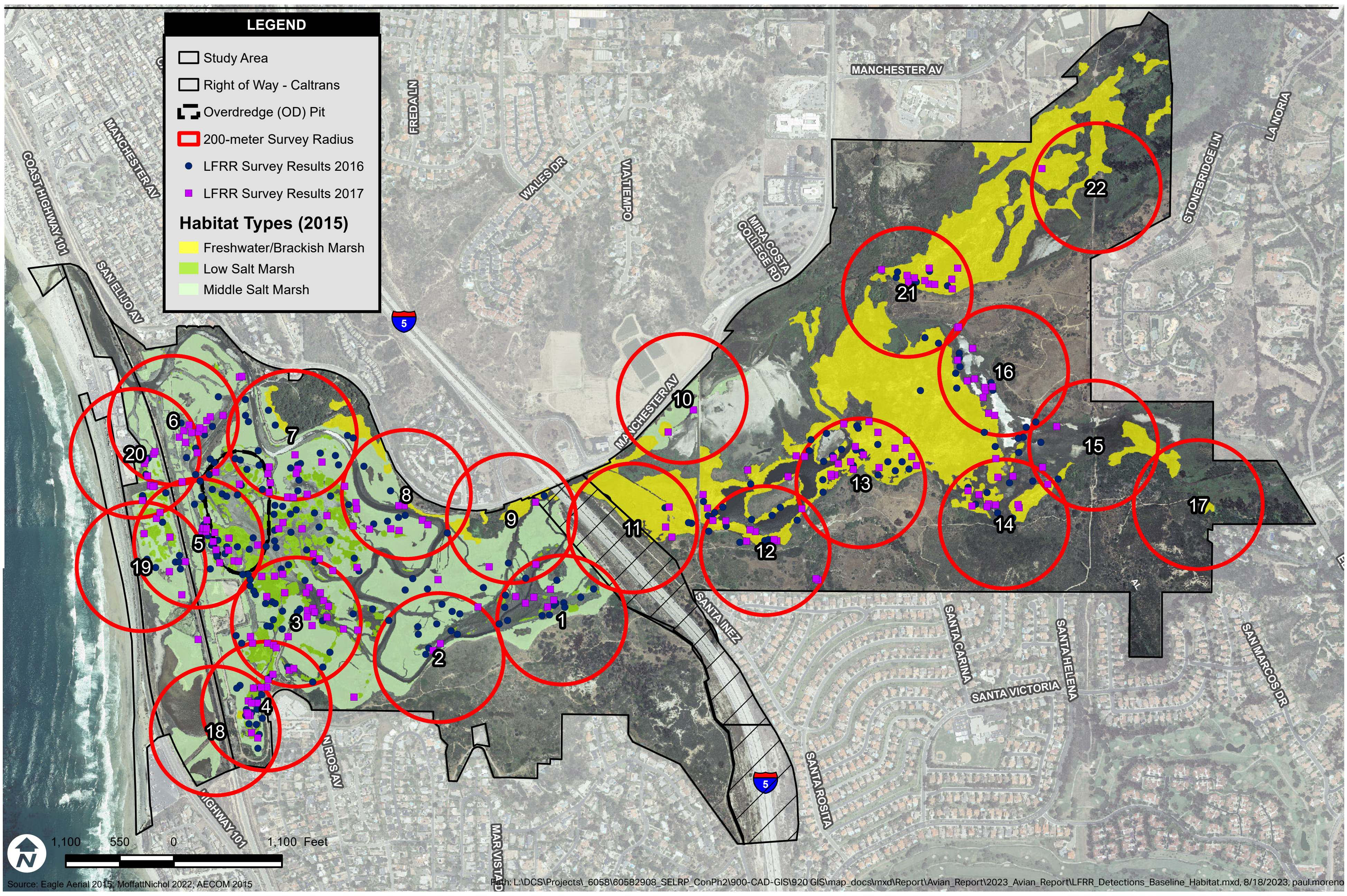
2.1.4.1 Light-footed Ridgway's Rail

The 2022 LFRR survey results yielded the lowest survey area density estimate of the 7-year survey project period at 0.10 individuals/acre, which is 0.07 individuals/acre lower than the 4-year construction/post-construction period running average, and 0.11 individuals/acre lower than the baseline period average. This density estimate resulted in a lagoon-wide abundance estimate of 26.70 individuals, which was approximately 5 fewer individuals than the previous low lagoon-wide abundance estimate of 31.77 individuals in 2019. The 2022 lagoon-wide abundance estimate was less than half of the previous year's estimate of 64.19 individuals (AECOM 2022b) and the baseline period average of 62.98 individuals. The 4-year construction/post-construction running average dropped from 53.34 individuals in 2021 to 43.83 individuals in 2022. This steep decline can be primarily attibuted to the fact that 2 of those 4 years (2019 and 2022) represent the lowest abundance estimates of the 7-year study.

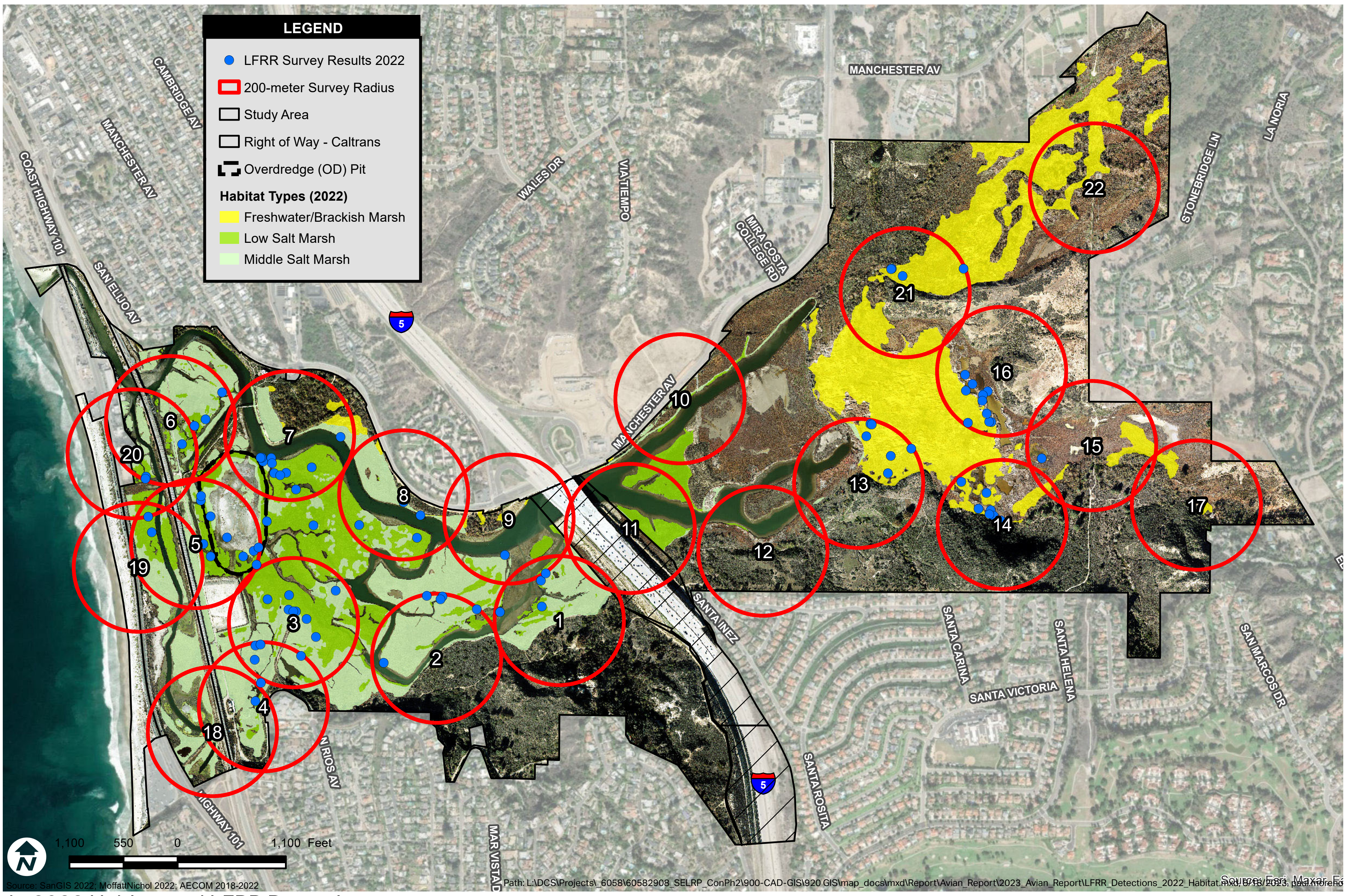
In 2022, LFRR were detected generally in the same areas as during the baseline period (Figure 2-4), with the major exception of survey areas 11, 12, and the western portion of survey area 13. These three survey areas, which are located in the east basin, experienced extensive changes in the amount of LFRR preferred habitat from baseline to 2022, in which much of the LFRR preferred habitat converted to open water and high salt marsh. Survey areas 7 through 10 also lost preferred habitat to open water, but the number of LFRR detections in those survey areas did not change dramatically from baseline to 2022. Survey areas 7 and 8 retained relatively high proportions of preferred habitat from baseline to post-construction despite the channel widening, and both survey areas had multiple LFRR detected during the baseline period and in 2022. In contrast, survey areas 9 and 10 had very few LFRR detections during the baseline period (Figure 2-4a), similar to their numbers post-construction. This pattern suggests that the LFRR preferred habitat in these two survey areas (much of which converted to open water) may not have been high quality pre-construction, and may now be limited in size, or remains low-quality.

In 2022, there was never more than one individual detected during a given survey at Stations 21 and 22 (Figure 2-1), whereas in 2020 and 2021 multiple LFRR individuals were regularly detected during surveys at both stations (AECOM 2022b; 2022d). The habitat at these stations did not change substantially in make-up or overall acreage from baseline to post-construction, but the drought conditions in 2022 may have made the Escondido Creek drainage less suitable for LFRR.

LFRR were detected primarily in LFRR preferred habitats (freshwater/brackish marsh, low and middle salt marsh) in 2022. When LFRR were detected outside of the preferred habitats they were in mudflats and salt pannes adjacent to the preferred habitats (Figure 2-4b). LFRR are known to forage in muddy habitats at the edges of salt marshes, where they feed on invertebrates like crabs and worms.



a. Baseline Habitat and LFRR Detections



b. 2022 Habitat and LFRR Detections

Figure 2-4
Light-footed Ridgway's Rail Preferred Habitat Types and Detections, Baseline Period and 2022

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\2023_Avian_Report\LFRR_Detections_Baseline_Habitat.ai 8/22/2023 dbrady

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The lower lagoon-wide abundance estimate generated by AECOM for 2022 compared to previous years corroborates data collected by Zembal and Hoffman, in which they reported 49 breeding pairs in the lagoon (Zembal and Hoffman 2022). This number was a sharp decrease from the record high 78 pairs Zembal and Hoffman reported in the lagoon in 2021 (Zembal and Hoffman 2021). Zembal and Hoffman also recorded declines across San Diego County, in which 15 subpopulations declined from 2021 to 2022 compared to only 5 that increased, with a net loss of 73 breeding pair detections (Zembal and Hoffman 2022). For a number of years, Zembal and colleagues have conducted LFRR surveys within San Elijo Lagoon and other nearby lagoons to provide a census of LFRR numbers throughout San Diego County. These lagoon-wide LFRR censuses tend to be higher than the estimates generated as part of the SELRP breeding marsh bird survey efforts, although it is important to note that the results from the two studies are not directly comparable. Methods in this study were designed to provide metrics of LFRR density and abundance throughout the breeding season rather than a census of individuals and/or documentation of nesting activity. The average of six surveys is used because it provides a standardized index for comparisons among survey years. This average remains unbiased because surveys are conducted at approximately the same time throughout the year. As illustrated in Figure 2-2, LFRR detections generally decrease over the course of the six survey periods, with the exceptions of 2020 and 2021. The general trend for declining estimates can likely be attributed to differences in detectability of birds throughout the breeding season. For example, LFRR in Southern California have been documented to give “clapper” and “kek” calls less frequently during May and June, after a peak in the early spring (Zembal and Massey 1987). LFRR in Arizona were also shown to be less responsive to playback during May and June compared to March and April (Conway et al. 1993). LFRR may also be more difficult to detect after most pairs have begun incubation, which generally occurs by late April or early May in Southern California (Eddleman and Conway 2018). Although Zembal and colleagues conduct their surveys from February through June (similar to this study), they try to target peak breeding activity when possible. Despite the lack of direct comparability between this study and the work of Zembal and colleagues, the catalog of data provided by Zembal and colleagues’ monitoring efforts provides useful background information of the LFRR population at San Elijo Lagoon.

The decrease in estimated LFRR numbers at San Elijo Lagoon and county-wide in 2022 could be a product of either reduced detections (e.g., due to reduced breeding activity and less vocalizing behavior), or actual decreases in the number of individuals in the lagoon (e.g., due to normal population cycling, an increase in predator activity, or sea-level rise causing more frequent nest inundation). Continued drought-conditions in 2022 may have impacted nesting substrate or food resources and caused some birds to abandon nesting activities, including territorial calling. Detections would therefore decrease without the population changing. However, there are some indications that the numbers reflect an actual decrease in the lagoon population. Zembal and Hoffman (2022) suggested that loss of habitat due to more frequent and extreme high water events was at least partly responsible for the declines in LFRR across San Diego County. In addition, data on juvenile LFRR survival at San Elijo Lagoon indicate that juvenile survival may have been relatively low in 2021 (2 of 10 wild-caught juveliles and 0 of 11 captive-bred juveniles all outfitted with Global Positioning System (GPS) trackers were alive approximately 6 months after being tagged) and 2020 (6 of 13 wild caught and 2 of 13 captive bred were alive for the same duration) (Sawyer et al. 2022). Low survival of juveniles often leads to low recruitement of reproductive individuals (especially for species that generally do not disperse widely), and if the LFRR population experienced low recruitment in both 2020 and 2021, that could lead to reduced population size in 2022. Predator control efforts from 2018 through 2022 have targeted potential LFRR nest-predators in the lagoon, including racoons, Virgina opossums, and non-native rats, among others. However, approximately 80% of juvenile LFRR mortality was attributed to raptor predation in 2020 and 2021 (Sawyer et al. 2022), indicating that raptors may play an important role after chicks have left the nest. Wild birds exhibited higher survival than captive-bred birds, suggesting that wild birds are better equipped to avoid predators. It is unclear what effect, if any, the release of captive-bred LFRR has had on the population at San Elijo Lagoon, but as additional information is collected on the survival and movement of released birds, this will be incorporated into future reports.

2.1.4.2 Other Focal Marsh Bird Species

Detections of the other focal species are presented as the average number of individuals per survey for the survey year 2022 in addition to the 4-year construction/post-construction running average and baseline period average, as shown in Table 2-3. Due to the low number of detections for each of these species, survey estimates were not corrected for detection probabilities, so the reported numbers probably underestimate true abundance of focal marsh bird species. Thus, abundance estimates are not directly comparable to the modeled abundance estimates of LFRR.

The overall average of 9.17 focal marsh bird individuals/survey in 2022 was slightly lower than the 4-year construction/post-construction running average and baseline period average of 10.00 individuals/survey (for both periods). Virginia rail and pied-billed grebe both increased slightly from 2021, American bittern declined slightly from 2021, and least bittern and common gallinule were not detected. Post-construction surveys will continue to monitor numbers of these birds moving forward.

2.2 WATERBIRD SURVEYS, INCLUDING WESTERN SNOWY PLOVER AND CALIFORNIA LEAST TERN

The monitoring of waterbird species (e.g., seabirds, waterfowl, shorebirds, wading birds) that use open water and mudflat habitats in the SELRP study area is a “pre-restoration absolute” monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. In the process of monitoring waterbirds, these avian surveys generate specific information about western snowy plovers (*Charadrius nivosus nivosus*) and California least terns (*Sternula antillarum browni*).

2.2.1 Performance Standards

Success for western snowy plovers and California least terns is measured by comparing project-specific pre-construction (baseline) data and construction/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Data on other waterbird species are presented to provide additional insight into the health and condition of the lagoon but are not assessed as part of the performance standards. Performance standards for western snowy plovers and California least terns are included below.

> **Interim standard**: Construction/post-construction 4-year running average number of individuals 75% or greater than that of pre-construction survey data (2016–2017) by year 7 post-construction

> **Final standard**: Construction/post-construction 4-year running average number of individuals 95% or greater than that of pre-construction survey data (2016–2017) by year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan [Nature Collective 2020]).

2.2.2 Approach

Waterbird surveys focused on birds that utilize open water, mudflat, and sand habitat, including western snowy plovers and California least terns. A complete description of methodology for waterbird surveys can be found in the Monitoring Plan (Nature Collective 2020). Each survey yielded a census of waterbirds observed in the west, central, and east basins of the lagoon. Abundances of the two focal species (western snowy plover and California least tern) were calculated as the lagoon-wide average of individuals observed per survey by month, as well as the average number observed per survey within each basin. These values were then used to calculate an overall per-survey average for 2022. Observations of other target waterbird species were grouped into specific taxonomic orders and summarized as both the number of individuals in each cohort observed per survey by month for each basin, and an overall per-survey average for 2022. A list of the species associated with each taxonomic order detected during surveys is provided in Appendix B.

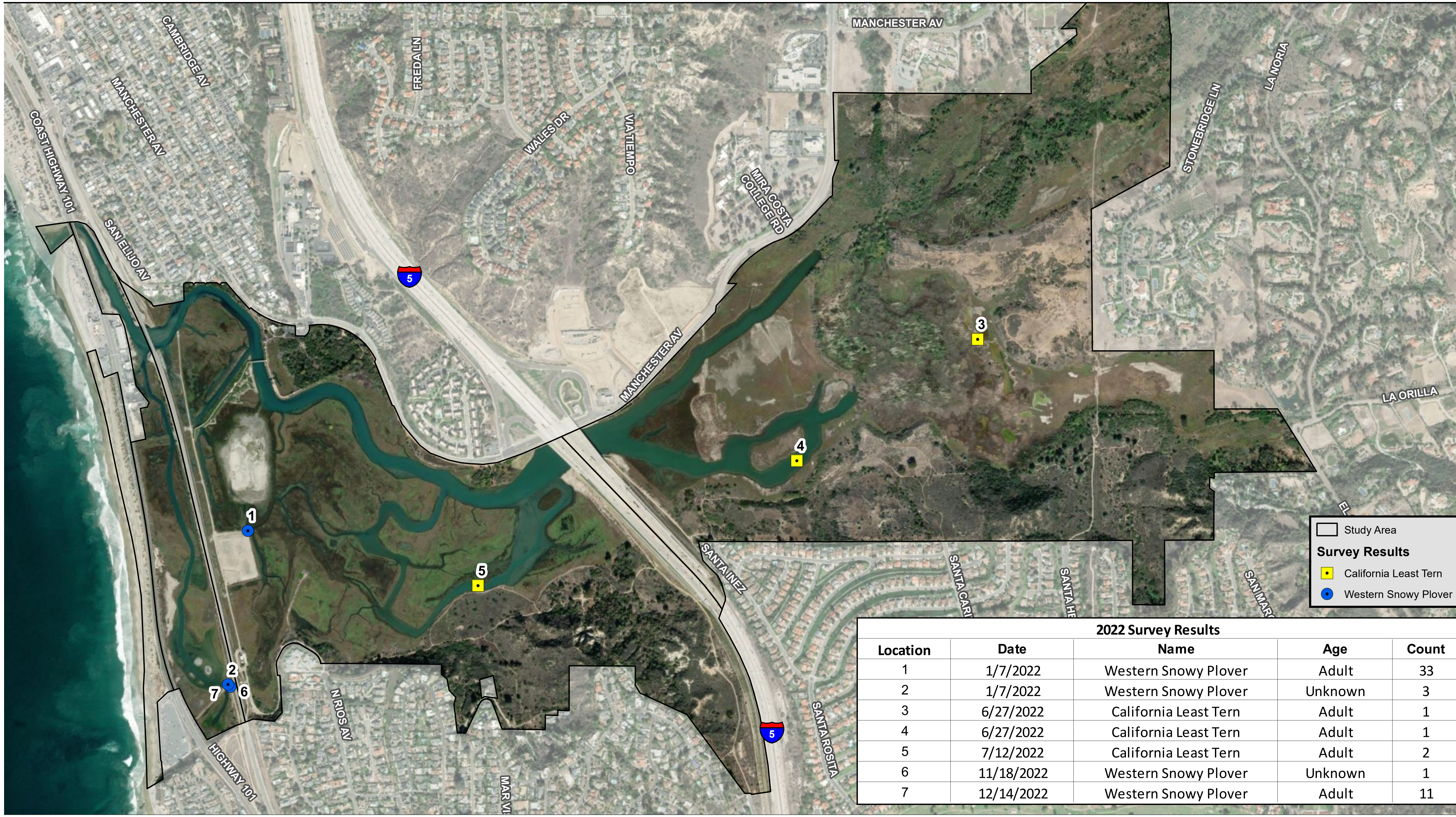
Surveys were conducted January through December with one survey conducted per month during January, February, October, November, and December, and at least two surveys conducted per month during March through September. Because California least terns overwinter in Central and South America and breed in Southern California during May and July, results for California least terns are provided for the months of April through September because the species is generally not present at the lagoon outside of these months.

2.2.3 Results

Survey results are summarized by month in the subsections for western snowy plover, California least tern, and waterbirds. Detailed summaries of the survey dates, survey times, survey personnel, and weather conditions are provided in Appendix C. When multiple surveys were conducted in a month for a given year, the mean number of individuals detected across surveys conducted within that month was calculated. The mean number of individuals detected per survey during each month was then used to evaluate temporal variation in abundance (across seasons and years). These values, along with the baseline data, are presented in Tables 2-4, 2-6, and 2-8.

2.2.3.1 Western Snowy Plover

Survey results for western snowy plovers from 2022, a 4-year running average of the construction/post-construction period (2019–2022), as well as the baseline period (2016–2017) are summarized in Table 2-4. In 2022, western snowy plovers were detected within the lagoon in three of the 19 surveys, with an overall monthly average of 4.00 individuals/survey. The high count of this species was recorded during January, with 36 birds detected that month. No western snowy plovers were detected in the lagoon from February through October. The mean number of detections per survey in 2022 was higher than the baseline average and the 4-year construction/post-construction running average by 3.73 and 1.32 individuals/survey, respectively. The mean number of western snowy plovers detected in each lagoon basin is shown in Table 2-5. In 2022, western snowy plovers were detected in the central and west basins (Figure 2-5).



2022 Survey Results

Location	Date	Name	Age	Count
1	1/7/2022	Western Snowy Plover	Adult	33
2	1/7/2022	Western Snowy Plover	Unknown	3
3	6/27/2022	California Least Tern	Adult	1
4	6/27/2022	California Least Tern	Adult	1
5	7/12/2022	California Least Tern	Adult	2
6	11/18/2022	Western Snowy Plover	Unknown	1
7	12/14/2022	Western Snowy Plover	Adult	11

Source: SanGIS 2022; MoffattNichol 2022; AECOM 2022.

1,000 500 0 1,000 Feet

Scale: 1:12,000; 1 inch = 1000 feet

Figure 2-5
2022 California Least Tern and Western Snowy Plover Survey Results

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\2022_Avian_Report\LeastTern_Plover_2022_Survey_Results.mxd, 8/18/2023, paul.moreno

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Table 2-4. Summary of Western Snowy Plover Results by Survey Number and Month

Month	2022 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Waterbird Survey #	# Individuals	2022	2019–2022 Construction/ Post-construction	2016–2017 Baseline
Jan	1	36	36.00	13.50	0.00
Feb	2	0	0.00	0.00	0.00
Mar	3	0	0.00	0.00	0.00
	4	0			
Apr	5	0	0.00	0.00	0.00
	6	0			
May	7	0	0.00	0.00	0.00
	8	0			
Jun	9	0	0.00	0.00	0.00
	10	0			
Jul	11	0	0.00	2.00	0.00
	12	0			
Aug	13	0	0.00	0.38	0.00
	14	0			
Sep	15	0	0.00	1.00	1.25
	16	0			
Oct	17	0	0.00	1.25	2.00
Nov	18	1	1.00	3.00	0.00
Dec	19	11	11.00	11.00	0.00
Overall Average (Standard Error)			**4.00 (3.05)**	**2.68 (1.33)**	**0.27 (0.19)**

Table 2-5. Mean Number of Western Snowy Plovers/Survey by Lagoon Basin

Lagoon Basin	Mean # Individuals/Survey/Month (Standard Error)
	2022; 19 surveys[1]
Central	2.75 (2.75)
East	0.00 (0.00)
West	1.25 (0.92)

[1] Mean and standard error values for each basin calculated from 12 monthly values (averaged among surveys when multiple surveys conducted in a month).

2.2.3.2 California Least Tern

Survey results for California least terns from 2022, including a 4-year running average of the construction/post-construction period (2019–2022) as well as the baseline period (2016–2017), are summarized in Table 2-6. During 2022, California least terns were detected in two of the 12 "California least tern surveys" from April through September; one survey in June and one survey in July. The number of individuals detected ranged from 0 to 2 birds, and the mean number of birds detected per survey in 2022 was 0.33 individuals. Overall, survey results in 2022 were lower than the baseline average and the 4-year construction/post-construction running average by 0.52 and 0.27 individuals/survey, respectively.

Table 2-6. Summary of California Least Tern Results by Survey Number and Month

Month	2022 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Waterbird Survey #	# Individuals	2022	2019–2022 Construction/ Post-construction	2016–2017 Baseline
Apr	5	0	0.00	0.00	0.00
	6	0			
May	7	0	0.00	0.50	1.40
	8	0			
Jun	9	0	1.00	1.88	3.35
	10	2			
Jul	11	2	1.00	1.25	0.40
	12	0			
Aug	13	0	0.00	0.00	0.00
	14	0			
Sep	15	0	0.00	0.00	0.00
	16	0			
Overall Average (Standard Error)			**0.33 (0.21)**	**0.60 (0.32)**	**0.86 (0.55)**

During 2022 surveys, the species was detected equally in the east and central basins of the lagoon (0.17 individuals/survey) with no detections in the west basin (Table 2-7). When present within the lagoon, individuals were observed engaging in aerial foraging over open water or were actively flying. The locations of California least tern observations from 2022 surveys are displayed in Figure 2-5.

Table 2-7. Mean Number of California Least Terns/Survey by Lagoon Basin

Lagoon Basin	Mean # Individuals/Survey (Standard Error)
	2022; 12 surveys[1]
Central	0.17 (0.17)
East	0.17 (0.17)
West	0.00 (0.00)

[1] Mean and standard error values for each basin calculated from six monthly values (averaged across the two surveys conducted each month).

2.2.3.3 Other Waterbird Species

Waterbird survey results from 2022, a 4-year running average of the construction/ post-construction period (2019–2022), as well as the baseline period (2016–2017) are summarized in Table 2-8. Averaged across the three lagoon basins, the mean number of waterbirds detected in 2022 was 463.54 individuals/survey. Detections in 2022 were almost exactly 200 individuals/survey lower than the 4-year construction/post-construction average of 663.84 individuals/survey, but approximately 108 individuals/survey higher than the baseline average of 355.8 individuals/survey (Table 2-8).

Table 2-8. Summary of Waterbird Results by Survey Number and Month

Month	2022 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Waterbird Survey #	# Individuals	2022	2019–2022 Construction/ Post-construction	2016–2017 Baseline
Jan	1	859	859.0	1,029.0	509.5
Feb	2	857	857.0	1,066.3	857.0
Mar	3	838	748.0	759.9	458.5
	4	658			
Apr	5	414	340.0	401.5	328.8
	6	266			
May	7	158	119.0	221.6	181.3
	8	80			
Jun	9	81	78.5	162.6	148.9
	10	76			
Jul	11	118	163.0	364.4	154.8
	12	208			
Aug	13	238	196.5	366.6	262.0
	14	155			
Sep	15	266	368.5	496.8	286.8
	16	471			
Oct	17	268	268.0	688.3	186.5
Nov	18	888	888.0	1,122.8	549.8
Dec	19	677	677.0	1,286.5	682.8
Overall Average (Standard Error)			**463.54 (91.66)**	**663.84 (110.95)**	**355.8 (72.7)**

Total waterbird numbers declined in 2022 in the east and especially the central basins, but increased in the west basin compared to 2021 (Figure 2-6). Taxonomic groups observed within each basin during waterbird surveys are detailed in Table 2-9. The two orders of birds most frequently detected during waterbird surveys were the Anseriformes (waterfowl) and Charadriiformes (shorebirds, gulls, and terns), which comprised just under 90.0% of observations during 2022, although this varied by basin. Together they comprised 86.4% of observations in the central basin, 82.1% of observations in the east basin, and 98.4% of observations in the west basin.

In 2022, Anseriformes were detected in the greatest numbers in the east basin (108.63 individuals/survey) and in the lowest numbers in the west basin (19.33 individuals/survey), with intermediate abundances in the central basin (51.75 individuals/survey) (Table 2-9). The change in total waterbird numbers from 2021 to 2022 in the east basin was driven mostly by patterns of usage among the Anseriformes (Figure 2-7), which exhibited a modest decline. Charadriiformes were detected in the greatest numbers in the west basin (165.13 individuals/survey), and at the lowest levels in the east basin (21.13 individuals/survey), with intermediate abundances in the central basin (50.42 individuals/survey) (Table 2-9). The dramatic decline in total waterbird activity in the central basin from 2021 to 2022 was primarily driven by the decline in Charadriiformes detections in that basin (Figuer 2-8), but there was an increase in total waterbird detections in the west basin (Figure 2-6) that was primarily driven by an increase in Charadriiformes detections in that basin (Figure 2-8).

Figure 2-6. Mean Number of Waterbirds by Year and Basin

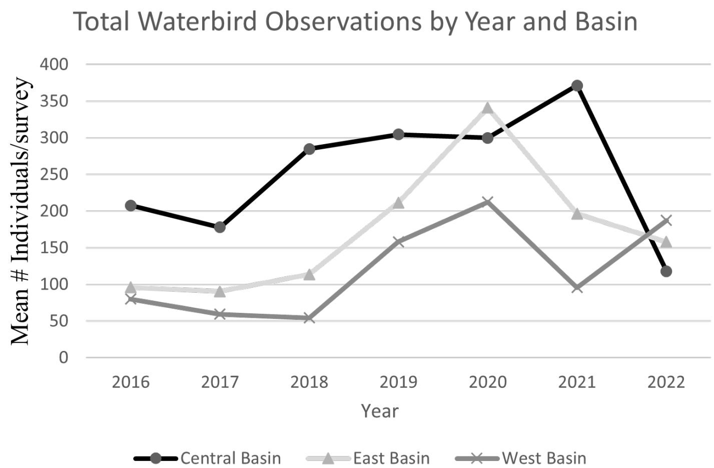


Figure 2-7. Mean Number of Anseriformes by Year and Basin

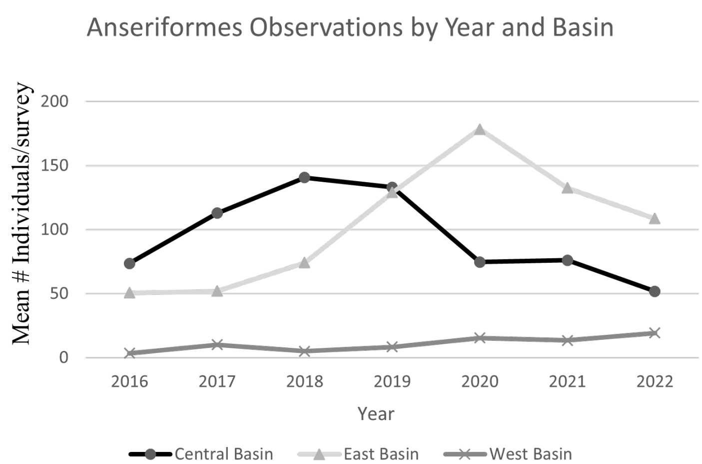


Figure 2-8. Mean Number of Charadriiformes by Year and Basin

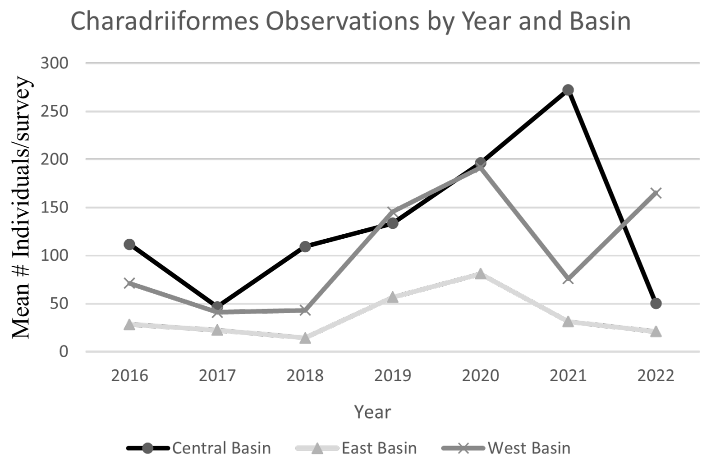


Table 2-9. Summary of Waterbird Results by Taxonomic Group and Lagoon Basin

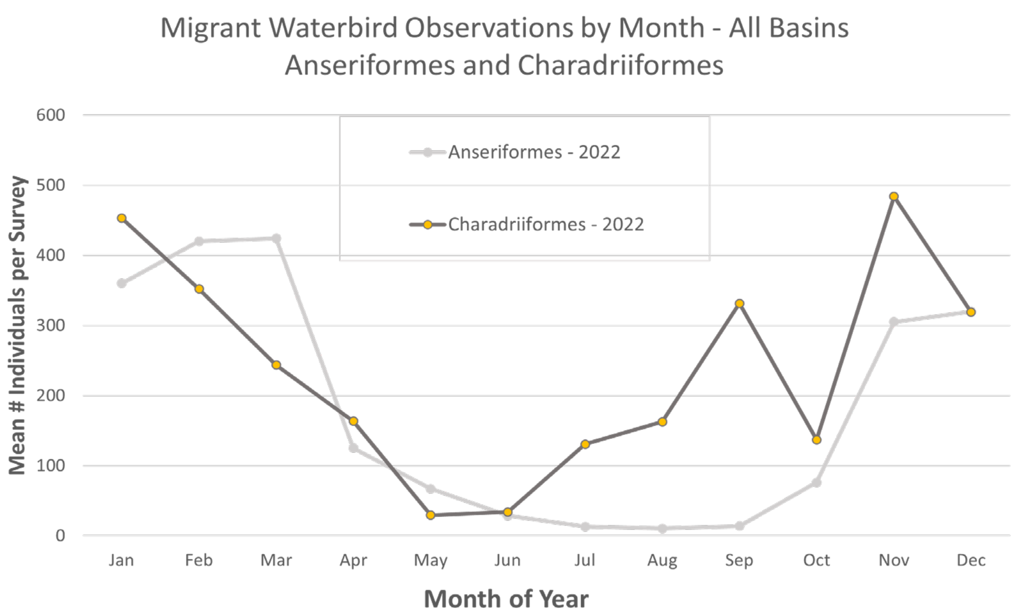
Lagoon Basin	Taxonomic Order	Mean # of Individuals Detected per Survey (Standard Error)
		2022; 19 surveys[1]
Central	**Total (all species)**	**118.21 (26.26)**
	Anseriformes (Waterfowl)	51.75 (15.61)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	50.42 (14.14)
	Gruiformes (Rails, Coots)	2.17 (1.04)
	Pelecaniformes (Pelicans, Wading birds)	6.96 (0.98)
	Podicipediformes (Grebes)	2.42 (0.77)
	Suliformes (Cormorants)	4.50 (1.68)
East	**Total (all species)**	**157.96 (39.37)**
	Anseriformes (Waterfowl)	108.63 (30.16)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	21.13 (6.16)
	Gruiformes (Rails and Coots)	19.92 (5.80)
	Pelecaniformes (Pelicans and Wading birds)	5.63 (0.90)
	Podicipediformes (Grebes)	2.00 (0.48)
	Suliformes (Cormorants)	0.67 (0.33)
West	**Total (all species)**	**187.38 (42.68)**
	Anseriformes (Waterfowl)	19.33 (7.30)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	165.13 (37.36)
	Gruiformes (Rails and Coots)	0.00 (0.00)
	Pelecaniformes (Pelicans and Wading birds)	1.88 (0.23)
	Podicipediformes (Grebes)	0.29 (0.16)
	Suliformes (Cormorants)	0.75 (0.35)

[1] Mean and standard error values for each basin calculated from 12 monthly values (averaged among surveys when multiple surveys conducted in a month).

After the Anseriformes and Charadriiformes, the next most abundant groups were birds in the orders Gruiformes (primarily American coots and LFRR), Pelecaniformes (primarily herons and egrets), and, to a lesser extent, Suliformes (cormorants) and Podicipediformes (grebes). Gruiformes were most abundant in the east basin while Pelecaniformes were present in low numbers in all three basins, as were Suliformes and Podicipediformes (Table 2-9).

Because both groups consist largely of migrant species that overwinter in the area or pass through when traveling between winter and breeding grounds, seasonal variation in overall waterbird numbers are largely driven by differences in the abundance of these two groups throughout the year. The average number of Anseriformes and Charadriiformes detected per survey, combined across the basins, is displayed below for each month of the year (Figure 2-9). As a group, Anseriformes were present in the lagoon in lower numbers from April through October, while peak numbers were observed during February and March (Figure 2-9). Charadriiformes displayed variable peaks in abundance, with high numbers detected in January and February, and again in September, November and December, while the lowest numbers were documented in May and June (Figure 2-9). Overall, waterbird numbers tended to be lower during the spring and summer months because this coincides with the time most migrants are away at breeding grounds farther north, and highest during the fall and winter months, which is consistent with the period of time these birds winter in Southern California.

Figure 2-9. Mean Number of Waterfowl, Shorebirds, Gulls, and Terns (2022)



2.2.4 Discussion

Similar to marsh bird surveys, as waterbird surveys continue to be conducted during the post-construction phase of the project, a new running average of western snowy plovers, California least terns, and waterbirds will continue to be calculated annually for the 4 most recent years of construction/post-construction surveys and compared to the baseline abundance levels described herein to evaluate interim and final performance standards as described in the Monitoring Plan (Nature Collective 2020). Statistical comparisons between the baseline and construction/ post-construction period data presented above for western snowy plovers and California least terns will be conducted for the annual SELRP monitoring reports.

2.2.4.1 Western Snowy Plover

During 2022, western snowy plovers were observed within the lagoon in modest numbers (Table 2-5). The high count for the year was 36 individuals, which were detected during the January survey, followed by 11 individuals in December, and a single bird in November. In 2022, western snowy plover detections were split between the central basin (33 detections) and the west basin (15 detections), with no detections in the east basin. These data continue a trend of more western snowy plovers detections in the central basin compared to the west basin. Prior to 2021, western snowy plovers were detected most consistently in the west basin, with the exception of 2017 and 2018 when no western snowy plovers were detected in any basin. Construction-related dredging activities initially resulted in an increase in the amount of open mudflat suitable for foraging in the central basin (i.e., the overdredge pit), and recently this has been transitioning to drier sandier conditions. It appears that the western snowy plovers have been utilizing that area for foraging and roosting in greater numbers.

The west basin is immediately adjacent to the coastal habitat, which is dominated by open sandy areas and the intertidal zone, where the species is traditionally most commonly found due to the presence of abundant foraging and roosting habitat. There were no western snowy plover detections in the west basin in 2021, but they were detected there again in 2022 (15 detections). As in each prior year, there were no western snowy plover detections in the east basin, which is dominated by vegetative cover and channels, neither of which is preferred by the western snowy plover.

The number of western snowy plover detections increased in 2022 relative to 2021 (48 individuals vs. 33 individuals, respectively) (AECOM 2022b), and the 4.00 individuals/survey average in 2022 remained higher than the 4-year construction/post-construction average (2.68 individuals/survey), and was markedly higher than the baseline average (0.27 individuals/survey). Western snowy plovers generally favor sandy substrate for foraging, but they will readily forage on mudflats as well. The establishment of the overdredge pit area and the nearby avian nesting area (see 2020-2021 Nest Area Monitoring and Management Plan Annual Report Memorandum [AECOM

2022c]) at the western end of the central basin has produced habitat that western snowy plovers will forage on and roost on. Indeed, 33 western snowy plovers were observed at the northeast corner of the nesting area in January (Figure 2-5). Trends for western snowy plover habitat usage in the lagoon should become more clear as additional data are collected.

2.2.4.2 California Least Tern

California least terns were present in low numbers during the months of June and July in 2022. Overall, the number of California least tern detections during 2022 was 0.33 individuals/survey, which was approximately one-half of the 4-year construction/post-construction running average, and approximately 38% of the baseline average (0.60 individuals/survey and 0.86 individuals/survey, respectively). California least terns were observed in the central and east lagoon basins in 2022, with identical numbers in the two basin (Table 2-7). During surveys, California least terns were observed engaging in aerial foraging over open water or simply flying over.

California least terns have not been abundant in the lagoon for the past several years. Based on monthly counts conducted at the lagoon from 1973–1983, and again from 2002–2017, California least tern numbers were substantially higher 10–20 years ago, with monthly counts as high as 69 and 78 individuals in 2004 and 2007, respectively (Nature Collective 2020). In 2020, 15 California least terns were detected in the lagoon (AECOM 2022d), but the four detections in 2022 was very close to the five detections from 2021 (AECOM 2022b) and 2019 (AECOM 2020b). These data suggest that California least terns continue to be relatively uncommon lagoon users, and that interannual variation in survey detections may be more reflective of sampling error than actual trends in habitat usage. Data from Patton Biological LLC and eBird were examined and corroborated the trends presented herein, although Patton and colleagues did observe numbers as high as seven individuals and they also observed some courtship behaviors. California least tern decoys, ceramic tile chick shelters, and crushed shells were added to the nesting area in April 2022 to encourage nesting activities (2020-2021 Nest Area Monitoring and Management Plan Annual Report Memorandum [AECOM 2022c]). In addition, predator control efforts at the lagoon targeted corvids (American crows and common ravens) for the first time in 2022 in an attempt to reduce the predation pressure at the nesting area. Seven American crows were removed from the lagoon, but this occurred after nesting would have begun, and the California least terns did not appear to initiate any breeding at the lagoon in 2022. Continued predator control efforts and attempts to attract California least terns to the nesting area could bolster their numbers in the lagoon moving forward.

2.2.4.3 Other Waterbird Species

Waterbird surveys were designed to assess the abundance of waterbird species (e.g., seabirds, waterfowl, shorebirds, wading birds) that use open water and mudflat habitats in San Elijo Lagoon. The 2022 survey numbers (463.54 individuals/survey) remained higher than baseline levels (355.8

individuals/survey), but for the second year exhibited a decline relative to the previous year (663.58 individuals/survey in 2021 and 853.71 individuals/survey in 2020). The 2022 average was almost exactly 200 individuals/survey lower than the 4-year construction/post-construction average (663.84 individuals/survey). Six orders of waterbird were recorded in the 2022 surveys with more than 90% of the observations consisting of birds in the orders Anseriformes (waterfowl) and Charadriiformes (shorebirds, gulls, and terns). This distribution is primarily a result of these two orders having more species than the other four orders. Additionally, Anseriformes and Charadriiformes species tend to be gregarious during the non-breeding season, which is when they are most abundant in the lagoon.

The abundance of birds in the different taxonomic orders varied among the three surveyed basins and showed both seasonal and annual variation (Table 2-9 and Figure 2-6). Spatial variation in the abundance of waterbirds is most likely driven by differences in habitat between basins relative to the habitat preferences of those groups. Among the three basins, overall waterbird numbers were highest in the west basin for the first time since surveys were initiated for this project (Figure 2-6), and averaged 187.38 individuals/survey during 2022. This temporal pattern was shaped by declines in Anseriformes numbers in both the central and east basins over the past few year (Figure 2-7), a steep decline in Charadriiformes in the central basin relative to the previous few years, and a rebound of Charadriiformes in the west basin in 2022 (Figure 2-8).

Waterbird numbers were lowest in the central basin (118.21 individuals/survey) for the first time since surveys were initiated for this project (Figure 2-6) following a dramatic drop in this basin from 2021 numbers. This decline was mostly shaped by a decline in Charadriiformes observations in the central basin from 2021 to 2022. Charadriiformes observations had increased in the central basin each year since 2017 from approximately 50 individuals/survey in 2017 to approximately 275 individuals/survey in 2021 before dropping back to approximately 50 individuals/survey in 2022 (Figure 2-8). Birds appear to be alternating use of the central and west basins in the past 2 years, and these patterns may be a result of changes to the overdredge pit in the central basin. When the overdredge pit was first formed, it provided high-quality foraging habitat for many Charadriiformes, but the addition of sand and a transition to a more upland type habitat in 2022 may have made it less attractive for foraging shorebirds.

Waterbird abundance was intermediate in the east basin in 2022 (157.96 individuals/survey), and this was shaped primarily by Anseriformes (108.63 individuals/survey; 68.8% of waterbird observations in the east basin). Waterfowl were initially most abundant in the central basin from 2016 through 2019, but starting in 2020 they became more abundant in the east basin following widening and deepening of channels there (Figure 2-7). Charadriiformes, by contrast, have always been least abundant in the east basin, and this continued in 2022 with 21.13 individuals/survey (13.4% of all waterbird detections there). Charadriiformes typically prefer exposed mudflat and open sandy areas for foraging, and these habitats are more common in the west and central basins.

Patterns in the general waterbird data are more complex to interpret than the other datasets involving a single species, such as western snowy plover or California least tern, due to the diversity of species within each group and the variability in the presence of these species across different basins in the lagoon and different seasons of the year. For example, 27 species of birds were observed within the order Charadriiformes, and 20 were observed within the order Anseriformes (Appendix B). Both Anseriformes and Charadriiformes exhibit large seasonal variation in their numbers, with peak levels occuring in the fall and winter months. Charadriiformes begin to increase a bit earlier in the summer than Anseriformes because shorebird migration typically starts earlier than waterfowl migration. Both orders are present in the lagoon in small numbers during the late spring and early summer, but the vast majority of individuals detected during the surveys are those that have come to the lagoon to winter there.

The overall waterbird numbers in 2022 were lower than 2021 by approximately 30% (463.54 individuals/survey and 663.58 individuals/survey, respectively). This decrease in abundance from 2021 to 2022 was reflected in both Anseriformes and Charadriiformes, but the magnitude of decline was steeper for Charadriiformes; Anseriformes declined by approximately 20% from 2021 to 2022, and Charadriiformes by almost 38%. Despite the lower overall waterbird numbers relative to 2021, the 2022 average was still markedly higher than the baseline average of 355.8 individuals/survey. Both orders appeared to respond favorably to restoration-associated changes to the lagoon beginning in 2017 and 2018 for Anseriformes and Charadriiformes, respectively (Figures 2-7 and 2-8), and it is unclear if the recent declines are related to ongoing shifts in lagoon habitats or changes in the predator community, or are indicative of broader, regional level changes in the populations of these birds. Post-construction surveys will continue to monitor numbers of these birds moving forward.

2.3 BELDING'S SAVANNAH SPARROW SURVEYS

The monitoring of Belding's savannah sparrows (*Passerculus sandwichensis beldingi*) is a "pre-restoration absolute" monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. Additionally, the specialized surveys required to adequately estimate abundance of Belding's savannah sparrows are not being conducted at a reference wetland, thereby making comparison impossible. Belding's savannah sparrow, a California endangered species, occurs in the salt marsh habitat present in the SELRP area. This species is endemic to the coastal salt marshes of Southern California and northern Baja California (AOU 1983).

2.3.1 <u>Performance Standards</u>

Success for Belding's savannah sparrow is measured by comparing pre-construction (baseline) data and construction/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Performance standards are included below.

> **Interim standard**: Construction/post-construction 4-year running average density 75% or greater than that of pre-construction survey data (2016–2017) by year 7 post-construction

> **Final standard**: Construction/post-construction 4-year running average density 95% or greater than that of pre-construction survey data (2016–2017) by year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan [Nature Collective 2020]).

2.3.2 Approach

The focus of these surveys was to estimate density for the state endangered Belding's savannah sparrow. Baseline surveys (2016 and 2017) were conducted during the breeding season for the species, from April 11 through May 20, 2016 (six surveys) and March 20 through May 19, 2017 (four surveys). In 2018 and 2019, surveys were conducted from February 25 through May 14 (four surveys each year), and, in 2020 through 2022, surveys were conducted from March through May (four surveys).

Survey results are summarized according to the following four "survey periods" designed to enable grouping of survey results across four roughly equal time periods and to minimize the effects temporal variation may have on analysis results:

- Late February to Mid-March
- Late March to Early April
- Mid- to Late April
- Early to Mid-May

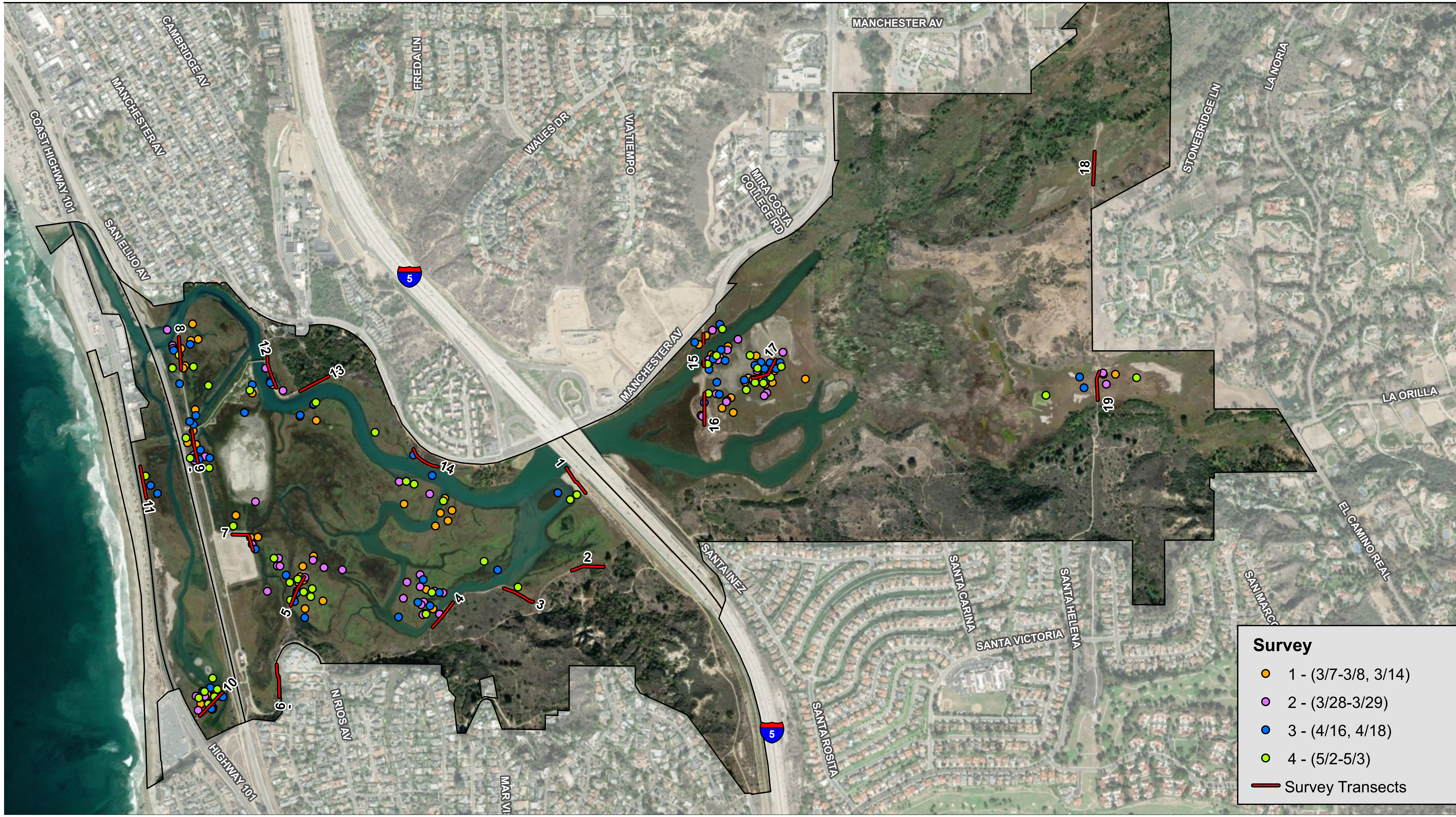
When multiple surveys were conducted in a survey period for a given year, the mean number of individuals detected across surveys was calculated. The mean number of individuals detected per survey during each survey period was then used to evaluate temporal variation in abundance (across seasons and between years), and to calculate the overall average abundance metrics.

Belding's savannah sparrow detections were recorded at all distances from the survey transects measuring 100 meters long located within suitable habitat and spread throughout the lagoon, following methods described in the Monitoring Plan (Nature Collective 2020). Initially, there were 19 transects (i.e., transects 1 through 19), with transects 1 through 4, 6, 9, and 11 through 15 surveyed only on one side due to the lack of sufficient suitable habitat on the other side. Between 2019 and 2021, transects 16 and 17 were not surveyed due to safety issues, but those transects were surveyed again in 2022. Detailed summaries of the survey dates, survey times, survey personnel, and weather conditions are provided in Appendix D.

Survey data were analyzed using a distance sampling approach (Buckland et al. 2001), which applied the distances between the observer and each detected bird to control for differences in detectability. Based on results from the distance sampling model approach (Buckland et al. 2001) and data collected in previous years, detections beyond 75 meters perpendicular distance from the transect were omitted from the analysis. An estimate of the density of Belding's savannah sparrow individuals was calculated for each survey as the number of individuals per acre across the survey area as a whole. The model selection process was revised following the 2020 season to better fit the distribution of the data. To ensure appropriate comparisons across years, this change was also applied to the previous years' data, resulting in modest changes to the annual estimates for the baseline and construction year periods (2020 Avian Monitoring Report [AECOM 2022d]).

2.3.3 Results

Locations of Belding's savannah sparrow detections from 2022 surveys are depicted in Figure 2-10. Belding's savannah sparrow density within the survey area was much higher in 2022 (1.95 individuals/acre) than the 2021 average (0.98 individuals/acre) and the 4-year construction/ post-construction average from 2019–2022 (1.31 individuals/acre), but was still moderately lower than the 2016–2017 baseline average (2.11 individuals/acre) (Table 2-10). In 2022, the density estimates ranged from 1.61 individuals/acre in the fourth survey period (early May) to 2.18 individuals/acre in the second survey period (late March).



Source: SanGIS 2022; MoffattNichol 2022; AECOM 2022.

1,000 500 0 1,000 Feet

Scale: 1:12,000; 1 inch = 1000 feet

Figure 2-10
2022 Belding's Savannah Sparrow Survey Results

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Table 2-10. Summary of Belding's Savannah Sparrow Survey Area Density Estimates

Survey Period	Survey Period Averages; Density defined as Mean # Individuals/acre		
	2022	2019–2022 Construction/ Post-construction	2016–2017 Baseline*
Late February to Mid-March	1.92	1.36	4.03
Late March to Early April	2.18	1.34	1.61
Mid- to Late April	2.08	1.35	1.45
Early to Mid-May	1.61	1.18	1.36
Overall Average (Standard Error)	**1.95 (0.12)**	**1.31 (0.04)**	**2.11 (0.64)**

*Baseline values differ from those reported in the Baseline Report due to revised model selection approach in estimating survey area densities (see Section 2.3.2 and 2020 Avian Monitoring Report [AECOM 2022d]).

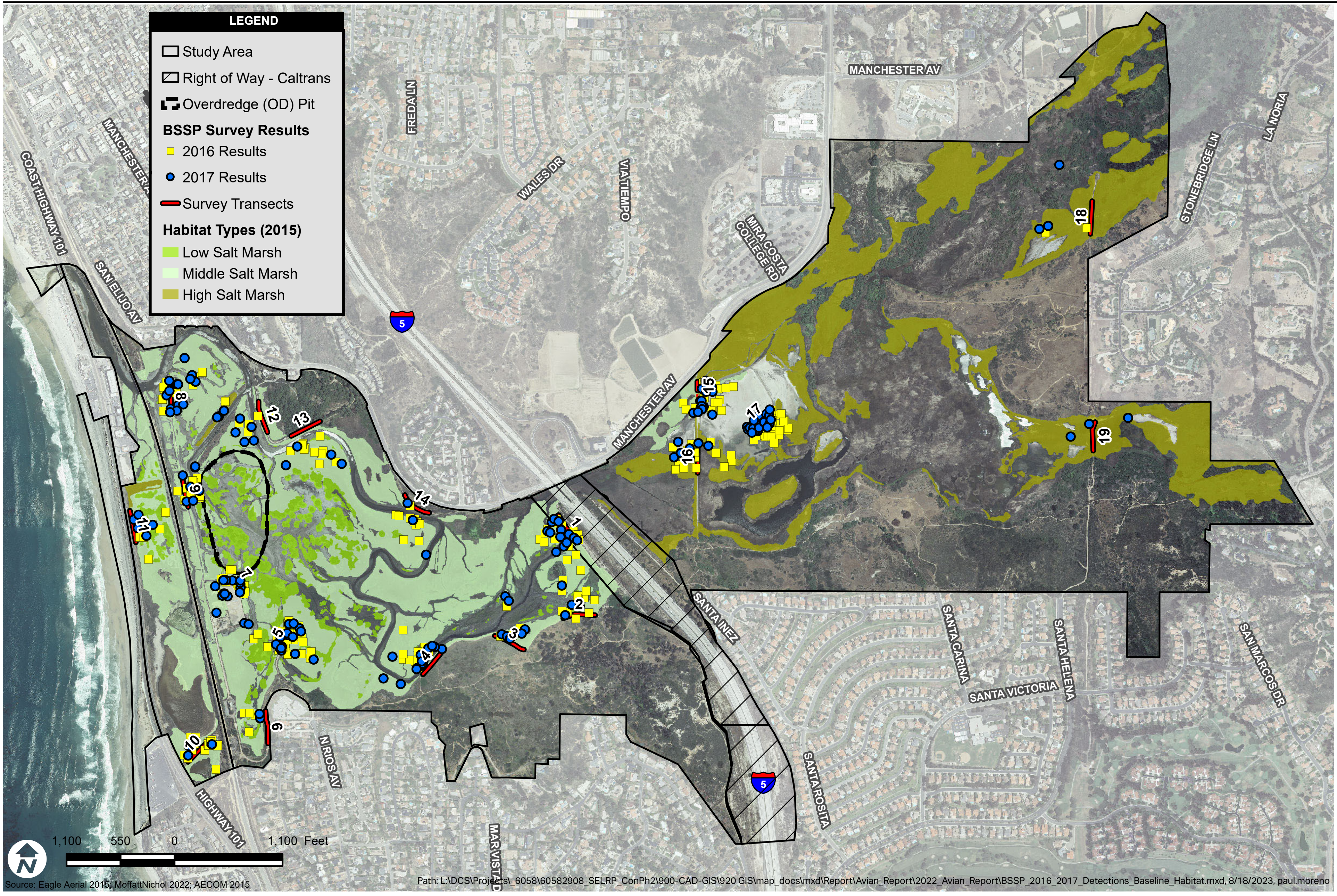
2.3.4 Discussion

As Belding's savannah sparrow surveys continue to be conducted during the post-construction phase of the project, running averages will continue to be calculated annually for the species' density within the survey area for the 4 most recent years of construction/post-construction surveys and compared to the baseline density levels to evaluate interim and final performance standards as described in the Monitoring Plan (Nature Collective 2020). Statistical comparisons between the baseline and construction/post-construction period survey data presented above will be made in the annual SELRP monitoring reports.

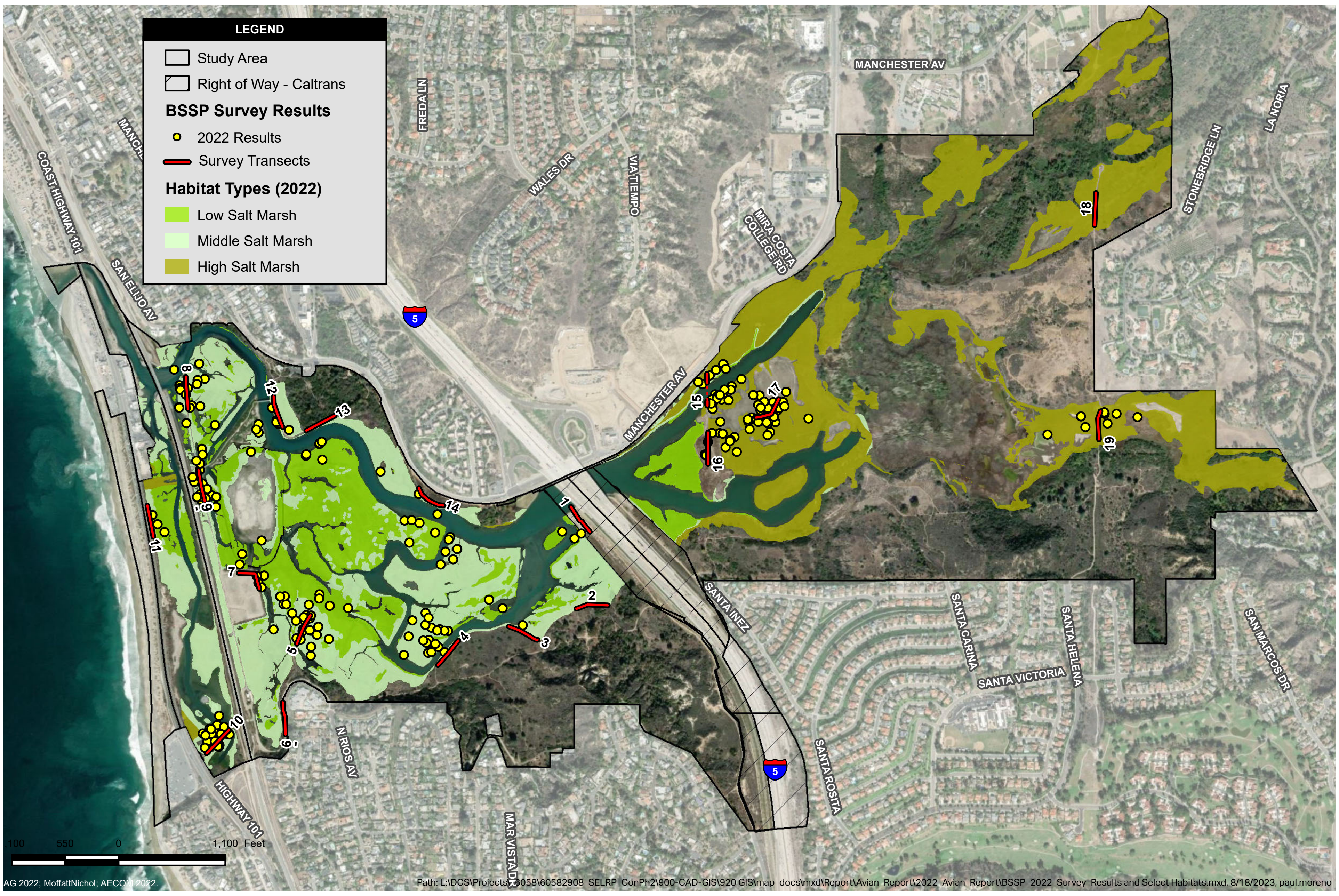
Belding's savannah were detected almost exclusively in low, middle or high salt marsh (Figure 2-11). A comparison of the baseline period (Figure 2-11a) and 2022 (Figure 2-11b) reveals that some transects have undergone shifts in the number of Belding's savannah sparrow detections during that time. Some have experienced marked declines (e.g., transects 1 and 2), whereas others (e.g., transect 4) have exhibited noticeable increases. These shifts likely reflect changes in the composition and/or quality of the habitat near those transects. The widening of main channels and associated increased tidal prism have reduced the amount of habitat around transects 1 and 2 that Belding's savannah sparrows can utilize for breeding and foraging. This loss of suitable habitat was an anticipated change, and the expectation was that other transect areas would experience improvements in the amount and/or quality of suitable habitat. This process is ongoing as the vegetation, especially that of low and middle salt marsh, responds to the changes in inundation and nutrient availability associated with the new tidal patterns.

The estimated Belding's savannah sparrow density within the survey area was higher in 2022 than in any year except 2017, and raised the 4-year running average from 1.21 individuals/acre to 1.31 individuals/acre. The 2022 estimate was still lower than the baseline average of 2.11 individuals/acre, but that high estimated density in the baseline period was heavily influenced by one unusually high estimate from the first survey in 2017 (see Baseline Monitoring Report

[AECOM 2020a] and 2020 Avian Monitoring Report [AECOM 2022d]). Aside from that high count in 2017, the density estimates have generally ranged from approximately 1.00 to 2.00 individuals/acre, with the exception of 2020 in which all four survey period estimates were below 1.00 individuals/acre (AECOM 2022d), and 2022 in which the density estimates were above 2.00 individuals/acre for two survey periods. The increased density estimates in 2022 are likely the result of two things: some areas of mudflat have been transitioning to low salt marsh, which is one of the habitats Belding's savannah sparrows prefer, and transects 16 and 17 were once again included in surveys. Transect 17 in particular had a large number of detections, which helped boost the density estimate, but the increased density in 2022 was not solely the product of re-incorporating transects 16 and 17 and is likely indicative of more widespread changes in the lagoon. The primary benefit of re-incorporating transects 16 and 17 is that it allows for a more robust "apple-to-apples" comparison of baseline to post-construction.



a. Baseline Habitat and BSSP Detections



b. 2022 Habitat and BSSP Detections

Figure 2-11
Belding's Savannah Sparrow Suitable Habitat Types and Detections, Baseline Period and 2022

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\2023_Avian_Report\LFRR_Detections_Baseline_Habitat.ai 8/22/2023 dbrady

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3. SUMMARY

Changes in bird abundances or density estimates from the baseline period to the construction/ post-construction period varied by species or group, as shown in Table 3-1 below. LFRR and waterbirds declined in 2022 from previous years, while Belding's savannah sparrows increased. Western snowy plovers and California least terns continued their trends of modest increases and decreases, respectively.

Table 3-1. Summary of Bird Estimates for the Baseline Period, the 4-year Construction/Post-construction Running Average, and Current Year

Species	Density/Acre			Lagoon-wide Abundance			Detections/Survey		
	Baseline[1]	Construction/ Post-construction[2]	2022	Baseline[1]	Construction/ Post-construction[2]	2022	Baseline[1]	Construction/ Post-construction[2]	2022
Light-footed Ridgway's Rails*	0.21	0.17	0.10	62.98	43.83	26.70	--	--	--
Other Focal Marsh Birds	--	--	--	--	--	--	10.00	10.00	9.17
Western Snowy Plovers*	--	--	--	--	--	--	0.27	2.68	4.00
California Least Terns*	--	--	--	--	--	--	0.86	0.60	0.33
Waterbirds	--	--	--	--	--	--	355.8	663.84	463.54
Belding's Savannah Sparrows*	2.11	1.31	1.95	--	--	--	--	--	--

[1] Baseline is 2016–2017.
[2] Construction/post-construction 4-year running average is 2019–2022.
* Species subject to interim and final performance standards based on 4-year running averages equivalent to 75% and 95% of baseline levels by year 7 and year 10, respectively.

In 2022, LFRR numbers dropped to their lowest levels of the project period, and brought down the lagoon-wide 4-year construction/post-construction running average from 53.34 to 43.83 individuals. The 4-year construction/post-construction running average is almost 20 fewer birds than the baseline period average of 62.98. The cause of the decline in the 2022 LFRR density estimate is unknown but either reflects an actual reduction in the number of birds in the lagoon (e.g., due to factors such as normal population cycling or increased predation) or is the result of decreased detection of individuals due to birds vocalizing less. It should be noted that the apparent decline at San Elijo Lagoon was also detected in a number of other wetlands in the county and may reflect a region-wide pattern. Predator-control efforts continued in 2022, but data from GPS-tagged juvenile birds indicated that raptors (which are not removed from the lagoon) may pose a threat to young birds. This threat was greater for captive-bred birds than wild-caught individuals, but survival of juveniles was considered low for both groups in 2020 and especially in 2021 (Sawyer et al. 2022). This low survival rate of juveniles may have resulted in very few birds recruiting into the reproductive population in 2022. It is also important to consider that the data from 2022 reflect one data point, and more data are needed to determine if this apparent decline is a result of reduced detections or an actual downturn in the population.

Some species-level variation occurred among other focal marsh bird species (Table 2-3), but the overall average was similar between the baseline period and construction/post-construction period, with moderately lower numbers in 2022 (Table 3-1).

Western snowy plover numbers in 2022 were higher than both the baseline and the 4-year construction/post-construction averages. The improved foraging conditions and the establishment of the overdredge pit and nesting area may lead to more consistent usage of the lagoon by western snowy plovers moving forward. California least tern numbers declined slightly in 2022, and were about half of the construction/post-construction period average and 38% of the baseline average. California least terns have not been common in the lagoon since before the project began, and small changes in detections due to random chance can result in proportionally large variations from year to year. Waterbirds also exhibited a marked decrease in 2022 for the second straight year, but the 4-year construction/post-construction running average still remained more than 100 individuals/survey higher than the baseline values. Changes in the waterbird numbers are primarily shaped by changes in the numbers of Anseriformes and Charadriiformes in the lagoon, and while both declined in 2022, the decline was steeper for Charadriiformes. Patterns of lagoon usage over time indicate that both orders responded very favorably to initial restoration-related changes to the lagoon. The cause of the recent declines is unclear but could be related to ongoing changes in the lagoon habitats, changes in the predator community, or regional level changes in the populations of these birds.

Belding's savannah sparrows increased markedly in 2022 compared to 2020 and 2021, but remained lower than the baseline period average. The reason for the stark increase in 2022 is not known, but some mudflat habitat has transitioned to low salt marsh, which is a preferred habitat by Belding's savannah sparrows, and two productive transects, 16 and 17, were added back into the surveys after 3 years of not being surveyed due to safety concerns. The 2022 density estimate was the highest of the project with the exception of the 2017 season. It is anticipated that preferred habitat by the Belding's savannah sparrow will continue to become established following post-restoration activities, thereby providing additional areas for foraging and breeding.

4. LIST OF PREPARERS

Table 4-1 includes a list of persons and organizations that participated in the monitoring program and/or preparation of this report.

Table 4-1. List of Preparers

Chapter/Section	Variable	Lead Author	Organization
1 and 2	General Report Preparation	Cindy Kinkade (Project Manager) Michael Anguiano	AECOM
2.1	Breeding Marsh Birds with Focus on Light-footed Ridgway's Rail	Loren Merrill	AECOM
2.2	Western Snowy Plover, California Least Tern, and Waterbird Species	Loren Merrill	AECOM
2.3	Belding's Savannah Sparrow	Loren Merrill	AECOM

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Appendix A

2022 Marsh Bird Surveys and Weather

Appendix A - 2022 Marsh Bird Surveys and Weather

Table A-1. Weather Conditions and Survey Times for each AM and PM Marsh Bird Survey[1]

Survey Number	Date	AM/PM Survey Session	Time	Average Temperature (°F)	Average Sky Condition Rating[2]	Average Wind Speed (mph)	Average Background Noise Rating[3]
1	3/15/2022	AM	06:37 - 08:09	50.0	2.0	0.0	0.8
		PM	17:13 - 18:06	64.0	1.0	1.7	1.3
	3/16/2022	AM	06:34 - 08:15	56.6	2.0	1.6	2.2
		PM	17:13 - 17:58	66.3	1.0	1.7	1.3
	3/17/2022	AM	06:34 - 07:47	50.0	0.0	3.0	1.5
	3/18/2022	AM	06:39 - 07:53	50.0	1.0	1.7	1.3
2	4/11/2022	AM	05:55 - 07:38	60.3	0.8	1.0	1.0
		PM	17:15 - 18:00	66.3	1.3	2.7	1.3
	4/12/2022	AM	05:58 - 07:48	57.4	1.6	1.0	2.2
		PM	17:55 - 18:02	63.0	0.0	7.7	2.0
	4/13/2022	AM	05:55 - 07:15	51.5	0.0	3.0	1.0
	4/14/2022	AM	05:52 - 06:54	50.0	0.0	1.7	1.7
3	4/28/2022	AM	05:39 - 07:10	60.6	2.0	0.8	1.2
		PM	17:30 - 18:27	63.2	0.5	3.2	1.2
	4/29/2022	AM	05:35 - 06:53	51.7	0.6	1.4	1.1
4	5/12/2022	AM	05:26 - 06:57	50.2	0.0	0.8	1.3
		PM	17:42 - 18:39	68.3	0.0	2.8	1.3
	5/13/2022	AM	05:27 - 06:36	50.0	0.0	1.7	1.4
5	5/19/2022	AM	05:36 - 07:21	60.0	2.0	1.6	1.9
		PM	17:45 - 18:34	63.8	2.0	3.0	1.5
	5/20/2022	AM	05:28 - 06:50	58.6	2.0	1.9	1.4
6	6/7/2022	AM	05:19 - 06:51	64.6	2.0	0.6	1.4
		PM	17:58 - 19:16	68.3	0.0	2.2	1.8
	6/8/2022	AM	05:13 - 06:22	64.1	2.0	0.7	1.3

°F = degrees Fahrenheit; mph = miles per hour

[1] Surveys were conducted by five ornithologists: James McMorran (AECOM); Heather Hughes (AECOM); Ian Maunsell (TE 42833A-3, AECOM); Antonette Gutierrez (TE-50992B-0, Blackhawk); and Ryan Quilley (Blackhawk).

[2] Sky Condition Ratings: 0 = clear or a few clouds; 1 = partly cloudy or variable sky; 2 = cloudy or overcast; 3 = fog; 4 = drizzle

[3] Background Noise Ratings: 0 = no noise; 1 = faint noise; 2 = moderate noise (probably can't hear some birds beyond 100 meters); 3 = loud noise (probably can't hear some birds beyond 50 meters); 4 = intense noise (probably can't hear some birds beyond 25 meters)

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Appendix B

2022 Waterbird Surveys Species List

Appendix B – 2022 Waterbird Surveys Species List

Table B-1. List of Bird Species Observed during 2022 Waterbird Surveys, Sorted by Taxonomic Order

Order	Common Name	Scientific Name
Anseriformes (Waterfowl)	American Wigeon	*Mareca americana*
	Blue-winged Teal	*Spatula discors*
	Brant	*Branta bernicla*
	Bufflehead	*Bucephala albeola*
	Canada Goose	*Branta canadensis*
	Canvasback	*Aythya valisineria*
	Cinnamon Teal	*Spatula cyanoptera*
	Eurasian Wigeon	*Mareca penelope*
	Gadwall	*Mareca strepera*
	Greater Scaup	*Aythya marila*
	Greater White-fronted Goose	*Anser albifrons*
	Green-winged Teal	*Anas crecca*
	Hooded Merganser	*Lophodytes cucullatus*
	Lesser Scaup	*Aythya affinis*
	Mallard	*Anas platyrhynchos*
	Northern Pintail	*Anas acuta*
	Northern Shoveler	*Spatula clypeata*
	Red-breasted Merganser	*Mergus serrator*
	Redhead	*Aythya americana*
	Ruddy Duck	*Oxyura jamaicensis*
Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	American Avocet	*Recurvirostra americana*
	Black-bellied Plover	*Pluvialis squatarola*
	Black-necked Stilt	*Himantopus mexicanus*
	California Least Tern	*Sternula antillarum browni*
	Caspian Tern	*Hydroprogne caspia*
	Dowitcher sp.	*Limnodromus* sp.
	Dunlin	*Calidris alpina*
	Forster's Tern	*Sterna forsteri*
	Greater Yellowlegs	*Tringa melanoleuca*
	Killdeer	*Charadrius vociferus*
	Least Sandpiper	*Calidris minutilla*
	Long-billed Curlew	*Numenius americanus*
	Long-billed Dowitcher	*Limnodromus scolopaceus*
	Marbled Godwit	*Limosa fedoa*
	Red-necked Phalarope	*Phalaropus lobatus*
	Ring-billed Gull	*Larus delawarensis*
	Royal Tern	*Thalasseus maximus*

Order	Common Name	Scientific Name
Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	Sanderling	*Calidris alba*
	Semipalmated Plover	*Charadrius semipalmatus*
	Short-billed Dowitcher	*Limnodromus griseus*
	Spotted Sandpiper	*Actitis macularius*
	Western Gull	*Larus occidentalis*
	Western Sandpiper	*Calidris mauri*
	Western Snowy Plover	*Charadrius nivosus*
	Whimbrel	*Numenius phaeopus*
	Willet	*Tringa semipalmata*
	Wilson's Snipe	*Gallinago delicata*
Gruiformes (Rails, Coots, Gallinules)	American Coot	*Fulica americana*
	Light-footed Ridgway's Rail	*Rallus obsoletus levipes*
	Sora	*Porzana carolina*
	Virginia Rail	*Rallus limicola*
Pelecaniformes (Pelicans, Wading birds)	American Bittern	*Botaurus lentiginosus*
	American White Pelican	*Pelecanus erythrorhynchos*
	Black-crowned Night-Heron	*Nycticorax nycticorax*
	Great Blue Heron	*Ardea herodias*
	Great Egret	*Ardea alba*
	Snowy Egret	*Egretta thula*
	White-faced Ibis	*Plegadis chihi*
	Yellow-crowned Night-Heron	*Nyctanassa violacea*
Podicipediformes (Grebes)	Eared Grebe	*Podiceps nigricollis*
	Pied-billed Grebe	*Podilymbus podiceps*
	Western Grebe	*Aechmophorus occidentalis*
Suliformes (Cormorants)	Double-crested Cormorant	*Phalacrocorax auritus*

Appendix C

2022 Waterbird Surveys and Weather

Appendix C – 2022 Waterbird Surveys and Weather

Table C-1: Waterbird Surveys (2022) Survey Dates and Personnel

Survey Number	Date	Survey Personnel	Start Time	End Time
1	1/7/2022	James McMorran, Heather Hughes	10:00 AM	11:17 AM
1	1/7/2022	James McMorran, Heather Hughes	08:45 AM	1:10 PM
1	1/8/2022	James McMorran	06:48 AM	1:38 PM
2	2/10/2022	James McMorran	07:46 AM	1:21 PM
2	2/11/2022	James McMorran, Madeline Bailey	08:44 AM	09:59 AM
2	2/11/2022	James McMorran, Madeline Bailey	07:36 AM	1:22 PM
3	3/9/2022	James McMorran	06:48 AM	12:58 PM
3	3/10/2022	James McMorran, Heather Hughes	08:39 AM	09:58 AM
3	3/10/2022	James McMorran, Heather Hughes	06:45 AM	12:10 PM
4	3/21/2022	James McMorran	07:00 AM	1:20 PM
4	3/22/2022	James McMorran	07:13 AM	1:13 PM
4	3/22/2022	James McMorran	09:05 AM	10:15 AM
5	4/7/2022	James McMorran, Madeline Bailey	06:32 AM	12:23 PM
5	4/8/2022	James McMorran	07:48 AM	08:45 AM
5	4/8/2022	James McMorran, Heather Hughes	06:50 AM	1:09 PM
6	4/19/2022	James McMorran, Heather Hughes	09:21 AM	12:33 PM
6	4/19/2022	James McMorran, Heather Hughes	07:09 AM	12:53 PM
6	4/20/2022	James McMorran	06:57 AM	12:46 PM
7	5/5/2022	James McMorran	06:21 AM	12:14 PM
7	5/5/2022	James McMorran	08:16 AM	10:04 AM
7	5/6/2022	James McMorran	07:24 AM	12:10 PM
8	5/23/2022	James McMorran	06:19 AM	11:22 AM
8	5/24/2022	James McMorran	11:39 AM	12:38 PM
8	5/24/2022	James McMorran	09:54 AM	2:25 PM
9	6/9/2022	James McMorran	01:45 PM	4:34 PM
9	6/9/2022	James McMorran	02:38 PM	3:32 PM
9	6/10/2022	James McMorran	06:55 AM	11:42 AM
10	6/27/2022	James McMorran, Heather Hughes	06:33 AM	10:27 AM
10	6/28/2022	James McMorran, Heather Hughes	08:05 AM	10:05 AM
10	6/28/2022	Heather Hughes	06:28 AM	11:29 AM
11	7/11/2022	Heather Hughes	07:25 AM	11:26 AM
11	7/12/2022	James McMorran, Heather Hughes	08:17 AM	09:46 AM
11	7/12/2022	James McMorran, Heather Hughes	06:36 AM	12:30 PM
12	7/25/2022	James McMorran	07:23 AM	12:10 PM
12	7/26/2022	James McMorran	07:04 AM	12:21 PM

Survey Number	Date	Survey Personnel	Start Time	End Time
12	7/26/2022	James McMorran	09:10 AM	10:47 AM
13	8/10/2022	James McMorran	08:16 AM	10:03 AM
13	8/10/2022	James McMorran	07:07 AM	1:13 PM
13	8/12/2022	James McMorran	06:31 AM	11:19 AM
14	8/25/2022	James McMorran	06:40 AM	10:30 AM
14	8/26/2022	James McMorran, Heather Hughes	06:00 AM	11:50 AM
14	8/26/2022	James McMorran, Heather Hughes	06:30 AM	11:46 AM
15	9/8/2022	Heather Hughes, James McMorran	07:05 AM	11:52 AM
15	9/10/2022	James McMorran, Heather Hughes	07:13 AM	09:50 AM
15	9/10/2022	James McMorran, Heather Hughes	06:57 AM	11:52 AM
16	9/22/2022	James McMorran	06:58 AM	11:54 AM
16	9/23/2022	James McMorran, Madeline Bailey	07:18 AM	12:53 PM
16	9/23/2022	James McMorran, Madeline Bailey	08:19 AM	09:44 AM
17	10/20/2022	James McMorran, Heather Hughes	07:03 AM	1:50 PM
17	10/21/2022	James McMorran, Heather Hughes	06:27 AM	09:29 AM
17	10/21/2022	James McMorran, Heather Hughes	07:26 AM	09:28 AM
18	11/17/2022	James McMorran, Heather Hughes	06:21 AM	12:51 PM
18	11/18/2022	James McMorran	06:49 AM	12:35 PM
18	11/18/2022	James McMorran, Heather Hughes	07:48 AM	09:15 AM
19	12/14/2022	James McMorran, Madeline Bailey	07:09 AM	1:27 PM
19	12/14/2022	James McMorran, Madeline Bailey	10:05 AM	11:35 AM
19	12/15/2022	James McMorran, Madeline Bailey	07:22 AM	1:06 PM

Table C-2: Waterbird Surveys (2022) Weather Conditions

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
1	01/07/2022	09:16:06 AM	Fog	53	20	1.7
1	01/07/2022	10:01:11 AM	Fog	53	20	1.7
1	01/07/2022	11:16:53 AM	Mostly cloudy	57	76	2.8
1	01/07/2022	11:17:16 AM	Mostly cloudy	57	76	2.8
1	01/08/2022	07:49:07 AM	Cloudy	52	94	1.7
1	01/08/2022	12:33:03 PM	Mostly cloudy	61	76	2.8
2	02/10/2022	1:19:13 PM	Sunny	86	0	5.9
2	02/10/2022	08:45:50 AM	Sunny	72	0	4.5
2	02/11/2022	1:53:38 PM	Sunny	79	0	4.3
2	02/11/2022	08:38:33 AM	Sunny	63	0	2.2
2	02/11/2022	08:44:48 AM	Sunny	63	0	2.2
2	02/11/2022	09:59:37 AM	Sunny	74	0	1.7

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
3	03/09/2022	07:06:19 AM	Sunny	44	0	2.7
3	03/09/2022	08:46:13 AM	Mostly Sunny	63	15	5
3	03/10/2022	08:39:33 AM	Cloudy	57	99	2.8
3	03/10/2022	09:06:04 AM	Mostly cloudy	58	83	2.8
3	03/10/2022	12:23:56 PM	Partly sunny	63	43	5
3	03/10/2022	12:24:44 PM	Partly sunny	63	43	5
4	03/21/2022	1:13:28 PM	Sunny	65	5	4.4
4	03/21/2022	08:57:58 AM	Mostly sunny	55	23	2.3
4	03/22/2022	1:13:52 PM	Sunny	77	4	4.4
4	03/22/2022	08:30:07 AM	Sunny	57	7	1.7
4	03/22/2022	09:05:31 AM	Sunny	59	6	2.2
4	03/22/2022	10:15:17 AM	Sunny	64	4	2.3
5	04/07/2022	07:22:20 AM	Sunny	54	3	3.8
5	04/07/2022	12:22:42 PM	Sunny	89	0	6.1
5	04/08/2022	06:50:25 AM	Sunny	67	5	3.2
5	04/08/2022	07:49:19 AM	Sunny	69	6	2.6
5	04/08/2022	12:40:42 PM	Sunny	82	5	5
5	04/08/2022	12:43:51 PM	Sunny	89	5	5
6	04/19/2022	08:29:06 AM	Mostly cloudy	57	76	1.2
6	04/19/2022	09:21:54 AM	Partly sunny	61	48	1.8
6	04/19/2022	12:30:05 PM	Mostly sunny	66	20	5
6	04/19/2022	12:32:34 PM	Mostly sunny	66	20	5
6	04/20/2022	07:47:28 AM	Partly sunny	56	33	2.3
6	04/20/2022	11:21:28 AM	Mostly sunny	64	18	5
7	05/05/2022	1:28:57 PM	Sunny	68	4	6
7	05/05/2022	1:33:07 PM	Mostly Cloudy	64	4	5
7	05/05/2022	07:28:54 AM	Cloudy	58	100	1.1
7	05/05/2022	08:17:04 AM	Cloudy	59	99	1.2
7	05/06/2022	07:53:29 AM	Drizzle	57	100	1.8
7	05/06/2022	10:57:07 AM	Mostly cloudy	65	76	3.9
8	05/23/2022	08:12:59 AM	Cloudy	59	100	1.7
8	05/23/2022	10:31:18 AM	Cloudy	58	100	2.4
8	05/24/2022	1:19:31 PM	Mostly cloudy	64	81	4.9
8	05/24/2022	2:25:09 PM	Mostly cloudy	65	81	5.3
8	05/24/2022	11:23:50 AM	Mostly cloudy	64	86	3.3
8	05/24/2022	11:39:43 AM	Mostly cloudy	64	86	3.3
9	06/09/2022	2:00:36 PM	Mostly cloudy	71	76	4.9
9	06/09/2022	2:38:40 PM	Partly sunny	69	35	5.4
9	06/09/2022	4:32:49 PM	Partly sunny	68	34	5.3

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
9	06/09/2022	4:34:39 PM	Partly sunny	68	34	5.3
9	06/10/2022	06:56:09 AM	Drizzle	62	100	1.1
9	06/10/2022	11:41:58 AM	Mostly cloudy	69	82	3.9
10	06/27/2022	07:57:40 AM	Fog	63	20	1.7
10	06/27/2022	09:41:05 AM	Mostly sunny	66	18	1.8
10	06/28/2022	06:29:40 AM	Sunny	66	9	1.1
10	06/28/2022	08:05:48 AM	Mostly sunny	69	12	1.2
10	06/28/2022	12:26:47 PM	Sunny	74	5	4.4
10	06/28/2022	12:27:42 PM	Sunny	72	5	4.4
11	07/11/2022	07:26:28 AM	Cloudy	65	100	1.7
11	07/11/2022	09:37:27 AM	Cloudy	72	60	3.2
11	07/12/2022	07:33:50 AM	Cloudy	64	100	1.1
11	07/12/2022	08:18:12 AM	Cloudy	64	100	1.7
11	07/12/2022	10:02:48 AM	Cloudy	70	97	4.6
11	07/12/2022	12:52:28 PM	Cloudy	67	100	3.8
12	07/25/2022	09:23:51 AM	Cloudy	69	100	1.8
12	07/25/2022	12:13:11 PM	Mostly sunny	73	18	4.4
12	07/26/2022	08:45:25 AM	Mostly cloudy	70	89	1.2
12	07/26/2022	09:11:04 AM	Mostly cloudy	69	87	1.2
12	07/26/2022	10:47:42 AM	Partly sunny	71	45	2.8
12	07/26/2022	12:21:40 PM	Mostly Sunny	72	8	3.8
13	08/10/2022	08:15:04 AM	Sunny	74	3	1.2
13	08/10/2022	08:41:00 AM	Mostly sunny	74	12	1.7
13	08/10/2022	12:34:03 PM	Sunny	80	3	4.4
13	08/11/2022	2:10:56 PM	Mostly Sunny	77	10	3.1
13	08/12/2022	07:22:35 AM	Mostly sunny	66	11	1.1
13	08/12/2022	11:19:12 AM	Sunny	75	7	3.9
14	08/25/2022	08:48:49 AM	Mostly sunny	72	26	1.2
14	08/26/2022	06:00:56 AM	Mostly cloudy	71	76	1.1
14	08/26/2022	06:31:25 AM	Mostly cloudy	71	80	1.1
14	08/26/2022	11:50:29 AM	Sunny	76	9	4.4
14	09/10/2022	04:42:51 PM	Cloudy	76	96	4.3
14	09/10/2022	4:43:09 PM	Cloudy	76	96	4.3
15	09/10/2022	4:43:42 PM	Cloudy	76	96	4.3
15	09/10/2022	06:57:44 AM	Cloudy	72	92	1.6
15	09/10/2022	07:00:18 AM	Partly Cloudy	78	15	1.2
15	09/10/2022	07:14:07 AM	Mostly cloudy	72	88	1.6
15	09/10/2022	11:07:07 AM	Sunny	84	5	2.3
15	09/12/2022	1:08:37 PM	Sunny	75	15	2.1

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
16	09/22/2022	08:48:13 AM	Sunny	64	7	1.2
16	09/22/2022	11:54:31 AM	Sunny	73	2	3.9
16	09/23/2022	08:03:40 AM	Sunny	68	7	1.1
16	09/23/2022	08:19:54 AM	Sunny	69	3	1.2
16	09/23/2022	12:52:22 PM	Mostly sunny	74	11	4.9
16	09/23/2022	12:53:29 PM	Mostly sunny	77	11	4.9
17	10/20/2022	3:36:24 PM	Mostly sunny	83	16	5.8
17	10/20/2022	08:03:47 AM	Partly sunny	66	32	2.7
17	10/21/2022	06:51:57 AM	Cloudy	64	100	1.1
17	10/21/2022	07:33:39 AM	Cloudy	64	100	1.6
17	10/21/2022	09:26:16 AM	Cloudy	65	99	2.3
17	10/21/2022	09:28:36 AM	Cloudy	68	84	3.2
18	11/17/2022	06:33:37 AM	Partly cloudy	50	48	2.6
18	11/18/2022	07:02:48 AM	Sunny	50	3	2.2
18	11/18/2022	07:49:01 AM	Sunny	52	10	2.2
18	11/18/2022	12:35:27 PM	Sunny	64	4	4.3
18	11/18/2022	12:35:47 PM	Sunny	64	4	4.3
18	12/02/2022	5:42:10 PM	Sunny	73	5	3.1
19	12/14/2022	1:26:44 PM	Sunny	59	3	3.9
19	12/14/2022	1:27:16 PM	Sunny	59	3	3.9
19	12/14/2022	09:12:46 AM	Sunny	52	3	1.7
19	12/14/2022	10:05:44 AM	Sunny	54	3	1.3
19	12/15/2022	1:53:04 PM	Mostly sunny	59	13	2.8
19	12/15/2022	09:07:12 AM	Mostly cloudy	52	76	1.6

°F = degrees Fahrenheit; mph = miles per hour

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Appendix D

2022 Belding's Savannah Sparrow Surveys and Weather

Appendix D – 2022 Belding's Savannah Sparrow Surveys and Weather

Table D-1: Belding's Savannah Sparrow Surveys (2022) Survey Dates, Personnel, and Weather Conditions

Survey Number	Date	Lead Survey Personnel	Time	Weather Conditions
1a	3/7/2022	James McMorran	06:00 – 09:54	Start: 40 °F; wind 2 mph; 0 % cloud cover End: 55 °F; wind 2 mph; 0 % cloud cover
1b	3/8/2022	James McMorran	06:14 – 11:00	Start: 39 °F; wind 3 mph; 8 % cloud cover End: 65 °F; wind 4 mph; 0 % cloud cover
1c	3/14/2022	James McMorran	09:51 – 10:35	Start: 59 °F; wind 2 mph; 6 % cloud cover End: 60 °F; wind 2 mph; 6 % cloud cover
2a	3/28/2022	James McMorran	06:53 – 09:55	Start: 55 °F; wind 3 mph; 88 % cloud cover End: 61 °F; wind 7 mph; 97 % cloud cover
2b	3/29/2022	James McMorran	06:55 – 10:50	Start: 49 °F; wind 2 mph; 37 % cloud cover End: 57 °F; wind 3 mph; 26 % cloud cover
3a	4/16/2022	James McMorran	06:10 – 08:50	Start: 54 °F; wind 1 mph; 99 % cloud cover End: 59 °F; wind 3 mph; 99 % cloud cover
3b	4/18/2022	James McMorran	06:43 – 10:38	Start: 54 °F; wind 2 mph; 97 % cloud cover End: 66 °F; wind 4 mph; 3 % cloud cover
4a	5/02/2022	James McMorran	06:39 – 09:55	Start: 56 °F; wind 2 mph; 100 % cloud cover End: 64 °F; wind 6 mph; 21 % cloud cover
4b	5/03/2022	James McMorran	06:30 – 09:56	Start: 58 °F; wind 3 mph; 96 % cloud cover End: 60 °F; wind 3 mph; 100 % cloud cover

°F = degrees Fahrenheit; mph = miles per hour

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APPENDIX G

SAN ELIJO LAGOON RESTORATION PROJECT PRE-RESTORATION AND POST-RESTORATION PHOTOPOINTS PHOTOLOG

SAN ELIJO LAGOON RESTORATION PROJECT
POST-CONSTRUCTION PHOTOGRAPHS

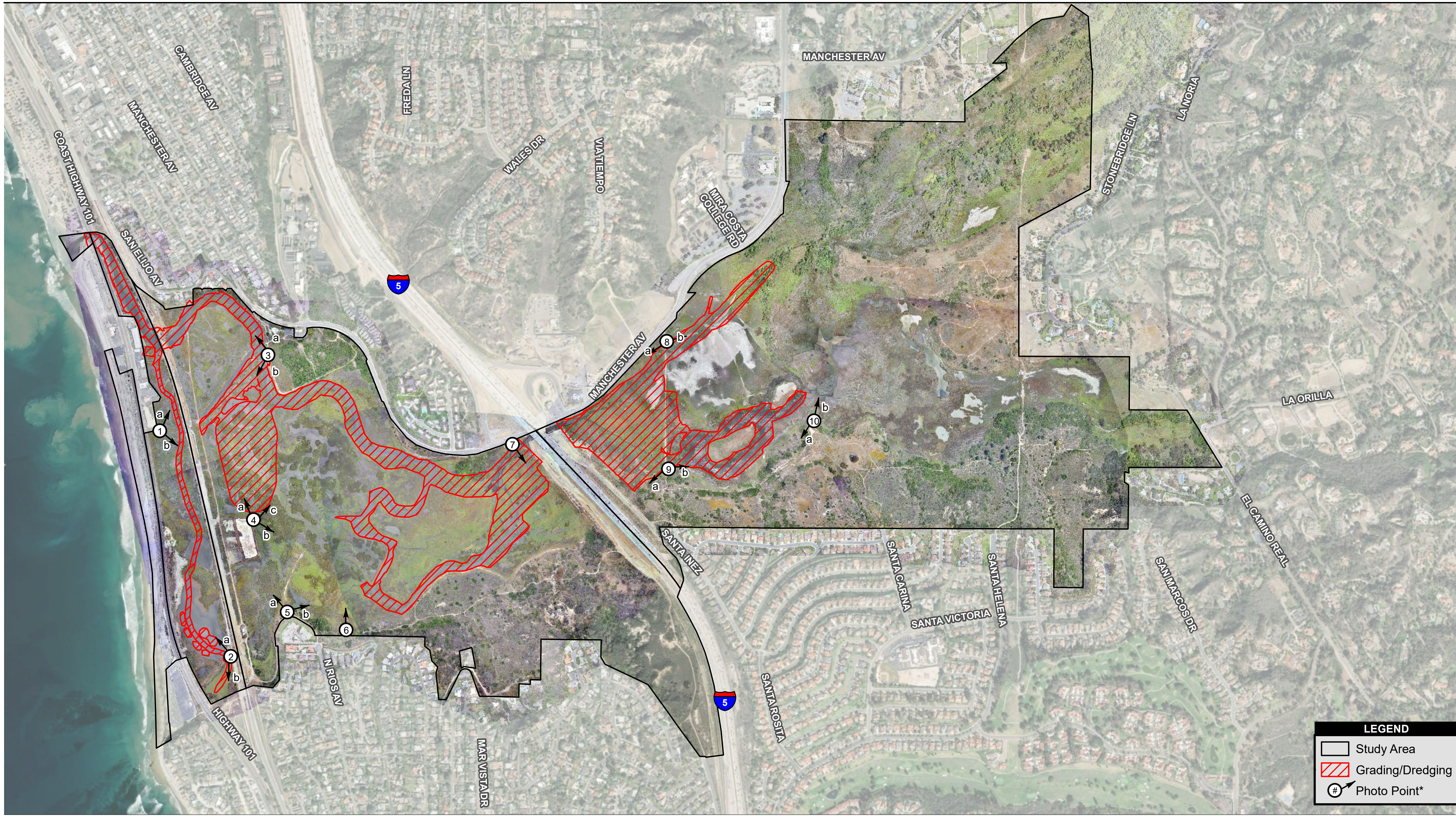
Applicant:

California Department of Transportation
District 11
4050 Taylor Street
San Diego, California 92110
and
Nature Collective
P.O. Box 230634
Encinitas, California 92023-0634

Prepared by:

AECOM
401 West A Street, Suite 1200
San Diego, California 92101
Phone: (619) 610-7600
Contact: Cindy Kinkade

August 2023



MoffattNichol (2015-18); AECOM (2018), SanGIS (2018).

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

* Photo point locations will be used pre- and post-construction.
Arrows depict direction of photo.

Photo Point Locations

San Elijo Lagoon Restoration Project

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\HMMP\Photo Point Locations_Restoration_Project.mxd, 7/18/2022, paul.moreno

MONITORING PHOTOGRAPHS

Photo Point 1a, West Basin (33° 0′ 38″ N, -117° 16′ 43″ W); bearing to subject 20° N

Photo Point 1b, West Basin (33° 0′ 38″ N, -117° 16′ 43″ W); bearing to subject 104° E

Permanent Photo Points 1a and 1b
08/24/2022

Photo Point 2a, West Basin (33° 0′ 25″ N, -117° 16′ 40″ W); bearing to subject 335° NW

Photo Point 2b, West Basin (33° 0′ 25″ N, -117° 16′ 40″ W); bearing to subject 112° SE

Permanent Photo Points 2a and 2b
08/24/2022

Photo Point 3a, Central Basin (33° 0′ 46″ N, -117° 16′ 28″ W); bearing to subject 272° W

Photo Point 3b, Central Basin (33° 0′ 46″ N, -117° 16′ 28″ W); bearing to subject 194° S

Permanent Photo Points 3a and 3b
08/24/2022

Photo Point 4a, Central Basin (33° 0′ 27″ N, -117° 16′ 31″ W); bearing to subject 293° W

Photo Point 4b, Central Basin (33° 0′ 27″ N, -117° 16′ 31″ W); bearing to subject 30° NE

Permanent Photo Points 4a and 4b
08/24/2022

Photo Point 4c, Central Basin (33° 0′ 27″ N, -117° 16′ 30″ W); bearing to subject 350° N

Permanent Photo Point 4c
08/24/2022

Photo Point 5a, Central Basin (33° 0′ 16″ N, -117° 16′ 24″ W); bearing to subject 313° NW

Photo Point 5b, Central Basin (33° 0′ 15″ N, -117° 16′ 22″ W); bearing to subject 17° N

Permanent Photo Point 5a and 5b
08/24/2022

Photo Point 6, Central Basin (33° 0′ 14″ N, -117° 16′ 19″ W); bearing to subject 11° N

Permanent Photo Point 6
08/24/2022

Photo Point 7, Central Basin (33° 0′ 35″ N, -117° 15′ 59″ W); bearing to subject 129° SE

Permanent Photo Point 7
08/24/2022

Photo Point 8a, East Basin (33° 0′ 46″ N, -117° 15′ 36″ W); bearing to subject 233° SW

Photo Point 8b, East Basin (33° 0′ 46″ N, -117° 15′ 36″ W); bearing to subject 44° NE

Permanent Photo Points 8a and 8b
08/24/2022

Photo Point 9a, East Basin (33° 0′ 37″ N, -117° 15′ 36″ W); bearing to subject 263° W

Photo Point 9b, East Basin (33° 0′ 37″ N, -117° 15′ 36″ W); bearing to subject 74° E

Permanent Photo Points 9a and 9b
08/24/2022

Photo Point 10a, East Basin (33° 0′ 38″ N, -117° 15′ 16″ W); bearing to subject 250° W

Photo Point 10b, East Basin (33° 0′ 38″ N, -117° 15′ 16″ W); bearing to subject 275° W

Permanent Photo Points 10a and 10b
08/24/2022