Year 1 (2021) Annual Monitoring Report

Corte Madera Four-Acre Tidal marsh Restoration Project

Corte Madera, Marin County, California

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GOLDEN GATE BRIDGE HIGHWAY & TRANSPORTATION DISTRICT

wra ENVIRONMENTAL CONSULTANTS

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LIST OF ACRONYMS

BCDC	Bay Conservation and Development Commission
Cal-IPC	California Invasive Plant Council
Corps	U.S. Army Corps of Engineers
District	Golden Gate Bridge, Highway & Transportation District
HMMP	Habitat Mitigation and Monitoring Plan
MHHW	Mean Higher High Water
NAVD88	North American Vertical Datum of 1988
RWQCB	Regional Water Quality Control Board
UAV	Unmanned aerial vehicle

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1.0 INTRODUCTION

This report presents the results from the first year of the 5-year annual monitoring period for the Golden Gate Bridge, Highway & Transportation District (District) Corte Madera Four-Acre Tidal Marsh Restoration Project (Project) located in Corte Madera, Marin County, California (Appendix A, Figure 1). Annual monitoring of the Project Area is specified for 5 years in the U.S. Army Corps of Engineers (Corps) Section 404 permit (File Number 1999-24251N), Regional Water Quality Control Board (RWQCB) Water Quality Certification (WDID# 2 CW429899), and Bay Conservation and Development Commission (BCDC) permit (M2019.011.00). Monitoring is conducted to assess whether the Project is meeting performance criteria. Monitoring criteria and performance goals for the restoration area are detailed in the Habitat Mitigation and Monitoring Plan (HMMP) written for the project and approved by the permitting agencies. A copy of the HMMP is included as Appendix B. This monitoring report presents the results of the first (1st) year of monitoring and the progress toward meeting performance goals.

1.1 Background

The Project meets the needs of the District's outstanding restoration obligations. The District's 1988 Corps permit authorized the dredging and disposal of 90,000 cubic yards of dredge sediment associated with maintenance of the Larkspur Ferry Terminal (#17486N). As a condition of the Corps permit covering these activities, the District was required to create a maximum of 2.0 acres of tidal marsh suitable for California Ridgway's rail (*Rallus longirostris obsoletus*, formerly California clapper rail). In 1996, ferry operation was modified to include the acquisition of a high-speed ferryboat for the Larkspur Ferry Terminal operations. Consequently, the District consulted with local environmental groups and permit agencies regarding mitigation and agreed to create an additional 2.0 acres of tidal marsh habitat, resulting in a commitment to restore a total of 4.0 acres of tidal marsh. The Project fulfills this commitment by restoring approximately 4.3 acres of tidal marsh habitat. The restoration efforts temporarily impacted existing 0.18 acre of tidal marsh and relocated 0.28 acre of seasonal wetlands within the Project Area.

1.2 Restoration Goals

The goals of the Project are to restore approximately 4.3 acres of tidal salt marsh and create habitat for Ridgway's rail. This includes restoring native plant species within the tidal marsh area and transition zone and reducing the presence of invasive plant species throughout the Project Area. In addition, the Project will be monitored to ensure that there is no adverse erosion or sedimentation within the restored tidal marsh or adjacent Northern Drainage Channel. The total restored acreages of jurisdictional wetlands are summarized in Table 1.

Summary of restoration goals:

- restore tidal wetlands in a diked marshland that was historically tidal wetlands;
- provide habitat for Ridgway's rail;
- create seasonal wetland habitat to mitigate for the Project's impacts to existing seasonal wetlands;
- restore native plant vegetation within the tidal marsh area, the transition zone; and upland refugia areas of the Project;
- reduce cover and control the spread of invasive plant species within the tidal marsh and transition zone in the Project Area; and

- minimize adverse sedimentation and channel erosion in the tidal channels of the new marsh and the adjacent Northern Drainage Channel.

TABLE 1. PROPOSED AND COMPLETED HABITAT RESTORATION

Wetland Type	Restored Area (acres)
Seasonal Wetlands	0.28
Tidal Habitats (Total)	4.30
Tidal Marsh – Channel	*0.30*
Tidal Marsh – Low Marsh	*0.23*
Tidal Marsh – High Marsh	*3.77*

1.3 Earthwork

1.3.1 Earthwork for the Creation of the Tidal Marsh

The restored tidal marsh was created by excavating historic Bay sediments and lowering the existing grades to create a tidal marsh plain to appropriate elevations for low marsh (3.75-4.75 feet relative to the North American Vertical Datum of 1988 (NAVD88)) and high marsh (4.75-6.5 feet NAVD88) tidal zones. In addition, a system of tidal channels was excavated (2.0-3.75 feet NAVD88) and connected to the adjacent Northern Drainage Channel (a tidal channel) in order to provide full tidal hydrology to the site. The excavated material was reused on-site and configured to create a perimeter berm and a low mound to the south and east of the restored tidal marsh area supporting a public trail. In all, approximately 28,000 cubic yards of material was excavated to create the new tidal marsh and deposited on-site to re-create a berm and low mound adjacent to the restored area.

The internal tidal channels have been sized to provide full tidal hydrology for the new tidal marsh. In addition, the channels have been designed to convey water at velocities within a range that will not cause scouring and preclude the channels from accumulating sediment. The size and configuration of the tidal channels is expected to develop and mature over time into a state of equilibrium.

1.3.2 Earthwork for the Creation of the Seasonal Wetland

Creation of new seasonal wetland habitat necessitated the excavation of approximately 600 cubic yards of soils. This involved creating a shallow depression with a maximum depth of 4 to 6 inches over a 0.28-acre area. The material removed to create the seasonal wetland was reused on-site to create the low mound supporting the public trail discussed in the previous section.

1.4 Revegetation Plan

Revegetation within the tidal marsh plain consisted of plantings sourced from local nurseries. Tidal marsh plain planting was restricted to the highest elevations of the marsh because of the risk that stronger and more frequent tidal action at lower elevations could wash away the plantings. Natural colonization of native tidal marsh species is being relied upon for vegetation in the lower elevations of restored tidal areas, as seeds and vegetative propagules capable of rooting in mudflats are carried on-site via tidal flows. Project design is intended to promote rapid colonization by creating suitable substrates and elevation

profiles for the establishment of salt marsh vegetation. To provide a seed source within the restored tidal area, approximately 10 percent of the high marsh was planted with pickleweed and other high marsh plant species. Seed production from this small area of planting is expected to augment natural seed input via tidal flows from adjacent tidal marshes. The low marsh was not actively planted based on recommendations from the San Francisco Estuary Institute Invasive Spartina Project (ISP). Due to the presence of invasive non-native *Spartina alterniflora* in the vicinity, there is a potential for it to hybridize with the native cordgrass, *Spartina foliosa*.

To support a functioning marsh ecosystem, including habitat for Ridgway's rail, the majority of planting was completed in the marsh transition zone. A well-vegetated transition zone increases cover for Ridgway's rail and other species to hide within during high tides. Prior to planting, a temporary spray irrigation system was installed within the transition zone planting area to provide supplemental water during the first 2 to 3 years following implementation. Irrigation will be applied during the dry season (summer) and during dry winters to supplement any deficiency in rainfall that may occur to ensure successful establishment of the plants. The transition zone was revegetated with a combination of native grass and shrub species in order to provide vegetative cover for Ridgway's rail, which is likely to use these areas for refugia during extreme high tide events. In addition, the transition zone and upland disturbed areas throughout the Project footprint were hydroseeded with a seed mix at densities as indicated in Table 2 in conjunction with an erosion control seed mix void of invasive plant species. The planting palette was chosen based on previous restoration experience in the Bay and the current vegetation inhabiting functioning marshes in the immediate vicinity of the site.

Planting and seeding occurred following the final site grading and during the rainy season. Table 2 summarizes the revegetation plan for the Project based on the project as-built report (WRA 2021).

TABLE 2. PLANTING PALETTE AND SEEDING RATES BY BIOLOGICAL COMMUNITY

	Botanical Name	Common Name	Size	On-center Spacing (feet)	Quantity Total
High Marsh Zone	*Distichlis spicata*	salt grass	TB5	1.0	2,651
	Jaumea carnosa	marsh jaumea	TB5	1.0	1,642
	Frankenia salina	alkali heath	TB5	1.0	541
	Limonium californicum	California sea lavendar	TB5	1.0	821
	Salicornia pacifica	pickleweed	TB5	1.0	11,090
				TOTAL	**16,745**
Transition Zone	*Baccharis glutinosa*	salt marsh baccharis	D16	3.0	189
	Grindelia stricta	coastal gumweed	D16	3.0	189
	Baccharis pilularis	coyote brush	D16	6.0	108
				TOTAL	**486**

TABLE 2 (CONTINUED). PLANTING PALETTE AND SEEDING RATES BY BIOLOGICAL COMMUNITY

	Botanical Name	Common Name	Pure Live Seed (lbs./acre)	Pure Live Seed (Total lbs.)
Seasonal Wetland Seed Mix	*Carex praegracilis*	field sedge	2.00	0.56
	Eleocharis macrostachya	creeping spike rush	1.00	0.28
	Elymus triticoides	creeping wild rye	4.00	1.12
	Hordeum brachyantherum	meadow barley	6.00	1.68
	Juncus bufonius	toad rush	1.00	0.28
	Juncus phaeocephalus	brownhead rush	1.00	0.28
	Oenothera elata	evening primrose	2.00	0.56
		TOTAL	**17.00**	**4.76**
Upland/ Transition Hydroseed Mix	*Baccharis pilularis*	coyote brush	0.15	1.50
	Bromus carinatus	California brome	3.00	30.00
	Danthonia californica	California oatgrass	3.00	30.00
	Elymus glaucus	blue wild rye	6.00	60.00
	Eschscholzia californica	California poppy	4.00	40.00
	Festuca microstachys	three weeks fescue	6.00	60.00
	Hordeum brachyantherum	meadow barley	8.00	80.00
	Sisyrinchium bellum	blue-eyed grass	3.00	30.00
	Stipa pulchra	purple needlegrass	4.00	40.00
	TOTAL		**37.15**	**371.50**

1.4.1 Coordination with the San Francisco Estuary Invasive Spartina Project

The Project consulted with the ISP regarding the planting of *Spartina foliosa* and received a response letter dated November 22, 2019, with the following recommendations:

- There are known occurrences of invasive *Spartina* in the vicinity of the project site;
- The ISP strongly recommends that the project not actively plant *Spartina foliosa* because of the risk of infestation and hybridization of invasive *Spartina*; and
- The ISP expects passive recruitment of native *Spartina foliosa* at this site because there are existing populations of native *Spartina* within adjacent tidal marsh areas.

As a result, the Project did not plant *Spartina foliosa*. No alternatives for planting in the low marsh are available since the native cordgrass *Spartina foliosa* is the only native species that grows at low marsh elevations. The Project will rely on natural recruitment for establishing vegetation in the low marsh. As requested, the ISP will be notified if monitoring detects *Spartina* colonization within the restoration area to allow them to incorporate the site into their monitoring plans.

1.5 Access Control and Species Protection Fencing

An access control fence was installed on either side of the perimeter berm and informal trail located south and east of the restored tidal area to minimize anthropogenic disturbance to the restored tidal marsh, transition zone, and upland refugia areas. The fence isolates an upland refugia area adjacent to the restored marsh that varies in width from 50 to 135 feet and also restricts recreational access to the southern portion of the Project Area as well as areas adjacent to the south and east of the Project Area. The fence consists of galvanized wire mesh mounted on wooden or metal posts.

1.6 As-Built Conditions

Construction was completed in January 2021. As-built conditions were documented following completion of restoration efforts, including a bathymetry and LiDAR survey of the Project Area and the Northern Drainage Channel. A brief letter report outlining the as-built conditions of the restoration area was submitted to the regulatory agencies following the completion of all restoration activities, inclusive of planting (WRA 2021).

2.0 PERFORMANCE AND MAINTENANCE MONITORING

2.1 Success Criteria

Monitoring is performed to demonstrate that the Project accomplishes all of the restoration goals and to help identify the need for maintenance activities. Monitoring covers the following factors:

- Tidal hydrology;
- Erosion and siltation within tidal channels;
- Seasonal wetland hydrology;
- Revegetation of the tidal marsh area, transition zone, and upland refugia areas; and
- Revegetation of the seasonal wetland.

Monitoring that would trigger maintenance activities focuses on the following:

- Identify areas of excess erosion or siltation within tidal channels;
- Identify the need to implement invasive weed control; and
- Identify the need to repair or replace the access control fence.
- Identify the need to replace plantings in the transition zone or high marsh

The monitoring program will last 5 years or until success criteria are achieved. Quantitative monitoring is performed to evaluate performance as specified in Tables 3 and 4. The final report will include a topographic survey of the Project Area and an updated jurisdictional wetland delineation.

Success of the proposed restoration activities will require the successful establishment of wetland vegetation, demonstration of channel stability (i.e., lack of significant erosion and sedimentation indicators), and control of invasive weed species that may invade the newly constructed jurisdictional features. Success criteria will be used to evaluate the development of the restored wetland habitats. The success criteria include:

- 50 percent total cover of native high marsh vegetation by Year 5;
- 80 percent survival of native shrub plantings within the transition zone;
- Control of invasive species;
- Absence of significant erosion affecting upper tidal range or cover over the area within the restored marsh where soil containing elevated levels of nickel was removed and replaced with clean soils;
- Presence of a functioning, self-sustaining wetland system;
- The restored seasonal wetland shall perform similarly to reference wetland conditions within the parcel by Year 5; and
- Permanent photo-documentation points will be established at several locations in order to visually track the progress of the restoration site toward meeting final success criteria described below.

Tables 3 and 4 summarize success criteria for completing annual monitoring in years 1, 2, 3, and 5 for the restored tidal marsh, transition zone, upland refugia, and seasonal wetland habitats. The Regional Water Quality Control Board permit requires that monitoring be completed each year during the 5-year monitoring period. However, no criteria were included for Year 4 in the approved HMMP (Appendix B).

Year 4 monitoring will occur in compliance with the permit, with results compared to the Year 5 monitoring criteria to assess any final actions required to achieve the criteria during Year 5.

TABLE 3. SUCCESS CRITERIA FOR RESTORED TIDAL HABITATS

Habitat Zone	Category	Year 1	Year 2	Year 3	Year 5
Tidal Marsh, Transition Zone, and Upland Refugia	Erosion and/or Sedimentation	Document baseline topography using low altitude, high resolution imagery Qualitative monitoring to observe signs of sedimentation/erosion	Compare digital topographic data with hydrology monitoring data to identify sedimentation/erosion reducing the extent of marsh ponded at Mean Higher High Water (MHHW) or cover over area with elevated nickel	Compare digital topographic data with hydrology monitoring data to identify sedimentation/erosion reducing MHHW or cover over area with elevated nickel	Compare digital topographic data with hydrology monitoring data to identify sedimentation/erosion reducing MHHW or cover over area with elevated nickel. Sedimentation does not contribute to reduction in MHHW by more than 0.3 ft depth and cover over area where elevated nickel was removed is at least 0.5 ft
	Hydrology	Install water-depth data loggers in main tidal channel, secondary tidal channel, and two within the marsh plain	Compare hydrographs; calculate and compare the tidal datum	Compare hydrographs; calculate and compare the tidal datum	MHHW within the tidal marsh is within 0.3 ft of MHHW within the Northern Drainage Channel.
	Vegetation	N/A No active planting of low marsh will be conducted.	Following native cordgrass establishment, low marsh cover will increase 5 percent annually.	Following native cordgrass establishment, low marsh cover will increase 5 percent annually.	Following native cordgrass establishment, low marsh cover will increase 5 percent annually.

TABLE 3. SUCCESS CRITERIA FOR RESTORED TIDAL HABITATS

Habitat Zone	Category	Year 1	Year 2	Year 3	Year 5
	Vegetation	N/A The high marsh will be planted with native species in Year 1.	Native plant cover within the restored high marsh will be ≥ 15 percent.	Native plant cover within the restored high marsh will be ≥ 22.5 percent.	Native plant cover within the restored high marsh will be ≥ 50 percent.
		N/A The transition zone will be planted with native shrubs in year 1.	Native shrub survival within the transition zone will be 90%.	Native shrub survival within the transition zone will be 80%.	Native shrub survival within the transition zone will be 80%.
		Invasive plants ranked by the California Invasive Plant Council (Cal-IPC) as "High" will not exceed 5 percent absolute cover within the tidal marsh, transition zone, and upland refugia, exclusive of annual grasses.			
		Report presence of *Spartina* sp. to facilitate on-site genetic testing and control of invasive and hybrid *Spartina* by the Invasive Spartina Project.			No invasive or hybrid *Spartina* within the tidal restoration area.
	Wetland Delineation	N/A			A protocol-level wetland delineation will be completed to verify boundaries of wetlands and non-wetland waters.

TABLE 4. SUCCESS CRITERIA FOR RESTORED SEASONAL WETLAND HABITAT

Habitat Zone	Category	Year 1	Year 2	Year 3	Year 5
Seasonal Wetland	Hydrology	Soils in the restored seasonal wetland will be inundated or saturated within 12 inches of the soil surface for at least 14 consecutive days.			
	Vegetation*	Absolute native plant cover in the restored seasonal wetland will be ≥ 40 of absolute native plant cover in the reference seasonal wetland.	Absolute native plant cover in the restored seasonal wetland will be ≥ 50 of absolute native plant cover in the reference seasonal wetland.	Absolute native plant cover in the restored seasonal wetland will be ≥ 60 of absolute native plant cover in the reference seasonal wetland.	Absolute native plant cover in the restored seasonal wetland will be ≥ 100 of absolute native plant cover in the reference seasonal wetland.
		Invasive plants ranked by the Cal-IPC as "High" will not exceed 5 percent absolute cover within the seasonal wetland.			
	Wetland Verification	N/A			A protocol-level wetland delineation will be completed to verify boundaries of wetlands and non-wetland waters.

*the success criterion language for native plant cover was changed from the original to allow the metrics to be mathematically possible given the definitions of "relative" and "absolute" cover in the scientific literature, and consistent with the intent of this metric.

2.2 Monitoring Methods

The following section outlines the monitoring methods that will be used to measure the success criteria for the Project, including an as-built topography survey of the Project. Vegetation monitoring efforts will be conducted in spring during the appropriate plant growth season to assess vegetation across the restored wetlands.

2.2.1 Photographic Documentation

Ten permanent monitoring locations were established where photographs will be taken to document the development of restored habitats and to illustrate that normal sediment transport processes are occurring within the Project Area over time. Photographs will be taken with a handheld camera from ground level or from a camera mounted on an unmanned aerial vehicle (UAV). These photographs will capture the development (revegetation success) and status of the following:

- Tidal marsh area, including potential signs of erosion and/or sedimentation within tidal channels;
- Transition zone;
- Upland refugia;
- Seasonal wetland; and
- Access control fence.

Photographic documentation for the first year of monitoring was recorded on December 21, 2021.

2.2.2 Erosion and Sedimentation

The potential adverse effects of erosion and sedimentation is monitored using digital topographic data developed from aerial photographs. Following construction and in years 2, 3, and 5, low altitude, high-resolution, color imagery will be acquired using a UAV for use in assessing both erosion and vegetative cover. Imagery will be acquired at low tide in order to expose the entire restoration area. Photogrammetry software will be used to generate high-resolution topography (digital terrain model) from the color imagery. Topographic data will be compared to post-construction baseline data to determine changes in marsh surface and tidal channel geometry and evaluate performance criteria. Should any significant adverse erosion or sedimentation be observed, the District will notify the regulatory permitting agencies to determine appropriate corrective actions. Baseline as-built topography was recorded via UAV photography on December 15, 2020.

2.2.3 Tidal Hydrology

Tidal hydrology will be considered successful by demonstrating that the new tidal marsh area is exposed to full tidal hydrology. Tidal hydrology is verified through use of pressure / water-level data loggers to measure and confirm full tidal inundation as well as biannual photographic evidence that the site is fully inundated at high tide events. Pressure transducers equipped with data loggers are installed each year in the Northern Drainage Channel and the restored tidal marsh within slotted PVC housings. Elevations of the housings were surveyed relative to the NAVD88; coordinates were surveyed using the California State Plane. On August 23, 2021, four pressure transducers equipped with data loggers were installed. Three were installed within the restored marsh: one in the lower tidal channel at the northern boundary of the restoration area, adjacent to the Northern Drainage Channel (1.8 feet NAVD88); one in an upper channel in the southern portion of the marsh (3.2 feet NAVD88); and one in high marsh near the southwestern

edge of the marsh, outside of a channel (6.5 feet NAVD88). A fourth was installed at the pump station at the western edge of the Northern Drainage Channel to provide reference data. The gauges were comprised of data loggers, a slotted PVC pipe, and T-posts. The locations were topographically surveyed using a Trimble RTK device and were tied in with an existing control point, which is located near the pump station at the western end of the Northern Drainage Channel at an elevation of 11.43 feet NAVD88. The loggers were left to collect data from August 23 to November 19, 2021, in order to capture a large range of tidal conditions. Tidal hydrology monitoring locations are depicted in Appendix A, Figure 2.

Photographs of the site fully inundated at high tide were taken on November 6 and December 3, 2021, and are included in Appendix C.

2.2.4 Vegetation Coverage in the Tidal Marsh

The development of vegetation coverage within the tidal marsh is monitored to demonstrate that the rate of revegetation is on-track based on the success requirements for the Project. This will include the low marsh and high marsh areas of the Project Area. The absolute cover of vegetation within the tidal marsh will be measured using one of the following or an equivalent method:

- Manual monitoring of vegetated areas using the transect-quadrat method; or
- Acquire high-resolution aerial imagery collected with a UAV, estimate percent coverage manually or using eCognition software, and verify desktop analysis on the ground.

The first year of monitoring only requires that tidal marsh vegetation has been installed, and no specific monitoring criteria are required. Therefore, no discrete vegetation data was collected in Year 1. However, the relative success of the site was evaluated qualitatively and shown in photographic monitoring points described in Section 2.2.1 and summarized in the results section below. Tidal marsh vegetation monitoring in years 2-5 will be evaluated by one of the two methods below.

Transect-Quadrat Vegetation Monitoring

To evaluate vegetation performance standards, wetland types are monitored using transects. Each transect serves as the sample unit, and the quadrats are averaged to obtain transect cover. Twelve transects will be spaced approximately every 50 feet to capture the restored 4.3-acre tidal marsh and will be laid out perpendicular to and across the primary channel to capture the full extent of the tidal marsh zones (Appendix A, Figure 2). At each transect, a random number will be chosen from 0 through 9 using a random number generator to select the first sampling location in meters. At each sampling location, an approximately 3-foot by 3-foot (1-meter by 1-meter) quadrat will be used to assess plant cover and species richness. Subsequent quadrats will then be placed approximately every 15 feet (5 meters) so that one quadrat is sampled approximately every 30 feet (10 meters) of transect length. Quadrat locations along each transect will be noted on field data forms. Approximately 6–foot-(2-meter)-wide belt transects will be used along the north side of each transect to record species richness by capturing additional species not detected in the quadrats.

Vegetation data will be stratified based on low- and high-marsh zones and will be used to quantify the average percent cover within both tidal marsh zones as well as capture percent invasion by plants ranked by California Invasive Plant Council (Cal-IPC) as “High” (Cal-IPC 2021).

If cordgrass is observed in the restored marsh, the ISP will be consulted to verify that cordgrass growing within the Project Area is native Pacific cordgrass and not one of the four invasive *Spartina* species or

hybrids found in San Francisco Bay. Their biologist will be given permission to access the site and verify that the Project site has only the native species.

Aerial Imagery Analysis

An alternative method to analyzing vegetation performance can be achieved with the remote-sensing analysis called "eCognition" or similar vegetation signature recognition tools available in ArcGIS. This software allows users to classify different signature outputs of satellite images and aerial photographs. Using a high-resolution aerial image collected during low tide, the software can determine the aerial cover of vegetation.

Using aerial imagery, vegetation signature recognition software can interpret signatures of the vegetation, and the software can automatically define the boundaries of every color signature on the color aerial photograph, a process also known as a multi-resolution segmentation analysis. This analysis generates polygons that require classification in the aerial imagery by a trained geospatial analyst familiar with the software and tidal ecology. A biologist would complete a site visit using a georeferenced map of the aerial imagery analysis results to confirm that the classification analysis accurately captures the vegetation composition and aerial cover observed. During this site visit, the biologist will also quantify any observed invasive species within the tidal marsh and complete monitoring for other required success criteria.

2.2.5 Vegetation Coverage in the Transition Zone

The development of the vegetation coverage within the transition zone will be measured to demonstrate that this area has sufficient shrub coverage to support Ridgway's rail refugia. The monitoring will measure absolute coverage of shrubs in the transition zone. Absolute coverage of shrubs will be used in later years when the size of the shrubs starts to become substantial. The coverage of shrubs will be measured using one of the following methods:

- Vegetation count of live shrubs species within the transition zone; and/or
- Acquire high-resolution aerial imagery collected with a UAV, estimate percent coverage manually or using aerial imagery analysis software, and verify desktop analysis on-the-ground.

Vegetation Counts

Utilizing the planting palette developed for the transition zone, qualified biologists will walk the transition zone and monitor all live shrub species within this zone to determine the planting success.

Aerial Imagery Analysis

A similar aerial imagery analysis will be completed as that described above for the tidal marsh.

On December 21, 2021, shrub survival was determined by walking the transition zone and counting all live plantings. Natural recruitment of native shrub species was included in the totals.

2.2.6 Seasonal Wetland Hydrology

The hydrology of the seasonal wetland will be measured by collecting data that demonstrates that the soils within the seasonal wetland are saturated or inundated for the required minimum duration of 14 consecutive days during the rainy season. Data will be collected using one of the following or an equivalent method:

- Installation and data collection from a shallow groundwater well;
- Installation and inspection of a staff gauge; or
- Field verification of inundation.

In Year 1, inundation and saturation were observed in UAV aerial imagery (December 15, 2020) and on the ground (February 12, 2021). Images of inundation and saturation during Year 1 are included in Appendix C.

2.2.7 Vegetation Coverage in the Seasonal Wetlands

The development of vegetation coverage within the restored seasonal wetland and a reference seasonal wetland is monitored to demonstrate that the rate of revegetation is on-track based on the performance requirements for the Project as outlined in Table 5. The established reference wetland is a local depressional wetland within an undisturbed area of the property of similar size to the restored seasonal wetland (Appendix A, Figure 2). The absolute cover of vegetation within the restored seasonal wetland and reference seasonal wetland will be measured using the transect-quadrat method or an equivalent method:

Transect-Quadrat Vegetation Monitoring

Seasonal wetland vegetation is monitored using transect-quadrat methods for both the restored seasonal wetland and reference seasonal wetland habitats (Appendix A, Figure 2). Transects are located in the restored and reference seasonal wetlands that are spaced 50 feet apart across the longest portion of the wetland, and one transect will extend perpendicular through the narrowest portion of the wetland. Given the relatively smaller size of the seasonal wetlands, the perpendicular transect has been included to ensure that transects adequately capture the variation of depth within each depressional feature. The application of quadrats will follow the same random number assignment and spacing as described above. Species composition and percent cover will be collected through this methodology. In Year 1, vegetation monitoring occurred on June 22, 2021.

2.2.8 Access Control Fence

The access control fence will be inspected during annual monitoring site visits to confirm that it remains in working condition. The fence will be repaired or replaced as-needed. The tidal marsh areas, transition zone, and upland refugia area will be inspected for evidence of significant anthropogenic disturbances.

2.3 Remedial Actions

If annual or final success criteria are not met, the District will prepare an analysis of the potential cause(s) of failure and, if determined necessary by the permitting agencies, propose remedial action for approval. Subsequent annual and final monitoring reports may be required to confirm that remedial actions were successful. The District will be responsible for reasonably funding the remedial actions necessary for successful completion of the mitigation efforts. Remedial actions may include additional planting of native wetland species, invasive species abatement activities, or modification of Project features to ensure proper hydrological functioning.

2.4 Reporting

The Year 1 annual monitoring report will be submitted by January 31 after the first full growing season and associated performance monitoring activities have been completed. Subsequent annual monitoring reports will cover the monitoring year beginning at the start of the rainy season (approximately October 1st) and will cover 12 calendar months forward from that point, with submittal occurring by January 31 of the following year.

3.0 MONITORING RESULTS

This section presents the results of Year 1 monitoring activities. The locations of vegetation monitoring transects and photo-monitoring locations are depicted in Appendix A, Figure 2. Photo-monitoring and high tide photographs are included in Appendix C. Tidal hydrology monitoring data collected is presented in Appendix D. Vegetation monitoring data is included in Appendix E. Table 5 below summarizes the Year 1 progress toward meeting each success criterion. A narrative summary of the progress toward meeting each success criterion is provided in the following sections.

TABLE 5. SUMMARY OF SUCCESS CRITERIA AND YEAR 1 MONITORING RESULTS

Performance Standard	Year 1 Success Criterion	Year 1 Result	Success Criterion Met?
Tidal Marsh, Transition Zone, and Upland Refugia			
Erosion and/or Sedimentation	Document baseline topography using UAV imagery. Qualitatively monitor to observe signs of erosion/sedimentation	Baseline topography documented using UAV. No evidence of erosion/sedimentation	Yes
Hydrology	Install water-depth data loggers in the main channel, secondary tidal channel, and two within the marsh plain	Data loggers were installed and data was collected	Yes
Vegetation	Cal-IPC High plants will not exceed 5 percent	Cal-IPC High plants were less than 5 percent	Yes
	Report presence of *Spartina* sp. to ISP	*Spartina* sp. reported to ISP	Yes
Seasonal Wetland			
Hydrology	Soils in restored wetland inundated or saturated ≥ 14 days	Soils inundated and/or saturated for > 14 days	Yes
Vegetation	Absolute native plant cover in the restored seasonal wetland will be ≥ 40 of absolute native plant cover in the reference seasonal wetland.	Absolute native cover in restored wetland 1,000% of the absolute native cover in the reference wetland	Yes
	Cal-IPC High plants will not exceed 5 percent	Cal-IPC High plants were less than 5 percent	Yes

3.1 Tidal Marsh, Transition Zone, and Upland Refugia

3.1.1 Photographic Monitoring

Photographic monitoring recorded on December 21, 2021, is provided in Appendix C. These photopoints will serve as a baseline for monitoring in future years and document conditions during the first year of monitoring.

3.1.2 Erosion and/or Sedimentation

Baseline topography was documented using UAV imagery of the site taken on December 15, 2020. The topography is depicted in Appendix A, Figure 3. No signs of erosion or sedimentation were observed during weekly maintenance visits completed between May and October 2021, nor during the vegetation and hydrology monitoring visits. Therefore, the Year 1 success criterion was met.

3.1.3 Hydrology

Tidal hydrology monitoring locations are depicted in Appendix A, Figure 2. The reference tidal gauge that was installed at the pump station at the western end of the Northern Drainage Channel went missing and was not recovered. However, the other three gauges remained in place. The data collected in Year 1 is presented in Appendix D. As anticipated, the greatest tidal fluctuation was recorded in the lower channel at the northern edge of the restored tidal area, which is closest to the San Francisco Bay and has the lowest base elevation (1.8 feet NAVD88). The least tidal fluctuation was recorded in the high marsh close to the southwest edge of the restored tidal area, which is located farthest from the San Francisco Bay and has the highest base elevation. This gauge, located at 6.5 feet NAVD88 in elevation, was only inundated at the highest tides.

Although the reference gauge in the Northern Drainage Channel went missing, the gauge in the lower channel of the restoration area is located approximately 15 horizontal feet south of the Northern Drainage Channel and still provides enough data to determine whether the restoration area is receiving full tidal influence. The highest tides in the upper and lower channels are approximately the same throughout the year. The timing of tidal inundation at the high marsh monitoring location, which is only inundated during the highest tides, coincides with some of the highest inundation levels in the upper and lower channels. The fact that tidal peaks are similar at the monitoring locations indicates that tidal inundation is functioning as designed within the restoration area.

The same tidal gauge locations used in the restoration area in Year 1 will be used in years 2-5. A different reference location, one that is not as vulnerable to vandalism and theft, will be used for future monitoring years.

The as-built elevation for full tidal inundation of the restored tidal area is 6.5 feet NAVD88. Photographs were taken on November 6 and December 3, 2021 (Appendix C), that depict the restored tidal area fully inundated at high tide. The gauge in the southwest portion of the site recorded an elevation of approximately 7.0 feet NAVD88 both dates, which corroborates the photographs. The photographs and corroborating logger data demonstrate that the restored tidal area is hydrologically functioning as designed. Because tidal data loggers were installed, the Year 1 success criterion was met.

3.1.4 Vegetation

<u>Marsh Vegetation Cover</u>

Year 1 monitoring of marsh vegetation cover consists only of verifying that marsh species were planted. Table 2 above provides the quantities of marsh species planted during restoration implementation based on the project as-built report. Quantitative analysis of vegetative cover within the marsh is not a required monitoring metric during Year 1.

Vegetation in the high marsh is expanding more rapidly than anticipated. Planted individuals have expanded, and natural recruits have also established beyond planted areas. Pickleweed (*Salicornia pacifica*) recruits were the most abundant, but other species were observed, including alkali heath (*Frankenia salina*), marsh jaumea (*Jaumea carnosa*), and salt grass (*Distichlis spicata*). Photographs showing tidal marsh species recruitment are provided in Appendix C.

Transition Zone Planting

Table 6 below summarizes the survival of transition zone plantings.

Table 6. Summary of Transition Zone Survival

Species	Common Name	Number Planted	Number Observed	Survival
Baccharis glutinosa	salt marsh baccharis	189	194	103%
Baccharis pilularis	coyote brush	108	94	87%
Grindelia stricta	coastal gumweed	189	150	79%
	Total	**486**	**438**	**90%**

Overall, native shrub survival was 90 percent. Although the site is meeting the Year 2 success criterion, it is performing even better than the numerical data would suggest. While some mortality did occur, living plants were generally robust. In particular, salt marsh baccharis was robust and frequently exhibited rhizomatous sprouts. For example, where a one-stemmed individual was planted, it was often the case that several new stems developed from that individual, forming a small colony. Where salt marsh baccharis colonies were larger than the 3-foot on-center spacing arrangement in which they were planted, they were considered more than one individual. As such, salt marsh baccharis survival exceeded 100 percent.

Additionally, natural colonization by salt grass, which was not planted in the transition zone, occurred. Salt grass is expected to continue to expand and increase native cover in the transition zone throughout the 5-year monitoring period.

Finally, while marsh gumplant had the greatest mortality, the mortality may represent an overestimation. Some individuals were observed that appeared mostly dead aboveground but were sprouting from their bases, suggesting that additional individuals that appeared to be dead aboveground may still be alive and will resprout during the growing season. The assessment of shrub survival will be modified to occur closer to the active growing season for this species in 2022 to better enable determination of survivorship.

Invasive Species Cover

Invasive and other non-native plant species were manually controlled throughout the year. As a result of this management effort, the presence of invasive species was less than 1 percent within the restoration area. Therefore, the Year 1 success criterion was met.

Spartina

A small number of individuals of *Spartina* sp. were observed at the boundary between the restoration area and the Northern Drainage Channel. None were observed in flower or fruit. ISP was notified of the presence of these plants on December 2, 2021, with a follow-up on January 20, 2022. The notification is included as Appendix F. WRA will follow-up with ISP in Year 2 to learn whether the plants are native, non-native, or a non-native hybrid.

3.2 Seasonal Wetland

3.2.1 Hydrology

The restored seasonal wetland was directly observed in UAV aerial imagery on December 15, 2020, and on the ground on February 12, 2021. On December 15, it was partially inundated in its eastern portion and saturated throughout the remainder. On February 12, it was inundated at lower elevations and saturated elsewhere. During the period of time between December 11 and December 15, 2020, a total 1.7 inches of precipitation occurred. Between December 15, 2020, and February 12, 2021, a total of 7.2 inches of precipitation occurred during several separate events (Deters 2021). It is reasonable to assume that the wetland could not have dried out completely during a 59-day period of time when 7.2 inches of rain fell. This assumption is supported by the fact that the wetland was directly observed to be inundated and saturated for 15 consecutive days in November and December 2021. Further, on December 3, the last day it was observed, the outermost edge of the wetland was saturated at the surface, and the remainder was inundated, indicating that the wetland will continue to be inundated and saturated for many more days after December 3. Although the November and December 2021 observations were made in the Year 2 monitoring period (which begins on October 1, 2021), it demonstrates that the restored wetland can be inundated and/or saturated for more than 14 days, supporting the assumption that it was so in Year 1. Therefore, the Year 1 success criterion was met.

3.2.2 Vegetation

Relative Native Plant Cover

Both the reference wetland and the restored wetland were dominated by non-native species and had a minimal presence of native species. The reference wetland had low diversity (seven total species present) and was dominated by brass buttons (*Cotula coronopifolia*) and Italian rye grass (*Festuca perennis*). Two native species were present, totaling 0.1 percent absolute cover: coastal tarweed (*Madia sativa*) and sand spurrey (*Spergularia macrotheca*). Absolute cover of all plant species was 82 percent.

The restored wetland had much high diversity (27 total species present) but was dominated by Italian rye grass. Absolute native plant cover was 1 percent, comprised of meadow barley (*Hordeum brachyantherum*), toad rush (*Juncus bufonius*), and coastal tarweed. Absolute cover of all plant species was 51 percent. Bare ground comprised 41 percent of the wetland, and litter was 8 percent absolute cover. While absolute cover of all plant species is expected to increase as the wetland becomes more established, some of the bare ground may be a naturally occurring result of prolonged inundation.

The absolute cover of native species in the restored wetland (1 percent) is 1,000 percent of the absolute cover of native species in the reference wetland (0.1 percent). Therefore, the Year 1 success criterion was met.

Invasive Species Cover

No invasive species were present in the reference wetland, and only a single invasive species, French broom (*Genista monspessulana*), was present in the restored wetland. French broom was present at less than 1 percent cover, and therefore, the Year 1 success criterion was met. While it is unlikely that French broom will persist in wetland conditions, the seasonal wetland will be reviewed for the presence of French broom in the spring, and any individuals present will be removed.

4.0 CONCLUSIONS AND MAINTENANCE RECOMMENDATIONS

The tidal marsh, transition zone, upland refugia, and seasonal wetland are performing well and met all Year 1 success criteria. This success was achieved as a result of regular management and maintenance activities that occurred throughout Year 1. Management and maintenance visits occurred weekly from May through October, with watering occurring for all shrub plantings during each maintenance visit. Although a functioning irrigation system was in place at the site, because of drought restrictions in Marin County, the irrigation system could not be used until August 7, 2021. A hydrant meter use permit was received from the Marin Municipal Water District on July 30, 2021, and the meter was set on August 6, 2021. Hot, dry conditions were present during that time, and to ensure that the transition zone plantings did not die as a result of these conditions, they were hand-watered weekly. Additionally, in response to the below normal precipitation and drought conditions that occurred in the region in 2021, the tidal marsh was irrigated on a weekly basis during the summer and fall months to help ensure that native plantings survive.

Weed management occurred in areas as needed from May through October. Invasive species were kept under control, and this is likely a key factor in the robust growth of shrub plantings and the natural colonization by native species observed during monitoring visits. Weed management activities reduce competition of non-native weeds with native plantings, allowing native plants to colonize and flourish.

Given the success of the site in Year 1, it is recommended that regular site management activities continue to help ensure that restoration goals continue to be met.

5.0 REFERENCES

Cal-IPC 2021 — California Invasive Plant Council. 2021. California Invasive Plant Inventory Database. California Invasive Plant Council, Berkeley, CA. Online at: http://www.cal-ipc.org/paf/; most recently accessed: November 2021.

Deters 2021 — Deters, J. 2021. Antecedent Precipitation Tool version 1.0.19. Available online at: https://github.com/jDeters-USACE; most recently accessed: September 2021.

WRA 2021 — WRA, Inc. 2021. Corte Madera Four-Acre Tidal Marsh Restoration Project As-Built Report. Prepared for the San Francisco Bay Conservation and Development Committee, U.S. Army Corps of Engineers, and San Francisco Regional Water Quality Control Board. April 23.

APPENDIX A – FIGURES

Path: L:\Acad 2000 Files\23000\23294\GIS\ArcMap\2018\Redesign\HMMP\Figure 1 Location.mxd

Sources: National Geographic, WRA | Prepared By: njander, 1/20/2022

Figure 1. Vicinity Map - Project Area Location

Corte Madera Four-Acre
Tidal Marsh Restoration Project
Town of Corte Madera, Marin County, California

0 0.5 1 Miles

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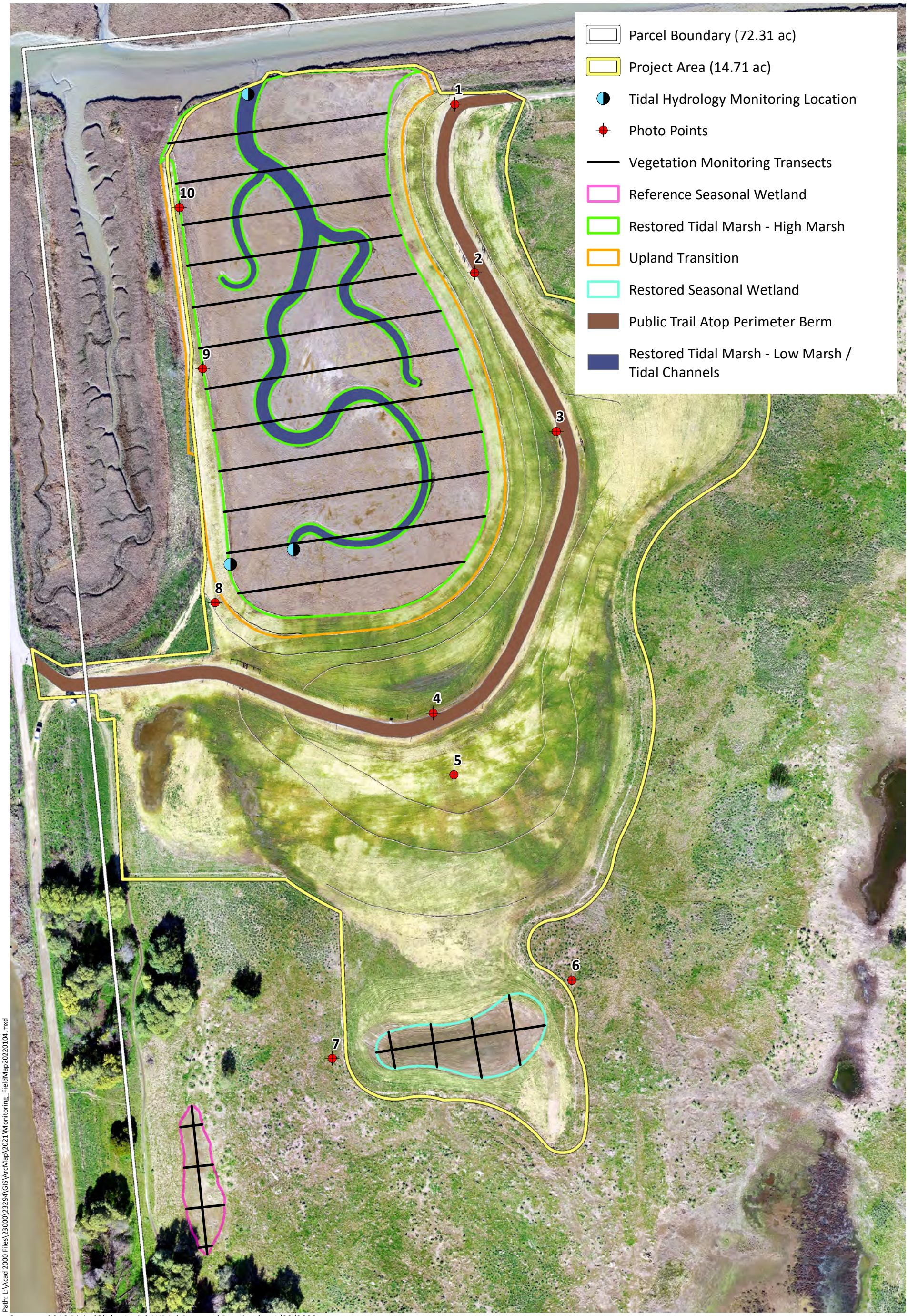

Sources: 2016 DigitalGlobe Aerial, WRA | Prepared By: njander, 1/20/2022

Figure 2. Monitoring Locations

Corte Madera Four-Acre Tidal Marsh Restoration Project
Corte Madera, Marin County, California

0 100 200 Feet

N

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Path: L:\Acad 2000 Files\23000\23294\GIS\ArcMap\2021\Fig_BaselineTopo_Port.mxd

Sources: UAV Aerial 20210204, WRA | Prepared By: njander, 1/4/2022

Figure 3.
Baseline Topography

Corte Madera Four-Acre Tidal Marsh Restoration Project
Corte Madera, Marin County, California

0 200 400 Feet

N

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APPENDIX B – HABITAT MITIGATION AND MONITORING PLAN

Habitat Mitigation and Monitoring Plan - Revised

CORTE MADERA FOUR-ACRE TIDAL MARSH RESTORATION PROJECT
CORTE MADERA, MARIN COUNTY, CALIFORNIA

Prepared For:
Golden Gate Bridge Highway & Transportation District
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Date:
September 12, 2019
Revised June 25, 2020

WRA Project #:
23294

GOLDEN GATE BRIDGE HIGHWAY & TRANSPORTATION DISTRICT

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1.0 INTRODUCTION

The purpose of this Habitat Mitigation and Monitoring Plan (HMMP) is to describe the goals and components of the restoration plan as well as the criteria and methods to monitor performance during the five years following completion of the Golden Gate Bridge, Highway & Transportation District Corte Madera 4-acre Tidal Marsh Restoration Project ("Project"; RWQCB Place ID 857558, BCDC Permit No. M2019.011.00, and US Army Corps of Engineers [USACE] File Number 1999-24251N).

The Golden Gate Bridge Highway & Transportation District (District, Applicant) is proposing to restore approximately 4.3 acres of tidal marsh habitat on its 72-acre property located in the Town of Corte Madera, Marin County, California (see Figure 1, attached). The Project Area includes a 14.7-acre portion of the property in which ground disturbance will occur (see Figure 1).

The proposed Project meets the needs of the District's outstanding restoration obligations to restore 4 acres of tidal marsh habitat suitable for California Ridgway's rail (*Rallus longirostris obsoletus*, Federal Endangered). The proposed Project will fulfill this commitment by restoring approximately 4.3 acres of tidal marsh habitat. The proposed restoration efforts will temporarily impact an existing 0.18 acre of tidal marsh and 0.28 acre of seasonal wetlands. The Project will relocate 0.28 acre of seasonal wetlands within the Project Area. The Project will result in restored tidal connectivity to the Project Area and provide tidal marsh habitat in support of Federal-listed species such as the California Ridgway's rail and salt marsh harvest mouse (*Reithrodontomys raviventris*, Federal Endangered).

2.0 EXISTING CONDITIONS

The proposed Project is located within the limits of the Town of Corte Madera, approximately 0.25 mile east of Highway 101 and 0.6 mile south of Sir Francis Drake Boulevard (see Figure 1). The Project Area is approximately 14.7 acres located in the northwestern portion of a 72-acre parcel owned by the GGBHTD (see Figure 2). The subject parcel is bordered on three sides by tidal salt marsh of the California Department of Fish and Wildlife (CDFW) Corte Madera Marsh Ecological Reserve (CMER): to the north by Heerdt Marsh; to the east by North Muzzi Marsh; and to the south by Muzzi Marsh. Shorebird Marsh is located just west of the northern extent of the Project Area and collects treated stormwater from the Town. In the greater vicinity of the Project Area to the west, land uses include the Redwood Highway and commercial development.

The Project Area occurs on diked former baylands along the margins of San Francisco Bay. Based on a review of historic aerial photographs, it was determined that the tidal salt marsh adjacent to and including the Project Area was diked and reconfigured starting in the 1950s, with man-made berms disrupting tidal influence to the baylands. In the 1970s, an inner set of berms was constructed on and around the perimeter of the subject parcel and tidal activity was returned north, east, and south of the perimeter berm.

The lands outboard of the perimeter berm and the surrounding CMER marshes currently support healthy stands of native tidal salt marsh vegetation. However, the subject parcel remains

disconnected from tidal activity by the perimeter berm. Over time, elevations within this diked portion of the subject parcel have subsided, resulting in the mix of seasonal wetlands and ruderal uplands that exists today. These lands contain a mix of highly disturbed habitat. Most of the plant communities on the Project Area, including seasonal wetland plant communities, are dominated by non-native, invasive plant species and are of relatively low quality for wildlife.

The Project Area contains 0.28 acre of seasonal wetlands and 0.18 acre of tidal marsh (high marsh pickleweed bench) subject to jurisdiction of the USACE as "Waters of the U.S." and to RWQCB as "Waters of the State" (Figure 2). The proposed Project will include impacting the existing seasonal wetlands by excavation of fill previously deposited in the Project Area, grading to the appropriate elevations to establish tidal marsh, and excavating new tidal channels to connect to an existing tidal channel (the northern drainage channel) by breaching the existing northern berm. Temporary impacts of the Project are summarized in Table 1. The Project has been designed to maximize the amount of wetland habitat restoration and enhancement, while minimizing impacts to existing wetland features. Existing tidal marsh impacted by the opening of the new tidal channel are mitigated for by the project design. Seasonal wetlands impacted by the creation of the new tidal channel will be mitigated by creating new seasonal wetlands at an area south of the new tidal marsh (Figure 2).

Table 1. Temporary Projects Impacts to Section 401/401 Wetlands and Non-Wetland Waters

JURISDICTIONAL FEATURES	TEMPORARY IMPACTS (ACRES)
Seasonal Wetlands	0.28
Pickleweed Bench	0.18
TOTAL	0.46

3.0 RESTORATION PLAN

3.1 Restoration Goals

The goals of the Project are to restore approximately 4.3 acres of tidal salt marsh and create habitat for Ridgway's rail. This includes restoring native plant species within the tidal marsh area and transition zone and reducing the presence of invasive plant species throughout the Project Area. In addition, the Project will be monitored to ensure success and that there is no adverse erosion or sedimentation within the restored tidal marsh or adjacent northern drainage channel. The total restored acreages of jurisdictional wetlands are summarized in Table 2.

Summary of restoration goals:

- restore tidal wetlands in an area that was historically tidal wetlands;
- provide habitat for Ridgway's rail;
- create seasonal wetland habitat to mitigate for the project's impacts to existing seasonal wetlands;
- restore native plant vegetation within the tidal marsh area, the transition zone; and upland refugia areas of the Project;
- reduce cover and control the spread of invasive plant species within the tidal marsh and transition zone in the Project Area; and

- minimize adverse sedimentation and channel erosion in the tidal channels of the new marsh and the adjacent northern drainage channel.

Table 2. Proposed Section 404/401 Habitat Restoration

JURISDICTIONAL FEATURES	RESTORED AREA (ACRES)
Seasonal Wetlands	0.28
Tidal Habitats (Total)	4.30
Tidal Marsh – Channel	*0.30*
Tidal Marsh – Low Marsh	*0.23*
Tidal Marsh – High Marsh	*3.77*

3.2 Earthwork

3.2.1 Earthwork for the Creation of the Tidal Marsh

The restored tidal marsh will be created by excavating historic Bay sediments and lowering the existing grades to create a tidal marsh plain to appropriate elevations for low marsh (3.75-4.75 feet NAVD88) and high marsh (4.75-6.5 feet NAVD88) tidal zones. In addition, a system of tidal channels will be excavated (2.0-3.75 feet NAVD88) and connected to the northern drainage channel in order to provide full tidal hydrology to the site. The excavated material will be reused on-site and configured to create a perimeter berm and a low mound to the south and east of the restored tidal marsh area. There will be a 10:1 slope from the tidal marsh area to the surrounding upland areas. In all, approximately 28,000 cubic yards of material would be excavated to create the new tidal marsh and deposited on-site to re-create a berm and low mound adjacent to the restored area.

The internal tidal channels have been sized to provide full tidal hydrology for the new tidal marsh. In addition, the channels have been designed to convey water at velocities within a range that will not cause scouring and preclude the channels from accumulating sediment. The size and configuration of the tidal channels is expected to develop and mature over time into a state of equilibrium.

3.2.2 Earthwork for the Creation of the Seasonal Wetland

Creation of new seasonal wetland habitat would necessitate the excavation of approximately 600 cubic yards of soils. This will involve creating a shallow depression with a maximum depth of 4 to 6 inches. The material removed to create the seasonal wetland will be reused on-site to create the low mound discussed in the previous section.

3.3 Revegetation Plan

Revegetation within the tidal marsh plain will consist of plugs or plantings sourced from local nurseries. In addition, as part of the restoration design, native tidal marsh species are expected to naturally colonize in the restored tidal areas, as seeds and vegetative propagules capable of

rooting in mudflats are carried on-site via tidal flows. Project design is intended to promote rapid colonization by creating suitable substrates and elevation profiles for the establishment of salt marsh vegetation.

Revegetation of the site will focus on establishing native plant species throughout the tidal marsh and transition zone. The Project will rely on a combination of active planting and natural recruitment to establish tidal marsh vegetation. The low marsh will not be actively planted based on recommendations from the Invasive Spartina Project (ISP). Due to the presence of invasive non-native *Spartina alterniflora* in the vicinity, there is a potential for it to hybridize with the native cordgrass, *Spartina foliosa*. To provide a seed source within the restored tidal area, 10% of the high marsh will be planted with pickleweed and other high marsh plant species. Seed production from this small area of planting is expected to augment seed input from adjacent tidal marsh.

Prior to planting, a temporary spray irrigation system will be installed within the transition zone planting area to provide supplemental water during the first two to three years following implementation. Irrigation will be applied during the dry season (summer) and during dry winters to supplement any deficiency in rainfall that may occur to ensure successful establishment of the plants. The transition zone will be revegetated with a combination of native grass and shrub species in order to provide vegetative cover for Ridgway's rail, which are likely to use these areas for refugia during extreme high tide events. In addition, the transition zone and upland disturbed areas throughout the Project footprint will be hydroseeded with a seed mix at appropriate densities as indicated in Table 3 in conjunction with erosion control seed mix void of invasive plant species. The planting palette was chosen based on previous restoration experience in the Bay and the current vegetation inhabiting the adjacent, functioning marsh.

Planting and seeding will occur following the final site grading and during the rainy season. Table 3 summarizes the revegetation plan for the Project.

Table 3. Planting Palette and Seeding Rates by Biological Community

	BOTANICAL NAME	COMMON NAME	SIZE	SPACING (O.C.# FEET)	% COVER	QUANTITY TOTAL
High Marsh Zone	*Distichlis spicata*	salt grass	4" or equivalent	1.0	1.5%	2,462
	Jaumea carnosa	marsh jaumea	4" or equivalent	1.0	1.5%	2,462
	Limonium californicum	western marsh rosemary	4" or equivalent	1.0	0.5%	821
	Salicornia pacifica	California pickleweed	TB2° or equivalent	1.0	6.5%	10,668
				TOTAL	**10%**	**16,413**
Transition Zone	*Baccharis glutinosa*	salt marsh baccharis	D16† or equivalent	3.0	6.66%	189
	Grindelia stricta	coastal gumweed	D16† or equivalent	3.0	6.66%	189
	Baccharis pilularis	coyote brush	D16† or equivalent	6.0	6.66%	108
				TOTAL	**20%**	**486**

° Treeband 2 (TB2) pots are 2.38 in. square by 5 in. deep for a total volume of 24 in^3

† Deepot 16 (D16) pots are 2 in. in diameter by 7 in. deep for a total volume of 16 in^3

On-center spacing (O.C.)

Table 3. Planting Palette and Seeding Rates by Biological Community (continued)

	BOTANICAL NAME	COMMON NAME	PURE LIVE SEED (LBS./ACRE)	PURE LIVE SEED (TOTAL LBS.)
Seasonal Wetland Seed Mix	*Carex praegracilis*	field sedge	2.00	0.56
	Eleocharis macrostachya	creeping spike rush	1.00	0.28
	Elymus triticoides	creeping wild rye	4.00	1.12
	Hordeum brachyantherum	meadow barley	6.00	1.68
	Juncus bufonius	toad rush	1.00	0.28
	Juncus phaeocephalus	brownhead rush	1.00	0.28
	Oenothera elata	evening primrose	2.00	0.56
		TOTAL	**17.00**	**4.76**
Upland/ Transition Seed Mix	*Baccharis pilularis*	coyote brush	3.00	30.00
	Bromus carinatus	California brome	3.00	30.00
	Castilleja exserta	Purple owl's clover	3.00	30.00
	Danthonia californica	California oatgrass	3.00	30.00
	Elymus glaucus	blue wild rye	6.00	60.00
	Eschscholzia californica	California poppy	4.00	40.00
	Festuca microstachys	three weeks fescue	6.00	60.00
	Hordeum brachyantherum	meadow barley	8.00	80.00
	Sisyrinchium bellum	blue-eyed grass	3.00	30.00
	Stipa pulchra	purple needlegrass	4.00	40.00
		TOTAL	**43.00**	**430.00**

3.3.1 Coordination with the San Francisco Estuary Invasive Spartina Project

The Project Applicant consulted with the San Francisco Estuary Invasive Spartina Project (ISP) regarding the planting of *Spartina foliosa* and received a letter with the following recommendations:

- There are known occurrences of invasive *Spartina* in the vicinity of the project site;
- The ISP strongly recommends that the project not actively plant *Spartina foliosa* because of the risk of infestation and hybridization of invasive *Spartina*; and
- The ISP expects passive recruitment of native *Spartina foliosa* at this site because there are existing populations of native *Spartina* within adjacent tidal marsh areas.

As a result, the Project will not plant *Spartina foliosa*, and the construction documents have been modified to remove *Spartina foliosa* from the planting palette. No alternatives for planting in the

low marsh are available since the native cordgrass *Spartina foliosa* is the only native species that grows at low marsh elevations. The Project will rely on natural recruitment for establishing vegetation in the low marsh. As requested, the ISP will be notified if monitoring detects *Spartina* colonization within the restoration area to allow them to incorporate the site into their monitoring plans.

3.4 Resilience to Sea Level Rise

The Project design was evaluated for resilience to rising sea levels. Sea level rise projections for this Project were selected from the Ocean Protection Council's State of California Sea Level Rise 2018 Guidance report. The report acknowledges an increase in uncertainty of sea level rise projections after the year 2100 due to a lack of available climate model experiments that extend beyond this date. Therefore, sea level rise estimates were selected from the earliest available years, 2030 to 2100. Specifically, the estimates selected are based on the San Francisco tide gauge for the years 2030, 2060, 2080, and 2100 in order to assess the impact of sea level rise in the Project Area over time. An average of the high and low projection values was used for these selected years. The report provides low, medium-high, and extreme risk aversion scenarios.

Sea level rise predictions were used for the low risk aversion scenario because this scenario is appropriate for the projects with "minimal consequences, flexibility to adapt, or low economic burden as a result of sea-level rise". Using these predictions, the restored tidal marsh plain will remain as pickleweed through 2030, and by 2060, it will mostly convert to low marsh habitat comprised of cordgrass. By 2080, tidal areas adjacent to the tidal channel within the Project Area will begin shifting to mudflat, as will adjacent marshes to the north of the Project Area. By 2100, only the edge of the proposed tidal marsh plain will remain as low marsh habitat, and the remainder of the tidal marsh plain will be mudflat. While the projection shows an eventual conversion of tidal marsh to mudflat, the Project's proposed elevations are appropriate because they correspond with the elevation of the existing tidal marsh in the adjacent CMER. Therefore, conversion of habitat in the Project Area will align with changes in the surrounding marsh.

3.5 Access Control and Species Protection Fencing

A permanent access control fence is proposed to be installed on either side of the berm and informal trail located south and east of the restored area to minimize anthropogenic disturbance to the created tidal marsh, transition zone, and upland refugia areas. The fence will isolate an upland refugia area adjacent to the created marsh that will vary in width from 50 to 135 feet and will also restrict recreational access to the center portions of the parcel, which is currently prohibited per posted no-trespassing signs. The fence will consist of galvanized wire mesh mounted on wooden or metal posts. The maximum height of the fence will be approximately 50 inches. The woven wire mesh will be mounted 8 inches above the ground to allow wildlife to move underneath the fence. Fence posts will be installed at eight foot intervals.

During construction, the Project will use temporary exclusionary fencing to keep small mammals, including the salt marsh harvest mouse, from entering the active construction site. Prior to installing the fence, the vegetation inside the work area will be removed, per details developed, reviewed, and approved by the US Fish and Wildlife Service (USFWS) through the consultation process under Section 7 of the Endangered Species Act.

3.6 Construction Schedule

To minimize disturbance to wildlife in adjacent tidal marshes, all construction activities including planting will be scheduled to avoid the California Ridgway's rail breeding season, which spans February through August. Construction will take approximately five months in total, and is anticipated to occur between September 1, 2020, and January 31, 2021. Construction mobilization and earthwork is expected to comprise the first three months of this period, with marsh planting to follow during the rainy season. Construction will occur during daytime hours, 7:00 AM to 5:00 PM on Monday through Friday, and between 10:00 AM and 5:00 PM on Saturdays and Sundays (if needed), in accordance with the Town's Noise Ordinance.

3.7 As-Built Conditions

As-built conditions will be documented following completion of restoration efforts, including a bathymetry and LiDAR survey of the Project Area and the northern drainage channel. A brief letter report outlining the as-built conditions of the restoration area will be prepared and submitted to the regulatory agencies within three months of the completion of all restoration activities, inclusive of planting.

4.0 PERFORMANCE AND MAINTENANCE MONITORING

4.1 Success Criteria

Monitoring will be performed to demonstrate that the Project accomplishes all of the restoration goals listed in Section 3.1, and will identify the need for maintenance activities. Monitoring will demonstrate performance of the following:

- Tidal hydrology;
- Erosion and siltation within tidal channels;
- Seasonal wetland hydrology;
- Revegetation of the tidal marsh area, transition zone, and upland refugia areas; and
- Revegetation of the seasonal wetland.

Monitoring that would trigger maintenance activities will focus on the following:

- Identify areas of excess erosion or siltation within tidal channels;
- Identify the need to implement invasive weed control; and
- Identify the need to repair or replace the access control fence.

The monitoring program will span for five years, or until success criteria are achieved. Quantitative monitoring will be performed to evaluate performance in years specified in Tables 4 and 5. The final report will include an as-built topo survey of the Project Area and an updated wetland delineation determination.

Table 4. Success Criteria for Restored Tidal Habitats

HABITAT ZONE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 5
Tidal Marsh, Transition Zone, and Upland Refugia	Erosion and/or Sedimentation	Document baseline topography using low altitude, high resolution imagery Qualitative monitoring to observe signs of erosion/ sedimentation	Compare digital topographic data with hydrology monitoring data to identify sedimentation/ erosion reducing MHHW or cover over area with elevated nickel	Compare digital topographic data with hydrology monitoring data to identify sedimentation/ erosion reducing MHHW or cover over area with elevated nickel	Compare digital topographic data with hydrology monitoring data to identify sedimentation/ erosion reducing MHHW or cover over area with elevated nickel Sedimentation does not contribute to reduction in MHHW by more than 0.3 ft Depth of cover over area with elevated nickel is at least 0.5 ft
	Hydrology	Install water-depth data loggers in main tidal channel, secondary tidal channel, and two within the marsh plain	Compare hydrographs; calculate and compare the tidal datum	Compare hydrographs; calculate and compare the tidal datum	MHHW within the tidal marsh is within 0.3 ft of MHHW within the Northern Drainage Channel.
	Vegetation	N/A No active planting of low marsh will be conducted.	Following native cordgrass establishment, low marsh cover will increase 5 percent annually.	Following native cordgrass establishment, low marsh cover will increase 5 percent annually.	Following native cordgrass establishment, low marsh cover will increase 5 percent annually.

Table 4. Success Criteria for Restored Tidal Habitats (continued)

HABITAT ZONE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 5
		N/A The high marsh will be planted with native species in year 1.	Native plant cover within the restored high marsh will be ≥ 15 percent.	Native plant cover within the restored high marsh will be ≥ 22.5 percent.	Native plant cover within the restored high marsh will be ≥ 50 percent.
		N/A The transition zone will be planted with native shrubs in year 1.	Native shrub survival within the transition zone will be 90%.	Native shrub survival within the transition zone will be 80%.	Native shrub survival within the transition zone will be 80%.
		Invasive plants ranked by the California Invasive Plant Council (CaI-IPC) as "High" will not exceed 5 percent absolute cover within the tidal marsh, transition zone, and upland refugia, exclusive of annual grasses.			
		Report presence of *Spartina* sp. to facilitate on-site genetic testing and control of invasive and hybrid *Spartina* by the Invasive Spartina Project (ISP).			No invasive or hybrid *Spartina* within the tidal restoration area.
	Wetland Delineation	N/A			A protocol-level wetland delineation will be completed to verify boundaries of wetlands and non-wetland waters.

Table 5. Success Criteria for Restored Seasonal Wetland Habitat

HABITAT ZONE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 5
Seasonal Wetland	Hydrology	Soils in the restored seasonal wetland will be inundated or saturated within 12 inches of the soil surface for at least 14 consecutive days.			
	Vegetation	Relative native plant cover within the restored seasonal wetland will be ≥ 40 percent relative cover of total plant cover in the reference seasonal wetland.	Relative native plant cover within the restored seasonal wetland will be ≥ 50 percent of total plant cover in the reference seasonal wetland.	Relative native plant cover within the restored seasonal wetland will be ≥ 60 percent of total plant cover in the reference seasonal wetland.	Relative native plant cover within the restored seasonal wetland will include 100 percent of total plant cover in the reference seasonal wetland.
		Invasive plants ranked by the Cal-IPC as “High” will not exceed 5 percent absolute cover within the seasonal wetland.			
	Wetland Verification	N/A			A protocol-level wetland delineation will be completed to verify boundaries of wetlands and non-wetland waters.

Success of the proposed restoration activities will require the successful establishment of wetland vegetation, demonstration of channel stability (i.e. lack of significant erosion and sedimentation indicators), and control of noxious weed species that may invade the newly constructed jurisdictional features. Success criteria will be used to evaluate the development of the restored wetland habitats. The success criteria include:

- 50 percent total cover of native high marsh vegetation by Year 5;
- Control of invasive species;
- Absence of significant erosion affecting upper tidal range or cover over area of elevated nickel;
- Presence of a functioning, self-sustainable wetland system;
- The restored seasonal wetland shall perform similarly to reference wetland conditions within the parcel by Year 5; and
- Permanent photo-documentation points will be established at several locations in order to visually track the progress of the restoration site toward meeting final success criteria described below.

Tables 4 and 5 summarize success criteria for completing annual monitoring in Years 1, 2, 3, and 5 for the restored tidal marsh, transition zone, upland refugia, and seasonal wetland habitats.

4.2 Monitoring Methods

The following section outlines the monitoring methods that will be used to measure the success criteria for the Project including an as-built topography survey of the Project (Section 3.7). Vegetation monitoring efforts will be conducted in the spring during appropriate plant growth season to assess vegetation across the restored wetlands

4.2.1 Photographic Documentation

A minimum of ten permanent monitoring locations will be established where photographs will be taken to document the development of restored habitats and to illustrate that normal sediment transport processes are occurring within the Project Area over time. Photographs will be taken with a hand held camera from ground level or from a camera mounted on an unmanned aerial vehicle (UAV).

These photographs will capture the development (revegetation success) and status of the following:

- Tidal marsh area, including potential signs of erosion and/or sedimentation within tidal channels;
- Transition zone;
- Upland refugia;
- Seasonal wetland; and
- Access control fence.

4.2.2 Erosion and Sedimentation

The potential adverse effects of erosion and sedimentation will be monitored over a period of 5

years using digital topographic data developed from aerial photographs. Following construction and in years 2, 3, and 5 low altitude, high-resolution color imagery will be acquired using an unmanned autonomous vehicle (UAV) for use in assessing both erosion and vegetative cover. Imagery will be acquired at low tide in order to expose the entire restoration area. Photogrammetry software will be used generate a high-resolution topography (digital terrain model) from the color imagery. Topographic data will be compared to post-construction baseline data to determine changes in marsh surface and tidal channel geometry and evaluate performance criteria. Should any significant adverse erosion or sedimentation be observed, the District will notify the regulatory permitting agencies to determine appropriate corrective actions.

4.2.3 Tidal Hydrology

Tidal hydrology will be considered successful by demonstrating that the new tidal marsh area is exposed to full tidal hydrology. Tidal hydrology will be verified through use of pressure / water-level data loggers to measure and confirm full tidal inundation as well as biannual photographic evidence that the site is inundated fully at high tide events. Pressure transducers equipped with data loggers will be installed in the northern drainage channel and in the new tidal marsh channel network, within a slotted PVC housing. Elevations of the housings will be surveyed relative to the North American Vertical Datum of 1988; coordinates will be surveyed using the California State Plane. Data from the devices will be collected and included in the annual monitoring report.

4.2.4 Vegetation Coverage in the Tidal Marsh

The development of vegetation coverage within the tidal marsh will be monitored to demonstrate that the rate of revegetation is on-track based on the success requirements for the Project. This will include the low marsh and high marsh areas of the Project Area. The absolute cover of vegetation within the tidal marsh will be measured through using one of the following or an equivalent method:

- Manual monitoring of vegetated areas using the transect-quadrat method; or
- Acquire high-resolution aerial imagery collected with a UAV, estimate percent coverage manually or using eCognition software, and verify desktop analysis on-the-ground.

<u>Transect-Quadrat Vegetation Monitoring</u>

To evaluate vegetation performance standards, wetland types are monitored using transects, including the tidal marsh. Each transect serves as the sample unit and the quadrats are averaged to obtain transect cover. Twelve transects will be spaced approximately every 50 feet) to capture the restored 4.3-acre tidal marsh and are laid out perpendicular to and across the primary channel to capture the full extent of the tidal marsh zones (see Figure 2, attached). At each transect, a random number will be chosen from 0 through 9 using a random number generator to select the first sampling location in meters. At each sampling location, an approximately 3 foot by-3 foot (1-m by 1m) quadrat will be used to assess plant cover and species richness. Subsequent quadrats will then be placed approximately every 15 feet (5 m) so that one quadrat is sampled approximately every 30 feet (10 m) of transect length. Quadrat locations along each transect will be noted on field data forms. Approximately 6–foot- (2-m)-wide belt transects will be used along the north side of each transect to record species richness by capturing additional species not detected in the quadrats.

Vegetation data will be stratified based on low- and high-marsh zones and will be used to quantify the average percent cover within both tidal marsh zones, as well as capturing percent invasion by plants ranked by Cal-IPC as "High."

The San Francisco Bay Invasive Spartina Project will be consulted to verify that cordgrass growing within the Project site is native Pacific cordgrass (*Spartina foliosa*) and not one of the four invasive *Spartina* species or hybrids found in San Francisco Bay. Their biologist will be given permission to access the site and verify that the Project site has only the native species.

Aerial Imagery with eCognition

An alternative method to analyzing vegetation performance can be achieved with the remote-sensing analysis called "eCognition" of high-resolution aerial imagery collected for the Project Area via UAV. The eCognition software is a remote-sensing software package that allows users to classify different signature outputs of satellite images and aerial photographs. Using a high-resolution aerial image, aggregate area data can be utilized to determine the percent cover of vegetative cover.

Using aerial imagery, eCognition software can interpret signatures of the vegetation and the software can automatically define the boundaries of every color signature on the color aerial photograph, which is also known as a multi-resolution segmentation analysis. This generates polygons that require classification in the aerial imagery by a trained geospatial analyst familiar with the software and tidal ecology. A biologist would complete a site visit using a georeferenced map of the eCognition analysis results to confirm that the classification analyses accurately captures the vegetation composition and aerial cover observed. During this site visit, the biologist will also quantify any observed invasive species within the tidal marsh and complete monitoring for other required success criteria.

4.2.5 Vegetation Coverage in the Transition Zone

The development of the vegetation coverage within the transition zone will be measured to demonstrate that this area has sufficient shrub coverage to support Ridgway's rail refugia vegetation coverage. The monitoring will measure absolute coverage of shrubs in the transition zone or the density of shrubs in the transition zone. Density of shrubs will be used to measure success in the early years when individual shrubs are still small. Absolute coverage of shrubs will be used in later years when the size of the shrubs start to become substantial. The vegetation coverage of shrubs will be measured using one of the following methods:

- Vegetation count of live shrubs species within the transition zone; and/or
- Acquire high-resolution aerial imagery collected with a UAV, estimate percent coverage manually or using eCognition software, and verify desktop analysis on-the-ground.

Vegetation Counts

Utilizing the planting palette developed for the transition zone, qualified biologists will walk the transition zone and monitor all live shrub species within this zone to determine the planting success.

Aerial Imagery with eCognition

Similar analyses will be completed as that described above for the tidal marsh.

4.2.6 Seasonal Wetland Hydrology

The hydrology of the seasonal wetland will be measured by collecting data that demonstrates that the soils within the seasonal wetland are saturated or inundated for the required minimum duration of 14 consecutive days. Data will be collected using one of the following or an equivalent method:

- Installation and data collection from a shallow groundwater well;
- Installation and inspection of a staff gauge; or
- Field verification of inundation.

4.2.7 Vegetation Coverage in the Seasonal Wetlands

The development of vegetation coverage within the created seasonal wetland and a reference seasonal wetland identified within the parcel will be monitored to demonstrate that the rate of revegetation is on-track based on the performance requirements for the Project as outlined in Table 5. The established reference wetland will be a local depressional wetland within undisturbed areas of the property of similar size to the restored seasonal wetland. The absolute cover of vegetation within the restored seasonal wetland and reference seasonal wetland will be measured through using the following or an equivalent method:

- Manual monitoring of vegetated areas using the transect-quadrat method

Transect-Quadrat Vegetation Monitoring

Similar transect-quadrat methods as discussed above will be utilized for monitoring both the restored seasonal wetland and reference seasonal wetland habitat (see Figure 2, attached). The restored and reference seasonal wetland will have transects established; spaced 50 feet apart across the longest portion of the wetland and one transect extending perpendicular through the narrowest portion of the wetland. Given the relatively smaller size of the seasonal wetlands, the perpendicular transect has been included to ensure that transects adequately capture the variation of depth within each depressional feature. The application of quadrats will follow the same random number assignment and spacing as described above. Species composition and percent cover will be collected through this methodology.

4.2.8 Access Control Fence

The access control fence will be inspected during annual monitoring site visits to confirm it remains in working condition. The fence will be repaired or replaced as-needed. The tidal marsh areas, transition zone, and upland refugia area will be inspected for evidence of significant anthropogenic disturbances.

4.3 Remedial Actions

If annual or final success criteria are not met, the District will prepare an analysis of the potential cause(s) of failure and, if determined necessary by the permitting agencies, propose remedial action for approval. Subsequent annual and final monitoring reports may be required to confirm that remedial actions were successful. The District will be responsible for reasonably funding the remedial actions necessary for successful completion of the mitigation efforts. Remedial actions may include additional planting of native wetland species, noxious weed abatement activities, or modification of Project features to ensure proper hydrological functioning.

4.4 Reporting

The first year's Annual Report will be submitted by January 31 after the first full growing season and associated performance monitoring activities have been completed. Subsequent Annual Reports will cover the monitoring year beginning at the start of the rainy season (approximately October 1st), and will cover 12 calendar months forward from that point, with submittal occurring by January 31 of the following year. Reports will summarize the monitoring results and make recommendations for maintenance or management, if determined necessary. The condition of seeded wetland areas shall be described, as well as any observed threats to these restored areas. New colonization of invasive species and plans for their removal or control shall be detailed, as necessary. The Final (Year 5) Annual Report will also include a formal delineation of jurisdictional wetlands and present an evaluation of whether the restoration area has become sufficiently self-sustaining or whether additional invasive species control work or other monitoring should be performed.

5.0 COMPLETION OF MITIGATION

5.1 Notification of Completion

Upon completion of the monitoring period, final reports will be sent to the permitting agencies detailing the results of the final year of monitoring. In addition, a Notice of Completion will be prepared, signed by the District, and submitted to the permitting agencies to confirm successful completion of the restoration effort.

6.0 REFERENCES

California Invasive Plant Council (Cal-IPC). 2006. California Invasive Plant Inventory. California Invasive Plant Council, Berkeley, CA. Available online: https://www.cal-ipc.org/plants/inventory/.

San Francisco Bay Conservation and Development Commission. 1968. San Francisco Bay Plan. Reprinted March 2012.

WRA. 2015. Jurisdictional Delineation Report. Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve. Prepared for Golden Gate Bridge Highway and Transportation District.

FIGURES

Figure 1. Vicinity Map - Project Area Location

Path: L:\Acad 2000 Files\23000\23294\GIS\ArcMap\2018\Redesign\HMMP\Figure 1 Location.mxd

Sources: National Geographic, WRA | Prepared By: mweidenbach, 7/24/2019

Figure 1. Vicinity Map - Project Area Location

Corte Madera Four-Acre
Tidal Marsh Restoration Project
Town of Corte Madera, Marin County, California

0 0.5 1 Miles

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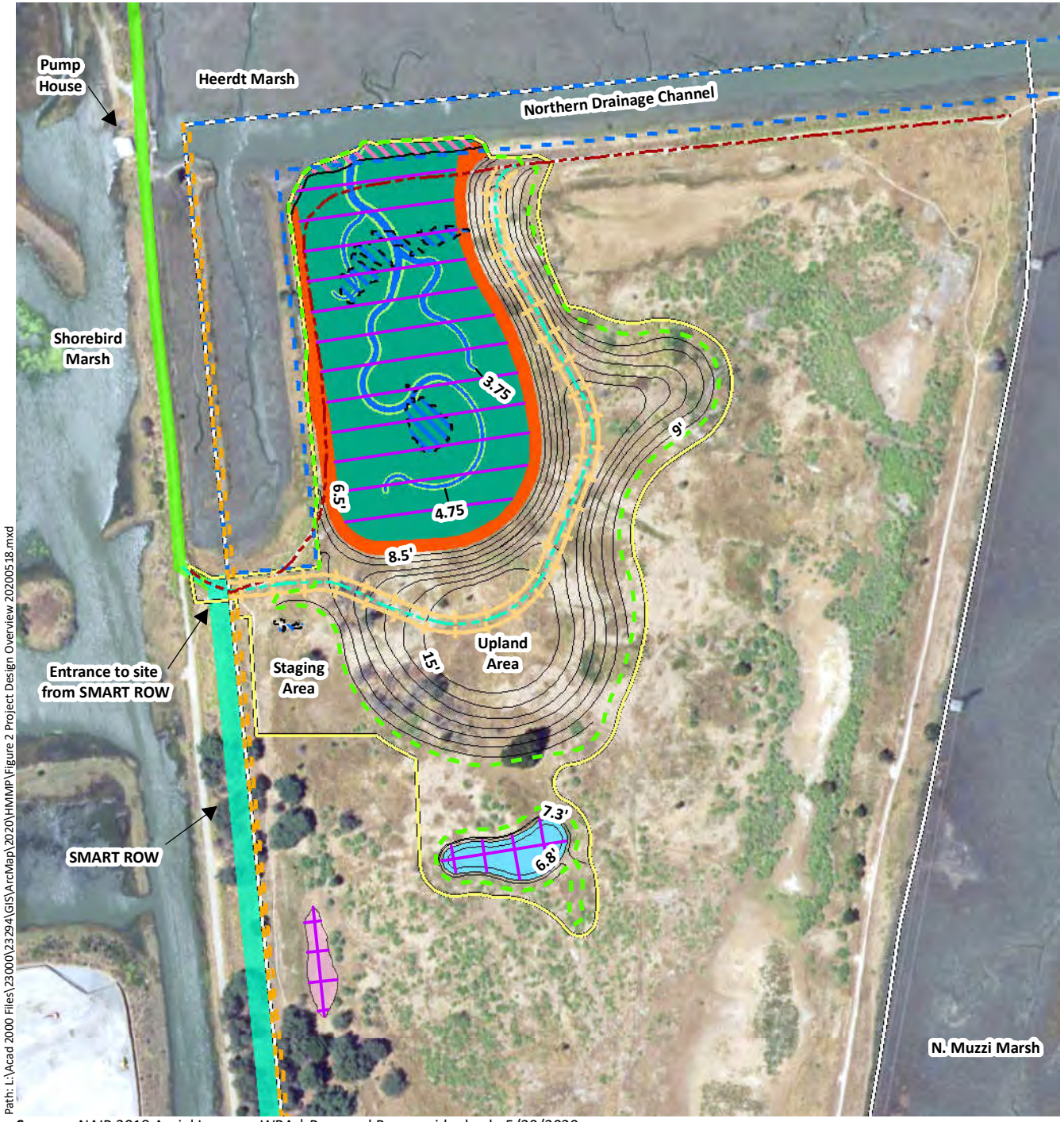
Figure 2. Project Design Overview

Figure 2.
Project Design Overview

Corte Madera Four-Acre
Tidal Marsh Restoration Project
Town of Corte Madera,
Marin County, California



Path: L:\Acad 2000 Files\23000\23294\GIS\ArcMap\2020\HMMP\Figure 2 Project Design Overview 20200518.mxd

Sources: NAIP 2018 Aerial Imagery, WRA | Prepared By: mweidenbach, 5/20/2020

- Parcel Boundary (72.31 ac)
- Project Area (14.71 ac)
- Monitoring Transects
- Reference Wetland
- Existing Unsanctioned Trail
- Proposed Informal Trail
- Pedestrian/Animal Exclusion Fence
- Limit of Grading (12.16 ac)
- Grading Contours

Existing Seasonal Wetlands

- Permanent Impact (0.28 ac)

Existing Tidal Marsh

- Temporary Impact (0.18 ac)*

Existing Easements (surveyed)

- Town of Corte Madera Drainage Easement
- AT&T Easement

District Access Easements (mapped from legal descriptions)

- 20' Public Access Easement within SMART ROW
- 35' Public Access Easement within SMART ROW

Proposed Habitat Restoration

- Tidal Marsh - Channel (0.30 ac)
- Tidal Marsh - Low Marsh (0.23 ac)
- Tidal Marsh - High Marsh (3.77 ac)
- Upland Transition Zone (0.75 ac)
- Seasonal Wetlands (0.28 ac.)

*This impact will result in the conversion of 0.01 ac. of High Marsh to Tidal Channel

N

0 200 400

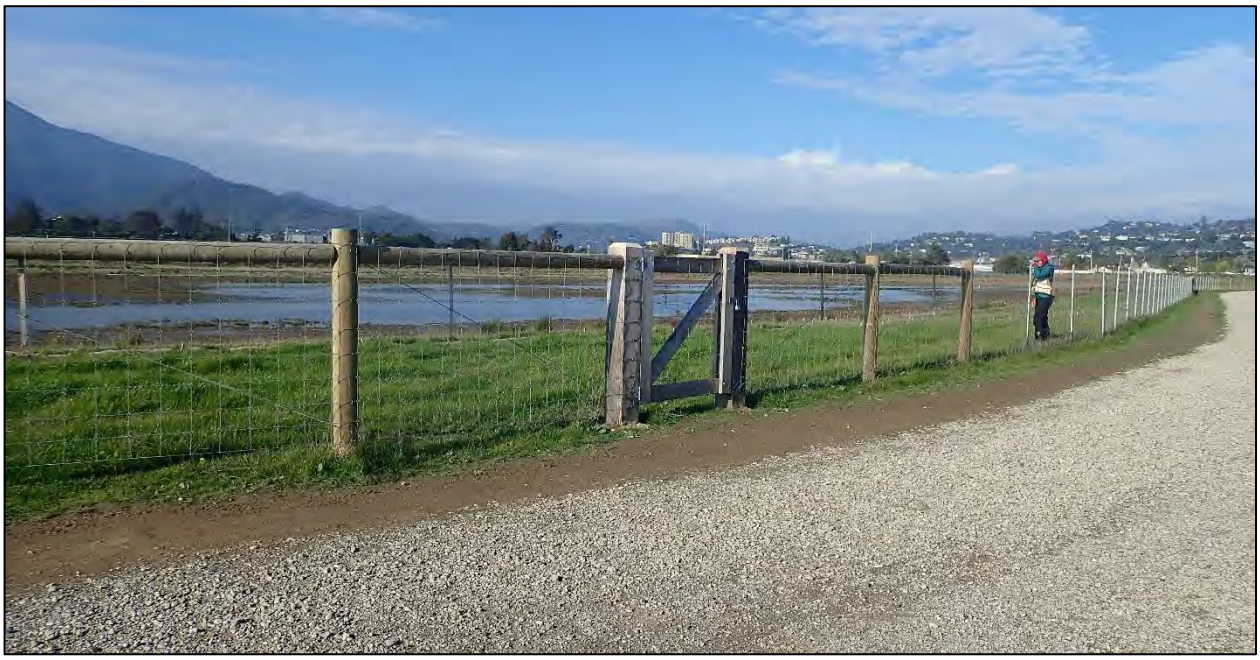
Feet

wra
ENVIRONMENTAL CONSULTANTS

APPENDIX C – SITE PHOTOGRAPHS

Photograph 1. Photo-monitoring Location 1. View of transition zone and tidal marsh, facing west. Photo taken December 21, 2021.

Photograph 2. Photo-monitoring Location 2. View of tidal marsh (background), transition zone (a narrow band adjacent to the tidal marsh), and uplands (foreground), facing northwest. Photo taken December 21, 2021.



Photograph 3. Photo-monitoring Location 3. View of trail and exclusion fence, facing southeast. Photo taken December 21, 2021.

Photograph 4. Photo-monitoring Location 4. View of transition zone and tidal marsh, facing west. Shrubs are meeting and exceeding expected cover for Year 1. Photo taken December 21, 2021.

Photograph 5. Photo-monitoring Location 5. View of upland disposal area with seasonal wetland in background, facing south. Photo taken December 21, 2021.

Photograph 6. Photo-monitoring Location 6. View of seasonal wetland, facing west. Photo taken December 21, 2021.

Photograph 7. Photo-monitoring Location 7. View of restored seasonal wetland, facing east. Photo taken December 21, 2021.

Photograph 8. Photo-monitoring Location 8. View of transition zone and tidal marsh, facing northeast. The tidal marsh vegetation in view is pickleweed (*Salicornia pacifica*). Photo taken December 21, 2021.

Photograph 9. Photo-monitoring Location 9. View of transition zone (foreground) and tidal marsh, facing east. Tidal marsh vegetation in view is dominated by pickleweed. Photo taken December 21, 2021.

Photograph 10. Photo-monitoring Location 10. View of tidal wetland and adjacent previously existing marsh, facing north. Tidal marsh vegetation in view is dominated by pickleweed. Photo taken December 21, 2021.

Photograph 11. View north of the restored tidal area fully inundated at high tide. The predicted high tide elevation was 6.6 feet mean lower low water. Photo taken November 6, 2021.

Photograph 12. View north of the restored tidal area fully inundated at high tide. The predicted high tide elevation was 6.7 feet mean lower low water. Photo taken December 3, 2021.

Photograph 13. View west of the restored tidal area fully inundated at high tide at the boundary with the Northern Drainage Channel. The predicted high tide elevation was 6.7 feet mean lower low water. Photo taken December 3, 2021.

Photograph 14. View west of the restored tidal area fully inundated at high tide at the boundary with the Northern Drainage Channel. The predicted high tide elevation was 6.7 feet mean lower low water. Emergent salt grass (*Distichlis spicata*), pickleweed, and marsh gumplant (*Grindelia stricta*) are visible. Photo taken December 3, 2021.

Photograph 15. View of the high marsh in the restored tidal marsh. Image shows expanding native plantings (primarily pickleweed) as well as natural native species recruits. Photo taken December 21, 2021.

Photograph 16. View of the high marsh in the restored tidal marsh. Image shows expanding native plantings as well as natural native species recruits. Marsh species visible include pickleweed, alkali heath (*Frankenia salina,* top left), and western marsh lavendar (*Limonium californicum,* top center). Photo taken December 21, 2021.

Photograph 17. View of the restored seasonal wetland taken from an unmanned aerial vehicle. Image shows partial inundation and saturation. Photo taken December 15, 2020.

Photograph 18. View southeast of the restored seasonal wetland (center of photo) from the public path. Image shows inundation and saturation. Photo taken February 12, 2021.

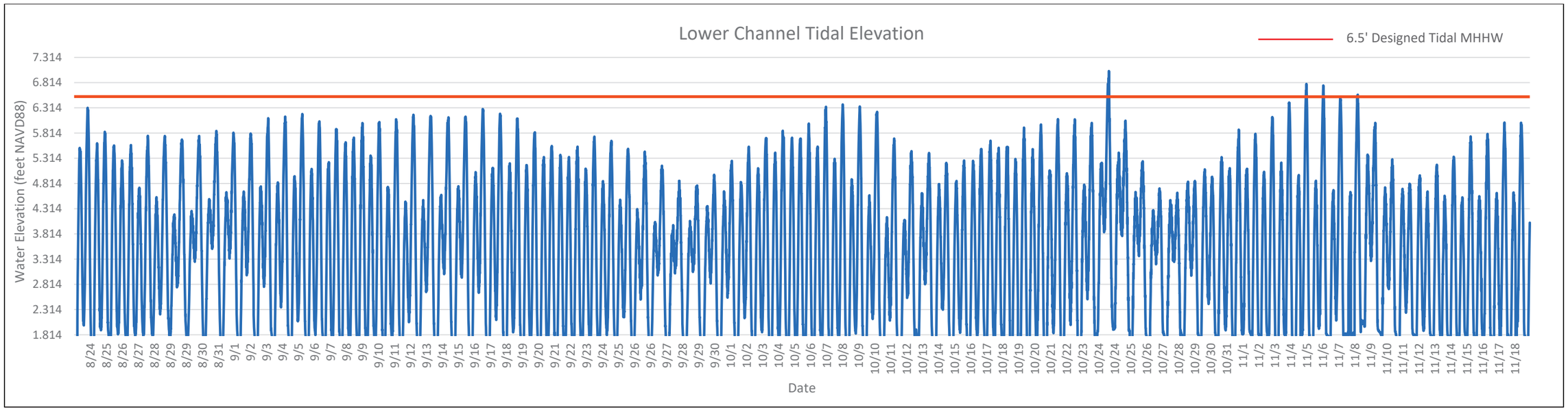
Photograph 19. View of the restored seasonal wetland, facing west. Image shows the wetland fully inundated. Photo taken November 19, 2021.

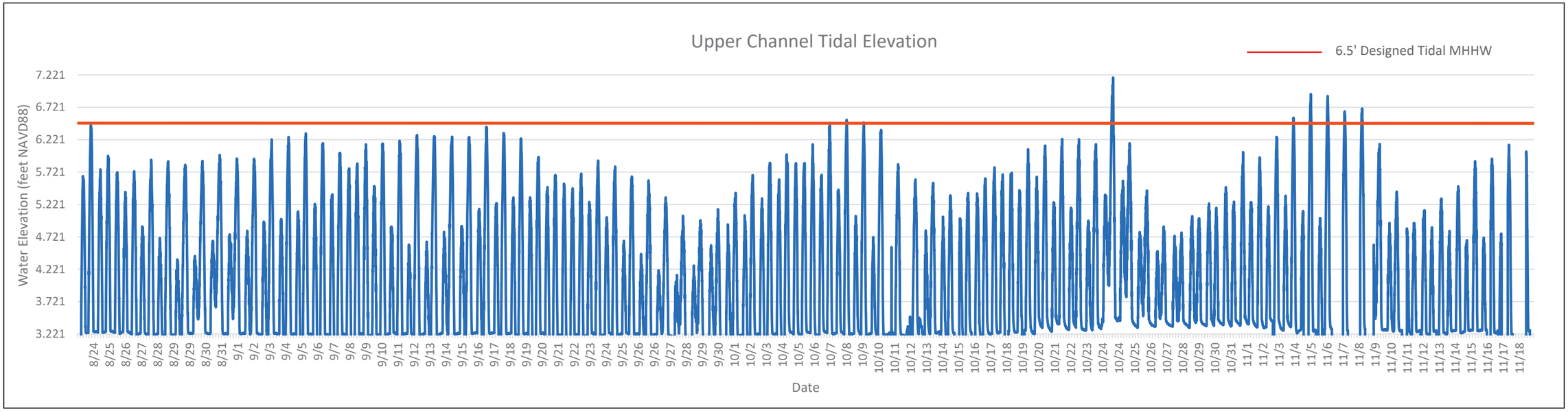
Photograph 20. View of the restored seasonal wetland, facing west. Image shows the wetland fully inundated. Image shows inundation and/or surface saturation throughout the wetland. Photo taken December 3, 2021.

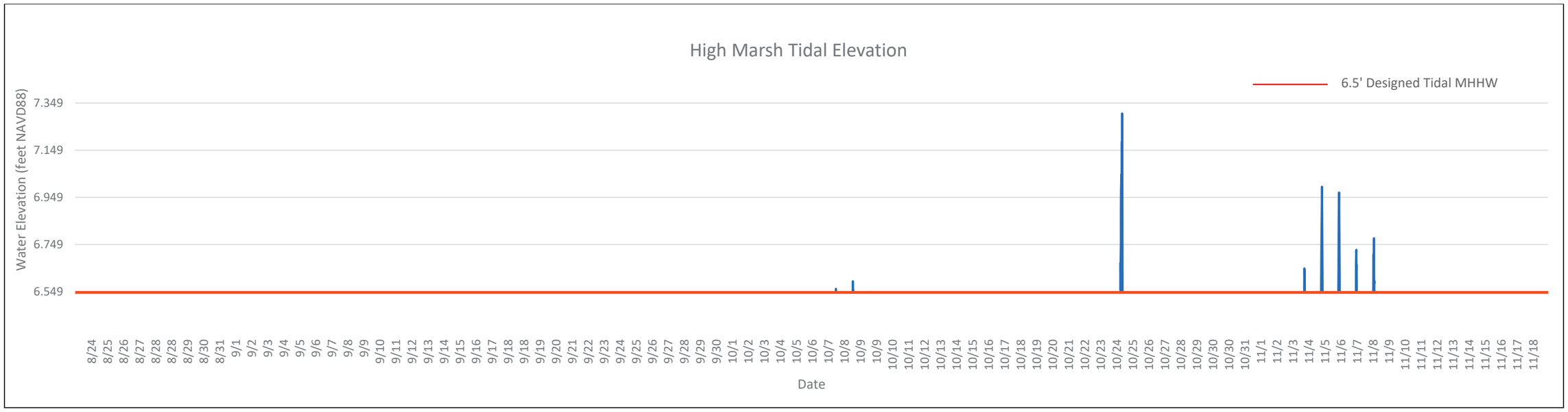
Photograph 21. View facing west of the restored seasonal wetland during annual vegetation monitoring. The more sparsely vegetated areas may be naturally occurring as a result of more prolonged inundation in slightly deeper areas. Photo taken June 22, 2021.

Photograph 22. View facing east of the restored seasonal wetland with dense vegetation during annual vegetation monitoring. Photo taken June 22, 2021.

APPENDIX D – TIDAL ELEVATION MONITORING DATA


Lower Channel Tidal Elevation
6.5' Designed Tidal MHHW
Water Elevation (feet NAVD88)
7.314
6.814
6.314
5.814
5.314
4.814
4.314
3.814
3.314
2.814
2.314
1.814
8/24 8/25 8/26 8/27 8/28 8/29 8/29 8/30 8/31 9/1 9/2 9/3 9/4 9/5 9/6 9/7 9/8 9/9 9/10 9/11 9/12 9/13 9/14 9/15 9/16 9/17 9/18 9/19 9/20 9/21 9/22 9/23 9/24 9/25 9/26 9/26 9/27 9/28 9/29 9/30 10/1 10/2 10/3 10/4 10/5 10/6 10/7 10/8 10/9 10/10 10/11 10/12 10/13 10/14 10/15 10/16 10/17 10/18 10/19 10/20 10/21 10/22 10/23 10/24 10/24 10/25 10/26 10/27 10/28 10/29 10/30 10/31 11/1 11/2 11/3 11/4 11/5 11/6 11/7 11/8 11/9 11/10 11/11 11/12 11/13 11/14 11/15 11/16 11/17 11/18
Date


Upper Channel Tidal Elevation
6.5' Designed Tidal MHHW
Water Elevation (feet NAVD88)
7.221
6.721
6.221
5.721
5.221
4.721
4.221
3.721
3.221
8/24 8/25 8/26 8/27 8/28 8/29 8/29 8/30 8/31 9/1 9/2 9/3 9/4 9/5 9/6 9/7 9/8 9/9 9/10 9/11 9/12 9/13 9/14 9/15 9/16 9/17 9/18 9/19 9/20 9/21 9/22 9/23 9/24 9/25 9/26 9/26 9/27 9/28 9/29 9/30 10/1 10/2 10/3 10/4 10/5 10/6 10/7 10/8 10/9 10/10 10/11 10/12 10/13 10/14 10/15 10/16 10/17 10/18 10/19 10/20 10/21 10/22 10/23 10/24 10/24 10/25 10/26 10/27 10/28 10/29 10/30 10/31 11/1 11/2 11/3 11/4 11/5 11/6 11/7 11/8 11/9 11/10 11/11 11/12 11/13 11/14 11/15 11/16 11/17 11/18
Date


High Marsh Tidal Elevation
6.5' Designed Tidal MHHW
Water Elevation (feet NAVD88)
7.349
7.149
6.949
6.749
6.549
8/24 8/25 8/26 8/27 8/28 8/28 8/29 8/30 8/31 9/1 9/2 9/3 9/4 9/5 9/6 9/7 9/8 9/9 9/10 9/11 9/12 9/13 9/14 9/15 9/16 9/17 9/18 9/18 9/19 9/20 9/21 9/22 9/23 9/24 9/25 9/26 9/27 9/28 9/29 9/30 10/1 10/2 10/3 10/4 10/5 10/6 10/7 10/8 10/9 10/9 10/10 10/11 10/12 10/13 10/14 10/15 10/16 10/17 10/18 10/19 10/20 10/21 10/22 10/23 10/24 10/25 10/26 10/27 10/28 10/29 10/30 10/30 10/31 11/1 11/2 11/3 11/4 11/5 11/6 11/7 11/8 11/9 11/10 11/11 11/12 11/13 11/14 11/15 11/16 11/17 11/18
Date

APPENDIX E – VEGETATION MONITORING DATA

Year 1 Monitoring	Observers: Scott Batiuk, Cody Lambrecht		Date: 6/22/2021	Average for Restored Seasonal Wetland	Restored Seasonal Wetland																																			
Species	Common name	Origin	Origin	Absolute Percent Cover (%)	Present?	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31
						Absolute Percent Cover (%)																																				
Agrostis avenacea	pacific bentgrass	Exotic	Cal-IPC Limited	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Avena barbata	slender oat	Exotic	Cal-IPC Moderate	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromus diandrus	ripgut brome	Exotic	Cal-IPC Moderate	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromus hordeaceus	soft chess	Exotic	Cal-IPC Limited	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirsium vulgare	Bullthistle	Exotic	Cal-IPC Moderate	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cotula coronopifolia	brassbuttons	Exotic	Cal-IPC Limited	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca bromoides	Brome fescue	Exotic	Exotic	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca myuros	Rattail sixweeks grass	Exotic	Cal-IPC Moderate	4	X	0	0	0	3	5	5	10	0	8	3	0	8	10	5	2	8	10	5	2	5	2	2	5	5	2	0	0	0	2	2	2
Festuca perennis	Italian rye grass	Exotic	Cal-IPC Moderate	36	X	15	20	80	85	70	50	45	50	40	8	15	35	10	25	15	30	50	25	25	80	35	70	15	50	60	15	25	15	20	15	15
Genista monspessulana	French broom	Invasive	Cal-IPC High	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Holcus lanatus	common velvet grass	Exotic	Cal-IPC Moderate	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
Hordeum brachyantherum	Meadow barley	Native	Native	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hordeum murinum	foxtail barley	Exotic	Cal-IPC Moderate	0	X	0	1	0	0	2	1	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0
Hypocharis radicata	catsear	Exotic	Cal-IPC Moderate	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Juncus bufonius	toad rush	Native	Native	1	X	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	12	0	0	2
Lotus corniculatus	birdsfoot trefoil	Exotic	Exotic	8	X	5	15	5	1	3	10	5	15	15	0	0	5	5	5	10	15	10	15	15	5	20	5	15	15	5	5	5	0	0	10	2
Madia sativa	coastal tarweed	Native	Native	0	X	0	0	0	0	0	0	0	0	2	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medicago polymorpha	bur clover	Exotic	Cal-IPC Limited	2	X	0	1	0	0	2	1	0	2	2	0	0	1	2	2	0	2	5	5	15	0	20	0	0	0	0	0	0	0	0	0	0
Melilotus indicus	annual yellow sweetclover	Exotic	Exotic	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phalaris aquatica	Harding grass	Exotic	Cal-IPC Moderate	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypogon monspeliensis	rabbitsfoot grass	Exotic	Cal-IPC Limited	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudognaphalium luteoalbum	Jersey cudweed	Exotic	Exotic	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raphanus sativus	radish	Exotic	Cal-IPC Limited	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumex crispus	curly dock	Exotic	Cal-IPC Limited	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spergularia rubra	red sandspurry	Exotic	Exotic	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vicia sativa	vetch	Exotic	Exotic	0	X	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	1	1	0	0	3	0	0	0	0	0	0	0	0	0	0
Vicia villosa	hairy vetch	Exotic	Exotic	0	X	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Litter/Thatch				8	-	20	32	0	3	13	5	8	5	8	0	0	26	34	5	5	20	5	15	3	9	2	10	0	0	5	0	0	0	0	0	0
Bare Ground				41	-	60	31	15	8	5	28	30	27	25	88	69	25	35	58	67	21	19	34	40	0	15	13	64	28	27	80	70	73	78	72	77
Average Plant Cover				51	-	20	37	85	89	82	67	62	68	67	12	31	49	31	37	28	59	76	51	57	91	83	77	36	72	68	20	30	27	22	28	23
Average Number Native Plant Species				3	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Average Native Grass Cover				0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average Native Cover				1	-	0	0	0	0	0	0	0	0	2	1	16	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	12	0	0	2
Relative Native Cover				4	-	0	0	0	0	0	0	0	0	3	8	52	0	0	0	4	0	0	0	0	0	0	0	3	0	0	0	0	44	0	0	9
Average Number Invasive Plant Species				1	-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Average Cal-IPC Invasive Cover				0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average Cal-IPC High Cover				0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Year 1 Monitoring	Observers: Scott Batiuk, Cody Lambrecht		Date: 6/22/2021	Average for Reference Seasonal Wetland	Reference Seasonal Wetland																	
Species	Common name	Origin	Origin	Absolute Percent Cover (%)	Present?	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17
						Absolute Percent Cover (%)																
Agrostis avenacea	pacific bentgrass	Exotic	Cal-IPC Limited	9	X	0	7	10	2	2	0	0	15	15	0	1	0	20	10	0	70	5
Bromus diandrus	ripgut brome	Exotic	Cal-IPC Moderate	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cotula coronopifolia	brassbuttons	Exotic	Cal-IPC Limited	23	X	25	30	40	35	35	35	40	50	0	0	30	2	30	35	0	5	0
Festuca perennis	Italian rye grass	Exotic	Cal-IPC Moderate	21	X	5	2	1	5	0	0	0	10	30	85	35	55	1	15	20	15	85
Lotus corniculatus	birdsfoot trefoil	Exotic	Exotic	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Madia sativa	coastal tarweed	Native	Native	0	X	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Spergularia macrotheca	sand spurrey	Native	Native	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Litter/Thatch	28	-	50	45	40	40	50	40	20	3	50	0	30	38	33	20	5	5	10
			Bare Ground	18	-	20	16	9	18	13	25	40	22	4	15	4	5	16	20	75	5	0
			Average Plant Cover	82	-	80	84	91	82	87	75	60	78	96	85	96	95	84	80	25	95	100
			Average Number Native Plant Species	2	-	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
			Average Native Grass Cover	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Average Native Cover	0.1	-	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
			Relative Native Cover	0.1	-	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
			Average Number Invasive Plant Species	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Average Cal-IPC Invasive Cover	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			Average Cal-IPC High Cover	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX F – NOTIFICATION TO THE INVASIVE SPARTINA PROJECT

Scott Batiuk <batiuk@wra-ca.com>

Spartina sp. at the Corte Madera Marsh restoration site

1 message

Scott Batiuk <batiuk@wra-ca.com> Thu, Dec 2, 2021 at 5:54 PM
To: info@spartina.org

Hello,

I am the project manager at WRA for the Corte Madera 4-Acre Tidal Marsh restoration site in Corte Madera, Marin County, approximately 0.5 mile south of the Larkspur Ferry Terminal. One of the monitoring requirements for the site is to report to ISP if any spartina is found within the restoration area. I apologize if ISP is already aware of the following information based. A small number of scattered *Spartina* sp. individuals have been found at the far northern edge of the restoration area, at the interface between the restoration area and the east-west oriented tidal channel adjacent to the restoration area. See the attached KMZ for the approximate location. I have not seen it in bloom, so I can't even make a tentative ID on it beyond genus. So far, no spartina has been observed within the interior of the restoration area. Let me know if you have any questions.

SCOTT BATIUK | Associate Plant Biologist, CCB #0026 | d: 415.524.7211|
o: 415.454.8868 x 1140 | c: | batiuk@wra-ca.com
WRA, Inc. | www.wra-ca.com | 2169-G East Francisco Blvd.,
San Rafael, CA 94901 | San Diego | Fort Bragg | Denver

Approximate Spartina sp. location.kmz
1K

Scott Batiuk <batiuk@wra-ca.com>

Spartina sp. at the Corte Madera Marsh restoration site

1 message

Scott Batiuk <batiuk@wra-ca.com> Thu, Jan 20, 2022 at 2:46 PM
To: marilyn.latta@scc.ca.gov

Marilyn,

I am the project manager at WRA for the Corte Madera 4-Acre Tidal Marsh restoration site in Corte Madera, Marin County, approximately 0.5 mile south of the Larkspur Ferry Terminal. One of the monitoring requirements for the site is to report to ISP if any spartina is found within the restoration area. I apologize if ISP is already aware of the following information. A small number of scattered *Spartina* sp. individuals have been found at the far northern edge of the restoration area, at the interface between the restoration area and the east-west oriented tidal channel adjacent to the restoration area. See the attached KMZ for the approximate location. I have not seen it in bloom, so I can't even make a tentative ID on it beyond genus. So far, no spartina has been observed within the interior of the restoration area. Let me know if you have any questions or if there is anything else we would need to do for follow-up.

SCOTT BATIUK | Associate Plant Biologist, CCB #0026 | d: 415.524.7211|
o: 415.454.8868 x 1140 | c: | batiuk@wra-ca.com
WRA, Inc. | www.wra-ca.com | 2169-G East Francisco Blvd.,
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Approximate Spartina sp. location.kmz
1K