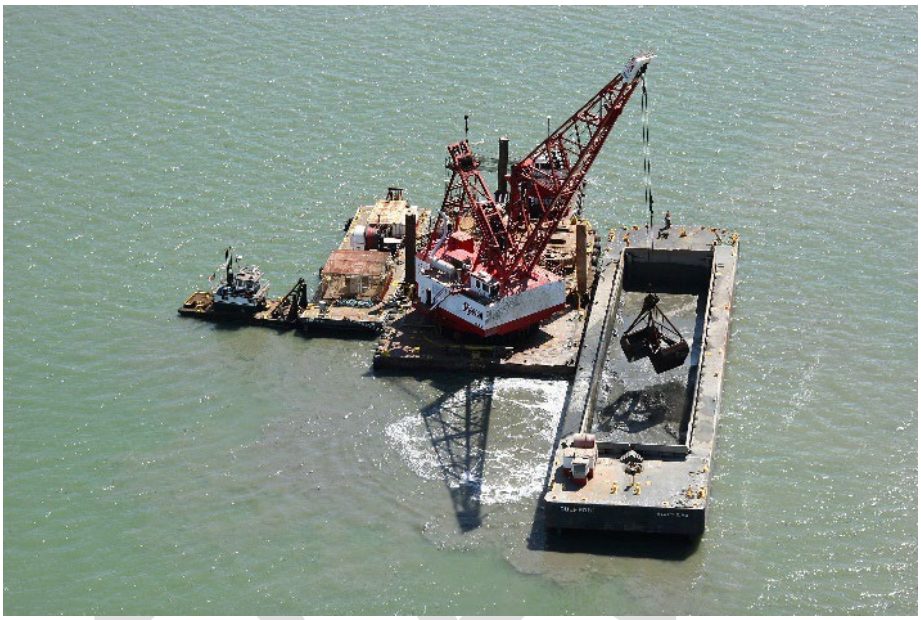
# SAN FRANCISCO BAY REGIONAL DREDGED MATERIAL MANAGEMENT PLAN 2025-2044

22 October 2024



# EXECUTIVE SUMMARY

The Regional Dredged Material Management Plan (RDMMP) is a 20-year plan for the dredging and placement of sediment from the 10 federal navigation projects in SF Bay maintained by the U.S. Army Corps of Engineers (USACE) (Figure ES-1). It is paired with a National Environmental Policy Act (NEPA) document for the USACE operations and maintenance (O&M) dredging program with implementation starting in 2025. The RDMMP presents a detailed assessment of dredging and dredged-material placement alternatives for federally authorized navigation channels within the study area and establishes a regional Federal Standard Base Plan, i.e., the least cost, environmentally acceptable, and technically feasible dredge material conveyance and placement option.

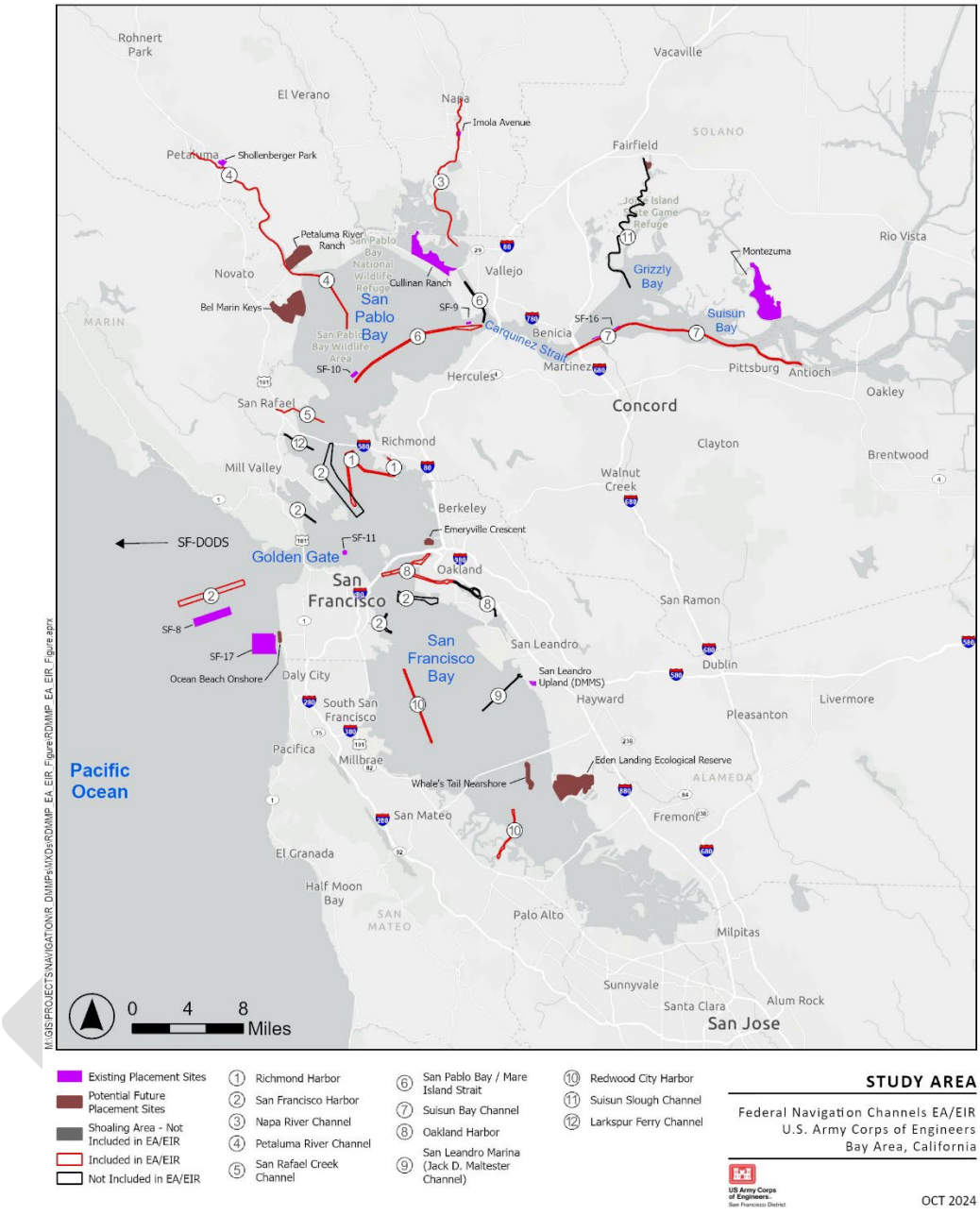



*Figure ES-1. The Study Area for the RDMMP showing federal navigation projects and placement sites in the San Francisco Bay Area. Three of the navigation projects listed in this figure, the Jack D. Maltester Channel, the Suisun Slough Channel, and the Larkspur Ferry Channel are not included in the RDMMP or corresponding NEPA/CEQA document.*

This RDMMP evaluates available placement options and capacities, specifically with a focus on the beneficial use of dredged material (BU) and coastal resilience, given the uncertainty of future climate and sea-level-rise conditions. A main goal of this 20-year RDMMP is to maximize BU opportunities, in line with Command Philosophy (70% BU by 2030 across USACE) and the USACE San Francisco District priorities, which include improving natural infrastructure by restoring critical ecosystem habitat; enhancing flood protection for low-lying, historically disadvantaged and socially vulnerable communities; and increasing regional resiliency to climate change hazards, including sea-level rise.

The RDMMP Project Delivery Team (PDT) developed four action alternatives in the array specifically focused on increasing BU relative to the current navigation program. These action alternatives were compared against the current condition (the no-action alternative), which is referred to as the Future Without Project condition (FWOP). The array of alternatives include:

Alternative 1: Diversion from San Francisco Deep Ocean Disposal Site (SF-DODS)

Alternative 2: Regional Optimization through Leveraging of Hopper Dredging

Alternative 3: Cost-share Opportunities above the Federal Standard Base Plan

Alternative 4: Maximizing BU above of the Federal Standard Base Plan

The USACE-preferred alternative is Alternative 2, Regional Optimization through Leveraging of Hopper Dredging and Retaining Sediment in the Bay System (hereinafter "Regional Optimization") because it results in the most BU as part of the Base Plan (at full federal cost) and contributes significantly to the Chief's 70/30 Goal across the enterprise by 2030 (see Table ES-1 and Figure ES-2).

*Table ES-1: Draft array of alternatives and their approximate costs.*

| Alternative | Name | Annualized Average Cost ($) |
|---|---|---|
| | Future Without Project Condition (FWOP) | $40,974,000 |
| 1 | BU – Diversion from Deep Ocean Disposal | $40,974,000 |
| 2 | BU – Regional Optimization, Leverage Hopper Dredging | $40,974,000 |
| 3 | BU – Cost-share Opportunity | $50,795,000 |
| 4 | BU - Maximized | $71,738,000 |

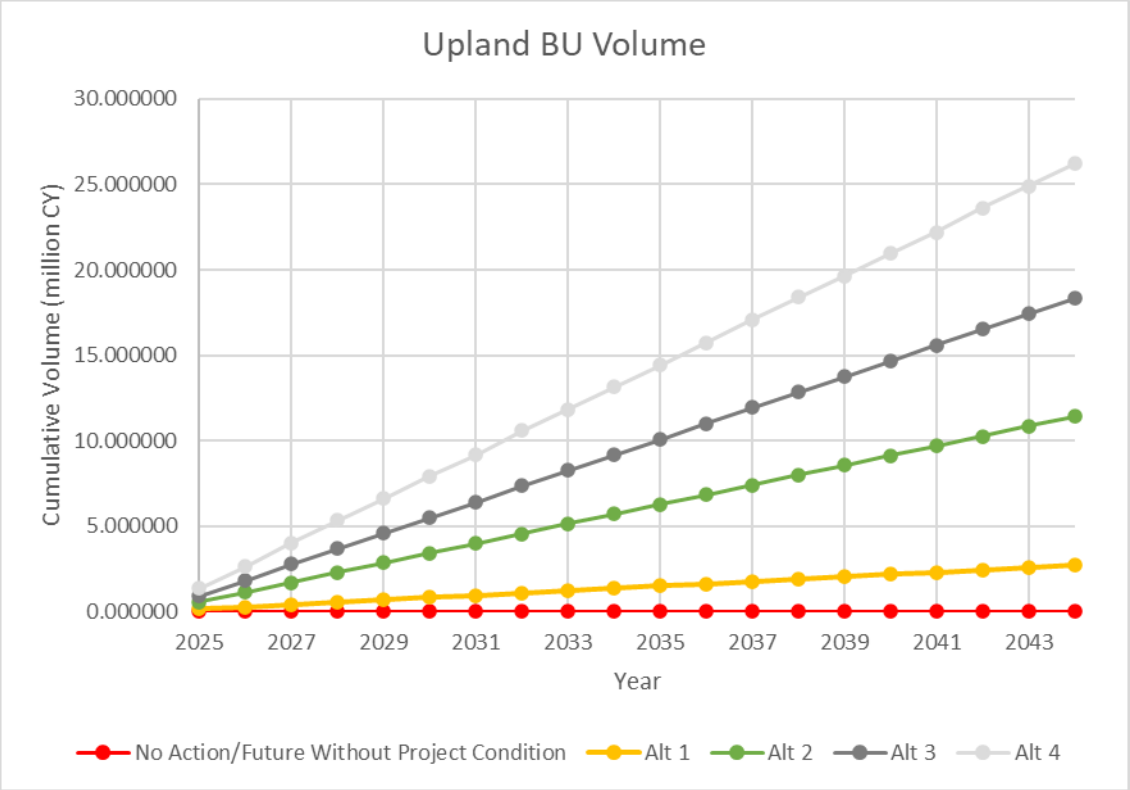



*Figure ES-2: Cumulative volume of upland BU volume for the four action alternatives and FWOP color-coded in Table ES-1. Alternative 2 (Regional Optimization) results in 11.5 million CY more upland BU than FWOP over the project lifetime and is the most beneficial Federal Standard Base Plan candidate.*

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# List of Acronyms, Initialisms, and Abbreviations

| | |
|---|---|
| ABAG | Association of Bay Area Governments |
| BayCAN | Bay Area Climate Adaptation Network |
| BCDC | San Francisco Bay Conservation and Development Commission |
| BPC | Bay Planning Coalition |
| BU | Beneficial Use |
| BUDDI | Beneficial Use Decision Document Integration |
| BUDM | Beneficial Use of Dredged Material |
| CAD | Confined Aquatic Disposal |
| CBO | Community Based Organization |
| CCC | California Coastal Commission |
| CDF | Confined Disposal Facility |
| CDFW | California Department of Fish and Wildlife |
| CEJST | Climate and Economic Justice Screening Tool |
| CEQ | Council on Environmental Quality |
| CEQA | California Environmental Quality Act |
| CFR | Code of Federal Regulations |
| CRSMP/R | Coastal Regional Sediment Management Plan/Report |
| CLSC | California State Lands Commission |
| COPC | California Ocean Protection Council |
| CSMW | Coastal Sediment Management Workgroup |
| CSRM | Coastal Storm Risk Management |
| CWA | Clean Water Act |
| CY | Cubic Yards |
| CZMA | Coastal Zone Management Act |
| DIS | Dredging Information System |
| DMMO | Dredged Material Management Office |
| DMMP | Dredged Material Management Plan |
| DQC | District Quality Control |
| EA | Environmental Assessment (National Environmental Policy Act) |
| EFH | Essential Fish Habitat |
| EIR | Environmental Impact Report (California Environmental Quality Act) |
| EIS | Environmental Impact Statement |
| EM | Engineer Manual |
| ER | Engineer Regulation |
| ESA | Endangered Species Act |
| EWN | Engineering with Nature |
| FWCA | Fish and Wildlife Coordination Act |
| FWOP | Future Without Project Condition |
| GFNMS | Greater Farallones National Marine Sanctuary |
| GGBHTD | Golden Gate Bridge Highway and Transportation District |
| HWRP | Hamilton Wetlands Restoration Project |
| IWG | Interagency Working Group |
| IWR | Institute for Water Resources (USACE) |
| JFB | John F. Baldwin |
| LERRD | Lands, Easements, Rights of Way, Relocations, and Disposal |
| LTMS | Long Term Management Strategy |
| MLLW | Mean Lower Low Water |
| MPRSA | Marine, Protection, Research, and Sanctuaries Act |
| MSC | Main Ship Channel |

| | |
|---|---|
| MTC | Metropolitan Transportation Commission |
| NCCSCC | North-Central California Coast Sediment Coordination Committee |
| NED | National Economic Development |
| NEPA | National Environmental Policy Act |
| NFS | Non-Federal Sponsor |
| NHPA | National Historic Preservation Act |
| NFMS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NRHP | National Register of Historic Places |
| O&M | Operations and Maintenance |
| OMRR&R | Operation, Maintenance, Repair, Replacement, and Rehabilitation |
| PA | Preliminary Assessment |
| PED | Pre-construction Engineering and Design |
| P&G | Principles and Guidelines |
| PM | Project Manager |
| PMP | Project Management Plan |
| POOCs | Problems, Opportunities, Objectives, and Constraints |
| RDMMP | Regional Dredged Material Management Plan (San Francisco Bay) |
| RED | Regional Economic Development |
| RSM | Regional Sediment Management |
| SF | San Francisco |
| SF-DODS | San Francisco Deep Ocean Disposal Site |
| SFEI | San Francisco Estuary Institute |
| SHPO | State Historic Preservation Officer |
| SLC | Sea-Level Change |
| SLR | Sea-Level Rise |
| SME | Subject Matter Expert |
| SPN | US Army Corps of Engineers San Francisco District |
| SWAP | San Francisco Bay Sediment for Wetland Adaptation Project |
| TP | Transitional Placement |
| TSP | Tentatively Selected Plan |
| USACE | US Army Corps of Engineers |
| USC | US Code |
| USGS | US Geologic Survey |
| USEPA | US Environmental Protection Agency |
| USFWS | US Fish and Wildlife Service |
| VE | Value Engineering |
| WQC | Water Quality Certification (Section 401 of the Clean Water Act) |
| WRDA | Water Resources Development Act |
| WRMP | Wetlands Regional Monitoring Program |

# Introduction

Sediment transport processes continuously redistribute sediment across San Francisco (SF) Bay, leading to erosion and deposition in different areas. While predicting sediment transport and erosion/deposition rates is challenging, the accumulation of sediment over time, also known as shoaling, occurs in all federal navigation channels. This shoaling raises the channel bed elevation, resulting in shallower depths than originally designed, which limits the draft and/or transit route for all vessels. In response, Congress authorized USACE to maintain certain depths to specific federal channels, done by removing this sediment by dredging, the process of excavating accumulated sediment from the bay or ocean bottom (i.e., benthic environment), to maintain navigation project depth; and to ensure the safety and functionality of navigable waterways for national security and economic purposes.

This document analyzes and describes options for the removal and placement of accumulated sediment from federal navigation channels in SF Bay, California. The Regional Dredged Material Management Plan (RDMMP) is a 20-year plan for the dredging and placement, of the resulting dredged sediment from the 10 federal navigation projects in SF Bay maintained by the U.S. Army Corps of Engineers (USACE). It is paired with a National Environmental Policy Act (NEPA) document for the USACE operations and maintenance (O&M) dredging program with implementation starting in 2025. The RDMMP presents a detailed assessment of dredged-material placement alternatives for federally authorized navigation channels within the study area and establishes the Federal Standard[1] Base Plan, i.e., the least cost, environmentally acceptable, and technically feasible dredging and placement option (see The Federal Standard).

Prior to this RDMMP, each SF Bay navigation project maintained its own Federal Standard, or least-cost dredging method and placement location. While one placement site for a specific project may be suitable, the interconnectedness of the projects and placement sites within the SF Bay area necessitates a comprehensive approach. Therefore, this RDMMP develops a regional Federal Standard that takes into consideration site capacity limits, environmental work windows, and any other characteristics of dredging that may be optimized via a regional, rather than case-by-case, approach. The benefits of a regional approach include cost savings, improved partnerships, improved regional and project sediment management, and improved environmental stewardship.

Key drivers behind the need to develop an RDMMP include the following:

- Uncertainty with future placement site availability; it is unclear if currently available placement locations will continue to have the capacity to accept dredged material in the next 20 years.
- Changing environmental and climate conditions; sea-level rise and other environmental processes could impact dredging operations.
- Increased BU opportunities in line with USACE policy, the district's strategic goal to develop a multi-benefit navigation program that preserves the environment (https://www.spn.usace.army.mil/About/Mission-and-Vision/), and the USACE 2023 Command Philosophy, which states that dredged material is a valued resource that is "not to be wasted,

[1] The Federal Standard is defined as the least-costly dredged material disposal or placement alternative consistent with sound engineering practices and meeting the environmental standards established by the Section 404(b)(1) evaluation process or ocean dumping criteria (33 C.F.R. § 335.7).

but instead used for benefits to the ecosystem, economy, and to deliver the USACE mission more effectively and efficiently." It also sets an agency-wide goal of 70% BU by 2030.

This RDMMP evaluates available placement options and capacities, specifically with a focus on BU and coastal resilience given the uncertainty of future climate and sea- level-rise conditions. A main goal of this 20-year RDMMP is to maximize BU opportunities, in line with Command Philosophy and district priorities, which may improve natural infrastructure by restoring critical ecosystem habitat; enhancing flood protection for low-lying, historically disadvantaged and socially vulnerable communities; and increasing regional resiliency to climate change hazards including sea-level rise. Additionally, this RDMMP sets a foundation for a cooperative permitting framework that reduces redundancy and unnecessary delays in permit processing.

## Study Authority

### Operation and Maintenance Responsibility for Existing Federal Projects

USACE policy dictates that management plan studies "shall be conducted pursuant to existing authorities for individual navigation project feasibility studies, Pre-construction Engineering and Design (PED), construction, or O&M, as provided in Congressional Committee study resolutions and public laws authorizing specific projects" (Engineering Regulation (ER) 1105-2-100). All federal navigation channels in the SF Bay RDMMP were authorized by Congress, with funds appropriated for construction in associated years. Navigation projects require regular maintenance to achieve authorized depths. Table 1 shows a list of the navigation projects with their authorizations and O&M Authorities.

*Table 1. USACE federal navigation project authorizations and O&M authorities, for SF Bay projects.*

| Navigation Project | | Authorized Depth (ft below MLLW) [1] | O&M Authority | | Dredging Recurrence (years) | Authorizations |
|---|---|---|---|---|---|---|
| | | | Length | Width | | |
| **Oakland Harbor** | Entrance Channel (Outer Harbor) | 50 | 3,600 | 1,050 | 1 | 23 Jun 1874; 14 Aug 1876; 5 Jul 1884; 3 Jan 1901; 13 Jun 1902; 4 Feb 1910; 25 Jun 1910; 17 Feb 1911; 4 Mar 1913; 8 Aug 1917; 24 May 1918; 2 Mar 1919; 3 Jan 1922; 21 Sept 1922; 29 May 1926; 21 Jan 1927; 28 Apr 1928; 3 Jul 1930; 17 Dec 1941; 2 Mar 1945; 23 Oct 1962; 17 Nov 1986; 17 Aug 1999. |
| | Oakland Inner Harbor | 50 | 21,100 | 600 - 950 | 1 | |
| | Oakland Outer Harbor | 50 | 16,720 | 600 - 1000 | 1 | |
| | Brooklyn Basin South Channel | 35 | 14,380 | 600 | - | |
| | Brooklyn Basin North Channel | 25 | 4,900 | 450 | - | |
| | Tidal Canal | 18 | 8,760 | 300 | - | |
| **Redwood City Harbor** | Entrance Channel | 30 | 15,460 | 300 - 350 | 1 | 8 Nov 2007; 17 Nat 1950; 2 Mar 1945; 30 Aug 1935; 3 Jul 1930; 25 Jun 1910; 13 Jun 1902; 5 July 1884. |
| | Outer Turning Basin | 30 | 2,210 | 400 - 900 | 1 | |
| | Connecting Channel | 30 | 1,320 | 400 | 1 | |
| | Inner Turning Basin | 30 | 1,550 | 900 | 1 | |
| | Inner Channel[5] | 30 | 7,000 | 150 | 1 | |
| | San Bruno Channel | 30 | 29,910 | 510 | 1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Richmond Harbor** | Southampton Shoal | 45 | 17,424 | 600 | 2 | 12 Jan 1914; 8 Aug 1917; 2 Mar 1919; 3 Jul 1930; 30 Aug 1935; 20 Apr 1938; 20 Jun 1938; 2 May 1940; 2 Mar 1945; 19 May 1954; 3 Sep 1954; 27 Oct 1965; 17 Nov 1986. |
| | Outer Harbor at Long Wharf | 45 | 4,535 | 4,095 | 2 | |
| | Inner Harbor Entrance Channel | 41[2] | 5,280 | 1,020 - 600 | 1 | |
| | Inner Harbor Approach Channel | 41[2] | 14,256 | 480 - 1,260 | 1 | |
| | Santa Fe Channel | 30 | 2,420 | 200 | 12 | |
| | Point San Pablo Channel | 20 | 2,000 | 150 | ID | |
| **San Francisco Harbor** | Main Ship Channel (Bar Channel) | 55 | 26,210 | 2,000 | 1 | 25 Jul 1868, 3rd Nar 1899; 13 Jun 1902; 9 Dec 1908; 25 Jun 1910; 8 Aug 1917; 2 Mar 1919; 21 Jan 1927; 9 Mar 1928; 20 Aug 1935; 26 Aug 1937; 17 May 1950; 27 Oct 1965. |
| | Marin Ship Channel (Richardson Bay)[3] | 20 | 11,120 | 300 | ID | |
| | Alameda Point Navigation Channel[3] | 37 | 15,430 | 1,000 | ID | |
| | North Ship Channel[3] | 45 | 31,230 | 3,900 | ID | |
| | West Richmond Channel[3] | 45 | - | - | ID | |
| | Islais Creek Shoal[3] | 40 | 8,890 | 500 | ID | |
| | Presidio Shoal[4] | 40 | - | - | - | |
| | Black Point Shoal[4] | 40 | - | - | - | |
| | Alcatraz Shoal[4] | 40 | - | - | - | |
| | Point Knox Shoal[4] | 35 | - | - | - | |
| **San Pablo Bay/ Pinole Shoal** | Pinole Shoal | 35 | 54,700 | 600 | 2 | 8 Dec 1908; 17 May 1917; 25 Mar 1918; 2 Mar 1919; 8 Dec 1925; 14 May 1941; 21 May 1941; 17 Jun 1965 |
| | Mare Island Strait[3] | 35 | 17,750 | 600 | ID | |
| **Suisun Bay Channel** | Main Channel (including Bulls Head Ranch) | 35 | 73,300 | 350 | 1 | Rivers & Harbors Act 4 Mar 1913; House Document 25 Mar 1918; Rivers and Harbors Act 2 Mar 1919; House Document 8 House Document Jan 1925; Rivers & Harbors Act 21 Jan 1927; House Document 17 Jun 1965; Baldwin Act of Rivers & Harbors 27 Oct 1965 |
| | New York Slough | 35 | 23,170 | 400 | 1 | |
| | South Sea Island Channel[3] | 25 | 5,600 | 250 | Infrequent | |
| **Napa River Channel** | Lower Napa River Channel (Mare Island Strait Causeway to Asylum Slough) | 15[6] | 52,350 | 100 | 6 – 11 | Rivers & Harbors Acts- August 11, 1888; March 2, 1919; August 30, 1935; July 24, 1946 |
| | Upper Napa River Channel (Asylum Slough to Third Street) | 10[7] | 16,800 | 75 | 6 – 11 | |
| **Petaluma River Channel** | Across the Flats | 8 | 29,990 | 200 | 4 – 7 | Rivers & Harbors Acts- June 14, 1880; March 3, 1925; July 3, 1930 |
| | River Channel | 8 | 21,760 (N) | 100 | 4 – 7 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | 54,370 (S) | 100 | | |
| **San Rafael Creek Channel** | Across the Flats | 8 | 11,880 | 100 | 7 | Rivers & Harbors Act- 1919 |
| | Inner Canal Channel | 6 | 8,180 | 60 | 4 | |
| | Turning Basin | 6 | 200 | 100 | 4 | |

Notes:

[1] Some federally authorized channels are not maintained to their authorized depth.
[2] Channel is authorized to 41 feet MLLW, but, maintained to 38 feet MLLW.
[3] Dredge locations that are not anticipated to require maintenance dredging in the planning horizon
[4] Shoal location where rocks were removed.
[5] Channel not presently maintained by
USACE.
[6]Channel is authorized to 15 feet MLLW, but is maintained at 9 feet MLLW.
[7]Channel is authorized to 10 feet MLLW, but is maintained at 9 feet MLLW.
Key:
- Information not available
MLLW = Mean Lower Low Water
MWRP = Montezuma Wetland Restoration Project
Dredge project location that will not be dredged by USACE in the planning horizon

## Preliminary Assessment Findings

Preliminary Assessments (PAs) are conducted at the beginning of the DMMP process to determine the adequacy and relevance of previously existing information for the continuation of dredging/placement activities. PAs seek to determine economic and engineering needs, identify locations and volumes of dredged materials, examine existing dredged material placement sites, and provide estimated costs for completing a DMMP.

PAs were conducted in 2019-2020 for the following channels: Larkspur Ferry Channel, Napa River Channel, Oakland Harbor, Suisun Bay Channel, Suisun Slough, SF Harbor, Petaluma, Richmond Harbor, San Leandro Marina (Jack D. Maltester Channel), San Pablo Bay and Mare Island Strait, and San Rafael Channel. Findings from these PAs indicate that, in the near-term, there is sufficient capacity to place dredged material at existing placement sites. However, there is significant uncertainty regarding the long-term capacity over the next 20 years due to potential future site restrictions, changes in BU opportunities, increase in volume of dredge material due to future new-work, and evolving environmental compliance requirements.

The recommendation based on the PA findings was to develop an RDMMP that addresses the interconnected nature of the federally authorized and maintained navigation channels in the SF Bay area and their associated placement capacities.

## Purpose

The purpose of the SF Bay RDMMP is to develop a comprehensive 20-year strategy for the dredging of the 10 USACE federal navigation projects in the SF Bay Area and placement of the resulting dredged material, given the interconnected nature of the channels, projects, and placement capacity, with implementation starting in 2025. For more information on the purpose and need for navigation dredging, see the Purpose and Need section in the companion NEPA document.

### Navigation Need for Dredging

Maintenance of navigational channels is essential to sustain both recreational and commercial activities in the SF Bay. The USACE, as mandated by Congress, is responsible for maintaining navigability of federal navigation channels up to authorized depth. Accumulation of sediment that settles in these channels can impede navigability. Maintenance dredging removes this sediment and returns the channels up to authorized depths to provide safe, reliable, and efficient waterborne transportation systems (channels, harbors, and waterways) for the movement of commerce, national security needs, and recreation.

### NEPA Documentation

The purpose of the SF Bay RDMMP does not include analyzing impacts or satisfying NEPA requirements. The 20-year SF Bay RDMMP has been developed concurrently with a 10-year joint NEPA/California Environmental Quality Act (CEQA) document. The 2025-2034 NEPA/CEQA document addresses the environmental effects of the maintenance dredging of federal navigation channels in SF Bay and the associated placement of dredged material for that 10-year period. The USACE is the NEPA lead agency, and the Waterboard is the CEQA lead agency. The 2025-2034 NEPA/CEQA document is consistent with and built upon the previously prepared 2015 EA/EIR, and other approved management plans. The 2025-2034 NEPA/CEQA document is included as a companion document to this decision document.

The RDMMP and NEPA analysis are parallel and inter-related.

## Study Area Description

As shown in Figure 1, the RDMMP study area includes 10 federal navigation channels, 11 existing placement sites, and an array of potential future placement sites. These channels and placement sites extend from approximately 55 nautical miles offshore at the San Francisco Deep Ocean Disposal Site (SF-DODS), through the Golden Gate Bridge, to the border of the Sacramento-San Joaquin Delta (Delta); the Delta border being defined herein as the upstream limit of the Suisun Bay Channel. The study area encompasses the federal navigation channels and placement sites in the following 9 counties: Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo, and San Francisco. The geographic scope of the study area includes the estuarine waters of the San Francisco Bay region (including the tidally influenced portion of tributaries of San Francisco Bay), portions of the Sacramento-San Joaquin River Delta (Delta) west of Sherman Island, and the western portion of the Sacramento River Deep Water Ship Channel and Stockton Deep Water Ship Channel. Outside of the Golden Gate, the study area includes the San Francisco Deep Ocean Disposal Site (SF-DODS), the San Francisco Main Ship Channel (MSC), San Francisco Bar Channel Placement Site (SF-8), and the nearshore zone off Ocean Beach.

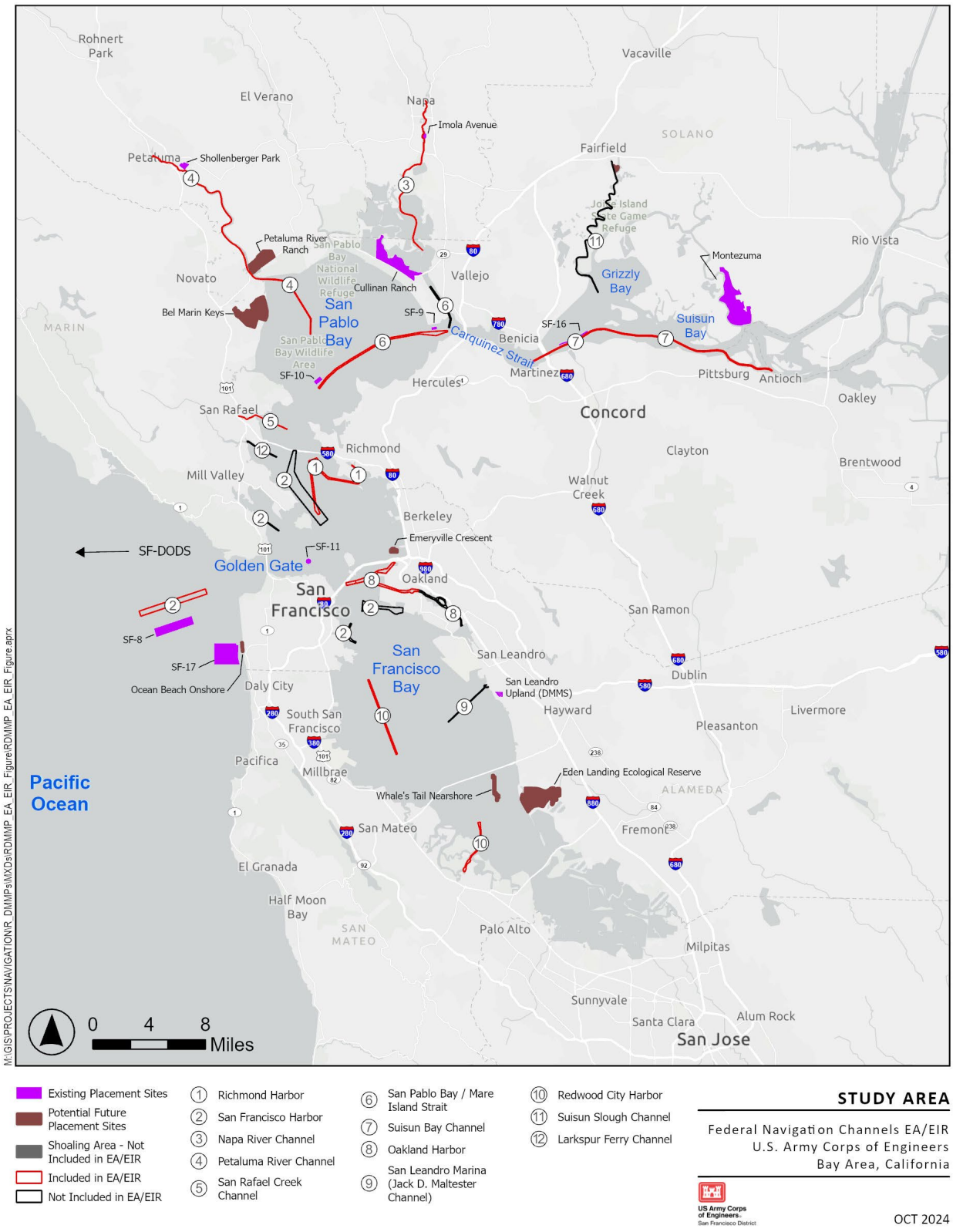


*Figure 1. The Study Area for the RDMMP showing federal navigation projects and placement sites in the San Francisco Bay Area. Three of the navigation projects listed in this figure, the Jack D. Maltester Channel, the Suisun Slough Channel, and the Larkspur Ferry Channel are not included in the RDMMP or corresponding NEPA/CEQA document.*

## San Francisco Bay Wetlands

The San Francisco baylands (e.g., mudflats, marshes, and other intertidal habitats) protect critical infrastructure, improve water quality, and provide habitat for thousands of fish and wildlife species, including several endangered and special-status species. Before 1850, San Francisco Bay and its environs included 350,000 acres of freshwater wetlands and 200,000 acres of salt marshes (Figure 2). Subsequently, the region has lost over 85% of that acreage through diking, dredging, and development. Today, only 125 square kilometers of un-diked marshes remain. This staggering loss results almost wholly from human activity, including hydraulic mining in the latter part of the 1800s and population pressures during the 1900s. The remaining 125 square kilometers of wetlands are threatened by development, erosion, pollution, and sea-level rise. In addition, sea- level rise (SLR) and sediment deficits further threaten long-term bayland sustainability.

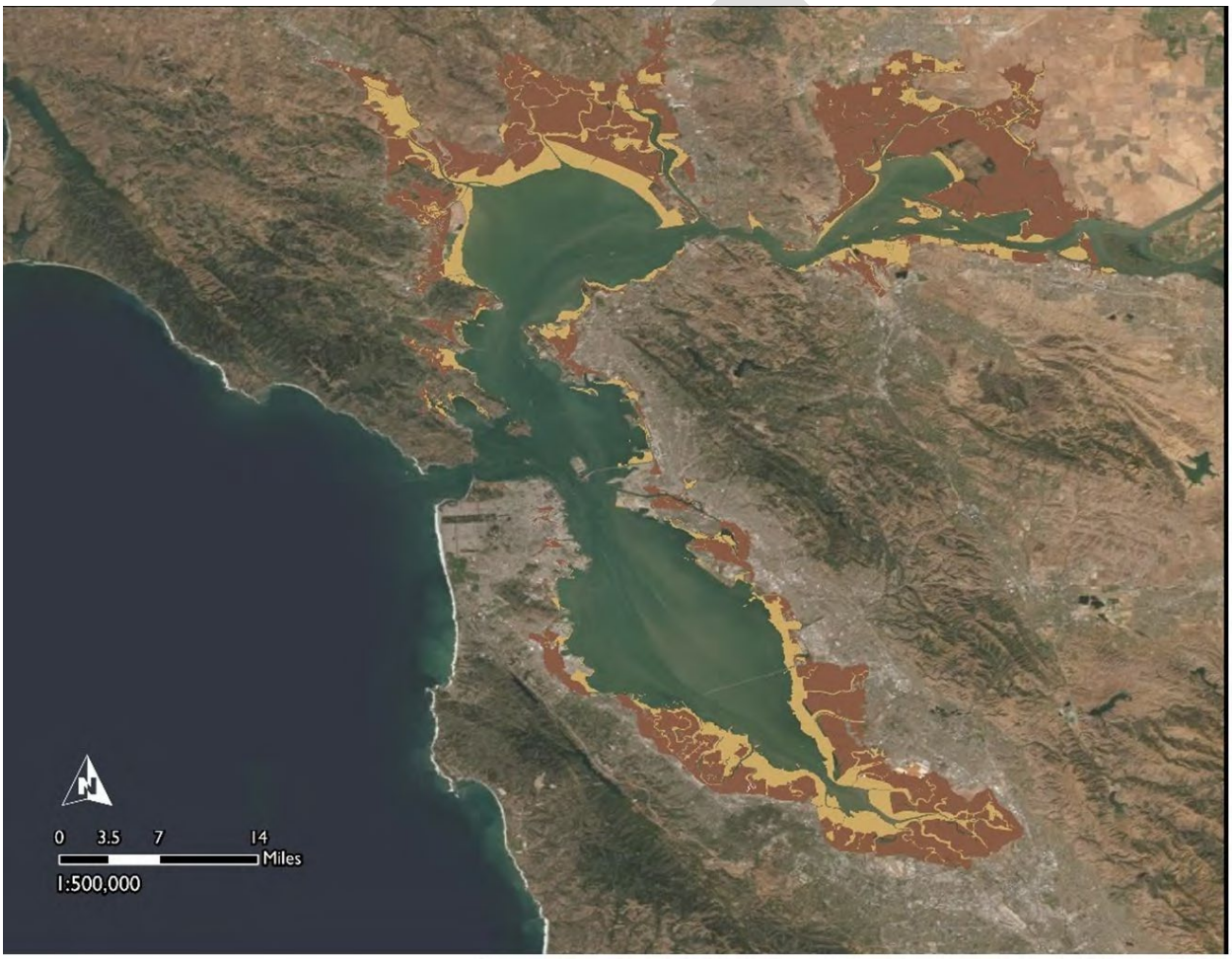


*Figure 2. Bay area historical (dark brown) and modern (light brown) baylands.*

Efforts are underway to restore these baylands with sediment sourced from other locations. According to Dusterhoff et al. (2021) of the San Francisco Estuary Institute (SFEI), the Bay's wetlands and mudflats will need an estimated 450 million cubic yards (CY) of sediment by 2100 to maintain existing wetlands and carry out planned restorations. Sediment dredged from federal navigation channels represents a significant resource available for restoration and maintenance of mudflats, marshes, and other intertidal habitats. The practice of beneficially using these sediments for restorations has already been

successfully implemented. Federal, state, and local agencies and organizations are currently on track to restore 60,000 acres of tidal wetlands in addition to the 40,000 already-restored acres. The resulting 100,000 acres will help protect the region from tidal flooding and reduce storm damage, especially if SLR continues as predicted or accelerates.

In the SF Bay area, the current paradigm of BU is to place material directly on subsided baylands to raise site elevations to adjacent marsh plains, thereby supporting rapid development of tidal marsh vegetation and habitat. Subsided restoration sites that are breached without raising site elevations are projected to take 60–75 years to develop into tidal marsh. BU can cut development time down to 10–15 years. This is important because restored marshes breached without sediment supply may not accrete fast enough to respond to future rates of SLR.

### Sea Level Rise and Sediment Supply

According to the USACE Sea Level Analysis Tool, the mean sea level (MSL) in SF in 2050 is estimated to reach 3.56, 3.86, or 4.81 ft (NAVD88) for a low, intermediate, or high SLR scenario, respectively. The most recent (July 2021) MSL 5-year moving average available is 3.37 ft. Thus, at the end of the RDMMP 20-year period, the sea level is expected to approach 0.19 to 1.44 ft higher than the sea level at the initial employment of this SF Bay RDMMP.

The impacts of climate change have the potential to substantially alter the Bay ecosystem by inundating or eroding wetlands and transitional habitats, altering species composition, changing freshwater inflow, and impairing water quality. There is evidence that the suspended sediment levels entering the Bay is in decline (Schoellhamer, 2011), which would mean an even greater variance between sediment supply and wetlands demand. Marsh growth will predictably make up for a portion of the variance. However, continued marsh growth via landward “migration,” will be significantly constrained by development densities throughout the Bay. There is evidence that, at least in some parts of the Bay, wetlands can keep pace with even higher rates of relative sea level rise. In southernmost reaches of the South Bay, rates of sedimentation and marsh growth were shown to have been sufficient to allow salt marshes to compensate for subsidence due to groundwater extraction over only a few decades (DeLaune and Patrick, 1990; Watson, 2004). However, this area has been a particularly strong depositional environment relative to other areas of SF Bay (Foxgrover et al., 2004; Jaffe and Foxgrover, 2006). Bay (Foxgrover et al., 2004; Jaffe and Foxgrover, 2006). Consequently, BU, which may be used to somewhat offset diminishing sediment supply, will become even more important to sustaining Bay habitats.

## Existing NEPA Documentation and Dredged Material Management

In April 2015, the USACE and the Waterboard released the Final Environmental Assessment/Environmental Impact Report for Maintenance Dredging of the Federal Navigation Channels in SF Bay, Fiscal Years 2015-2024 (2015 EA/EIR). The 2015 EA/EIR covered maintenance dredging of the federal navigation channels in SF Bay, California, for a period of ten years. The 2015 EA/EIR addressed the environmental effects of the USACE's maintenance dredging of federal navigational channels and the associated placement of dredged materials over that period. The 2015 EA/EIR also fulfilled the Regional Water Board's requirements for CEQA compliance and for issuance of multi-year Water Quality Certifications (WQCs) under the Clean Water Act (CWA) Section 401 to USACE during that period. The analysis presented in the 2015 EA/EIR served as the basis for all environmental permits required for the operations and maintenance dredging of the federal navigational channels.

Detailed in Table 1, current maintenance dredging is conducted per individual project authorizations for channel boundaries and depths as authorized, per authorized frequency or less based on shoaling and benefit to the nation. Some project authorizations do not specify a maintenance dredging recurrence and the dredging each year is based on the request and receipt of federal funding (appropriations). The current dredging recurrence intervals, dredging types, and authorized placement sites for each project are listed in the Table 2. Note that Richmond Harbor, Petaluma, and Redwood City have multiple lines to represent multiple channels within the same project and that some recurrences might vary from original authorizations previously listed.

*Table 2. Current dredge methods, placement sites, and dredging recurrence for federal navigation projects in San Francisco Bay.*

| Channel | Dredge Type | Dredging Recurrence (Years) | Federal Standard Placement Site |
|---|---|---|---|
| Richmond Inner Harbor | Clamshell-bucket | 1 | SF-DODS |
| Richmond Outer Harbor | Hopper | 1 | SF-11 |
| San Francisco Main Ship Channel | Hopper | 1 | SF-8, SF-17 |
| Napa River Channel | Cutterhead-Pipeline/Clamshell-Bucket | 6 to 10 | Upland (Sponsor Provided) |
| Petaluma – River Channel | Cutterhead-Pipeline | 4 to 7 | Upland (Sponsor Provided) |
| Petaluma – Across the Flats | Clamshell Bucket | 4 to 7 | SF-10 |
| San Rafael Creek Channel | Clamshell-Bucket | 4 to 7 | SF-11 |
| San Pablo Bay (Pinole Shoal) | Hopper | 1 | SF-10 |
| Suisun Bay Channel and New York Slough | Clamshell-Bucket | 1 | SF-16 |
| Oakland Inner and Outer Harbor | Clamshell-bucket | 1 | SF-DODS |
| Redwood City - Harbor | Clamshell-Bucket | 1 | SF-11 |
| San Bruno Channel | Hopper | As needed | SF-DODS |

## Prior SF Bay RDMMP and Concurrent Efforts

In the early 2000s, the SF District began preparation of a RDMMP for the 10 maintained federal navigation channels in the SF Bay region. In 2011, a draft RDMMP was completed; however, the development of the 2011 RDMMP was halted due to lack of funding. An Environmental Impact Statement (EIS) was planned to accompany the 2011 RDMMP, and a NEPA Notice of Intent to prepare an EIS for the 2011 RDMMP was published in the Federal Register on 29 November 2004.

The 2011 RDMMP was prepared as a component of the Implementation Phase of the Long-Term Management Strategy (LTMS) for dredging and the placement/use of dredged material based on the EIS Record of Decision signed in 1999. The problem to be addressed by the 2011 RDMMP was that future dredging volumes significantly exceeded the capacity of identified BU sites. The 2011 RDMMP consisted of one of four planned volumes (I. baseline conditions, II. alternatives, III. EIS components, IV. supporting scientific studies), also referred to as technical studies, and 29 manuscripts developed as the reference material for Volume I of the RDMMP. Volumes II-IV were not completed. While incomplete, the 2011 effort provides useful information that has supported the development of this RDMMP.

Using prior studies and technical reports, as mentioned above, to support its development and recognize the need for a regional plan, the SF Bay RDMMP now serves as the long-range plan for dredging and placement for the 10 federal channels. The initial phase of the SF RDMMP included the

scoping of a data gap analysis, which included the necessary models and reports to address these gaps. Data gaps were identified by an interagency work group (IWG) composed of dredging stakeholders (e.g., ports), dredging industry (e.g., dredging contractors), resource agencies and was led by the SF Estuary Institute (SFEI). A Gaps Analysis Report was produced, and four efforts were scoped to specifically address data gaps. The four projects include a regional analysis to inform the prioritization of sediment placement locations for direct and strategic placement; sediment transport modeling for nearshore strategic sediment placement; development of a sediment monitoring framework to fill data gaps, inform modeling, and standardize monitoring; and ecological modeling to assess potential impacts of nearshore strategic sediment placement on benthic habitats and species. A fifth effort was scoped to address Decision Support and Benefit-Pathways Analysis.

Not all efforts will be completed in time to use the data for the FY25 dredging season, however, subsequent annual updates to the RDMMP conducted per Water Resources Development Act (WRDA) of 2020 Section 125 will benefit from the modeling and reports being generated. The information collected from these scientific studies will allow for the development of BU Decision Document Integration (BUDDIs) for new BU placement sites, to justify the benefits for the WRDA 2020 Section 125 cost-sharing opportunity, and to analyze the costs, benefits, and relevant information of new placement sites in relation to existing placement sites when implementing the annual RDMMP updating process. See the Water Resources Development Act 2020 section for more information on the cost-sharing and annual updating opportunities referenced above.

### Development of the SF RDMMP

The development of the SF Bay RDMMP was also supported through a variety of meetings, charrettes, and presentations to relevant stakeholders, community organizations, and members of the public prior to the release of this document. This section details the outreach that was done to support the formulation of the alternatives for the SF Bay RDMMP. Additional outreach and engagement information can be found in APPENDIX B.

The SF District held a public meeting Friday, July 19, 2019, from 10 a.m. to noon at the Federal Building located at 90, 7th Street in SF to provide details about the process for completing a Dredge Material Management Plan and to provide a forum for public comment and recommendations about the scope of this effort. The Corps sought public input for development of the Project Management Plan for the SF RDMMP. A few months later, the USACE SF District held a public meeting on Wednesday, Nov. 13, 2019, to present an overview of the District's Navigation Program. The meeting was part of an effort by the Corps to evaluate the agency's SF Bay Navigation Program to best position the program for success over the next several decades. It took place from 6-8 p.m., at the Pinole Library located at 2935 Pinole Valley Rd, Pinole, Calif., 94585.

The USACE SF District then hosted a series of virtual charrettes to discuss comments submitted on the draft Project Management Plan (PMP) for the SF Bay RDMMP. The charrettes were organized into four comment categories (agenda, and notes linked below):

1. Toxicology – July 7, 2020
2. Climate Change and Other Environmental Issues – July 9, 2020
3. Physical Processes – sediment transport, sea walls, erosion controls, etc.
4. Economics, Social Studies, and Policies – July 16, 2020

5. Summary and Next Steps – July 21, 2020

These charrettes helped scope supporting products and studies to frame sustainable dredging and placement solutions.; to quantify metrics to support and prioritize BU efforts; to model sediment transport processes at the Bay-wide scale; to model ecological impacts from dredging and placement activities; and to quantify coastal storm damage benefits for beach nourishment projects. These studies (referred to as the Gaps Analyses) were developed based on the input received from these charrettes, and an Interagency Working Group was developed to provide ongoing input to these study efforts and products.

On June 2, 2023, The USACE SF District held an additional SF Bay RDMMP Charrette from 9 a.m. – 12:30 p.m. Pacific Daylight Time. The objectives of the SF Bay RDMMP planning process are to ensure SF Bay's federally dredged navigation channels have placement site capacity over 20 years, to identify the array of dredged material placement alternative plans, and to determine the Federal Standard Base Plan for USACE maintenance dredging projects. As part of the planning process, USACE staff and partners are currently considering the following important factors impacting future placement site capacity:

1. Dredged material ~~supply~~ volume (i.e., quantity of dredge material removed from 11 federal navigation projects in and adjacent to SF Bay);
2. Dredged material placement sites, including BU (i.e., placement site opportunities, capacity, and timing); and
3. Dredged material placement equipment type and placement methods & strategies (e.g., direct placement, water column seeding, strategic placement, marsh spraying).

This interactive event consisted of presentations on the SF Bay RDMMP planning process to date, as well as group discussion and brainstorming (e.g., measures and alternative plans). Over 70 participants attended and contributed to the charrette spanning resource and regulatory agencies, LTMS partners, partner federal agencies, county governments, municipal governments, flood control districts, parks districts, dredgers, environmental non-profits, ports and non-federal sponsors, environmental planning consultants, and restoration site managers, among others. The charrette included several rounds of breakout sessions to brainstorm plan formulation elements of the RDMMP (e.g., problems, opportunities, objectives, constraints, etc.); and to identify dredging methods and new BU placement sites and coalesce around alternative themes.

A consistent topic raised throughout the process was the need to maximize BU within the logistical and economic constraints to match sediment and elevation capital needs under future SLR regimes. As a direct result of this charrette, the RDMMP Project Delivery Team (PDT) developed four action alternatives, all focused on BU, with a specific goal to maximize BU within the Federal Standard Base Plan.

## Legislative, Regulatory, and Policy Overview

As mandated by Congress, USACE is responsible for providing safe, reliable, and efficient waterborne transportation for the movement of commerce, national security needs and recreation. This applies to federal navigational channels, harbors, and waterways. Policy, guidance, and procedures for development of dredged material management plans and the establishment of the Base Plan Federal or Standard Base Plan are provided in Section E-15 of the Planning Guidance Notebook [Engineering Regulation (ER) 1105-2-100]. Recent USACE guidance requiring annual RDMMP updates with 5-year time

horizons has also been promulgated in accordance with Section 125 of the Water Resources Development Act of 2020 (WRDA 2020). BU is defined within Engineering Manual 1110-2-5026 as "productive and positive uses of dredged material, which cover broad use categories ranging from fish and wildlife habitat development to human recreation to industrial/commercial uses."

### The Federal Standard

The Federal Standard is defined as the least-costly dredged material disposal or placement alternative consistent with sound engineering practices and meeting the environmental standards established by the Section 404(b)(1) evaluation process or ocean dumping criteria (33 C.F.R. § 335.7). Once the Federal Standard has been determined, site specific factors will lead to the identification of a Base Plan from which to develop potential dredged material management alternatives. As required by USACE ER 1105-2-100, a Base Plan must be identified that represents the least-cost, environmentally acceptable, and technically feasible dredged material management alternative.

### Water Resources Development Act 2020

The Supplemental Procedure for Section 125(c) of the WRDA 2020, Regional Dredged Material Management Plans, directs USACE to maximize BU from O&M water resource development projects through the development of annual dredged material management plan updates with a five-year time horizon. This supplementary guidance was developed to clarify budget procedures, implementation, and documentation requirements for establishing and maintaining DMMPs, including RDMMPs. It also establishes the BUDDI process to augment existing 20-year DMMPs.

Section 125(a)(2)(C) of the WRDA 2020, which amends Section 204(d) of WRDA 1992 (33 U.S.C. § 2326(d)), authorizes the USACE to use appropriated funds for the O&M of a navigational project that involves the placement of dredged material, when selecting a placement method that is not the least cost option. The least cost option is based on a determination that the incremental costs of the placement method are reasonable, in relation to the environmental benefits or flood risk reduction benefits. See Appendix A, RDMMP Implementation Guidance, for the requirements to implement WRDA 2020.

Additionally, Section 1122 of the Water Resources Development Act (WRDA) of 2020 establishes the National Policy for BU, emphasizing the goals of utilizing dredged material as an importance resource. Over the past three years, as tracked by the Coastal and Hydraulics Laboratory of the Engineer Research and Development Center (ERDC), nearly 62 percent of dredged material has been placed for BU, which approaches the USACE goal to beneficially use 70 percent of dredged material by the year 2030.

In 2016, the Center for Public Service at Portland State University published a literature review regarding BU and listed seven primary BU categories (Portland State University, 2016):

1. Beach Nourishment
    a. Replacement of eroded sand to reduce coastal storm damages and environmental improvements.
2. Habitat Restoration, Creation, and Development
    a. Using dredged sediment can help improve, restore, or create entirely new habitat where available and appropriate.
3. Structural and Shore Protection

    a. Like beach nourishment but in a more permanent manner, such as reinforcing or building new structures like jetties and levees.
4. Recreation
    a. Suitable dredged material can be used in construction of recreation features such as parks.
5. Agricultural, Forestry, Horticulture, and Agriculture
    a. Sediments that are rich in nutrients can be used as a soil amendment or to replace lost topsoil.
6. Strip-Mine Reclamation and Solid Waste Management
    a. Remediation practices for decommissioned landfills and mines can be supplemented with the use of dredged materials to cap or fill.
7. Construction/Industrial Development
    a. Support for commercial or industrial activities, primarily near waterways to expand or raise the height of the land base or provide bank stabilization and in construction material.

Where the opportunity exists, the seven primary BU categories can be leveraged within USACE studies and synergize with other USACE initiatives such as Engineering with Nature, which strives to maximize efficiencies and benefits by aligning natural and engineering processes.

#### *2023 Command Philosophy Notice on Beneficial Use of Dredged Material*

In January 2023, Chief of Engineers Lieutenant General Scott A. Spellmon issued a "Beneficial Use of Dredged Material Command Philosophy Notice", which outlined the USACE-wide goal of beneficially using at least 70% of its dredged material by 2030 (70/30 goal). This ambitious goal, directed by USACE's top leader, reflects a shifting landscape where dredged material is recognized as a resource and BU is prioritized. The intent of the Command Philosophy Notice was to encourage innovation, planning, and categorization of dredged material for BU. The SF Bay RDMMP has been developed in alignment with the 70/30 goal, prioritizing BU, as outlined in the Goals of the Regional DMMP section of this document.

### Dredged Material Management Plan Guidance

Management Plan development shall proceed in two phases: preliminary assessments, and if needed, Management Plan studies. A preliminary assessment is required for all Federal navigation projects to document the continued viability of the project and the availability of dredged material placement capacity sufficient to accommodate twenty years of dredging. If the continued viability of the project is uncertain, then Management Plan studies are required.

Management Plan studies are then further divided and conducted in two phases: an initial phase and a final phase. The initial phase concentrates on developing a detailed Scope of Work, and the final phase executes that Scope of Work. The initial phase shall produce a Scope of Work for the final phase of the study. The Scope of Work shall be the basis for estimating the total study cost.

For the SF RDMMP, preliminary assessments were conducted in 2019 and 2020. The findings from these PAs determined that there is sufficient capacity for the placement of dredged material at existing sites in the near-term, but there is significant uncertainty regarding the long-term capacity over the next 20 years. The long-term uncertainties of placement created the need for this management plan. All project stakeholders and agencies participated in meetings, charrettes, and other events to further refine the

scope of work with their input (see Development of the SF RDMMPP for more information). This RDMMP is the execution of the scope of work.

### Clean Water Act

The USACE's regulations for its operation and maintenance dredging projects involving the discharge of dredged materials into waters of the United States or ocean waters are detailed in 33 C.F.R. pt. 335-338. The regulations describe the procedures that USACE must follow to conduct dredged material placement in compliance with Section 404 of the CWA (for placement in waters of the United States) and the Marine, Protection, Research and Sanctuaries Act (MPRSA) described in the next section (for placement in ocean waters). The Inland Testing Manual, a national testing manual jointly published by USEPA and USACE, contains procedures applicable to the evaluation of potential contaminant-related environmental impacts associated with the discharge of dredged material in inland waters, near coastal waters, and surrounding environments (i.e., all waters other than the ocean, regulated pursuant to Section 404).

Under Section 401 of the Clean Water Act, water quality certification (WQC) is required for any activity that requires a federal permit or license, and that may result in discharge into navigable waters. To receive certification under Section 401, an application must demonstrate that activities or discharges into waters are consistent with state effluent limitations (CWA Section 301), water quality effluent limitations (CWA Section 302), water quality standards and implementation plans (CWA Section 303), national standards of performance (CWA Section 306), toxic and pretreatment effluent standards (CWA Section 307), and "any other appropriate requirements of State law set forth in such certification" (CWA Section 401). In California, the authority to grant water quality certification is delegated to the State Water Resources Control Board, and in the SF Bay area, applications for certification under CWA Section 401 are processed by the Regional Water Board. The CWA and USACE regulations (33 C.F.R. § 336.1(a)(1)) require USACE to seek state WQC for discharges of dredged or fill material into waters of the United States.

The USACE's evaluation of discharges (i.e., placement) of dredged material in SF Bay and ocean placement sites and compliance with Sections 401 and 404 of the CWA is guided by regional dredging plans and policies.

### Marine, Protection, Research and Sanctuaries Act

The MPRSA is the United States' implementation of an international treaty, the Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (also known as the "London Convention"). Section 102 of the MPRSA authorizes U.S. Environmental Protection Agency (USEPA) to establish criteria for evaluating all dredged material proposed for ocean dumping. These criteria are published separately in the Ocean Dumping Regulations at 40 C.F.R. pt. 220-228. Section 102 also authorizes the USEPA to designate permanent ocean-dredged material disposal sites in accordance with specific site selection criteria designed to minimize the adverse effects of ocean disposal of dredged material. Section 103 of the MPRSA authorizes USACE to issue permits, subject to USEPA concurrence or waiver, for dumping dredged materials into the ocean waters. The Ocean Testing Manual (also known as the Green Book), a national testing manual jointly published by USEPA and USACE, contains procedures applicable to the evaluation of potential contaminant-related environmental impacts of the ocean

disposal of dredged material. Although USACE does not issue itself permits, USACE and USEPA apply these standards to USACE projects as well.

### Coastal Zone Management Act

The Coastal Zone Management Act (CZMA), established in 1972 and administered by the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management, provides for management of the nation's coastal resources. The overall purpose is to balance competing land and water issues in the coastal zone. The CZMA encourages states to develop coastal management programs. The federal government certified the California Coastal Management Program (CCMP) in 1977. Under the CZMA, any federal agency conducting or supporting activities directly affecting the coastal zone must proceed in a manner consistent with the federally approved state coastal zone management programs, to the maximum extent practicable (16 U.S.C. § 1456). The processes established to implement this requirement are called a consistency determination for federal activities and development projects; this determination is made by the lead federal agency, and concurrence is requested from the state or local agency responsible for implementing the CZMA. For SF Bay, the Bay Conservation and Development Commission (BCDC) is the state's coastal zone management agency responsible for issuing concurrence with consistency determinations under the CZMA. The SF Bay Plan is BCDC's policy document specifying goals, objectives, and policies for BCDC jurisdictional areas. For portions of the study area outside of SF Bay, concurrence with consistency determinations is issued by the California Coastal Commission (CCC). The USACE requests consistency determination concurrence from the BCDC or CCC prior to commencing dredging activities. In lieu of a consistency determination, pursuant to 15 C.F.R. § 930.35, a federal agency may submit a negative determination for an activity that "is the same as or is similar to activities for which consistency determinations have been prepared in the past." The enforceable policies of the CCMP are in Chapter 3 of the California Coastal Act of 1976.

### Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, and the Marine Mammal Protection Act

These Endangered Species Act (ESA), Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), and the Marine Mammal Protection Act (MMPA) protect species. Constraints includes detailed information on how implementing these protections impacts dredging, specifically identifying species of concern.

#### *Endangered Species Act*

The ESA provides a program for conserving threatened and endangered plants and animals, and the habitats in which they are found. It is designed to protect critically imperiled species from extinction. The ESA is administered by the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS), a bureau of the National Oceanic and Atmospheric Administration. In general, NMFS is responsible for protection of ESA-listed marine species and anadromous fishes, while other species are under USFWS jurisdiction.

The ESA provides protection for federally listed special status species and requires conservation of the critical habitat for those species. An "endangered" species is a species in danger of extinction throughout all or a significant portion of its range. A "threatened" species is one that is likely to become "endangered" in the foreseeable future without further protection. Other federally listed special-status species include "proposed" and "candidate" species. Proposed species are those that have been officially proposed (in the Federal Register) for listing as threatened or endangered. Candidate species

are those for which enough information is on file to propose listing as endangered or threatened. A "delisted" species is one whose population has reached its recovery goal and is no longer in jeopardy. Areas of habitat considered essential to the conservation of a listed endangered or threatened species may be designated as critical habitat, which is protected under the ESA. Critical habitat designations are the USFWS and NMFS method of identifying, for federal agencies, those physical or biological features believed to be essential to the conservation of the species (such as space, food, cover, and protected habitat), focusing on the principal biological or physical constituent elements in an area considered essential (such as roost sites, nesting grounds, seasonal wetlands, water quality, tide, and soil type). Critical habitat designations are intended as a tool to be used by the USFWS and NMFS in helping federal agencies comply with their obligations under the ESA.

Under Section 7 of the ESA (16 U.S.C. §1536), federal agencies, including USACE, are required to ensure that actions they undertake, authorize, or fund are not likely to jeopardize listed species or adversely modify designated critical habitat for listed species. To satisfy ESA Section 7, USACE generally consults with the USFWS or NMFS when proposed projects, including dredging projects, may affect listed species or critical habitat. This process, generally referred to as Section 7 consultation, can result in a biological opinion, a document which states the opinion of USFWS or NMFS on how federal agencies' actions affect listed species and designated critical habitat. The SF Bay federal navigation channels must be dredged in accordance with biological opinions from USFWS and NMFS.

#### *Magnuson-Stevens Fishery Conservation and Management Act*

The Magnuson-Stevens Act establishes a management system for national marine and estuarine fishery resources. This legislation mandates the identification, conservation, and enhancement of Essential Fish Habitat (EFH), which is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity," for all managed species. Federal agencies consult with NMFS on proposed actions that may adversely affect EFH. The main purpose of the EFH provisions of the act is to avoid loss of fisheries due to disturbance and degradation of the fisheries habitat.

#### *Marine Mammal Protection Act*

The Marine Mammal Protection Act (16 U.S.C. §§ 1361-1421h), adopted in 1972, makes it unlawful to take or import any marine mammals and/or their products. Under Section 101(a)(5)(D) of this act, an incidental harassment permit may be issued for activities other than commercial fishing that may impact small numbers of marine mammals. As described in Section 3.6.4 of the 2015 EA/EIR, the maintenance of SF Bay federal navigation channels is not expected to result in impacts to marine mammals that would require an incidental harassment permit. Marine mammals may occasionally be found in the vicinity of project dredging and placement areas, but they are frequently exposed to vessel traffic, are highly mobile, and can easily avoid dredging and placement activities. Therefore, marine mammals are not discussed in the SF Bay RDMMP.

### Commerce Clause of the Constitution

Navigable servitude is a United States constitutional doctrine that gives the federal government the right to regulate navigable waterways as an extension of the Commerce Clause of the Constitution. The federal navigational servitude entitles the government to exert a dominant servitude in all lands below the ordinary high-water mark of navigable waters. Navigable waters of the United States are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce (33 C.F.R. § 329.4).

For rivers, lakes and marshlands, federal regulatory jurisdiction and powers of improvement for navigation extend laterally to the entire water surface and bed of a navigable waterbody, which includes all the land and waters below the ordinary high-water mark (33 C.F.R. § 329.11).

## Additional Regional Sediment Management Efforts and Organizations

The SF Bay region has numerous interagency working groups with similar objectives centered on dredged material management planning, climate and SLR adaptation planning, and wetland restoration coordination. These groups broadly include federal and state regulatory and resource agencies, non-profits, local cities and municipalities, parks districts, departments of public works, flood control districts, and community-based organizations (CBOs). Some of these groups coalesce and coordinate regulatory authority utilizing on their agency-specific jurisdictions, while some groups are more conceptual and roadmap-oriented in seeking to achieve certain policy goals. The biggest overlapping theme across these groups in relation to this RDMMP is the promotion of the BU of dredged material and the placement of sediment at permitted, unconfined, and dispersive aquatic placement sites in SF Bay. In addition, USACE staff who are leading the RDMMP effort are also actively involved in all other groups (listed below), so there is continuity in how the region is planning for increased BU for multiple benefits. These efforts provide forums for coordination on climate change adaptation, opportunities for BU, and feedback from stakeholders, industry, interested parties, and partner agencies on regional sediment and dredged material management planning.

### Long Term Management Strategy

The Long-Term Management Strategy for the Placement of Dredged Material (LTMS) first convened in 1998 in response to uncoordinated dredged material management policies in SF Bay and the large volume of dredged material that was being placed at the permitted aquatic placement sites. The large volumes of placed sediment was resulting in significant deposition and mounding at the site adjacent to Alcatraz Island. There was concern that the sediment placed there was increasing turbidity, impacting water quality, and affecting the various fisheries in the Bay. In response, the fishing community staged a blockade of the Alcatraz placement site, termed “mudlock”. This event, along with the view of dredged material as a pollutant and thus, the assumption that the dredged placed in the Bay was significantly degrading water quality, spurred formation of this interagency working group, the LTMS, which includes USACE, the U.S. Environmental Protection Agency (USEPA), the Waterboard, and BCDC. The goals for the LTMS are to maintain - in an economically and environmentally sound manner - navigation channels in SF Bay; conduct dredged material disposal (and/or placement) in the most environmentally sound manner; maximize the use of dredged material as a resource; and maintain the cooperative permitting framework for dredging/placement. All management activities under the LTMS management plan were designed to accomplish these goals.

Together, these agencies coordinate permitting and planning of dredging and dredged material placement activities under the Clean Water Act (Waterboard, USACE), Rivers and Harbors Act (USACE), the CZMA (BCDC), and the Ocean Dumping Act (USEPA). Other cooperating federal agencies in the LTMS include NMFS, which administers ESA Section 7 and EFH Biological Opinions, and USFWS, which also administers the ESA Section 7 and the Fish and Wildlife Coordination Act (FWCA). Cooperating state agencies include the California State Lands Commission and the California Department of Fish and Wildlife.

In 1998, the LTMS agencies completed an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) , and subsequently in 2001, a Management Plan that outlines various alternatives to reduce the volume of dredged material placed in the Bay on an annual basis. The agencies concluded that a stepwise approach toward a target of 1.25 million CY of in-bay placement for all dredgers was the preferred alternative, resulting in a step-down of dredged material placement in the Bay over the course of a decade, approximately. This includes 250,000 CY automatically reserved for small dredgers, defined as those moving less than 50,000 CY of dredged material, but does not include 250,000 CY of additional material defined as "contingency volume" that can be utilized in "emergency" situations, including high-water years (i.e., high precipitation and sediment shoaling years) and for addressing navigational hazards to sustain maritime safety. The Management Plan outlines goals for the entire dredging community (i.e., federal and non-federal) to be evaluated on a tri-annual basis, outlining targets for all dredgers to keep the aggregate volume below the 1.25 million CY target plus the 250,000 CY contingency volume voluntarily. Should this voluntary threshold be exceeded, shown as 1.5 million CY in the Management Plan (LTMS 2001), it would "trigger" the LTMS agencies to convene and consider imposing mandatory allocations for each of the approximately 100 dredgers in SF Bay and has served as a deterrent to maintain dredged material placement volumes below the voluntary threshold. These specific targets are not mandatory requirements or limitations on the placement of dredged material, but are instead goals and based on voluntary participation by dredging entities.

Together, these agencies discuss, and process permit applications to ensure a unified response to applicants and to streamline permitting efficiency, as well as to coordinate dredged material plans and placement across both federal and non-federal dredgers. The inter-agency structure includes a Management Committee, comprised of agency leaders (e.g., USACE District Commander, Executive Directors of the regulatory agencies, etc.), and Program Managers (PMs) (i.e., staff level). The PMs meet monthly, and the Management Committee meets bi-annually or more frequently as needed.

#### *Dredged Material Management Office*

The LTMS agencies also comprise the Dredged Material Management Office (DMMO), which provides regulatory oversight of dredged material management in the bay area, including dredged material disposal/placement suitability determinations for all dredging projects proposed in SF Bay. The DMMO was established to coordinate the regulatory processes for SF Bay dredging projects and make consensus-based sediment suitability determinations using guidelines in the LTMS EIS/EIR and a "preponderance-of-evidence" approach when reviewing the results of sediment chemical and toxicological analyses. The possible determinations include "suitable for unconfined aquatic disposal" or "not suitable for unconfined aquatic disposal" and the various existing solid waste categories that apply to upland placement or reuse. The sediment suitability determinations made by the DMMO constrain where dredged material from the federal navigation channels can be placed.

### California Coastal Sediment Management Workgroup

The California Coastal Sediment Management Workgroup is a broad organization of coastal scientists, agencies, practitioners, municipalities, planners, and managers focused on knowledge-sharing and supporting statewide climate change adaptation. The working group's mission is to facilitate regional approaches to protecting, enhancing and restoring California's coastal beaches and watersheds through federal, state and local cooperative efforts. Its goals are to:

- Prioritize sediment needs and opportunities,

- Identify means to streamline regional sediment management activities through development of a comprehensive "Sediment Master Plan",
- Make sediment-related information available to resource managers and the public, and
- Coordinate California's coastal beach and watershed restoration, protection and enhancement efforts with local, state and federal stakeholders and programs.

### Wetlands Regional Monitoring Program

The Wetlands Regional Monitoring Program (WRMP) delivers coordinated regional monitoring of the SF Estuary's wetlands to (1) inform science-based decision-making for wetland restoration and adaptive management and (2) increase the cost-effectiveness of permit-driven monitoring associated with wetland restoration projects. The WRMP is a robust, science-driven, and collaborative regional monitoring program that includes:

- Monitoring site network;
- Open data sharing platform; and
- Comprehensive science framework to guide monitoring.

### Bay Area Climate Adaptation Network

The Bay Area Climate Adaptation Network (BayCAN) is a collaborative network of local government staff and partnering organizations working to help the Bay Area region to respond effectively and equitably to the impacts of climate change.

Developed by local government, for local government and the communities they serve, BayCAN focuses on adaptation challenges in water supply, sea level rise, wastewater and stormwater management, wildfires, ecosystems, and public health.

BayCAN convenes its members at both a regional and subregional level, maintains a website for resource sharing, coordinates a bimonthly Equity Working Group, produces a newsletter, conducts regular webinars on topics of interest, and offers consultations from BayCAN staff to help members problem-solve key issues.

### Bay Planning Coalition

The mission of the Bay Planning Coalition is to provide expert advocacy and facilitation to advance a strong economy that supports a sustainable environment within the SF Bay and its watershed.

Founded in 1983, the Bay Planning Coalition (BPC) is a non-profit, membership-based organization representing public and private entities in the maritime industry and related shoreline businesses, ports and local governments, landowners, recreational users, labor unions, residential and commercial builders, environmental and business organizations, and professional service firms in engineering, construction, law, planning, and environmental sciences.

The maritime industry, movement of goods, and trade are central to business continuity and economic vitality of the Bay Area Region. The long-term future of the region depends on the vitality and responsibility of these industries.

BPC focuses specifically on the economic interests and vitality of the Bay. Reaching up to Sacramento, Stockton, into the Central Valley and the South Bay, the organization's efforts connect businesses, regulatory agencies, local, state and federal officials, and nonprofits.

### North-Central California Coastal Sediment Coordination Committee

The North-Central California Coastal Sediment Coordination Committee (NCCSCC) serves as the coordinating body for 17 federal, state, and local agencies to identify and adapt to these impacts and vulnerabilities with increased regional coordination. It does not represent a regulatory or permitting decision body.

The intent of the NCCSCC is to leverage and build upon the Coastal Sediment Management Workgroup's collaborative efforts to develop the California Coastal Sediment Management Master Plan, which is an ongoing effort to evaluate California's coastal sediment management needs and promote regional, system-wide solutions.

Committee members are resource and regulatory agency representatives with sediment and coastal management expertise who together provide a broad knowledge of agency, land use, technical, and scientific information and are well-informed about present and future coastal issues along the North-Central California Coast.

NCCSCC's seven guiding principles for sediment management include:

- Leverage partnerships and agency coordination;
- Engage communities and stakeholders;
- Expand research and monitoring;
- Pursue nature-based solutions and restore natural sediment dynamics;
- Increase the BU of sediment;
- Use a holistic watershed approach to sediment management; and
- Consider environmental justice.

The Committee's objectives are as to:

- Strive for consensus-driven recommendations on regional sediment management actions based on relevant guiding documents;
- Coordinate programmatic and project-based consultations with other agencies where feasible;
- Facilitate technical assistance to member agencies;
- Pursue funding partnerships and/or opportunities;
- Support collaborative education and outreach efforts;
- Facilitate coordinated permit review where feasible; and
- Assess environmental justice considerations where feasible.

In November 2019, GFNMS released a Coastal Resilience Sediment Plan that aligned planning efforts and guidance documents across the region into a collaborative, holistic, and nature-based roadmap to increasing shoreline resilience.

The Sediment Plan leverages and builds upon CSMW's four Coastal Regional Sediment Management Plan/Reports (CRSMP/Rs) spanning most of the coast managed by GFNMS, from Sonoma to San Mateo counties. Each CRSMP/R, developed collaboratively and vetted with input from federal, state and local agencies, and other stakeholders, outlines coastal sediment issues for a given region and a suite of recommended strategies to address them.

The Sediment Plan provides an assessment of those recommendations, identifies overlap with sanctuary goals and policies, and synthesizes potential sediment management actions to achieve a holistic approach to sediment management and coastal resilience.

In 2020, the NCCSCC adopted the Sediment Plan as its guiding document and developed its Guiding Principles and Committee Objectives based on its findings.

### Other Regional Restoration and Sediment Management Planning and Policy Projects

In addition to the standing working groups listed above, there have been several projects focused on regional sediment management and restoration through planning and policy lenses. These include the Baylands Ecosystem Habitat Goals Project, the SF Bay Joint Venture Policy Roadmap, SFEI's Sediment for Survival Report, and BCDC's Bay Adapt Plan and Sediment for Wetlands Adaptation Project. These initiatives all contribute to moving the needle toward regional climate change adaptation and sediment management planning, identifying wetland restoration opportunities, and coordinating BU of dredged material.

## Existing Placement Sites

As described in Legislative, Regulatory, and Policy Overview section, BU is defined as the productive and positive use of dredged material. Disposal is defined as the placement of material in an area where the material is anticipated to remain in place and have no measurable benefit. In open water placement sites, nondispersive sites are considered disposal; in confined placement sites, disposal applies if the material is not intended to be offloaded for another BU. Transitional placement is defined as keeping sediment in the riverine or coastal system as a part of a management process or in a period of transition. Generally, this material will be managed or dredged again and is considered neither BU nor disposal. The transitional placement category is separated from open water BU to capture those efforts of managing sediment within a system without a specific BU intent or when material was placed in a site temporarily. If material is placed in open water and there is a benefit derived, this would be characterized as open water BU category, or another BU category. These definitions, delineated in the August 2023 memorandum on Expanding BU of Dredged Material in the USACE, differ from the definitions used by stakeholders for the same categories. While other SF Bay sediment management agencies and documents use other definitions, the SF Bay RDMMP uses the USACE definitions to plan for the placement of dredged material from the 10 USACE federal navigation projects around the SF bay.

The conventional classification scheme, used by many stakeholders and formerly used by USACE, of either disposal or BU does not fully characterize open water dredged material placement operations where sediment is retained in the system, but the sediment is not intentionally used beneficially; hence,

the third category of transitional placement. For the purposes of calculating placement percentages for the SF Bay RDMMP alternatives, transitional placement applies where open water placement results in the conservation of sediment within the SF Bay Estuary system, but where the placement is temporary or made without direct BU intent. This differs from the purposeful construction or nourishment of aquatic habitats and beaches where dredged material discharges have measurable and easily recognizable benefits, and from the disposal of dredged material where sediment is intentionally transported and discharged into an area where its residence has no probable benefit.

There is a broad range of possible placement sites, particularly for BU. In accordance with USACE guidance, the SF Bay RDMMP classifies placement sites into one of three categories: 1) BU, 2) Disposal, and 3) Transitional Placement. Additional USACE guidance delineates specific sub-categories of placement sites. Engineer Manual (EM) 1110-2-5025 defines 13 overarching Dredged Material Management Categories for dredge placement. The August 2023 memorandum on Expanding BU of Dredged Material in the USACE provides guidance on how these new dredged material placement definitions can be applied to the 13 dredged material placement categories (Table 3) and leaves the placement classification to the district's discretion. Since not all situations may be covered by the 13 overarching categories, districts determine the category (BU, transitional placement, or disposal) that best fits their available placement sites. These new categorization and definitions are considered during the development of this SF Bay RDMMP to properly account each type of beneficially useable material and align with the USACE Chief's 70/30 goal.

*Table 3. Dredged material placement categories with new definitions (BU, transitional placement, and disposal) per the 28 August 2023 memorandum on Expanding BU of Dredged Material in the USACE.*

| | |
|---|---|
| **Agriculture, Horticulture, Forestry and Aquaculture**<br>***BU*** | **BU**<br>Material placed for use by the agriculture, forestry, horticulture, and aquaculture industries. Examples: provide livestock pastures, cattle bedding, incorporating dredged material into marginal soils. |
| **Aquatic Habitats**<br>***BU*** | **BU**<br>Placed to improve submerged habitats extending from near sea, river, or lake level down several feet. Examples are tidal flats, oyster beds, seagrass meadows, fishing reefs, clam flats, and freshwater aquatic plant beds.<br>Select "Open-Water Placement TP" (described below) when sediment is kept in the system, but without specific BU intent. |
| **Beach/Shoreline Nourishment**<br>***BU*** | **BU**<br>Beach nourishment is placement of material from a borrow area, channel, or rehandled stockpile directly onto a beach or river shoreline, in the littoral zone, nearshore, or shallow water with the intent to expand, stabilize or nourish the beach or shoreline.<br>Select "Open-Water Placement TP" (described below) when sediment is kept in the system, but without specific BU intent. |
| **Confined (Diked) Placement**<br>***Disposal*** | **Disposal**<br>Placement of dredged material in a diked nearshore or upland Confined Disposal Facility (CDF). Upland placements not intended for a BU fall into this category.<br>If dredged material placed at a CDF will be offloaded for BU, select a placement category that characterizes the offloaded sediment use for that quantity of material. |
| **Confined Aquatic Disposal**<br>***Disposal*** | **Disposal**<br>Confined aquatic disposal (CAD) is the placement of contaminated dredged material into an open water placement site that is capped with uncontaminated sediment. The uncontaminated cap sediment is classified as BU under aquatic habitats. |
| **Construction and Industrial/Commercial Uses**<br>***BU*** | **BU**<br>Placement activities to improve or construct harbor and port facilities, residential and urban areas, airports, dikes, levees and containment facilities, roads, and island and historic preservation areas. Material placed in a CDF and rehandled for construction activities would be classified in this category. |
| **Island Habitats** | **BU** |

| | |
|---|---|
| ***BU*** | Placement activities that construct, improve, or maintain islands and/or high zone wetland habitats. |
| **Multipurpose Uses and Other Land Use**<br>***BU*** | **BU**<br>Combinations of uses, aquatic and/or land based. Purpose(s) does not need to be defined in DIS. Example: a park and recreational development built over an existing solid waste landfill using dredged material as a cap. |
| **Open-Water Placement**<br>***Transitional Placement*, *Disposal* or *BU***<br>(see definitions, at right)* | Select either: **TP/Disposal/BU**<br>Open-water placement in riverine, lacustrine, estuarine, and marine environments with overlying volumes of water.<br>*Open-water placement areas are classified either as: (1) *Transitional Placement (TP)* when sediment is kept in the system but will naturally move through the system or be rehandled; (2) *Disposal* when sediment is removed from the dispersive system or discharged where it has no demonstratable value; or (3) *BU* when placement is intended for direct BU. If known, BU placement should be categorized based upon the specific intent of that placement "Aquatic Habitats", "Beach Nourishment", "Multipurpose", etc. |
| **Parks and Recreation**<br>***BU*** | **BU**<br>Placement activities supporting the development of recreational areas range from simple projects such as fill for a recreation access to large and complex projects that support both public and private commercial and noncommercial recreation facilities. |
| **Strip Mine Reclamation, Solid Waste Landfill, and Alternative Uses**<br>***BU*** | **BU**<br>Material, including moderately contaminated material, used for the reclamation of abandoned strip mine sites, capping or protecting solid waste landfills, or manufacturing bricks and hardened materials such as road surfaces. Material placed in a CDF and rehandled for reclamation activities would be classified in this category. |
| **Upland Habitats**<br>***BU*** | **BU**<br>Material placed upland to construct or improve habitats. Upland habitat includes terrestrial communities not normally subject to inundation. |
| **Wetland Habitats**<br>***BU*** | **BU**<br>Material placed to construct or nourish wetland habitats, including freshwater and saltwater marshes, relatively permanently inundated freshwater marshes, bottomland hardwood |

## Beneficial Use

There are three existing BU sites that are currently permitted for placement of dredged material in 2025. In subsequent updates to this SF Bay RDMMP, other sites will be available for placement. Permits will be obtained on a site-by-site basis, and potential sites are described in Future Placement Sites.

### Upland Direct Placement

Within the scope of the SF Bay RDMMP, upland direct placement BU sites are those where sediment is transported and placed at the desired location, where it remains for the purposes of wetland restoration or beach nourishment. These placements occur at or above the water level (Bay or ocean depending on type of placement) between the intertidal and supratidal zones. Below are examples of upland direct placement projects for wetland restoration (Montezuma Wetlands Restoration Project, Cullinan Ranch Restoration Project) and beach nourishment (Ocean Beach Onshore).

#### *Montezuma Wetlands Restoration Project (MWRP) BU Placement Site*

The Montezuma Wetlands Restoration Project (MWRP) is a privately owned and operated restoration project, consisting of an approximately 1,800-acre site adjacent to the Montezuma Slough in Solano County, bordering Suisun Bay. MWRP has remaining capacity of approximately 30 million CY through Phases 2 and 3 of the project and received sediment most recently in 2023 utilizing WRDA 2016 Section 1122 BU of Dredged Material pilot project funding. Imported material is being used to create wetlands, and the site can accept both cover and foundation quality material. The site has deep-water access, as well as a docking area and dredged material off-loading equipment. The offloading equipment can accommodate most dredged material transport scows with 1,000 CY or greater capacity.

#### *Cullinan Ranch Restoration Project*

The 1,575-acre Cullinan Ranch Restoration Project is part of the San Pablo Bay National Wildlife Refuge. The USFWS operates the site for the purpose of increasing habitat for salt marsh harvest mouse and Ridgway's rail by restoring diked baylands to historic tidal marsh conditions. The southern property boundary is a naturally formed levee that is the base for State Highway 37. Cullinan Ranch is permitted to restore approximately 290 acres of tidal marsh habitat through the importation of approximately 2.8 million cubic yards of dredged material via an offloading facility temporarily located in the Napa River near its confluence with Dutchman Slough, which will accommodate deep draft barges. According to current USACE survey estimates, at the start of 2024, there was approximately 700,000 CY of capacity remaining at the site.

#### *Ocean Beach Onshore*

USACE and City and County of San Francisco, in coordination with Golden Gate National Recreation Area, beneficially used sediment from maintenance dredging of the San Francisco MSC for direct beach nourishment at Ocean Beach between Sloat Boulevard and Fort Funston. The beach nourishment project included the construction of a 4,000-foot–long sacrificial dune, using approximately 270,000 toto 300,000 CY of dredged sand. Placement of material on the beach occurred in 2021 using the Continuing Authorities Program 204 BU of Dredged Material authority. The City and County of San Francisco has indicated a desire for future dredged material placements, which will be discussed in the Future Placement Sites section, below.

### Nearshore Strategic Placement

Strategic placement is defined as the placement of sediment at one location with the expectation that natural forces will transport the sediment to another desired location (Stantec and SFEI Stakeholder Report 2017). The USACE SF District has utilized two types of strategic placement sites – one in the nearshore ocean environment to leverage wave energy to transport sediment into the sandbar system off Ocean Beach, CA (SF-17); and one in the nearshore bay environment to leverage tidal and wave processes to transport sediment onto the intertidal mudflat (Whale's Tail). Nearshore strategic placement along the entire Bay margin is a new option for SF Bay BU placement. USACE has also identified potential future strategic placement sites as discussed later in Nearshore Strategic Placement (BU).

#### *SF-17 (Ocean Beach Nearshore Placement Site)*

The SF- 17 placement site is in waters of the Pacific Ocean adjacent to the south-of-Sloat-Boulevard stretch of Ocean Beach, and outside of the southern section of SF-8 (SF Bar Channel). SF-17's eastern boundary is approximately 0.35 mile offshore from the back-beach bluff, its center is 4 miles southwest of SF-8, and the site's area is 3.3 square miles. Water depths along the shoreward boundary range from approximately 25 to 35 feet MLLW, and depths along the seaward boundary ranges from approximately 37 to greater than 50 feet MLLW. SF-17 has a similar placement boundary and location as the Ocean Beach demonstration site.

#### *Whale's Tail Nearshore Strategic Placement Site*

The Whale's Tail site is a 138-acre subtidal placement site approximately two miles offshore of Eden Landing Ecological Reserve Whale's Tail marsh. Under the WRDA 2016 Section 1122 BU of Dredge Material Pilot Program, SPN was chosen as one of 10 pilot projects to test innovative BU methods. The sediment placement was timed with tidal stage to leverage natural tidal and wave fluxes to transport the material toward the nearby intertidal mudflats and salt marsh ecosystem. Lessons learned from the design, plans and specifications, and permitting processes will inform future nearshore strategic placement sites as new BU sites to be considered as part of the SF Bay RDMMP and BUDDI.

## Transitional Placement

### SF-8 (SF Bar Placement Site)

The SF-8 placement site is a 15,000-foot by 3,000-foot-wide rectangle 7,500 feet south of the MSC in the Pacific Ocean. Depths at SF-8 range from approximately 30 to 45 feet MLLW. Placement is limited to sandy material dredged by USACE from the MSC. However, the easternmost portion of SF-8 is within the Clean Water Act (CWA) 3-mile limit, and sand from other SF Bay Area dredging projects can be permitted there as BU for littoral cell support. There is no set limit on placement of dredged material at SF-8. The site was thought to be dispersive, but operation reports from the captain of the USACE hopper dredge, Essayons, state that vessel maneuverability is impaired during times of rough seas because sand is being placed faster than it disperses.

### SF-9 (Carquinez Strait Placement Site)

The SF-9 placement site is a 1,000-foot by 2,000-foot rectangle, approximately 10 to 55 feet deep, 0.9 mile west of the entrance to Mare Island Strait in eastern San Pablo Bay in Solano County. Placement is limited by LTMS Management Plan and the Bay and Basin Plan amendments to 1.0 million cubic yards of dredged material per month and a maximum of 3.0 million cubic yards per year during wet or above-

normal water flow years; and 2.0 million cubic yards per year during all other years. Mounding at the site has resulted in USACE limited placement to the southern half of SF-9.

### SF-10 (San Pablo Bay Placement Site)

The SF-10 placement site is a 1,500-foot by 3,000-foot rectangle, approximately 30 to 45 feet deep, 3.0 miles northeast of Point San Pedro in southern San Pablo Bay in Marin County. Placement is limited to 500,000 cubic yards of dredged material per year.

### SF-11 (Alcatraz Placement Site)

The SF-11 placement site is a 1,000-foot-radius circular area, approximately 40 to 70 feet deep, approximately 0.3 mile south of Alcatraz Island in the Central Bay. Since at least 1972, SF-11 has been the most utilized placement site in SF Bay. Placement is currently regulated at a maximum of 400,000 cubic yards per month from October to April; and 300,000 cubic yards per month from May to September. Placement is limited to 4.0 million cubic yards of dredged material per year.

### SF-16 (Suisun Bay Placement Site)

The SF-16 placement site is a single-user site reserved for sand dredged from the Suisun Channel and New York Slough only. SF- 16 is a 500-foot by 11,200-foot rectangle adjacent to the northern side of Suisun Bay Channel, approximately 1 mile upstream of the Interstate-680 Bridge. The depth at this site is approximately 30 feet MLLW. Currently, the site is authorized to receive 200,000 cubic yards of dredged sand per year. The basis of the limit is LTMS goals to preserve the dispersive nature of the site and to prevent mounding.

### Shollenberger Park (Upland Site [Sponsor-provided])

The City of Petaluma (the city) purchased this 165-acre ranch along the Petaluma River for the purpose of using it as a dredged materials placement site. In 1975, an agreement was reached between the city and the former California Department of Fish and Game (now CDFW) regarding management of the site. Pursuant to this agreement, the city dedicated, in perpetuity, the 80-acre Alman Marsh for open space and fish and wildlife uses. The City also executed an open-space deed restriction for approximately 65 acres of the dredged material placement site. The City continues to protect and maintain Alman Marsh and the 65-acre area for the agreed upon uses. In 2002, the City began the formal process to continue using the Shollenberger site for the placement of dredged material. In response to resource agency requirements pertaining to salt marsh harvest mouse habitat on the site, the city proposed development and implementation of a management, maintenance, and monitoring plan to operate a 48-acre mitigation site adjacent to the dredged materials placement site. The city prepared the Shollenberger Marsh Plan and constructed a berm to separate the mitigation area from the dredged material placement area. This placement site is at capacity and is unable to take more material over the 20-year lifespan of this RDMMP.

### Imola Avenue (Upland Site [Sponsor-provided])

The Napa County Flood Control and Water Conservation District's Imola Avenue dredged material beneficial reuse site is in the City of Napa (Figure 1-6) on the eastern bank of the Napa River, at the previous location of the Napa Sanitation District. The accumulated dredged material placed at the Imola Avenue site was used by USACE in 2006 as part of the Napa River/Napa Creek Flood Protection Project. The overall capacity of the Imola Avenue site is 60,000 CY. During placement of dredged materials, any decant water is discharged into Tulocay Creek, which is connected to the Napa River to the west.

### Disposal

#### SF-DODS (SF Deep Ocean Disposal Site)

Approximately 55 nautical miles west of the Golden Gate Bridge, SF-DODS is the farthest offshore and deepest (8,000 to 10,000 feet MLLW) dredged material placement site in the United States. SF-DODS is authorized to receive up to 4.8 million cubic yards of dredged material per year. However, annual placement at SF- DODS since 2000 for all dredging projects in SF Bay, not just the federal navigation channels, has averaged less than 1 million cubic yards. SF-DODS was designated by the EPA in 1995, specifically in coordination with development of the LTMS Management Plan to facilitate the reduction of in-bay placement volumes in accordance with that plan.

## Future Placement Sites

The RDMMP describes capacity for sites that are currently permitted and accepting material. However, it also gives USACE the ability to add in sites as they come online. In this section, we describe both the upland BU sites that we anticipate being ready to accept material in the coming years (after 2025) and alternate and innovative ways to increase the resilience of existing marshes using BU.

The USACE San Francisco District plans to continue to expand Engineering with Nature opportunities, including nearshore strategic placement (e.g., Whale's Tail Nearshore Strategic Placement), water column seeding, elevation augmentation (i.e., marsh spraying), and others.

The pilot project implemented in December 2023 at the Whale's Tail Nearshore Strategic Placement site placed sediment in the shallow subtidal environment with the expectation that tidal and wave forces would transport that sediment onto the intertidal mudflat and marsh. Water column seeding is the transport of dredged sediment to the mouth of an existing marsh tidal channel using a modified pipeline offloader, and the placement of that sediment on a flood tide to leverage the tidal flux into the marsh channel and facilitate sediment deposition on the slack high tide. Elevation augmentation, or marsh spraying, is the transport of sediment by pipeline to an existing marsh and the use of a modified pipeline offloader to fan the sediment over top of the existing marsh plain to provide a thin layer boost of inorganic sediment without burying the marsh ecosystem, thus facilitating continued natural organic marsh sedimentation.

The following figures outline future placement site opportunities that leverage Engineering with Nature approaches to maximize BU through existing and novel placement methods at the SF Bay regional scale (Figure 3), and for each sub-region of the SF Bay Area. These include the Suisun Bay sub-region (Figure 4), the San Pablo Bay sub-region (Figure 5), the Central Bay North sub-region (Figure 6), the Central Bay South sub-region (Figure 7), the South Bay sub-region (Figure 8), the Ocean North sub-region (Figure 9), the Ocean Central sub-region (Figure 10), and the Ocean South sub-region (Figure 11). The corresponding placement sites are listed out in the following document sections: Upland Direct Placement (BU), Nearshore Strategic Placement (BU), Elevation Augmentation (BU), and Water Column Seeding (BU). Note that many of these placement sites are in the early stages of ideation, and the development of these sites as pilot projects would require more in-depth planning. As we learn more about these and other options, more sites may be added, or removed, as the science and understanding evolves.

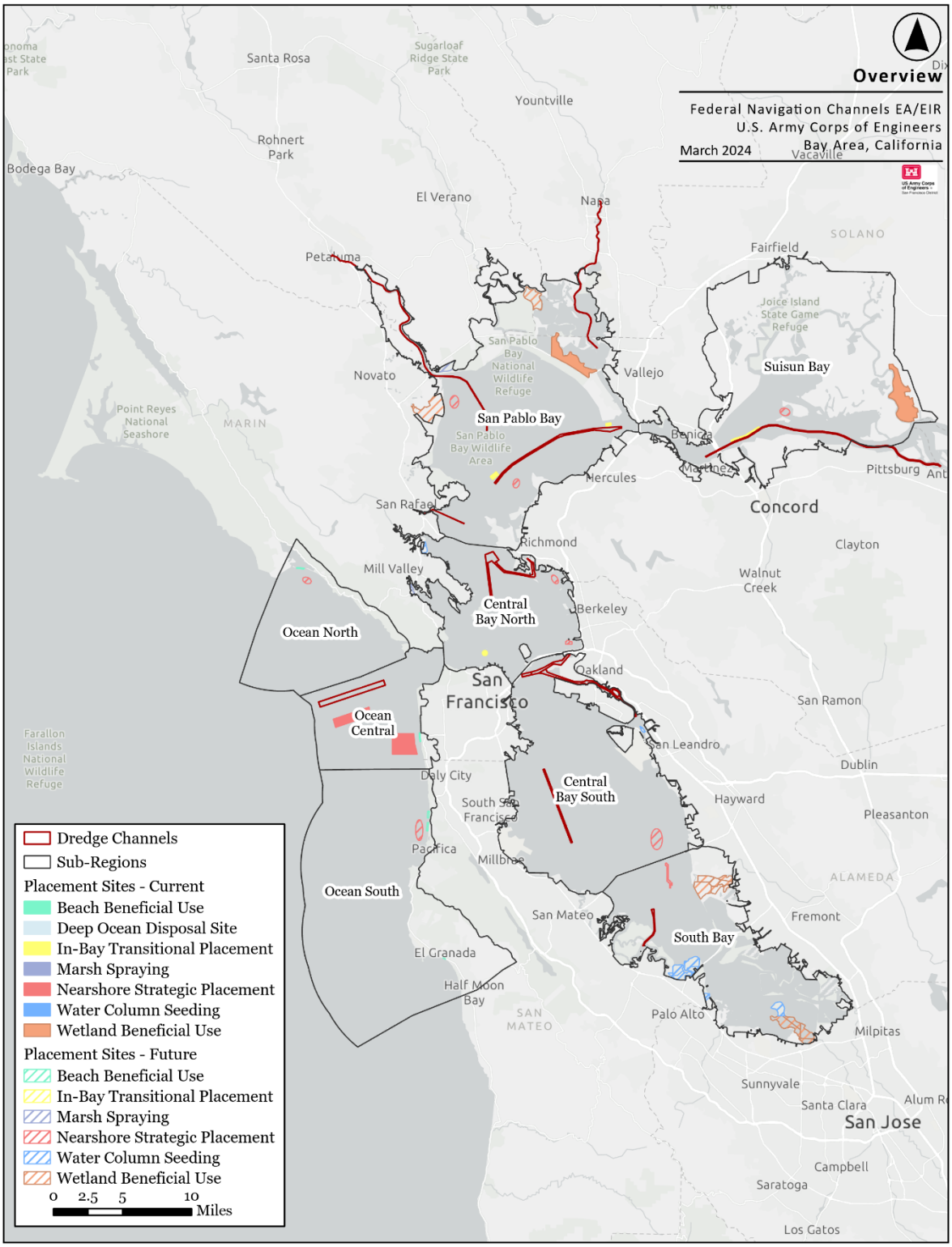


*Figure 3. Future placement sites and methods that include direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects. The figure represents all potential future sites that could come online in and around San Francisco Bay.*

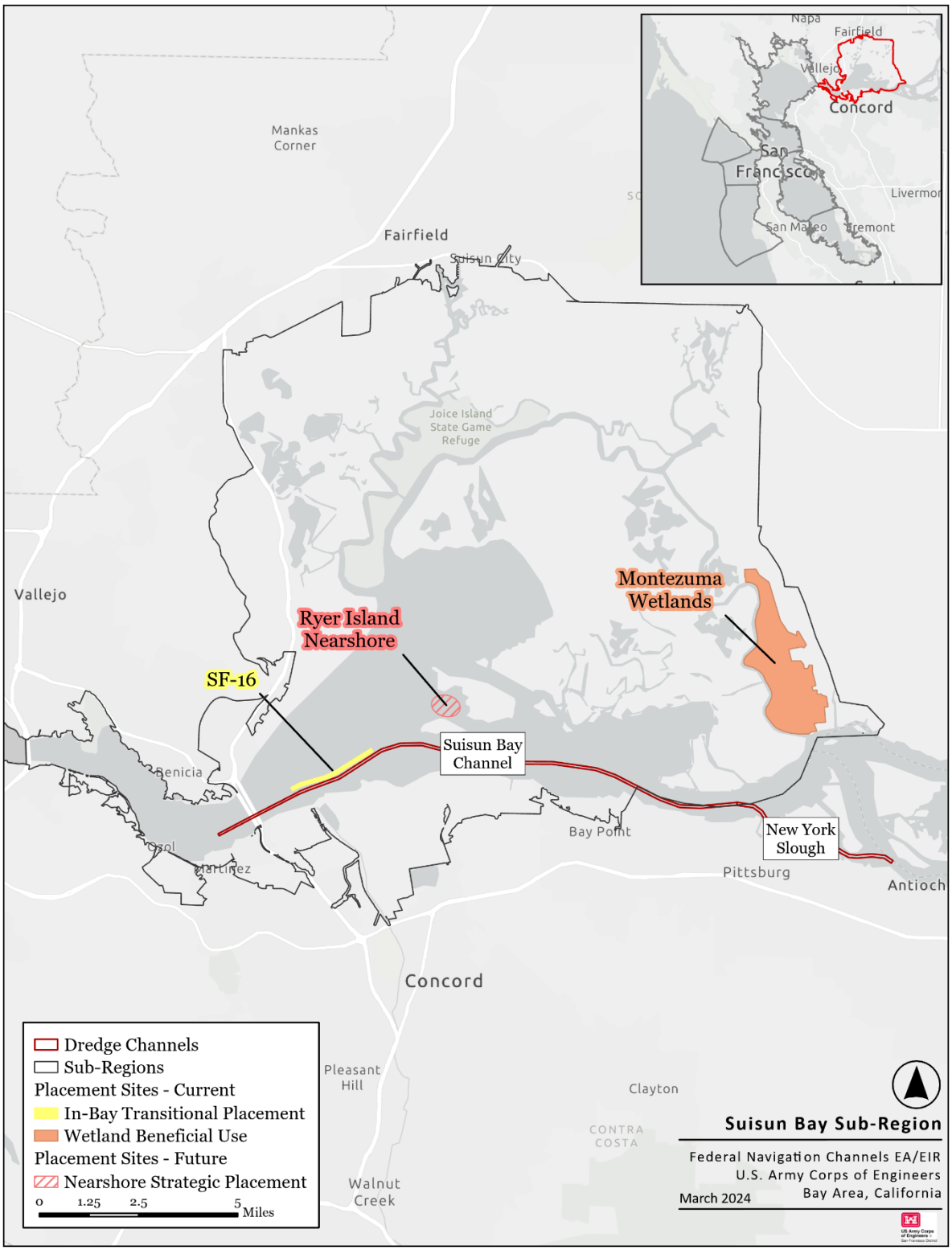


*Figure 4. Potential future placement sites and methods in the Suisun Bay sub-region including direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects.*

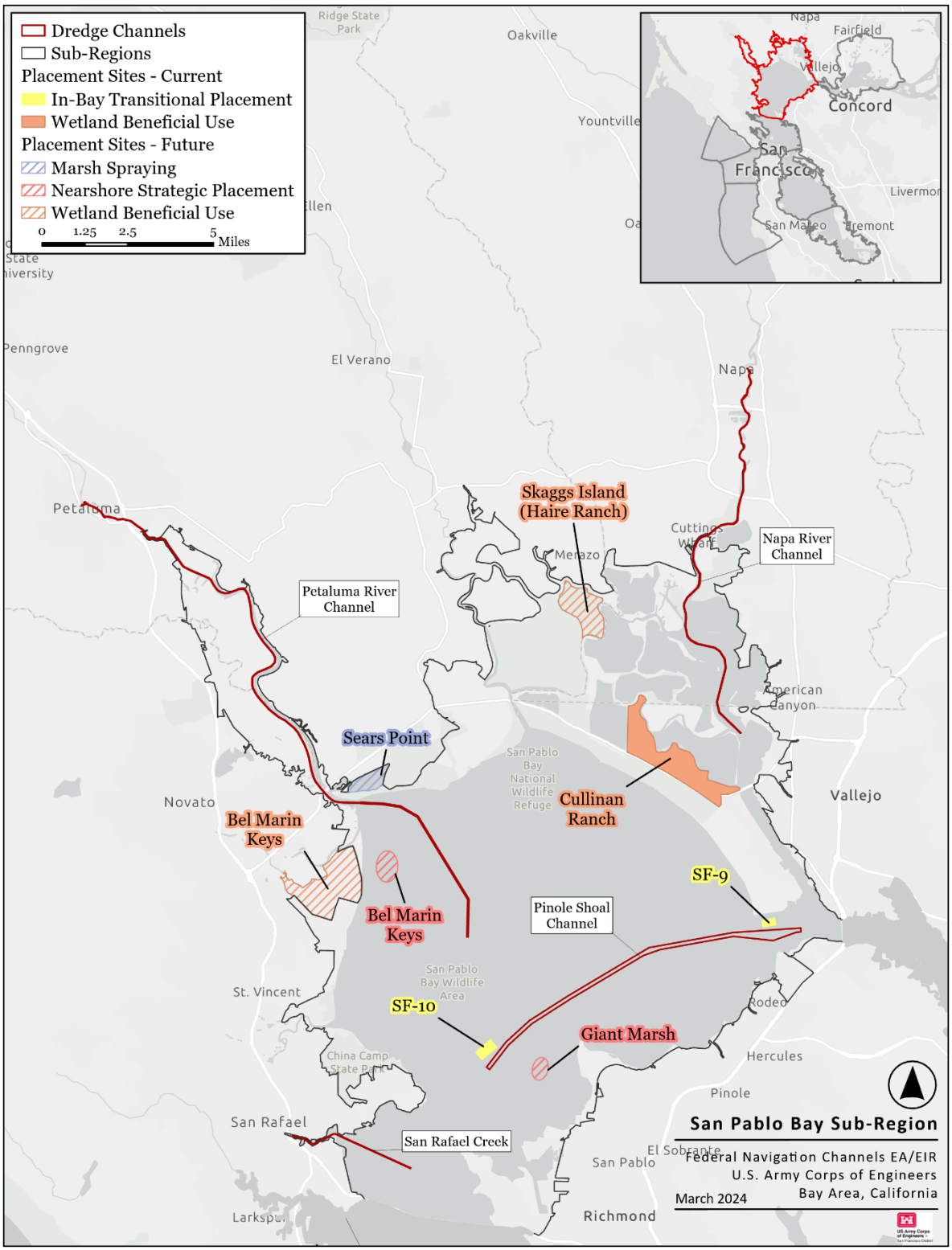


*Figure 5. Potential future placement sites and methods in the San Pablo Bay sub-region including direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects.*

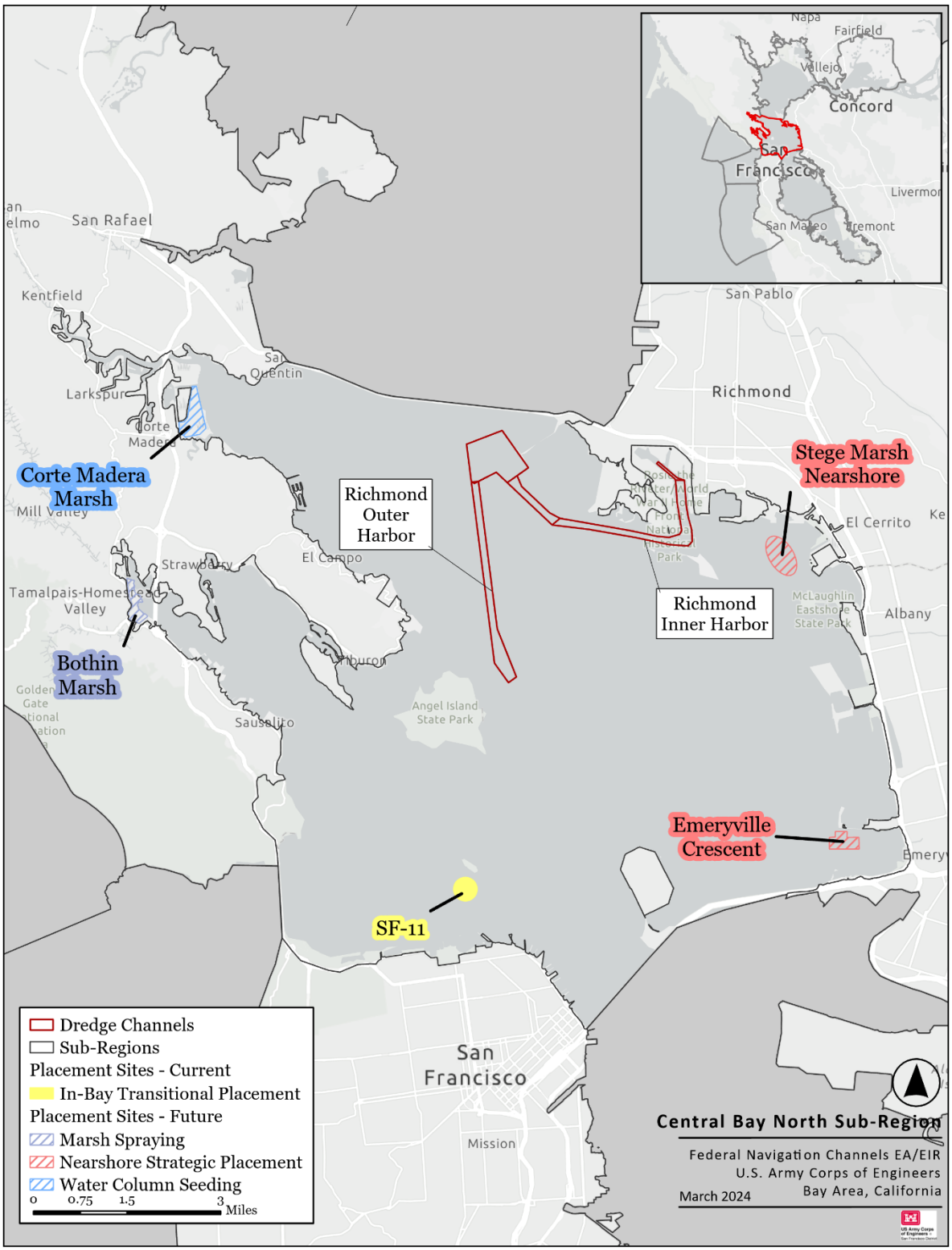


*Figure 6. Potential future placement sites and methods in the Central Bay North sub-region including direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects.*

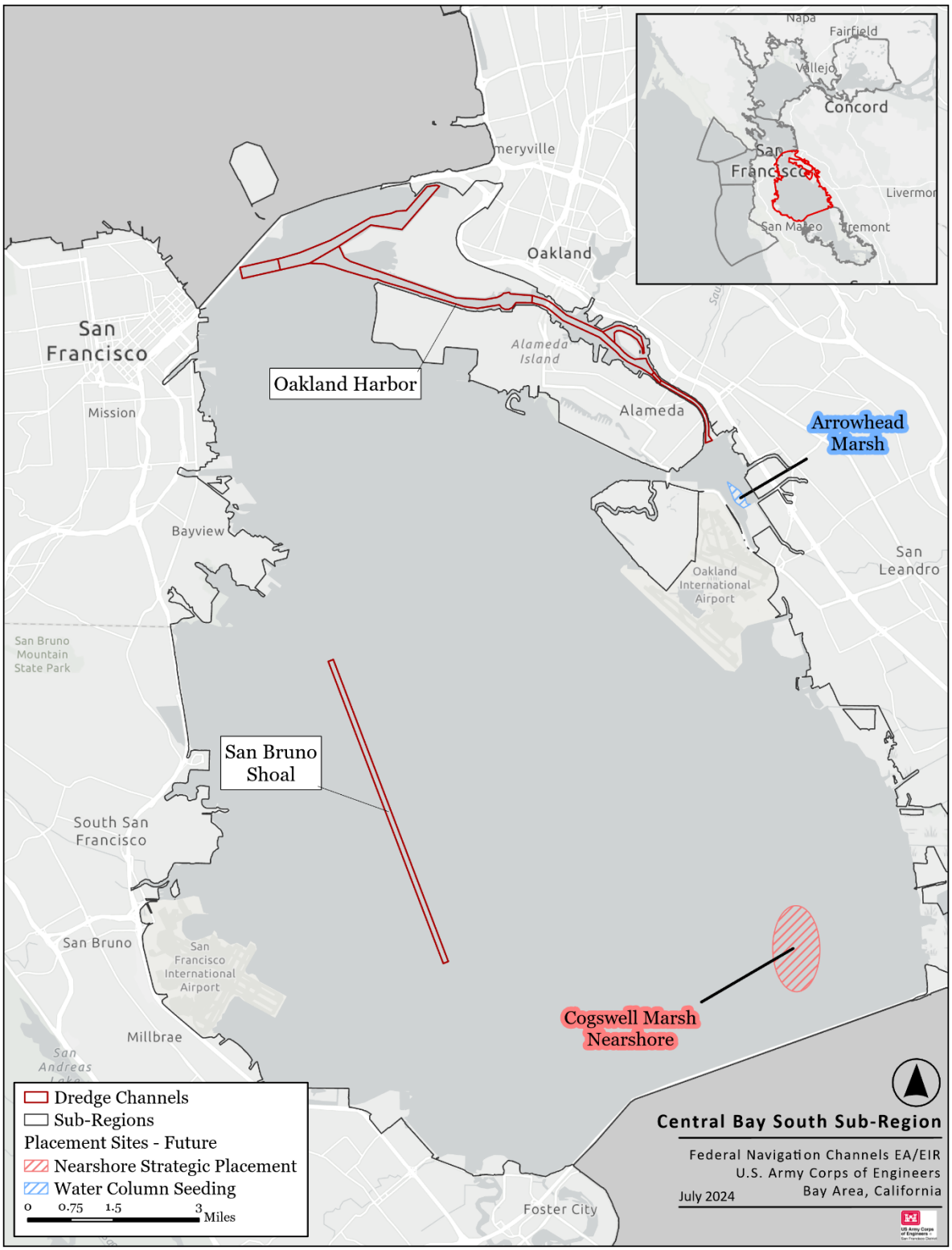


*Figure 7. Potential future placement sites and methods in the Central Bay South sub-region including direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects.*

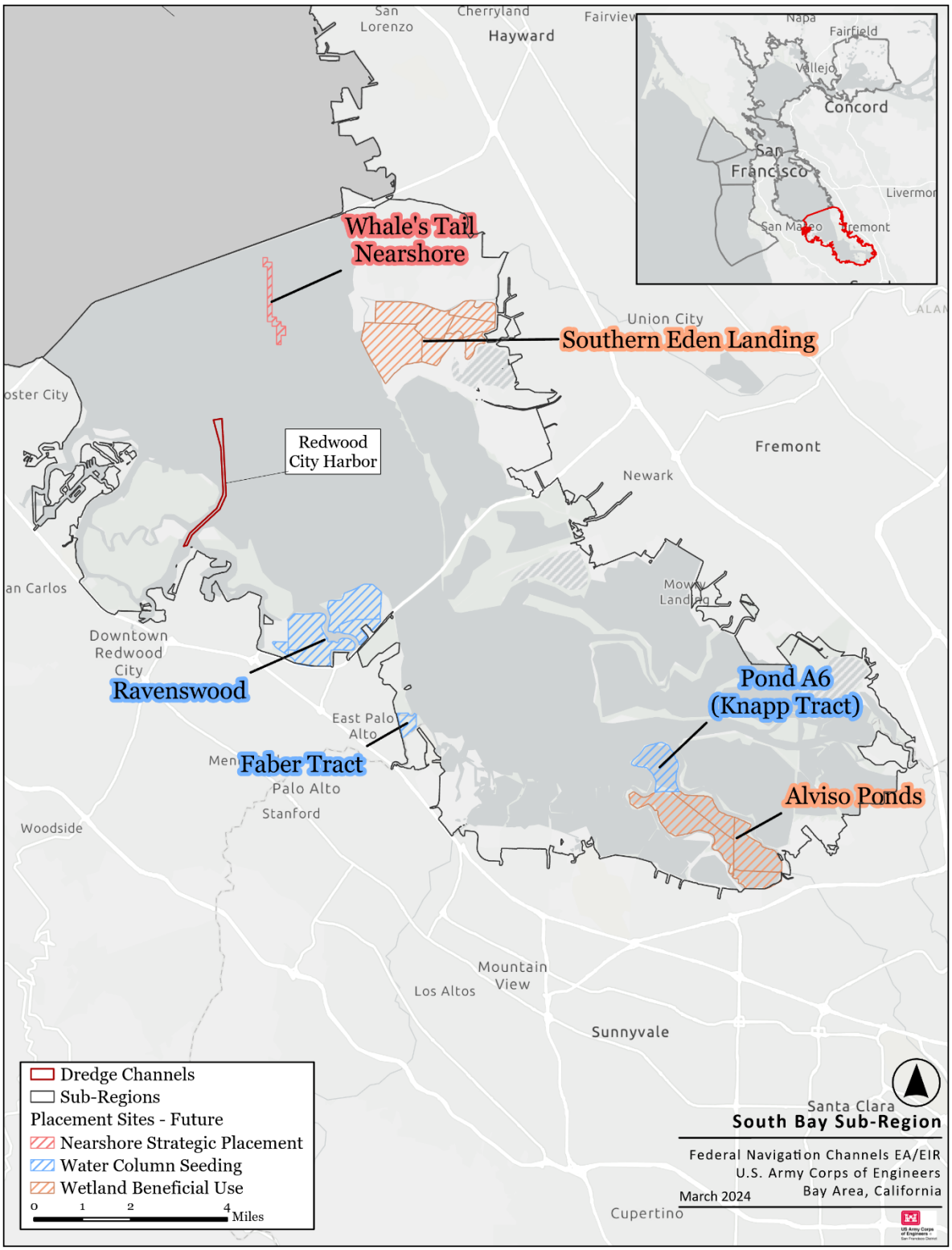


*Figure 8. Potential future placement sites and methods in the South Bay sub-region including direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects.*

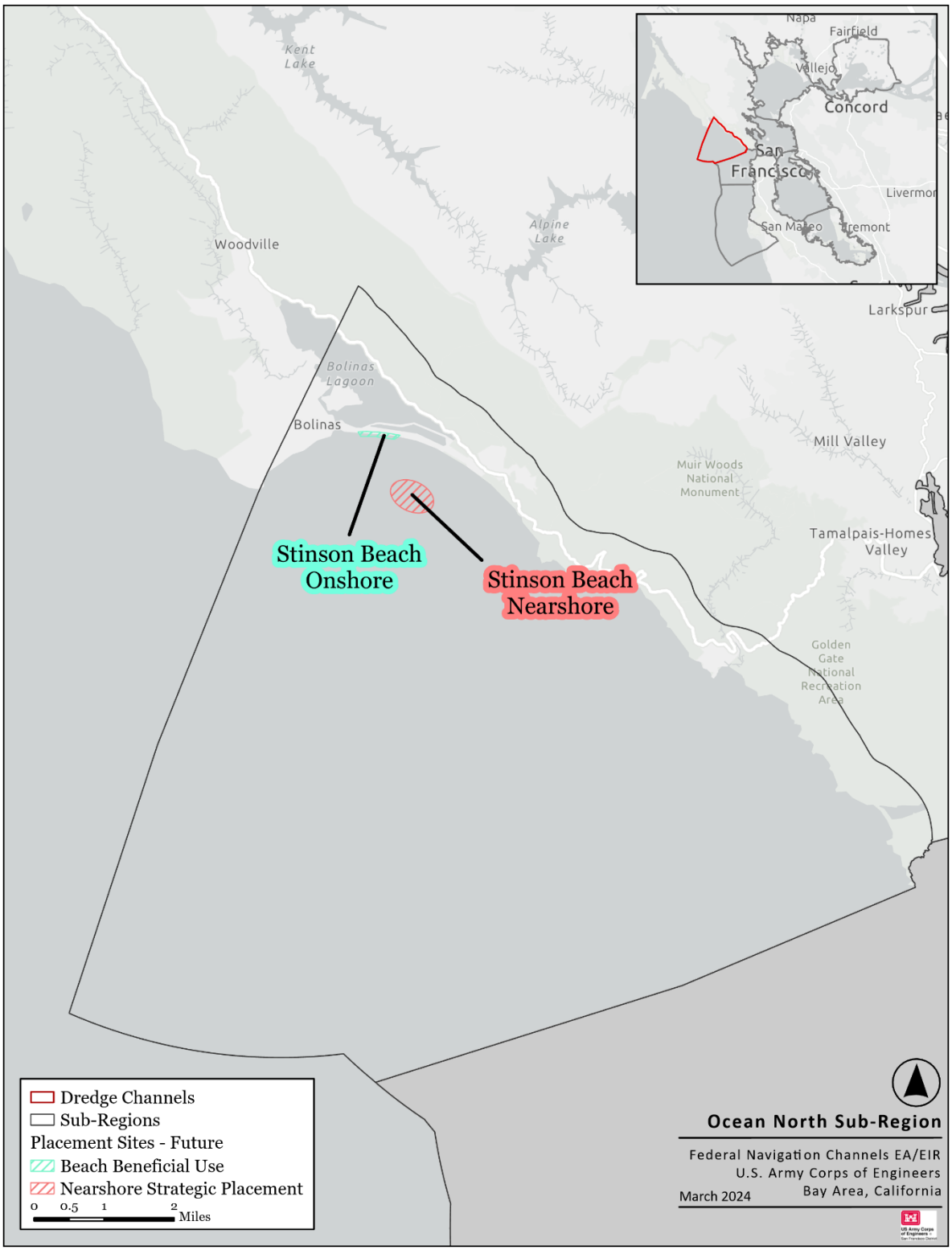


*Figure 9. Potential future placement sites and methods in the Ocean North sub-region including direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects.*

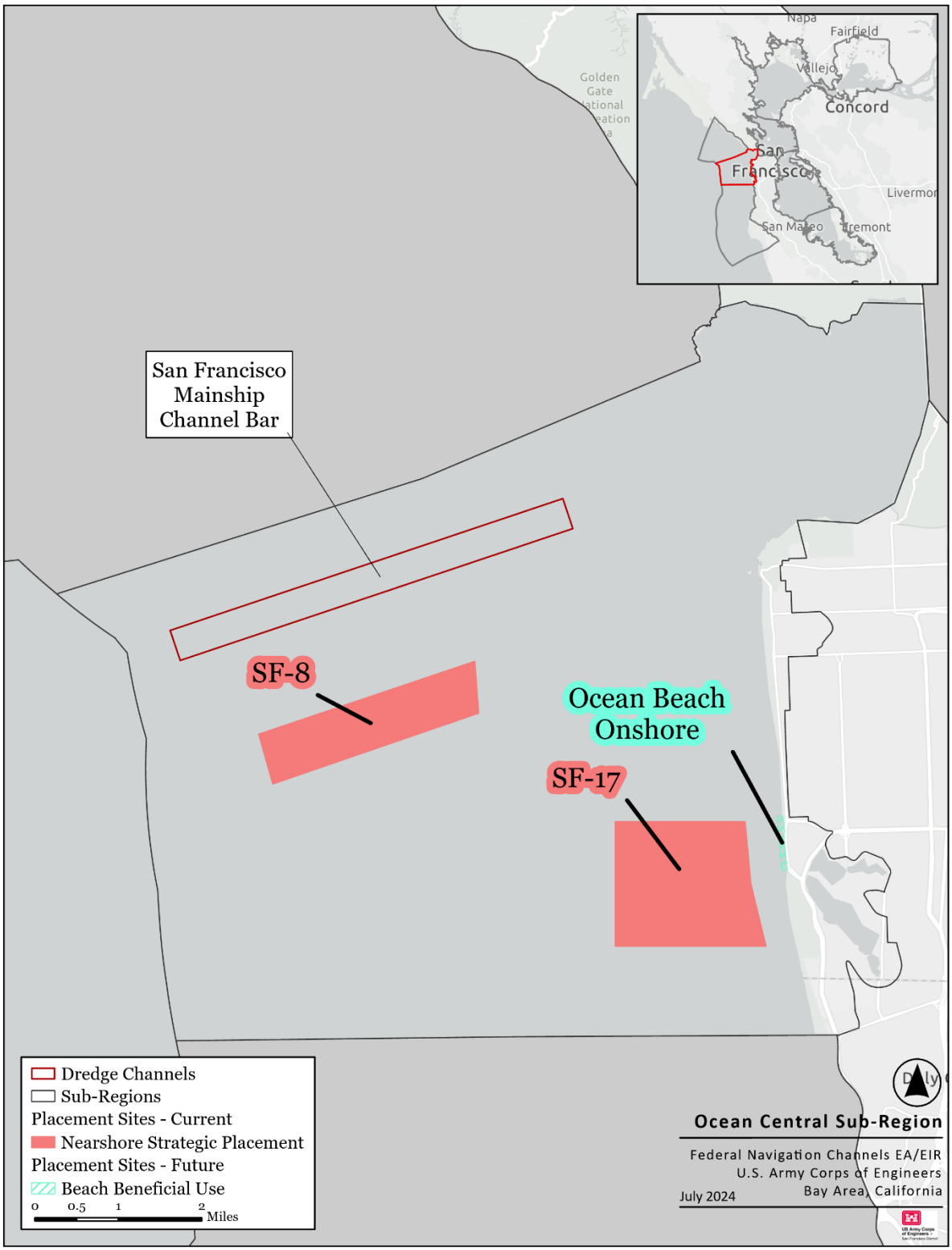


*Figure 10. Potential future placement sites and methods in the Ocean Central sub-region including direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects.*

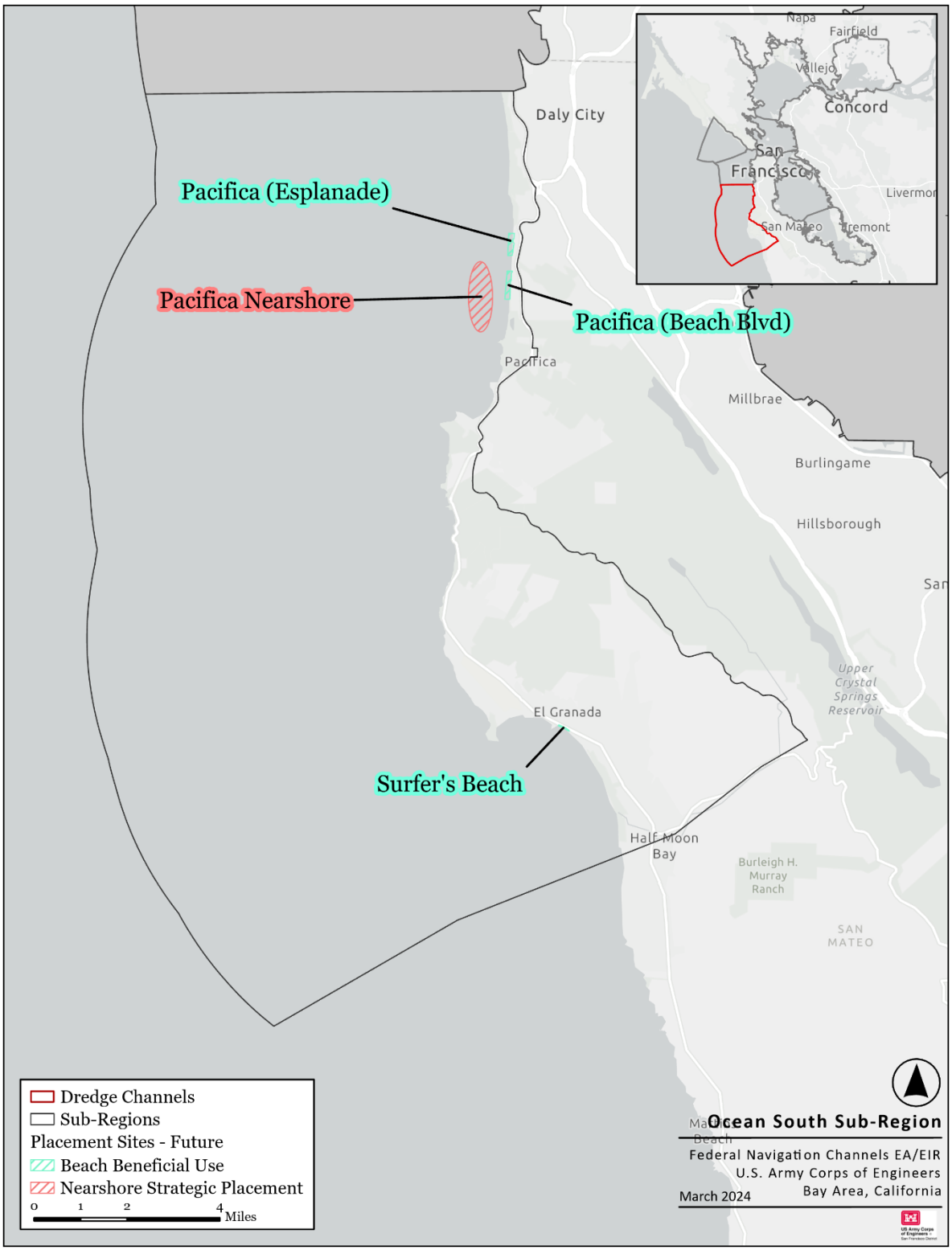


*Figure 11. Potential future placement sites and methods in the Ocean South sub-region including direct placement at wetland restoration sites and novel Engineering with Nature methods for pilot projects.*

## Upland Direct Placement (BU)

### Bel Marin Keys

The roughly 1,000-acre Hamilton Wetland Restoration Project (HWRP) is 25 miles north of SF in the City of Novato, Marin County, on the western shore of San Pablo Bay (Figure 5). The former airfield portion of HWRP stopped accepting dredged material in 2011 and the outboard levees were breeched in 2014. The adjacent Bel Marin Keys Unit V site, authorized by the Water Resources Development Act of 2007, would expand HWRP by 1,576 acres, for a total of nearly 2,600 acres of restored wetlands. The Bel Marin Keys Unit V site was converted from salt marsh habitat to agricultural use over the past 150 years. The site would add between 4 and 13.8 million CY of capacity for dredged material. The exact quantity of material delivered will depend on construction costs, potential other sources of funding for dredged material delivery, offloader configuration, the ability to coordinate with deepening projects, and other factors.

### Skaggs Island (Haire Ranch)

As described in the Sonoma Creek Baylands Strategy (2020), Haire Ranch, Camp 2, West End, and Detjen are currently managed as diked wetlands. Haire Ranch forms the northeastern corner of Skaggs Island (Figure 5) and was converted to a diked wetland from agricultural bayland in 2018. Haire Ranch currently provides seasonal wetland habitat with a long-term goal of becoming tidal wetlands connected to the rest of Skaggs Island when it is fully restored. Camp 2 consists mostly of freshwater perennial pond and seasonal wetlands which were constructed in 2003. West End and Detjen are comprised of non-tidal and muted tidal salt marsh and seasonal ponds/salt pannes. West End, which used to be managed as a private duck hunting club, is currently a muted tidal marsh, operated with tide gates to allow tidal exchange (URS 2011). The site is dominated by annual pickleweed (*Salicornia depressa*) and contains other common tidal marsh vegetation (URS 2011). Detjen was also previously operated as a duck club and contains habitat similar to West End that is dominated by perennial pickleweed.

According to Sonoma Land Trust (private communications with Julian Meisler), while the specific sites and plans for restoration are still under development, the placement of dredged material at Skaggs Island Haire Ranch could represent a good opportunity given it is easier to deliver dredged material there with fewer booster pumps than other locations within the project footprint. Most of the site would go tidal under this proposal with a goal of more wetlands and upland transition zone. Haire Ranch was designed for dredged material (levee, swale system, etc.) and has applied for funding to advance the project through the planning phase. Preliminary CEQA discussions are underway, and a project specific EIR would require an additional three years from its start (i.e., completed as early as 2027-2028). Sonoma Land Trust anticipates an 18-month permitting process with the goal of constructing within three years after permits have been obtained.

Site managers have indicated a broad capacity range between approximately 25 million and 60 million CY. This would result in close to 6,000 acres of restored habitat. The timing and capacity are still uncertain but will be tracked for future BU opportunities as the details become clearer.

### Southern Eden Landing Ecological Reserve

The South Bay Salt Pond Restoration Project proposes to convert 15,100 acres of commercial salt ponds at the southern end of SF Bay to a mix of tidal marsh, mudflat, and other wetland habitats. The property was purchased by the State of California and the federal government from Cargill Salt as part of a larger

land transaction which includes 1,400 acres of salt crystallizer ponds on the eastern side of the Napa River; construction of the Napa River restoration portion of the project is complete. The acquisition of the South Bay salt ponds provides an opportunity for landscape-level wetlands restoration, improving the physical, chemical, and biological health of SF Bay. The goals of the project are to restore and enhance a mix of wetland habitats, to provide wildlife-oriented public access and recreation, and to provide for flood management in the South Bay. The Southern Eden Landing Ecological Reserve site (Figure 8) can accept approximately 4.7 million CY of dredged material (Moffatt and Nichol 2020).

### Alviso Ponds (A8 Complex)

The Alviso A8 Ponds Complex is part of the former salt production ponds in south San Francisco Bay and currently managed by the South Bay Salt Pond Restoration Project. The South Bay Salt Ponds were acquired in 2003 from Cargill Inc. Funds for the acquisition were provided by federal and state resource agencies and several private foundations. This A8 Complex has thus far linked four former salt ponds and converted them to reversibly muted tidal habitat. Goals of this controlled tidal restoration were to benefit endangered and aquatic species and manage ponds for migratory shorebirds and waterfowl. Additional work currently in progress will create 20 acres of ecotone habitat. The A8 Complex will also receive approximately one million cubic yards of sediment from an upcoming Bay Area Rapid Transit (BART) tunnel project sediment and could be a good candidate for future placement of dredged material, given the site elevation is approximately five feet below marsh plain elevation.

### Ocean Beach Onshore

This site is the same site as listed in the Ocean Beach Onshore, Existing Placement Sites section, above (Figure 10). There are chronic erosion problems along Ocean Beach south of Sloat Boulevard, which have been threatening City and County of San Francisco (CCSF) assets since the late 1990's. The city, via Public Works, declared erosion emergencies 3 times in 15 years to place stabilization measures (i.e., large rock revetments and sandbags) on the beach. Those measures ultimately impeded safe public access and affected habitat. These actions precipitated intense political pressure, including litigation and subsequent settlement agreement, on CCSF to remove the revetments and improve access to the beach. In addition, the Coastal Commission denied CCSF requested permits for said stabilization measures and required CCSF to develop a long-term management strategy by December 2021.

The Ocean Beach Climate Change Adaption Project will develop a comprehensive shoreline management and protection plan against bluff erosion and climate change induced SLR consistent with the recommendations in the 2012 Ocean Beach Master Plan. The project is necessary to protect the integrity of wastewater assets built to protect public health and the environment, including the Lake Merced Tunnel (LMT) which is currently at high risk of failure, the Westside Pump Station (WPS) and the Oceanside Treatment Plant (OTP). The project is one of the first CCSF Climate Change Adaptation projects, which is being led by the San Francisco Public Utilities Commission (SFPUC). The LMT has a storage capacity of up to 10 million gallons for combined sewage and stormwater flows and is located closest to the section of Ocean Beach most severely impacted from, and most vulnerable to, continued bluff erosion. The tunnel could become structurally compromised if sudden bluff retreat, similar the storms that resulted in emergency declarations, is experienced during a large storm event. If the LMT is compromised, it could result in significant environmental and public health impacts. The project is being developed in partnership with relevant stakeholders and regulatory agencies to provide a long-term

solution to the erosion issue along Ocean Beach, and to mitigate potential impacts to the LMT and other critical wastewater assets at this location.

The Project is being implemented in three phases: Short-term Improvements Phase (protects the coast & wastewater infrastructure during development of the long-term improvements), USACE Beach Nourishment Phase (long & short-term strategy to add sand to the beach), and Long-term Improvements Phase which includes SFPUC components (installation of a below-grade wall and sand placement to protect the LTM and a service road to provide continued access to OTP and WPS) and non-SFPUC components (e.g., coastal access trail, public parking lot, restrooms, altered intersections, SF Zoo parking improvements, etc.).

Delivery of dredged material from the Main Ship Channel would constitute the USACE Beach Nourishment Phase, and the CCSF has indicated they are interested in re-nourishment every 3-5 years.

### Pacifica Onshore (Beach Blvd)

The Pacifica Beach Blvd (Figure 11) stretch of coast is fronted by a seawall, with access to a pier roughly at the halfway point, north to south. The reach of the seawall north of the pier has essentially no sandy beach on its seaward boundary. The beach widens south of the pier but is still insufficient to prevent all runup and overtopping, especially at a gap in coastal protection immediately south of the Beach Blvd seawall. The current condition is wave lapping at the seawall base along the north reach during most tidal stages, and wave overtopping during high wave or King Tide events, threatening beachfront infrastructure and public safety. The non-federal sponsor, the City of Pacifica, requested assistance under Section 204 of the Water Resources Development Act of 1992 (33 U.S.C. § 2326), as amended, to beneficially use dredged material to reduce the risk from coastal storm damage in Pacifica, California. A positive Federal Interest Determination signed in June 2024 for a Continuing Authorities Program (CAP) Section 204 study. Preliminary alternatives identified that may fit within the $10M federal CAP 204 limit include beach nourishment, beach nourishment with engineered dunes, beach nourishment with groins (i.e., alongshore sand retention structures), and beach nourishment with small artificial reefs or breakwaters. The city has also requested a Section 125(a) beach nourishment, which would include delivery of Main Ship Channel sand without additional measures. The city also has a long-term goal larger project, in which the preferred alternative combines construction of a new seawall, construction of artificial reefs for sand retention, and a 500,000 CY initial beach nourishment with subsequent renourishments on a multi-year schedule (City of Pacifica 2023). All this activity represents a present and ongoing BU opportunity from the Main Ship Channel.

### Pacifica Onshore (Esplanade)

The Esplanade Avenue (Figure 11) stretch of Pacifica coast is approximately 1.2 miles north of the Pier in the Beach Blvd coastline. It comprises rapidly eroding bluffs that represent some of the last remaining unprotected cliff base along this stretch of Pacifica coastline. A positive FID for a CAP 103 shoreline protection study. Several preliminary measures were identified that may fit within the $10M federal CAP limit, including placement of riprap, continued beach nourishment, and several hard structures to protect the toe of the bluff. Beyond the CAP 103 study, additional beach nourishment via 125(a) requests could be added for this area, to allow cycles of beach nourishment over appropriate time periods, representing an ongoing BU opportunity from the Main Ship Channel.

### Surfers Beach

Located adjacent to the Pillar Point breakwater constructed between 1959-1961 and California State Route 1 in northern Half Moon Bay, Surfers Beach (Figure 11) is severely eroded shoreline. Prior to construction of the federal breakwater, the log-spiral shoreline of Half Moon Bay had sufficient sand to support sandy beaches with low, uniform rates of erosion. However, after construction of the federal breakwater between 1959-1961, the alongshore system experienced disequilibrium and has since been re-equilibrating based on the addition of this hard structure that's impeded alongshore sediment transport and concentrated wave energy at Surfers Beach. As a result, the beach has eroded significantly, and in response, the California Department of Transportation (CalTrans) constructed a seawall to protect State Route 1, but which has resulted in limited or no sandy beach on its seaward edge. The San Mateo County Harbor District has expressed concern about the future of this site, pressing for a solution. There have been previous USACE studies seeking to address the erosion issue at the site, and the Harbor District plans to dredge the Harbor and place sediment east of the breakwater to widen the beach. During the RDMMP planning charrette in June 2023, participants suggested Surfers Beach be included as a potential future placement site for dredged material, and the RDMMP PDT considers it a future BU opportunity leveraging the WRDA 2020 Section 125a cost-share authority for material from the Main Ship Channel.

### Stinson Beach Onshore

Seadrift is a sandspit fronting Bolinas Lagoon and connected to land in Stinson Beach at the westward base of Mount Tamalpais (Figure 9). As a low-lying, dynamic landscape, this geomorphic feature experiences frequent changes due to alongshore and cross-shore sediment transport, as well as overtopping due to high wave and water events. Extensive development along the spit has resulted in narrow beaches, especially toward the northern edge of spit, where a rock revetment protects home from damage but has resulted in degraded beach quality and limited public access seaward of it.

With a grant from the State Coastal Conservancy, Marin County Community Development Agency (CDA) contracted with Environmental Science Associated (ESA) to examine the feasibility of a nature-based green infrastructure project at Stinson Beach (Federal ownership) and Upton Beach Park (County ownership). Adaptation alternatives were developed for the study area by selecting a natural infrastructure type for each reach. Suitability of the natural infrastructure types was determined by comparing the minimum desired widths for each natural infrastructure type with actual beach widths in each reach (based on recent surveys and observed seasonal fluctuations). Alternatives under consideration include traditional armoring (e.g., rock revetment, reinforced concrete seawall), foredunes and dune embankments, cobble berms, cobble-gravel berms, and cobble-gravel berms with dunes. The County of Marin has expressed interest in including sediment from the Main Ship Channel to supplement the alternatives proposed by ESA and leveraging the WRDA 2020 Section 125(a) cost-sharing opportunity for the BU of dredged material.

## Nearshore Strategic Placement (BU)

As described in the Existing Placement Sites section above, nearshore strategic placement is the placement of sediment in the shallow subtidal (or potentially intertidal) environment with the expectation that tidal and wave forces will transport that sediment onto the intertidal mudflat and marsh. Building upon the Eden Landing Whale's Tail 2023 pilot project, the RDMMP team in coordination with non-federal partners and based on feedback received during the June 2023 planning

charrette, has identified several opportunities to implement future nearshore strategic placement pilot projects. These include: Ryer Island Nearshore (proximal to Suisun Bay Channel), Giant Marsh Nearshore (proximal to San Pablo Bay Pinole Shoal Channel), Bel Marin Keys Nearshore (proximal to Petaluma River and Across-the-Flats Channel), Stege Marsh Nearshore (proximal to Richmond Inner Harbor Channel), Emeryville Crescent Nearshore (proximal to Oakland Outer Harbor Channel), Cogswell Marsh Nearshore (proximal to Oakland Inner and Outer Harbor and Redwood City Harbor Channels), Whale's Tail Nearshore (proximal to Redwood City Harbor Channel), Faber Tract (proximal to Redwood City Harbor Channel), Stinson Beach Nearshore (proximal to Main Ship Channel), Surfers Beach Nearshore (proximal to Main Ship Channel) (Figures 3-11).

### Elevation Augmentation (BU)

Elevation augmentation, or marsh spraying, is described in the Future Placement Sites section as the transport of sediment by pipeline to an existing marsh and the use of a modified pipeline offloader to fan the sediment over top of the existing marsh plain to provide an elevation boost of inorganic sediment, thus facilitating continued natural organic marsh sedimentation. Based on conversations with restoration site managers and local flood control districts, in addition to feedback gathered from the June 2023 planning charrette, the RDMMP team has identified two potential options: Bothin Marsh in Marin County, and Sears Point in Sonoma County (Figures 3-6). Other elevation augmentation sites will be developed and piloted in the future based on changing conditions and willing non-federal partners. Such projects can be funded by the WRDA 2020 Section 125a cost-share authority.

### Water Column Seeding (BU)

As described above, water column seeding is the transport of dredged sediment to the mouth of an existing tidal marsh channel using a modified pipeline offloader, and the placement of that sediment on a flood tide to leverage the tidal flux into the marsh channel and facilitate sediment deposition on the slack high tide. Based on conversations with restoration site managers and others who provided feedback at the June 2023 planning charrette, the RDMMP team has identified four potential options: Arrowhead Marsh in Alameda County, Ravenswood in San Mateo County, Pond A6 (Knapp Tract) in Santa Clara County, and Corte Madera Marsh in Marin County (Figures 3-11). Other water column seeding sites will be developed and piloted in the future based on changing conditions and willing non-federal partners. Such projects can be funded by the WRDA 2020 Section 125a cost-share authority.

## Formulation of Alternatives

### Study Process

The subsequent sections present the general goals of a DMMP, as outlined in USACE Guidance, as well as the specific objectives pertaining to this RDMMP and the specific problems and opportunities which exist in the SF Bay region. Identification of goals, problems, and opportunities helps to inform the objectives to be accomplished by the plan, constraints to be avoided by the plan, and other important factors which will influence alternative plan formulation and selection.

The Corps' Planning Policy for Conducting Civil Works Planning Studies, ER 1105-2-103 (7 Dec 2023) defines objectives as the things which alternative plans are trying to achieve. Objectives are therefore more specific than externally provided goals and are developed as a response to the identified problems and opportunities. During the development of objectives, planning constraints are also identified. Planning constraints are restrictions to the plan formulation process, which limit the set of potential

alternative plans. The purpose of the DMMP planning process is to formulate plans to achieve the objectives while avoiding the constraints. Because planning is an iterative process, objectives and constraints are modified as new information concerning problems and opportunities becomes available.

Problems are defined as the undesirable conditions or characteristics that need to be changed. In the development of a DMMP, problems need to be identified over a twenty-year study period. Opportunities are situations or conditions which may be exploited to address or resolve the problems identified in the planning process. Opportunities often include the means to favorable outcomes which would result from plan implementation.

Corps of Engineers project planning follows the six-step process (Figure 12) first described in the Principles and Guidelines (1983) and further elaborated in the Planning Guidance Notebook, ER 1105-2-100 (22 Apl 2000). The planning process was refined in the Planning Policy for Conducting Civil Works Planning Studies, ER 1105-2-103 (7 Dec 2023), which supersedes the Planning Guidance Notebook. Although presented in series, these steps are applied in an iterative process, which focuses emphasis on succeeding steps.

The PDT utilized the following plan-formulation process from the Policy for Conducting Civil Works Planning Studies (ER 1105-2-103), which proposes a six-step iterative planning process, outlined in Figure 12 below.

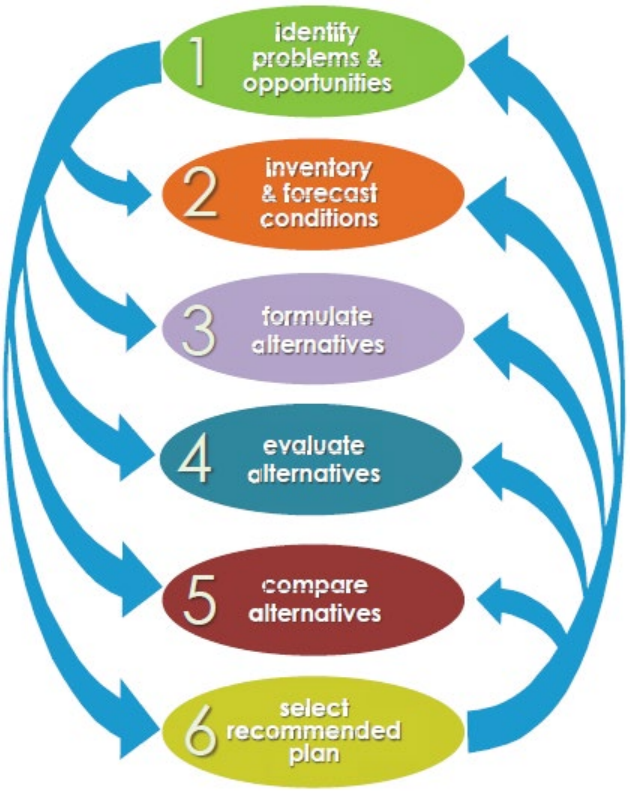


*Figure 12. USACE Planning Process from identifying problems and opportunities through selecting a plan.*

The six-step planning process is applicable to development of a DMMP. The identification of problems and opportunities and development of objectives and constraints are all components of the first step of the iterative planning process.

## Goals of the Regional DMMP

The goals of the SF Bay RDMMP are developed through the national DMMP policy specified in the Principles and Guidelines (1983), the USACE Planning Guidance Notebook (2000), and the Planning Policy for Conducting Civil Works Planning Studies, ER 1105-2-103 (7 Dec 2023). National dredged material management planning policy is further directed by Section 2037 of WRDA 2007 (Regional Sediment Management). These policies set the goals for the SF Bay RDMMP.

SF Bay RDMMP goals based on federal and regional dredged material management guidelines include:

- DMMPs must identify the least cost, environmentally acceptable, and technically feasible plan (i.e., the Federal Standard Base Plan);
- Dredged material management must contribute to the Federal Objective:
    - The Federal Objective is to contribute to National Economic Development consistent with protecting the nation's environment. Federal water resources development planning is further directed to include local participation, such as state and local agency cooperation and public involvement. Achievement of the Federal Objective is a goal of all USACE water resource planning[2];
- DMMPs must be consistent with the current environmental requirements and evaluated for sound engineering;
- The costs of selected dredged material management alternatives must be warranted based on economic, environmental, and social benefits;
- DMMPs must address dredged material placement over a 20-year planning horizon (Planning Guidance Notebook, Engineering Regulation 1105-2-100);
- There should be annual updates to the RDMMP with a five-year planning time horizon (per WRDA 2020 125(c) guidance);
- DMMPs must consider the BU of sediments.
- USACE Command Philosophy has set a goal of 70% BU of dredged material by volume by 2030 across the enterprise; and
- The RDMMP should leverage WRDA 2020 Section 125 to facilitate BU. Section 125(a)(2)(C) of the Water Resources Development Act (WRDA) of 2020 amends Section 204(d) of WRDA 1992 (33 U.S.C. 2326(d)) to authorize the Secretary to use funds appropriated for construction or operation and maintenance of a project involving the placement of dredged material when selecting a placement method that is not the least cost option based on a determination that the incremental costs of the placement

[2] The current Principles, Requirements, and Guidelines (PR&G) for Federal Investments in Water Resources is being updated. A new PR&G may be implemented during future updates to the RDMMP. Updates to the PR&G are located at https://planning.erdc.dren.mil/

method are reasonable in relation to the environmental benefits or the hurricane and storm or flood risk reduction benefits[3].

## Problems

The projected volume of SF Bay area dredged material requiring placement from 2025 through 2044 is estimated to be between 30-40 million cubic yards, not accounting for additional future dredged quantities from potential new projects. The potential for in-bay placement of dredged material, although convenient and typically less costly, is limited by regional policies and regulatory agencies concerned with perceived water quality, fish and wildlife impacts and potential navigation safety concerns. The problematic nature of regional dredged material management in San Francisco Bay is largely based on the projected volume of sediment requiring placement being greater than currently identified BU capacity. The full list of problems include:

- BU is the costliest placement method and there have been limited historical sources to cost share the incremental cost above the Federal Standard Base Plan;
- The projected volume of sediment to be dredged from the 10 navigation channels needs to be coordinated across placement sites to avoid over-shooting in-bay site capacity limits, and the available BU site capacity is limited, resulting in sediment loss to the deep ocean;
- The SF Bay system requires sediment to adapt to SLR and reduce flood risk, and deep ocean disposal results in reduced sediment availability:
    - There is an urgent need to address climate change, specifically SLR and the loss of marshes and mudflats;
    - The timing of actions in relation to SLR is limited by environmental work windows, environmental permitting reviews, schedule delays, and environmental coordination;
- It is unclear how much federally dredged sediment is acceptable for BU due to changing material characterization through the tiered sediment testing process; and
- The current project--specific approach to dredged material management is constraining toward achieving regional climate adaptation goals and effectively managing several inter-connected projects; and
- The dredging market is limited in the number of bidders on projects, and the cost of dredging and placement depends on the lowest bid.

## Opportunities

Opportunities which may be addressed by the SF Bay RDMMP include the reduction of source material, more intensive use of existing BU sites, expansion of existing BU sites, and development of new BU sites. The full list of opportunities include:

[3] 125(a) allows USACE to budget operations and maintenance (O&M) funds to respond to requests to investigate Federal interest in cost sharing implementation of BU; and the Federal share of the implementation is also to be from O&M funds. As such, incorporating new BU opportunities is intended to be a relatively seamless process. https://planning.erdc.dren.mil/

- Maintain navigation safety and efficiency and sustain the regional and national economy by removing shoaled sediment in navigation channels;
- Reduce channel source material via channel realignments and re-evaluation of channel-by-channel dredging needs to reduce the future quantity of dredged material;
- Implement a regional approach to planning rather than channel-specific planning to align the efficient use of dredge equipment and to coordinate the distribution of sediment across placement sites;
- Increase BU from federal O&M dredging within the Federal Standard Base Plan by balancing higher cost BU placement from certain channels with cost efficiencies from others across the navigation dredging program; and Increase BU above the Federal Standard Base Plan by leveraging WRDA 2020 Section 125 to incorporate new BU sites and identify non-federal cost share partners for the incremental cost of BU above the Federal Standard Base Plan.
- Encourage negotiation between contractors, reducing overall costs to the Government;

## Objectives

The objectives of the SF Bay RDMMP are developed in response to the problems and opportunities. The objectives presented here can be further refined as more information from work being conducted concurrently adds to the understanding of the region's dredged material management problems and opportunities.

Although the definition of individual objectives may be refined with additional information, and additional objectives may be identified, the following bullet-point list of objectives serves as the current base for plan formulation and additional information gathering:

- Develop the Federal Standard, or the "Base Plan", which is the least cost and technical feasible placement method that meets Federal environmental standards and fully meets material placement needs over the planning horizon (2025-2044);
- Maximize BU of dredged material within the federal standard according to USACE command philosophy and district strategic goals, leveraging novel Engineering with Nature approaches to target cost efficiencies and providing opportunities to cost share according to WRDA 2020 Sec. 125(a) and (c)).

## Constraints

Development of the SF Bay RDMMP is being conducted in an environment where there are numerous competing uses and users of the Bay. Successfully meeting the objectives requires that the SF Bay DMMP be formulated within the bounds of constraints which delineate unsuitable or undesirable outcomes. SF Bay RDMMP planning constraints are based on specific regulatory, physical, and other conditions within the study area.

The major planning constraints identified thus far include:

- Compliance with all environmental laws and regulations that pertain to the proposed action; and
- Monthly and annual placement capacity limits for in-bay placement sites

## Other Considerations

Other considerations that are important to the formulation and selection of alternative plans as part of the RDMMP include:

- Dredged material suitability, historical contamination, special handling requirements, and mitigation responsibility;
- Identifying the benefits of BU to facilitate future BU opportunities as much as possible;
    - Continually update and define BU opportunities based on stakeholder, partner agency, public, and community-level input;
    - Match sites with BU need with material supply over the 20-year horizon;
    - Identify areas in which BU may contribute to environmental justice and social benefits;
- Incorporating pilot projects for BU for various Engineering with Nature applications (e.g., nearshore strategic placement, water column seeding, elevation augmentation) into project alternatives;
- Conducting Research and Development and implementing an innovation lab to test BU concepts to inform alternatives development;
- Maintaining and promoting inter-agency and local coordination in the formulation and implementation of the SF Bay RDMMP;
    - Developing a communication plan to share information between agencies over the course of the planning horizon and link together sediment management efforts across the watershed;
    - Working with industries and resource agencies to reduce the shoaling and reduce the overall maintenance needs in the channels;
    - Integrating ongoing processes, leverage ongoing sediment management processes and local/regional plans;
    - Creating a framework to manage material in a way that matches regional needs with an emphasis on BU consistent with the Federal standard;
    - Through an inclusive process, identifying cost-share sources; and
    - Creating a mechanism to pair materials needs with material supply (GIS mapping tool).
- Developing a plan that advances the LTMS goals of 40% BU, 40% ocean disposal, and 20% in-bay placement to the maximum extent practicable;
- Avoiding ocean disposal, given that ocean travel to SF-DODS has a higher risk to operators than in-bay or BU sites, as well as to the dredging schedule period of performance due to wave and weather conditions and long haul distances;
- Considering equity, Coastal Storm Risk management (CSRM) resilience and recreation for underserved communities in future BU opportunities aligned with the alternatives themes[4]; and

[4] Executive Order (E.O.) 14096 (21 Apr 2023), Revitalizing Our Nation's Commitment to Environmental Justice for All and E.O. 14091 of Feb 16, 2023 Further Advancing Racial Equity and Support for Underserved Communities Through the Federal Government

- Quantifying the benefits of BU (e.g., carbon sequestration, habitat acreage created, flood and coastal storm risk mitigated) to justify federal cost-sharing of the incremental cost for BU above the Federal Standard Base Plan.

### Sediment Characteristics

The placement of dredged material from SF Bay is constrained by the sediment suitability determinations made by the DMMO on a project-by-project basis. The least contaminated material is suitable for the broadest range of placement options, while the most contaminated material must receive very specific handling. Every year, on the order of three million cubic yards of sediment is dredged from SF Bay (including non-federal dredging), and most of the dredged material is determined to be suitable for unconfined aquatic disposal in the SF Bay by the DMMO. For the projects that do not meet in-bay suitability requirements, the dredged sediment is typically not directly toxic to benthic organisms in bioassays but exceeds the SF Bay Total Maximum Daily Limit (TMDL) based on sediment chemistry test results.

Physical characteristics (e.g., grain size, gradation of the sediment samples, and moisture content) influence conditions during dredging, material transportation, and placement activities. Physical characteristics often dictate the suitability for particular BU alternatives. For example, most fine-grained sediment with an overall poor gradation will lack suitability for many construction uses, such as structural fill and beach nourishment. There is a considerable range of dredged material types that commonly shoal in the federal channels of SF Bay, ranging from soft mud (composed primarily of silts and clay) to sand.

### Special Status Species, Critical Habitat, and Essential Fish Habitat

The presence of federally protected species in SF Bay constrains our dredging methods, placement options, and timing of both. As described in Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, and the Marine Mammal Protection Act, we consult with USFWS and NMFS on our dredging projects, and we agree upon how (mechanical or hydraulic dredging) and when (time of year) we can dredge each channel. In the SF Bay region, environmental windows[5] for both dredging and dredged material placement were established because of ESA Section 7 consultations with NMFS and USFWS, and these environmental windows are reflected in the biological opinions for the federal navigation channel dredging projects. Special-status species designated critical habitat, and EFH with the potential to occur in the areas where dredging and placement activities would occur are described below. Because of the large geographic extent of the study area, only species that likely inhabit areas in or adjacent to the federal navigation channels or placement sites are discussed, rather than all special-status species that may occur in the greater SF Bay area. A more detail description is included in the companion EA/EIR document.

[5] Environmental work windows refer to specific periods of time (e.g., July 1 to August 31) during which certain activities, typically those with potential environmental impacts, are permitted. These windows are often designated based on ecological factors such as breeding seasons for wildlife, migration patterns, or periods of sensitivity for ecosystems.

### *Special Status Species*

Table 4 below lists the federally threatened (FT), endangered (FE), and proposed (PE) species located in the SF Bay RDMMP study area. Listed species in SF Bay include Distinct Population Segments (DPSs) of taxonomic species.

Special-status reptiles and amphibians (e.g., Alameda whipsnake (*Masticophis lateralis*) and California red-legged frog (*Rana draytonii*) could inhabit certain land-based placement sites. This restricts future opportunities for land-based placement sites, and existing sites have been established with consideration of these species. In accordance with their permits for receiving dredged materials, site operators are responsible for coordinating protected species issues with resources agencies and managing the placement of dredged materials at the placement sites in accordance with conditions of their permits and other regulatory approval. For these reasons, these species are not further discussed in this section.

*Table 4. Federally listed special status species in the RDMMP study area*

| Class | Species | Federal Status | Habitat |
|---|---|---|---|
| Reptiles | Green Sea Turtle<br>*Chelonia mydas* | FT | Shallow waters of lagoons, bays, estuaries, mangroves, eelgrass and seaweed beds. Prefers areas with abundant aquatic vegetation, such as pastures of sea grasses and algae, in shallow, protected water. |
| Fish | Tidewater Goby<br>*Eucyclogobius newberryi* | FE | Brackish lagoons, estuaries, marshes, and freshwater tributaries |
| | Longfin Smelt<br>*Spirinchus thaleichthys* | PE | Nearshore waters, estuaries, and lower portions of freshwater streams |
| | Delta smelt | FT | Fresh and salt-water mixing zones of the SF Bay Delta |
| | Steelhead, Central California Coast DPS and Central Valley Steelhead DPS<br>*Oncorhynchus mykiss* | FT | The waters of the Bay are considered critical habitat up to the extent of extreme high tide (Federal Register No. 52488). |
| | North American Green sturgeon, Southern DPS<br>*Acipenser medirostris* | FT | The waters of the Bay are considered critical habitat up to the extent of mean higher high water (Federal Register No. 52300). |
| | Central Valley spring-run Chinook Salmon<br>*Oncorhynchus tshawytscha* | FT | The waters of the Bay are considered a migratory pathway to and from spawning grounds. |
| | Sacramento River Winter-run Chinook salmon<br>*Oncorhynchus tshawytscha* | FT | The waters of the Bay are considered a migratory pathway to and from spawning grounds. |
| | Central California Coast Coho Salmon ESU<br>*Oncohyrnchus kisutch* | FE | The waters of the Bay are considered a migratory pathway to and from spawning grounds. |
| Mammals | Salt Marsh Harvest Mouse<br>*Reithrodontomys raviventris* | FE | Saline or subsaline marsh habitats especially where pickleweed is abundant |
| Birds | California Ridgeway's (=Clapper) Rail | FE | Upper to lower zones of coastal marshes that are dominated by pickleweed and cordgrass |

| | | | |
|---|---|---|---|
| | *Rallus longirostris obsoletus* | | |
| | California Least Tern<br>*Sterna antillarum browni* | FE | Foraging habitat includes nearshore waters, estuaries and river mouths; nesting habitat includes sparsely vegetated sites near water, usually on sandy or gravelly substrate. |
| | Western Snowy Plover<br>*Charadrius nivosus nivosus* | FE | Open, sandy areas adjacent to water. This includes ocean beaches and barrier islands as well as barren shores of saline lakes inland. |

### *Critical Habitat*

Steelhead. Critical habitat was established for the Central California Coast steelhead DPS on September 2, 2005 (70 C.F.R. pt. 52488-52626). Designated critical habitat for this species includes all portions of SF Bay below the ordinary high water line. The designation includes natal spawning and rearing waters, migration corridors, and estuarine areas that serve as rearing areas. In tidally influenced waters, the lateral extent of this critical habitat is defined by the mean higher high water line (NOAA, 2005).

Chinook Salmon. Critical habitat for the Sacramento River winter-run Chinook salmon was designated by the NMFS (50 C.F.R. pt. 226) in 2005. The designation includes natal spawning and rearing waters, migration corridors, and estuarine areas that serve as rearing areas. Designated critical habitat for this species includes the waters of SF Bay north of the SF – Oakland Bay Bridge. The lateral extent of this critical habitat is defined by the mean higher high water line (NOAA, 2005).

Delta Smelt. Critical habitat was established for the delta smelt on January 18, 1995 (50 C.F.R. pt. 65256-65279). Designated critical habitat for this species includes all water and submerged lands below ordinary high water, and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained in the Delta, as defined in Section 12220 of the California Water Code. The downstream limit of critical habitat for delta smelt is the Carquinez Bridge.

Green Sturgeon. On October 9, 2009, the NMFS issued a final designation of critical habitat for green sturgeon (74 C.F.R. pt. 52300-52351). This includes the designation of specific rivers, estuaries, and coastal areas as critical habitat for this species. Under this ruling, the entire SF Bay below mean higher high water is designated as critical habitat, which includes the portion of SF Bay in the project area (NMFS, 2009).

Leatherback Turtle. In 1979, NMFS designated critical habitat for leatherback turtles to include the coastal waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands. In January 2012, NMFS designated additional critical habitat to provide protection for endangered leatherback sea turtles along the west coast of the United States (77 FR 4170). This designation includes approximately 16,910 square miles (43,798 square kilometers) stretching along the California coast from Point Arena to Point Arguello, east of the 3,000-meter depth contour. A portion of this critical habitat lies in the ocean portion of the study area.

### *Essential Fish Habitat*

SF Bay and the portions of the project area in the Pacific Ocean (including SF-DODS) are classified as EFH under the Magnuson-Stevens Act. The project area serves as habitat for species of commercially important fish and sharks that are federally managed under three fisheries management plans (FMPs): the Pacific Groundfish FMP, the Coastal Pelagic FMP, and the Pacific Coast Salmonid FMP.

The Pacific Groundfish FMP is designed to protect habitat for more than 90 species of fish, including rockfish, flatfish, groundfish, some sharks and skates, and other species that associate with the underwater substrate. This includes both rocky and soft substrates.

The Coastal Pelagic FMP is designed to protect habitat for a variety of fish species that are associated with open coastal waters. Fish managed under this plan include planktivores and their predators.

The Pacific Salmon FMP is designed to protect habitat for commercially important salmonid species, including Chinook salmon, and coho salmon.

The SF Bay Estuary, including any eelgrass beds contained within, is identified as a "habitat of particular concern" under these FMPs. These habitats are of particular importance to certain life stages of species managed under the FMPs and are more sensitive to degradation.

Although they are not a state-listed or federally listed species, native oysters (Ostrea conchaphila) are considered a historical keystone species for SF Bay and contribute to EFH where oyster beds occur. However, Oyster beds are not known to occur in the federal navigation channels or in-water placement sites.

## Alternatives Development

As outlined above, alternatives are developed with various components to produce solutions that achieve all or part of one or more objectives. Plan formulation strategies are used to develop the alternative plans and address the objectives. The following section outlines the various components and plan formulation strategies used to develop the alternatives.

The alternatives development process focused on the economics of combining different placement sites across the 10 federal channels. The cost of each placement site depends on dredge and placement equipment type, market conditions and equipment availability, sediment haul distances, and other factors described in more detail in the following subsections. The differences in relative costs were used to construct the alternatives and outline how channels might be dredged and where the sediment might be placed toward meeting the objectives of the RDMMP – the primary objectives being identifying the Federal Standard Base Plan and maximizing BU. As part of this process, channel utilization and re-alignment were analyzed to determine if reductions in O&M dredged volumes would be possible, and no opportunities were presently available to do so.

Volumes were estimated using the 2023 USACE Integrated Alternatives Analysis (USACE IAA, 2023) for SF Bay channels, which spanned dredging years 2000-2022. This time range was utilized to estimate average, minimum, and maximum volumes per channel, and the annualized average was used as the metric for planning which placement site would receive sediment from each channel. The only channel that did not use this time range was the Oakland Inner and Outer Harbor, which was deepened during this timeframe in 2010. As such, the time horizon for the Oakland Inner and Outer Harbor volume is 2011-2022.

*Table 5. Volume estimates from USACE's 2023 Integrated Alternatives Analysis, including the minimum, annualized average, maximum, and average volume per episode over that timeframe. The annualized average is the sum of all dredging events over the time horizon divided by the number of years in the time horizon, while the average volume per episode is the average over only the dredging years. The former is the metric used to develop the alternatives (removing temporal variability significantly simplifies the planning process), while the latter is the volume used to calculate each channel's contribution to the different placement sites and categories for each unique year in the 20-year planning time horizon.*

| | **2000-22 Minimum Volume (CY)** | **2000-22 Annualized Average Volume (CY)** | **2000-22 Maximum Volume (CY)** | **2000-2022 Average Volume per episode (CY)** |
|---|---|---|---|---|
| Oakland Inner and Outer Harbor | 140,000 | 750,000[6] | 1,220,000 | 750,000 |
| Richmond Inner Harbor | 10,000 | 300,000 | 630,000 | 300,000 |
| Richmond Outer Harbor | 80,000 | 210,000 | 730,000 | 250,000 |
| SF Main Ship Channel | 80,000 | 350,000 | 610,000 | 350,000 |
| Pinole Shoal (San Pablo Bay) and Mare Island Strait | 60,000 | 150,000 | 560,000 | 190,000 |
| Suisun Bay Channel and New York Slough | 50,000 | 170,000 | 420,000 | 170,000 |
| Redwood City Harbor | 10,000 | 180,000 | 650,000 | 180,000 |
| San Bruno Shoal | 30,000 | 1,000 | 30,000 | 30,000 |
| Napa River | 60,000 | 10,000 | 160,000 | 110,000 |
| Petaluma River | 70,000 | 20,000 | 210,000 | 150,000 |
| Petaluma Across the Flats | 70,000 | 3,000 | 70,000 | 70,000 |
| San Rafael Creek | 30,000 | 20,000 | 280,000 | 110,000 |

Robust cost engineering was conducted by a Dredge Cost Subject Matter Expert (SME) from the USACE Cost Engineering Center of Expertise housed in the Walla Walla District. The cost estimates included detailed information on dredge equipment and methods, sail distances, placement methods, and market conditions for each unique method.

The two dredge equipment types mainly used for the 10 USACE federal navigation projects are Hydraulic and Mechanical Clamshell (Figure 13). Hydraulic dredger uses agitation methods to break up compacted material by means of rotating cutter head or waterjet jet pulse while at the same time applying suction to remove or transport the material; or directly pick up soft uncompacted material without agitation. Hopper is a hydraulic dredger with a capability of serving as a powered barge or a scow to transport the dredge material to the designated placement site. The mechanical dredger mainly used is a clamshell

[6] Oakland Harbor's timeframe for volume estimation is 2011-2022 given it was last deepened in 2010, and the maintenance volume should reflect consistent and current channel dimensions when projecting into the future.

bucket type that digs channel material via its own weight.  Material removed using a mechanical clamshell is loaded on to a barge or scow. Placement of the material dredged using mechanical clamshell or hopper is accomplished via bottom-dumping from split-hull or belly of a hopper for in-bay placement, or via a slurry (i.e., mixed water and sediment for mobilization) that is pumped off to upland site using  and an offloaded from either the scows or hopper dredges.  Cutterhead dredges pump dredge material directly to the designated placement site using a submerged or floating material conveyance pipeline which requires depending on the distance of the placement site  from es and transported by booster pumps, if necessary, to the placement site.

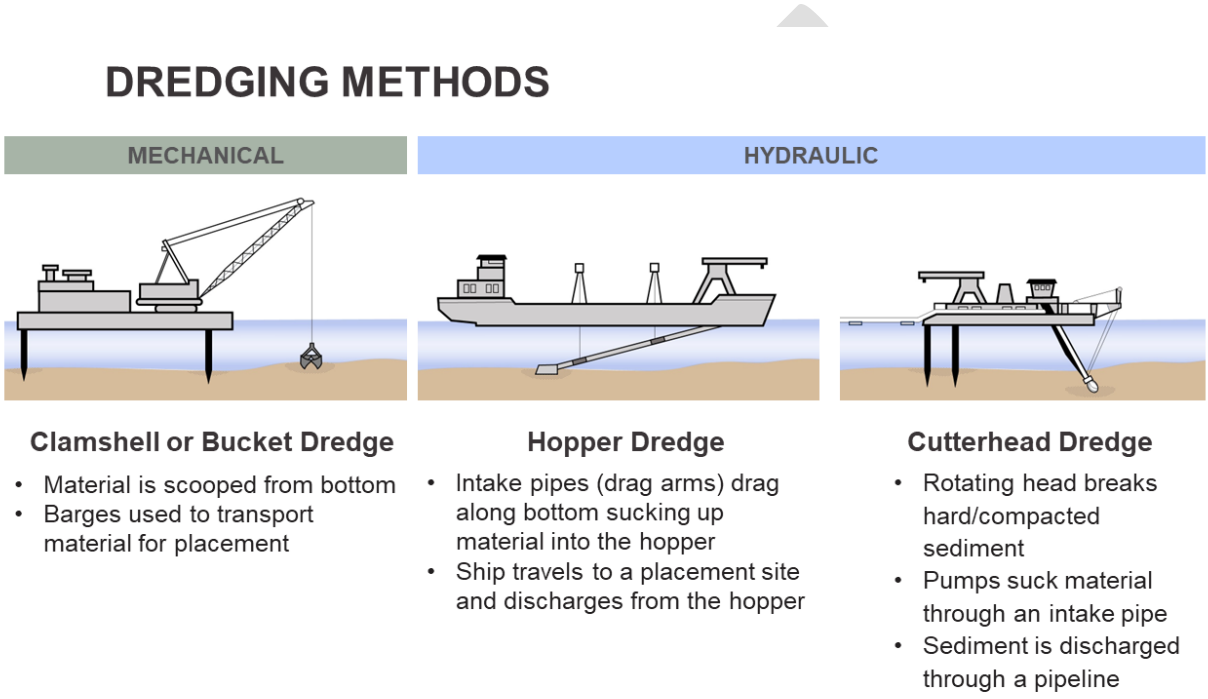


*Figure 13. Dredging methods can be either mechanical (clamshell or bucket dredge) or hydraulic (hopper or cutterhead dredge).*

The most current, 2023 Cost Engineering Dredge Estimating Programs (CEDEP) were utilized for all contracted estimates and included current labor and marine fuel rates for the San Francisco area. CEDEP is required by regulation to be used for all dredging estimates and was most recently validated by the USACE Engineer Research and Development Center (ERDC) in 2023. Inputs to CEDEP for each estimate, such as dredging productivity, time efficiency, and scow load size were obtained from Resident Management System (RMS) and Dredging Quality Management (DQM) data from past similar projects at each method's location. Estimated pricing was then compared to bid abstracts to determine reasonability.

The components of the alternatives utilizing government hopper dredges were estimated using the known daily rate for the *Essayons* and *Yaquina* (i.e., the two federal hopper dredges homeported on the west coast in Portland, OR), multiplied by the number of days to complete each component of the plan, divided by the dredging volume of the channel in question. The number of days for each was estimated by inputting production data obtained from RMS and DQM for each of the hopper dredges and dredging areas.

In general, the cost of placing material at in-bay aquatic placement sites is the cheapest option, while disposal in the deep ocean is more expensive than in-bay placement, and placement at a BU site (e.g., wetland restoration sites such as Cullinan Ranch Restoration Project or Montezuma Wetlands Restoration Project) is the most expensive. The cost estimating process, however, provided specific costs associated with each federal navigation channel, dredging method, and placement site combination.

A Cost and Schedule Risk Analysis meeting was conducted with USACE San Francisco District dredging SMEs and PDT members to identify risks, likelihoods and impacts of risk on the costs estimates. A Monte Carlo analysis was run using the data created from the meeting and a project contingency of 22% was calculated, using the 80% confidence level.

Cost estimate classifications are largely based on the level of design used as a basis for the estimate, but the classification also depends on the level of detail of the cost estimate. The resulting classification level for this effort is a Class 3.

The strategies the alternatives development process sought to address were to meet the federal standard (i.e., least cost, technically feasible, and environmentally acceptable plan); to maximize BU; to identify the regional federal standard rather than channel-specific federal standards to apply cost savings from certain channels to more expensive BU placements in other channels; to avoid systemic sediment losses to the ocean by diverting dredged material from the deep ocean disposal site to upland BU and in-bay sites; and to incorporate more hydraulic (e.g., hopper) dredging to reduce the cost and time of dredging. While each alternative does not utilize all strategies listed above, the array of alternatives comprehensively incorporates all of them.

The estimated costs and volumes described above were used as inputs to compare the various channel dredging and placement site options in a spreadsheet analysis. Ultimately, each channel had an array of dredging method and placement site options. The dredging method and placement site was chosen for each channel based on both factors. For example, when trying to determine the least cost dredging and placement option (i.e., one component of the first strategy), the process for doing so was a simple cost minimization exercise, and the volume from the channel would be attributed to the corresponding placement site. After doing this across several channels, a check was conducted to compare the volume designated to be placed at the site to its annual and monthly capacity limits. If a site was over its capacity limit, the most efficient diversion of that material to another site (i.e., the lowest cost difference to the next least cost option) was determined. If the aim of the alternative is to maximize BU, then the diversion efficiency was based on minimizing the cost difference between the least cost option and the cost of placement at the BU site across multiple channels. Toward meeting the federal standard, the dredging method and placement site were also checked for technical feasibility and environmental acceptability.

In response to USACE agency-wide policy focused on increasing BU, San Francisco District strategic planning to deliver multi-benefit navigation, and local stakeholder and interested party priorities to maximize BU within the Federal Standard Base Plan, the RDMMP PDT developed four action alternatives in the array specifically focused on increasing BU relative to the current navigation program (Table 2). These action alternatives are compared against the current condition, which is referred to as the Future Without Project condition (FWOP). The array of alternatives are:

Future without Project Condition (FWOP) or No Action Alternative

   a. Sustains the current navigation program as authorized, including annual hopper dredging of San Pablo Bay (Pinole Shoal) and Richmond Outer Harbor channels.

1. BU – Diversion from Deep Ocean Disposal
   a. Builds upon FWOP but diverts one channel from the SF-DODS and splits the dredged material placement between an in-bay site and an upland BU site. This can be accomplished with either the Richmond Inner Harbor channel or the Oakland Inner and Outer Harbor channel. For the purposes of this RDMMP, we provide Richmond Inner Harbor split as an example based on the current economics. This alternative results in more BU than FWOP at the same cost, though only a marginal amount.
2. BU – Regional Optimization, Leverage Hopper Dredging, and Retain Sediment in Bay System
   a. Regionalizes the approach to identifying the Federal Standard Base Plan by mixing and matching dredging methods and placement sites across the 10 navigation projects to find ways to increase BU relative to diversion from ocean disposal, alternative 1. The alternative accomplishes this by realizing cost savings from certain channels through expanded hopper dredging, avoiding ocean disposal, and placing more sediment at in-bay sites (i.e., lowest cost placement site category), in exchange for more BU from other channels (i.e., highest cost placement site category). This alternative would help the region reach its climate/sea-level-rise adaptation and wetland restoration goals, and contibutes significantly to the Chief's 70/30 Goal across USACE by 2030 and the San Francisco District's strategic plan goal to deliver multibenefit navigation. The alternative would represent raising the floor of BU for wetland restoration, beach and sandbar nourishment, mudflat nourishment, and other benefits at full federal expense without increasing the cost of San Francisco Bay's federal navigation dredging program.
3. BU – Cost-share Opportunity
   a. Builds upon the regional optimization, alternative 2 and identifies how much additional BU can be done by cost-sharing the incremental cost with a non-federal sponsor per the WRDA 2020 Section 125a authority within the 25% threshold set by that legislation, below which justifying the federal portion of the cost-share is simpler.
4. BU – Maximized
   a. Identifies the maximum amount of dredged material that can be beneficially used and how much it would cost to do so. This will inform external partners how much BU can be accomplished and the cost order of magnitude to achieve that level of restoration, whether through full non-federal funding, or through a cost-share with the federal government, provided the benefits are justified and exceed the additional costs.

The specifics (i.e., volumes, placement sites, dredging recurrence, and regional costs) of the alternatives are described in more detail in the subsequent section, Alternatives Considered.

## Alternatives Considered

### Future Without Project (No Action Alternative)

This alternative would continue to execute the navigation dredging program in the same way as it has been done in the past, as authorized. This alternative would place approximately 0% at upland BU sites, approximately 45-55% at deep ocean disposal sites, approximately 30-40% at in-bay sites, approximately 5-15% at ocean BU sites, approximately 0-10% at ocean sites, and approximately 0-10% at upland (sponsor provided) sites.[7] The specific details of the Future Without Project condition (FWOP) are detailed in Table 6. This baseline condition was constructed based on the current navigation program, replicating how each channel would be dredged, how frequently each would be dredged, and where the sediment would be placed from each channel.

*Table 6. Details on the Future Without Project condition, including average volume and volume range per dredging episode, dredging recurrence, and placement site by channel.*

| Navigation Channel | Placement Site(s) | Typical Dredging Recurrence (years) | Likely Method | Alternate Method | Average Volume per Episode (1K CY) | Typical Volume Range per Episode (1K CY) |
|---|---|---|---|---|---|---|
| Oakland (Inner & Outer) | SF-DODS (Upland BU site placement for out-of-work window dredging mitigation) | 1 | Clamshell | N/A | 750 | 120– 1,225 |
| Redwood City | SF-11 (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 180 | 10 – 650 |

[7] Placement Type Categories (with examples)

- In-bay sites: SF-9, SF-10, SF-11, SF-16
- Ocean BU sites: SF-17 (Ocean Beach Demonstration Site)
- Nearshore strategic placement BU sites: Eden Landing (Whale's Tail) Nearshore, Emeryville Crescent Nearshore
- Ocean sites: SF-8
- Upland (sponsor provided) sites: Shollenberger Park (Petaluma River), Imola Avenue (Napa River)
- Upland BU sites: Montezuma Wetlands, Cullinan Ranch
- Deep ocean disposal sites: SF-DODS

| | | | | | | |
|---|---|---|---|---|---|---|
| Richmond Inner Harbor | SF-DODS (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 300 | 10 – 630 |
| Richmond Outer Harbor | SF-11 (Upland BU site out of work window as mitigation) | 1 | Hopper | Clamshell | 210 | 85 – 730 |
| SF Main Ship Channel | SF-17, SF-8 | 1 | Hopper | N/A | 255 (SF-17)<br>90 (SF-8) | 80 – 615 |
| San Pablo Bay (Pinole Shoal) | SF-10 (Upland BU site out of work window as mitigation) | 1 | Hopper | Clamshell | 150 | 60 – 560 |
| Suisun Bay Channel | SF-16 (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 165 | 50 – 425 |
| Napa River | Upland (Sponsor Provided) | 6-11 | Cutterhead-Pipeline | Clamshell | 110 | 65 – 165 |
| Petaluma River | Upland (Sponsor Provided) | 4-7 | Cutterhead-Pipeline | Clamshell | 150 | 75 – 210 |
| Petaluma Across the Flats | SF-10 (Upland BU site out of work window as mitigation) | 4-7 | Clamshell | N/A | 70 | 70 |
| San Rafael Creek | SF-11 (Upland BU site out of work window as mitigation) | 4-6 | Clamshell | N/A | 110 | 35 – 280 |

| | | | | | | |
|---|---|---|---|---|---|---|
| San Bruno | SF-DODS (Upland BU site out of work window as mitigation) | Once | Hopper | N/A | 30 | 30 |

### Alternative 1: BU – Diversion from Deep Ocean Disposal

This alternative proposes to implement the Future Without Project alternative, except that a federal project otherwise slated for ocean disposal at SF-DODS may be split between placement in-bay and at an upland BU site to achieve additional BU while maintaining the same cost. In taking this approach, at the Bay-wide programmatic level, this alternative proposes to increase placement at upland BU sites from approximately 0% (FWOP) to 5-20%; to decrease deep ocean disposal from approximately 45-55% (FWOP) to 10-40%; and to increase in-bay placement from approximately 30-40% to 35-55% at in-bay sites. The remaining placement category percentage ranges would remain the same as FWOP. The percentages of material going to each category vary depending on the level of maintenance dredging required and the project being diverted from SF-DODS. This alternative in the RDMMP identifies that the material diverted from SF-DODS to in-bay/upland would come from Richmond Inner Harbor as one example of how to execute the theme of this alternative (Table 7). The current cost estimates suggest that it is more effective to utilize Richmond Inner Harbor, which results in a 55% in-bay to 45% upland BU split, rather than Oakland Inner and Outer Harbor, which results in a 65% in-bay to 35% BU split. However, it is feasible that a different federal channel, such as Oakland, may be the source of the diversion in the future due to different economic and market conditions, equipment availability, technical feasibility, or environmental acceptability.

This alternative was constructed by identifying the opportunities to divert material from deep ocean disposal, i.e., which channels' previous Federal Standard Base Plan sites were SF-DODS under FWOP, which include Oakland Inner and Outer Harbor and Richmond Inner Harbor. Based on the cost estimates developed by the RDMMP's cost engineering process (see Alternatives Development), the optimal split for each channel was determined between in-bay placement and upland BU placement matching the combined cost of the two placements with the cost of disposal at SF-DODS. Based on the volume to be placed at in-bay and upland BU sites from each channel, it was then determined which channel would be the more efficient split to pursue based on the current economic conditions, or whether pursuing both would be a viable option. At present, Richmond Inner Harbor produced a split comprised of 55% in-bay placement to 45% upland BU placement, while Oakland Harbor produced a split comprised of 65% in-bay placement to 35% upland BU placement. Given splitting both channels would result in a high volume of in-bay placement, and Richmond Inner Harbor produces a higher percentage of BU placement between the two channels, this alternative includes the Richmond Inner Harbor split and not the Oakland Harbor split at present. As mentioned above, this breakdown (Table 7) is one example of how this alternative can be executed, and it may be possible to execute this alternative with a better Oakland split (i.e., higher BU percentage) in the future. The percentage ranges listed at the top of this alternative description include the programmatic categorical percentages should the future economic conditions be such that Oakland can be split in the more favorable breakdown as Richmond Inner Harbor is currently.

*Table 7. Details on the Diversion from Deep Ocean Disposal Alternative, 1 including average volume and volume range per dredging episode, dredging recurrence, and placement site by channel.*

| Navigation Channel | Placement Site(s) | Typical Dredging Recurrence (years) | Likely Method | Alternate Method | Average Volume per Episode (1K CY) | Typical Volume Range per Episode (1K CY) | Cost Relative to FWOP |
|---|---|---|---|---|---|---|---|
| Oakland (Inner & Outer) | SF-DODS (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 750 | 120– 1,225 | Equal |
| Redwood City | SF-11 (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 180 | 10 – 650 | Equal |
| Richmond Inner Harbor | SF-11, Upland BU (Upland BU site out of work window as mitigation) | 1 | Clamshell | Hopper | 160 (SF-11)<br>140 (upland BU) | 10 – 630 | Equal |
| Richmond Outer Harbor | SF-11 (Upland BU site out of work window as mitigation) | 1 | Hopper | Clamshell | 210 | 85 – 730 | Equal |
| SF Main Ship Channel | SF-17, SF-8 | 1 | Hopper | N/A | 255 (SF-17)<br>90 (SF-8) | 80 – 615 | Equal |
| San Pablo Bay (Pinole Shoal) | SF-10 (Upland BU site out of work window as mitigation) | 1 | Hopper | Clamshell | 150 | 60 – 560 | Equal |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Suisun Bay Channel | SF-16 (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 165 | 50 – 425 | Equal |
| Napa River | Sponsor-provide Upland Site or other Upland BU site | 6-11 | Cutterhead-Pipeline | Clamshell | 110 | 65 – 165 | Equal |
| Petaluma River | Sponsor-provide Upland Site or other Upland BU site | 4-7 | Cutterhead-Pipeline | Clamshell | 150 | 75 – 210 | Equal |
| Petaluma Across the Flats | SF-10 (Upland BU site out of work window as mitigation) | 4-7 | Clamshell | Cutterhead-Pipeline | 70 | 70 | Equal |
| San Rafael Creek | SF-11 (Upland BU site out of work window as mitigation) | 4-6 | Clamshell | N/A | 110 | 35 – 280 | Equal |
| San Bruno | SF-DODS (Upland BU site out of work window as mitigation) | Once | Hopper | Clamshell | 30 | 30 | Equal |

### Alternative 2: BU – Regional Optimization, Leverage Hopper Dredging

This alternative proposes to increase hopper dredging in the Bay to offset the increased cost of BU to achieve more BU than Alternative 1 and FWOP. Hopper dredging can be increased to include Richmond Inner Harbor or Oakland Harbor or a mixture of both projects. Placement with a hopper dredge is usually limited to in-bay as the government dredge, the Essayons, is unable to place material upland. Therefore, BU volume from another project utilizing clamshell or a hydraulic dredge with pumpoff capability would be required. Ultimately, this alternative proposes to increase upland BU placement from approximately 0% (FWOP) to 20-30%; to decrease deep ocean disposal from approximately 45-55% (FWOP) to 0-10%; and to increase in-bay placement from approximately 30-40% (FWOP) to 50-60%. The other category percentage ranges remain the same as FWOP. These percentages at the Bay-wide, programmatic level may vary depending on the level of maintenance dredging required and which channels are dredged hydraulically to be placed in-bay. This alternative in the RDMMP identifies that Richmond Inner Harbor would be dredged hydraulically to allow most of Oakland Harbor to be placed at an upland BU site. This is one example of how to execute the navigation program in line with the theme of this alternative (Table 8). However, it is possible that hydraulic dredging could occur in other channels (e.g.,

Oakland Inner and Outer Harbor) in exchange for mechanical dredging in others for upland BU (e.g., Richmond Inner and/or Outer Harbor) to execute the program differently than above in the future due to different economic and market conditions, technical feasibility, or environmental acceptability.

This alternative was constructed by first identifying the least cost dredging method and placement site combination for each channel. In most cases, the least cost options were in-bay sites, and the least cost dredging methods were hydraulic dredging where technically feasible. However, since this would result in nearly all dredged sediment being placed at in-bay sites, a cost effectiveness analysis was done to determine which channels should be diverted from in-bay placement to upland BU placement. This approach utilized the cost difference between each channel's BU placement and least cost placement site option, and resulted in the selection of the most cost-effective channels to be diverted to upland BU. BU placement was prioritized over ocean disposal as the diversion destination to address the strategies and objectives listed in the Formulation of Alternatives section, namely, to maximize BU and avoid ocean disposal. Importantly, this alternative also sought to achieve cost parity with FWOP, like alternative 1, but at the regional scale. As such, the maximum volume of sediment was diverted to upland BU that kept the regional cost the same as FWOP, and in doing so, represents the regionally optimal approach (i.e., maximum BU, minimum ocean disposal, and equal cost to FWOP).

This breakdown is one example of how to execute this alternative at the regional scale (Table 8). While some channels can achieve cost savings by placing dredged material at a different in-bay site than its placement site under FWOP (e.g., San Pablo Bay [Pinole Shoal]), the bulk of the cost savings comes from Richmond Inner Harbor and a portion of Oakland Harbor, which would utilize hydraulic (hopper) dredging and would place dredged material at an in-bay site. This contrasts with FWOP, in which both channels would be mechanically dredged and transported to SF-DODS for ocean disposal. This cost savings is then applied to other channels and reaches to cover the additional cost of taking material to BU (i.e., the most expensive option). In the example listed in Table 8, the cost savings is applied to the majority (~70%) of Oakland Harbor and a portion (~20%) of Suisun Bay Channel. Suisun Bay Channel, while clean, can only send ~20% to BU due to suitability concerns resulting from the historical Port of Chicago explosion at the nearby Marine Ocean Terminal Concord, and the possibility of unexploded ordnances in the sediment.

*Table 8. Details on the Regional Optimization alternative, including average volume and volume range per dredging episode, dredging recurrence, and placement site by channel.*

| Navigation Channel | Placement Site(s) | Typical Dredging Recurrence (years) | Likely Method | Alternate Method | Average Volume per Episode (1k CY) | Typical Volume Range per Episode (1k CY) | Cost Relative to FWOP |
|---|---|---|---|---|---|---|---|
| Oakland (Inner & Outer) | Upland BU site, SF-11 (Upland BU site out of work window as mitigation) | 1 | Clamshell (Upland BU), Hopper (SF-11) | Cutterhead-Pipeline (Upland BU) Clamshell (SF-11) | 540 (upland BU) 210 (SF-11) | 120 – 1,225 | Higher |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Redwood City | SF-11 (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 180 | 10 – 650 | Equal |
| Richmond Inner Harbor | SF-11 (Upland BU site out of work window as mitigation) | 1 | Hopper | Clamshell | 300 | 10 – 630 | Lower |
| Richmond Outer Harbor | SF-10 (Upland BU site out of work window as mitigation) | 1 | Hopper | Clamshell | 210 | 85 – 730 | Lower |
| SF Main Ship Channel | SF-17, SF-8 | 1 | Hopper | N/A | 255 (SF-17)<br>90 (SF-8) | 80 – 615 | Equal |
| San Pablo Bay (Pinole Shoal) | SF-9 (Upland BU site out of work window as mitigation) | 1 | Hopper | Clamshell | 150 | 60 – 560 | Lower |
| Suisun Bay Channel | SF-16, Upland BU site (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 130 (SF-16)<br>35 (upland BU) | 50 – 425 | Higher |
| Napa River | Sponsor-provide Upland Site or other Upland BU site | 6-11 | Cutterhead-Pipeline | Clamshell | 110 | 65 – 165 | Equal |
| Petaluma River | Sponsor-provide Upland Site or other Upland BU site | 4-7 | Cutterhead-Pipeline | Clamshell | 150 | 75 – 210 | Equal |
| Petaluma Across the Flats | SF-10 (Upland BU site out of work window as mitigation) | 4-7 | Clamshell | Cutterhead-Pipeline | 70 | 70 | Equal |
| San Rafael Creek | SF-9 (Upland BU site out of work window as mitigation) | 4-6 | Clamshell | N/A | 110 | 35 – 280 | Equal |
| San Bruno | SF-11 (Upland BU site out of work window as mitigation) | Once | Hopper | Clamshell | 30 | 30 | Lower |

### Alternative 3: BU – Cost-Share Opportunity

This alternative proposes building off Alternative 2 (above) and taking more sediment to upland BU sites within the WRDA 2020 section 125a threshold for easily justifying the cost-share of the BU incremental cost for Operations and Maintenance budgets[8]. At the Bay-wide programmatic level, this alternative proposes to increase upland BU placement from approximately 0% (FWOP) to 35-45%; to decrease deep ocean disposal from approximately 45-55% (FWOP) to 0-10%; and to increase in-bay placement from approximately 30-40% (FWOP) to 35-45%. The other category percentage ranges remain the same as FWOP. . This alternative is not a candidate to be the Federal Standard Base Plan given it is not the least cost alternative and would require non-federal funding for 35% of the incremental cost above the Base Plan given the benefits are qualitatively justified.

The alternative was built upon the regional optimization alternative 2, with the level of increased BU calculated as the 25% threshold identified in WRDA 2020 Section 125a, which is described as the point at which the federal share of the incremental cost share (i.e., 65% of the incremental cost) is 25% above the Federal Standard Base Plan cost. This authority delineates between simpler, qualitative articulation of benefits below the threshold, and more comprehensive, quantitative articulation of benefits above the threshold to justify the federal investment from the O&M budget on the incremental cost of BU. The alternative, therefore, utilizes this 25% federal share of the incremental cost above the Federal Standard Base Plan to determine what level of BU can be justified using the simpler, qualitative approach described above. This amount provides information on the approximate amount of additional BU volume that can be achieved in a relatively straightforward fashion. For more information, see the Water Resources Development Act 2020 section of the document. The specific volumes from each channel are described as an example of how this alternative can be executed in Table 9.

*Table 9. Details on the Cost-share Opportunity alternative, including average volume and volume range per dredging episode, dredging recurrence, and placement site by channel.*

| Navigation Channel | Placement Site(s) | Typical Dredging Frequency (years) | Likely Method | Alternate Method | Average Volume per Episode (1K CY) | Typical Volume Range per Episode (1K CY) | Cost Relative to FWOP |
|---|---|---|---|---|---|---|---|

[8] The Water Resources Development Act (WRDA) 2020 Section 125a specifies the incremental cost above the Federal Standard Base Plan for the BU of dredged material can be cost-shared at 65% federal/35% non-federal given the benefits justify the additional cost. This justification is different depending on the cost magnitude. If the federal portion (i.e., the 65% of the incremental cost) is less than 25% above the Federal Standard Base Plan cost, the benefits simply need to be listed qualitatively to justify spending federal money on the BU of dredged material. If the federal portion (i.e., the 65% of the incremental cost) is greater than 25% above the Federal Standard Base Plan cost, the benefits must be listed quantitatively and shown to exceed the incremental cost.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Oakland (Inner & Outer) | Upland BU site | 1 | Clamshell | Cutterhead-Pipeline | 750 | 120 – 1,225 | Higher |
| Redwood City | SF-11,<br>Upland BU site (Upland BU site out of work window as mitigation) | 1 | Clamshell<br>Clamshell | N/A<br>Cutterhead-Pipeline | 100 (SF-11)<br>80 (upland BU) | 10 – 650 | Higher |
| Richmond Inner Harbor | SF-11,<br>Upland BU site (Upland BU site out of work window as mitigation) | 1 | Hopper (SF-11),<br>Clamshell (upland BU) | Clamshell (SF-11),<br>Cutterhead-Pipeline (upland BU) | 265 (SF-11)<br>35 (upland BU) | 10 – 630 | Lower |
| Richmond Outer Harbor | SF-10,<br>Upland BU site (Upland BU site out of work window as mitigation) | 1 | Hopper (SF-10),<br>Clamshell (upland BU) | Clamshell (SF-10),<br>Cutterhead-Pipeline (upland BU) | 195 (SF-10)<br>15 (upland BU) | 85 – 730 | Higher |
| SF Main Ship Channel | SF-17, SF-8 | 1 | Hopper | N/A | 255 (SF-17)<br>90 (SF-8) | 80 – 615 | Equal |
| San Pablo Bay (Pinole Shoal) | SF-9,<br>Upland BU site (Upland BU site out of work window as mitigation) | 1 | Hopper (SF-9),<br>Clamshell (upland BU) | Clamshell (SF-9),<br>N/A (upland BU) | 140 (SF-9)<br>10 (upland BU) | 60 – 560 | Higher |
| Suisun Bay Channel | SF-16,<br>Upland BU site (Upland BU site out of work window as mitigation) | 1 | Clamshell | N/A | 130 (SF-16)<br>35 (upland BU) | 50 – 425 | Higher |
| Napa River | Sponsor-provide Upland Site or other Upland BU site | 6-11 | Cutterhead-Pipeline | Clamshell | 110 | 65 – 165 | Equal |
| Petaluma River | Sponsor-provide Upland Site or other Upland BU site | 4-7 | Cutterhead-Pipeline | Clamshell | 150 | 75 – 210 | Equal |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Petaluma Across the Flats | SF-10 (Upland BU site out of work window as mitigation) | 4-7 | Clamshell | Cutterhead-Pipeline | 70 | 70 | Equal |
| San Rafael Creek | SF-9, Upland BU site (Upland BU site out of work window as mitigation) | 4-6 | Clamshell | N/A | 65 (SF-9)<br>45 (upland BU) | 35 – 280 | Higher |
| San Bruno | SF-11 (Upland BU site out of work window as mitigation) | Once | Hopper | Clamshell | 30 | 30 | Lower |

### Alternative 4: BU – Maximized

This alternative proposes placing all suitable material at upland BU sites, including a portion of sediment being placed at nearshore strategic placement BU sites designed to leverage tidal and wave energy to transport sediment from shallow subtidal placement areas to existing intertidal mudflats and marshes. This alternative can also be executed with the volume of sediment placed at the nearshore strategic placement BU sites being placed at upland BU sites instead. At the Bay-wide programmatic level, this alternative proposes to increase upland BU placement from approximately 0% (FWOP) to 65-75%; to increase BU nearshore strategic placement from approximately 0% (FWOP) to 5-15%; to decrease deep ocean disposal from approximately 45-55% (FWOP) to 0-10%; and to decrease in-bay placement from approximately 30-40% (FWOP) to 0-10%. The other category percentage ranges remain the same as FWOP. This alternative is not a candidate to be the Federal Standard Base Plan given it is not the least cost alternative and would require non-federal funding for the full incremental cost above the Base Plan, or for 35% of the incremental cost given the benefits justify and quantitatively exceed the incremental cost under the WRDA 2020 Section 125a cost-sharing authority. At this time, no non-federal entity has expressed interest in such a programmatic wide scale partnership. However, USACE remains open to the possibility should any non-federal entity express such interest or for any partnerships on a project by project or year by year basis.

This alternative was constructed based on maximizing the amount of suitable material for upland BU and nearshore strategic placement BU. All channels capable of supplying dredged material for upland BU do so under this alternative, including placement of Main Ship Channel sand directly on Ocean Beach for beach nourishment (see Ocean Beach Onshore section for more details). The alternative outlines the amount of BU that would be achievable given the more comprehensive, quantitative articulation of benefits above the threshold to justify federal investment from the O&M budget on the incremental cost of BU. Additionally, should the federal investment not be deemed justified, it is still possible to execute this alternative if non-federal partners are willing to fund the full 100% of the incremental cost for BU above the Federal Standard Base Plan. For more information, see the Water Resources Development Act 2020 section of the document. The specific volumes from each channel are described as an example of how this alternative can be executed in Table 10.

*Table 10. Details on the maximized BU alternative, including average volume and volume range per dredging episode, dredging recurrence, and placement site by channel.*

| Navigation Channel | Placement Site(s) | Typical Dredging Recurrence (years) | Likely Method | Alternate Method | Average Volume per Episode (1K CY) | Typical Volume Range per Episode (1K CY) | Cost Relative to FWOP |
|---|---|---|---|---|---|---|---|
| Oakland (Inner & Outer) | Upland BU site, Strategic Placement site | 1 | Clamshell | Cutterhead-Pipeline | 650 (upland BU)<br>100 (strategic placement) | 120– 1,225 | Higher |
| Redwood City | Upland BU site, Strategic Placement site | 1 | Clamshell | Cutterhead-Pipeline | 100 (strategic placement)<br>80 (upland BU) | 10 – 650 | Higher |
| Richmond Inner Harbor | Upland BU site | 1 | Clamshell | Cutterhead-Pipeline | 300 | 10 – 630 | Higher |
| Richmond Outer Harbor | Upland BU site | 1 | Clamshell | Cutterhead-Pipeline | 210 | 85 – 730 | Higher |
| SF Main Ship Channel | SF-17, Onshore BU site | 1 | Hopper | N/A | 260 (SF-17)<br>85 (onshore BU) | 80 – 615 | Higher |
| San Pablo Bay (Pinole Shoal) | Upland BU site | 1 | Clamshell | N/A | 150 | 60 – 560 | Higher |
| Suisun Bay Channel | SF-16, Upland BU site | 1 | Clamshell | N/A | 130 (SF-16)<br>35 (upland BU) | 50 – 425 | Equal |
| Napa River | Sponsor-provide Upland Site or other Upland BU site | 6-10 | Cutterhead-Pipeline (sponsor-provided upland) | Clamshell | 110 | 65 – 165 | Equal |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Petaluma River | Sponsor-provide Upland Site or other Upland BU site | 4-7 | Cutterhead-Pipeline | Clamshell | 150 | 75 – 210 | Equal |
| Petaluma Across the Flats | SF-10, Upland BU Site (Upland BU site out of work window as mitigation) | 4-7 | Clamshell | Cutterhead-Pipeline | 70 | 70 | Equal |
| San Rafael Creek | Upland BU site | 4-6 | Clamshell | Cutterhead-Pipeline | 110 | 35 – 280 | Higher |
| San Bruno | Upland BU site | Once | Hopper | Clamshell | 30 | 30 | Higher |

## Evaluation Criteria

The SF Bay DMMP is not a USACE Feasibility Study, and therefore does not evaluate alternatives following USACE policy for Feasibility Studies. Rather, the alternatives are evaluated in accordance with policies described in the Legislative, Regulatory, and Policy Overview section of this document. In short, the recommended alternative(s) (i.e., the identified Federal Standard Base Plan) of the SF Bay RDMMP must be least cost, environmentally acceptable, and technically feasible. All alternatives consider only established methods of dredging and placement, and therefore all alternatives are technically feasible. .

For the SF Bay RDMMP, the total cost of dredging and placement was used to identify the likely Base Plans and to evaluate alternatives. In alignment with the goals described in Goals of the Regional DMMP, BU has been included where possible, and it has been identified as a likely Base Plan where its costs were equal to or less than other alternative's costs, at the Bay-wide programmatic level.

Alternatives other than the Base Plan which are proposed by other parties may be pursued provided that any incremental cost beyond the Base Plan is funded in full by a non-Federal interest, or that the alternative is determined through study to qualify for implementation under another USACE authority (such as the Section 204 or 103 continuing authorities, or through the WRDA 2020 Section 125a provision for cost-sharing with O&M budgets) with Federal/non-Federal cost-sharing and partnership. Any alternative beyond the Base Plan that requires Federal cost-sharing for implementation must be found in the federal interest, including displaying that the benefits accrued as a result of the higher cost alternative above the Base Plan are justified relative to the incremental cost.

In the SF Bay Area, there exist policy differences between state and federal regulatory and resource agencies, environmental non-profit organizations, users of federal navigation projects and the Marine Transportation System, stakeholders, non-federal sponsors and partners, dredging stakeholders, fishing interests, and the public concerning acceptability of various alternatives, particularly open water, in-bay placement and the strategic expanded use of hydraulic dredging to accomplish more BU at full federal cost. USACE must weigh the concerns of these various interests and other agencies, together with the results of its own investigations, in making its determination of impacts and environmental acceptability relative to the Federal Standard. For the projects of SF Bay, the history of sediment sampling and testing was used to determine acceptability of the many projects and materials for various placement site alternatives, generally. Similarly, placement site annual and/or monthly volume capacity limitations, the volume of material for BU and deep ocean disposal, and the percentage of BU volume relative to deep ocean disposal were used to determine acceptability of the alternatives evaluated. Use of these criteria was considered appropriate for this programmatic-level evaluation of potential alternatives and likely Federal Base Plans.

## Comparison of Alternatives

Table 11 outlines the array of alternatives and the annualized average costs of each alternative. Alternatives 1, 2, and FWOP are all lowest cost, technically feasible, and environmentally acceptable, and are therefore all candidates to be the Federal Standard Base Plan. Color coding corresponds to subsequent figures in this section that compare the four action alternatives to identify which alternative should be the recommended Federal Standard Base Plan.

*Table 11. Draft array of alternatives and their approximate costs. Color coding (red, yellow, green) corresponds to the subsequent figures below (Figure 16-18).*

| Alternative | Name | Annualized Average Cost ($) |
|---|---|---|
| | Future Without Project Condition (FWOP) | $40,974,000 |
| 1 | BU – Diversion from Deep Ocean Disposal | $40,974,000 |
| 2 | BU – Regional Optimization, Leverage Hopper Dredging | $40,974,000 |
| 3 | BU – Cost-share Opportunity | $50,795,000 |
| 4 | BU - Maximized | $71,738,000 |

As mentioned throughout this document,the RDMMP aims to maximize BU and minimize ocean disposal within the Federal Standard Base Plan. Figure 14 groups the percentage ranges listed in the Alternatives Considered section into three categories: disposal, transitional placement, and BU (see Beneficial Use section). To re-iterate, disposal refers to deep ocean disposal, BU is either upland BU or nearshore strategic placement, and transitional placement is placement either at a transfer site or within an estuarine or aquatic system that is not explicitly for beneficial purposes but is expected to disperse throughout the system. In calculating the District's BU percentage toward the Chief's Goal (see 2023 Command Philosophy Notice on Beneficial Use of Dredged Material), transitional placement is considered a null value and does not count toward either category, BU or disposal. FWOP, alternative 1 (diversion from ocean disposal), and alternative 2 (regional optimization) are all least cost, while alternative 3 (cost-share opportunity) and alternative 4 (maximum BU) are progressively more expensive. Of the three least cost options that are candidates to be the Federal Standard Base Plan, FWOP results in the most ocean disposal and least BU, and the regional optimization alternative 2 results in the most BU and the least ocean disposal (Figure 14).

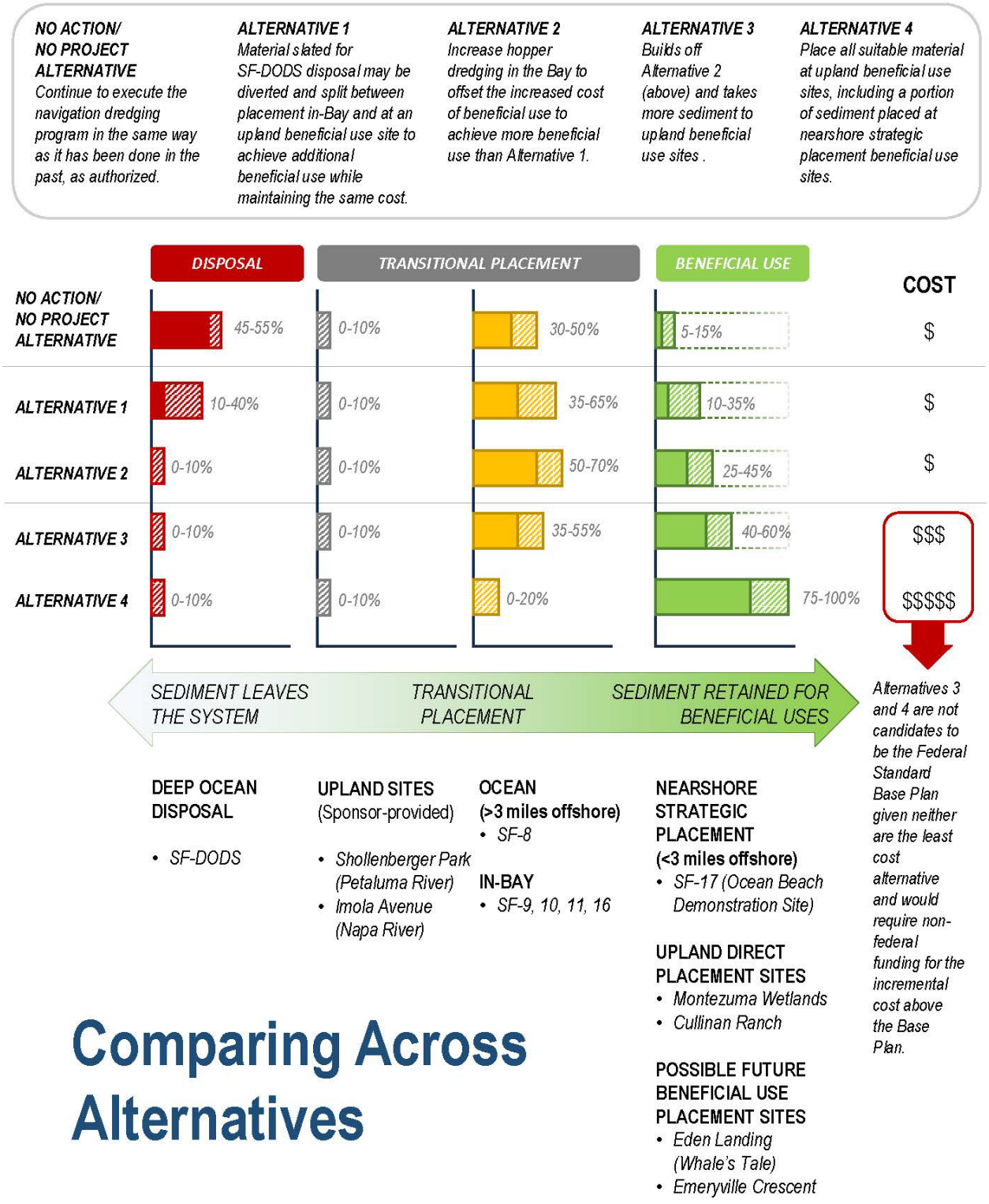


*Figure 14. Comparison of categorical percentage ranges across alternatives for disposal (i.e., ocean disposal), transitional placement (i.e., aquatic placement sites and sponsor-provided upland sites), and BU (nearshore strategic placement, wetland*

*restoration, and beach nourishment sites). Percentage ranges listed in this figure correspond to the textual descriptions in the Alternatives Considered section.*

Figure 15 zooms into the BU category and details the percentage range for combined BU categories listed in Figure 14. The red line indicates the least cost threshold: to the left of the line are FWOP, alternative 1 (diversion from ocean disposal), and alternative 2 (regional optimization), which are all equally least cost; and to the right of the line are alternative 3 (cost-share opportunity) and alternative 4 (BU maximized).

Of the candidates to be the Federal Standard Base Plan, alternative 2 (regional optimization) results in the most BU. This means that BU is paid for in full by the federal government as part of the USACE SF District's navigation program. The more expensive alternatives 3 and 4 (thus, not Federal Standard Base Plan candidates) result in even more BU. However, funding of the additional cost is contingent upon a non-federal cost-sharing partner willing to pay either the full incremental cost or 35% of the incremental cost above the Federal Standard Base Plan should the benefits justify federal expenditure on BU.

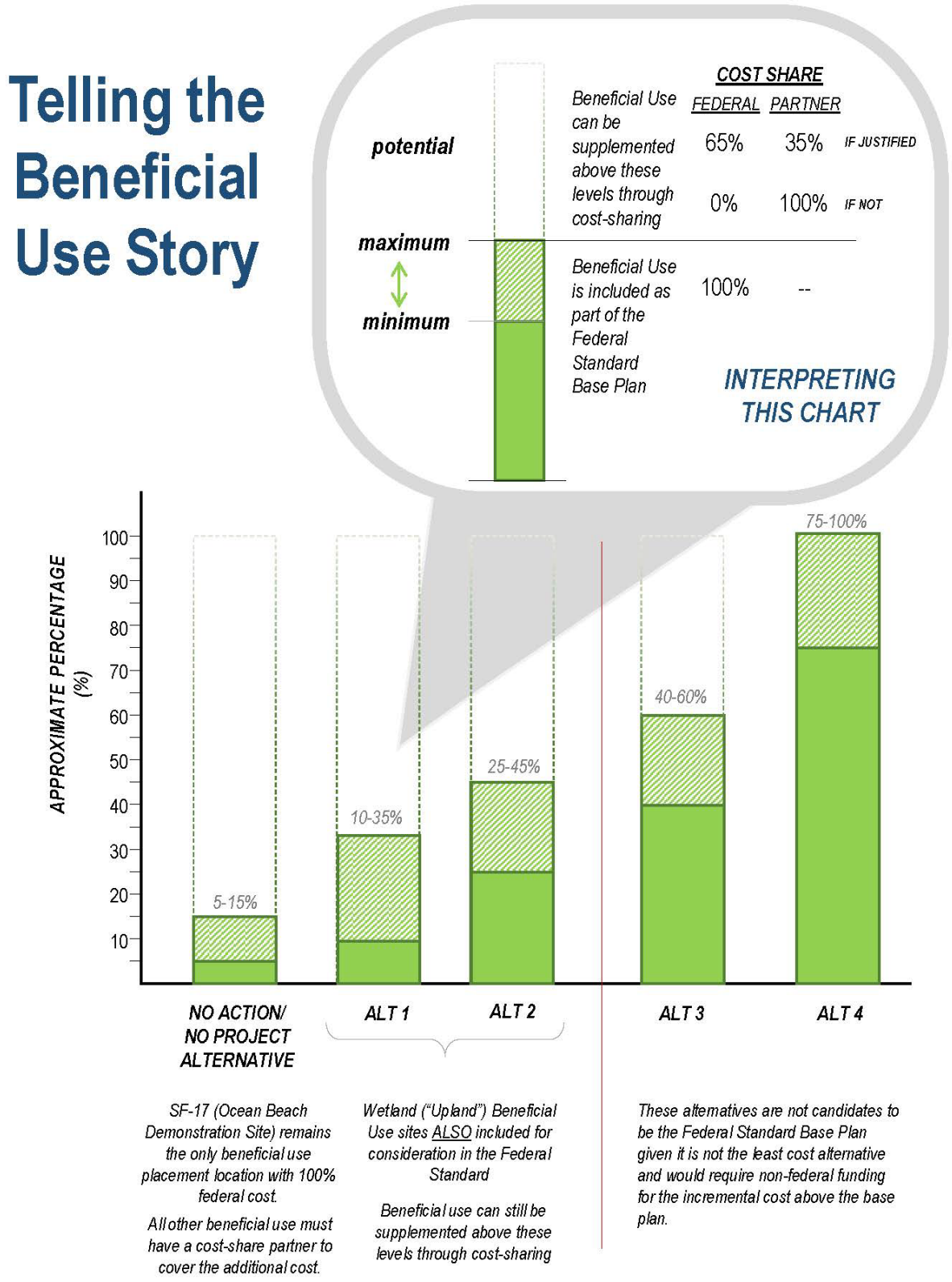


*Figure 15. Zoom-in comparison for BU percentage ranges across the array of alternatives, as described textually in the Alternatives Considered section and potential cost-share breakdowns to fund the incremental cost of additional BU above the Federal Standard Base Plan.*

In addition to tracking and comparing the percentages across alternatives, Figure 16 details the cumulative volume to be placed at upland BU sites (i.e., wetland restoration and beach nourishment) by each alternative (color coding matches Table 11 ) over the 20-year lifetime of the plan. Similar to the percentage relationship between alternatives in Figures 15-16, the regional rptimization approach (alternative 2) would result in approximately 11.5 million CY more upland BU from annual federal dredging at full federal cost compared to the current status quo, FWOP (Figure 16). Should funding become available to pay the full or a portion of the incremental cost of BU above the Federal Standard Base Plan, this could yield approximately 26.5 million CY over the 20-year plan lifetime.

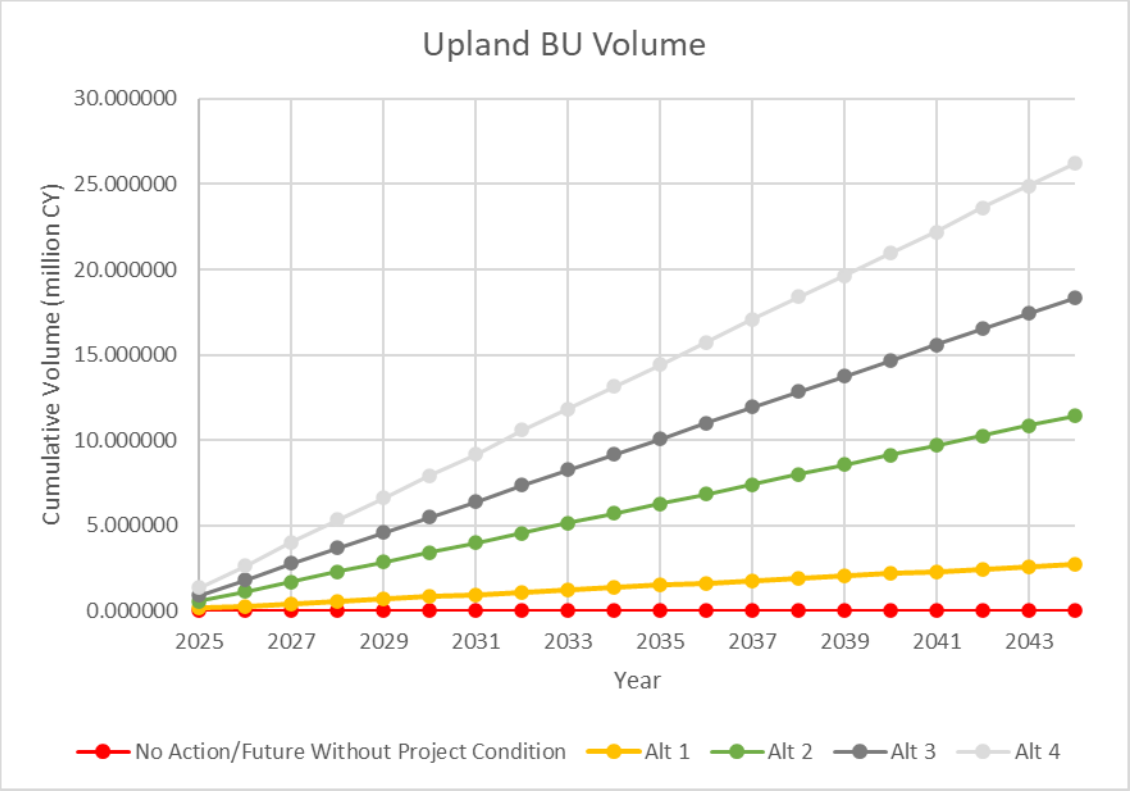


*Figure 16. Cumulative volume of upland BU volume for the four action alternatives and FWOP color-coded in Table 11. Alternative 2 (Regional Optimization) results in 11.5 million CY more upland BU than FWOP over the project lifetime and is the most beneficial Federal Standard Base Plan candidate.*

In addition to maximizing BU within the Base Plan Federal Standard Base Plan, the RDMMP also aims to reduce the amount of sediment that is placed at the SF Deep Ocean Disposal Site, which is a net loss of sediment from the San Francisco Bay system. Figure 17 details the cumulative volume of sediment that would be sent to deep ocean disposal under each action alternative and FWOP, color-coded to match Table 11. Over the 20-year lifetime of the plan, the regional optimization alternative 2 would save approximately 21 million CY from disposal in the deep ocean compared to the status quo, i.e., FWOP (Figure 17). Of the Federal Standard Base Plan candidates, regional optimization is the most effective at significantly reducing deep ocean disposal, which represents a lost opportunity to adapt to sea-level rise in a bay system that has high sediment demands in the future. Alternatives 3 and 4 would also result in the same sediment savings from the deep ocean as alternative 2 but would accomplish this aim at a much higher cost, given they are not Federal Standard Base Plan candidates.

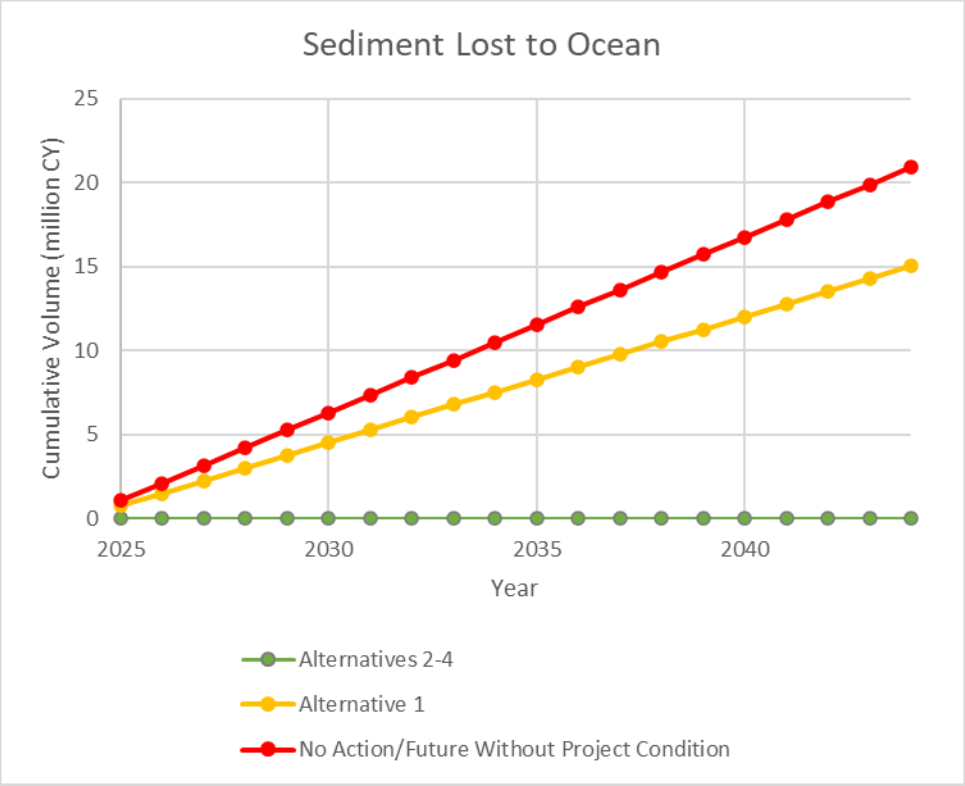


*Figure 17. Cumulative volume of dredged material disposed at the SF Deep Ocean Disposal Site across the four action alternatives and FWOP highlighted in Table 11. Alternative 2 (Regional Optimization) avoids approximately 21 million CY of sediment lost to the Ocean compared to FWOP over the project lifetime and is the most disposal avoidant alternative of the Federal Standard Base Plan candidates. Alternatives 3 and 4 also result in the same sediment savings as alternative 2 (as signified by the gray and green line/data points in the figure) but are more expensive than alternative 2, and thus, are not Federal Standard Base Plan candidates.*

As mentioned above, the regional optimization approach seeks to find cost efficiencies to cover the more expensive BU placement built into the alternative.

To increase BU for restoration projects by an order of magnitude (Figure 16) and avoid 21 million CY of deep ocean disposal (Figure 17), the cost to match FWOP and the volume of sediment on a system scale must be balanced by a certain amount of in-bay placement. As such, the regional optimization alternative 2 would result in more in-bay placement than FWOP (Figure 18). The three-year average dredging volume placed in-bay (including small, medium, and large dredgers, both federal and non-federal) is the metric used by LTMS to determine if allocations of dredged sediment placement in the Bay should be considered. Figure 18 outlines these three-year averages for each action alternative and for FWOP over the course of the 20-year plan lifetime in three-year increments relative to the LTMS 1.25 million CY target (short, dashed line) and 1.5 million CY trigger for considerations of mandatory allocations (long, dashed line).

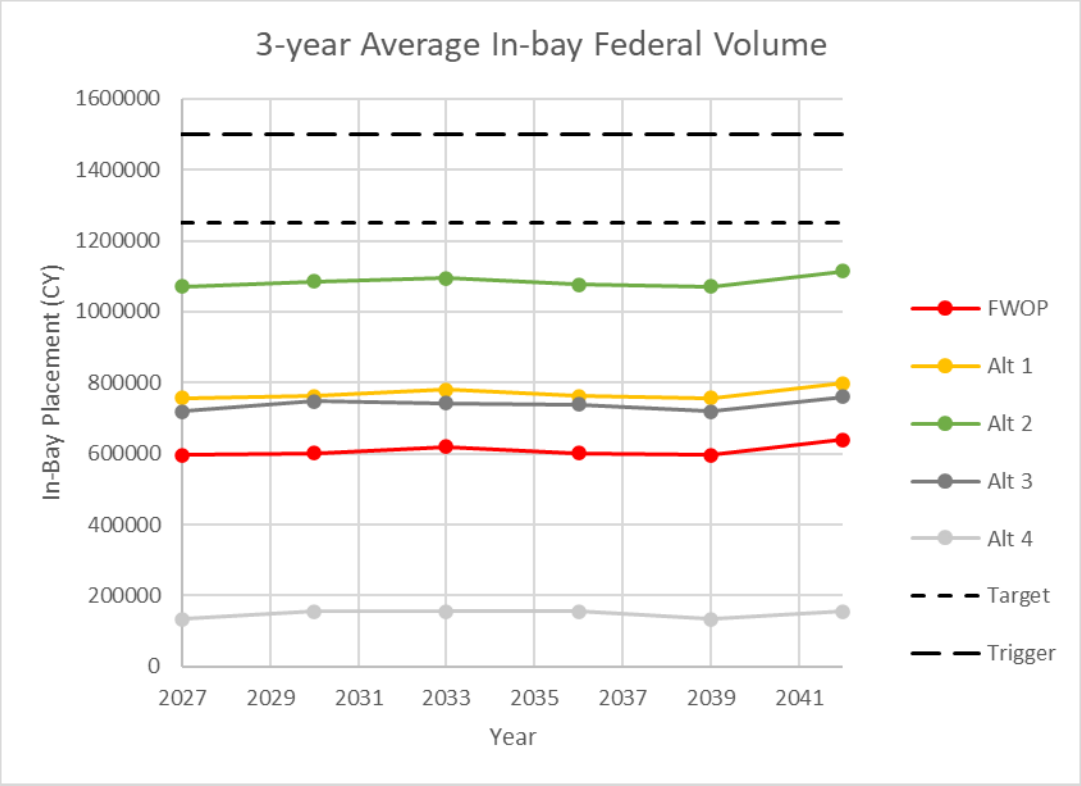


*Figure 18. Three-year average in-bay placement volumes across the four action alternatives and FWOP color-coded in Table 11 relative to the LTMS 1.25 million CY/year in-bay volume target (short, dashed line), and the LTMS 1.5 million CY/year in-bay volume trigger (long, dashed line) for the consideration of mandatory allocations (see Long Term Management Strategy section for more details). Alternative 2 (Regional Optimization) would result in more sediment placement in-bay compared to FWOP over the project lifetime.*

Given the in-bay placement numbers are higher for the regional optimization alternative 2 than what USACE has placed in-bay in the past (i.e., FWOP), this alternative might require permitting flexibility from regulatory agencies, revisiting regional policies (i.e., LTMS alternatives for in-bay placement targets in exchange for more BU in the Base Plan), and potential amendments to regulatory agency plans/policies to achieve the maximum federally funded BU floor (Figure 16) and the avoidance of sediment loss to the deep ocean (Figure 17).

However, while the three-year average for in-bay placement at the region-wide scale would be higher for the regional optimization alternative 2 than for FWOP, it is critical to highlight that the volume of sediment placed at each in-bay site (i.e., SF-9, SF-10, SF-11, and SF-16) would be well under each site's respective annual and monthly capacity limitation (see Table 14 and Existing Placement Sites section for site-specific capacity information). Tables 12-16 detail the annual in-bay site-specific placement volumes for the entire array of alternatives to show that none of the alternatives would result in placement above the capacity limit for any site each year. As such, the marginal increase in bay-wide in-bay placement of dredged material would not result in any additional environmental impacts or navigational safety hazards not already permitted within the placement-site-specific volume capacities.

*Table 12. Annual placement volume at SF-9, SF-10, SF-11, and SF-16 over the 20-year RDMMP timeframe for FWOP.*

**FWOP**

| Year | SF-9 Placement Volume (CY) | SF-10 Placement Volume (CY) | SF-11 Placement Volume (CY) | SF-16 Placement Volume (CY) |
|---|---|---|---|---|
| 2025 | 0 | 190,000 | 180,000 | 170,000 |
| 2026 | 0 | 0 | 430,000 | 170,000 |
| 2027 | 0 | 190,000 | 290,000 | 170,000 |
| 2028 | 0 | 70,000 | 430,000 | 170,000 |
| 2029 | 0 | 190,000 | 180,000 | 170,000 |
| 2030 | 0 | 0 | 430,000 | 170,000 |
| 2031 | 0 | 190,000 | 180,000 | 170,000 |
| 2032 | 0 | 70,000 | 540,000 | 170,000 |
| 2033 | 0 | 190,000 | 180,000 | 170,000 |
| 2034 | 0 | 0 | 430,000 | 170,000 |
| 2035 | 0 | 190,000 | 180,000 | 170,000 |
| 2036 | 0 | 70,000 | 430,000 | 170,000 |
| 2037 | 0 | 190,000 | 290,000 | 170,000 |
| 2038 | 0 | 0 | 430,000 | 170,000 |
| 2039 | 0 | 190,000 | 180,000 | 170,000 |
| 2040 | 0 | 70,000 | 430,000 | 170,000 |
| 2041 | 0 | 190,000 | 180,000 | 170,000 |
| 2042 | 0 | 0 | 540,000 | 170,000 |
| 2043 | 0 | 190,000 | 180,000 | 170,000 |
| 2044 | 0 | 70,000 | 430,000 | 170,000 |

*Table 13. Annual placement volume at SF-9, SF-10, SF-11, and SF-16 over the 20-year RDMMP timeframe for alternative 1 diversion from deep ocean disposal.*

**Alternative 1: BU - Diversion from Deep Ocean Disposal**

| Year | SF-9 Placement Volume (CY) | SF-10 Placement Volume (CY) | SF-11 Placement Volume (CY) | SF-16 Placement Volume (CY) |
|---|---|---|---|---|
| 2025 | 0 | 190,000 | 340,000 | 170,000 |
| 2026 | 0 | 0 | 590,000 | 170,000 |
| 2027 | 0 | 190,000 | 450,000 | 170,000 |
| 2028 | 0 | 70,000 | 590,000 | 170,000 |
| 2029 | 0 | 190,000 | 340,000 | 170,000 |
| 2030 | 0 | 0 | 590,000 | 170,000 |
| 2031 | 0 | 190,000 | 340,000 | 170,000 |
| 2032 | 0 | 70,000 | 700,000 | 170,000 |
| 2033 | 0 | 190,000 | 340,000 | 170,000 |
| 2034 | 0 | 0 | 590,000 | 170,000 |
| 2035 | 0 | 190,000 | 340,000 | 170,000 |
| 2036 | 0 | 70,000 | 590,000 | 170,000 |
| 2037 | 0 | 190,000 | 450,000 | 170,000 |
| 2038 | 0 | 0 | 590,000 | 170,000 |
| 2039 | 0 | 190,000 | 340,000 | 170,000 |
| 2040 | 0 | 70,000 | 590,000 | 170,000 |
| 2041 | 0 | 190,000 | 340,000 | 170,000 |
| 2042 | 0 | 0 | 700,000 | 170,000 |
| 2043 | 0 | 190,000 | 340,000 | 170,000 |
| 2044 | 0 | 70,000 | 590,000 | 170,000 |

*Table 14. Annual placement volume at SF-9, SF-10, SF-11, and SF-16 over the 20-year RDMMP timeframe for alternative 2 regional optimization.*

**Alternative 2: BU - Regional Optimization**

| Year | SF-9 Placement Volume (CY) | SF-10 Placement Volume (CY) | SF-11 Placement Volume (CY) | SF-16 Placement Volume (CY) |
|---|---|---|---|---|
| 2025 | 190,000 | 0 | 690,000 | 130,000 |
| 2026 | 0 | 250,000 | 690,000 | 130,000 |
| 2027 | 310,000 | 0 | 690,000 | 130,000 |
| 2028 | 0 | 320,000 | 720,000 | 130,000 |
| 2029 | 190,000 | 0 | 690,000 | 130,000 |
| 2030 | 0 | 250,000 | 690,000 | 130,000 |
| 2031 | 190,000 | 0 | 690,000 | 130,000 |
| 2032 | 110,000 | 320,000 | 690,000 | 130,000 |
| 2033 | 190,000 | 0 | 690,000 | 130,000 |
| 2034 | 0 | 250,000 | 690,000 | 130,000 |
| 2035 | 190,000 | 0 | 690,000 | 130,000 |
| 2036 | 0 | 320,000 | 690,000 | 130,000 |
| 2037 | 310,000 | 0 | 690,000 | 130,000 |
| 2038 | 0 | 250,000 | 690,000 | 130,000 |
| 2039 | 190,000 | 0 | 690,000 | 130,000 |
| 2040 | 0 | 320,000 | 690,000 | 130,000 |
| 2041 | 190,000 | 0 | 690,000 | 130,000 |
| 2042 | 110,000 | 250,000 | 690,000 | 130,000 |
| 2043 | 190,000 | 0 | 690,000 | 130,000 |
| 2044 | 0 | 320,000 | 690,000 | 130,000 |

*Table 15. Annual placement volume at SF-9, SF-10, SF-11, and SF-16 over the 20-year RDMMP timeframe for alternative 3 cost-share opportunity.*

**Alternative 3: BU - Cost-share Opportunity**

| Year | SF-9 Placement Volume (CY) | SF-10 Placement Volume (CY) | SF-11 Placement Volume (CY) | SF-16 Placement Volume (CY) |
|---|---|---|---|---|
| 2025 | 180,000 | 0 | 370,000 | 130,000 |
| 2026 | 0 | 240,000 | 370,000 | 130,000 |
| 2027 | 250,000 | 0 | 370,000 | 130,000 |
| 2028 | 0 | 300,000 | 390,000 | 130,000 |
| 2029 | 180,000 | 0 | 370,000 | 130,000 |
| 2030 | 0 | 240,000 | 370,000 | 130,000 |
| 2031 | 180,000 | 0 | 370,000 | 130,000 |
| 2032 | 70,000 | 300,000 | 370,000 | 130,000 |
| 2033 | 180,000 | 0 | 370,000 | 130,000 |
| 2034 | 0 | 240,000 | 370,000 | 130,000 |
| 2035 | 180,000 | 0 | 370,000 | 130,000 |
| 2036 | 0 | 300,000 | 370,000 | 130,000 |
| 2037 | 250,000 | 0 | 370,000 | 130,000 |
| 2038 | 0 | 240,000 | 370,000 | 130,000 |
| 2039 | 180,000 | 0 | 370,000 | 130,000 |
| 2040 | 0 | 300,000 | 370,000 | 130,000 |
| 2041 | 180,000 | 0 | 370,000 | 130,000 |
| 2042 | 70,000 | 240,000 | 370,000 | 130,000 |
| 2043 | 180,000 | 0 | 370,000 | 130,000 |
| 2044 | 0 | 300,000 | 370,000 | 130,000 |

*Table 16. Annual placement volume at SF-9, SF-10, SF-11, and SF-16 over the 20-year RDMMP timeframe for alternative 4 maximized BU.*

**Alternative 4: BU - Maximized**

| Year | SF-9 Placement Volume (CY) | SF-10 Placement Volume (CY) | SF-11 Placement Volume (CY) | SF-16 Placement Volume (CY) |
|---|---|---|---|---|
| 2025 | 0 | 0 | 0 | 130,000 |
| 2026 | 0 | 0 | 0 | 130,000 |
| 2027 | 0 | 0 | 0 | 130,000 |
| 2028 | 0 | 70,000 | 0 | 130,000 |
| 2029 | 0 | 0 | 0 | 130,000 |
| 2030 | 0 | 0 | 0 | 130,000 |
| 2031 | 0 | 0 | 0 | 130,000 |
| 2032 | 0 | 70,000 | 0 | 130,000 |
| 2033 | 0 | 0 | 0 | 130,000 |
| 2034 | 0 | 0 | 0 | 130,000 |
| 2035 | 0 | 0 | 0 | 130,000 |
| 2036 | 0 | 70,000 | 0 | 130,000 |
| 2037 | 0 | 0 | 0 | 130,000 |
| 2038 | 0 | 0 | 0 | 130,000 |
| 2039 | 0 | 0 | 0 | 130,000 |
| 2040 | 0 | 70,000 | 0 | 130,000 |
| 2041 | 0 | 0 | 0 | 130,000 |
| 2042 | 0 | 0 | 0 | 130,000 |
| 2043 | 0 | 0 | 0 | 130,000 |
| 2044 | 0 | 70,000 | 0 | 130,000 |

In addition, it is also important to note that the placement of dredged material in the bay, and in particular, the in-bay placement of dredged material by non-federal dredgers has declined over the past decade, ranging between 160,000-290,000 CY for small and medium-sized, non-federal dredgers (Figure 19).

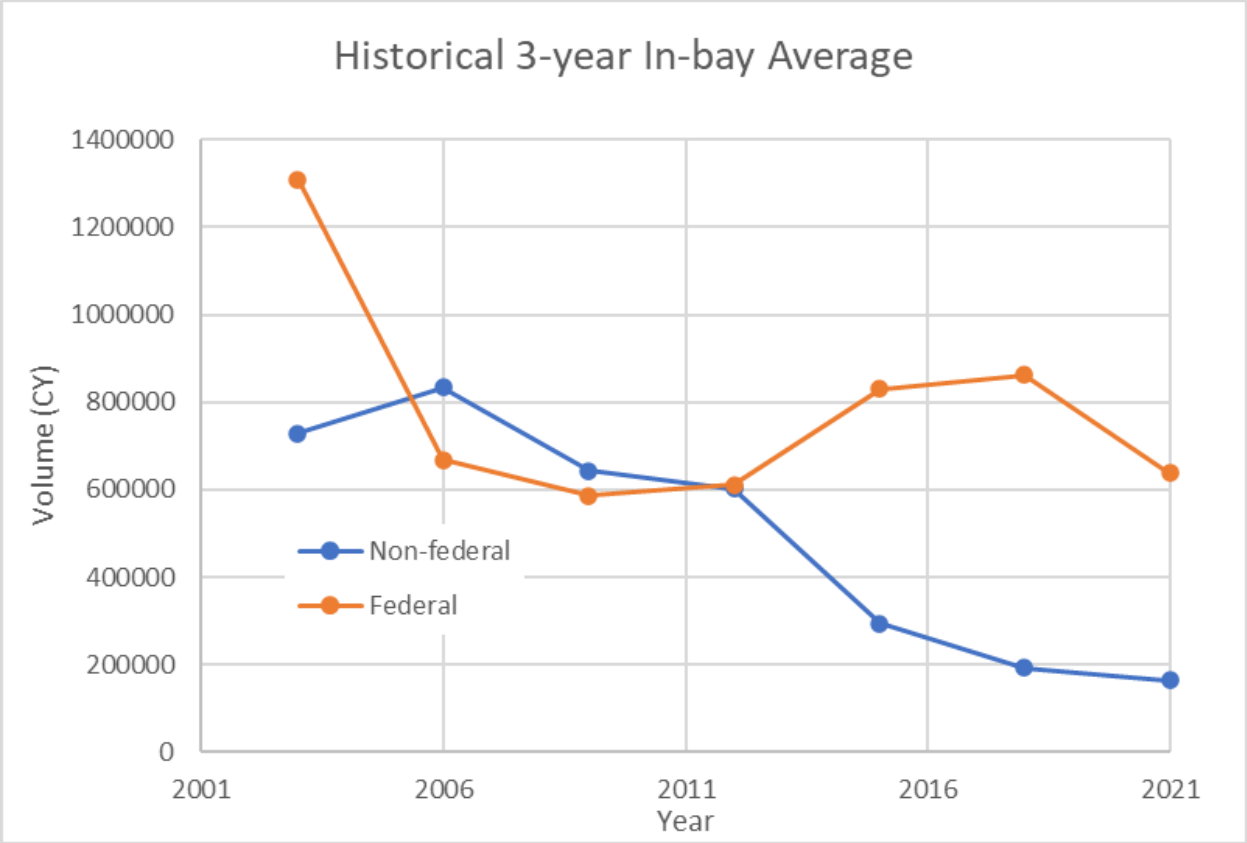


*Figure 19. 3-year historical average volume of in-bay placement of dredged material for federal (orange) and non-federal (blue) dredgers. The 3-year non-federal average has dipped as low as 165,000 CY, which includes both small and medium-sized dredgers.*

This volume is significantly lower than the volume set aside for small dredgers (250,000 CY) and the allowable volume for medium-size dredgers (between approximately 150,000-250,000 CY). This suggests that even with higher federal in-bay placement of dredged material, between approximately 1,070,000-1,110,000 CY for the three-year average (Table 17, Figure 18), the combination of federal and non-federal (i.e., approximately 160,000-290,000 CY three-year average [Figure 19]) in-bay placement would range between approximately 1,230,000-1,400,000 CY.

*Table 17. Three-year in-bay placement volume averages across array of alternatives for three-year accounting periods over RDMMP's 20-year plan lifetime.*

| | Alternative | 2027 | 2030 | 2033 | 2036 | 2039 | 2042 |
|---|---|---|---|---|---|---|---|
| 3-year in-bay placement volume (CY) | FWOP | 600,000 | 600,000 | 620,000 | 600,000 | 600,000 | 640,000 |
| | 1 | 760,000 | 760,000 | 780,000 | 760,000 | 760,000 | 800,000 |
| | 2 | 1,070,000 | 1,090,000 | 1,090,000 | 1,080,000 | 1,070,000 | 1,110,000 |
| | 3 | 720,000 | 750,000 | 740,000 | 740,000 | 720,000 | 760,000 |
| | 4 | 130,000 | 160,000 | 160,000 | 160,000 | 130,000 | 160,000 |

While in certain three-year periods, this in-bay average would be slightly above the 1.25 million CY target, the LTMS Management Plan indicates the trigger for the consideration of mandatory allocations

is the 1.25 million CY target plus the 250,000 CY contingency volume. As outlined in the Management Plan, "at the triennial LTMS review, if the average in-bay placement volume from the prior three years exceeds the in-bay targets plus the 250,000-cy contingency, the LTMS agencies will initiate consideration of allocations. (LTMS, 2001). As such, the regional optimization alternative 2 would not trigger the consideration of mandatory allocations for in-bay sediment placement, though it would require requests to utilize the contingency volume. Per the Management Plan, "dredgers would apply to the DMMO and document their need and applicability for contingency volumes, subject to review and approval by the Management Committee" (LTMS, 2001).

The need for utilizing the contingency volume is to beneficially use approximately 11.5 million CY of dredged material over 20 years to adapt to SLR, reduce flood risk, and support habitat creation for numerous endangered and threatened species, and to avoid unnecessarily and wastefully placing approximately 21 million CY of dredged material over 20 years at the deep ocean disposal site, SF-DODS, 55 miles offshore of the Golden Gate Bridge.

## Uncertainty in Alternatives Development

Volumes and costs are estimates and were used to make planning level assumptions. Dredging and placement volumes were collected from the 2023 Integrated Alternatives Analysis conducted by USACE, which pulled data from the USACE-maintained Legacy Dredging Database for years 2000 to 2022. These data were used to generate the average volume of sediment dredged for each project, which served as the planning assumption for placement site allocation. These volumes, which encompass the range of recent historical data, could change in the future due to several factors, including i) increases or decreases in shoaling rates, ii) construction of channel deepening or widening projects, iii) project-specific congressional appropriations, and iv) increased variability and intensity of El Niño Southern Oscillation (ENSO) patterns and climate-change related shifts in precipitation and weather extremes. Additionally, since alternative development considered the average volume of sediment removed based on historical data, there is a risk that future volumes may be lower or higher than the reported average, resulting in different total operation and maintenance costs than what is used in this report. Any deviation from the current volume or cost estimate will not likely have an acute impact on the selected plan given these factors of uncertainty, will affect all channels and placement sites relatively equally.

There is uncertainty around future BU placement site availability, timing, and capacity. There is one wetland restoration project slated to come online in the next 5-10 years (i.e., Bel Marin Keys Unit V), although it is unclear what year it will be available to accept sediment due to logistical constraints (i.e., access channel construction) and budget constraints (i.e., low budget to pay the incremental cost to divert dredged material from federal standard sites). Similarly, there are other wetland restoration sites with even less certainty, whose site managers have indicated capacity ranges spanning dozens of millions of cubic yards and with no clear indication on when the site might be designed and permitted. There are several potential Engineering with Nature pilot projects that USACE San Francisco District will be pursuing, similar to the 2023 Whale's Tail Nearshore Strategic Placement pilot project, but the exact locations, timing, and capacities are yet to be determined. As a result, the alternatives development process did not explicitly factor in future sites, and instead centered on existing sites which have certainty around its ability to accept material and how much it can accept. The uncertainty around future sites will be addressed by the WRDA 2020 Section 125 annual updating process outlined in the Legislative, Regulatory, and Policy Overview of this document, which allows sites to be integrated into

the RDMMP through time when they become available, and when the costs associated with delivering material there are better constrained.

Coordination with regulatory and resource agencies has been consistent and ongoing for several years since the beginning of the RDMMP development. Their inclusion has primarily served to communicate about the identification of knowledge gaps, the plan formulation process, the development of alternatives, and the likely Federal Standard Base Plan. However, even with continuous communication and feedback, there is uncertainty around how agencies will choose to interpret and apply agency-specific policies around the volume of dredged material placed in San Francisco Bay, the strategic expansion of hydraulic dredging in San Francisco Bay to significantly increase programmatic BU, and whether agencies will complete their permit application review in time to meet the implementation of dredging beginning in Calendar Year 2025.

## Selection of Recommended Plan (Likely Federal Standard Base Plan)

All alternatives are complete, effective in maintaining the federal navigation channels, and acceptable. Alternatives 1, 2, and FWOP are the most efficient given they are all least cost, but alternatives 1 and 2 are most effective in achieving the BU goals outlined out by USACE Command Philosophy, and most consistent with regional goals. Alternatives 1, 2, and FWOP are all technically feasible and are all environmentally acceptable (see companion NEPA/CEQA document), and thus could all be considered the Base Plan or Federal Standard Base Plan. However, given FWOP is not effective in achieving USACE's BU goals, the recommended plan is either Alternative 2: BU – Regional Optimization or Alternative 1: BU – Diversion from Deep Ocean Disposal.

The USACE-preferred alternative is alternative 2 (regional optimization) because it results in the most BU as part of the Base Plan (at full federal cost) and contributes significantly to the Chief's 70/30 Goal across the enterprise by 2030. However, alternative 1 (diversion from ocean disposal) is also a viable plan. Both alternatives are equivalent Federal Standard Base Plans and while we recommend alternative 2, alternative 1 may be implemented if regulatory constraints or equipment availability limit the implementation of alternative 2. USACE does not anticipate recommending FWOP as this does not include upland BU as part of the Base Plan and represents the most sediment lost to the deep ocean each year from the bay system.

Note that Alternative 2 is one way to match the cost of FWOP while maximizing BU and minimizing deep ocean disposal based on planning assumptions of dredged material volumes and cost estimates. In future years, as new BU sites become available, new federal or state money becomes available to fund the incremental cost of BU, and as the new cost-sharing opportunity under WRDA 2020 Section 125a to cover the incremental cost of BU is exercised, this plan and the associated volumes used to restore wetlands may change (Figures 14-15). The RDMMP can also be augmented by WRDA 2020 Section 125c, which articulates an annual update process to include a 5-year RDMMP spreadsheet analysis that examines how new sites and costs might be incorporated into or become the Federal Standard Base Plan.

## Channel Utilization Analysis

A Channel Utilization Report was completed concurrently to the RDMMP in 2024 with a purpose to determine the existing usage of the federal navigation channels included in this document. The analysis followed USACE guidance for dredged material management planning, as outlined in ER 1105-2-100, and

examined past and present use of the San Francisco Bay navigation channels including shipping volumes, the characteristics of vessels calling, and channel utilization.

All deep-draft federal navigation projects in this RDMMP provide benefits for the regional and national economy. The shallow-draft harbors mostly provide recreational benefits (and sometimes light commercial benefits) to local populations and have a critical public safety component.

More information regarding each federal project is provided in the Channel Utilization Annex to this report.

### Real Estate Requirements

A basic Real Estate Plan is included that discusses placing material specific to dredging of the federal navigation channels in the San Francisco Bay Region at the existing placement sites currently in use within available real property interests to support each placement area. All lands, easements, rights-of-ways, relocations, and disposals (LERRD) have been provided at these Federal Standard Placement sites or have been available through navigation servitude and would continue to be contracted for use during recurring maintenance dredging.

Because the federal navigation channels in this RDMMP are congressionally authorized navigation projects, dredging and placement activities would not require a lease agreement from the California State Lands Commission (CSLC) for use of public trust lands based on the navigational servitude provisions of the Submerged Lands Act. Although the Submerged Land Act grants CSLC title to all submerged navigable lands in the state, the act provides that nothing in the act shall affect the federal government's constitutional authority for the purposes of navigation.

If a future upland placement site is required, the Realty Specialist would be responsible for ensuring that all LERRD required for the project would be acquired by the Non-Federal Sponsor (NFS). The Chief of Real Estate would be responsible for certifying all required property interests (LERRD) prior to advertisement of a construction contract. HQUSACE approval would be needed to approve a lesser estate than fee or to approve a non-standard estate. However, it is not anticipated that such a placement site would be required within the time frame of this study.

## Compliance with Federal Laws and Regulations

The dredging and placement described in the SF Bay RDMMP will need permissions from relevant federal and state regulatory agencies, and consultations with federal resource agencies, to ensure the implementation of the navigation dredging program is consistent and compliant with all relevant federal laws and regulations as outlined in Legislative, Regulatory, and Policy Overview , as well as the companion NEPA/CEQA document included with the RDMMP.

## Schedule for Implementation

| Action | Date |
|---|---|
| District Submittal of Draft DMMP PMP – Phase I initial Scope of Work (CW150) | January 2023 |
| District Quality Control | May 2024 |
| Release Draft Report to Public | October 2024 |
| Agency Technical Review | October 2024 |
| Division Review (concurrent draft report/NEPA document) | October 2024 |
| Final Report Transmittal | January 2025 |
| Environmental Permits Obtained | May 2025 |
| O&M Dredging | June 2025 |

## Recommendations

### Federal Standard Base Plan

The Federal Standard Base Plan is the alternative that is least cost, environmentally acceptable, and technically feasible. FWOP, alternative 1 (BU – Diversion from Deep Ocean Disposal) and alternative 2 (BU – Regional Optimization, Leverage Hopper Dredging) are all equal cost, environmentally acceptable, and technically feasible. Given alternative 2 maximizes BU and minimizes ocean disposal within the federal standard while keeping the most sediment in the Bay system, it is the recommended plan. Note, however, that alternative 1 can be implemented as an equivalent Federal Standard Base Plan if regulatory or equipment constraints limit the implementability of alternative 2.

### Alternatives to Base Plan

Alternatives 3 (BU – Cost-Share Opportunity) and 4 (BU – Maximized) are both technically feasible and environmentally acceptable options that can be implemented given sufficient additional funding from either federal or state set-asides for BU, or by justifying the benefits of BU toward exercising the WRDA 2020 Section 125 cost-sharing opportunity. Neither of these alternatives are candidates to be the Federal Standard Base Plan, but are viable alternatives given the above conditions are met to implement a navigation program that is more expensive than the Federal Standard Base Plan.

## Approval of Decision Document

The San Francisco District recommends approval of the Regional Dredged Material Management Plan's recommended Federal Standard Base Plan, regional optimization alternative (2), as well as the diversion from ocean disposal alternative (1) in the event alternative 2 is not immediately implementable due to regulatory or logistical limitations. This plan will be implemented for the San Francisco Bay navigation program's Operations & Maintenance dredging activities covering dredging years 2025 through 2044 (i.e., the project's planning horizon).



_____ _____

Date

James J. Handura

Colonel, U.S. Army

Commanding

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