

MARINE TAXONOMIC SERVICES, LTD.

Pillar Point Harbor-Wide Eelgrass Management and Mitigation Plan

July 27, 2020 (Revised December 16, 2023)

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Pillar Point Harbor-Wide Eelgrass Management and Mitigation Plan

July 27, 2020 (Revised December 16, 2023)

1 Introduction

On behalf of the San Mateo County Harbor District (District), Brad Damitz the District consultant, contracted with Marine Taxonomic Services, Ltd. (MTS) to identify the extent of eelgrass (*Zostera marina* and *Z. pacifica*) within Pillar Point Harbor (MTS 2019). MTS was then asked to review the extent of eelgrass presence and create a management and mitigation plan that considered current bathymetry and the proposed plans for the Pillar Point Harbor maintenance dredging and Surfers Beach Pilot Restoration Project, and to be utilized in the event of future harbor maintenance dredging undertaken by the District. These actions represent a suite of management needs and are collectively referred to as “Projects” in this document.

The July 2020 eelgrass mitigation plan (MTS 2020) has been updated to reflect the most recent harbor-wide eelgrass survey data (MTS 2023), and address comments from National Marine Fisheries Service. In addition to making modifications based on the updated eelgrass data, this revised plan provides a new concept for the creation of the mitigation site. The primary modification is that the prior plan called for cut and fill within the west basin to create suitable depths for eelgrass. This revised plan avoids cutting intertidal depths to create suitable depths for eelgrass; instead, only fill is utilized at subtidal depths to make specific areas more suitable to support eelgrass.

As the only harbor between Santa Cruz and San Francisco, Pillar Point Harbor (PPH) serves a crucial function for vessels that rely on the boat launch ramps and anchorage area in the Harbor’s east basin. The District has an obligation to ensure that safe navigation and anchoring be maintained within PPH, which requires periodic dredging. Due to the construction of the PPH outer breakwaters, the east basin has experienced shoaling of trapped sand that would have otherwise been part of the littoral cell. If no dredging occurs in the future, then ultimately the harbor would not be available for navigation or anchoring. The eelgrass mitigation described in this report is part of a larger effort by the District to obtain permits that would allow for the Surfers Beach Project and required future maintenance dredging.

MTS was also tasked with identifying the steps necessary to create a successful mitigation site for the proposed Projects, and to approximate the change in eelgrass coverage that may result from proposed maintenance activities. The creation of a mitigation site is proposed such that areas currently populated with eelgrass can be managed such that any losses to eelgrass within those areas would be compensated for through restoration within a portion of the PPH that is considered non-critical for safe navigation, berthing, mooring, or boating.

1-1 Project Location

The Project sites are located within the PPH in Half Moon Bay, California (Figure 1). Half Moon Bay is located approximately 18 miles south of San Francisco on the Pacific coast side of San Mateo County, California. Eelgrass is proposed to be salvaged within the east basin and creation of a mitigation site is proposed in the west basin. There are additional minor impacts to eelgrass associated with the creation of the mitigation site. The minor amounts of eelgrass currently within the footprint of the mitigation site will be salvaged and planted in nearby secondary mitigation sites.

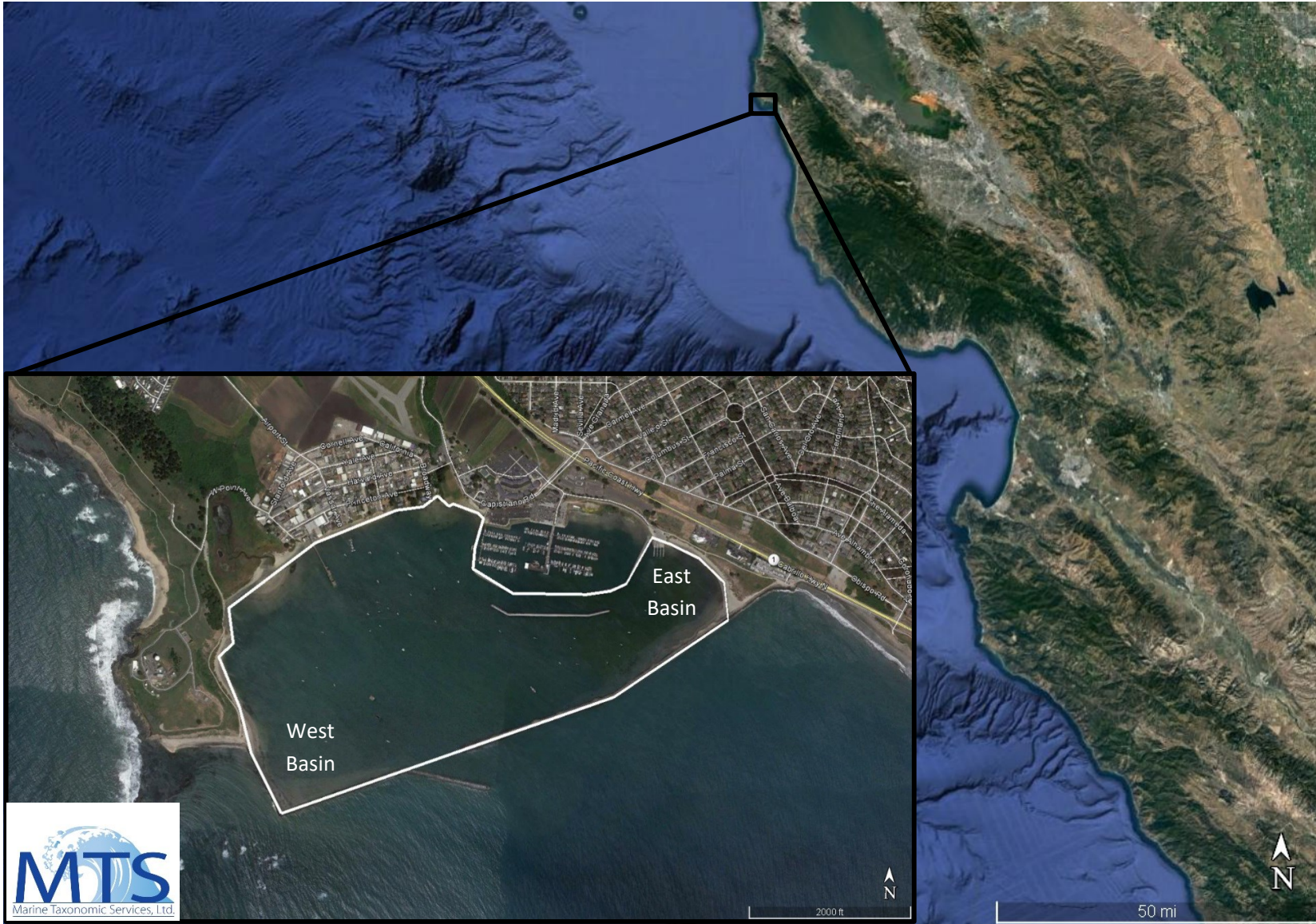


Figure 1. Location of Pillar Point Harbor Facility and Project boundary of the area surveyed for eelgrass and potential restoration sites

1-2 Project Summary

PPH provides a protected harbor for berthing and mooring of commercial and recreational vessels and includes a public boat launch ramp (Figure 1). To maintain safe access for vessel navigation as well as boat launching, maintenance dredging is required. Additionally, as part of the Surfers Beach Pilot Restoration Project, sand that is entrained in the harbor is proposed to be beneficially re-used by being placed on the beach and back into the littoral cell. The sand loss along nearby swaths of Surfers Beach has resulted in the need for beach re-nourishment actions to support overlying public access and roadways adjacent to the Project area.

MTS completed the first harbor-wide eelgrass inventory assessment in November 2019 (MTS 2019). In May 2023, the eelgrass inventory was updated by focusing survey efforts on areas that were previously shown to support eelgrass and then mapping the eelgrass in those regions of the harbor (MTS 2023). The findings provided in MTS (2023) are utilized to inform the creation of this revised management and mitigation plan. The results from the 2023 survey mapped 1,360 square meters in the east basin (Figure 2) and 5,449 square meters of eelgrass in the west basin (Figure 3). The total vegetated eelgrass area was 6,809 square meters. Figure 4 and Figure 5 show the extents of both the vegetated and unvegetated eelgrass habitat mapping in 2023 as required by the California Eelgrass Mitigation Policy (CEMP; NMFS 2014) for the east and west harbor, respectively.

Based on the results from the survey, it is estimated that approximately 773 square meters of vegetated eelgrass habitat and 4,107 square meters of unvegetated eelgrass habitat will be directly impacted due to Project dredge activities in the east basin (Figure 4). That eelgrass exists in the east basin due to entrainment of sand in the harbor and associated shoaling which has created shallow water conditions that are favorable for eelgrass growth. However, it is interesting to note that continued shoaling between 2019 and 2023 appears to have reduced the vegetative cover of eelgrass significantly. Simple inspection of Figure 2 shows that eelgrass has been pushed further offshore as the shoals have pushed outward and become shallower.

The CEMP outlines a replacement or mitigation ratio of at least 1.2:1 for impacts to eelgrass habitat (NMFS 2014). As a result, the Projects will be required to establish an estimated minimum of 928 square meters of new eelgrass habitat to mitigate for impacts. In creating the proposed mitigation site, an additional 132 square meters of existing eelgrass will be impacted. This additional impact is described in Section 5 and requires an additional mitigation need of 162 square meters. The resulting total eelgrass mitigation is 1,090 square meters.

This mitigation plan does not account for impacts to unvegetated eelgrass habitat. Although it is noted above that 4,107 square meters of unvegetated eelgrass habitat will be lost in the east basin it is not possible to generate that much unvegetated eelgrass habitat at the mitigation site. This is because the mitigation site will create a more contiguous eelgrass bed with less “edge”. To generate an equal amount of unvegetated eelgrass habitat, the mitigation site would have to be intentionally designed to create a patchy eelgrass bed that is arguably of lower habitat value than a contiguous bed due to lower connectivity (Voller and Harrison 1998).

This document provides a management and mitigation plan to account for impacts to eelgrass due to Projects’ activities. It includes details on the location and methods for creating new eelgrass habitat as part of the proposed mitigation. Additionally, the plan includes a five-year monitoring plan to assess establishment of the created eelgrass habitat to ensure that the minimum coverage and density obligations are met per the CEMP.



Figure 2. Comparison of eelgrass mapping results as performed in November 2019 and May 2023 in the east basin.

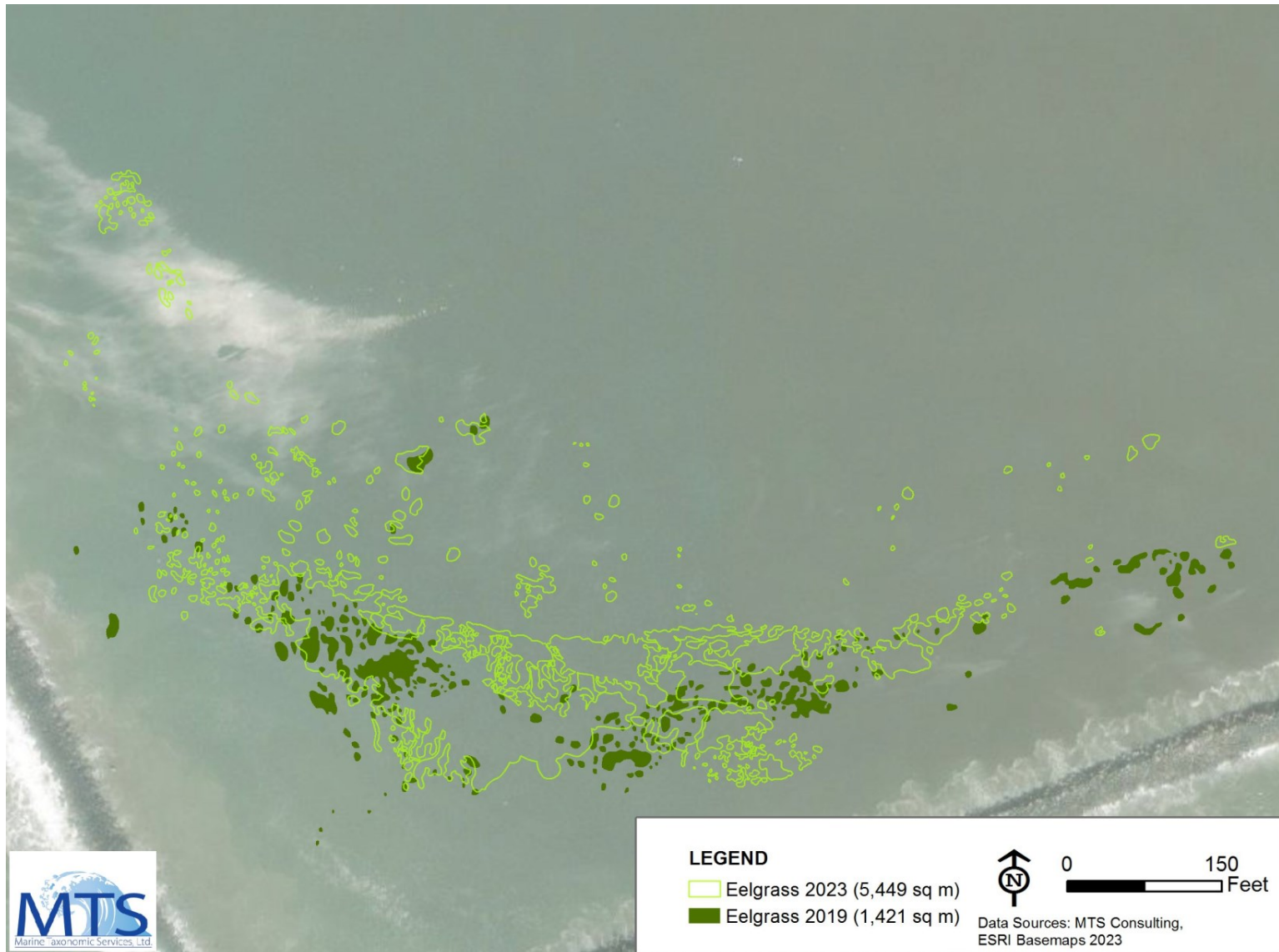


Figure 3. Comparison of eelgrass mapping results as performed in November 2019 and May 2023 in the west basin.

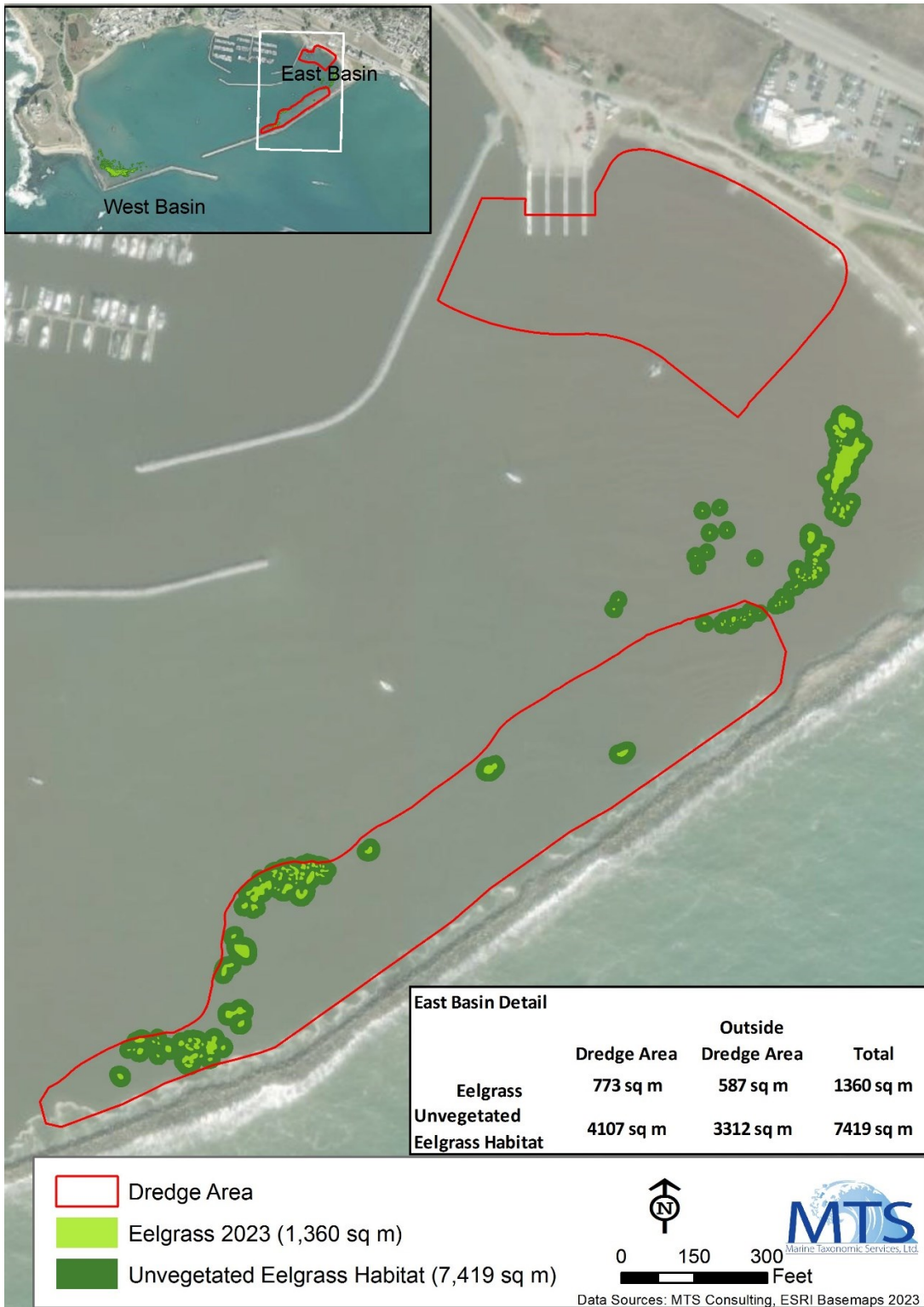


Figure 4. Eelgrass mapping results showing vegetated and unvegetated eelgrass habitat for the east basin as determined by the May 2023 eelgrass inventory. Inset details show the amount of eelgrass and unvegetated eelgrass habitat inside and outside of proposed dredge areas.



Figure 5. Eelgrass mapping results showing vegetated and unvegetated eelgrass habitat for the west basin as determined by the May 2023 eelgrass inventory.

2 Regulatory Reasoning & Mitigation Approach

Seagrass habitat is designated as a Habitat Area of Particular Concern (HAPC) by NOAA Fisheries. *Z. marina* is the dominant eelgrass within the PPH. Because of its designation as an HAPC and its notable contributions to ecological processes, it is protected under the Clean Water Act and managed by NOAA in California through adherence to the California Eelgrass Mitigation Policy (NMFS 2014). Additionally, the California Public Resources Code is committed to expanding eelgrass resources to mitigate effects from ocean acidification and hypoxia (*California Legislative Information* 2020).

Eelgrass plays many important roles in marine systems. Its functions and contributions to ecological processes are summarized by Mooney and Woodfield (2009). It clarifies water through sediment trapping and stabilization (de Boer 2007). It also provides the benefits of nutrient transformation and water oxygenation (Yarbro and Carlson 2008). Eelgrass serves as a primary producer in detritus-based food webs (Thresher et al. 1992) and is further directly grazed upon by invertebrates, fish, and birds (Valentine and Heck 1999), thus contributing to eco-system health at multiple trophic levels. Additionally, it provides physical structure in the form of habitat to the community and supports epiphytic plants and animals, which are in turn grazed upon by other invertebrates, fish, and birds. Eelgrass is also a nursery area for many commercially and recreationally important finfish and shellfish (Heck et al. 2003), including both those that are resident within bays and estuaries, as well as oceanic species that enter the protected areas to breed or spawn. Among recreationally important species, sand basses Dungeness crab, and lobster make use of eelgrass beds as habitat. Besides providing important habitat for fish, eelgrass and eelgrass-associated invertebrates provides important food resources that support migratory birds during critical life stages.

Given the protected status of eelgrass species, the District is required to mitigate for impacts to eelgrass associated with the projects. In recognition of this ongoing need and the beneficial uses of eelgrass habitat, the District is taking a proactive approach to eelgrass management by determining potential eelgrass restoration sites prior to application of proposed dredge projects and are planning ahead for future eelgrass mitigation needs related to the maintenance of the PPH.

The approach of identifying restoration opportunities ahead of proposed dredge projects and performing restoration before future maintenance needs benefits the resource and the District's management of the harbor. Moreover, if mitigation does not take place in a timely fashion, there are calculations included in the CEMP to increase the mitigation requirements to make up for temporal losses of the resource (NMFS 2014). Establishing eelgrass restoration ahead of the need makes sure the District does not incur costly penalties. Additionally, having the resource in place early means the resource is present in greater abundance than would otherwise and therefore greater ecological benefits are realized from the ecological processes performed by eelgrass beds.

In addition to simply providing for greater eelgrass area, the goal of any restoration program is to provide the best quality habitat possible. While making comparisons among eelgrass beds is arguably subjective and based on human judgement, it is generally accepted that moderately dense eelgrass beds provide for the functions and processes described above. The goal of eelgrass restoration should be to provide eelgrass beds with at least 80 turions per square meter. While somewhat arbitrary, this density likely provides sufficient refuge from predation while also providing significant root mass to stabilize sediments and material to support food webs. Moreover, replacing the patchily distributed existing eelgrass beds with a more contiguous eelgrass bed means greater habitat connectivity and fewer deleterious effects associated edges (Voller and Harrison 1998, Gorman et al. 2009).

3 Methods

The entirety of the PPH was reviewed for potential eelgrass restoration sites. The determination of sites most suitable for potential eelgrass restoration within the PPH area required implementation of a 5-step process. The steps involved collection of harbor-wide eelgrass information, development of a model to illustrate potential site selections, review of the model results, review of site alterations, draft preliminary concepts of proposed restoration sites, and field verification of existing conditions to support the selection of the restoration sites. The methods used in each of the steps are provided below,

3-1 Collection of Harbor-Wide Eelgrass Information

Understanding what areas are most likely to support eelgrass depends largely on knowing where eelgrass currently exists and the depth at which eelgrass occurs. Eelgrass data for this report were collected by MTS in May 2023 (MTS 2023). The methods and results of the analysis are described in the following sections.

Bathymetry within the survey area was provided by Environmental Science Associates (ESA). Those data were interpolated to a 1-ft depth grid with floating point (Decimal) values for depth and then processed into a 1-foot vertical resolution (topographic lines). MTS performed additional bathymetry measurements within the areas that support eelgrass in the east basin and the west basin in May 2023 (MTS 2023). In these specific locations the data were merged to compare eelgrass presence with bathymetry at the time of the eelgrass survey.

3-2 Preliminary Site Selection Model

The bathymetric and eelgrass data were used to determine the depth distribution of eelgrass across the surveyed area. The cumulative eelgrass cover area was designated as eelgrass habitat and fit into the same 1-foot grid as used for the bathymetry data. Dividing the eelgrass present within each depth bin by the total available habitat for each depth bin allowed the eelgrass habitat to be evaluated based on percent occurrence by depth and the cumulative percent contribution for each depth category to overall eelgrass cover. The evaluation of eelgrass percent contribution to each depth category was calculated specifically for the eelgrass bed area in the west basin because this is the area where construction of a mitigation site is proposed (refer to Section 5). Areas where eelgrass was not present, but depths were “suitable” were ignored because those areas are likely restricted with regards to eelgrass growth based on factors other than depth.

The depth-distribution curves were evaluated within the PPH west basin to determine the depths most suitable to support eelgrass and to determine the maximum depth for eelgrass. The use of the 1-foot depth grid meant that on slopes a small percentage of eelgrass could be misclassified. The maximum depth used for selection purposes was determined by looking at the percent of habitat occupied by eelgrass within each depth range and the cumulative percent of eelgrass with increasing depth. The maximum depth was chosen where the slope in the cumulative percent contribution of eelgrass by depth bin and the percentage of eelgrass within depth bins noticeably declined. The selection was subjective but based on meaningful trends in the data.

Once the maximum suitable depth was determined, all depths above that value to a maximum of +2 feet MLLW were classified as having the “greatest” likelihood of either supporting eelgrass or requiring minimum site modification to support eelgrass. Just beyond the maximum suitable depth any area within 2 feet of the maximum suitable depth was classified as having “good” potential to support eelgrass with site modification (where modification is imported fill). The next 2 feet of deeper seafloor beyond the “good” category was deemed “moderate”. Moderately suited areas would require more significant site modification to be deemed suitable to support eelgrass.

3-3 Review of Model Results

Potential restoration sites were sought whereby planting success could be maximized while minimizing the amount of site modification. This meant looking for sites that were as close as possible to the maximum depth for eelgrass within a region and yet did not contain eelgrass habitat. These areas were then inspected to determine if there were any features within them that would prevent site modification. For example, being close to a channel and proposing fill could result in loss of any placed material into the channel. Additionally, areas known to support another managed or sensitive habitat would be avoided. Generally, sites were sought adjacent to existing eelgrass habitat such that site modification would work to increase the scale of the existing habitat.

3-4 Draft Restoration Concepts

Once sites were evaluated, a conceptual restoration site was created for the selected area. For the mitigation site, a preliminary grading plan was developed. The grading plan was designed to generally tie into existing contours and then build up sediment within the site so that elevations were achieved that were within the depth ranges observed to support the relatively high eelgrass cover. The fill plan proposed in this report is conceptual. An official dredge and fill plan should be prepared by a licensed engineer prior to moving forward with the eelgrass mitigation.

4 Results

4-1 Compilation of Existing Information

The data from the 2023 harbor-wide eelgrass inventory update were used to determine areas most suitable to support eelgrass within the PPH. Combining the bathymetric data (from ESA) as modified by MTS with recent data allowed classification of eelgrass habitat with depth. The results show that the maximum suitable depth for eelgrass in the west basin is approximately -8 feet (ft). The maximum suitable depth was chosen based on visual inspection of the trends in percent eelgrass cover within depth bins and the curve of cumulative percent eelgrass cover with depth. The combination of eelgrass and bathymetric mapping did show eelgrass growing to -11 ft MLLW; however, the data at deeper depths may represent mapping error (Figure 6).

To support future maintenance activities within the PPH, the mitigation plan needs to accommodate for the potential loss of all eelgrass resources within the east basin. The total amount of eelgrass cover within the east basin as of May 2023 is 1,360 square meters. Of this amount, 773 square meters are within the proposed dredge limits. However, per CEMP guidelines of a 1:1.2 mitigation for eelgrass cover, 928 square meters of eelgrass would need to be restored unless a mitigation bank was established prior to the impact. Given anticipated timing of the Projects, it is not possible to prove restoration success prior to the need to dredge.

Currently, habitats in the proximity of the proposed mitigation site range from approximately +3 to -7 feet MLLW with eelgrass occupying space primarily from 0 to -5 feet. The proposed mitigation is to extend eelgrass presence in the west basin by importing fill from dredged areas and using that material to fill deeper portions of the mitigation site. Material would come primarily from placing sediment dredged from the launch ramp area and portions of the east basin where dredged sediment is not suitable for beach replenishment.

It is recommended that the mitigation site be modified to maximize the area with a depth between -2 and -3 ft MLLW. Eelgrass in the west basin at 0 to -1 ft covers approximately 45% of the seafloor within this depth range. However, filling to this depth range could result in loss of eelgrass if additional shoaling occurs. For this reason, a slightly deeper mitigation site is recommended. The proposed site and the predicted amount of eelgrass supported by the mitigation site is the subject of the next section.

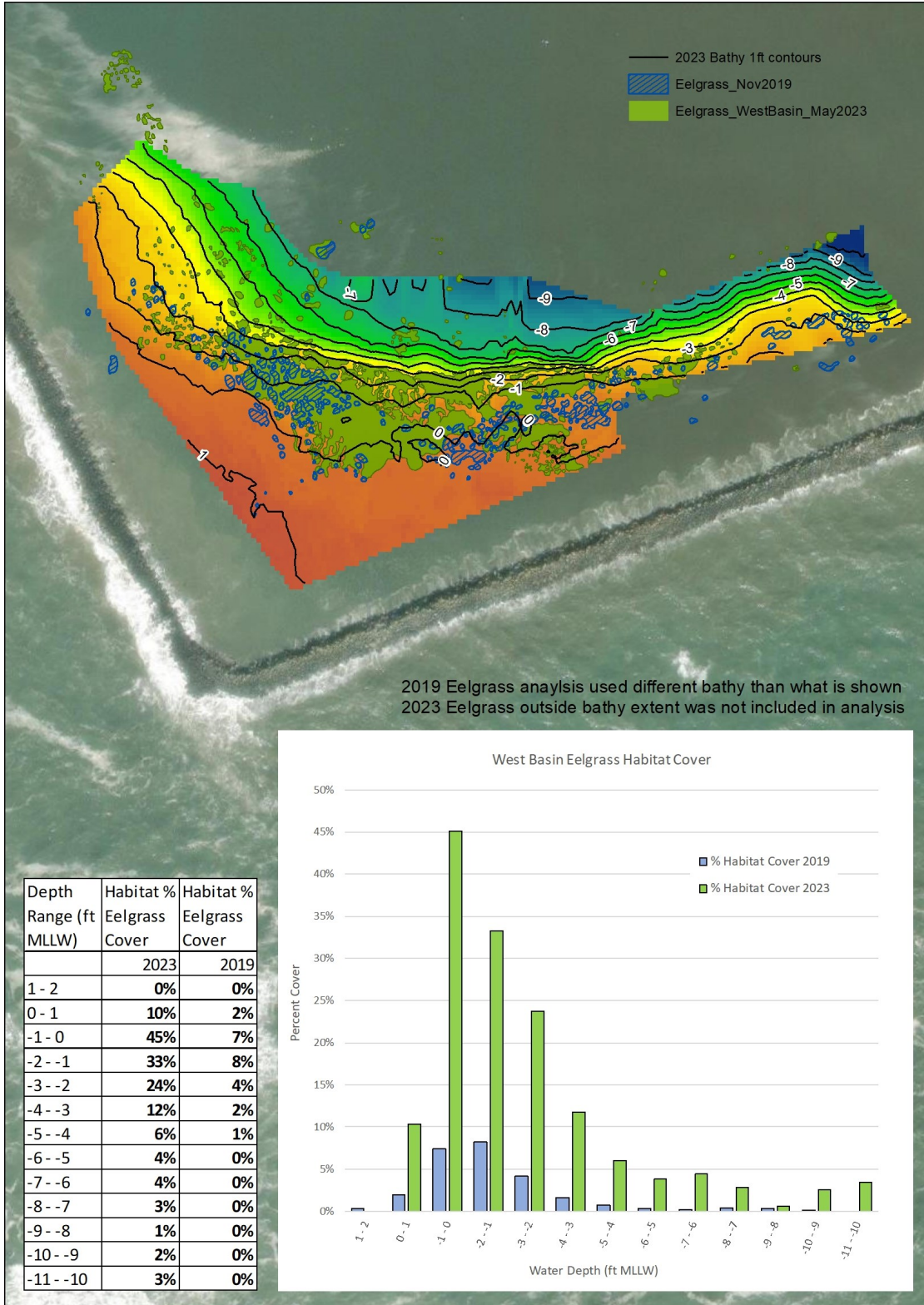


Figure 6. Map of the west basin with the results from the bathymetry data and eelgrass data (MTS 2019 & 2023). The table within the figure at left and the graph at right show the percent occurrence of eelgrass cover within each 1-ft depth contour.

5 Mitigation

Under the proposed Projects, direct impacts to eelgrass habitat will occur. Any direct loss or significant indirect impacts to eelgrass would be mitigated in accordance with the provisions of the CEMP (NMFS 2014). The CEMP requires that mitigation be provided for losses to eelgrass beds directly or indirectly damaged by Project elements. For each square meter of eelgrass adversely impacted, 1.2 square meters of new eelgrass habitat must be created. The goal of this mitigation plan is to develop a mitigation site that can be utilized for the initial transplant and expanded upon, if necessary, to comply with mitigation needs and mitigation site success.

Removal of eelgrass by dredging in the east basin will result in direct impacts to 773 square meters of vegetated eelgrass habitat and result in a need to establish 928 square meters of eelgrass. However, the mitigation site as presented below will result in fill being placed over 135 square meters of eelgrass. This will require an additional 162 square meters of newly established eelgrass beds to meet the mitigation requirements. Based on the known Projects and mitigation site impacts a total of 1,090 square meters of eelgrass are required based on the 1.2:1 mitigation ratio. In central California areas (ranging from the Point Conception to the mouth of San Francisco Bay) the CEMP recommends a planting area of 1.2:1 to meet the requirement. The planting area goal and the mitigation ratio are the same because there were only 4 evaluated transplants to establish the criteria and all of them were successful. Any conservative planning approach should increase the planting area to account for the fact that not all of the planting area will successfully support eelgrass. A similar approach was used during the transplants referenced in the CEMP. The planting area in this mitigation plan is 9,987 square meters and is 9.2 times larger than the mitigation requirement. The size of the planting area is larger than the eelgrass mitigation requirement for three reasons. First, conservative planning to ensure success. Second, much of the graded area contains slope with depths less suitable to support eelgrass. Finally, the model results predict that the proposed site will support 1,846 square meters of eelgrass. This is 1.7 times larger than the mitigation requirement.

5-1 Mitigation Site

An area for eelgrass mitigation has been identified in the west basin (Figure 7). The identified mitigation site occurs adjacent to an existing eelgrass bed and occurs on top of some scattered smaller patches of eelgrass. The proposed mitigation site is enough to accommodate the initial mitigation need based on the current estimate of potential impacts.

The mitigation site was chosen to capitalize on areas within PPH that have the potential to support eelgrass habitat. The localized growth of eelgrass within the PPH suggests that eelgrass growth may be limited by various environmental parameters within the harbor including water circulation, turbidity, nutrient inputs, presence of competing algae species, and sediment grain size. By selecting an area within PPH that already supports eelgrass and optimizing the areas around the eelgrass to support mitigation needs, the potential for mitigation site success may be higher relative to other areas more removed from eelgrass supporting areas.

Proposed mitigation site modifications would result in the creation of a 9,987 square meter eelgrass restoration and mitigation site. Most of the site (6,928 square meters) would be contoured to provide eelgrass habitat between -2 and -3 ft MLLW. The remaining depths to approximately -9 ft MLLW would occur on the slope supporting the site where the site would meet the existing bathymetry. A total of 11,227 cubic yards of fill material are needed to create the mitigation site. These values may change slightly during engineering and final design of the site by ESA.

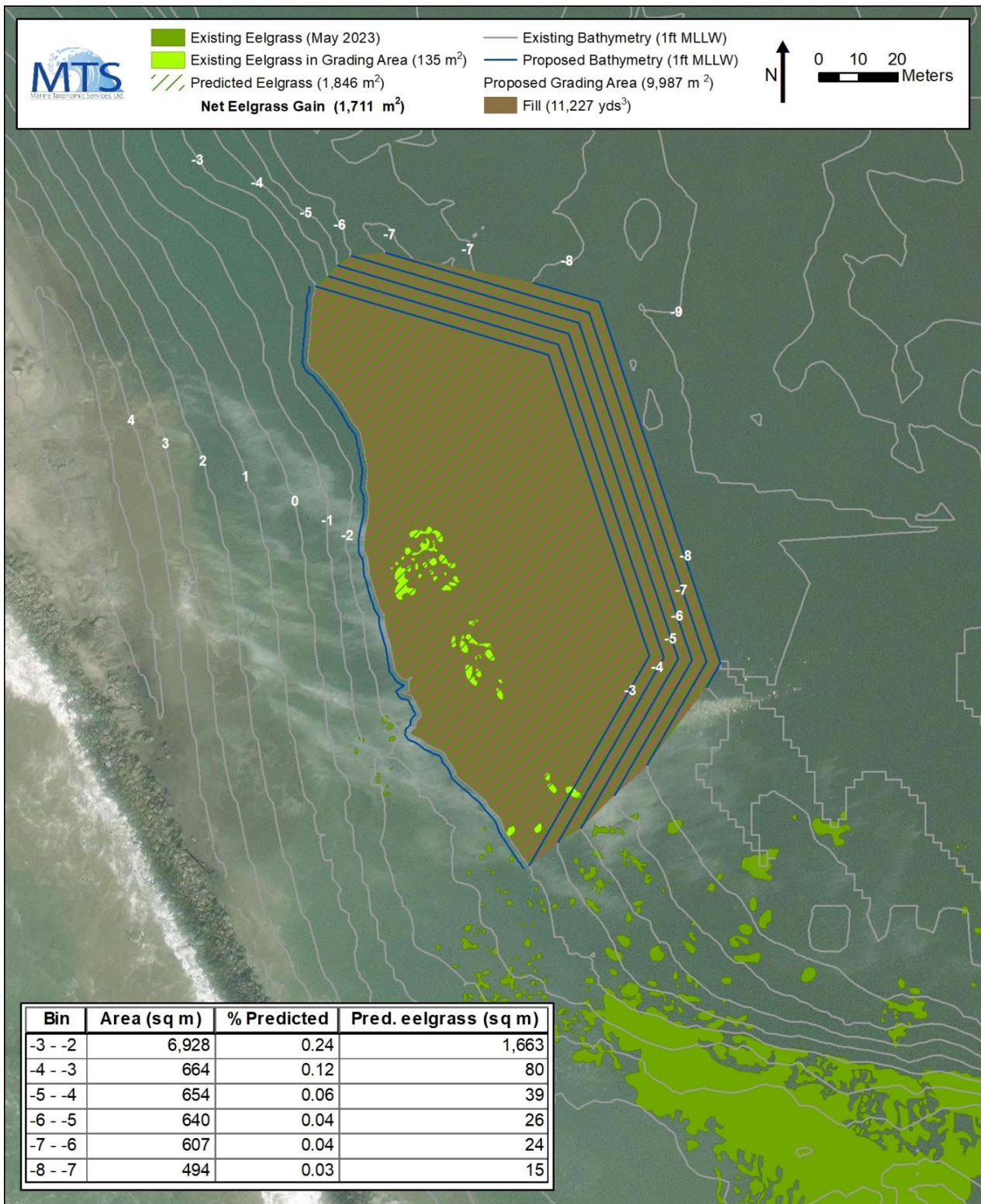


Figure 7. Map showing the current condition of the selected mitigation site where eelgrass would be planted. Contour lines (bathymetry) represent current conditions.

5-2 Secondary Mitigation Sites

As noted above, the creation of the mitigation site will result in additional impacts to eelgrass where the proposed mitigation site will be built on top of 135 square meters of existing eelgrass. During planning meetings with representatives from National Marine Fisheries Service, it was requested that this impacted eelgrass be salvaged. Given that the eelgrass cannot be salvaged and stored for use on the mitigation site, secondary mitigation sites are proposed. These secondary mitigation sites will act as receiver sites for eelgrass to be salvaged from within the footprint of the mitigation site prior to creation of the mitigation site.

Two secondary mitigation sites are proposed to act as receiver sites for salvaged eelgrass. One each will be placed on the north of the proposed mitigation site and immediately east of the eelgrass bed in the west basin (Figure 8). The sites will not receive any form of modification. They were chosen to be near existing eelgrass and in water of similar depth to the eelgrass that is currently growing within the proposed footprint of the mitigation site. Each of the sites is 400 square meters for a total secondary mitigation site area of 800 square meters. The amount of area was selected based on the following assumptions. First there will be 135 square meters or more of eelgrass growing within the mitigation area footprint when it is time to salvage the eelgrass. Second, that eelgrass density will be at least 50 turions per square meter. This combination results in 6,750 turions being present. That is enough eelgrass to create 1,125 planting units composed of an average of 6 turions each. However, divers will not be 100% efficient at harvesting the eelgrass present. Moreover, not all of the harvested eelgrass will be suitable for creation of eelgrass bundles. For these reasons, it is assumed that there will be enough material to plant 800 square meters with one eelgrass bundle per square meter. Eelgrass harvest and planting methods are the same as those provided below for the mitigation site.

It should be noted that the need for the secondary mitigation sites is dependent upon the assumption that eelgrass will be impacted within the footprint of the proposed mitigation site. If no eelgrass is identified within the mitigation site footprint prior to construction, there will be no need to designate the secondary mitigation sites. If there is more or less eelgrass at the time of the construction, the secondary sites may be reduced or expanded as necessary to adequately act as receiver sites for the salvaged eelgrass. If the site boundaries are modified, they will not be modified in any way that interferes with existing eelgrass resources. Given the uncertainty associated with the secondary mitigation sites, both in terms of whether they will be necessary and the extent to which they will successfully support eelgrass, they will be tracked as part of the performance monitoring, but they are not considered as part of the planting ratio relative to the mitigation requirement. This is an additional part of the conservative approach to ensuring successful mitigation.

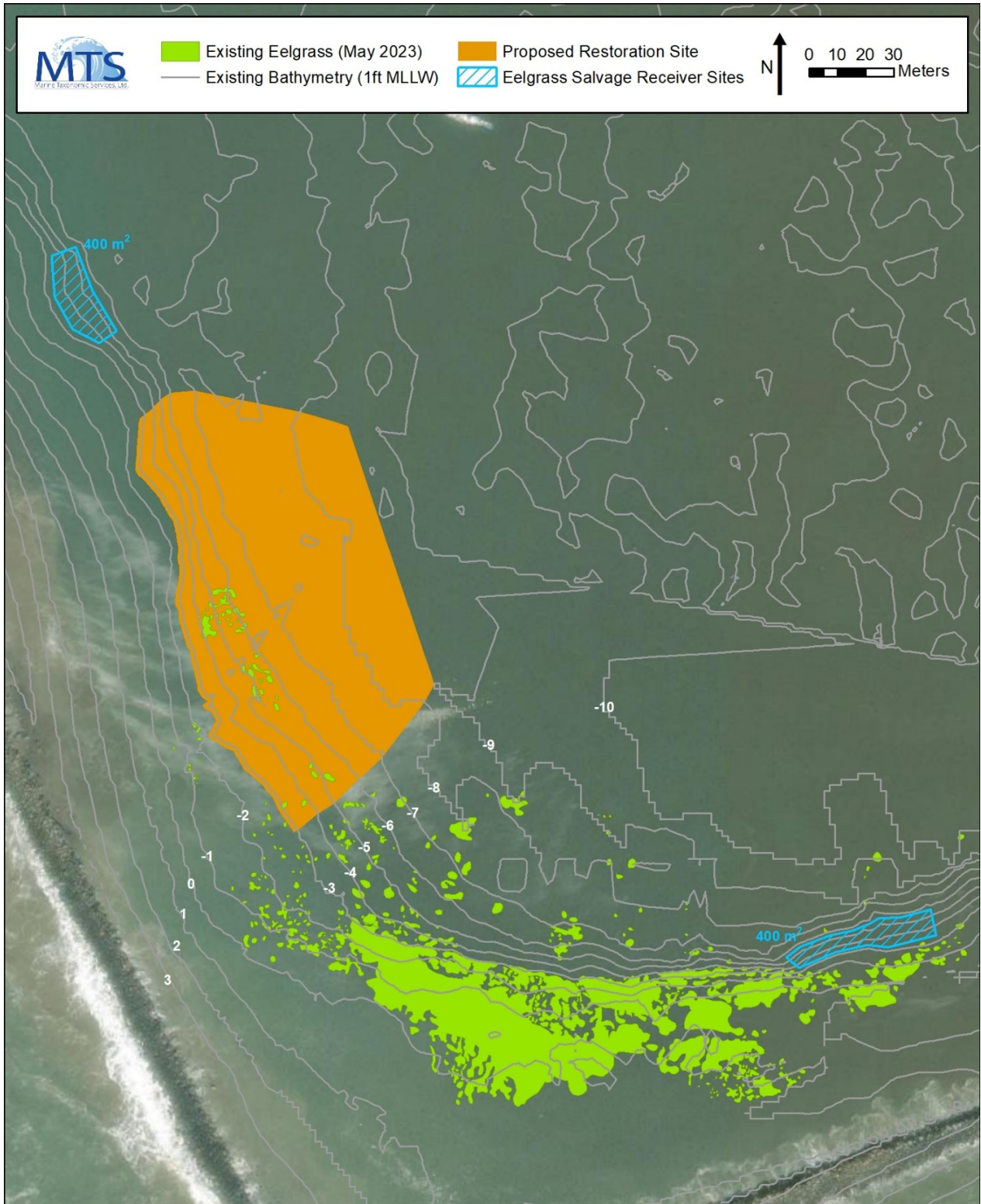


Figure 8. Map showing the locations of the proposed secondary mitigation sites that will act as receiver sites for eelgrass salvaged from the footprint of the mitigation site prior to construction.

5-4 Proposed Mitigation Methods

5-4.1 Eelgrass Harvesting Methods

Eelgrass existing within the PPH east basin is located within areas proposed for dredging as part of the Surfers Beach Pilot Restoration Project and Pillar Point Boat Launching Facility Maintenance. Any eelgrass harvest material required for transplanting at the proposed mitigation site would be salvaged from proposed dredge footprints (prior to dredging). Since all harvested eelgrass would be salvaged from areas proposed to be dredged, there is no need to designate a specific harvest site within existing eelgrass beds for collecting donor material. Additionally, there is no need for harvest site monitoring once donor material has been collected because the collection would be considered as salvage. The goal for eelgrass utilized as part of the transplant effort would be to salvage all required material within the east basin and not require any additional eelgrass from other areas outside of PPH. The harvest site was selected based on the following factors:

- Eelgrass would be entirely salvaged from proposed dredge areas.
- Proximity to the mitigation site allows for logistical suitability, including similar oceanographic conditions for the transplant material, similar environmental conditions between harvest and mitigation site, ease of access and diver safety.
- Appropriate genetic profile for eelgrass growing in the region.
- Prevention of the spread of invasive species.

Donor material will be harvested by first removing loose sediment around the rhizome and then removing the rhizome using a hand raking method. Care will be taken when removing rhizomes to avoid tearing or ripping them to preserve as much rhizome as possible. This method minimizes disturbance to surrounding eelgrass and substrate, however surrounding eelgrass and substrate is to be dredged so impacts are negligible. Collected rhizomes will be loosely placed in mesh bags for processing at the surface. Donor material will be considered viable if there are a minimum of three internodal segments per rhizome. Higher numbers of internodal segments are preferred for improved transplant success.

Once on the surface, donor material will be stored in floating mesh bags in the ocean prior to preparation and in a flow-through seawater system during processing. Material will be stored no longer than 24 hours from harvesting to transplant unit preparation. Once prepared, transplanted units will be stored in open water no longer than 24 hours prior to planting.

5-4.2 Eelgrass Transplanting Method

Eelgrass harvested from the harvest site will be bundled into transplant units comprised of approximately 5-8 turions each. This bundling method has a high success rate in achieving self-sustaining eelgrass habitat post-transplanting (Merkel 1988). Transplant units will be installed by hand digging a hole approximately the size of the unit and placing the unit with the rhizomes approximately two inches below the surface. The unit will then be anchored to the substrate using biodegradable stakes and the hole will be back filled. Divers will conduct planting on monumented grid system, accessing the planting area from boats. The grid layout will provide for ease of tracking and quality control of planting. Transplant unit spacing will be dependent upon the amount donor material that can be salvaged from the east basin. It is conservatively estimated that 5,000 eelgrass bundles can be created from the eelgrass beds to be salvaged in the east basin dredge footprint. The goal will be to plant the top of the mitigation site (area at -2 to -3 ft MLLW) with units spaced at approximately one unit per 1.5 square meter). This will require approximately 4,600 units to fill the top of the mitigation site. The top of the mitigation site provides for 6928 square meters of area between -2 and -3 feet below MLLW. Any remaining transplant bundles that can be created from the salvaged donor beds will be planted on the slopes where the mitigation site slopes to existing depths.

6 Mitigation Timing

Mitigation will begin upon receipt of state, federal, and local permits and authorizations (including California Department of Fish and Wildlife (CDFW) Letter of Permission for eelgrass harvest) for the Project. All mitigation work shall be conducted within the eelgrass growing season from March through October, as specified in the CEMP (NMFS 2014). Since the mitigation site would be created from multiple dredge events/locations and harvested material would be salvaged from areas proposed for dredging there is an order in which the site can be created most efficiently.

- Eelgrass within the footprint of the proposed mitigation site will be salvaged and transplanted at the secondary mitigation sites.
- Dredge material from the launch ramp will be used to fill and create the mitigation site. Dredge material placed at the mitigation site should be allowed to settle for a minimum of 2 weeks (4 weeks preferred) to allow consolidation of placed material. This will also allow observation of site stability prior to planting.
- Harvest all eelgrass from east basin areas proposed for dredging and transplant in created eelgrass mitigation site.
- Dredge in the east basin can occur once eelgrass salvage in the east basin is complete.

7 Mitigation Monitoring & Performance

7-1 Eelgrass Mitigation Monitoring Surveys

Within the harvest area, pre- and post-harvest surveys are not proposed. All eelgrass material harvested for the transplant effort would come from areas proposed for dredging. Thus, all eelgrass collected would be salvaged from proposed dredge footprints. Since all eelgrass material would be salvaged and any material not salvaged would be lost due to dredging, as much material as can be salvaged from within the dredge footprints will be. This will likely result in eelgrass thinning above that typically permitted (10%) in harvest areas. Given that this is also the eelgrass being mitigated for, any impact associated with harvesting should not be considered by regulatory agencies.

Once the planting effort has concluded, monitoring of the mitigation site will be conducted for 60 months (5 years) to document the success of the mitigation as outlined in the CEMP. Monitoring surveys will begin immediately after transplanting has been completed at intervals of 0, 6, 12, 24, 36, and 60 months post-transplant. The monitoring program will assess the aerial extent, percent cover, and density of eelgrass in the mitigation sites by SCUBA and side-scan sonar. SCUBA divers will swim transects across the mitigation site to confirm side-scan sonar recordings and to randomly place quadrats for density. Monitoring dates will be scheduled during the active eelgrass growing season to collect information on growth and survival.

Additional monitoring after the fifth year may be necessary if the aerial extent and density of eelgrass in the mitigation site does not meet the mitigation performance milestones. The primary reference site will be within the eelgrass beds adjacent to the mitigation site (Figure 9). An additional secondary reference will be located in the remaining eelgrass bed within the east harbor. The primary reference is chosen because it is adjacent to the proposed mitigation site and the secondary mitigation sites. The existing eelgrass beds will be carefully monitored during and after construction to minimize impact and hopefully document the lack of impacts to adjacent eelgrass. Moving forward, this adjacent eelgrass can act as a suitable reference. The secondary reference provides a reference relative to conditions in the east basin for which mitigation is occurring and can act as a reference for any trends in eelgrass occurrence that may occur due to changes in condition at a larger scale.



Figure 9. Map showing the locations of the proposed primary and secondary reference areas.

7-2 Mitigation Performance Milestones

Criteria for transplanting success will be determined based on the mitigation performance milestones as specified in the CEMP and outlined in Table 1 below.

Table 1. Mitigation performance milestones for eelgrass transplanting (CEMP, NMFS 2014)

Monitoring Date (post transplanting)	Performance Milestones
Month 0	Confirmation of full coverage distribution of planting units over the initial mitigation site
Month 6	Persistence and growth of eelgrass in the initial mitigation site 50% survival of initial planting units and well distributed coverage Monitoring date should be flexible to fall within active growth season
Month 12	40% eelgrass coverage in the initial mitigation site 20% density of adjacent reference areas No less than 1.2 times the area of the impact site
Month 36	100% eelgrass coverage in the initial mitigation site 85% density of reference area No less than 1.2 times the area of the impact site
Month 48	100% eelgrass coverage in the initial mitigation site 85% density of reference area No less than 1.2 times the area of the impact site
Month 60	100% eelgrass coverage in the initial mitigation site 85% density of reference area No less than 1.2 times the area of the impact site

7-3 Mitigation Contingency & Adaptive Management

If the eelgrass transplanted fails to meet the established success criteria in the initial mitigation site, supplemental mitigation may be required in consultation with CDFW and NMFS. If additional planting area is required, subsequent maintenance dredging events can be used to create additional mitigation area. The timing of any supplemental transplant would have to be performed in accordance with the dredge schedule. The implications of the potential for supplemental planting should be discussed with NMFS prior to the start of the initial mitigation effort. The District is committed to supporting eelgrass resources by providing supplemental material to expand the mitigation site each time maintenance dredging occurs at the launch ramp. Thus, providing additional material to encourage eelgrass expansion and/or transplant area in the mitigation site.

8 Mitigation Coordination and Schedule

8-1 Letter of Permission and Notifications

Prior to the beginning of the eelgrass transplant work, a letter of permission to harvest and plant eelgrass will be obtained from the CDFW. Also prior to the beginning of the eelgrass transplant work, a scientific collecting permit will be obtained to account for the harvesting of eelgrass within the donor site in accordance with this mitigation plan. A minimum five-day notification and a preliminary transplanting schedule will be given to CDFW prior to commencement of the transplant work.

8-2 Planting Schedule

The project may require phasing of dredge elements to ensure that donor material can be salvaged as described in this document. For instance, the initial cut and fill of the mitigation site can be performed as phase 1. Then donor material can be salvaged from areas designated within the first phase of dredging to plant the upper portions of the mitigation site. During the first phase of dredging additional material can be placed in the mitigation area to provide material to complete the deeper portions of the mitigation site. Then the final eelgrass material can be salvaged from the area designated for the final phase of dredging.

8-3 Monitoring Reports

Monitoring reports shall be provided to the resource agencies (CDFW, NMFS) within 30 days after the completion of each required monitoring period and shall include spatial data. Per the CEMP (NMFS 2014), these reports will include: a description of the action, action party, mitigation consultants, relevant points of contact, and relevant permits; the size of permitted impacted estimates, location of activities, actual eelgrass impacts, and eelgrass mitigation needs; a detailed description of eelgrass habitat survey methods, donor harvest methods, and transplant methods; and mitigation performance milestone progress. The initial monitoring report (0 Month) will document any variance from the mitigation plan, sources of donor material, and the full area of planting. The final monitoring report will include an overall assessment of the performance of the eelgrass mitigation site relative to natural variability of the reference site to evaluate if mitigation responsibilities were met.

8-4 Notification of Completion

If mitigation performance milestones (Table 1) have been met once the final monitoring event has been completed, a Notice of Completion will be forwarded along with the final monitoring report. At that point, implementation of the Mitigation Plan will be considered complete.

9 References

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