

2019 (YEAR 3)

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

Prepared by:



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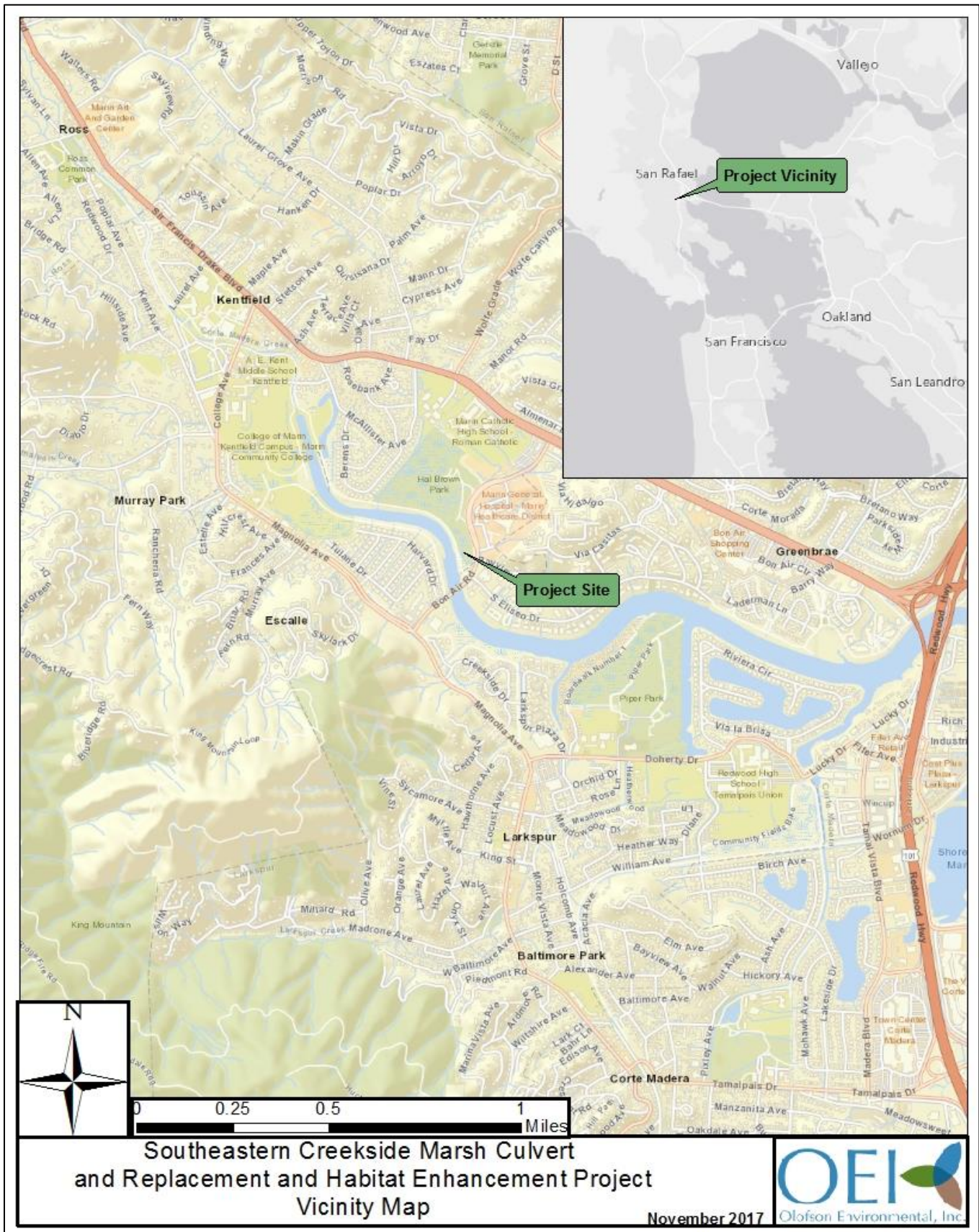
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## 2. List of Contributors

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## 2.1. Vicinity Map



## 3. Executive Summary

### 3.1. 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 began 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.

In December 2017, soil unsuitable for plant growth was removed from the restoration area with the expectation that 200 cubic yards of Young Bay Mud would be available to replace it. Unfortunately, only 100 cubic yards of mud was supplied. The Young Bay Mud was used to fill only part of the restoration area. The Young Bay Mud was placed at an elevation to promote passive recruitment of salt marsh vegetation. Since this part of the project was completed a year after the culvert construction, it was evaluated based on Year 2 success criteria.

The other half of the proposed restoration area that did not receive Young Bay Mud was enhanced using soil amendments and active plantings. Soil amendments occurred in August 2018 and native plants were planted by January 2019. Since this part of the project was completed two years after the culvert construction, it was evaluated based on Year 1 success criteria.

The project is to be monitored for 5 years, or until final success criteria has been met. This Year 3 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)*.

### 3.2. Results

The culvert project site (3.5 Site Map) reached the Year 5 success criteria last year. This area was not monitored quantitatively this year. Monitoring included photo points and an invasive species survey to ensure Year 5 success criteria was still achieved.

The soil replacement restoration site (3.6 Habitat Restoration Site Map) had native plant percent cover of 45.1% compared to an adjacent reference site, meeting the Year 2 criteria. The soil amendment restoration area was completed last year and had a percent cover of 43.3%, meeting Year 1 criteria. Both sampling areas had an invasive cover of less than 5%.

### 3.3. Remedial Action

No remedial action is required at this time.

### 3.4. Requested Agency Action

No agency action is requested at this time.

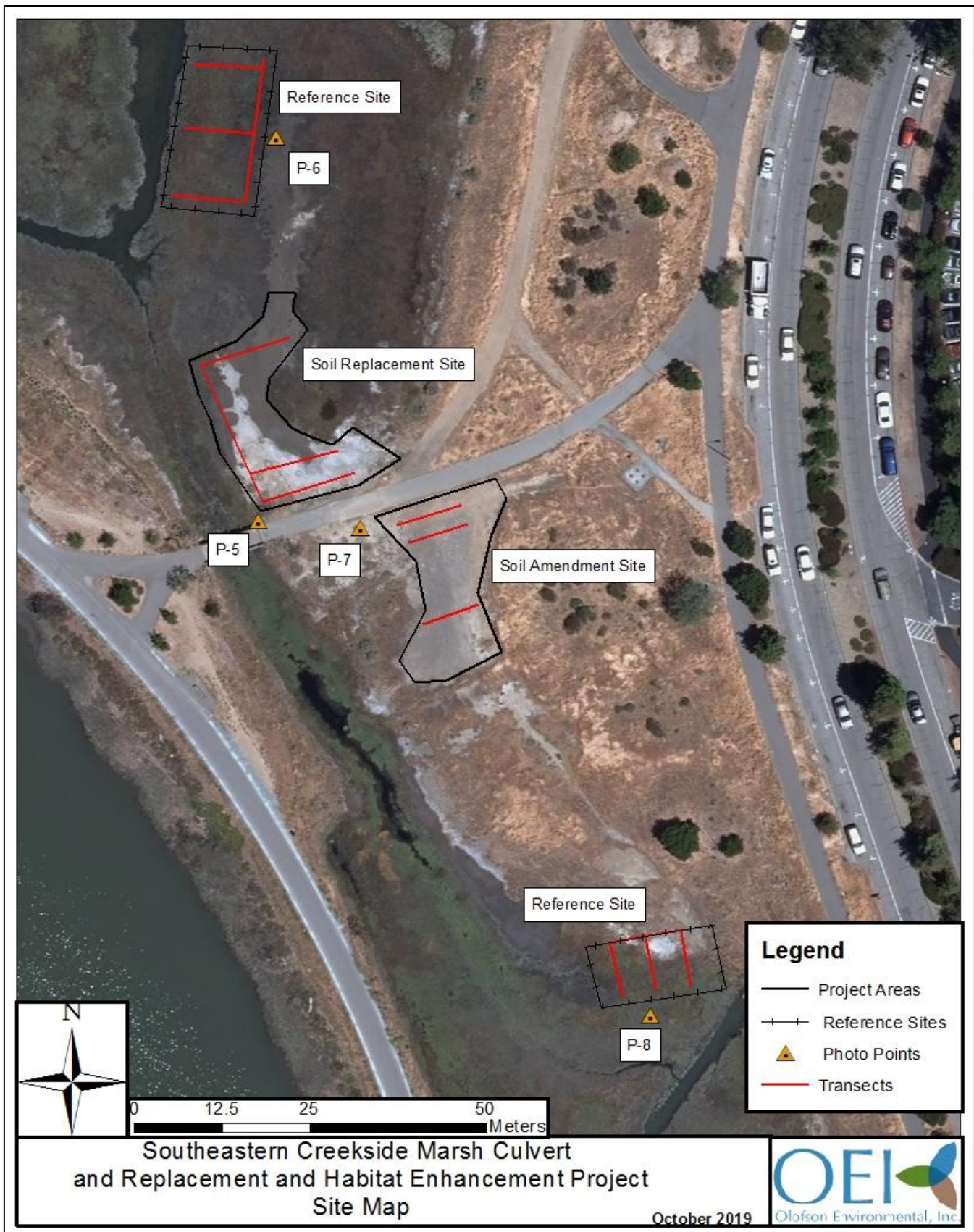


### 3.5. Culvert Replacement Site Map





### 3.6. Habitat Restoration Site Map





## 4. 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 berm 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 berm 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 berm excavation were seeded with native grasses (3.5. Culvert Replacement Site Map).

In December 2017, the second component of the project was completed (3.6. Habitat Restoration Map). An area of marsh approximately 8,290 square feet had soil that was compacted and unsuitable to support salt marsh vegetation. The top eight inches of soil was removed and replaced with Young Bay Mud. The mud was placed at the same elevation as the surrounding marsh. Due to the lack of available Young Bay Mud, only half of the proposed 8,290 square feet restoration site was treated.

In the other half of the restoration area, soil amendments were added to encourage plant growth. Gypsum and compost were added to the soil and native plants were planted by January 2019. This report summarizes the Year 1 monitoring of the soil amendment site.

This Year-3 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).

## 5. Revegetation Efforts

Revegetation has been completed in two areas. First, plants salvaged before the culvert replacement were installed after culvert construction was complete (3.5. Culvert Replacement Site Map). Second, in restoration areas (3.6. Habitat Restoration Site Map), soil was removed and replaced with Young Bay Mud in late 2017 or amended with gypsum and compost and planted by January 2019.

**Culvert Area:** Prior to excavation of the berm, 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.

**Soil Replacement Area:** In December 2017, an area of marsh north of the culvert project site was restored by replacing existing soil with Young Bay Mud and left for passive recruitment of salt marsh vegetation. This year, pickleweed (*Salicornia pacifica*) was planted to further enhance restoration efforts.

**Soil Amendment Area:** Due to a lack of Young Bay Mud, the proposed habitat restoration area could not be replaced with suitable soil. Instead, soil amendments and active planting were done to meet restoration requirements. First, large rocks were removed from the existing soil. Then, gypsum and composted green waste were added followed by active planting of native plant species. Native plant species included saltgrass (*Distichlis spicata*), creeping wild rye (*Elymus triticoides*), alkali heath (*Frankenia salina*), cuman ragweed (*Ambrosia psilostachya*), marsh baccharis (*Baccharis glutinosa*), California mugwort (*Artemisia douglasiana*), and Pacific aster (*Symphotrichum chilense*).

## 6. Success Criteria

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

### 6.1. Percent Cover

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%

## 6.2. 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 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*).

## 6.3. Establish Reference Sites

To evaluate the percent cover of the project sampling areas, adjacent reference sites must be established. Reference sites were established with following criteria: within 45 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. In Year 2, a reference site was established adjacent to the soil replacement restoration area, and in Year 3, a reference site was established for the soil amendment area.

# 7. 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.

## 7.1. Monitoring Schedule

OEI biologists conducted the vegetation monitoring on September 26, 2019.

## 7.2. Percent Cover of Native Salt Marsh Species

The culvert replacement project site (3.5. Culvert Replacement Site Map) was not evaluated quantitatively this year. Year 5 success criteria was achieved last year for percent cover of native species and presence of invasive species.

The soil replacement habitat restoration was evaluated using the point line intercept method (3.6. Habitat Restoration Site Map). A primary transect of 30m was established and 3 secondary transects of 9m each were placed perpendicularly to it. The three 9m transects were sampled every half meter yielding 54 data points. A reference site was established north of the area at similar elevation to compare the percent cover of the restoration site.

The soil amendment habitat restoration was evaluated using the point line intercept method (3.6. Habitat Restoration Site Map). Three 9m transects were established from low to high elevations and were sampled every half meter. A reference site was established south of the restoration area at a similar elevation.

### 7.3. 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 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.

The soil replacement site was evaluated based on Year 2 success criteria, and the soil amendment site was evaluated using Year 1 success criteria.

### 7.4. 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.

### 7.5. Plant Survivorship

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

### 7.6. Photo Point Monitoring

Eight photographs were taken on September 26, 2019 documenting the culvert replacement project site and habitat restoration site. The compass bearing of each and GPS coordinated were recorded for each photo point.

## 8. Culvert Replacement Project Site Results

The culvert replacement project site was not monitored quantitatively because Year 5 success criteria was reached last year in Year 2. Photo point and invasive species monitoring was done this year.



## 8.1. Absolute Percent Cover

Table 2. Percent Cover of native species at the culvert replacement project 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	116	93.9
Year 3	≥30		
Year 4	≥50		
Year 5	≥75		

Year 5 success criteria was achieved in Year 2. Percent cover compared to an adjacent reference site was not evaluated this year.

## 8.2. Photo Point Monitoring

Photo points will continue to be taken at the culvert replacement project site to monitor the success of the plantings.

## 8.3. Invasive Species Cover

The culvert replacement project sites were monitored for invasive species this year. No invasive species were found. Invasive species will continue to be monitored during quarterly site visits.

## 8.4. 8.4 Plant Survival

Plant survivorship was visually monitored at the culvert replacement site. Plant survivorship was above 90%, and the plantings have completely intermixed with passive recruitment in the project site.

# 9. Habitat Restoration Results

The following are the results of monitoring conducted on September 26, 2019 at the habitat restoration sites (3.6 Habitat Restoration Site Map). The habitat restoration is separated into two sites: The soil replacement site which was restored using Young Bay Mud in December 2017, and the soil amendment area that was restored in January 2019.

## 9.1. Absolute Percent Cover

Table 3. Absolute percent cover at the soil replacement site.

	<b>Absolute Percent Cover (%) of Soil Replacement Site</b>	
<b>Cover Type</b>	<b>Soil Replacement Site</b>	
	Soil Replacement Site	Reference Site
Bare Ground	57.4	5.6
Wrack	0	0
Target Invasive Cover	0	0
Native Vegetation Cover	42.6	94.4
Absolute Vegetation Cover	42.6	94.4

Table 4. Absolute percent cover at the soil amendment site.

	<b>Absolute Percent Cover (%) of Soil Amendment Site</b>	
<b>Cover Type</b>	<b>Soil Amendment Site</b>	
	Soil Amendment Site	Reference Site
Bare Ground	62.9	14.8
Wrack	0	0
Target Invasive Cover	0	0
Native Vegetation Cover	37.1	85.2
Absolute Vegetation Cover	37.1	85.2

Absolute cover was determined at the project sites and the adjacent reference sites. This was used to calculate the percent cover compared to reference site success criterion.

Table 5. Percent cover compared to an adjacent reference site at the soil replacement and soil amendment site.

<b>Percent Cover (%) of Native Salt Marsh Species Compared to Reference Site</b>			
<b>Monitoring Year</b>	<b>Success Criteria</b>	<b>Soil Replacement Site</b>	<b>Soil Amendment Site</b>
Year 1	≥5	12.7	43.3
Year 2	≥15	45.1	
Year 3	≥30		
Year 4	≥50		
Year 5	≥75		

The soil replacement restoration took place in December 2017, so it was evaluated with Year 2 criteria. The soil replacement site had a percent cover compared to a reference site of 45.1%. The soil amendment site was completed in January 2019 and evaluated using Year 1 criteria. This year it had a percent cover compared to a reference site of 43.3%.

## 9.2. Invasive Species Cover

Table 6. Invasive species cover at the soil replacement site and the soil amendment site.

Year 3 Absolute Cover (%) of Invasive Species at Habitat Restoration Site		
Success Criteria	Soil Replacement Site	Soil Amendment Site
≤5	0	0

No invasive species were found at the soil replacement and soil amendment site.

## 9.3. Species Composition

Table 7. Species composition at the soil replacement site and adjacent reference site.

Cover Type	Species Composition (%)	
	Soil Replacement Site	
	Project Site	Reference Site
<i>Salicornia pacifica</i>	71	49.1
<i>Jaumea carnosa</i>	3.2	5.8
<i>Spartina foliosa</i>	0	0
<i>Distichlis spicata</i>	25.8	45.1
<i>Grindelia stricta</i>	0	0
<i>Frankenia salina</i>	0	0
<i>Limonium californicum</i>	0	0
<i>Atriplex spp.</i>	0	0
Target Invasive Species	0	0

Pickleweed (*Salicornia pacifica*) was the major species colonizing the soil replacement site. The site is at the same elevation as the surrounding marsh where pickleweed is the dominant species.

Table 8. Species composition at the soil amendment site and adjacent reference site.

Cover Type	Species Composition (%)	
	Soil Amendment Site	
	Project Site	Reference Site
<i>Distichlis spicata</i>	0	41.2
<i>Salicornia pacifica</i>	23.5	5.9
<i>Frankenia salina</i>	11.8	14.7
<i>Elymus triticoides</i>	23.5	0
<i>Ambrosia psilostachya</i>	11.8	0
<i>Baccharis glutinosa</i>	29.4	0
<i>Artemisia douglasiana</i>	0	0
<i>Symphotrichum chilense</i>	0	0
<i>Grindelia stricta</i>	0	2.9
Annual Upland Grass	0	35.3
Target Invasive Species	0	0

Marsh baccharis (*Baccharis glutinosa*), creeping wild rye (*Elymus triticoides*), and pickleweed (*Salicornia pacifica*) are growing successfully in the soil amendment site. The reference site is dominated by saltgrass (*Distichlis spicata*) and annual upland grasses.

#### 9.4. Plant Survival

Plant survivorship was visually estimated where active plantings had taken place. Plant survivorship at the soil amendment site was 60-70%. Active plantings occurred this past year at the soil replacement site, but it was impossible to distinguish between active plantings and passive recruitment this year.

## 10. Discussion

The following sections discuss the results of the monitoring that occurred on September 26, 2019.

### 10.1. Percent Cover of Salt Marsh Species

The Year 2 success criterion of  $\geq 15\%$  native vegetation cover was met at the soil replacement site. The site had a native vegetation cover of 45.1% compared to the adjacent reference site. Friends of Corte Madera Creek Watershed planted pickleweed this past year which has boosted the native cover significantly. The Young Bay Mud was become firmer and is at an elevation suitable for mid and upper elevation marsh plants to recruit.

Year 1 success criterion of  $\geq 5\%$  native vegetation cover was met at the soil amendment site as well. The site had a native vegetation cover of 43.3% compared to a reference site. This area was actively planted and irrigated which has allowed plant survival to be approximately 60-70%.



The culvert replacement project site was visually monitored to ensure that the percent cover of salt marsh species was still at the Year 5 success criteria. The plantings continue to be successful and net cover appeared very high.

## 10.2. Invasive Species Cover

The success criterion of less than 5% invasive cover was met at all sampling sites. No invasive plants were found at the soil replacement or soil amendment site. Invasive species will be monitored during quarterly site visits.

## 10.3. Species Composition

At the soil replacement site, *Salicornia pacifica* and *Distichlis spicata* made up the largest percentage of the species composition. The project site had a larger percentage of *Salicornia pacifica* than the adjacent reference site because it was actively planted this year. The surrounding area is dominated by these species as well allowing passive recruitment to occur.

At the soil amendment site, *Elymus triticoides* and *Baccharis glutinosa* were the most successful upland plantings. They made up approximately 50% of the total species composition. Installing irrigation has been vital to the initial survivorship of the upland plantings. At lower elevation, *Salicornia pacifica* was the most abundant species and will hopefully fill in the area through passive recruitment.

## 10.4. Plant Survival

Plant survival at the soil amendment site appeared to be 60-70%. The plantings have spread and are now intermixed with plants that have recruited passively. *Elymus triticoides* and *Baccharis glutinosa* were the most successful species, while only a few *Artemisia douglasiana* were found. The irrigation has been crucial for plant survival at upland elevations.

Plant survival at the soil replacement site was very high. It was impossible to distinguish what was planted by Friends of Corte Madera Creek and what had been passive recruitment. All established plants in this area appeared healthy.

## 10.5. Wildlife Observations

Species observed in or adjacent to the project site were documented during onsite vegetation monitoring. One Ridgway's rail (*Rallus obsoletus*) was heard calling approximately 25m north of the soil replacement site.

# 11. Adaptive Management and Remedial Actions

## 11.1. Quarterly Site Visits

OEI will conduct quarterly site visits throughout 2020 and will make additional recommendations as needed to ensure project goals are met.

## 11.2. Annual Vegetation Monitoring

OEI will conduct the next vegetation monitoring in fall 2020 to determine if success criteria are met for Year 4.

## 12. References

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

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[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.

## 13. Appendix A- Photo Point Monitoring

Photo point monitoring was conducted on 9/26/19.



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



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





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



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





**P-5. Project Site: Soil Replacement Site**



**P-6. Reference Site: Soil Replacement Site**





**P-7.** Project Site: Soil Amendment Site



**P-8.** Reference Site: Soil Amendment Site