Appendix F. Northern Levee Cordgrass Planting

Appendix F

Northern Levee Cordgrass Planting

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To: Julian Meisler, Baylands Program Manager

From: Kate Freeman, Field Crew Leader

Subject: Sears Point Levee Planting Project Memo

Date: 21 August 2019

Project Area and Focal Species

This project took place on the north shore levee of San Pablo Bay (Figure 1), as a small facet of Sears Point Tidal Wetland Restoration Project. The primary and immediate objective of this work was to slow the scarp erosion of the levee by planting native saltmarsh plants in the intertidal zone. Focal species were *Spartina foliosa* (cordgrass), *Distichlis spicata* (saltgrass), and *Sarcocornia pacifica* (perennial pickleweed).

Planting commenced on 27 June 2019 and continued two days per week through 26 July 2019 for ten total days. Timing of planting varied daily with the tides[1], but time spent planting was consistently 6 hours per day, with two additional hours for prepping, harvesting, cleaning and transport. Our four person crew, therefore, spent 240 hours planting and 320 hours on the project overall[2].

For the purpose of this project, we divided the levee into functional units, referred to as cells. Each cell consisted of the bay pan between headlands, numbered 1–12 from east to west (Figure 1). Planting began at cell 2[3] and progressed in an eastward direction to Cell 10.

Methods

Intertidal vegetation planting occurred in two zones: 1) Low-middle zone and 2) middle-high zone. Planting in low-middle zone occurred along the upper edge of the smooth and soft depositional surface mudflat, just below the rough and compacted, wave-scoured mud. Planting in the middle-high zone occurred in areas within reach of neap high tides, with intention of facilitating their clonal spread to higher elevations. Dry zones above this elevation were not planted due to high risk of lethal stress to young transplants. The exact elevation of each zone varied from cell to cell. We used the location of existing cordgrass and pickleweed/saltgrass colonies to estimate appropriate planting elevations within each cell.

Efforts were focused on the low-middle zone as this was seen as the first and most immediate remedy for levee erosion. The majority of each day was spent harvesting and planting cordgrass, generally until tides forced us to transition to higher elevation planting.

Low elevation zone

Cordgrass Harvest — Days began with cordgrass harvest from the Sonoma Baylands Marsh. We accessed harvest areas by driving down the west shore levee (Dickson Trail) and walking into the marsh on pre-established paths. We stayed within a 10 m radius of two source locations[4] (Figures 2 & 3). To minimize impact, we never harvested more than 3 plant clusters from any given point. We harvested

[1] To maximize time in the field during low tide for access to low elevation tidal zone.

[2] The total hours does not include crew training, which was an additional 8 hours per person.

[3] Due to the presence of Bay Camp campers in cell 1, we began in cell 2.

[4] Source 1 coordinates: N 38.12441° W 122.47339°; Source 2 coordinates: N 38.12416° W 122.47350°

cordgrass plugs by digging into the mud using a drain spade to extract 1–3 vegetative shoot clusters with roots intact, leaving mud around the base (Figure 4). We collected plugs in 5-gal buckets with a small amount of water in the bottom to keep roots wet. Each crew member harvested approximately 2 buckets of cordgrass plugs per harvest session. We then transferred plants into wetted white nylon debris bags for translocation. Bags were stored in the shade until transplant—typically a 2–4 hour window.

Cordgrass Transplanting— We worked in teams of two to accomplish all planting. In each team, one person dug holes with the drain spade (Field Tech 1), while the second followed behind with a 5-gal bucket of cordgrass (Field Tech 2), burying plugs in holes. First, Field Tech 1 dug a hole at a 45 degree angle, at least 24 inches deep, perpendicular to the shoreline. Next, they added a tablespoon of high N turfgrass fertilizer[5] to the hole, mixing fertilizer with mud to create a slurry[6]. This ensured roots were never directly exposed to fertilizer. Field Tech 2 then placed a cordgrass plug well into the hole, ensuring roots and basal stalk of plant were buried[7] (Figure 5). It was important to bury plugs well and stamp down on mud with boots afterwards, preventing plug from being washed away with the tides. Lastly, Field Tech 2 placed a small bamboo stake next to transplant for future monitoring.

Cordgrass planting occurred in two phases. The first phase consisted of a lower tier of plantings. Lower tier transplanting took place in the smooth and soft depositional surface mudflat at the lowest elevation of local cordgrass seedlings. The second phase consisted of a second tier of cordgrass, approximately 2 meters landward of the lower tier in rough-surfaced eroded mudflat.

We planted plugs at two meter intervals, using the length of the drain spade to measure distance between each hole. Beginning in cell 2, we progressed east until we reached cell 10, where erosion impacts are less detrimental than the western-most cells. Additionally, lower-tier mud in cells 9–12 was extremely soft and sticky, making planting slow and arduous. Once completing the lower tier of cell 9, we started back at cell 1, planting a lower and upper tier concurrently. We then moved east with the second tier, reaching cell 5. Plugs in the upper tier were at two meter intervals, in the gaps above lower tier plants. At project completion, we had planted 1750 cordgrass units.

High elevation zone

Saltgrass/pickleweed Harvest – We harvested saltgrass from the drainage ditch paralleling the northern edge of the levee. Our two primary source locations were: near the gated entrance to the Bay Trail just south of the railroad crossing (N 38.12851° W 122.47124°), and adjacent to the SW corner of the vineyard (N 38.13651° W 122.45078°). We harvested large volumes of saltgrass propagules very efficiently from these two small areas. In areas with standing water, we simply reached down and grabbed handfuls of saltgrass, gently pulling upward so rhizomes remained intact[8]. With this method two people could easily fill a 5-gal bucket in five minutes—generally enough plants to cover the length of one cell.

Due to its relative abundance, we harvested pickleweed locally within each cell. This saved the time and energy of transport. We sourced plants from large, vigorous stands of pickleweed, generally found at the

[5] Bandini Pro 16-6-8 Turf All Purpose Lawn Fertilizer

[6] We never added fertilizer when the tide was high enough for water to fill transplant holes. Fertilizer was only added to pits, never left near the surface.

[7] Note: early in the project we were sometimes separating plugs, so that only one shoot with rhizomes was buried. However, after three weeks of monitoring these early plantings, we found larger plugs (i.e. 2–3 stalks and rhizomes) had much better establishment (more basal tillers emerging, more growth of original transplant, less mortality). We therefore kept plugs intact with at least 2 stalks for the remainder of the project.

[8] *Bolboschoenus maritimus* (Alkali-bulrush) grows along this drainage, mixed in with saltgrass. When shoots of alkali-bulrush were extracted during saltgrass harvest, we planted these as well (in the high-elevation zone).

far ends of a given cell. Using the spade, we lifted clumps of plants with woody base and roots intact and placed in 5-gal bucket. We harvested no more than a few plants from each location to minimize impact to local stands.

Transplanting— We planted pickleweed and saltgrass in the wave-scoured, rough-surfaced eroded mud, below neap high tide elevation. Similar to cordgrass planting, we worked in teams of two, with one person digging and a second person transplanting. For pickleweed, we dug holes at a 45 degree oblique angle, deep enough so that the plug could rest 2–4 inches below surface. We then placed a tablespoon of high N fertilizer in the bottom of a pit, making a slurry with mud. Plants were placed in the hole with 2/3 of the above-ground shoots buried, leaving only the shoot tips emergent (Figure 5). This often required gently folding plants into the hole. We angled plants upslope aligned with wave swash. The holes for saltgrass were shallower and nearly parallel to the surface. We planted saltgrass in small clumps comprised of 3–5 green shoots and their rhizomes. We buried about 2/3 of the above ground shoots with 2–4 inches of mud, leaving 3–5 inches of shoot tips exposed (Figure 5). On sunny days above 80° F we buried saltgrass deeper, leaving only the very tips emergent to protect from desiccation.

We alternated plantings by having one team plant pickleweed and the second fill in gaps with saltgrass. We kept spacing to a two meter interval, measuring with the spade. One tier of high elevation planting spans the length of cells 1–6, where we stopped to due time constraints. We estimated 750 total plantings in the high elevation zone at project completion.

Photo Monitoring

On19 August 2019, K. Freeman selected a sample of cells in the project area for future photo monitoring. There are four photostations, numbered Station 1 through Station 4. Each station is a fixed point, with 3–4 corresponding pictures, labeled with the station number followed by the photo number (i.e 1.1 is the first photo in station one). The first photolog is attached as an appendix to this memo. It is meant to provide a representative snapshot of the transplants at a given point in time.

Appendix F-1

Figure 1 Google Earth image of project area with functional planting units—cells—labeled 1 through 12.

Figure 2 This Google Earth image highlights project key features with yellow pins. Source 1 and Source 2 on the western edge of the project area (Sonoma Baylands Marsh) are cordgrass harvest locations. Stations 1–4 indicate photo monitoring points. Saltgrass pins show saltgrass harvest locations. Orange, teal and green lines along the shore of the north levee represent the extent of three transplant zones: high elevation, cordgrass tier 2, and cordgrass tier 1, respectively.

Appendix F-1

Figure 3 shows the cordgrass harvest source location in the Sonoma Baylands Marsh. The field technician in the center of the photograph is harvesting cordgrass from Source 1 (N 38.12441° W 122.47339°).

Figure 4 —This photograph shows an example of one cordgrass transplant, or plug. There are 2–3 vegetative stalks with rhizomes attached, which are covered in dark, silty marsh mud.

Appendix F-1

Figure 5 shows examples of each focal species once transplanted. A) cordgrass planted at 45° angle, with new daughter tillers emerging around base; B) pickleweed transplant with rock baffle around base of plant for added wave protection; C) saltgrass planted almost horizontally with 3 inches of vegetative tips exposed.

Photo Monitoring Sheet

Appendix F-1

Property: Sears Point Levee **Date:** August 19, 2019

Station/Photo #:

1 . 1

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:

40 °

Time: 11:20

Description:
Standing in first cell on west end of levee, looking northeast. View shows two tiers of cordgrass transplants with new tillers on most plants.

Station/Photo #:

1 . 2

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:

200 °

Time: 11:22

Description:
Standing in first cell looking SW. Two tiers of cordgrass plantings are shown in sheer/soft mudflat. Note local colony of *Spartina* flowering in right side of photo.

Photo Sheet

Appendix F-1

Property Name: Sears Point Levee **Date:** August 19, 2019

Station/Photo #:

1 . 3

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:

350 °

Time: 11:22

Description:
Standing aligned with lower tier of cordgrass transplants in first cell, looking north at levee. Higher elevation transplants are in background.

Station/Photo #:

2 . 1

Coordinates:
N 38.12881°
W 122.46850°

Compass Bearing:

30 °

Time: 11:38

Description:

Standing in Cell 2, looking east. Two tiers of cordgrass transplants showing new growth.

Photo Sheet

Appendix F-1

Property: Sears Point Levee **Date:** August 19, 2019

Station/Photo #:

2 . 2

Coordinates:
N 38.12881 °
W 122.46850 °

Compass Bearing:
210 °

Time: 11:38

Description:
Standing in bay pan of second cell, looking SW. Two tiers of cordgrass transplants can be seen in left side of photograph. Saltgrass transplants can be seen 2m above on right.

Station/Photo #:

2 . 3

Coordinates:
N 38.12896 °
W 122.46841 °

Compass Bearing:
50 °

Time: 11:41

Description:
Standing in Cell 2, slightly east and higher in elevation than photo 2.2. Photo shows pickleweed & saltgrass plantings in foreground (indicated by bamboo stakes) and cordgrass transplants in background.

Photo Sheet

Appendix F-1

Property: Sears Point Levee **Date:** August 19, 2019

Station/Photo #:

3 . 1

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:

50°

Time: 12:03

Description:
Standing in bay pan of Cell 4 looking NE. Cordgrass transplants in foreground with lots of new daughter shoots. Bigger plants appear healthier than smaller plants.

Station/Photo #:

3 . 2

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:

230°

Time: 12:04

Description:

Standing in Cell 4 looking west. Cordgrass transplants are along shear edge of mudflat on left of photograph.

Photo Sheet

Appendix F-1

Property: Sears Point Levee **Date**: August 19, 2019

Station/Photo #:

3 . 3

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:

330 °

Time: 12:04

Description:
Facing N towards levee scarp in Cell 4, showing upper elevation saltgrass, pickleweed, and bulrush transplants. Many are dormant and brown, but not dead.

Station/Photo #:

4 . 1

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:

50°

Time: 12:20

Description:
Standing in cell 6 looking NE. One row of cordgrass transplants are to right of photograph.

Photo Sheet

Appendix F-1

Property: Sears Point Levee **Date:** August 19, 2019

Station/Photo #:

4 . 2

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:

200 °

Time: 12:21

Description:
Standing in Cell 6 looking west at one tier of cordgrass transplants in rough-surfaced wave scoured mudflat.

Station/Photo #:

4 . 3

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:

90 °

Time: 12:22

Description:
Standing on escarpment of Cell 6 (5 m inland from previous point) looking S at cordgrass plantings.

Sears Point Spartina Planting, Phase 2
Project Summary Report

September 24, 2020

Prepared by:
Kate Freeman
Regional Biologist
Ducks Unlimited (DU)

Prepared for:
Julian Meisler
Baylands Program Manager
Sonoma Land Trust (SLT)

Introduction

This report summarizes the second phase of low marsh revegetation work within the Sears Point Tidal Restoration Project Area (SPRA). The first phase occurred in July and August of 2019 and primarily involved *Spartina foliosa* (cordgrass) plantings in the low-mid marsh elevation zone of the SPRA North shore. *Distichlis spicata* (saltgrass) and *Sarcocornia pacifica* (perennial pickleweed) were also planted, in a subset of the site, at high marsh elevations. High survivorship of cordgrass transplants one- and two-years post-establishment (77% and 42 % mean survival, respectively) incentivized a second year of planting. In phase 2 of the project, the sole focus was on establishing *Spartina* in the lowest (bayward) edge of its viable range.

Objectives

The primary objective of this work is to establish wide swaths of cordgrass marsh fringing the shore to minimize erosion of the Sears Point habitat levees. Mature cordgrass stands are densely spaced and form tall canopies giving them unique capacity to dampen wind-wave energy and prevent shoreline erosion. By planting *Spartina* at the lowest observable elevation we aim to accelerate the development of a continuous 5–6-meter-wide belt along the northern and western shorelines. Stands will also facilitate sediment accretion and tidal marsh evolution within SPRPA.

Methods

Phase 2 of this work took place along the northern and western shores of SPRA, in the northern reaches of San Pablo Bay (Figure 1). Planting commenced on 31 July 2020 and continued 2–3 days per week through 28 August 2020. Timing of planting varied daily with the tides—executing the work around low tide was necessary to effectively bury transplants at low elevations. The time spent planting was consistently 7–8 hours per day, including time for prepping, harvesting, cleaning and transport. Our planting crew spent 280 total hours in the field. Personnel included Kate Freeman (DU), Taj Hittenberg (DU), Eric Riordan (DU), Michael Zehyr (DU), and Steve Pye (volunteer).

Figure 1 Google Earth Image highlighting the source location (green line) and transplant area (red line) for Phase 2 *Spartina* plantings within Sears Point Tidal Wetland Restoration site.

Borrow locations

All *Spartina* propagules came from local internal site translocation, preapproved by the Invasive Spartina Project (ISP). We borrowed plants from the West shore of the Sears Point Dickson Unit. *Spartina* stands are relatively densely spaced in this area, growing in firm intertidal mud below the eroded levee bench. We divided the West shore into four functional units (cells), to track the origin of translocated propagules. The first cell began at the boat launch and cells progressed in a southward direction (figure 3). We harvested first from Cell 1—taking caution to space borrow locations several meters apart— and then worked our way through cells 2, 3, and 4. Within each stand we were careful to harvest behind the leading/bayward edge. We dug up cordgrass plugs with drain spades, extracting 3–5 vegetative shoot clusters with roots and rhizomes intact, leaving cohesive mud embedded around the roots (Figure 2). We collected plugs in 5-gal buckets and then transferred plants into wetted white nylon debris bags for translocation. Bags were stored in the shade until transplant—typically a 2–4 hour window.

Figure 2 Photos of Spartina foliosa propagules, or sod plugs, used for transplanting. Panel a. shows propagule close-up with cohesive mud surrounding roots and white rhizomes sticking out of the bottom. In Panel b., a crew member holds several plugs by the vegetative shoots, ready to plant.

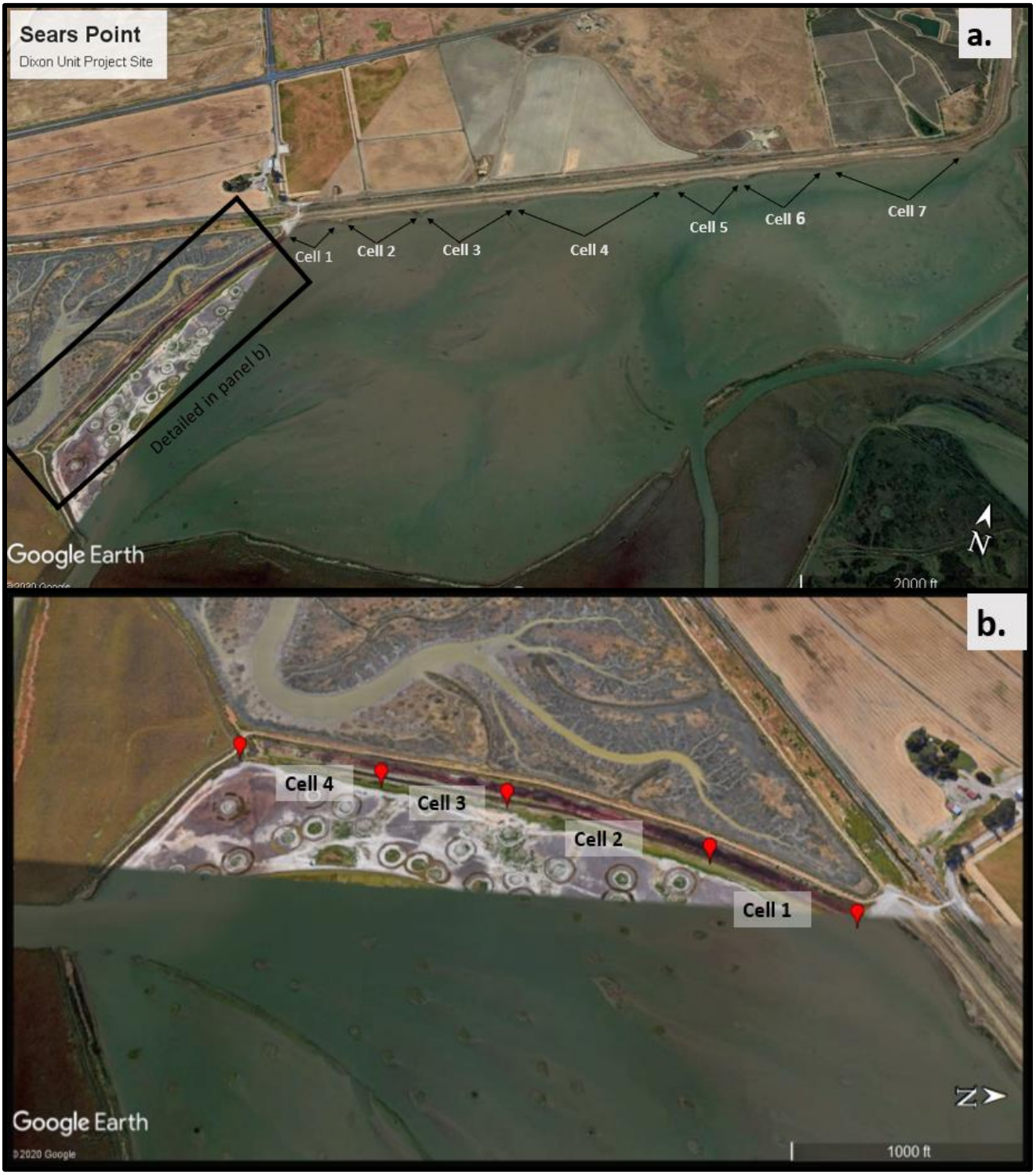

Figure 3 Google Earth imagery gives an overview of the functional planting and harvest units for *S. foliosa* planting within Sears Point Restoration Area. Panel a. shows the North levee labeled with Cells 1 through 7. Below, Panel b. highlights the borrow cells (1 through 4) of the West levee. *Note the difference in orientation and scale between panels a. and b.*

Planting locations

Planting occurred along stretches of the north and west shores within SPRA. The North shore planting paralleled the separator levee (and 2019 *Spartina* plantings), approximately 14,800 ft in length. For the purpose of ongoing restoration work the North shore/separator levee is divided into cells bounded by headlands, numbered 1–7 from east to west (Figure 3). Cells were used as functional units in both Phase 1 and 2 of Spartina planting and will be referred to throughout this report. Note: there was a slight discrepancy between Stuart Siegel's numbering and the Cell numbers we used in 2019. In August 2020 we adjusted Cell numbers to be in alignment with partner projects. This system will be used for any future planting and monitoring.

North shore *Spartina* transplanting occurred in an upper zone from Cell 1 to Cell 7, below (bayward of) the 2019 transplants. To estimate the elevation of the N. shore upper zone we centered on the relative tidal elevation of the lowest observed robust cordgrass edge along the South shore. As the water line was either rising or falling to reach the level of the lowest observed S. shore cordgrass leading edge, we flagged the water line on the North shore of the cell to be planted. (This was achieved with one person standing on the South levee calling the remain crew members on the North levee when the waterline reached the cordgrass edge). We planted along the flagged line, spacing plugs at 2–meter intervals.

Following completion of the upper zone in cells 1 through 7 we planted a second row in a lower zone. Due to time and source material constraints the lower zone was planted in select locations. We planted lower zone *Spartina* rows in cells 1, 3, 4 and 5. These cells were prioritized because they are also the focus of an ongoing living shoreline adaptive management project. The lower zone was approximately 2 meters bayward of the upper zone. Table 2 (pg. 6) summarizes the number of plugs planted in each cell.

The West shore planting bordered the levee scarp from the boat launch to the sediment containment berm, approximately 1600 ft. in length (Figures 1 & 3). Planting along the West shore occurred in two parallel rows and included 295 individual transplants. The upper row was centered on the outer edge of lowermost isolated cordgrass colonies in the smooth depositional mud surface. We planted the lower zone on accreted flats approx. 2m bayward of the upper zone. The lower row plantings stop about 20m short of the boat launch ramp. Note: transplants along the West shore were sourced from cordgrass stands directly behind (landward) planting location. Plugs were not stored in sacs but planted immediately upon digging up, using either the press or toss method (described below).

Lastly, we planted cordgrass on several unvegetated marsh mounds to verify whether sod fragments can establish on mounds or accreted mudflats. We transplanted 3–6 sod plugs on mounds in cells 2, 4 and 5 as well as one accreted mudflat in Cell 5 (Figure 4). Mound planted method is depicted in Figure 5.

Figure 4 Google Earth image shows locations (pink marker) for *S. foliosa* planting on six nearshore mounds.

Transplanting techniques

Upper and lower elevation planting required wading through knee to thigh deep unconsolidated soft mud. Neoprene waders/wetsuits worn with booties facilitated moving in and out of thick mud. Crew members carried 5-gallon buckets with cordgrass plugs out the flagged elevation. If the water level was high enough, plugs could be placed on boogie boards and floated out to desired location. We pressed sod plugs into mud, in a vertical orientation, until the root ball was several inches below the surface. Plugs were spaced at 2-meter intervals. For lower elevation planting in semi-fluid mud we used a toss method to bury plugs into the mud. Standing on consolidated shoreline, we underhand tossed sod transplants with enough force to sink the root balls. Methods varied depending on tide level and mud characteristics.

Experimental nutrient additions

To informally test the hypothesis that SF Bay is not nutrient limited, we created treatment and control cells. In treatment cells, each transplant received 5–10 g of fertilizer, while no fertilizer was applied to control cells. We selected a high-nitrogen turfgrass fertilizer (20-0-0) meant to stimulate vegetative growth. To add nutrients, we pre-dug holes and mixed additives with local mud to ensure roots were never directly exposed to fertilizer. We then dropped sod plugs into holes. Fertilizer was not added when the tide was high enough to cause run-off and was never broadcast or applied to the surface.

Appendix F-2

Table 1 describes North shore planting metrics including number of plugs per cell in 2019 and 2020, nutrient treatment in 2020, and Phase 2 source location.

Cell #	2019 *S. foliosa* transplant count	Plugs alive July 2020	2020 *S. foliosa* Phase 2 transplant count	Number of rows planted	2020 Nutrient addition	West shore source location
1	201	157	134	2	Y	Cell 1
2	227	118	94	1	Y	Cell 1
3	331	128	202	2	N	Cell 1
4	385	61	240	2	N	Cell 2
5	132	63	85	1	N	Cell 2
6	102	43	122	1	Y	Cell 3
7	106	45	106	1	Y	Cell 4
8	346	149	n/a	n/a	n/a	n/a

Figure 5—This photo series illustrates the process of planting *S. foliosa* on nearshore marsh mounds. Near high tide we: **a**. prepared boogie board and bucket of sod plugs; **b.** loaded plugs onto boogie board; **c.** floated boogie board out to marsh mound; **d.** planted plugs in soft mud of bare mounds.

Figure 6— Snapshots of the *S. foliosa* planting process. The left-hand photo shows crew members planting cordgrass plugs in Cell 1 during an outgoing tide. *Spartina* plants in the foreground are from 2019 plantings. Submerged plants in the lower elevation are 2020 plantings. The upper right-hand photo shows crew members and volunteers clad in waders (and masks for COVID/smoke safety). The lower left-hand image shows planting in soft mud during low tide.

Photo and Survivorship Monitoring

On 19 August 2019, K. Freeman selected a sample of cells in the project area for on-going photo monitoring. The photolog is meant to provide a representative snapshot of the transplants at a given point in time. Additional photo monitoring occurred in November 2019, July 2020, and September 2020. In September 2020 monitoring data was collected using Avenza maps with the intention creating of a more consistent and streamlined monitoring system.

Appendix F-3

Spye General Engineering
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● Email: spyegeneralengineering@gmail.com
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Julian Meisler, Baylands Program Manager
Sonoma Land Trust
822 5th Street
Santa Rosa, CA 95405
(707)331-8259

Subject: Project Completion Report RE: Cordgrass and Bulrush Plantings within Sears Point Wetlands

Between September 20 and 24 of 2021, Spye General Engineering's (SGE) crew of 5 completed planting work of Cordgrass (*Spartina foliosa*) and Alkali bulrush (*bolboschoenus maritimus)* along a portion of the habitat levee at Sears Point. Cells 7,6,5,4, and 3 per planted with Spartina and a small area of cell 7 was planted with bullrush.

All material was harvested from the eastern face of the separator levee (Spartina) and at Pump 1's pond (Bulrush). Harvesting methodology consisted of using shovels to uproot clumps of Spartina and bullrush. 4-5 clumps were placed in a 5-gallon bucket, and then transported to the planting location. Approximately 30 buckets were filled at each harvest. Two to three harvests were conducted each working day.

This work was done to aid plant establishment across the levee and provide longer-term erosion reduction along the levee face by aiding in the establishment of lower marsh vegetation that dampens wave action. Dixon Marine Services was simultaneously implementing levee grading and erosion prevention measures for which the plantings were supplemental. At cells 7 and 6, SGE planted two rows of Cordgrass between two Baccharis brush fences that Dixon installed below the high tide line. Each row of Cordgrass was planted approximately 1'-2' landward of each brush fence, with plants spaced approximately 1 meter apart. At cells 5,4, and 3, Cordgrass was planted in a single or double row in any location where previous years' plantings had failed to establish. In many locations, plants were installed without shovels due to deep layers of soft sediment. A small amount of bulrush was planted landward and bayward of 3 logs placed by Dixon at the eastern edge of cell 7. Approximately 10 clumps of rhizome material were buried around each log. This location can be identified by the wooden anchoring that was used on the logs- all other logs are anchored by cables and Duckbill anchors and thus do not have wooden bracing.

Sincerely,

Steve Pye

Owner of Spye General Engineering

To: Julian Meisler, Baylands Program Manager

From: Kate Freeman, Field Biologist

Subject: Sears Point Restoration Area *Spartina* monitoring memo

Date: 8 November 2019

Purpose: Our intention for monitoring the *Spartina foliosa* (cordgrass) transplants in the Sears Point Restoration Area is to understand their rate of survival post-translocation. We planted *Spartina* in the intertidal zone of the north shore levee from late June through late July of 2019. At the time of monitoring, transplants had been established for approximately three months. Understanding survival rate is critical for gauging the effectivity of our methods and will help determine future project goals.

Methods: I conducted the monitoring visit on November 6, 2019 during low tide (approximately 1300 to 1530h). During this time I observed *Spartina* mortality and survival in Cells 1 through 8 on the north shore levee (Figure 1). Monitoring began with Cell 8 and progressed in a westward direction to cell 1. In each cell I sampled 30% of *Spartina* originally planted to estimate differences in survival per cell. Sampling began at randomly selected locations within each cell, and moved in a westward direction from the starting point. From the random start location, I counted each consecutive plant until the count reached 30%. In cells with two tiers of transplants (and a low-elevation row and a mid-elevation row ≈ 2 meters landward) both tiers were counted in the sample. A transplant was counted as alive if it showed new growth (daughter tillers). Plants were counted as dead if there was no evidence of new growth or if the plant had eroded, leaving only a bamboo stake. I estimated survival rate as the total number of plants alive divided by the total sample size (see table).

Cell #	Total # of *Spartina* planted	Sample size (30%)	Alive	Dead	Estimated survival rate (%)
1	201	60	56	4	**93**
2	227	68	53	15	**78**
3	331	99	80	19	**81**
4	211	63	37	26	**58**
5	174	52	34	18	**65**
6	132	40	31	9	**78**
7	208	62	50	12	**80**
8	346	104	84	20	**81**
			Mean survival		**77**

Observations: Survival rate estimates were very high for *Spartina* transplants. The mean survival rate of cells 1–8 was 77%. Overall transplants appear healthy and well established, with 3 or more tillers growing around the original transplant. In some cases there were over 15 new shoots, approximately 1 to 5 inches in height. Notably, transplants with more than one vegetative shoot (a cluster of rhizomes and 2 to 3 vegetative stalks) show more growth and have higher survival rates than smaller transplants. Many of the smaller plugs with only one vegetative shoot were yellow to brown and desiccated with no sign of new growth.

Cell 4 had markedly fewer established *Spartina* than others. This could be due to unintended placement of more single-shoot plugs in this cell; however, other variables such as soil condition, wind erosion, and elevation should not be ruled out. In contrast to Cell 4, transplants in cell 1 seemed especially vigorous, with abundant new growth in both tiers.

Appendix F-4

Figure 1 Google Earth image of project area with functional planting units—cells—labeled 1 through 12.

Photo Monitoring Sheet

Appendix F-4

Property: Sears Point Levee **Date:** November 6, 2019

Station/Photo #:

1 . 1

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:

40 °

Time: 14:23

Description:
Standing in first cell on west end of levee, looking northeast. View shows two tiers of cordgrass transplants with new growth and high survival rates.

Station/Photo #:

1 . 2

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:

200 °

Time: 14:34

Description:
Standing in first cell looking SW. Two tiers of cordgrass plantings are shown in sheer/soft mudflat.

Photo Sheet

Appendix F-4

Property Name: __Sears Point Levee____ **Date:** __November 6, 2019_____

Station/Photo #:

1 . 3

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:

350 °

Time: 14:34

Description:
Standing aligned with lower tier of cordgrass transplants in first cell, looking north at levee. Higher elevation transplants are in background.

Station/Photo #:

2 . 1

Coordinates:
N 38.12881°
W 122.46850°

Compass Bearing:

30 °

Time: 14:16

Description:

Standing in Cell 2, looking east. Two tiers of cordgrass transplants sustaining new growth and relatively high survival in this cell.

Photo Sheet

Appendix F-4

Property: Sears Point Levee **Date:** November 6, 2019

Station/Photo #:

2 . 2

Coordinates:
N 38.12881 °
W 122.46850 °

Compass Bearing:
210 °

Time: 14:21

Description:
Standing in bay pan of second cell, looking SW. Two tiers of cordgrass transplants can be seen with new growth on many plants.

Station/Photo #:

2 . 3

Coordinates:
N 38.12896 °
W 122.46841 °

Compass Bearing:
50 °

Time: 14:23

Description:
Standing in Cell 2, slightly east and higher in elevation than photo 2.2. Photo shows pickleweed & saltgrass plantings mostly washed away and no longer present in foreground.

Photo Sheet

Appendix F-4

Property: Sears Point Levee **Date:** November 6, 2019

Station/Photo #:

3 . 1

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:

50°

Time: 13:49

Description:
Standing in bay pan of Cell 4 looking NE. Cordgrass transplants show relatively low survival here. Plugs (along water's edge) are hard to discern in photograph .

Station/Photo #:

3 . 2

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:

230°

Time: 13:50

Description:

Standing in Cell 4 looking west. Cordgrass transplants are along shear edge of mudflat. Transplants have fewer new tillers in this cell.

Photo Sheet

Appendix F-4

Property: Sears Point Levee **Date**: November 6, 2019

Station/Photo #:

3 . 3

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:

330 °

Time: 13:51

Description:
Facing N towards levee scarp in Cell 4, showing upper elevation saltgrass, pickleweed, and bulrush transplants. Many have eroded or died.

Station/Photo #:

4 . 1

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:

50°

Time: 13:20

Description:
Standing in cell 6 looking NE. One row of cordgrass transplants is apparent at water's edge, while a second is submerged.

Photo Sheet

Appendix F-4

Property: Sears Point Levee **Date:** November 6, 2019

Station/Photo #:

4 . 2

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:

200 °

Time: 13:23

Description:
Standing in Cell 6 looking west at tow tiers of cordgrass transplants in rough-surfaced wave scoured mudflat. Plants with new growth and relatively high survival.

Station/Photo #:

4 . 3

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:
90 °

Time: 13:24

Description:
Standing on escarpment of Cell 6 (5 m inland from previous point) looking S at cordgrass plantings and one surviving pickleweed.

To: Julian Meisler
Baylands Program Manager
Sonoma Land Trust

From: Kate Freeman
Regional Biologist
Ducks Unlimited

Subject: Sears Point Restoration Area *Spartina* survivorship monitoring memo

Date: 3 August 2020

Purpose: This is the second survivorship monitoring report for the *Spartina foliosa* (cordgrass) transplants in the Sears Point Restoration Area. We planted *Spartina* in the intertidal zone of the north shore levee from late June through late July of 2019. Transplants had been established for one year as of the second monitoring event. Our goal is to understand the rate of survival post-translocation to gauge the effectiveness of our planting methods and help determine future project goals.

Methods: I conducted the monitoring visit on July 30th, 2020 during low tide (approximately 1400 to 1600h). During this time, I observed *Spartina* mortality and survival in Cells 1 through 8 on the north shore levee (Figure 2). I also visited the pre-established photostations, and a photo-monitoring log is attached separately with this memo. Monitoring began with Cell 1 and progressed in an eastward direction to Cell 8, where I counted the total number of transplant units alive per cell. I recorded only the original units and did not count small new shoots growing between plugs. In cells with two tiers of transplants (a low-elevation row and a mid-elevation row ≈ 2 meters landward) both tiers were counted. I estimated survival rate as the total number of plants alive divided by the total number of plugs originally planted per cell (see table).

Cell #	Total # of *Spartina* planted	# of plugs Alive July 2020	Estimated survival rate (%)
1	201	157	**78**
2	227	118	**52**
3	331	128	**39**
4	211	31	**15**
5	174	30	**17**
6	132	63	**48**
7	208	88	**42**
8	346	149	**43**
		Mean survival	**42**

Observations: The cordgrass survival rate estimate, one year post-transplanting, is promising. The mean survival rate of cells 1–8 is 42% as of July 2020. While this rate is lower than the 77% survivorship observed in November 2019, transplant units that are alive overall appear robust and well established. Propagule units are notably denser than last summer. Many units have 8 or more ≈2 ft tall vegetative stalks from last season, surrounded by a dozen or more new tillers (2–10 inches in height; Figure 1). The stalks of larger plants have turned a pale-yellow color, while

the newer shoots remain entirely green. Many cordgrass transplants are flowering, concurrent with resident stands.

Figure 1 Propagule unit in Cell 6 with new growth (smaller green tillers). Photo taken July 30, 2020.

The first cell (Cell 1) appears to have the highest Spartina survival and recruitment. Plugs in this cell are established with a higher density and there is notably more lateral rhizomatous spread. As observed in 2019, cells 4 &5 have markedly lower rates of establishment. Most plants in the middle of the cells are dead/washed away, while units surrounding the headlands have higher survival. Wind and wave energy may be higher toward the center of the levee, increasing erosion here. I observed lots of new shoots (small, single-stemmed seedlings) in the same elevation as cordgrass transplants, particularly in cells 3 and 8.

Figure 2 Google Earth image of project area with functional planting units—cells—labeled 1 through 12.

Sears Point Restoration Area

Spartina photo monitoring 2019 –2020

SONOMA LAND TRUST

Station/Photo #:

1 . 1

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:
40 °

Description:
Standing in first cell on west end of levee, looking northeast. View shows two tiers of cordgrass transplants with new growth and high survival rates.

Station/Photo #:

1 . 1

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:
40 °

Description:
Standing in first cell on west end of levee, looking northeast.

Station/Photo #:

1.1

Coordinates:
Lat: 38.12814
Long: -122. 47057

Compass Bearing:
40 °

Description:
Standing in first cell on west end of levee, looking northeast. View shows four tiers of *Spartina* plugs from 2019 and 2020 (outer right).

Station/Photo #:

1 . 2

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:
200 °

Description:
Standing in first cell looking SW. Two tiers of cordgrass plantings are shown in sheer/soft mudflat.

Station/Photo #:

1 . 2

Coordinates:
N 38.12798°
W 122.47076°

Compass Bearing:
200 °

Description:
Standing in first cell looking SW. Two tiers of cordgrass plantings are shown in sheer/soft mudflat. Plugs are denser, with more vegetative shoots than seen in Nov 2019.

Station/Photo #:

1.2

Coordinates:
Lat: 38.12814
Long: -122. 47057

Compass Bearing:
200 °

Description:
Standing in Cell 1 looking SW at four rows of cordgrass plantings. The far right are from 2019. The two lower/bayward rows were planted Aug 2020). *Hazy sky is due to regional wildfire smoke.*

Station/Photo #:

2 . 1

Coordinates:
N 38.12881°
W 122.46850°

Compass Bearing:
30 °

Description:
Standing in Cell 2, looking east. Two tiers of cordgrass transplants sustaining new growth and relatively high survival in this cell.

Station/Photo #:

2 . 1

Coordinates:
N 38.12886°
W 122.46850°

Compass Bearing:
30 °

Description:
Standing in Cell 2, looking east. Two tiers of cordgrass transplants sustaining new growth and relatively high survival in this cell.

Station/Photo #:

2.1

Coordinates:
Lat: 38.12889
Long: -122.46847

Compass Bearing:
30 °

Description:
Standing in Cell 2, looking east at 2019 cordgrass plantings and one row of 2020 plantings below.

Station/Photo #:

2 . 2

Coordinates:
N 38.12881 °
W 122.46850 °

Compass Bearing:
210 °

Description:
Standing in bay pan of second cell, looking SW. Two tiers of cordgrass transplants can be seen with new growth on many plants.

Station/Photo #:

2 . 2

Coordinates:
N 38.12881 °
W 122.46850 °

Compass Bearing:
210 °

Description:
Standing in bay pan of second cell, looking SW. Two tiers of cordgrass transplants with some recruitment between plugs.

Station/Photo #:

2.2

Coordinates:
Lat: 38.12889
Long: -122.46847

Compass Bearing:
210 °

Description:
Standing in bay pan of second cell, looking SW. Single row of 2020 plantings are below sparse row of 2019 transplants. Newly planted mound visible in upper left.

Station/Photo #:

2.3

Coordinates:
N 38.12896 °
W 122.46841 °

Compass Bearing:
50 °

Description:
Standing in Cell 2, slightly east and higher in elevation than photo 2.2. Photo shows pickleweed & saltgrass plantings mostly washed away and no longer present in foreground.

Station/Photo #:

2.3

Coordinates:
N 38.12896 °
W 122.46841 °

Compass Bearing:
50 °

Description:
Standing in Cell 2, slightly east and higher in elevation than photo 2.2. Resident Spartina stand (right foreground) flowering.

Station/Photo #:

2.3 – New Station

Coordinates:
Lat: 38.1287
Long: -122.46903

Compass Bearing:
130 °

Description:
Standing in bay pan of second cell, looking SE at newly planted mound and one row of low elevation cordgrass. Resident *Spartina* are flowering in immediate foreground.

Station/Photo #:

3 . 1

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:
50°

Description:
Standing in bay pan of Cell 4 looking NE. Cordgrass transplants show relatively low survival here. Plugs (along water's edge) are hard to discern in photograph .

Station/Photo #:

3 . 1

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:
35°
Description:
Standing in bay pan of Cell 4 looking NE. Cordgrass transplants show relatively low survival here, especially in the middle of the cell. Plugs (along water's edge) are hard to discern in photograph.

Station/Photo #:

3.1

Coordinates:
Lat: 38.13159
Long: -122.46185

Compass Bearing:
35 °
Description:
Standing in Cell 4, looking northeast. Two bayward/lower rows are new 2020 Spartina plugs. Upper 2019 row is sparse with low survival. 2019 row is above tide line while both 2020 rows are just below tidal elevation.

Station/Photo #:

3 . 2

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:
230°

Description:
Standing in Cell 4 looking west. Cordgrass transplants are along shear edge of mudflat. Transplants have fewer new tillers in this cell.

Station/Photo #:

3 . 2

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:
230°

Description:
Standing in Cell 4 looking west. Spartina survival was low in this cell, although there are many small seedlings coming up in the same elevational range as transplants (visible on the sheer mud).

Station/Photo #:

3.2

Coordinates:
Lat: 38.13159
Long: -122.46185

Compass Bearing:
230°

Description:
Standing in Cell 4 looking west. Two 2020 rows visible in intertidal zone (left side of photo). 2019 Spartina survival was low in this cell—sporadic clusters can be seen along water's edge.

Station/Photo #:

3 . 3

Coordinates:
N 38.13160°
W 122.46183°

Compass Bearing:
330 °

Description:
Facing N towards levee scarp in Cell 4, showing upper elevation saltgrass, pickleweed, and bulrush transplants. Many have eroded or died.

Station/Photo #:
3 . 3
Coordinates:
N 38.13160°
W 122.46183°
Compass Bearing:
330 °

Description:
Facing N towards levee scarp in Cell 4, showing upper elevation saltgrass, pickleweed transplants. Notably, only those protected by rock baffles seem to remain. Many have eroded or died (no bulrush transplant survival here).

Station/Photo #:

3.3

Coordinates:
Lat: 38.13159
Long: -122.46185
Compass Bearing:
330°

Description:
Facing N towards levee scarp in Cell 4, showing 2019 upper elevation saltgrass, pickleweed transplants. Notably, only those protected by rock baffles seem to remain.

Station/Photo #:

4 . 1

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:
50°

Description:
Standing in cell 5 looking NE. One row of cordgrass transplants is apparent at water's edge, while a second is submerged.

Station/Photo #:

4 . 1

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:
50°

Description:
Standing in cell 5 looking NE. Two rows of Spartina transplants appear to be robust, with new growth. There has been ample pickleweed growth in this cell since Nov 2019.

Station/Photo #:

4.1

Coordinates:
Lat: 38.13355
Long: -122.45650

Compass Bearing:
50°

Description:
Standing in Cell 5 looking NE. Lowest elevation cordgrass row is from new 2020 plantings Upper two 2019 rows have high survival and are spreading horizontally.

Station/Photo #:
4 . 2

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:
200 °

Description:
Standing in Cell 5 looking west at tow tiers of cordgrass transplants in rough-surfaced wave scoured mudflat. Plants with new growth and relatively high survival.

Station/Photo #:
4 . 2

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:
200 °

Description:
Standing in Cell 5 looking west at two tiers of cordgrass transplants in rough-surfaced wave scoured mudflat. Plants show new growth and some vertical and lateral spread since Nov 2019.

Station/Photo #:

4.2

Coordinates:
Lat: 38.13355
Long: -122.45650

Compass Bearing:
260°

Description:
Standing in Cell 5 looking west at two tiers of cordgrass transplants in rough-surfaced wave scoured mudflat. A third bayward row (at water's edge) is from 2020 plantings.

Station/Photo #:

4 . 3

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:
90 °

Description:
Standing on escarpment of Cell 65 (5 m inland from previous point) looking S at cordgrass plantings and one surviving pickleweed.

Station/Photo #:

4 . 3

Coordinates:
N 38.13363°
W 122.45651°

Compass Bearing:
90 °

Description:
Standing on escarpment of Cell 5 (5 m inland from previous point) looking S at cordgrass planting. Pickleweed plantings have eroded from this spot

Station/Photo #:

4.3- New bearing at station

Coordinates:
Lat: 38.13355
Long: -122.45650
Compass Bearing:
260°

Description:
Standing in Cell 5 looking bayward at two mounds experimentally planted with cordgrass plugs Aug 2020. Orange arrows point to mounds 3 and 4.

Photo Sheet –New Stations as of 9/14/20

Appendix F-5

Property: Sears Point Levee **Date:** September 14th,2020

Station/Photo #:

4.3

Coordinates:
Lat: 38.13355
Long: -122.45650
Compass Bearing:
260°
Time: 18:12

Description:
Standing in Cell 5 looking bayward at two mounds experimentally planted with cordgrass plugs Aug 2020. Orange arrows point to mounds 3 and 4.

Station/Photo #:

4.4

Coordinates:
Lat: 38.13418
Long: -122.45526 °
Compass Bearing:
90 °
Time: 14:52

Description:
Standing on the far end of Cell 5 looking bayward at Mound 5, planted with cordgrass plugs in 2020. Orange arrow points to mound plantings.

Photo Sheet

Appendix F-5

Property: Sears Point Levee **Date:** September 14th,2020

Station/Photo #:

5.1

Coordinates:
Lat: 38.12653
Long: -122.47184

Time: 18:36

Description:
Standing below west shore levee, looking N (towards boat ramp). New 2020 cordgrass transplants are visible in sheer mud just below resident colonies.

Station/Photo #:

5.2

Coordinates:
Lat: 38.12653
Long: -122.47184

Time: 18:36

Description:
Standing below west shore levee, looking south at lower and upper elevation rows of 2020 cordgrass plugs (in sheer mud to the left of photograph).

Photo Sheet

Appendix F-5

Property: Sears Point Levee **Date:** September 14th,2020

Station/Photo #:

6.1

Coordinates:
Lat: 38.12496
Long: -122.47291

Time: 18:41

Description:
Standing below west shore levee, halfway down 2020 plantings. Photo looking N at two rows of cordgrass planted at lowest elevation of resident stands.

Station/Photo #:

6.2

Coordinates:
Lat: 38.12496
Long: -122.47291

Time: 18:41

Description:
Standing below west shore levee looking S at containment berm. Two new cordgrass rows visible on sheer mudflats bayward of local stands.

Photo Station Locations for Sears Point *Spartina* Monitoring

Appendix F-5

Title	Latitude	Longitude	Northing	Easting
Photo Station 1	38.12814	-122.47057	1808837	6426295
Photo Station 2	38.12889	-122.46847	1809105	6426901
Photo 2.3	38.12870	-122.46903	1809037	6426738
Photo Station 3	38.13159	-122.46185	1810080	6428811
Photo Station 4	38.13355	-122.45650	1810787	6430353
Photo 4.3	38.13418	-122.45526	1811014	6430711
Photo Station 5	38.12653	-122.47184	1808251	6425927
Photo Station 6	38.12496	-122.47291	1807681	6425617