

2017 (YEAR 1)

# Annual Revegetation Monitoring Report for the Southeastern Creekside Marsh Culvert Replacement and Habitat Enhancement Project

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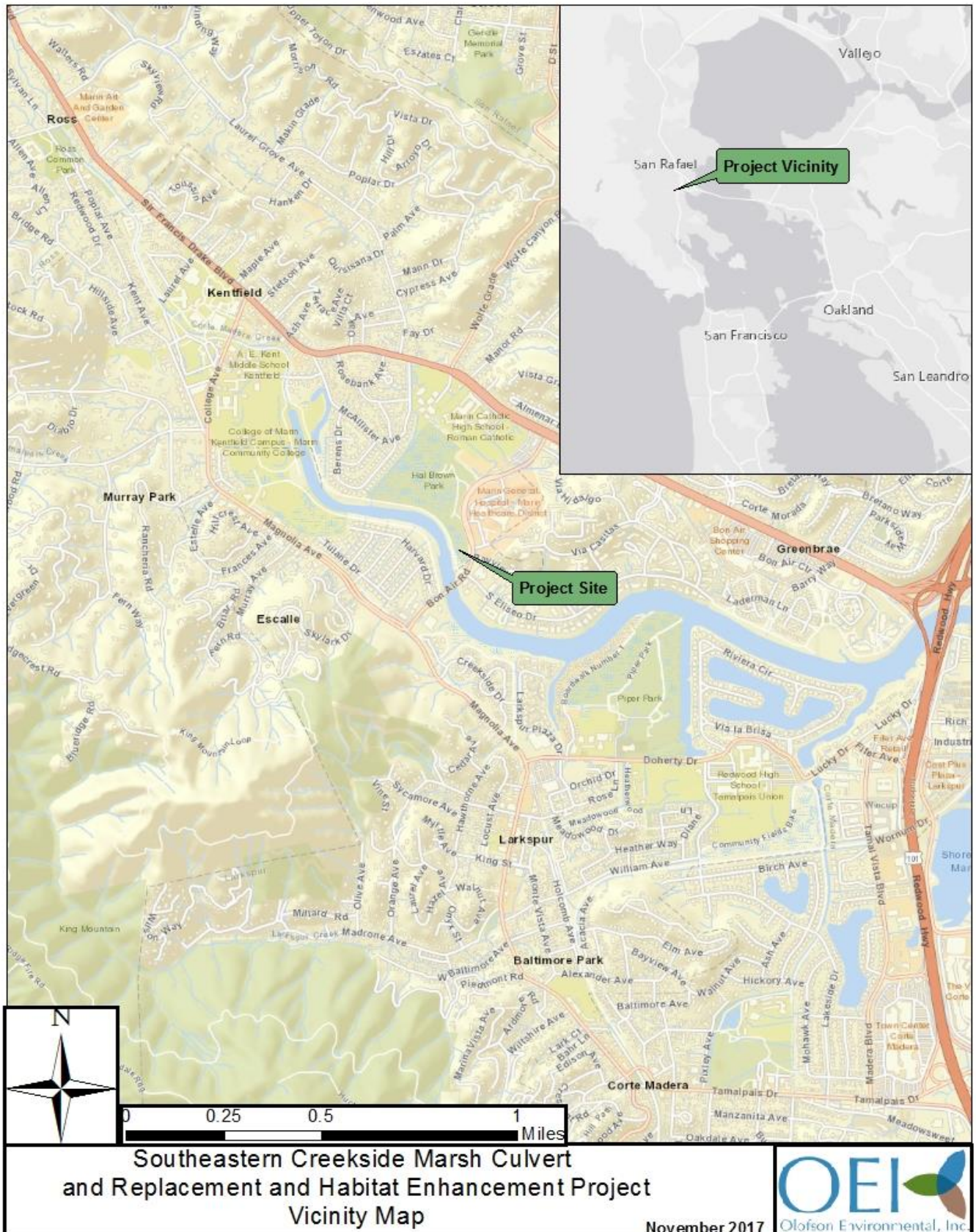
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# 1 List of Contributors

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## 1.1 Vicinity Map



## 2 Executive Summary

### 2.1 Background

Construction was completed for the Southeastern Creekside Marsh Culvert Replacement and Habitat Enhancement Project in November 2016. The primary goal of the project was to increase the tidal prism in the southern portion of Creekside Marsh by replacing a single bore culvert with three 60-inch culvert pipes. Before construction in the marsh, the salt marsh vegetation was removed by hand and kept on-site. After construction activities in the marsh concluded, the project area was revegetated.

The project area will be monitored for a minimum of 5 years, or until final success criteria has been met. This Year 1 monitoring report summarizes the results from the vegetation monitoring as prescribed in *Southeastern Creekside Marsh Culvert Replacement and Enhancement Mitigation and Monitoring and Reporting Plan (MMRP)*.

### 2.2 Results

Two sampling areas (Eastern Sampling Area, Western Sampling Area) were monitored in Year 1. The Eastern Sampling Area had a native plant cover of 72% compared to an adjacent reference site. The Western Sampling Area had a native plant cover of 82% compared to an adjacent reference site. The Year 1 monitoring cover criterion have been met at both sampling areas. Both sites had an invasive species cover of less than five percent, meeting Year 1 success criteria.

### 2.3 Remedial Action

The upland seeded areas had a total plant cover of 10% and appeared to have been mowed. Quarterly site visits are scheduled by OEI biologists, and if cover does not improve, seeding this area will be recommended.

### 2.4 Requested Agency Action

No agency action is requested at this time.



## 2.5 Site Map



### 3 Project Description

On September 9, 2016, work began to replace an existing single bore culvert that connects Corte Madera Creek to Creekside Marsh. The goal of the project was to increase the tidal prism in the southeastern portion of Creekside Marsh. Cofferdams were constructed, the levee was excavated, and the existing culvert was removed and replaced with three 60-inch culverts. In addition, the project closed a path north of the project area by placing soil in these areas as well as signs and fencing to discourage people from using the path.

The project area encompasses salt marsh habitats on both sides of the levee where construction occurred. Temporary impacts, including removal of salt marsh vegetation, occurred in 0.14 acre of estuarine wetland in Creekside Marsh and Corte Madera Creek. The salt marsh vegetation was replanted in the project area. In addition, upland areas removed by levee excavation were seeded with native grasses. This Year-1 Monitoring Report summarizes the results of our biological monitoring, as was specified in the *Southeastern Creekside Marsh Culvert Replacement and Enhancement Mitigation and Monitoring and Reporting Plan* (MMRP).

### 4 Revegetation Efforts

Prior to excavation of the levee, the salt marsh vegetation was removed from the project site. The removal began at the upland edge and continued towards higher quality habitat at the lower elevations. The salt marsh vegetation was removed with six inches of soil underneath.

During construction, the salt marsh vegetation was kept on-site until it could be replanted at the completion of the project. The vegetation was stored in a shady area; the low elevation plants (*Spartina foliosa* and *Jaumea carnosa*) were stored in small plastic pools and maintained with several inches of fresh water, and the mid elevation plants (*Salicornia pacifica*, *Distichlis spicata*) were placed on plastic sheeting and watered daily. The salt marsh vegetation had an approximate survivorship of 90% while out of the marsh.

On October 26, 2016, the salt marsh vegetation was replanted in the work area. The plants were placed based on species and elevation. Vegetation was not placed higher than where existing salt marsh vegetation was observed on site. Planting was completed using hand tools over a four-hour period at low tide. A coir mat was placed on the upland area, and native grass seed mix was spread over of the impacted upland transition zone.

### 5 Success Criteria

The MMRP established success criteria for percent cover, invasive species cover, and plant survival in the project area.



## 5.1 Percent Cover

For Year 1, vegetation coverage must be at least 10% compared to the reference site and have an absolute vegetation cover of at least 15% or active planting must occur. The MMRP stated that after Year 1, the following years must meet the success criteria as stated by Table 1.

Table 1. Success Criteria for Salt Marsh Species

Year	Average Total Plant Cover Compared to Adjacent Reference Site	Average Absolute Cover of Native Species Compared to Adjacent Reference Site	Absolute Cover Undesirable Exotic Species
One	≥10%	≥5%	≤5%
Two	≥20%	≥15%	≤5%
Three	≥35%	≥30%	≤5%
Four	≥55%	≥50%	≤5%
Five	≥80%	≥75%	≤5%

## 5.2 Target Invasive Species

The target invasive species shall not exceed 5% absolute cover in any year. Undesirable exotic species are defined as having a Cal IPC Inventory Rating of High or in some circumstances newer weeds identified to be invasive and not yet updated on the Cal IPC lists.

In the upland areas, non-native annual grass species that dominate the site prior to project impacts are not considered target invasive species requiring control because they meet pre-construction conditions. The target exotic species of note called out in the MMRP are invasive cordgrass species (*Spartina alterniflora*, *Spartina densiflora*) and perennial pepperweed (*Lepidium latifolium*).

## 5.3 Establish Reference Sites

To evaluate the percent cover of the project sampling areas, two adjacent high-quality reference sites must be established. Reference sites were established with following criteria: within 25 meters of the project sampling area, having marsh species that grow at a similar elevation as the adjacent sampling area, are located on the same channel or creek as the adjacent sampling area, and are the same size as the adjacent sampling area.

# 6 Monitoring Methods

To evaluate the progress of restoration in the project site, percent vegetation cover was evaluated quantitatively using the point line intercept method. Plant growth and survival were determined visually on-site. Photo points were established to track revegetation progress in the project area.

## 6.1 Monitoring Schedule

OEI biologists conducted the salt marsh vegetation monitoring on October 24, 2017. Vegetation monitoring will occur in September in the following years.

## 6.2 Percent Cover of Native Salt Marsh Species

The average percent cover of vegetation at the project site was evaluated using the point line intercept method. Because a raised pedestrian trail intersected the salt marsh habitats at the project site, two sampling areas were established: The Western Sampling Area located west of the levee/trail, and the Eastern Sampling Area located on the east side of the levee. Three permanent transects were established in each sampling site.

The Western Sampling Area had one 14m long primary transect with two secondary transects of 7m perpendicular to it. The primary transect was placed south to north in the mid marsh elevation where a majority of the revegetation occurred. The two secondary transects were placed perpendicular to the primary transect to allow low marsh species to be represented in the sampling. Both primary and secondary transects were sampled by dropping a pin every 0.5m and recording the species the pin intersects. The total length of transects were 27m yielding 54 data points.

Due to the larger size of the Eastern Sampling Area, a primary transect of 30m was established south to north but not sampled. Three secondary transects of 9m each were randomly placed perpendicular to the primary transect. The three secondary transects were sampled every 0.5m using the point intercept method. The three transects sample from high to low marsh elevation. The total length of transect sampled was 27m yielding 54 data points.

The transects at the Western Reference Site were established identically to the Western Sampling Area. The Western Reference Site transects were established with one 14m long primary transect and two secondary 7m transects. The secondary transects were placed perpendicular to the primary transect. Both primary and secondary transects were sampled yielding a total transect length of 27m yielding 54 data points.

The transects in the Eastern Reference Site were established using the same protocol as the Eastern Sampling Area. A primary transect of 30m was placed east to west parallel to the main channel. Three secondary transects of 9m were randomly placed along the primary transect running from high to low marsh elevation. Only the secondary transects were sampled yielding a total of 54 data points.

## 6.3 Data Analysis

Absolute cover of each species was calculated using the point intercept data. Species composition was calculated by dividing the number of hits of a particular species by the total number of data points (54) taken along that transect. This is multiplied by 100 to yield a percentage of each species.

Absolute cover of vegetation was calculated as the number of hits of vegetation divided by the total number of points recorded along the transect and multiplied by 100.

Cover of invasive species was calculated as the number of hits of invasive species recorded along the transect divided by the total number of points and multiplied by 100.

## 6.4 Presence of Invasive Species

In addition to invasive species recorded using the point intercept method, all invasive species were visually estimated at the project site. Visual surveys were conducted for invasive species including cordgrass species (*Spartina alterniflora*, *Spartina densiflora*) and perennial peppergrass (*Lepidium latifolium*). Due to the small size of the project area, any invasive species found were recommended for removal.

## 6.5 Plant Survivorship

Due to the small size of the project area, plant survivorship of the salt marsh species was visually estimated.

## 6.6 Photo Point Monitoring

Four photographs were taken on October 24, 2017 documenting the two sampling sections as well as the adjacent reference sites. The compass bearing of each and GPS coordinated were recorded for each photo point.

# 7 Results

The following are the results of the vegetation monitoring survey that took place 10/24/17.

## 7.1 Absolute Percent Cover

Absolute percent cover of each sampling area as determined using the point intercept method is detailed in Table 2.

Table 2. Absolute Percent cover

Cover Type	Absolute Percent Cover (%)			
	Project Site		Reference Site	
	Western Sampling Area	Eastern Sampling Area	Western Reference Site	Eastern Reference Site
Bare Ground	20	29.6	3.7	3.7
Wrack	4	0	3.7	0
Target Invasive Cover	0	1.8	0	0
Native Vegetation Cover	76	69.6	92.6	96.3
Absolute Vegetation Cover	76	71.4	92.6	96.3

Absolute cover was determined at the Project Site and Reference Site sampling areas. The absolute cover of the reference areas was used as a baseline for the Project Site vegetation cover. The percent cover of the Project Site compared to the adjacent reference site is detailed below in Table 3.

Table 3. The Percent Cover of the Project Site Compared to the Adjacent Reference Site

Percent Cover (%) of Native Salt Marsh Species Compared to Reference Site			
Monitoring Year	Success Criteria	Western Sampling Area	Eastern Sampling Area
Year 1	≥5	82	72
Year 2	≥15		
Year 3	≥30		
Year 4	≥50		
Year 5	≥75		

As shown in Table 3, the success criteria of ≥5% native vegetation cover was met for both sampling areas at the Project site. Western Sampling Area reached Year 5 success criteria and the Eastern Sampling Area reached Year 4 success criteria.

## 7.2 Invasive Species Cover

Table 4. Invasive Species Cover at Project Site

Absolute Cover (%) of Invasive Species		
Success Criteria	Western Sampling Area	Eastern Sampling Area
≤5	0	1.8

Target Species cover criteria of ≤5% was met at both sampling areas. No invasive species were found at the Western Sampling Area. At the Eastern Sampling Area, only one invasive plant (*Salsola soda*) was identified using the point intercept method. Visual inspection of the site revealed one more invasive plant (*Spartina densiflora*). Both were removed.

### 7.3 Species Composition

Table 5. Species Composition of Salt Marsh Vegetation

Cover Type	Species Composition (%)			
	Project Site		Reference Site	
	Western Sampling Area	Eastern Sampling Area	Western Reference Site	Eastern Reference Site
<i>Salicornia pacifica</i>	5	2.7	23.9	11.5
<i>Jaumea carnosa</i>	37.5	73.7	0	61.7
<i>Spartina foliosa</i>	17.5	5.2	0	0
<i>Distichlis spicata</i>	40	15.7	69.6	23
<i>Grindelia stricta</i>	0	0	6.5	0
<i>Frankenia salina</i>	0	0	0	1.9
<i>Limonium californicum</i>	0	0	0	1.9
Target Invasive Species	0	2.7	0	0

Each species was recorded along the transects at each sampling area, and the percentage of each species was determined. Both project site sampling areas had high percentages of *Jaumea carnosa* and low invasive species percentage. The Western Sampling Area had significant percentages of *Distichlis spicata* where it is abundant along the creek near the project area.

### 7.4 Plant Survival

Plant survival was estimated visually at the project sites. OEI biologists monitored planting areas for signs of plant mortality. The visual survey found that survivorship of planted vegetation was above 90% at both sampling areas.

### 7.5 Upland Seeded Areas

After construction, the upland levee between the bike path and the marsh was seeded with native grass species. Due to the small area, percent cover was visually estimated. The cover of the upland areas was 10% unknown grass species. The vegetation on the levee was recently mowed to a height of six inches making identification difficult. Site visits will be conducted in the winter and spring when species will be identifiable. Actions will be taken to avoid mowing in the project area.

### 7.6 Photo Point Monitoring

A total of four photo points were established for yearly monitoring. A single photo was taken at each of the sampling areas and the adjacent reference sites. The photographs are provided in Appendix A.



## 8 Discussion

The following sections discuss the results presented above.

### 8.1 Percent Cover of Salt Marsh Species

The first-year success criterion of  $\geq 5\%$  native vegetation cover was met at both Western and Eastern Sampling Areas. The Western Sampling Area had a cover of 82%, meeting the Year 5 success criteria. The Eastern Sampling Area had a native species cover of 72.2%, meeting the Year 4 success criteria.

The Eastern Sampling Area had very high percent cover in a majority of the area, but had one patch of bare ground where passive recruitment is slow. This area was sparsely revegetated compared to the rest of the sampling site. Recruits are present here, but they are small and will require more time to achieve a high cover class.

The success in the planting areas may be due to wet weather conditions in 2016/2017. Species such as *Jaumea carnosa* and *Distichlis spicata* made up a majority of the cover in the project area. The wet weather may have facilitated rhizomatous growth in both *Jaumea carnosa* and *Spartina foliosa* that lead to higher percent cover in those species. In addition, wet weather may have led to an increase in passive recruitment of salt marsh species and high percent cover in the project area.

### 8.2 Invasive Species Cover

The success criterion of less than 5% invasive cover was met at both sampling sites. Only two plants were found in the project area (*Spartina densiflora* and *Salsola soda*) and removed.

### 8.3 Species Composition

*Jaumea carnosa*, *Distichlis spicata*, and *Spartina foliosa* made up a majority of the cover in the project area sampling sites. During construction, these species were kept onsite in small plastic pools to allow a few inches of water under the soil. This method proved to be effective, and the plant survivorship while in the plastic pools was 90%. When replanted in the project area, these species had a high survivorship and allowed for rapid revegetation.

The cover of perennial pickleweed (*Salicornia pacifica*) was low in the project site due to only moderate survivorship while out of the marsh. The pickleweed was not as robust as the other species during planting. Perennial pickleweed is abundant adjacent to the project site, and higher percentages of cover are expected in future monitoring.

### 8.4 Plant Survival

Vegetation that was replanted into the project site had  $\geq 90\%$  survivorship, and appeared robust. The *Spartina foliosa* and *Jaumea carnosa* were both flowering during monitoring.

### 8.5 Wildlife Observations

Species observed in or adjacent to the project site were documented during onsite vegetation monitoring. One North American river otter (*Lontra canadensis*) was observed in Corte Madera Creek

next to the culvert at the project site. In addition, one Ridgway's rail (*Rallus obsoletus*) was heard calling approximately 100m north of the project site.

## 9 Adaptive Management and Remedial Actions

### 9.1 Upland Vegetation

The upland seeded areas will be monitored in winter and spring for percent cover and invasive species. We recommend that mowing of the seeded areas be prevented in the future. This has been communicated to Marin County Parks and they have agreed to stop mowing the area.

### 9.2 Quarterly Site Visits

OEI will conduct quarterly site visits throughout 2018, and will make additional recommendations as needed to ensure project goals are met.

### 9.3 Annual Vegetation Monitoring

OEI will conduct the next vegetation monitoring in September 2018 to determine if success criteria is met for Year-2.

# References

California Native Plant Society. 2010. Jaumea Carnosa Water Requirement. Accessed November 2017;  
[http://calscape.org/Jaumea-carnosa-\(\)](http://calscape.org/Jaumea-carnosa-())

Coulloudon, Bill. & National Applied Resource Sciences Center (U.S.). (1999). Sampling vegetation attributes interagency technical reference. Denver, Colo : Bureau of Land Management : National Business Center. Pages 62-68

Friends of Corte Madera Creek Watershed. Southeastern Creekside Marsh Culvert Replacement and Habitat Enhancement. Accessed November 2017.  
[http://friendsofcortemaderacreek.org/new\\_site/restoration/larkspur/](http://friendsofcortemaderacreek.org/new_site/restoration/larkspur/)

Marin County Parks, Southeastern Creekside Marsh Culvert Replacement and Enhancement Mitigation and Monitoring and Reporting Plan.

# Appendix A- Photo Point Monitoring

Photo point monitoring was conducted on 10/24/17.



**P-1.** Project Site: Eastern Sampling Area



**P-2.** Project site: Western Sampling Area





**P-3.** Reference site: Eastern Sampling Area



**P-4.** Reference site: Western Sampling Area