BIOLOGICAL ASSESSMENT
and
ESSENTIAL FISH HABITAT ASSESSMENT

FOR

MILITARY OCEAN TERMINAL CONCORD PIER MAINTENANCE DREDGING CONTRA COSTA AND SOLANO COUNTY, CALIFORNIA

Submitted to the
National Marine Fisheries Service

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1.0 Introduction

This Biological Assessment / Essential Fish Habitat Assessment (BA/EFH Assessment) was prepared to meet the consultation requirements under section 7 of the Endangered Species Act (ESA), pursuant to 50 C.F.R. § 402.12, and the Magnuson-Stevens Fisheries Conservation and Management Act (Magnuson-Stevens Act;50 C.F.R 600.920(e)). The purpose of this BA/EFH Assessment is to analyze the potential effects from the proposed maintenance dredging of Piers 2 through 4, and Barge Pier at the Military Ocean Terminal, Concord, California (MOTCO), (proposed action) on ESA-listed threatened and endangered species and their designated critical habitat within the project's action area, and on Essential Fish Habitat (EFH). This BA is a component of the environmental compliance for a Dredged Material Management Office (DMMO) dredging permit.

Formal or informal section 7 consultation and Magnuson-Stevens Act EFH consultation with the and National Marine Fisheries Service (NMFS), as appropriate, would be initiated by Military Ocean Terminal, Concord (MOTCO), as necessary.

1.1 Project Location and Action Area

MOTCO is located on Suisun Bay, 30 miles northeast of San Francisco, in Contra Costa County. MOTCO's infrastructure was constructed by the U.S. Navy beginning in WWII and operated as a Navy installation. The U.S. Army MOTCO began operations in 1997. Under a Base Realignment and Closure (BRAC) process, the installation was transferred to the Army in 2008. This installation is the primary West Coast common-user transshipment terminal, home to the SDDC's 834th Transportation Battalion.

Maintaining deep-draft access to MOTCO's piers is critical. The MOTCO installation accounts for 72% of the Army's West Coast ammunition handling and approximately 25% of the nation's total ammunition throughput capability. The U.S. Navy dredged the piers, pier navigation approach, and the South Seal Island Channel on average every two years from 1943 through 1981 (Table 1). More than 1.8 million cubic yards was dredged over this time period averaging 87,000 cubic yards per dredge event. Since 1981, additional dredging events are documented from 1986 and 1994. MOTCO does not have any documentation of dredge events between 1994 and 2008. Dredging has not occurred since the U.S. Army assumed the property in 2008 at the conclusion of the BRAC process. Sediment accumulation around the piers has resulted in sediment elevations above the proposed depth of 35 feet (MLLW) at Piers 2-4, and 20 feet (MLLW) at the Barge Pier, and is currently impacting military operations by restricting the times that the MOTCO piers can be used. Dredged material from MOTCO was historically placed on upland levee sites and infrequently at the Carquinez Straight (SF-9) and Suisun Bay disposal sites (SF-16) (see Figure 1).

Figure 1 - Dredging and Material Placement Sites

1.1 Action Area

The action area includes MOTCO's Barge Pier and Piers 2 through 4. Disposal at the Carquinez Strait (SF-9), SF-16, Montezuma Wetlands Restoration Project (MWRP), Cullinan Ranch Restoration Project (CRRP), and the Antioch Dunes National Wildlife Refuge (ADNWR) are excluded from the action area, as these sites are fully permitted to accept dredged material for wetland restoration, including complying with the ESA. Other direct and indirect impacts (e.g., noise) of the proposed action would likely affect a smaller footprint of the action area.

This BA incorporates by reference information contained in the *LTMS National Marine Fisheries Service Biological Opinion* (NMFS 2015b). This document transmits the National Marine Fisheries Service (NMFS) Biological Opinion (BO) for the LTMS Program and its effects on Federally-listed species under NMFS' jurisdiction at the time the consultation was completed. The BO outlines implementing procedures and minimization measures that would be used by MOTCO for dredging and material placement.

2.0 MOTCO Piers and Project Description

This section provides a discussion of the proposed action to conduct maintenance dredging of MOTCO's Barge Pier and Piers 2 through 4 from 2020 to 2030; as well as a detailed project description and description of future maintenance dredging.

Table 1. Historic MOTCO Dredging

Year	Dredge Volume	Document
1943	620,000	1975 LTMS EIS[1]
1944	298,000	
1945	70,500	
1950	82,300	
1951	48,500	
1953	37,000	
1957	108,700	
1959	20,900	
1960	69,700	
1962	40,000	
1965	52,000	
1967	36,800	
1969	30,000	
1970	63,200	
1975	78,000	
1976-1981	171,035	USACE (1995, 2015)
1986	unknown	
1994	unknown	
TOTAL	**1,826,635**	

NOTES:
1- http://www.spn.usace.army.mil/Missions/Dredging-Work-Permits/LTMS/December-1975-Volume-1/

Under MOTCO's Proposed Action/Project Alternative, MOTCO would perform dredging practices to maintain operational and mission capacity for Piers 2, 3, 4, and Barge Pier (totaling 38 acres). Dredging would be conducted under the LTMS. The frequency of dredging to be conducted, and volumes dredged would maintain suitable depths for navigability and cargo operations at piers 2-4 (35 feet MLLW) and the barge pier (20 feet MLLW). Maintenance dredging includes dredging to the respective project's regulatory depth, plus up to 2 feet of overdepth. MOTCO dredging operations would use a clamshell dredge depending on DMMO permit and equipment availability. Knockdown dredging up to 1,000 cubic yards per year may be implemented when shoaling is limited to level shoals on the berthing approaches between clamshell dredging episodes. Local water velocities appear to slow sediment deposition, therefore, MOTCO currently expects to dredge every 2 years when necessary to maintain navigability.

Sediment testing will be performed to identify appropriate placement sites for dredge material. Current conditions and estimated dredge event volume and area are provided in Table 2. Table 3 identifies the preferred Federal standard placement site and proposed alternate placement sites that would be used for each location, as well as expected dredge volumes. MOTCO would beneficially reuse dredged material to the maximum extent its authorities allow.

Table 2. Pier area conditions with proposed dredging actions.

Pier	Hydrographic Survey Date	Proposed Dredge Parameters			
		Year	Depth	Volume (CY)	Area (acres)
Barge	13-Mar-2019	2020	-22'	7,835	2.57
2	13-Mar-2019	2020	-37'	75,225	29.26
3	13-Mar-2019	2020	-37'	2,602	1.03
4	7-Jun-2018	Post-2020	-37'	12,571	4.73
Proposed 2020 Dredging				85,662	32.87
Post-2020 Dredging				12,571	4.73

Table 3. Summary of the proposed dredging action.

Location	Dredge Type	Initial Dredge Volume (CY)	Dredge Frequency	Range of Volume Dredged (CY)	Median Volume Dredge (CY)	Proposed Action Placement Site
Piers 2, 3, 4, and Barge Pier	Clamshell	85,662	1-2	2,602-75,225	28,000	MWRP, CRRP, ADNWR, SF-9, SF-16

Dredging and placement would be conducted in accordance with the conditions described under the DMMO permit and associated compliance documents. For the purposes of this BA, dredging is defined as mechanical dredging with removal of loose- or hard-compacted materials by clamshell, bucket, excavator, dipper, or ladder dredges.

Dredging would be conducted using mechanical dredges, with material being placed in a bottom-dumping scow. Once full, the scow will be transported by a tug to the dredged material placement site for disposal. The maximum anticipated volume of material proposed for maintenance dredging the first year is approximately 85,662 cubic yards (cy). If the dredging is continuous (24 hours a day) and the maximum daily rate of approximately 7,000 cubic yards is achieved dredging, the project could be completed in 13 full days. However, dredging typically does not occur 24 hours per day; rather, the effective work time (actual digging of shoaled material) is often 12 to 16 hours per day. Additionally, crew changes, relocation of the dredge, and other activities (e.g. breakdowns) limit the amount of dredging that occurs. Therefore, completing the proposed action's first year dredging could require anywhere from 30 to 60 days. Future dredging maintenance events are anticipated to be completed in shorter time periods. Dredging would be conducted during the August 1 through November 30 work window.

Mechanical clamshell dredging is the preferred proposed dredge type for this project, in order to minimize and reduce the potential risk of entrainment of special-status fishes. The project proposes to maximize beneficial use by placing dredged sediment at two wetland restoration beneficial use sites. Specifically, sediments would be placed at either MWRP, CRRP, or ADNWR . These proposed dredged material placement sites are already fully permitted to accept dredged material from Bay Area dredging projects; permits include Endangered Species Act and Magnuson-Stevens Act approvals (NMFS 2001, 2010, 2011, 2015b; USFWS 2001, 2010).

All dredging would be conducted during the existing environmental work windows August 1 through November 30 work window for Suisun Bay (USACE 2014A, 2015), unless expanded environmental work windows are provided through appropriate consultation. Dredging within the environmental work windows would reduce the potential impacts of the proposed action on sensitive life stages of threatened and endangered species.

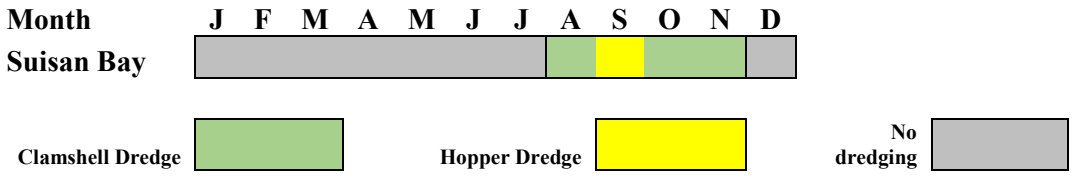

Figure 2 – Suisan Bay dredging work window

2.1 Dredging Methods

This section discusses details regarding the construction methods that would be employed to maintain the Pier Access, transport and place dredged material. The clamshell bucket capacity would range between 20 to 50 cy, depending on dredge availability. Up to seven scows, with a capacity of 2,000 to 4,000 cy, and four 1,800 horsepower (hp) tugs would be used to transport dredged material to placement sites. In addition, one 1,000 hp tender tug would be required to maneuver each dredge plant.

The estimated daily production rate would range between 3,100 and 6,600 cy, depending on the location of dredging and the placement site being used. For example, production rate would be approximately 5,000 cy if dredged material were placed at the upland beneficial use sites. The production rate would decrease if material were transported to one of the federal standard disposal sites.

A mechanical clamshell dredge consists of a crane mounted on a floating deck barge, with a clamshell bucket on the end of the crane boom (Figure 3). The deck barge has two to four spud piles attached to the platform, generally at the corners. The spud piles are long pipes that are driven vertically into the bay bottom by hydraulic assistance. The spud piles are used to anchor the dredge barge. Clamshell dredges are not self-propelled so they require a tug boat to tow or push the dredge to and from the dredge sites. Once a tug moves the dredge into place, the spuds are driven into the bay bottom anchoring the dredge. Once the dredge is anchored in place, dredging can begin. Relocating the dredge requires approximately 1 hour to complete. On average, the mechanical clamshell dredge plant for this project would need to be relocated approximately every 3 hours. In addition, when working adjacent to the ship channel, the dredge would need to be moved out of the shipping channel to allow deep draft vessels to transit the channel.

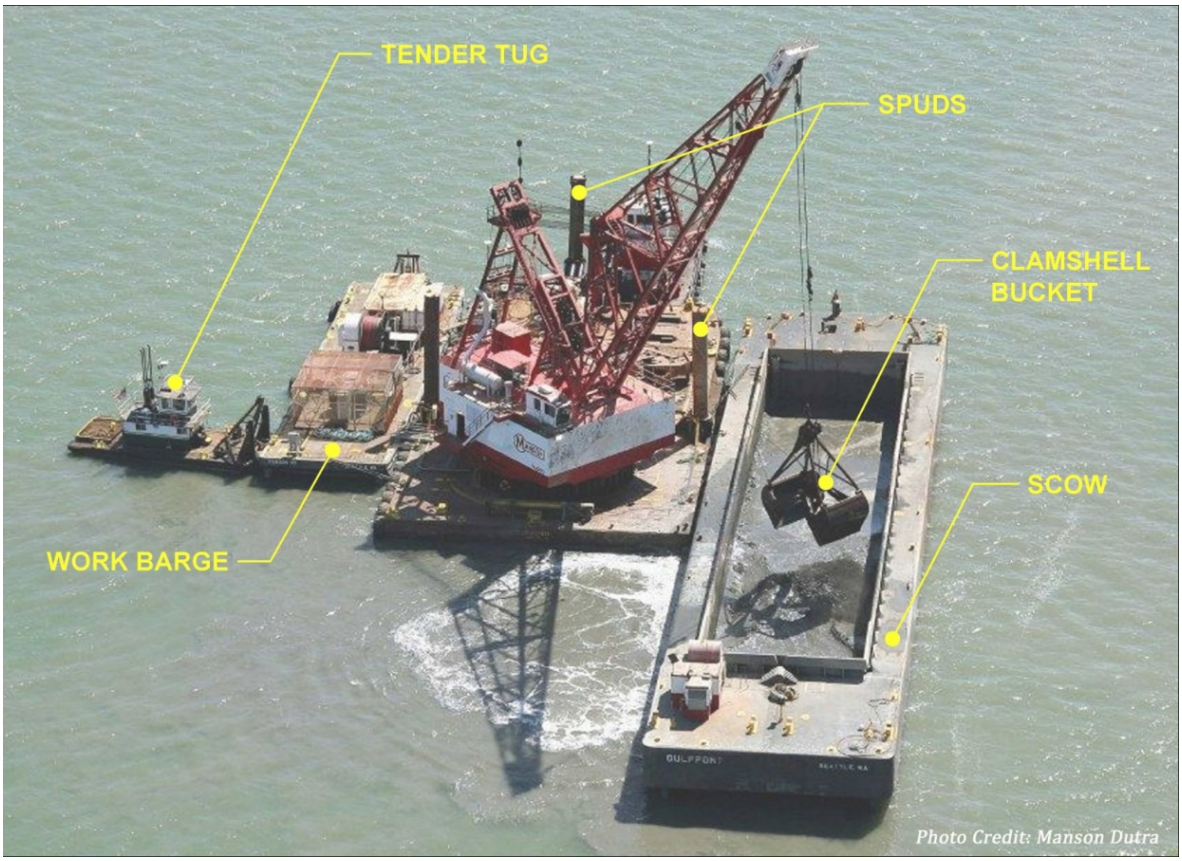

Figure 3 - Typical Mechanical Clamshell Dredge and Scow

The crane has a boom that is long enough to extend out beyond the end of the work barge in any direction and is able to swivel 360 degrees on its mount. A large clamshell bucket is attached to the end of a series of cables at the end of the boom, which allows the bucket to be raised and lowered into the water. The cables also open and close the bucket as it is filled with sediment and then emptied into scows. The scows are open barges that can carry large quantities of sediment and are towed with tug boats to and from disposal sites. As soon as one scow is filled and hauled away, another empty scow is maneuvered into place alongside the dredge and the digging continues.

Clamshell buckets are raised from and lowered to the bottom using a system of cables. The weight of the bucket is sufficient for it to fall through the water column into the bottom sediment. The cables restrict the clamshell from going too deep, or beyond the maximum allowable overdepth. The clamshell then closes and is pulled up through the water column to above the scow. Once over the scow, the clamshell opens and deposits the dredged material into the scow. When all the material within reach of the clamshell is dredged, the spuds are raised and the tender tug transports the dredge and scow to the next area requiring dredging. The process is repeated until all material is dredged from the channel. Following dredging, hydrographic surveys would be conducted to ensure that the entire area is dredged to the desired depth.

During dredging, clamshells place a slurry of sediment and water in the scows. Depending on the sediment type being dredged, the sediment-to-water ratio of the slurry is expected to be approximately 60 to 70 percent sediment and 30 to 40 percent water. To increase the sediment

volume in the scows, the scows may decant water back to the water column in a process called overflow. Overflowing the scows increases the sediment volume, compared to water, which can decrease the number of scow-tug trips to placement sites, thereby decreasing construction costs. The San Francisco Bay Regional Water Quality Control Board allows unrestricted overflow in San Francisco Bay when sediment is greater than 80 percent sand. When sediment is less than 80 percent sand, overflow is only allowed if turbidity monitoring is conducted within 500 feet of dredging operations to demonstrate that the turbidity plume generated by overflow activities does not increase the ambient turbidity by more than 10 percent, does not reduce dissolved oxygen concentrations to below 7.0 mg/L in Suisan Bay, or result in the pH going below 6.5 or above 8.5.

Barring is a routine part of dredging episodes to smooth out high-spots as needed after dredging has occurred (USACE 2015). This method involves using a tug to pull a weighted blade across the channel bottom. As the blade encounters material, it scrapes the material into the adjoining areas with deeper depressions, redistributing the shoaled material in each channel. Barring is restricted to the dredging footprint and the project depth, including the over-dredge depth allowance.

Knockdowns are separate from barring at the end of dredging episodes (USACE 2015). Knockdown events may be implemented to improve channel conditions between dredging episodes. Knockdowns use the same equipment and procedures as barring, but apply to isolated shoals or high-spots, rather than the entire dredging footprint. Knockdowns are most useful when time constraints may not allow for normal dredging, or when a shoal threatening navigation covers a small portion of a project area that is otherwise at or below its permitted depth. Conducting separate knockdown operations is often more efficient than mobilizing dredging equipment and transporting the material to a disposal site. Because knockdowns typically create less resuspension than full dredging episodes (especially in the upper water column), they have at times been approved in the San Francisco Bay Area to minimize necessary work outside environmental work windows.

Sediment proposed for dredging in front of the MOTCO Piers is anticipated to classify as clay, silt, and sand. The alternating layers of silty clay, clayey silt, sandy silt, silty sand, sand, and inter-bedded clay and sand are discontinuous and of varying thickness. Shells, wood debris (e.g., branches, twigs, and rootlets), and organic soils grading to peat also are expected to be encountered. Sediment directly in front of MOTCO Piers 2, 3 and 4, and Barge Pier was <80% sand when analyzed for pier renovations. Therefore, overflow turbidity monitoring would be required to demonstrate that the turbidity plumes are not adversely affecting water quality in the vicinity of the dredge.

2.1.1 Dredge Material Transport and Placement

When the scows are full, they would be transported to the dredged material placement site by diesel-powered tug boats. When the scow arrives at an open water disposal site, the doors at the bottom of the scow would open and dredged sediment would fall through the scow doors to the bottom of the placement site (Figure 4). As material falls through the water column, some sediment is stripped from the descending plume, creating turbidity around the scow. However, most sediment would fall to the bottom of the placement site. Scows transported to beneficial use sites would moor to an offloader at the respective site, such that sediment could be pumped out

of the scow and onto the restoration site. Pumping out the sediment, or offloading, typically involves the use of a modified hydraulic pipe dredge, which serves as an offloader. Montezuma Wetlands typically uses the Liberty offloader (Figure 5), which is on a floating barge. Cullinan Ranch uses an offloader that is land-based (Figure 6). Once moored, the offloader would insert a snorkel into the scow, simultaneously injecting water into the scow to create a water-sediment slurry and pumping the slurry from the scow to a designated cell within the site. The offloader's water intake system must be screened in accordance with the California Department of Fish and Wildlife's screening criteria. It takes approximately 2 hours to completely offload dredged sediment from a scow. Scows-tugs from the MOTCO would travel an average of 12 miles to Montezuma Wetlands. The distance from MOTCO to Cullinan Ranch is approximately 19 miles. Scows-tugs would travel approximately 7 knots (8 miles per hour) from dredge sites to the beneficial use sites. On average, each scow-tug trip to and from the beneficial use sites, including offloading, would take approximately 6 hours.

The project proposes to use existing dredged material placement sites, which have all of their environmental approvals in place to currently accept dredged material, including biological opinions, incidental take permits, and EFH conservation recommendations. The intent would be to maximize beneficial use of dredged material for construction of wetlands. Dredged material placement sites included in the project description are discussed below.

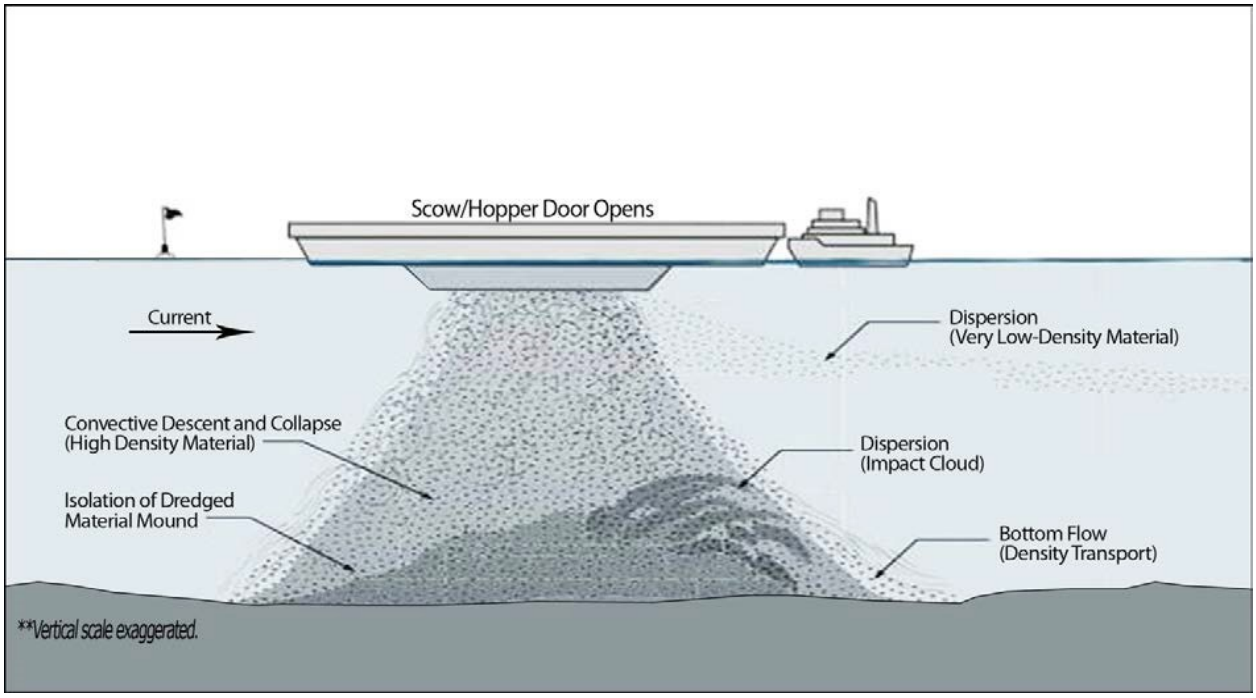

Figure 4 – Aquatic Placement of Dredged Material

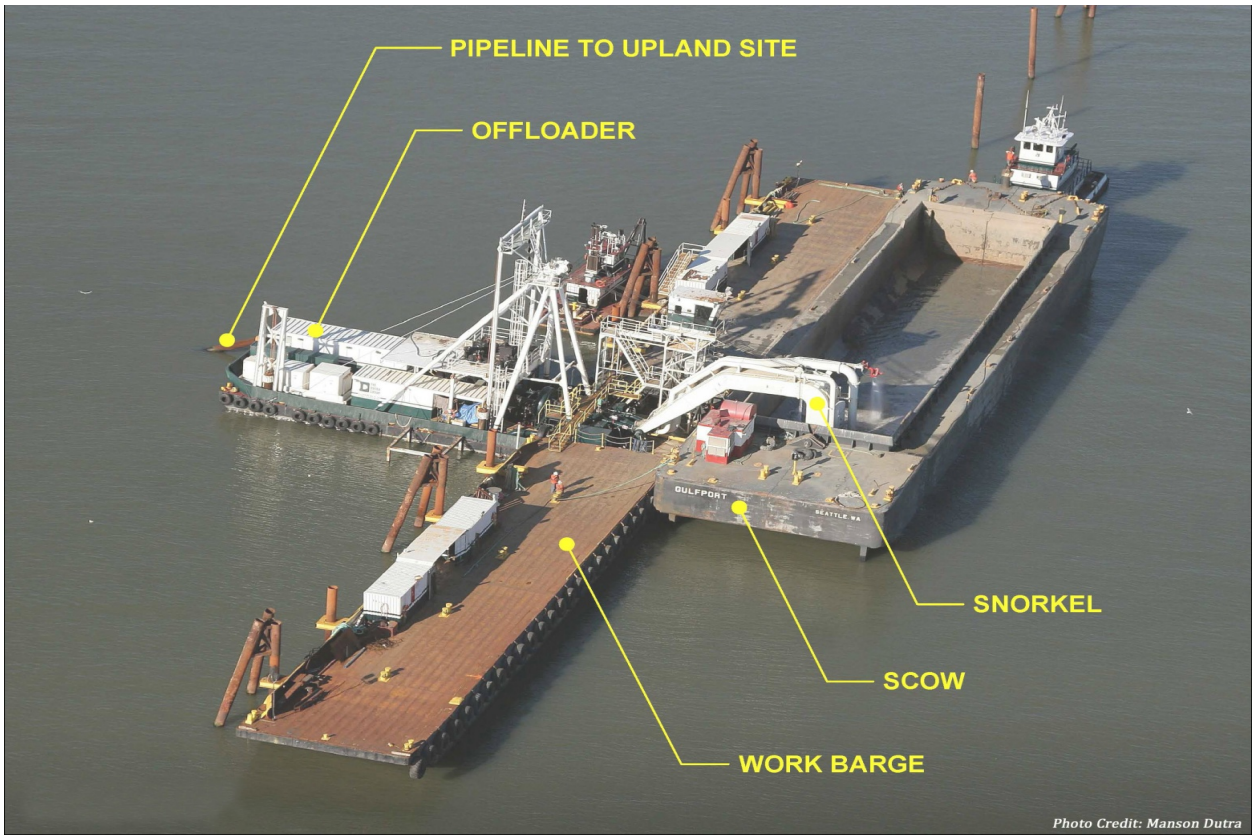

Figure 5 - Liberty Offloader during Typical Offloading at Montezuma Wetlands Restoration Project

2.1.2 Montezuma Wetlands

Montezuma Wetlands Restoration Project (MWRP) is a privately-owned restoration project located on the eastern edge of Suisun Marsh, north of the confluence of the Sacramento and San Joaquin Rivers near the town of Collinsville, in Solano County. In the early 1900s, the site was diked, drained, and used for agriculture. Since the site was diked, the land has subsided up to 10 feet. Once completed, Montezuma Wetlands is expected to restore 1,820 acres of tidal, seasonal, and managed wetlands (Collins and Grosso 2006). Approximately 17.5 million cubic yards of dredged material are needed to raise site elevations. As of August 2017, approximately 4 million cy of dredged material have been placed at Montezuma Wetlands, contributing to the restoration of over 350 acres of wetlands (https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/dredging.html). The site can accept both cover and foundation material. Foundation material is allowed only in the deepest portions of the site and must be covered with at least 3 feet of clean cover material.

A detailed description of the restoration activities and associated impacts to special status species and critical habitat are fully described in the Montezuma Wetland Restoration Project's biological opinions (USFWS file numbers 1-1-99-F-12; 1-1-02-F-0175 and 1-1-04-F-0270; NMFS file number F-SA-00-6:EAC), which are incorporated into this document by reference.

Based on the above information for Montezuma Wetlands, 9,000 to 11,429 cy of dredged sediment is required to create 1 acre of wetland habitat at the above locations. Using an intermediate value of 10,000 cy per acre of habitat, the approximately 98,500 cy of dredged sediment resulting from the proposed project is expected to create 9.8 acres of wetland habitat due to its beneficial reuse.

2.1.3 Cullinan Ranch Restoration Project

The Cullinan Ranch Restoration Project is located along the northern shoreline of San Pablo Bay near the city of Vallejo in Solano and Napa Counties. The site consists of diked baylands that was used for agriculture until the late 1980s. Following diking and draining the site, much of it lost up to 6 feet of elevation as a result of sediment deposition, soil compaction, and loss of organic matter (USFWS 2010). The USFWS is currently restoring over 1,500 acres of the site to tidal wetlands consistent with the USFWS' recovery plan for salt marsh harvest mouse and California clapper rail. In addition, it is believed that the restored marsh would provide suitable habitat for delta smelt, Central California coastal Steelhead, Central Valley Steelhead, winter-run Chinook Salmon, Central Valley spring-run Chinook Salmon, Green Sturgeon, and western snowy plover (USFWS 2010). The Cullinan Ranch Restoration Project also is expected to provide food and nutrients for aquatic species in the adjacent Napa River Estuary and San Pablo Bay.

In 2014, regulatory permits were revised to increase the volume of dredged sediment authorized for placement in support of tidal marsh habitat restoration at Cullinan Ranch (DMMO 2015). Specifically, the amount was increased from 450,000 cy to restore 50 acres to 2.8 million cy to restore 290 acres of the 1,575-acre site to elevations suitable for marsh plain establishment. As of December 2017, approximately 800,000 cy had been placed at Cullinan Ranch (Ducks Unlimited 2017), leaving a remaining capacity of approximately 2 million cy.

A detailed description of the restoration activities and associated impacts to special status species and critical habitat are fully described in the Cullinan Ranch Restoration Project's biological

opinion (Intra-Service section 7 consultation number SFB-1010-01), which is incorporated into this document by reference.

2.1.4 Antioch Dunes National Wildlife Refuge

The Antioch Dunes National Wildlife Refuge (ADNWR) is an approximately 55-acre refuge managed by USFWS that consists of two parcels separated by a Georgia-Pacific Gypsum Plant and a Pacific Gas & Electric utility easement. The refuge was founded in 1980 and is located along the shoreline of the San Joaquin River in Antioch, California. The western parcel, the 41-acre Stamm Unit, is the only unit proposed to receive dredge sediment for this project. The ADNWR is located about 12 miles east of MOTCO.

The site is surrounded by industry including a gypsum plant to the east, a former shipyard to the west, a former wastewater treatment facility which now functions as a municipal landfill, and a set of railroad tracks to the south. A total of three Federally-listed species: the Contra Costa Wallflower (*Erysimum capitatum ssp. angustatum*), the Antioch Dunes Evening Primrose (*Oenothera deltoides ssp. howellii*), and the Lange's Metalmark Butterfly (*Apodemia mormo langei*), have been identified at ADNWR.

As part of the Comprehensive Conservation Plan (CCP) for the ADNWR, dune restoration is one of the primary objectives for habitat restoration (USFWS 2002). Beginning in 1991, the USFWS has imported sand to the ADNWR in order to create additional habitat. The CCP specifies identifying potential sources of clean sand, specifically from the Stockton DWSC, and importing the sand for habitat restoration. Due to the sandy substratum in the areas surrounding Antioch Dunes, the shoaling that typically occurs in this section of the San Joaquin River is sand. In 2013, the Port of Stockton and the USFWS at Antioch Dunes partnered with the Corps to begin restoration efforts using dredged material. The beneficial reuse of dredged material allows the recreation of sand dunes, the natural habitat of the Contra Costa wallflower, the Antioch Dunes evening primrose, and Lange's metalmark butterfly. Continued use of this DMPS as a site for the beneficial reuse of dredged material will eventually allow natural restructuring of the sand dunes, possibly recreating the natural function and habitat value of the ADNWR. This site was used as a DMPS in 2013, 2015, and is planned to be used in 2019.

2.1.5 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 miles west of the entrance to Mare Island Strait in eastern San Pablo Bay in Solano County (Figure 1). Disposal is limited to 1.0 million cubic yards (cy) of dredged material per month and a maximum of 3.0 million cy per year during wet or above-normal water flow years; and 2.0 million cy per year during all other years.

2.1.5.1 SF-16 Suisun Bay Placement Site

The SF-16 placement site is a single-user, in-Bay, unconfined disposal site reserved for sand dredged from the Suisun Channel and New York Slough projects 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 (Figure 1). The depth at this site is approximately 30 feet MLLW. Currently, the site is authorized to receive 200,000 cy of dredged sand per year.

Figure 6 - Modified Offloader Currently Offloading Dredged Material at Cullinan Ranch (Dutchman Slough)

2.2 Future Operations and Maintenance Activities

Local water velocities appear to slow sediment deposition therefore, MOTCO currently expects to dredge every 2 years when necessary to maintain navigability starting in 2020, and continuing through 2030. Maintenance dredging includes dredging up to 2 feet of overdepth.

2.3 Military Ocean Terminal Pier Modernization

The Department of the Army (DOA) requested formal consultation for the modernization and repair of Piers 2 and 3 at the Military Ocean Terminal Concord (MOTCO) on October 28, 2013 (NMFS 2014; USFWS 2015; DOA 2015, 2016).. Major activities included demolition of pier 2, replacement of the existing pier pilings, and repairs of piers 2 and 3. Formal ESA consultation was completed in February 2015. Subsequent re-design removed maintenance dredging and reduced other effects associated with replacement of the pilings from the proposed action (DOA 2016).

The National Marine Fisheries Service (NMFS) concluded in their Biological Opinion (BO, NMFS 2014) that the pier maintenance project is not likely to jeopardize the continued existence or result in the destruction or adverse modification of critical habitat for the North American Green Sturgeon (*Acipenser medirostris*) Southern distinct population segment (DPS), Central Valley Steelhead (*Onchorhynchus mykiss*), Central California Coast Steelhead (*Onchorhynchus mykiss*), Central Valley Spring-run Chinook Salmon (*Onchorhynchus tshawytscha*), Sacramento River Winter-run Chinook Salmon (*Onchorhynchus tshawytscha*), and/or Sacramento River Winter-run Chinook Salmon (*Onchorhynchus tshawytscha*).

The NMFS also determined that the proposed project would adversely affect EFH for federally managed fish under the Pacific salmon Fishery Management Plan (FMP), the Pacific groundfish FMP, and the coastal pelagic FMP. The NMFS made EFH conservation recommendations for pre- and post-construction submerged aquatic vegetation surveys.

3.0 Consultation History

On Aug 30, 2019 a species list was received from National Marine Fisheries Service. This project would follow the best management practices (BMPs) and reasonable and prudent measures (RPMs) of the Long Term Management Strategy (LTMS) for the Placement of Dredge Material in the San Francisco Bay Region (USFWS 1999). This project would follow the BMPs and RPMs of the LTMS (2015a,b).

On September 18, 2019 the USFWS and NMFS participated on a conference call with MOTCO and USACE to discuss the content in the forthcoming BA(s). The conversation focused on clearly describing the proposed dredging action at MOTCO.

4.0 Environmental Baseline and General Effects of the Proposed Action

This section discusses the existing environmental conditions in the vicinity of the MOTCO waterfront, and other aspects of the proposed project that could impact the existing conditions either directly or indirectly. This section is limited to only those impacts that may adversely affect special status species or critical habitat, and further discusses the general impact mechanisms of the project which would be similar for all special status species and habitat analyzed herein. For specific impacts on special status species, refer to Sections 5.0 (NMFS-managed species), and 6.0 (Essential Fish Habitat). The resources and potential impacts included in this analysis are listed below:

- Direct impacts through dredging and dredged material transportation. These impacts could range from injury or death of special status fishes or changes in their behavior, to adverse effects on critical habitat and essential fish habitat.
- Direct and indirect impacts to water quality resulting from turbidity and suspended sediment, release of constituents of concern, and salinity intrusion.
- Direct and indirect impacts resulting from hydrodynamic noise.

The "Action Area" for the project, as defined in 50 CFR 402.02, includes all areas in which federally listed species would be affected directly and indirectly by the proposed action. The "effects of the action" to be analyzed in the BA are defined as the direct and indirect effects of the action, together with the effects of other interrelated or interdependent actions and non-federal cumulative activities. The Action Area includes the berthing approaches to the Barge Pier and Piers 2 through 4.

4.1 Habitats in the vicinity of MOTCO

The proposed action would occur on the south side of Suisun Bay, which comprises the eastern, upstream portion of San Francisco Bay and the western extent of the Sacramento-San Joaquin Delta. Suisun Bay represents the central, brackish-transition zone of the largest estuary, and contains the largest continuous area of brackish wetlands found in the Western United States. Habitat types from the San Francisco Estuary Institute (SFEI) EcoAtlas Baylands Mapping Project within the project area are discussed below (Figure 3-1) (SFEI 2013). More detailed descriptions are provided in MOTCO's Integrated Natural Resources Management Plan (INRMP) (USACE 2011a).

4.1.1 Subtidal Habitats

Suisun Bay represents a brackish tidal environment and by definition, its subtidal habitats are tidally influenced but continuously submerged. Salinity in Suisun Bay and especially in the project area is highly variable, being strongly influenced by the interaction of freshwater runoff down the Delta, which is subject to both natural (tidal, seasonal, and interannual) and manmade controls, and tidal influx from the Bay. A survey along the shoreline of the project area in November 2009 indicated salinities of 10–20 parts per thousand (ppt) (USACE 2011a).

Except during periods of heavy outflows from the Delta, the dominant currents of Suisun Bay are those associated with rising (flood) or falling (ebb) tides. In addition to strong tidal currents, strong winds and shallow depths result in thorough mixing and well-oxygenated waters.

The subtidal waters and substrates of Suisun Bay help to sustain a number of commercially important fisheries, and as a result have been designated as Essential Fish Habitat (EFH) under three Fishery Management Plans, including those for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species (Pacific Fishery Management Council 1998, 2011a–c, 2012). Shallow bay habitat is found inshore of the MOTCO piers as well as in the sheltered lees of the piers and headlands. Although not common in Suisun Bay, numerous small beds of submerged aquatic vegetation (SAV) consisting of pondweed (*Stuckenia* spp.) have been observed in this area at MOTCO. Refer to Section 4.1.2, Aquatic Vegetation, for a discussion of SAV in the project area.

Suisun Bay channels are dominated by introduced bivalves (*Corbula amurensis* and *Corbicula fluminea*), polychaetes (*Marenzellaria viridis* and *Heteromastus filiformis*), and a small surface-dwelling cumacean (*Nippoleucon hinumensis*). In shallow subtidal areas the dominant species include a bivalve (*C. amurensis*), a polychaete (*M. viridis*), and an amphipod species (*Monocorophium alienense*) (NMFS 2007).

Suisun Bay is a turbid, nutrient-rich but low-productivity system, with about 85 percent of primary production being allochthonous (from inflow), and only 15 percent autochthonous (from local sources), the latter mainly due to phytoplankton, with minor contributions by macrophytes and benthic algae (Winder and Jassby 2011). The main classes of phytoplankton are dinoflagellates, diatoms, and cyanobacteria (blue-green algae), which are free-floating and serve as a primary food source for zooplankton, which in turn provide food for fish. Diatoms were historically the dominant component of the phytoplankton in Suisun Bay, and tended to increase in abundance through the summer (Cloern et al. 1985). The zooplankton community was characterized by abundant phytoplankton grazers including cladocerans, rotifers, and mysids, all of which provided a high-quality food resource for planktivorous fishes such as the Delta smelt (Winder and Jassby 2011).

Regular sampling of physical and biological conditions in Suisun Bay over the period 1973–2008 reveals dramatic changes to the food web that are continuing to the present (Winder and Jassby 2011). Especially significant changes occurred during 1987–1994, coincident with drought and the establishment of the invasive clam, *Corbula amurensis* (Winder and Jassby 2011). Filter-feeding by *C. amurensis* is the primary cause of a roughly 75 percent decline in phytoplankton biomass since the preceding period, and the food web as a whole has shifted from phytoplankton-based to detrital-based. Diatoms have been largely replaced by dinoflagellates and cyanobacteria, which are a nutrient-poor food resource for zooplankton. The zooplankton community has changed in parallel, with rotifers, calanoid copepods, and mysids being replaced by the introduced cyclopoid copepod *Limnoithona tetraspina*, which is a smaller species, the dominance of which probably reduces the foraging efficiency of planktivorous fishes (Winder and Jassby 2011).

Within Suisun Bay, phytoplankton become concentrated within the estuarine turbidity maximum or entrapment zone, where variations in tidal inflow of saline water along the bottom from San Francisco Bay, interact with bathymetry and freshwater outflow on the surface from the Delta, resulting in turbulent mixing, sinking, and resuspension of phytoplankton. Particles sinking out of the surface water become entrained in the deeper current and are carried back upstream (landward). Near the upstream limit of landward flow, turbulent mixing or a net upward movement prevents settlement of some particles and these then become trapped between the outflowing surface current and the landward flowing bottom current, such that no net landward

or seaward movement occurs. The entrapment zone is generally in Suisun Bay but its location shifts as a function of daily tidal variations as well as seasonal and inter-annual variations in freshwater outflow (Kimmerer 1992; Schoellhamer and Burau 1998).

4.1.2 Aquatic Vegetation

Aquatic flora includes SAV and various species of algae and phytoplankton. Submerged aquatic vegetation includes vascular plants that are adapted for life under water. In general, the occurrence of aquatic vegetation in the subtidal habitats in the vicinity of MOTCO is not common due to the lack of hard substrate and high water motion in the area (Goals Project 1999). Estuarine soft bottom habitat is not ideal habitat for most SAV and algae, as fine-grain sediments create complications for organisms that require attachment to the substrate. Most SAV and macroalgae require coarse-grain materials to anchor into or attach to. Algae species typically require higher salinity levels than those found in Suisun Bay, but some species (e.g. *Gracilaria sjoestedtii*, Enteromorpha spp., and Ulva spp.) can adapt to changing salinity levels. Although flexible in their salinity range tolerance, these algae species still require coarse sediments, rocks, or some other stable substrate to attach to (Goals Project 2000), and hence their occurrence at MOTCO is limited to artificial hard substrates along the shoreline.

Eelgrass (*Zostera marina*) is one species of SAV that is capable of anchoring into fine-grain sediments. Eelgrass is an important species because it forms large beds which function as habitat for many invertebrates and a nursery area for juvenile fish. Previous SAV surveys in the San Francisco Bay-Delta did not reveal the presence of eelgrass along the shorelines of Suisun Bay near MOTCO. Eelgrass was patchily distributed in Carquinez Straits and Suisun Bay west of MOTCO (Merkel and Associates, 2014). Eelgrass may have disappeared from the project area in response to prolonged lower salinity prior to recent surveys (Kiewit/Manson 2018). High turbidity and eutrophication driven by nutrient loading associated with localized agricultural runoff increase the probability that eelgrass communities will not become established at MOTCO (Cardno TEC et al. 2013).

Aquatic vegetation survey (Kiewit/Manson 2018) found Sago pondweed and California bulrush in the shallower water landward of the piers within 250 m of the dredging area. SAV consisting of pondweed (*Stuckenia pectinata* and *Stuckenia filiformis*), however, occurs frequently along Suisun Bay shorelines, and research into the ecological relationships and importance of pondweed SAV in Suisun Bay has only recently begun (Boyer 2011). Areas surveyed within the project footprint were dominated by in-water vegetative communities consisting primarily of California bulrush and pondweed (see Figure 3-1). Therefore, any concerns regarding disturbance or impacts to SAV potentially caused by dredging at MOTCO should be focused on pondweed and associated biological communities.

4.1.3 Intertidal Habitats

There are a number of habitats within the 8-foot vertical range of extreme low to extreme high tides at MOTCO. Low intertidal shores and flats are largely unvegetated areas occurring below mean tide level. There are three different types of substrates and associated biological communities that occur on shores and flats in the project area at MOTCO: low tidal marsh mudbanks that front natural shorelines; hard substrates of the piers and developed areas that support sparse, patchy growths of green algae (*Ulva spp*., Enteromorpha spp.) and attached epifauna – predominantly barnacles (*Balanus improvisus*); and narrow fringes of low intertidal

sand or mudflat below the mudbanks and artificial substrates. Away from the shoreline and outside of the project area there are extensive mudflats around the edges and shallowest portions of muted tidal ponds (USACE 2011a).

The tidal marshlands at MOTCO are a mosaic of marsh vegetation and bodies of water including tidal sloughs, channels, ponds, and manmade ditches, all of which function as a circulatory system for water, oxygen, sediments and nutrient transport, and as pathways for the movement of fish and aquatic wildlife. The interface between marsh vegetation and water throughout the marshes provides a structurally complex and productive habitat that is used for nesting, foraging, nursery, and refuge by a variety of fish and wildlife. Within the project area, there are two primary slough channels, Belloma Slough, and an unnamed channel, which provide tidal circulation to Belloma Marsh, inland from Pier 3. These channels are relatively wide, deep, open, and extend under White Road, connecting to remnants of the network of natural tidal channels on the marsh plain of Pier Marsh, between the shore and the railroad tracks. In this area and elsewhere, linear ditches were excavated in the past across the Tidal Area for drainage and agricultural use, resulting in a series of parallel or intersecting ditches that crisscross the historic marsh plain. In these areas, the natural tidal channels are largely obliterated. Linear stands of upland (often weedy) vegetation established on the soils that were excavated and mounded along the banks of the ditches fragment the native marsh habitat. Benthic invertebrate communities in slough channels are similar to those found in the shallow subtidal habitat described above, although species abundance is much lower (NMFS 2007).

The vast majority of marshlands on MOTCO are brackish tidal marshes, either fronting Suisun Bay or connected to it by sloughs, channels, and ditches. On the immediate shoreline and in well-flushed portions of the marshes, the vegetation is dominated by species that occur across a broad range of salinities both up- and downstream in the Bay-Delta. Except along the immediate shoreline, these marshlands are Muted Tidal Marsh habitats. These areas are subject to regular daily or monthly tidal action, but to an extent that is lessened by the tidal circulation that has been constricted, impeded, or diverted relative to historic conditions. The distribution of tidal marsh plants at MOTCO is strongly (but not exclusively) influenced by tidal elevation and salinity, as described further below.

- Low-Tidal Brackish Marsh. Low tidal brackish marsh vegetation is important in stabilizing shorelines, is a major source of primary production in this part of the estuary, and provides a structurally complex habitat for fish and wildlife. The low tidal brackish marsh vegetation is characterized by several tall emergent monocot species, including cattail (*Typha latifolia*), smooth cordgrass (*Spartina foliosa*), common reed (*Phragmites australis*), hardstem tule (*Scirpus acutus*), and California bulrush (*Scirpus californicus*). In addition to the tall emergents, on wave-exposed consolidated mud banks there is a low-growing turf made up of dwarf spikerush (*Eleocharis parvula*), low bulrush (Scirpus cernuus), Delta mudwort (*Limosella subulata*), and Mason's and western lilaeopsis (*Lilaeopsis masonii* and *L. occidentalis*).

- Mid- to High Tidal Brackish Marsh. The mid- to high intertidal zone typically supports low-growing herbaceous vegetation patchily dominated by saltgrass (*Distichlis spicata*), pickleweed (*Salicornia virginica*), Baltic rush (the J*uncus balticus-lesueurii* complex), spearscale (*Atriplex triangularis*), jaumea (*Jaumea carnosa*), creeping spikerush (*Eleocharis macrostachya*), alkali heath (*Frankenia salina*), dodder (*Cuscuta salina*), and arrowgrass (*Triglochin spp*.). The endangered soft bird's-beak (*Cordylanthus mollis ssp. mollis*) and Suisun Marsh aster (*Aster lentus*) also occur within this zone. Areas that were probably native mid-tidal

marsh on MOTCO have been converted to high marsh by diking and ditching, which limit tidal flooding onto the former marsh plain. Near and above the upper limits of tidal inundation, extensive areas have become dominated by the extremely invasive perennial (broadleaved) pepperweed (*Lepidium latifolium*). This high marsh-upland transition zone at MOTCO also supports San Francisco Bay gumplant (*Grindelia stricta* var. *angustifolia*), western goldenrod (*Euthamia occidentalis*), salt marsh baccharis (*Baccharis douglasii*), and western ragweed (*Ambrosia psilostachya*).

Freshwater-associated species such as cattail and common reed comprise approximately 34 percent of the wetland plant cover types mapped in the Tidal Area (H.T. Harvey and Associates [HTH] 2011). In contrast, saltmarsh species such as pickleweed and saltgrass comprise only about 10 percent of wetland cover types (Figure 3-2). In the vicinity of Piers 2 and 3, the outboard marshes of these sites are dominated by a mixture of broadleaved pepperweed and Baltic rush (33 percent) and cattail (22 percent). There are also patches of brackish vegetation that is dominated by Olney's bulrush (4 percent). Salt marsh vegetation, consisting of pickleweed (2 percent), saltgrass (less than 1 percent), and a mixture of salt marsh gumplant, alkali weed, marsh jaumea, spearscale, and other salt marsh plants occurs in these outboard marshes as well.

Pier Marsh, south of White Road in the vicinity of Pier 3, is dominated by cattail and common reed, with smaller patches of pickleweed, Olney's bulrush, and other marsh vegetation. There are two tidal sloughs that allow for tidal exchange through culverts under White Road. This muted tidal action results in dominance by freshwater marsh habitat in Pier Marsh and likely has allowed for the spread of common reed at the southern portion of the marsh, which is not typically found in tidally-influenced saline environments. During low tides, there is exposed mudflat in the tidal sloughs and shallow portions of the edge of Suisun Bay.

4.2 Impacts Associated with Dredging and Dredged Material Transportation

Special status fishes have the potential to be directly injured by construction equipment, including through contact with the dredge clamshell bucket or contact with the tug and scows. In addition, fish may become entrained in prop wash from tugs or other shallow-draft skiff vessels transporting crew and equipment. The most likely cause of injury would be from the clamshell bucket falling through the water column or entrainment in tug prop wash.

While individual fish have the potential to be struck or entrained by clamshell bucket as if falls through water column to the bottom, the falling bucket would generate a pressure wave around it that would force small fish away from the falling bucket. As a result of the pressure wave, mechanical clamshell dredging has a very low risk of entraining fishes (USACE DOER 1998). As such, the use of a clamshell dredge minimizes the risk of fish entrainment for all fishes.

Special status fish also have the potential to be entrained in tug prop wash. The project proposes to use two 1800 hp tugs to transport scows to and from the beneficial use sites, and up to three 1,000 hp tugs to maneuver the clamshell dredges. The smaller tugs would remain in the vicinity of the dredge area; whereas the larger tugs would move between the dredge areas and the placement sites. The dredges would draft between 10 and 18 feet MLLW. While operating, the tugs would create propeller wash as they move through the water. Propeller wash is a pressure disturbance that results in a system of diverging and transverse waves. As the propeller spins, it generates a turbulent, continuous stream of fast moving water (AMOG Consulting 2010). Fish entrained in propeller wash may become disoriented or injured.

4.3 Habitat Alteration

The proposed project area provides habitat for a wide variety of aquatic species, including species associated with the benthos (e.g., annelids, mollusks, and crustaceans); phytoplankton and zooplankton; common fish species; special status fish species; invasive aquatic plants, fish, and invertebrates; and marine mammals. Aquatic habitats include tidal marsh and tidal mudflats; intertidal, shallow sub-tidal, and deep sub-tidal habitats; managed wetlands; rocky intertidal and subtidal; and open bay waters. Much of the land adjacent to Suisun Bay, the Carquinez Strait, San Pablo Bay, and San Francisco Bay is developed. Suisun Bay is adjacent to Suisun Marsh and other wetland areas, as well as some developed shorelines. The habitat types around the Bay and Delta often blend with one another and with nearby upland habitats in transition zones called ecotones. Species found in these areas often occur in more than one habitat type (USACE 2014a).

The proposed project would remove several feet of accumulated sediment the MOTCO Piers Access area. The total project area of 38 acres is the maximum area that would be disturbed. Removal of benthos may temporarily reduce the food supply for special status fish species that are benthic predators, such as Green Sturgeon. Benthic recolonization of the dredged area may take months or years (Oliver et al. 1977). Dredging of accumulated sediment would not decrease the area of shallow water habitat in the project area.

4.4 Water and Sediment Quality

The project has the potential to affect water and sediment quality by temporarily increasing suspended sediment during dredging, which also can result in releases of constituents of concern; salinity intrusion; and changing the sediment quality of the channel bed following dredging. Salinity intrusion especially could affect the quantity and quality of habitat available for fishes which depend on a particular range of salinity as suitable habitat; of particular concern is Delta Smelt. These potential impacts to water and sediment quality are discussed in greater detail below.

4.4.1 Sediment Sampling and Testing

The Inland Testing Manual (ITM), Ocean Testing Manual, and the Upland Testing Manual specify the sampling and testing requirements for dredged material based upon the potential placement site. Some upland sites may have additional requirements beyond those specified in the three manuals.

The DMMO is a forum used by project proponents and the regulatory agencies to ensure sampling and testing programs meet water quality standards and that dredged material is placed in sites that are appropriate for the type and quality of the material to be dredged. The Sampling and Analysis Plan (SAP) describes the process for compositing, analyzing and reviewing sediment results for Federal maintenance dredging projects (see example USACE 2014b). The SAP for MOTCO dredging describes how material should be collected, shipped, stored, handled, and tested for certain physical, chemical, and biological analyses. The SAP would be updated in 2019 prior to sampling toward the end of the calendar year.

In accordance with the ITM, when the material to be dredged is greater than 80 percent sand and is in a high-energy environment, it is assumed to be clean and exempt from further testing. Sediment directly in front of MOTCO Piers 2, 3 and 4, and Barge Pier is <80% sand. The sediment was previously tested in 2014 in accordance with a DMMO reviewed Sediment SAP

(USACE 2014c). Sampling would be implemented in 2019 to provide current sediment data for identifying appropriate disposal sites in the permitting compliance (EA).

A comparison of DMMO criteria and bioaccumulation tissue concentration results indicate that bioaccumulation of PAHs, PCBs, pesticides and metals is not anticipated (USACE 2014c). Additional z-layer samples are not likely required in the proposed dredging area following dredging. Using NOAA sediment quality guidelines, significant adverse effects are not expected. The NOAA Enterprise Risk Management (ERM) criteria is considered the most appropriate comparison value and with the exception of nickel, which was further evaluated, no values exceed the available ERM. Results show elevated levels of metals and polycyclic aromatic hydrocarbons as expected. However, the results of the toxicity and bioaccumulation bioassays indicate that significant adverse effects are not anticipated for vertebrate and invertebrate receptors (USACE 2014). Deionized Water Waste Extraction Test results do not exceed the Soluble Threshold Limit Concentration criteria. Therefore, material placement is not expected to impact groundwater via infiltration, or impact surface water due to stormwater discharge (USACE 2014). Waste Extraction Test results indicate that further evaluation or monitoring for chemical constituents is not necessary because effluent concentrations are similar to site water (background) concentrations. Discharge into Suisun Bay is not likely to cause adverse impacts to water quality or ecological receptors regardless of dredging methodology (USACE 2014).

Based on grain size results alone, the anticipated dredge materials from Suisun Bay Channel and New York Slough were suitable for in-Bay disposal at the Suisun Bay Disposal Site (SF-16). In addition, the Grain Size results were greater 80 percent sand in a high energy environment is considered to be clean sand suitable for aquatic placement.

Dredged materials from Suisun Bay Channel and New York Slough have historically been comprised predominantly of sand with low levels of metals and butyltins and very low or non-detect levels of polyaromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs), which excludes these dredged materials from further chemical and biological analyses.

Sampling and testing for the Suisun Bay Channel is on a 5-year cycle, with the next episode scheduled for 2019. USACE would implement sediment sampling in the MOTCO project area using the updated SAP.

4.4.2 Turbidity and Suspended Sediment

The proposed action could produce increased suspended sediments and turbidity in the action area from clamshell dredging operations and placement of spoils at the disposal site. Background turbidity in the estuary is naturally high, with total suspended solids (TSS) levels varying from 10 mg/L to more than 100 mg/L (Robinson and Greenfield 2011). However, sediment plumes would be generated from excess sediment and other material entrained (e.g. air bubbles) being discharged back into the water during dredging. Plumes typically have an increased suspended sediment concentration, thus elevated turbidity. The degree of sediment re-suspension depends on the material, size and composition the sediment being re-suspended. Plume size, concentration, and duration of the plume depend on environmental and operational specific factors. During dredging, sediments may become suspended because of the clamshell bucket's impact to the bottom, material washing from the top and side of the bucket as it passes through the water column, sediment spillage as it breaks the water surface, spillage of material

during barge loading, and intentional overflow in an attempt to increase the barge's effective load which is only permissible for material that is 80 percent or more sand.

Turbidity plumes were measured during clamshell dredging in the Oakland Harbor and Richmond Inner Harbor, located in Central San Francisco Bay, and Redwood City Harbor, located in the South San Francisco Bay in 2016 and 2017. Sediment in these channels ranges from very fine silt to sandy-silt. The purpose of the turbidity monitoring was to determine if dredging and/or overflowing of scows exceeded the turbidity requirements in the project's water quality certification. The water quality certification requires that increased turbidity be less than 50 NTU or no greater than 10 percent if the baseline NTU is greater than 50 at the point of compliance (i.e., 500 feet downstream of dredging). Ambient turbidity was measured 200 feet up current from dredging, in areas that were not affected by the turbidity plume. The turbidity plumes were measured at 200 feet down current from the dredge (referred to as the early warning location) and 500 feet down current from the dredge (referred to as the point of compliance). For each location, turbidity was measured near the surface (approximately 2 feet below the surface), mid-depth, and near the bottom (approximately 2 feet above the bed). Turbidity was measured when the scow was overflowing (decanting) and when the scow was not overflowing, and also represented the range of tides in the region. Measurements were taken every 10 minutes at each location. Exceedances of the water quality turbidity standards occurred periodically for all channels, with most exceedances occurring in the Richmond Inner Harbor, where sediment is very fine-grained.

Exposure to excessive suspended sediment concentrations could lead to physiological stresses such as clogged gills, eroded gill and epithelial tissues, impaired foraging activity and feeding success, and altered movement and migration patterns of juvenile and adult fish (Clarke and Wilber 2000; Minello *et.* al.1987; Newcombe and Jensen 1996; Newcombe and MacDonald 1991). Exposure of fish to elevated suspended sediment concentrations could result in behavioral avoidance and exclusion from otherwise suitable habitat, disrupt movement and migration patterns, reduce feeding rates and growth, result in sublethal and lethal physiological stress, habitat degradation, or delayed hatching; and, under severe circumstances, could result in mortality (Newcombe and Jensen 1996; Clarke and Wilber 2000). The response of fish to suspended sediments varies among species and life stages as a function of suspended particle size, particle shape, water velocities, suspended sediment concentrations, water temperature, depressed dissolved oxygen concentrations, contaminants, and exposure duration (O'Connor 1991; Sherk 1971; Newcombe and Jensen 1996). Short-duration exposure to elevated suspended sediment concentration associated could result in sublethal effects; however, potential exposure and dosage of suspended sediment concentrations drops exponentially from the source of the plume.

4.4.3 Exposure to Constituents of Concern and Bioaccumulation

Sediment sampling was conducted and analysed for the MOTCO Pier renovation (USACE 2014c). These analyses indicate there are unlikely to be constituents of concern in the sediments to be dredged. USACE proposes to conduct confirmatory sediment sampling and analysis during fall 2019 to the depths proposed for this project, plus the required overdepth, prior to dredging. Confirmatory testing would verify that the sediments are suitable for placement at Montezuma Wetlands, and SF- Cullinan Ranch, and DODS.

4.4.4 Noise

Underwater sound pressure waves can harass and harm fish species (Reyff 2003, Abbott and Bing-Sawyer 2002, Caltrans 2001, Langmuir and Lively 2001, Stotz and Colby 2001). As the pressure wave passes through a fish, the swim bladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the under pressure component of the wave passes through the fish. This can cause effects including: rupture of the swim bladder, rupture capillaries, internal hemorrhage, neurological stress, and auditory damage. Extreme sound waves can cause instantaneous death, latent death within minutes after exposure, or can occur several days later. Increase in sound waves can also result in reduced fitness of fish, making it susceptible to predation, disease, starvation, or ability to complete its life cycle.

The proposed action is expected to cause increased underwater sound pressures waves. The noise from a clamshell dredge is punctuated by its entry into the water, contact with bottom substrate and the closing of the jaws of the clamshell. There are also periods of quiet between the events when the clamshell enters the water. In 2001, the U.S. Army Engineer Research and Development Center prepared an analysis of increased sound pressure level (SPLs) produced by clamshell dredging in Cook Inlet, Alaska. In that analysis, the most extreme peak SPLs (dB rms) was produced by the dredge bucket striking the bottom in mixed coarse sand and/or gravel. The increase in sound measured at a 150 meter distance to the dredge plant source, produced peak SPLs (dB rms) of 124.0 dB, or 50.8 dB above peak ambient conditions. Ambient noise conditions, in the action area during the proposed work window, are comprised primarily of commercial ship traffic, wind and wave turbulence, and hydrodynamic noise associated with variable tidal flow condition. The ambient noise conditions in the action area are expected to be similar to that of Cook Inlet Alaska, ergo the peak SPLs at 150 meters are expected to be higher than ambient.

To quantify the level of sound expected to cause harassment and harm, the Fisheries Hydroacoustic Working Group has established interim criteria for evaluating underwater noise impacts from pile driving on fish. These criteria are defined in the document entitled *Agreement in Principal for Interim Criteria for Injury to Fish from Pile Driving Activities* (Fisheries Hydroacoustic Working Group 2008). This agreement identifies a peak sound pressure level (SPLs) of 206 decibels (dB) and an accumulated sound exposure level of 187 dB as thresholds for injury to fish ≥ 2 grams. For fish less than 2 grams, the accumulated sound exposure level threshold is reduced to 183 dB. Although there has been no formal agreement on a behavioral threshold, National Marine Fisheries Service (NMFS) uses 150 dB-root mean square (rms) as the threshold for adverse behavioral effects (NMFS 2009b). The proposed project is expected to produce peak SPLs of 124.0 db as determined in the Cook Inlet study, which is below all of the thresholds described above. Therefore, the noise from the proposed project is not expected to adversely affect listed species greater than 150 m from the clamshell dredge plant. Effects on fish closer than 150 m are unclear, but likely to involve behavioral avoidance of the area.

5.0 NMFS Endangered Species Act Resources

Species identified in the official list are provided in Table 4, along with a brief analysis of whether the species or critical habitat is in the action area and could be affected by the proposed action. A detailed analysis of the potential effects on the project's effects on threatened and endangered species and critical habitat that has the potential to be affected is also provide herein.

5.1 Central Valley Spring-run ESU Chinook Salmon (*Oncorhynchus tshawytscha*) (FT) (CH) (ST) *and* Sacramento River Winter-run ESU Chinook Salmon (*Oncorhynchus tshawytscha*) (FE) (CH) (SE)

5.1.1 Listing Status and Range

The Central Valley spring-run Chinook Salmon ESU was initially listed as threatened by NOAA Fisheries on September 16, 1999 (64 FR 50394) and re-listed as threatened on June 28, 2005 (70 FR 37160). The CDFW designated the Central Valley spring-run Chinook Salmon as threatened on February 5, 1999 (CDFW 2009b).

The Sacramento River winter-run Chinook Salmon was initially listed as endangered on January 4, 1994 (59 FR 440); this listing was reaffirmed on June 28, 2005 (70 FR 37160). The CDFW listed the Sacramento River winter-run Chinook Salmon as endangered on September 22, 1989 (CDFW 2009b).

Historically, Chinook Salmon ranged from Ventura River, California to Point Hope, Alaska, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia. Central Valley spring-run Chinook Salmon once were widely distributed and spawned in larger tributaries to both the Sacramento and San Joaquin rivers (Moyle 2002). Currently, only three naturally spawning populations remain and occur in Deer, Mill, and Butte creeks, which are all tributaries to the Sacramento River (NMFS 2016a). Sacramento River winter-run Chinook Salmon originally spawned in the Pit, McCloud, and upper Sacramento rivers but now consists of a single spawning population in the Sacramento River downstream of Keswick Dam (Moyle 2002). A captive broodstock conservation hatchery program was initiated in 2015 to supplement the population, and reintroduction of winter-run Chinook Salmon to newly accessible habitat in Battle Creek is planned for 2020 (NMFS 2016b).

5.1.2 Life Cycle and Habitat Use

Chinook Salmon are the largest of the Pacific salmon species. They are anadromous and migrate to natal grounds where they spawn and die. They exhibit two separate reproductive life histories, stream-type and ocean-type. Stream-type juveniles reside in freshwater for a year or more before migrating to marine environment, whereas ocean-type migrate within their first year of life (Healey 1991). Spring-run Chinook Salmon juveniles primarily are stream-type, whereas winter-run Chinook Salmon exhibit a mix of stream- and ocean-type characteristics (Moyle 2002). Both winter- and spring-run Chinook Salmon utilize high spring flows to access spawning grounds (Fisher 1994). Adult spring-run Chinook Salmon migrate upstream between March and September, whereas winter-run adults migrate to spawning grounds between December and July. Spawning occurs in late August through October for spring-run fish, and late April through early August for winter-run fish (Moyle 2002). Spawning grounds require gravel and cobble, ranging from 0.1–6 inches in diameter, generally at the head of riffles. Females dig a shallow depression in the gravel and lay their eggs for the males to fertilize.

Table 4. NMFS listed fish species that may occur in the project area.

Common Name	Scientific Name	Status	Potential to be in the Action Area	Designated Critical Habitat	Critical Habitat in the Action Area	Effects Determination	
						Species	Critical Habitat
California Central Valley Steelhead	*Oncorhynchus mykiss*	FT	Yes	Yes	Yes	Not Likely to Adversely Affect	Not Likely to Adversely Affect
Central California Coast Steelhead	*O. mykiss*	FT	Yes	Yes	Yes	Not Likely to Adversely Affect	Not Likely to Adversely Affect
Sacramento River winter-run Chinook Salmon	*O. tshawytscha*	FE	Yes	Yes	Yes	Not Likely to Adversely Affect	Not Likely to Adversely Affect
Central Valley spring-run Chinook Salmon	*O. tshawytscha*	FT	Yes	Yes	Yes	Not Likely to Adversely Affect	Not Likely to Adversely Affect
North American Green Sturgeon	*Acipenser medirostris*	FT	Yes	Yes	Yes	Not Likely to Adversely Affect	Not Likely to Adversely Affect

Eggs hatch in 3–4 months, and larvae remain in the gravel for an additional 2–3 weeks (Moyle et al. 1995). Spring-run juveniles reside in stream waters for 3–15 months; winter-run for 5-10 months (Moyle 2002). The results of the 2007 *San Francisco Bay Juvenile Outmigration Study* (conducted by the USACE, NOAA-Fisheries, University of California Davis, East Bay Municipal Utilities District, and San Francisco Bay Area Planning Coalition) indicate that juveniles generally spend approximately 3 to 15 days (LTMS 2007), up to 40 days (MacFarland et al. 2002) out-migrating through the San Francisco Bay to the ocean. Juveniles require rearing habitat that has enough space for growth, instream and overhanging cover, adequate food supply (invertebrates), suitable water quality (dissolved oxygen concentrations above 9 milligrams per liter, pH between 6.8 and 8.0, temperatures between 32 and 75 °F and relatively low turbidity), and adequate depth (Moyle et al. 1995 and SWRI 2003).

The diet of outmigrating Chinook Salmon varies geographically and seasonally and feeding appears to be opportunistic. Aquatic insect larvae and adults, such as *Daphnia,* amphipods (*Eogammarus* and *Corophium spp.*), and *Neomysis* are common Chinook food species. Other species that make up Chinook Salmon diet include anchovies and herring.

5.1.3 Threats

The biggest threat to Chinook Salmon is the existence of numerous migratory barriers, such as dams, and diversions of water from rivers and streams. Other threats include juvenile entrainment in state and federal water projects, loss of rearing habitat, exploitation, predation, invasive species, competition with hatchery-reared salmon, disease, pollution, siltation, and loss of riparian habitat that provides essential cover (Moyle 2002).

5.1.4 Status in the Action Area

Adult spring-run Chinook Salmon migrate upstream between March and September. Winter-run adults migrate upstream between December and July. Consequently, adults may be in the action area during these months. Juveniles outmigrate to the ocean during the late fall, winter, and spring, typically October through June. During their outmigration, they may be in the action area.

5.2 Central Valley Spring-run ESU Chinook Salmon and Sacramento River Winter-run ESU Chinook Salmon Critical Habitat

Critical habitat for Central Valley spring-run Chinook Salmon includes 162,560 acres of estuarine habitat, all located in the San Francisco-San Pablo-Suisun Bay estuarine complex, and 2,308 miles of riverine habitat; located in Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solano, Colusa, Yuba, Sutter, Trinity, Alameda, San Joaquin, and Contra Costa Counties (70 FR 52488). Critical habitat for Sacramento River winter-run Chinook Salmon includes the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) and all waters in the San Francisco-San Pablo-Suisun Bay estuarine complex (50 FR 33212). The action area is within critical habitat for both the spring-run DPS and winter-run ESU.

Primary constituent elements for both include:

- Freshwater spawning sites with water quality and substrate conditions that can support spawning, incubation, and larval development.

- Freshwater rearing sites with water quality and floodplain connectivity to support juvenile growth, mobility, foraging, and development.
- Aquatic habitat with natural cover, such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
- Freshwater migration corridors free of obstruction and excessive predation with water quality conditions and natural cover to support juvenile and adult mobility and survival.
- Estuarine areas free of obstruction and excessive predation.
- Water-quality conditions that support juvenile and adult physiological transitions between fresh- and saltwater, natural cover, and foraging.

5.3 Central Valley Steelhead DPS (*Oncorhynchus mykiss*) (FT) (CH) *and* Central California Coast Steelhead DPS (*Oncorhynchus mykiss*) (FT) (CH)

5.3.1 Listing Status and Range

The Central Valley Steelhead was initially listed as threatened by NOAA-Fisheries on March 19, 1998 (63 FR 13,347); this listing was reaffirmed on January 5, 2006 (71 FR 834) and revised on April 14, 2014 (79 FR 20802).

The Central California Coast Steelhead was initially listed as threatened by NOAA-Fisheries on August 18, 1997 (62 FR 43937); this listing was reaffirmed on January 5, 2006 (71 FR 834) and revised on April 14, 2014 (79 FR 20802).

O. mykiss (Rainbow Trout/Steelhead) are distributed worldwide in cold waters (Moyle 2002). In North America, *O. mykiss* historically was distributed from Alaska to Baja California. Central Valley Steelhead presently occur in the Sacramento and San Joaquin river drainages (71 FR 834). However, except for the Stanislaus River, they may no longer occur in the San Joaquin River watershed (Moyle 2002). Central California Coast Steelhead occur in coastal streams from the Russian River south to Aptos Creek, and in the San Francisco, San Pablo, and Suisun Bay drainages west of Chipps Island (71 FR 834).

5.3.2 Life Cycle and Habitat Use

Steelhead are the anadromous form of Rainbow Trout; however, because of their ecological requirements, their life history more closely resembles Pacific salmon. After spending approximately two years rearing in freshwater, Steelhead migrate to marine waters where they reside for two or three more years until sexually mature.

Biologically, Steelhead can be separated into two reproductive ecotypes, based on their state of sexual maturity at the time they enter their natal water body. These two ecotypes are referred to as stream maturing and ocean maturing. Stream maturing Steelhead enter freshwater sexually immature and require several months to become sexually mature before spawning. Ocean maturing Steelhead enter natal streams with well-developed sexual organs and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by the season of freshwater entry. Summer river maturing enters between May and October and winter ocean maturing enters between November and April. The Central Valley Steelhead is predominately ocean maturing (65 FR 36075; NOAA-Fisheries 2007c).

Once sexually mature, adult Steelhead return to their natal stream to spawn, usually at the age four or five. Generally, the Central Valley Steelhead migrate to spawning grounds between December and July, peaking in March, and spawn from early March through July, peaking in May through June (NOAA Fisheries 1996). Steelhead are iteroparous, meaning they are capable of spawning more than once before they die; however, it is highly unlikely that they spawn more than twice in a lifetime (65 FR 36074).

Depending on water temperature, Steelhead eggs may incubate in redds for 1.5 to 4 months before hatching as alevins. Following absorption of the yolk sack, fry emerge from the gravel and begin actively feeding. Juveniles migrate to marine waters as smolts to rear in estuaries (65 FR 36075).

5.3.3 Threats

The biggest threat to these species is habitat destruction. Logging, agriculture and mining activities, urbanization, stream channelization, dams, wetland loss, and water diversions also threaten Steelhead. Depletion and storage of natural flows have altered natural hydrological cycles in several California rivers and streams, altering important water quality parameters, such as temperature, dissolved oxygen and nutrient loads, resulting in injury or mortality of some individuals. Reduced flows also degrade and diminish viable fish habitat by increasing deposition of fine sediments in spawning gravels, which decreases recruitment of new spawning gravels and promotes encroachment of riparian vegetation into spawning and rearing areas (65 FR 36075).

5.3.4 Status in the Action Area

Adult Steelhead would be expected to migrate through the action area between December and March (Moyle 2002). Juveniles rear in the action area and adjacent estuary and may be present year-round.

5.4 Central Valley Steelhead DPS and Central California Coast DPS Critical Habitat

Critical habitat for Central Valley Steelhead was designated on September 2, 2005 (70 FR 52488). Critical habitat includes stream channels within the designated stream reaches and the lateral extent of the ordinary high water mark or, where not defined, by bankfull elevations in Tehama, Butte, Glenn, Shasta, Yolo, Sacramento, Solano, Yuba, Sutter, Placer, Calaveras, San Joaquin, Stanislaus, Tuolumne, Merced, Alameda, and Contra Costa Counties, California. The action area is located within the Marin Coastal Hydrologic Unit, Bay Bridges Hydrologic Unit, and San Pablo Hydrologic Unit. Approximately 247,040 acres of critical habitat exist in San Francisco and San Pablo Bays (NOAA Fisheries 2007c). Critical habitat for Central California Coast Steelhead includes several coastal watersheds and approximately 282,880 acres in San Francisco and San Pablo bays; the waters of the Carquinez Strait and Suisun Bay are not designated critical habitat.

Primary constituent elements for these both include:

- Freshwater spawning sites with water quality and substrate conditions that can support spawning, incubation, and larval development.
- Freshwater rearing sites with water quality and floodplain connectivity to support juvenile growth, mobility, foraging, and development.

- Aquatic habitat with natural cover, such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
- Freshwater migration corridors free of obstruction and excessive predation with water quality conditions and natural cover to support juvenile and adult mobility and survival.
- Estuarine areas free of obstruction and excessive predation.
- Water-quality conditions that support juvenile and adult physiological transitions between fresh- and saltwater, natural cover, and foraging.

The action area is partially within Central Valley Steelhead and Central California Coast Steelhead critical habitat.

5.5 Southern DPS Green Sturgeon (*Acipenser medirotris*) (FT) (CH)

5.5.1 Listing Status and Range

April 7, 2006, the Southern DPS of the North American Green Sturgeon (*Acipenser medirostris*) was listed as threatened by NOAA-Fisheries (71 FR 17757). The listing was updated on April 14, 2014 (79 FR 20802). Green Sturgeon is also considered a species of special concern by the CDFW (CDFW 2009b).

Green Sturgeon are found in nearshore marine waters ranging from Mexico to the Bering Sea and are common in bays and estuaries along the west coast of the Americas. The North American Green Sturgeon are composed of two genetically distinct population structures (DPS), the Northern DPS (Klamath and Rogue River spawning populations) and Southern DPS (Sacramento River spawning populations) (68 FR 4433; NOAA Fisheries 2005). The range of Southern DPS Green Sturgeon was thought to be within the coastal waters south of the Eel River through Mexico; however, adults travel as far north as Canada (NOAA Fisheries 2008). San Francisco Bay and its tributaries are thought to contain a majority of the Southern DPS Green Sturgeon population.

5.5.2 Life Cycle and Habitat Use

Green Sturgeon are long-lived, slow growing and iteroparous. They spawn every 3 to 5 years. Adults typically migrate to freshwater in the upper Sacramento River, beginning in late February, and spawning occurs from March through July, with peak spawning occurring from mid-April through mid-June in freshwater. Green Sturgeon generally spawn in their natal stream and appear to have high homing capabilities for spawning grounds. Historically, spawning occurred in areas above Shasta Dam and in the Feather River; however, following the construction of Shasta and Oroville Dams, Green Sturgeon were not able to migrate farther upstream (NOAA Fisheries 2005a). Spawning occurs in deep pools with large cobble substrate; however, spawning also occurs on clean sand and bedrock substrate.

Mature males range from 139 to 199 centimeters fork length at 15 to 30 years of age; mature females, on the other hand, range from 157 to 233 centimeters fork length at 17 to 40 years of age. Generally, spawning occurs at 160 to 170 centimeters fork length for males (17 to 18 years old) and 182 to 192 centimeters fork length for females (27 to 28 years old) (68 FR 4433). Females produce approximately 60,000 to 140,000 eggs that are spawned over cobble substrate where they settle in the spaces between cobbles. Water temperatures must be less than 60 °F (20° C) for the eggs to be viable.

After spawning, adults may hold between June and November in deep pools near spawning grounds and outmigrate in the late fall to early winter, or they may directly outmigrate in the late spring to early summer after spawning. In the Sacramento River, adult Green Sturgeon may be present through November and December before moving downstream with increased flows (68 FR 4433).

Green Sturgeon larvae begin feeding approximately 10 to 15 days after hatching, and approximately 35 days later metamorphose into juveniles.

Juveniles spend approximately one to 3 years in freshwater before moving to the ocean. Following outmigration from freshwater, Green Sturgeon disperse widely in ocean waters and coastal estuaries. Tagging studies indicate that the Southern DPS Green Sturgeon migrate extensively in ocean waters and are located in waters off the Oregon and Washington coasts.

Juveniles in the San Francisco-San Joaquin Delta feed on opossum shrimp and amphipods (68 FR 4433). Adult Green Sturgeon feed on benthic invertebrates including shrimp, mollusks, amphipods, and small fish (68 FR 4433).

5.5.3 Threats

The biggest threat to Green Sturgeon is loss of spawning habitat in the upper Sacramento River. Insufficient freshwater flows in spawning areas, contaminants, bycatch in fisheries, poaching, entrainment in water projects, exotic species, impassable barriers at other locations, and elevated water temperatures may also pose a threat to Green Sturgeon.

5.5.4 Status in the Action Area

The action area is within Green Sturgeon critical habitat. Green Sturgeon juveniles (age 1-3 years) outmigrate to the ocean to continue rearing and growing, and may return after spending up to 13 years in the ocean (Moyle 2002). They may be expected to occur in the action area during the summer and fall.

5.6 Southern DPS of North American Green Sturgeon Critical Habitat

Critical habitat for Green Sturgeon was designated on October 9, 2009 (74 FR 52300). Critical habitat includes freshwater riverine systems, including the stream channels and the lateral extent defined by the ordinary high-water line (33 C.F.R § 329.11) or bankfull elevation, where the ordinary high water mark is not defined and all United States coastal marine waters out to the 60 fathom depth boundary line (relative to MLLW), from Monterey Bay, California north and east, including the Straits of Juan de Fuca, Washington. Riverine stream systems include the Sacramento River, from the Sacramento I-Street Bridge upstream to Keswick Dam, including waters encompassed by the Yolo Bypass and Sutter Bypass areas, and the lower American River from the confluence with the mainstem Sacramento River upstream to Fish Barrier Dam on the Feather River; and portions of the Lower Yuba River and Lower Feather River; the Sacramento–San Joaquin Delta waterways up to the elevation of mean higher high water, San Francisco Bay, San Pablo Bay, Suisun Bay, and Humboldt Bay, California; Coos Bay, Winchester Bay, Yaquina Bay, Nehalem Bay, and the Lower Columbia River Estuary, Oregon; and Willapa Bay and Grays Harbor, Washington.

Green Sturgeon PCEs includes various components of freshwater, estuarine, and nearshore marine habitats. Components include food resources, substrate for spawning, water flow, water

and sediment quality, water depth, and migratory corridor. Green Sturgeon PCEs are described below.

Freshwater Systems: The lower Sacramento River, from I Street Bridge to the downstream side of the Red Bluff Diversion Dam gates, is considered a PCE because this area supports egg incubation, larval and juvenile rearing, feeding and migration, and adult and subadult holding and migration. This PCE does not occur in the action area.

Estuarine Habitats: Estuarine habitat provides food resources, migratory corridors, juvenile rearing, and adult and subadult holding habitat for Green Sturgeon. Of the various habitat types that comprise Green Sturgeon PCE, estuarine habitat is the only habitat type that occurs within the action area and could be affected by the proposed action. Components of the PCE include:

- Food resources. Green Sturgeon require abundant prey items within estuarine habitats and benthic substrate for juvenile, adult, and subadult life stages. Adult and subadults prey on ghost shrimp, amphipods, clams, juvenile Dungeness crab, anchovies, sand lances, ling cod, and other unidentified fish. Juveniles feed on shrimp, amphipods, isopods, clams, annelid worms, and unidentified crabs and fishes.
- Water flow. Sufficient water flow into the San Francisco Bay and Delta is required to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds.
- Water quality. Water quality includes temperature, salinity, oxygen content, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages. Adults and subadults occur across the entire temperature (11.9–21.9 °C) and salinity range (8.8–32.1 parts per thousand) and a wide range of dissolved oxygen (6.54–8.89 milligrams per liter).
- Migratory corridor. The migratory corridor should allow for safe and timely passage of sturgeon within estuarine habitats and between estuarine and riverine or marine habitats. Adults enter the Estuary in late February and quickly migrate to spawning grounds. After spawning, they either reside over the summer in deep holding pools deeper than 5 meters (16.4 feet), or they migrate downstream. Tagged Green Sturgeon were present in holding pools in the Sacramento River through November and December before migrating downstream They appear to migrate in shallow waters, swimming near the surface, but foraging on the bottom.
- Depth. Green Sturgeon require a diversity of depths for shelter, foraging, and migrating. Juveniles are present year round in the Bay and Delta in shallow depths ranging from one to 3 meters (3.3–9.8 feet). Tagged adults and subadults appear to stay in shallow depths less than 10 meters (32.8 feet).
- Sediment quality. Sediment quality is necessary for normal behavior, growth, and viability of all life stages.

Nearshore Coastal Marine Areas: Green Sturgeon require nearshore coastal marine areas with adequate migratory corridors, water quality, and food resources.

5.7 Potential Effects of the Proposed Action on ESA-Protected Resources

See section 5, Environmental Baseline and General Effects of the Proposed Action. The potential impacts to listed salmonids and Green Sturgeon from the proposed project include: impacts from dredging including potential entrainment and temporary degradation of water quality; physical disturbance of habitat, and noise or disturbance of fish and habitat. However, the action area is used primarily as a migration corridor by the listed Chinook Salmon, Steelhead, and Green Sturgeon as described above. Adult salmonids migrate from the Pacific Ocean through the San Francisco Bay estuary as they seek the upstream spawning grounds of their natal streams. Considering all of the different species, most migration through San Francisco Bay occurs in the late fall, winter, and spring (McEwan and Jackson 1996). Juvenile (smolt) salmonids migrate from their natal streams through San Francisco Bay estuary to the ocean. Emigration timing is highly variable among Sacramento River winter-run Chinook, CV spring-run Chinook, CCC Steelhead and CCV Steelhead smolts, but peak migrations downstream typically occur through the action area during the late winter and spring months. To assess juvenile salmonid outmigration behavior and timing, a series of studies were performed from 2006 through 2010 with Central Valley late fall-run Chinook Salmon and CCV Steelhead smolts. Smolt-sized juveniles originating from Coleman National Fish Hatchery were tagged with acoustic transmitters and released in the Sacramento River to monitor their downstream movement to ocean-entry at the Golden Gate. Results showed that smolts generally transited the Bay rapidly in 2 to 4 days, yet also made repeated upstream movements, coinciding with incoming tidal flows (Hearn et al. 2013). Most Chinook and Steelhead smolts were detected by acoustic receivers located over deep, channelized portions of the Bay (Hearn et al. 2013). Smolts detected at nearshore, shallow sites such as marinas, or up tributaries generally returned to the main channel to finish their migration (Hearn et al. 2013).

During the course of their downstream migration, juvenile listed salmon and Steelhead may utilize the estuary for seasonal rearing, but available information suggests that fish are actively migrating and currently they do not reside in the San Francisco Bay estuary (Hearn et al. 2010). MacFarlane and Norton (2002) found that fall-run Chinook experienced little growth, depleted condition, and no accumulation of lipid energy reserves during the relatively limited time the fish spent transiting the 40-mile length of the estuary. Sandstrom et al. (2013) found that CCC Steelhead smolts emigrated more rapidly through the Bay than the Napa River and the ocean. In contrast to demersal fish that are associated with the bottom, salmonids are pelagic fish and, as such, primarily occupy the water column and near surface when over deeper waters (Mari-Gold Environmental and Novo Aquatic Sciences 2009). Within the action area, listed salmon and Steelhead are thought to typically display a preferential use of the middle and upper water column. Studies by Kjelson et al. (1982) in the Sacramento-San Joaquin Delta concluded juvenile Chinook Salmon appear to prefer shallow water habitats near the shore and the upper portion of the water column (less than 10 feet deep).

Green Sturgeon may be more likely than juvenile salmonids to use the action area for foraging and rearing habitat. However, because of the work windows of the proposed project (i.e., August 1 through November 30); the use of a clamshell dredge; the small impact area compared with the overall size of Suisun Bay; the large size and strong swimming ability of adult salmonids and Green Sturgeon; and the brief length of time that juvenile salmonids are expected to spend in the project area and their preferential use of the middle and upper water column, the potential effects of the proposed project on listed salmonids and Green Sturgeon are expected to be small. The

consequent exposure to increased sediment or toxic elements, potential entrainment, or disturbance should be minor. When exposure does occur, both juvenile and adult salmonids and Green Sturgeon are relatively strong swimmers that should be able to avoid the local area around the dredge plant and proceed into more suitable habitat or simply continue their migration.

The proposed project would cause some loss of LSZ and shallow water habitat due to physical loss to the steepened side slopes of the project, and an anticipated 0.11 km upstream shift in X2 in critically dry years. However, adult salmonids and Green Sturgeon do not rely on shallow water or low salinity habitat. Although shallow floodplain rearing habitat is critical for juvenile salmonids especially in rivers, the action area is used by juveniles primarily as a migratory corridor, and their time there is expect to be brief. Still, the expected creation or restoration of 9.8 acres of tidal wetland habitat due to the beneficial reuse of dredged sediment may benefit juvenile salmonids

5.8 Cumulative Effects

Cumulative effects include the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to section 7 of the Act. Adverse effects to delta smelt may result from point and non-point source chemical contaminant discharges within the action area. These contaminants include, but are not limited to ammonia and free ammonium ion, numerous pesticides and herbicides from agricultural activities, and oil and gasoline product discharges into Delta waterways from shipping and boating activities and from urban activities and runoff. Implicated as potential stressors of smelt, these contaminants may adversely affect fish reproductive success and survival rates.

Potential to dredge the MOTCO project area concurrent with the Suisun Bay Channel dredging would result in a blended dredge material for disposal. In 2014, physical analyses on sediment samples from the three Suisun Bay Channel and New York Slough composite areas confirmed that the anticipated dredge materials are predominantly sand (86 percent) with very low amounts of total organic carbon (TOC) ranging from 0.21 to 0.52 percent (USFWS 2017).

Other future, non-federal actions within the action area that are likely to occur and may adversely affect delta smelt include: the dumping of domestic and industrial garbage that decreases water quality; oil and gas development and production that may affect aquatic habitat and may introduce pollutants into the water; agricultural activities, including burning or removal of vegetation on levees that reduce riparian and wetland habitats that contribute to the quality of habitat used by Delta Smelt; and livestock grazing activities that may degrade or reduce riparian and wetland habitats that contribute to the quantity and quality of habitat used by Delta Smelt.

5.8.1 Long-Term Management Strategy for Dredged Material

Maintenance dredging that removes an annual average of 6M cy of sediment from shipping channels regularly occurs in San Francisco, San Pablo, and Suisun bays under the auspices of the LTMS (USACE et al. 1998). Methods may include hopper, clamshell-bucket, and cutterhead-pipeline dredging. Disposal sites include in-bay at federal standard placement sites, offshore at SF-DODS, or at beneficial reuse locations typically for wetland restoration. The LTMS includes

several avoidance and minimization measures to protect ESA-listed species, such as work windows.

This BA incorporates by reference information on the Long-Term Mangement Strategy (LTMS) contained in the following documents:

- *Programmatic Essential Fish Habitat (EFH) Assessment for the Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region* (USACE and USEPA, 2009). Pursuant to Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (16 U.S.C. § 1855[b]), USACE and USEPA submitted a Programmatic EFH Assessment to NMFS for the San Francisco Bay Region LTMS. This document provides an assessment of the potential effects to EFH from the ongoing dredging and dredged material placement activities of all Federal and non-Federal maintenance dredging projects in the San Francisco Bay Region.
- *Agreement on Programmatic EFH Conservation Measures for Maintenance Dredging Conducted Under the LTMS Program* (USACE and USEPA, 2011). This document identified a comprehensive suite of EFH conservation measures developed in coordination with NMFS and completed the Programmatic EFH consultation covering all maintenance dredging projects under the LTMS Program.
- *LTMS National Marine Fisheries Service Biological Opinion* (NMFS, 2015b). This document transmits the NMFS Biological Opinion (BO) for the LTMS Program and its effects on Federally-listed species under NMFS' jurisdiction at the time the consultation was completed. The BO outlines implementing procedures and minimization measures.
- *The 2015 Maintenance Dredging of the Federal Navigation Channels in the San Francisco Bay Final EA-Finding of No Significant Impact (FONSI) and Environmental Impact Report (EIR)* prepared jointly by USACE and the Regional Water Quality Control Board (RWQCB) (referred to as 2015 Federal Navigation Channels EA/EIR) (USACE 2015). This document analyzed the environmental impacts associated with Programmatic maintenance dredging of Federal navigation projects in San Francisco Bay-Delta.

5.9 Conclusion and Determination of Effects

As discussed above, the effects of the proposed action on Central Valley spring-run Chinook Salmon, Sacramento River winter-run Chinook Salmon, Central Valley Steelhead, Central California Coast Steelhead, and the Southern DPS of North American Green Sturgeon would be greatly reduced due to the use of best management practices and the behavior and swimming ability of the fish. The use of work windows and clamshell dredging especially would greatly reduce the exposure of these species to all potential adverse effects associated with dredging activities.

The creation or restoration of 9.8 acres of tidal wetland habitat due to the beneficial reuse of dredged sediment may benefit juvenile salmonids. Based on the analysis provided, the project may affect, but is not likely to adversely affect of the listed species described above, and may affect, but is not likely to adversely modify critical habitat.

6.0 Essential Fish Habitat Assessment

The Magnuson-Stevens Act protects the essential fish habitat of species managed under federal Fishery Management Plans (FMPs). EFH is defined as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity…" (16 U.S.C. 1802(10)).

In addition to preparing FMPs, the Magnuson-Stevens Act requires NOAA Fisheries to designate a Habitat Area of Particular Concern (HAPC) for each species. HAPCs are "subsets of EFH, which are rare, particularly susceptible to human-induced degradation, ecologically important, or are located in an environmentally stressed area" (NMFS 2010). HAPCs do not qualify for additional protection beyond that provided for EFH in general; however, project impacts on HAPCs would be carefully considered during the consultation process. The proposed project occurs within areas identified as EFH for fish species managed as part of three FMPs.

Table 5 Essential Fish Habitat (EFH) and Habitat Area of Particular Concern (HAPC) that occur in the project area.

Fishery Management Plan that describes EFH in the Project Area	**Habitat in the Action Area**	**Does the Action Have an Adverse Effect on EFH?**
Pacific Groundfish	Yes	Yes
Pacific Salmon	Yes	Yes
Coastal Pelagic	Yes	Yes
Habitat Area of Particular Concern (HAPC)	**HAPC in the Action Area**	**Does the Action Have an Adverse Effect on HAPC?**
San Francisco Bay estuarine	Yes	Yes
Seagrass	Yes	Yes
Submerged Aquatic Vegetation	Yes	Yes

6.1 Potential Effects of the Proposed Action on Essential Fish Habitat

The HAPCs described in the 2010 NMFS-Corps programmatic EFH consultation for the LTMS (NMFS 2010) as potentially affected by LTMS activities include San Francisco Bay estuarine and seagrass habitats (see Section 4.1). The proposed project falls within the LTMS area, and includes all of these HAPCs within the proposed project footprint. In accordance with the habitat categorizations provided by NMFS (2010), the proposed project dredging activities would disturb a total of 38 acres of soft bottom habitat (Table 1) which may be considered either sand or fine-grained habitat. Adverse effects to EFH will occur through increased turbidity in the water column (Section 4.4.2), suspension of sediment-associated contaminants (Section 4.4.3), disturbance of benthic habitat (Section 4.3) including the associated biological community and SAV (Section 4.1.2). EFH will also be temporarily impacted by elevated underwater sound levels during dredging. MOTCO shall conduct pre-dredge and post-dredge surveys of aquatic vegetation adjacent to the dredging area to assess potential impacts. MOTCO will coordinate with NMFS on appropriate measures to mitigate adverse impacts.

Dredged sediment is to be placed at beneficial reuse wetland restoration sites, so no additional area of adverse impacts is anticipated from in-bay disposal. No wetland or seagrass habitat would be affected at the placement site. Sandy benthic habitat, which is expected to comprise

most of the dredge area of MOTCO, is considered to have reduced value as foraging habitat for fish due to reduced productivity and invertebrate species diversity, although it can be used for reproduction and rearing (NMFS 2010).

Dredged sediment from the proposed project would be used for beneficial reuse, specifically wetland creation. Once completed, Montezuma Wetlands is expected to restore 1,820 acres of tidal, seasonal, and managed wetlands (Collins and Grosso 2006). Approximately 17.5 million cubic yards of dredged material are needed to raise site elevations. As of August 2017, approximately 4 million cy of dredged material had been placed at Montezuma Wetlands, contributing to the restoration of over 350 acres of wetlands (California State Water Board 2019). Cullinan Ranch is expected to accept 2.8 million cy to restore 290 acres of the 1,575-acre site to elevations suitable for marsh plain establishment. Additionally, the Cullinan Ranch project would provide food and nutrients for aquatic species in the adjacent Napa River Estuary and San Pablo Bay (USFWS 2010).

Based on the above information for Montezuma Wetlands and Cullinan Ranch, 9000 to 11,429 cy of dredged sediment is required to create 1 acre of wetland habitat at these locations. Using an intermediate value of 10,000 cy per acre of habitat, the approximately 98,500 cy of dredged sediment resulting from the proposed project is expected to create 9.8 acres of wetland habitat due to its beneficial reuse. This habitat would be accessible to species managed under FMPs.

In addition to disturbance of habitat through dredging and creation of habitat through beneficial reuse, the proposed action has the potential to cause a subset of the adverse impacts on EFH described by NMFS (2010) for the LTMS program. These include:

- Removal of food organisms through entrainment or burial
- Increased suspended sediment and release of contaminants
- Noise

As stated above, the proposed action would remove approximately 98,500 cy of sediment covering 38 acres from the project area. Consequently, benthic organisms which could serve as food especially for species managed under the Pacific Groundfish FMP would be removed from the channel during dredging and likely buried in the wetlands of Montezuma Wetlands and Cullinan Ranch where they would die. Benthic recolonization rates are expected to be months or years (see NMFS 2010 for a review).

Sediment proposed for dredging at MOTCO is anticipated to classify as clay, silt, and sand. The alternating layers of silty clay, clayey silt, sandy silt, silty sand, sand, and inter-bedded clay and sand are discontinuous and of varying thickness. Shells, wood debris (e.g., branches, twigs, and rootlets), and organic soils grading to peat also are expected to be encountered. Sediment sampled for the MOTCO Piers 2, 3 and 4 renovations was <80% sand when analyzed. Overall, the area of benthic habitat affected by the proposed project would be very small compared to the total size of Suisun Bay which has a surface areas of approximately 40,000 acres.

The adverse effects of suspended sediment, potential release of toxins, and noise are discussed extensively in section 5.3. Effects specifically on listed Pacific salmon are discussed in section 7.2.

Background turbidity in the estuary is naturally high, with total suspended solids (TSS) levels varying from 10 mg/L to more than 100 mg/L (Robinson and Greenfield 2011). However, turbidity plumes generated by dredging activities typically have an increased suspended

sediment concentration. Monitoring of turbidity plumes during clamshell dredging indicates that exceedances of the water quality turbidity standards occur periodically, especially in locations where sediment is very fine-grained. These effects would be temporary, and exposed fish would be expected to avoid the area if necessary. More sessile organisms such as benthic invertebrates would be unable to flee; food intake by filter feeders could be reduced if increased sediment is taken in instead.

Sediment would be sampled from the MOTCO Pier Access area and undergo physical, chemical, and bioaccumulation analyses, as well as studies to determine if the sediment is suitable for wetland creation (see section 5.3.4). Sediment would be sampled to a depth of 35 feet MLLW, plus 2 feet of overdepth, for a total sampled depth of 37 feet MLLW at Piers 2-4, and and 20 feet (MLLW) plus 2 feet of overdepth, for a total sampled depth of at the Barge Pier. Previous analyses indicate there are unlikely to be constituents of concern in the sediments to be dredged. Use of MOTCO sediments for wetland creation would produce wetlands comparable to existing wetlands in the Bay area.

The proposed project is expected to produce peak SPLs of 124.0 Db measured 150 m distant from the clamshell dredge plant, which is below the sound thresholds described by Fisheries Hydroacoustic Working Group (2008) and NMFS (2009b). Therefore, the noise from the proposed project is not expected to adversely affect listed species greater than 150 m from dredge plant. Effects on fish closer than 150 m are unclear, but likely would involve behavioral avoidance of the area.

6.2 Conclusions and Determination of Effects

The proposed action may adversely affect EFH for Pacific Groundfish, Pacific Salmon, and Coastal Pelagic species. The proposed action also may adversely affect the San Francisco Bay estuarine, seagrass, and Submerged Aquatic Vegetation HAPCs. The greatest effect would occur to physical habitat, due to the removal of sediment with a clamshell dredge. Although essentially all of the effects of the proposed project may be considered temporary, the recolonization of disturbed areas by benthic invertebrates is thought to require several months at a minimum, and may take years. Other effects such as the creation of noise or turbidity plumes would cease immediately or within minutes or hours of when active dredging stops, and may be avoided or minimized by fish (including prey fishes) exhibiting avoidance behavior.

The disturbance of soft-bottom habitat and removal sediment containing benthic invertebrates may be partially offset through the beneficial reuse of the dredged sediment, which is expected to be used to create 9.8 acres of wetland habitat.

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