FINAL INTEGRATED GENERAL REEVALUATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT

SAN FRANCISCO BAY TO STOCKTON, CALIFORNIA NAVIGATION STUDY

APPENDIX G: Environmental

JANUARY 2020

Appendix G – Attachment 1
404(b)(1) Evaluation

SECTION 404(b)(1) EVALUATION

I. Project Description

a. Location. The San Francisco Bay to Stockton project area is located in the San Francisco Bay Delta. The navigation channel includes the Pinole Shoal Channel, Bulls Head Reach, and the surrounding waters of Central Bay, San Pablo Bay, Carquinez Strait, and Suisan Bay.

b. General Description. The U.S. Army Corps of Engineers (Corps) is proposing to deepen the current Federal navigation channel. The proposed plan includes the following: deepening the existing maintained channel depth of -35 feet MLLW to -38 feet MLLW, along with creating a sediment trap at Bulls Head Reach, which would be maintained at -42 feet MLLW. The dredged material would be placed on one or two beneficial reuse sites; Montezuma Wetlands and Cullinan Ranch.

A small rock outcrop is present immediately north of the downstream portion of the Suisun Bay Channel. The top of the outcrop is currently at a depth of 39.7 feet MLLW. While coordinating with the San Francisco Bay Bar Pilots for this project, the Bar Pilots expressed safety concerns as the outcrop poses a threat to safe navigation. Even though this rock formation is not in the federal channel, it is located in the shipping lane and will need to be addressed as part of this project to provide safe navigation. The rock formation will be lowered so that there is a minimum of 3-ft of additional clearance below the 2-ft of overdepth tolerance. As part of the project, the outcrop would be lowered by approximately 3.3 feet, to a depth of 43 feet MLLW.

The resuse sites are currently permitted, therefore, this 404(b)(1) Evaluation does not include the disposal sites.

c. Authority and Purpose. See **Chapter 1** of the integrated draft GRR/EIS.

d. General Description of Dredged Material

(1) General Characteristics of Material: Please see **Section 2.2** of the integrated GRR/EIS and Appendix E – Geotechnical Analysis for additional detail on the sediment characteristics. Generally, the following material is expected within the project limits: Sand with infiltrated silt and/or clay in the West Richmond Channel, sand with varying amounts of silt and clay in Pinole Shoal, and a range of fine sands to sand or silt and clay with sand in the Bulls Head Reach. The rock outcrop would be expected to dissipate onto the bottom of the channel area.

(2) Quantity of Material: The total dredging volume of material would be approximately 1,443,900 cubic yards in the Pinole Shoal Channel, and approximately 159,300 cubic yards in the Suisan Bay Channel. Please see **Chapter 4 in the Civil Design Appendix** of the integrated GRR/EIS for additional detail.

(3) Source of Material: Dredged material would come from the Federal navigation channel shown in the reference map in the **Executive Summary** of the integrated GRR/EIS.

e. Description of the Proposed Discharge Site(s)

(1) Location. It is anticipated that all of the material to be excavated from the channel would be placed in a currently permitted beneficial reuse site, either Cullinan Ranch or Montezuma Wetlands. Please see **Section 2.4.5 Dredged Material Placement** in the integrated GRR/EIS.

(2) Size. The excavated material would be placed in the currently permitted beneficial reuse site. The Cullinan Ranch Wetland Restoration Site accepts over 2.8 million cubic yards of dredged material, with potential for 9 million cubic yards. Montezuma Wetland Restoration Site is approximately 2,400 acres and is able to accept the volume of deepening material that will be disposed.

(3) Type of Site. Beneficial reuse site.

(4) Type(s) of Habitat. See **Section 2.4.5** for a description of the Beneficial Use Sites.

(5) Timing and Duration of Discharge. The exact timing of dredging operations is not known, although dredging activities are expected to occur within the approved work windows for critically endangered species throughout the Bay.

f. Description of Disposal Method. The dredged material would be placed on scows using a clamshell dredge. Scows will be towed to the beneficial use site and offloaded as a slurry and pumped to the placement location.

II. Factual Determinations

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope: Deepening would occur between the existing channel toes, widening the channel is not part of the project. However, the channel side slopes require a 3-foot horizontal to 1-foot vertical (3:1) side slope to ensure slope stability. Therefore, dredging would occur on the side slopes of the channel to ensure the side slopes maintain stability following construction. (**Appendix A – Engineering and Appendix B – Water Resources**).

(2) Sediment Type. The material to be dredged is composed most of a sandy, silty/clay.

(3) Dredged Material Movement: N/A. The dredged material will be placed on beneficial reuse sites.

(4) Physical Effects on Benthos: Dredging would displace benthos within the channel, however, recolonization would be expected upon construction completion. This site is currently dredged for maintenance at -35 feet MLLW once a year (-36 feet including overdraft). Some benthic organisms that are not mobile may be covered by the placement at the beneficial reuse sites. Recolonization soon after project completion is expected to replace those organisms that do not survive project construction. It is anticipated that no long-term adverse impacts would occur.

(5) Other Effects: N/A

(6) Actions Taken to Minimize Impacts: All dredging will occur within the approved environmental work windows, as described in the main report. The dredged material for the deepening project would be placed upon existing beneficial reuse sites to offset environmental impacts.

b. Water Circulation. Fluctuation and Salinity Determinations
The increase in depth will result in an increase in cubic yards of maintenance dredging. The dredged material from maintenance dredging will continue to be placed within the In-Bay disposal sites, SF-10 and SF-16. This is discussed further within the draft GRR/EIS and the Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay Fiscal Years 2015 – 2024 Long Term Maintenance Strategy Environmental Assessment (April 2016).

(1) Water column: During dredging operations, turbidity would increase temporarily in the water column adjacent to the project. The increased turbidity would be short-term; therefore no long-term or significant impacts are expected to occur to salinity, water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients or eutrophication.

(2) Current Patterns and Circulation: The net movement of water in the project footprint is from east to west. All of the streams and rivers begin on the east face of the Sierra Nevadas and flow west to the Sacramento River Basin and the San Joaquin River Basin. The Sacramneto River flows north to south and the San Joaquin flows from east to the west. The flow in Suisun Bay Channel and Pinole Shoal Channel is east to west. The project would have no significant effect on existing current patterns, current flow, velocity, stratification, or the hydrologic regime in the area.

(3) Normal Water Level Fluctuations: Mean tidal range near the midway point of the project area is 4.4 feet (https://tidesandcurrents.noaa.gov/stationhome.html?id=9415143). Typical spring tide ranges are 5-8 feet in San Francisco Bay, and the range in the project area is expected to be at the upper end of these values (AECOM 2016).

(4) Salinity Gradients: Salinity in the project area is highly variable and largely dependent on tides and freshwater outflow. Data collected near Bulls Head Reach available from the California Data Exchange Center indicates that salinity in that location can vary from less than 1 (i.e., fresh water) to 27 practical salinity units (PSU). However, data collected near the most seaward portion of Pinole Shoal ranges from approximately 17 PSU to the salinity of oceanic water (Hutton et al. 2016).

Modeling indicates that the low salinity zone (LSZ) will shift approximately 0.3 km east on average after project implementation. Impacts to X2 directly affect fish and wildlife through changes to the spatial distribution of salinity in the delta, and therefore, available LSZ habitat. This project is expected to have minimal impacts to fish and wildlife due to the shift in LSZ and X2 (see Biological Assessment for predicted effects to delta smelt). Impacts also may have minor effects on water supply reliability during periods of the year when the position of X2 is managed by regulating (i.e., increasing)

Delta outflow to push the X2 farther west. These impacts were evaluated against effects criteria and determined to be insignificant.

(5) Actions That Will Be Taken to Minimize Impacts: BMPs and other benthic protection measures have been coordinated with the resource agencies to minimize impacts.

c. Suspended Particulate/Turbidity Determinations

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site: There may be a temporary increase in turbidity levels in the project area. Turbidity would be short-term and localized and no significant adverse impacts are expected. State water quality standards for turbidity outside an allowable mixing zone would not be exceeded.

(2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column: The sea floor, at this location, is characterized by a sandy substrate. There would be little, if any, adverse effects to chemical and physical properties of the water as a result of dredging.

(a) Light Penetration: Some decrease in light penetration may occur in the immediate vicinity of the dredged area. This effect would be temporary, limited to the immediate area of construction, and would have no adverse impact on the environment.

(b) Dissolved Oxygen: Dissolved oxygen levels would result in short term increases by this project due to the high energy wave environment and associated adequate reaeriation rates.

(b) Toxic Metals and Organics: No toxic metals or organics are expected to be released by the project.

(d) Pathogens: No pathogens are expected to be released by the project.

(e) Aesthetics: The aesthetic quality of the water in the immediate area of the project would be reduced during construction due to increased turbidity. This would be a short-term and localized condition. Material placed in the beneficial resuse area would likely provide improved wetland aesthetics.

(f) Others as Appropriate: None.

(3) Effects on Biota

(a) Primary Production, Photosynthesis: Primary productivity in the benthic area would be disturbed temporarily during dredging, but should quickly return to ambient conditions.

(b) Suspension/Filter Feeders: An increase in turbidity could adversely impact burrowing invertebrate filter feeders within and adjacent to the immediate construction area. It is not expected that a short-term, temporary increase in turbidity would have any long-term negative impact on these highly fecund organisms.

(c) Sight Feeders: No significant impacts on these organisms are expected as the majority of sight feeders are highly motile and can move outside the project area.

(4) Actions taken to Minimize Impacts: BMPs and other benthic protection measures would be coordinated with the resource agencies to minimize impacts.

d. Contaminant Determinations: The Pinole Shoal and Suisan Bay Channels sediment has been tested as it is currently dredged for maintenance once a year. Samples in the project foot print collected in 1997 at depths below -35 ft show that the material is likely suitable for upland cover or deep ocean disposal. Additional sampling and testing will occur during the Preconstruction, Engineering, and Design (PED) phase of this project to confirm.

e. Aquatic Ecosystem and Organism Determinations: The material that would be placed in the beneficial reuse site would help to increase the wetland quality in the area. Additional testing of the sediment during the PED phase will confirm quality of the sediment for beneficial reuse.

(1) Effects on Plankton: No adverse impacts on autotrophic or heterotrophic organisms are anticipated.

(2) Effects on Benthos: The dredging would disturb benthic organisms during the construction. Recolonization is expected to occur within a year after construction activities cease. No adverse long-term impacts to non-motile or motile benthic invertebrates are anticipated.

(3) Effects on Nekton: No adverse impacts to nektonic species are anticipated.

(4) Effects on Aquatic Food Web: No adverse long-term impact to any trophic group in the food web is anticipated.

(5) Effects on Special Aquatic Sites: There are no hardground or coral reef communities located in the immediate area that would be impacted by disposal activities. **Chapter 4** of the integrated GRR/EIS offers a more detailed discussion on impacts.

(6) Threatened and Endangered Species: Appropriate measures to avoid, minimize, and mitigate for impacts to listed species are being fully coordinated with NMFS and USFWS. Beneficial reuse of the dredge material will minimize effects to delta smelt by contributing to the Cullinan Ranch and Montezuma Wetaland sites to improve habitat for delta smelt.

(7) Other Wildlife: No adverse impacts to small foraging mammals, reptiles, or wading birds, or wildlife in general are expected. Beneficial reuse of the dredge material is expected to improve the habitat for several species.

(8) Actions to Minimize Impacts: Minimization efforts by the Corps include working within the listed species construction windows, using a clamshell dredge, and beneficially reusing the disposal material. Other BMPs along with terms and conditions associated with ESA Biological Opinions would be followed.

f. Proposed Disposal Site Determinations

(1) Mixing Zone Determination: No adverse impacts related to depth, current velocity, direction and variability, degree of turbulence, stratification, or ambient concentrations of constituents are expected from implementation of the project.

(2) Determination of Compliance with Applicable Water Quality Standards: All applicable water quality standards would be met upon placing the material at the beneficial reuse sites.

(3) Potential Effects on Human Use Characteristic

(a) Municipal and Private Water Supply: The project will result in minor and insignificant changes to salinity at the nearest Delta water utility intake pump stations as detailed in Section 4.6 of Chapter 4 of the EIS/EIR.

(b) Recreational and Commercial Fisheries: Fishing in the immediate construction area would be prohibited during construction. Otherwise, recreational and commercial fisheries would not be impacted by the implementation of the project.

(c) Water Related Recreation: No long term impact. Water related recreation in the immediate vicinity of construction would be prohibited during construction activities. This would be a short-term impact.

(d) Aesthetics: The existing environmental setting would not be adversely impacted. Construction activities would cause a temporary increase in noise and air pollution caused by equipment as well as some temporary increase in turbidity. These impacts are not expected to adversely affect the aesthetic resources over the long term and once construction ends, conditions would return to pre-project levels.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves: No such designated sites are located within the project area.

g. Determination of Cumulative Effects on the Aquatic Ecosystem: There would be no cumulative effects that result in a major impairment in water quality of the existing aquatic ecosystem resulting from the deepening, dredging, or placement of material.

h. Determination of Secondary Effects on the Aquatic Ecosystem: There would be no secondary impacts on the aquatic ecosystem as a result of the deeper channel, dredging, or material placement.

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge

a. Adaptation of the Section 404(b)(l) Guidelines to this Evaluation: No significant adaptations of the guidelines were made relative to this evaluation.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem: No practicable alternative exists which meets the study objectives. Further, no less environmentally damaging practical alternatives to the proposed actions exist because the material will be used to benefit the environment by adding to the creation of wetland areas. The no action alternative would allow the present condition of the channel to need maintenance dredging at increased frequency compared to the preferred alternative.
The maintenance requirements of the completed project are not expected to substantially differ from the existing 35-foot project. The estimated future O&M volumes include approximately 351,000 CY biannually for Pinole Shoal, and 55,000 CY annually for Bull's Head Reach (including the sediment trap). Maintenance material dredged from the existing channel would be placed in the existing SF-10 and SF16 while material removed from the deepening project would be place onto the beneficial reuse sites. The LTMS study completed in April, 2015 Action is to continue maintenance dredging the federal navigation channels in the San Francisco Bay. Specifically, the Main Ship, Pinole Shoal, Outer Richmond, and Suisun Bay Channels will be dredged annually using a hopper dredge. In instances where a hopper dredge is not available, a mechanical dredge may be used for these channels. Richmond Inner, Oakland Inner and Outer Harbor, and Redwood City will be dredged annually using a mechanical dredge. Petaluma River Channel, Napa River Channel, San Rafael Creek, San Leandro Marina, and San Bruno Shoal will be maintained every 4 to 10 years during the 10-year planning period. Dredged material will be placed at the respective project's federal standard, or at a site secondary site, as discussed under the Proposed Action in the EA (April 2015). Consequently, this Section 404 (b)(1) Evaluation focuses on the impacts associated with the discharge of dredged or fill material that would occur during construction of the 38-foot project.

c. Compliance with Applicable State Water Quality Standards: After consideration of disposal site dilution and dispersion, the discharge of dredged materials would not cause or contribute to, violations of any applicable State water quality standards.

d. Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 Of the Clean Water Act: The discharge operation would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

e. Compliance with Endangered Species Act of 1973: The disposal of dredged material would not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended. Deeping the channel may result in displacement of the state endangered longfin smelt and the federally endangered delta smelt. However, placing the dredged material onto the beneficial reuse sites will offset impacts by restoring tidal marsh habitat for these species, and also increasing the input of nutrients and food into adjacent open water habitat.

f. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection. Research, and Sanctuaries Act of 1972: No marine sanctuaries are located within the project area.

g. Evaluation of Extent of Degradation of the Waters of the United States: The deepening and/or the placement of dredged material would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values would not occur.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem: The placement of material onto beneficial reuse sites minimizes the environmental impact as much as possible.

i. On the basis of the guidelines, the proposed dredging and disposal sites are specified as complying with the requirements of these guidelines.

Appendix G – Attachment 2
Coastal Zone Management Act Evaluation

San Francisco Bay to Stockton Navigation Improvement Project

Coastal Zone Management Act Evaluation

Introduction

The USACE planning project, titled the San Francisco Bay to Stockton Navigation Improvement Project is considering deepening of the shipping channel, which includes the John F. Baldwin Ship Channel from the Golden Gate to Avon.

The planning process and environmental effects of each alternative are discussed in the GRR/EIS, in Chapters 3 (alternatives) and 4 (environmental effects). The Tentatively Selected Plan (proposed action) is to deepen 10.3 miles of Pinole Shoal Channel (STA 0+00 to STA 547+00), in San Pablo Bay, and the 2.9 miles in the portion of Suisun Bay Channel at the eastern extremity of the Carquinez Strait, Bulls Head Reach (STA 0+00 to STA 62+00 and STA 88+00 to STA 160+00). The affected channels are in the Commission's Bay and Suisun Marsh jurisdictions of the Coastal Zone.

Regulatory Background

The following is excerpted from the San Francisco Bay Plan (Bay Plan), the main document outlining the Commission's coastal zone policies.

> "The federal Coastal Zone Management Act of 1972, as amended, is a voluntary law enacted to encourage coastal states and territories to develop and implement programs to manage the nation's coastal resources. The Commission was one of the first agencies to participate in the federal program. In February 1977, the U.S. Department of Commerce approved the Commission's coastal management program for the San Francisco Bay segment of the California coastal zone. The Commission's coastal management program is based on the provisions and policies of the McAteer-Petris Act, the Suisun Marsh Preservation Act of 1977, the San Francisco Bay Plan, the Suisun Marsh Protection Plan, and the Commission's administrative regulations.
>
> "Under the Coastal Zone Management Act, federal agencies are generally required to carry out their activities and programs in a manner "consistent" with the Commission's coastal management program. To implement this provision, federal agencies make "consistency determinations" on their proposed activities, and applicants for federal permits, licenses, other authorization, or federal financial assistance make "consistency certifications." The Commission then has the opportunity to review the consistency determinations and certifications and to either concur with them or object to them. The Commission's decisions on federal consistency matters are governed by the provisions of the Coastal Zone Management Act and the Department of Commerce regulations. Four different and distinct consistency requirements exist, each applying to a different kind of situation.
>
> "1. A federal activity that directly affects land or water uses within the coastal zone must be consistent to the maximum extent practicable with the coastal management program.
>
> "2. A federal development project located within the coastal zone must be consistent to the maximum extent practicable with the coastal management program.

> "3. A project that affects land or water uses located within the coastal zone and that requires a federal permit, license, or other authorization must comply with and be conducted in a manner that is fully consistent with the coastal management program.
>
> "4. A state or local project that affects land or water uses within the coastal zone and that is supported by federal financial assistance must comply with and be conducted in a manner that is fully consistent with the coastal management program."

The proposed action is a federal activity directly affecting water uses within the coastal zone and must be consistent to the maximum extent practicable with the coastal management program. This evaluation considers each of the policy categories in the Bay Plan and the Suisun Marsh Protection Plan to determine whether the policy is applicable to the proposed action and, if applicable, whether the proposed action is consistent with the Commission's policy.

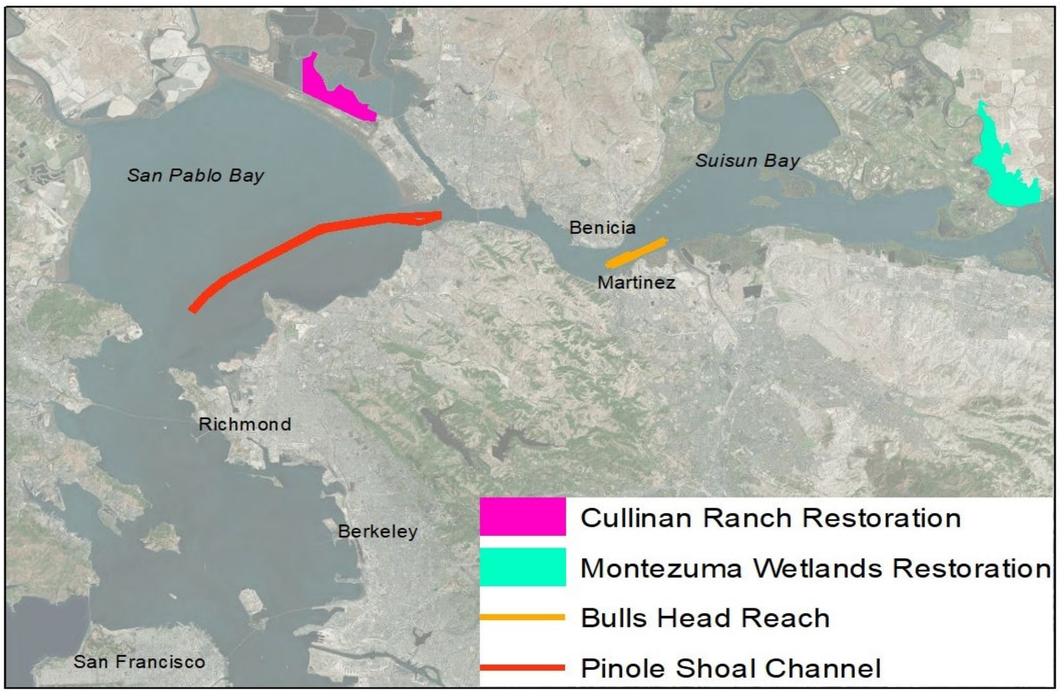

Figure 1. Proposed Action Features (channels to be deepened and restoration sites for dredged material placement).

CZMA Evaluation

Proposed Action Overview

The Tentatively Selected Plan/Proposed Action is to deepen and widen only the existing side slopes within the federally maintained shipping channels in San Pablo Bay and the Bull's Head Reach portion of Suisun Bay. The economic analysis performed by USACE has determined that the cost of deepening these channels is offset by benefits to the national economy (see

Appendix D, Economics). Deepening the channel will allow ships to transit the channels more heavily loaded, and is intended to provide the economic benefits of increased shipping volume and minimized ship traffic.

Specific elements of the proposed action are as follows:

- Deepen the existing Pinole Shoal Channel and the Bulls Head Reach of the Suisun Bay Channel from -35 feet to -38 feet mean lower-low water (MLLW). Approximately 13.2 miles of channel will be deepened allowing shipping (Panamax) vessels to transit the channels carrying heavier loads.
- Dredge a 2,600 foot sediment trap at Bulls Head Reach with a depth of -42 feet MLLW, plus 2 feet of overdepth. The sediment trap will alleviate the need for emergency maintenance dredging to assure the authorized depth for Panamax type vessels in the channels.
- Level the rock outcropping located to the west of Pinole Shoal from a peak of -39.7 feet MLLW to -43 feet MLLW.
- Use dredged material at previously permitted beneficial reuse sites.

The project depth of -38 ft MLLW was selected as the alternative with the greatest net National Economic Development benefits that is environmentally acceptable. The TSP/proposed action includes using the dredged sediment from deepening the navigation channels to restore tidal marsh habitat at Cullinan Ranch Tidal Restoration Project and Montezuma Wetlands Restoration Project (both existing and permitted sites). Rock fragments from leveling the rock outcropping would be sidecast (deposited in the adjacent open water area of the Bay). The table below provides quantities and characteristics of the dredged material and where it will be placed.

Summary of Consistency with San Francisco Bay Plan

Fill

The proposed action is consistent with the Bay Plan's policies regarding fill of the Bay. Deepening of the existing deep draft channels would add volume to the open water area of the Bay because the dredged sediments would not be placed in the Bay. Dredged sediment would be used to restore tidal marsh sites in the Bay and Delta, and the rock fragments from leveling the rock outcropping, estimated to total 40 CY, would be sidecast.

Dredging

The proposed action is consistent with the Commission's dredging policies. The second major proposal listed in the Bay Plan is to deepen shipping channels from the Golden Gate to the Delta if they limit marine terminal activity and are economically and environmentally acceptable.

In its discussion of dredging, the Bay Plan finds that "dredging is often necessary to provide and maintain safe navigation channels and turning basins with adequate underkeel clearance." The proposed deepening of the Pinole Shoal and Bulls Head Reach channels is meant to allow safe passage of existing Panamax vessels by providing the required underkeel clearance when they are more fully loaded. The deeper channels allow for the ships to be more heavily loaded, which is expected to result in a reduction in the number of vessel transits through the channels (see Appendix D, Economics).

The Commission's policies, consistent with the Long Term Maintenance Strategy (LTMS), include the goal of limiting in-Bay disposal volume at one million cubic yards per year. The proposed action is to either place the dredged material from deepening at Montezuma Wetlands, Cullinan Ranch Tidal Marsh Restoration or a similar, economically feasible, beneficial reuse site.

Water Quality

The proposed action is consistent with the Commission's water quality policies. Deepening will temporarily increase turbidity. Concentration of resuspended sediment typically reduces to near background levels within several hundred feet of dredging (Palermo et al 1990). The turbidity plume from dredging the navigation channels is expected to dissipate before reaching the closest eelgrass or shellfish beds.

The increased turbidity can lead to increased nutrient levels in the water column and temporarily change other water quality parameters such as dissolved oxygen (DO) and pH. Results of sediment sampling of Pinole Shoal and Bulls Head Reach (at depths equal to or greater than the proposed depth) have not shown levels of pollutants high enough to cause significant changes to water quality in the Bay, or prohibit the use of the dredged material for beneficial reuse as either wetland foundation or wetland cover material (ECM 2014; Lee 2000; Kohn et al. 1991; Kohn et al. 1993; Kohn et al. 1994; Word and Kohn 1990). Confirmatory testing on the dredged sediment will be completed during Preconstruction, Engineering, and Design (PED).

Extensive modeling was completed to evaluate the effect of the proposed action on salinity intrusion into the Delta (Appendix B, Attachment 1 Salinity Modeling Report). USACE performed hydrodynamic modeling that considered both hydrologic (climatic) conditions and water project operations to predict the effect of the proposed action on salinity and has determined that salinity intrusion will not increase significantly as a result of the proposed action. USACE recognizes that significant increase of salt intrusion into the Delta would not only affect fish and wildlife in the Commission's jurisdiction, it would also cause problems for freshwater intakes and diversions for water supply. The proposed action provides economic benefits while minimizing the effect on salinity intrusion.

Detailed Evaluation of Consistency with Bay Plan and Suisun Marsh Protection Plan

A detailed evaluation was completed based on the complete list of categories of policies in the Bay Plan and Suisun Marsh Protection Plan. A few categories of non-applicable policies have been combined under one heading.

Consistency Evaluation with San Francisco Bay Plan

The Bay as a Resource:

Fish, Other Aquatic Organisms and Wildlife

The Commission's policies for protecting and conserving fish, other aquatic organisms and wildlife include conserving, restoring and increasing tidal marsh, tidal flats, and subtidal habitats. The proposed action is not a habitat restoration project. The proposed action is to deepen existing navigation channels in the Bay. Dredged materials from deepening will be placed at existing/permitted sites to benefit tidal marsh restoration.

The proposed action could, depending on dredging technique of the successful contractor bid, result in "taking" of some fish, other aquatic organism or wildlife species listed as endangered or threatened (T&E species). Due to the existing depths of the channels to be deepened, there are no T&E plant species that will be affected. Dredging will be conducted during environmental work windows, as well as using clamshell dredges, asestablished in the LTMS to minimize the potential for adverse effects on T&E fish species. The proposed project is in coordination with the USFWS and NMFS. The proposed action is consistent with this policy.

Water Quality

Deepening the navigation channels will temporarily increase turbidity. Concentration of resuspended sediment typically reduce to near background levels within several hundred feet of dredging (Palermo et al 1990). The turbidity plume from dredging the navigation channels is expected to dissipate before reaching the closest eelgrass or shellfish beds. ***Figures 2 and 3*** show the locations of shellfish and eelgrass beds relative to the Pinole Shoal Channel.

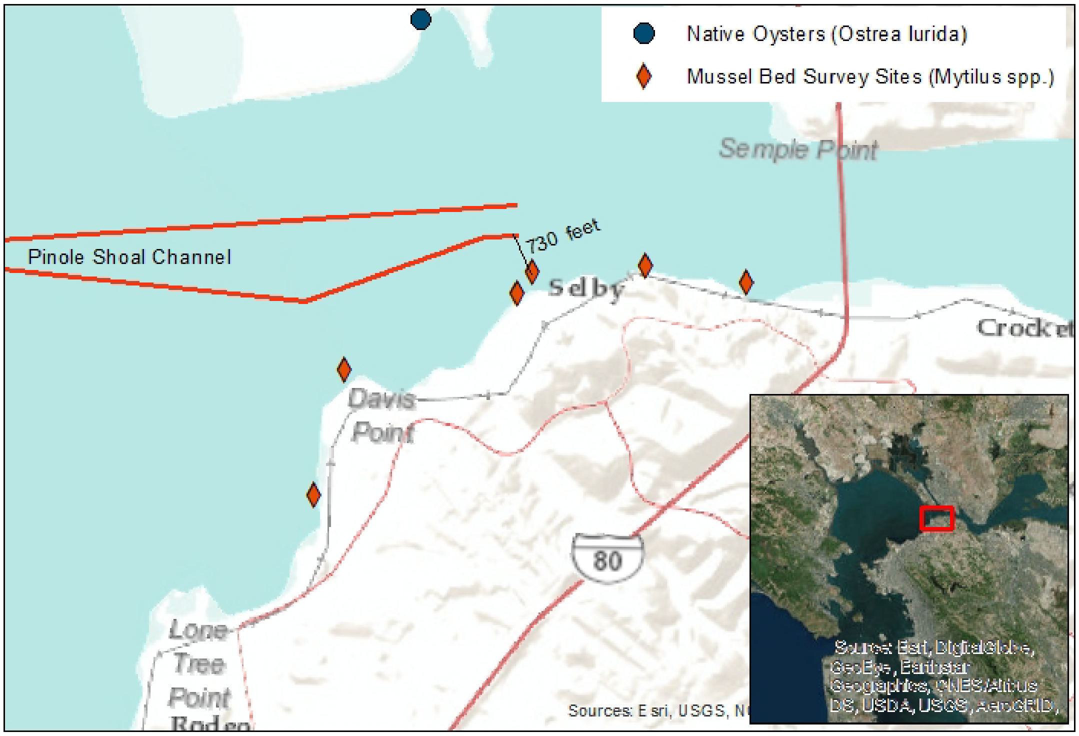

Figure 2. Location of Shellfish Beds. (Data from Subtidal Habitat Goals Report)

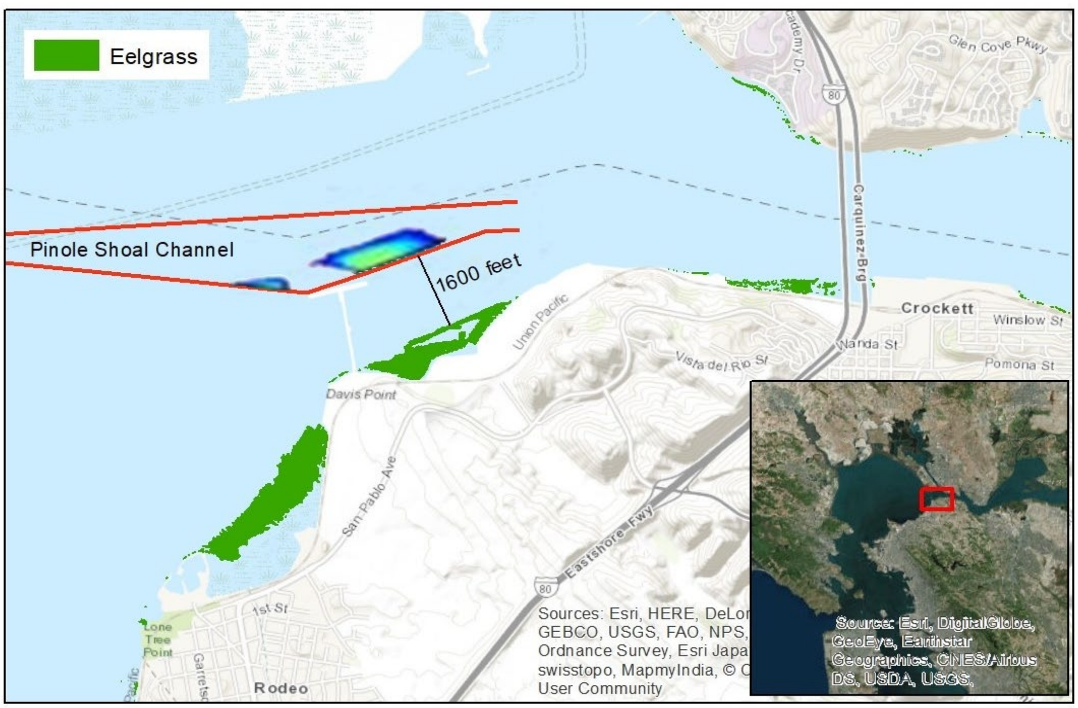

Figure 3. Location of known Eelgrass Beds According to 2014 Survey.

Increased turbidity can lead to increased nutrient levels in the water column and temporarily change other water quality parameters such as dissolved oxygen (DO) and pH. Results of sediment sampling of Pinole Shoal and Bulls Head Reach (at depths equal to or greater than the proposed depth) have not shown levels of pollutants high enough to cause significant changes to water quality in the Bay, or prohibit the use of the dredged material for beneficial reuse as either wetland foundation or wetland cover material. (ECM 2014; Lee 2000; Kohn et al. 1991; Kohn et al. 1993; Kohn et al. 1994; Word and Kohn 1990). Confirmatory testing will be completed during the PED phase of the project. A Water Quality Certification under Section 401 of the Clean Water Act will be obtained for the proposed action. The proposed action is consistent with the Commission's water quality policies.

Water Surface Area and Volume

Placement of dredged material from deepening will not reduce water surface area and would nominally increase the volume of the Bay, which is consistent with the policy of increasing the volume of water in the Bay when possible.

Hydrodynamic simulations of flow, stage and salinity were performed to assess the effects of the proposed action on salinity in the Bay and Delta. Water circulation and tidal action were simulated with existing bathymetry (including existing deep-draft channels) and with the proposed deepened channels and sediment trap. The modeling predicted that the proposed action would not have a significant effect on water circulation and tidal action (See Appendix B Water Resources, Attachment 1 Salinity Modeling Report). The proposed action is consistent with the Commission's policies regarding Bay water surface area and volume.

Tidal Marshes and Tidal Flats

The proposed project would have no negative effect on tidal marshes or tidal flats. Dredged material from deepening will be placed at tidal marsh restoration sites, which would be consistent with the goals, findings and policies of the Bay Plan. The proposed action is consistent with the Commission's tidal marshes and tidal flats policies.

Smog and Weather

The policy of the Commission regarding smog and weather is concerned with the effect that the Bay has on climate of the Bay Area. The Commission's smog and weather policy is to maintain to the greatest extent feasible, the remaining water volume and surface area of the Bay. Infill of the Bay is not a feature of the proposed action. The proposed action is consistent with the Commission's policies regarding smog and weather.

Shell Deposits

The turbidity plume from deepening will not have a significant effect on shellfish beds (mussels or oysters) (see ***Figure 2***). The proposed action is consistent with the Commission's shell deposits policies.

Freshwater Inflow

Diversion of fresh water is not a feature of the proposed action and therefore will have no effect on freshwater inflow. The proposed action is consistent with the Commission's freshwater inflow policies.

Subtidal Areas

The Commission's policies pertaining to subtidal areas (shallow and deep land and water below mean low tide) are related to avoidance of filling, dredging or changing use of subtidal areas that have an abundance and diversity of fish, other aquatic organisms and wildlife (e.g. eelgrass beds, sandy deep water or underwater pinnacles), and policies related to restoration of subtidal areas. The Pinole Shoal Channel is an existing deep-draft channel, which is promoted in the Bay Plan because of its regional economic benefits.

The proposed action will change the Bay's bathymetry by deepening the existing navigation channel. The channel does not contain special status submerged vegetation or aquatic habitat, and it is not a restoration project. The rock outcrop that will be removed from Pinole Shoal channel currently does not protrude above the bottom sediment, and so does not provide cover or habitat for fish.

Mapping of natural resources available from San Francisco Estuary Institute (SFEI) includes eelgrass beds and wetland types. Based on the most recent Bay wide eelgrass survey available (2014), the submerged eelgrass bed closest to Pinole Shoal Channel is approximately 1,600 feet from the channel to the east of the wharf at Davis Point (Phillips 66, Oleum Dock in Rodeo) (***Figure 3***). In contrast to previous surveys, the 2014 survey[1] was conducted with interferometric sidescan sonar. Deepening of Pinole Shoal Channel will not negatively affect this submerged eelgrass bed. The proposed action is consistent with the Commission's policies pertaining to subtidal areas.

Development of the Bay and Shoreline:

Climate Change

The Commission's climate change policies address sea level rise, shoreline flooding and flood protection. No shoreline development is included in the proposed project, and therefore, the proposed action is consistent with the Commission's policies regarding climate change.

Safety of Fills

The Commission's policies regarding construction on filled lands are not applicable to the proposed action because the proposed action does not include any construction on filled lands within the Bay and would not create risks for any marine petroleum terminal structures.

Shoreline Protection

The proposed action does not include any shoreline protection features and is not expected to have a negative effect on existing shoreline protection features by increasing erosion. Therefore, the proposed action is consistent with the Bay's policies.

[1] Performed in October 2014 by Merkel & Associates for NOAA Fisheries

Dredging

The second major proposal listed in the Bay Plan is to deepen shipping channels from the Golden Gate Bridge to the Delta if they limit marine terminal activity and are economically and environmentally acceptable. In its discussion of dredging, the Bay Plan finds that “dredging is often necessary to provide and maintain safe navigation channels and turning basins with adequate underkeel clearance” (Dredging finding b). The proposed deepening of the Pinole Shoal and Bulls Head Reach channels is meant to allow safe passage of Panamax vessels by providing the required underkeel clearance when they are more fully loaded. The deeper channels and more heavily loaded ships are expected to result in a reduction in vessel transits.

The Commission’s policies, consistent with the LTMS, include the goal of limiting in-Bay disposal volume at one million cubic yards per year. The proposed action is to either place the dredged material from deepening at Montezuma Wetlands, Cullinan Ranch Tidal Marsh Restoration or a similar, economically feasible, beneficial reuse site.

The proposed action is consistent with the Commission’s dredging policies.

Water-Related Industry

The proposed action is consistent with the Commission’s water-related industry policies. The Bay Plan recognizes that “navigable, deep water sites around the Bay are unique and limited resource and should be protected for uses requiring deep draft ship terminals, such as water-related industries and ports.” The proposed action is to improve accessibility to water-related industries by deepening channels transited by Panamax type ships. Deepening, by allowing ships to transit the channels more heavily loaded, is intended to increase shipping volume per transit and reduce ship traffic.

Ports

The proposed action is consistent with the Commission’s policies pertaining to ports, which is based on the Seaport Plan developed jointly by the Commission and the Metropolitan Transportation Commission (MTC). The Commission finds that “deeper shipping channels will be needed to preserve and enhance the standing of the Bay Area as a major world harbor and to keep pace with changes in shipping technology.” The proposed action is intended to improve the efficiency of vessels when transiting to and from marine terminals.

Airports

The Commission’s policies pertaining to airports are not applicable to the proposed action.

Transportation

The proposed action does not create an incentive to fill open-water areas of the Bay for new transportation infrastructure. The proposed action is consistent with the Commission’s policies regarding transportation on and around the Bay.

Commercial Fishing

The Commission's policies pertaining to commercial fishing, shellfishing, and mariculture in the Bay are not applicable to the proposed action.

Recreation

The proposed action to deepen the existing navigation channels would not change any portion of the Bay from its existing use. Beneficial use of the dredged materials in restoration of tidal marsh at sites such as Montezuma Wetlands and Cullinan Ranch would contribute to improvement of recreational opportunities in the Bay region. The proposed action is consistent with the Commission's policies regarding recreational facilities.

Public Access

The Commission's public access policies are not applicable because the proposed action will not alter public access to the Bay.

Appearance, Design, and Scenic Views

The Commission's policies regarding appearance, design and scenic views of development are not applicable to the proposed action.

Salt Ponds

The Commission's policies pertaining to salt ponds are not applicable because the proposed action will have no effect on existing natural or man-made salt ponds nor will it create any salt ponds.

Managed Wetlands

The Commission's managed wetlands policies are not applicable because there are no managed wetlands within the area of proposed dredging/deepening. The Bay Plan defines managed wetlands as "areas of historical tidal marshes that have been diked off from the Bay and are managed for wildlife, primarily waterfowl."

Other Uses of the Bay and Shoreline

The Commission's other uses of the Bay and shoreline policies are not applicable because the proposed action would not affect houseboats, desalination plant intakes, high voltage transmission or telephone lines, sewage treatment or wastewater reclamation plants, power plants, pipeline terminal and distribution facilities.

Fills in Accord with the Bay Plan

The Commission's policies on fills in accord with the Bay Plan are not applicable because the proposed action does not include fills in areas designated on Bay Plan maps for ports, water-related industry, water related recreation airports, roads, utility routes, shoreline improvements, or public access.

Fill for Commercial Recreation, Public Assembly and Public Trust Uses

The Commission's policies on fills for bay-oriented commercial recreation and bay-oriented public assembly on privately-owned or publicly-owned property are not applicable to the proposed action, nor are policies on fill for public trust uses on publicly-owned property granted in trust to a public agency.

Mitigation

In the USACE's planning process, the proposed action (with the proposed project depth) was selected as the alternative with the greatest net National Economic Development benefits that is environmentally acceptable.

The proposed action provides economic benefits while minimizing the potentialfor negative environmental effects, including effects related to salinity intrusion. USACE performed hydrodynamic modeling that considered both hydrologic (climatic) conditions and water project operations to predict the effect of the proposed action on salinity and has determined that salinity intrusion will not increase significantly as a result of the proposed action (Appendix B Water Resources, Attachment 1 Salinity Modeling Report). USACE recognizes that significant increase of salt intrusion into the Delta would not only affect fish and wildlife in the Commission's jurisdiction, it would also cause problems for freshwater intakes and diversions for water supply.

The distance in kilometers from the Golden Gate Bridge to the tidally-averaged near-bed 2-psu isohaline, known as X2, is the standard for how far salinity is penetrating into the Delta. Output from hydrodynamic simulations was used to predict the change in X2 by comparing simulations with the same hydrologic conditions and water project operations, one with existing bathymetry and one with the proposed deepened channels. Hydrologic conditions for a critical water year (2014), a below normal water year (2012), and a wet water year (2011) were simulated.

The hydrodynamic simulations predicted that the deepened channels would cause annual-average X2 to increase by 558 feet (170 m) upstream for a critical water year and existing water project operations. For a critical water year and the same (existing) water project operations, simulations that included sea level rise of 2.38 feet (0.73 m) predicted that the increase in X2 attributable to the deepened channels would be the same, 558 feet (170 m). During the wet water year and existing water project operations the deepened channels would cause annual-average X2 to increase by 886 feet (270 m), and during a below normal water year the annual-average X2 was predicted to increase by 689 feet (210 m)

The predicted maximum monthly change at any intake or export locations in the Delta was 1.5% of the allowable Cl- concentration based on D-1641 water quality objective of 250 mg/L Cl- concentration at the municipal water intakes during Year 0 conditions with existing water operations and 3.0% of the allowable Cl- concentration under Year 50 conditions which included sea level rise with existing water operations.

The proposed action includes beneficial reuse of dredged material to offset the minimal effects due to the deepening. Using the material to contribute to restoration within the Bay minimizes the effects to the extent practicable, and therefore, no compensatory mitigation is expected due to this project. The proposed action is consistent with the Commission's mitigation policies.

Public Trust

Deepening the existing channels is consistent with trust uses, one of which is navigation. The proposed action is consistent with the Commission's public trust policies.

Navigational Safety and Oil Spill Prevention

Deepening the channel and removing the rock outcrop are intended to promote navigational safety of deep-draft vessels in the shipping channels. The proposed action is consistent with the Commission's navigational safety and oil spill prevention policies.

Consistency with Suisun Marsh Protection Plan

Most of the federally maintained navigation channels in Suisun Bay fall under the jurisdiction of the primary management area of the Commission's Suisun Marsh Protection Plan. The proposed action is to deepen only the westernmost portion of the Suisun Channel, called Bulls Head Reach with a length of about 15,983 feet.

Environment

Deepening the Bulls Head Reach, an element of the proposed action, will not affect the nearby tidal marsh and managed wetlands along the coastline of Solano County to the north. The proposed action is consistent with the Suisun Marsh Protection Plan.

Water Supply and Quality

Deepening the Bulls Head Reach will not have a significant effect on the salinity, turbidity, temperature or pollution levels in the Marsh. Hydrodynamic modeling of the proposed action predicts an insignificant increase in salinity in the Marsh (see Appendix B Water Resources, Attachment 1 Salinity Modeling Report). The proposed action is consistent with the Suisun Marsh Protection Plan.

Natural Gas Resources

The proposed action does not conflict with the Commission's natural gas resources policies because it would have no effect on the natural gas geologic formations several thousand feet below the tidal marshes. The proposed action is consistent with the Suisun Marsh Protection Plan.

Utilities, Facilities and Transportation

The proposed action will cause minor, localized, disruption to the Marsh ecosystem at the time of construction, but will have no lasting effects on wildlife by forming barriers and obstacles to their movement and will not stimulate urban development. The proposed action is consistent with the Commission's policies on utilities, facilities and transportation.

Recreation and Access

Deepening of the existing channel at the southwest extremity of the primary protection area would not deter recreation or access to the Marsh. The proposed action is consistent with the Commission's policies on recreation and access.

Water-Related Industry

The proposed action would improve navigation access to the Benicia water-related industry site and is consistent with the Commission's policies on water-related industry.

Land Use and Marsh Management

The proposed action would not convert any Marsh habitat to any other uses. The proposed action is consistent with the Commission's policies that, within the Marsh, existing land uses should continue and wetlands should be restored.

References

[ECM] Environmental Cost Management, Inc. 2014. *Suisun Bay Channel and New York Slough 2014 Maintenance Dredging Sampling and Analysis Report*. Sept.

Kohn NP, Lefkovitz LF, Barton KO, and Word JQ. 1991. *Chemical evaluations of the John F. Baldwin Ship Channel Sediment Phase II*. PNL-7700. San Francisco: U.S. Army Corps of Engineers, San Francisco District.

Kohn NP, Karle LM, Pinza MR, Mayhew HL, White PJ, Gruendell BD, and Word JQ. 1993. *Ecological Evaluation of Proposed Dredged Material from the John F. Baldwin Ship Channel (Phase III-Biological Test)*. PNL-8828.

Kohn NP, White PJ, Gardiner WW, and Word JQ. 1994. *Ecological evaluation of proposed dredged material from Bulls Head Channel (lower Suisun Bay)*. Battelle/Pacific Northwest Laboratory. San Francisco: U.S. Army Corps of Engineers, San Francisco District.

Lee CR. 2000. *Evaluation of wetland creation with John F. Baldwin Ship Channel sediment*. U.S. Army Corps of Engineers, Engineer Research and Development Center.

Palermo, M.R., Teeter, A.M., and Homziak, J., 1990. *Evaluation of Clamshell Dredging and Barge Overflow, Military Ocean Terminal, Sunny Point, North Carolina*, *Technical Report D-90-6*, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Word JQ and Kohn NP. 1990. *Chemical evaluations of John F. Baldwin Ship Channel Sediment*. Prepared by Pacific Northwest Laboratory. Prepared for the U.S. Army Corps of Engineers under a Related Services Agreement with the U.S. Department of Energy.

San Francisco Bay Conservation and Development Commission

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September 11, 2019

Mrs. Stacie Auvenshine
US Army Corps of Engineers, Jacksonville District
701 San Marco Boulevard
Jacksonville, FL 32232-0019

SUBJECT: Draft Integrated General Re-evaluation Report and Environmental Impact Statement for the San Francisco Bay to the Port of Stockton, CA (John F. Baldwin and Stockton Ship Channels) Navigation Study, SCH #20190509049; BDCD Inquiry File No. MC.MC.2016.001, and Federal Consistency Determination

Dear Ms. Auvenshine:

Thank you for your email of August 27, 2019, requesting information regarding the San Francisco Bay Conservation and Development Commission's (Commission) process for conducting consistency reviews under Section 307(c)(1) of the Coastal Zone Management Act of 1972, as amended (CZMA). As we discussed, the Commission receives consistency determinations from Federal agencies and processes them under the Federal Code of Regulations, 15 CFR Part 930. Specifically, you had inquired as to whether the Commission staff had begun processing the federal consistency determination for the Stockton Deepening Project. You noted that the Draft Environmental Impact Report included in Appendix G a federal consistency determination analysis. As discussed with you on the phone, we viewed the draft document, including the appendices as a draft environmental document required by the National Environmental Policy Act, and not the submission and request for a concurrence in a federal consistency determination. The status of the provided document as a draft is also reflected in the cover letter dated May 10, 2019, signed by Ms. Angela Dunn. That letter requested comments on the Draft General Re-evaluation Report and Environmental Impact Statement (DGRR/EIS), but made no mention of submission of a consistency determination for review, and as such we reviewed it as a draft environmental document as reflected in our letter of June 27, 2109.

In our telephone discussions, you requested information regarding the process for consistency determination review and concurrence in California, as it appears to differ from the process in Florida. Once your project alternative is chosen, please finalize the consistency determination accordingly, provide information necessary to analyze the potential effects to the San Francisco Bay Coastal Zone, and submit them to us along with a letter requesting the Commission's review and concurrence. The requirements can be found in the above referenced part of the federal regulations. Once we receive that document, Commission staff will respond within 14 days noting the additional information we believe is necessary to complete the analysis or questions about the project. We typically request the mandatory 15-day time extension to the 60-day review period, and request that the review period not start until the information is provided. We also regularly request that the process include coordination among the state (such as, in the San Francisco Bay region, the San Francisco Bay Regional Water Quality Control Board) and Federal agencies (such as the US Fish and Wild Service and National Marine Fisheries Service acting pursuant to their authority to protect threatened or endangered species of wildlife) agencies in accord with the CMZA that looks to reduce redundancy and government waste.

Once the complete information is provided, the “application” is deemed complete and the 75-day (60 days plus the mandatory 15-day time extension) review period begins. During that time, we will schedule a public hearing and a vote before the Commission. The Commission meets the first and third Thursdays of each month. The public hearing and vote can be scheduled for the same day or separate days depending on the agenda, anticipated public comment, and other concerns. Prior to the Commission meeting(s), staff prepares an “application” summary and a recommendation for the Commission, which are typically mailed to the Commission two weeks prior to the hearing and vote. The Federal agency project proponent has the opportunity to do a short presentation to describe the project to the Commission. After the presentation, there is a period for public comments. It is generally closed the same day but can be extended if needed. The Commission then deliberates on the project and a vote is called. Once the Commission has voted, the final Letter of Agreement, typically conditioned, is issued generally within 10 days of the vote.

Please let me know if more details or information are needed regarding our process. Once you have finalized your request for a consistency concurrence, please send it to my attention at the address above. If you have further questions, please feel free to contact me at 415. 352.3623 or via email at brenda.goeden@bcdc.ca.gov. I look forward to working with you on this project.

Sincerely,

BRENDA GOEDEN
Sediment Program Manager

cc: Ms. Angela Dunn, Chief Environmental Branch

BG / yy

Appendix G – Attachment 3

Regulatory Settings

This appendix lists applicable federal, state, and local laws, regulations, and plans that influence the implementation of water and related land projects in the study area. This proposed project is in compliance or will be in compliance upon circulation of the draft NEPA/CEQA document and once all permits are received. The resource categories are mirrored as written in Section 2 and Section 4 of the main draft GRR/EIS/EIR. The study area is situated within the San Francisco region of California and is subject to both federal and California state laws and regulations. All references are located in the main report.

Regulatory Settings for Resources within the Study Area

1.1 Geology and Seismicity

1.1.1 Federal Regulatory Setting

USACE Coastal Engineering Manual. The USACE Coastal Engineering Manual (USACE 2015a) provides a single, comprehensive technical document that incorporates tools and procedures to plan, design, construct and maintain coastal projects. The engineering manual includes the basic principles of coastal processes, methods for computing coastal planning and design parameters, and guidance on how to formulate and conduct studies in support of coastal flooding, shore protection and navigation projects. The manual includes sections related to dredging and disposal. Dredging and construction along the shoreline and at placement sites would comply with these standards.

National Earthquake Hazards Reduction Program. Under the National Earthquake Hazards Reduction Program, four federal agencies have responsibility for long-term earthquake risk reduction: the USGS, the National Science Foundation, FEMA, and the National Institute of Standards and Technology. These agencies assess U.S. earthquake hazards, deliver notifications of seismic events, develop measures to reduce earthquake hazards, and conduct research to help reduce overall vulnerability to earthquakes. The analyses discussed in this report are supported by assessments developed through the National Earthquake Hazards Reduction Program, including seismic hazard maps.

1.1.2 State Regulatory Setting

California Code of Regulations (CCR): Title 23, Division 1, Article 8, Sections 111 137. These standards govern the design and construction of encroachments that would affect flood control works and floodways, including limitations or approval requirements for placement of dredge material and channel excavation. Dredging of material from channel waterways generally must be confined to the area beyond 100 feet of the toe of the bank, and the slope of the "borrow" perimeter nearest the toe of the bank generally may not exceed five feet horizontal to one-foot vertical. Before any "borrow" operation (including dredging) is permitted within one mile of a bridge or 1,000 feet of any pipeline or cable crossing beneath any channel, a study must be submitted to show that the "borrow" operation will not adversely affect such facilities. Since habitat restoration placement sites have already been approved, placement standards under these regulations are not analyzed herein.

1.1.3 Local Regulatory Setting

City and County General Plans. City and county General Plans identify geologic hazards and associated policies at the local level. This includes identification of geologic and seismic hazard zones, often developed using state and federal hazard maps supplemented with local studies and investigations. General Plans typically establish policies and goals for minimizing geologic and seismic hazards, requirements to adhere to state and federal building standards, and requirements for supplemental geotechnical investigations or approvals for projects in identified seismic hazard areas. General Plans that would apply to the study area include those developed for the counties of Contra Costa, Marin, Solano, Sacramento and San Joaquin and the cities of Richmond, Pinole, Hercules, Martinez, Tiburon, Vallejo, Benicia, Pittsburg, Antioch, Oakley and Stockton. Dredging activities would occur in federal waters outside of these plan areas. Placement of dredge material would need to occur in consideration of policies contained in these plans.

1.2 Sediment and Sedimentation

1.2.1 Federal Regulatory Setting

Dredged Material Management Office Review. The Dredged Material Management Office (DMMO) is a joint program led by the USACE, and staffed by representatives from the USACE, USEPA, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board (RWQCB) and California State Lands Commission (CSLC). Participating agencies include the California Department of Fish and Wildlife (CDFW), the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). The DMMO was established in 1998 as part of the Long-Term Management Strategy (LTMS) program to streamline the permitting processes for dredging projects in the San Francisco Bay. The purpose of the DMMO is to cooperatively review sediment quality sampling plans, analyze the results of sediment quality sampling, and make suitability determinations for material proposed for placement in San Francisco Bay, beneficially reused, or disposed offshore. All testing is done pursuant to applicable requirements such as the Inland and Ocean Testing Manuals, and other relevant requirements.

As such, the DMMO provides the basis for uniform federal and state dredged material disposal policies and regulations. The process for obtaining approvals for dredging or dredged material disposal has three phases: (1) suitability determination, (2) permit processing, and (3) episode approval. Applicants must submit results from recent sediment testing or submit sufficient data to support a finding by the agencies as to whether sediments are suitable for placement in the proposed disposal environment. The applicant must submit the sampling results to the DMMO for review, which then makes a determination about where the materials can be disposed.

Although the DMMO provides initial review of permit applications, applicants must eventually obtain separate approval from the appropriate DMMO member agencies as required. Those approvals include:

- DMMO review of the sediment characterization and approval to dispose or beneficially reuse material and meets the requirements for disposal site alternatives analyses under the CWA Section 404 and Section 103 of the Marine Protection Research and Sanctuaries Act.

- A water quality certification or a waiver, as required under Section 401 of the CWA from the RWQCB for dredging in the study area.
- For Civil Works projects, a federal consistency determination under CZMA is required from the San Francisco Bay Conservation and Development Commission.
- The USACE follows the Agreement on Programmatic Essential Fish Habitat Conservation Measures for Maintenance Dredging Conducted under the LTMS Program (USEPA and USACE 2011). Per the Agreement on Programmatic Essential Fish Habitat, if residual layer contamination exposed after maintenance dredging is greater than that in the overlying sediment and exceeds the bioaccumulation trigger values established, consideration of the need for potential management actions to address the residual contamination would be made on a case-by-case basis.

USACE Coastal Engineering Manual. The USACE Coastal Engineering Manual (USACE 2002) provides a single, comprehensive technical document that incorporates tools and procedures to plan, design, construct, and maintain coastal projects. The engineering manual includes the basic principles of coastal processes, methods for computing coastal planning and design parameters, and guidance on how to formulate and conduct studies in support of coastal flooding, shore protection and navigation projects. The manual includes sections related to dredging and disposal of dredged sediment. Dredging and construction along the shoreline and at ecosystem restoration or placement sites would comply with these standards.

1.2.2 State Regulatory Setting

Beneficial Reuse of Dredged Sediment. In the San Francisco Bay Area, placement of dredged material at upland sites or for beneficial reuse is regulated under California's Porter-Cologne Act and the McAteer-Petris Act. Screening guidance is provided in the San Francisco Bay RWQCB's May 2000 staff summary report, or the most current revised version. There are two levels of screening guidelines for beneficial reuse of sediments for wetland restoration: (1) guidelines for cover material and (2) guidelines for foundation material. The two classes of material are defined as follows:

- **Cover material** is a class of material that is not expected to pose a threat to water quality or to the aquatic environment, even in places where the material is in direct contact with surface waters or aquatic organisms, and is suitable for unconfined aquatic disposal.
- **Wetland foundation material** is not of a quality that constitutes a hazardous or listed waste but has a potential for biological effects if directly exposed to organisms. Wetland foundation material is not expected to be a threat to water quality when an adequate amount of cover material is used to reduce the risk of foundation material coming into contact with the aquatic environment. The amount of cover material needed to adequately reduce this risk depends on site-specific characteristics. Placement of dredged sediment at beneficial reuse sites is also governed by acceptance criteria included in project-specific biological opinions for placement activities that may affect threatened or endangered species.

California Code of Regulations: Title 23, Division 1, Article 8, Sections 111 137. These standards govern the design and construction of encroachments that would affect flood control works and floodways, including limitations or approval requirements for placement of dredged material and channel excavation. Dredging of material from channel waterways generally must be confined to the area beyond 100 feet of the toe of the bank, and the slope of the borrow perimeter nearest the toe of the bank generally may not exceed five feet horizontal to 1-foot vertical. Before any borrow operation (including dredging) is permitted within 1 mile of a bridge or 1,000 feet of any pipeline or cable crossing beneath any channel, a study must be submitted to show that the borrow operation will not adversely affect such facilities. Standards pertaining to placement of dredged material would apply to any future sites used that have not already been subjected to previous environmental evaluations and approved to receive dredged material.

1.2.3 Local Regulatory Setting

City and County General Plans. City and county General Plans identify local policies, studies and investigations, and requirements to adhere to state and federal standards. General Plans that would apply to the study area include those developed for the counties of Contra Costa, Marin, Solano, Sacramento and San Joaquin and the cities of Richmond, Pinole, Hercules, Martinez, Tiburon, Vallejo, Benicia, Pittsburg, Antioch, Oakley, and Stockton.

1.3 Water Quality and Hydrology

1.3.1 Federal Regulatory Setting

Clean Water Act (33 USC § 1257 et seq.). The Clean Water Act (CWA) established the federal structure for regulating surface water quality standards and discharges of pollutants into waters of the U.S. The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The genesis of the CWA, enacted in 1948, was the Federal Water Pollution Control Act. It was significantly reorganized and expanded in 1972 by the CWA. The CWA requires states to set standards to protect water quality. Specific sections of the CWA control discharge of pollutants and wastes into marine and aquatic environments, as discussed below.

Section 303 – Water Quality Standards and Implementation Plans (Title 40 of the CFR pt. 131.2). This Section of the CWA describes water quality standards as the water quality goals for a particular water body. The water quality goals are the designated uses for the water and the criteria to protect those uses. A water quality standard defines the water quality goals for a water body, or portion thereof, by designating the use or uses to be made of the water, and by setting criteria necessary to protect those uses.

States adopt water quality standards that are approved by USEPA to protect public health or welfare, enhance the quality of water, and serve the purposes of the CWA. To serve the purposes of the CWA, as defined in Sections 101(a)(2) and 303(c), means that water quality standards should, wherever attainable, provide water quality for the protection and propagation of fish, shellfish, and wildlife, and provide water quality for recreation in and on the water. The standards should consider the use and value of public water supplies, propagation of fish, shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other uses including navigation.

The SWRCB administers the water quality standards developed under the CWA and the California Water Code. The SWRCB is required to routinely monitor the condition of water bodies in the state and maintain a list of impaired water bodies having water quality concerns as per Section 303(d) of CWA. The RWQCBs are required to develop measures to restore impaired water bodies.

Section 303(d) – Impaired Water bodies and Total Maximum Daily Loads. Under this Section of the CWA, each state is required to identify those waters within its boundaries that do not meet water quality standards. The state must establish priority rankings for these waters and develop TMDLs to maintain beneficial uses and improve water quality. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards. Seasonal variations in loading and a margin of safety are considered when TMDLs are established. In California, the SWRCB and RWQCBs prepare the CWA Section 303(d) List of Water Quality Limited Segments Requiring TMDLs.

As stated previously, San Francisco Bay is listed as impaired for pesticides (e.g., chlordane, DDT, dieldrin, dioxin, and furan compounds), mercury, invasive species, PCBs, selenium, and trash. In greater San Francisco Bay, Suisun Bay and San Pablo Bay are listed for these same parameters, except for trash (SFBRWQCB 2010). TMDLs have been established for these parameters.

The Delta is listed as impaired for insecticides (i.e., diazinon, chlorpyrifos), pesticides (e.g., chlordane, DDT, dieldrin, mercury, invasive species, PCBs, and selenium). TMDLs have been established for insecticides and pesticides. The Central Valley RWQCB anticipates TMDLs for PCBs, invasive species, and unknown toxicity to be established by 2019 (CVRWQCB 2009).

Section 401 – Water Quality Certification. Under Section 401 of the CWA, Water Quality Certification (WQC) is required for any activity that requires a federal permit or license, and that may result in discharge into navigable waters. To receive certification under Section 401, an application must demonstrate that activities or discharges into waters are consistent with state effluent limitations (CWA Section 301), water quality effluent limitations (CWA Section 302), water quality standards and implementation plans (CWA Section 303), national standards of performance (CWA Section 306), toxic and pretreatment effluent standards (CWA Section 307), and “any other appropriate requirements of State law set forth in such certification” (CWA Section 401).

In California, the authority to grant water quality certification is delegated to the SWRCB, and in the San Francisco Bay area and the Delta, applications for certification under CWA Section 401 are processed by SFBRWQCB and CVRWQCB, respectively. The CWA and USACE regulations (33 CFR § 336.1[a][1]) require USACE to seek state WQC for discharges of dredged or fill material into waters of the U.S. The appropriate RWQCB reviews a proposed project before granting or denying certification.

Section 404 – Discharge of Dredged or Fill Material. Section 404 of the CWA regulates the discharge of dredged or fill material (e.g., fill, pier supports, and piles) into waters and wetlands of the U.S., which includes the San Francisco Bay and Delta. The USACE implements Section 404 of the CWA. Section 404(b)(1) of the CWA establishes procedures for the evaluation of permits for discharge of dredged or fill material into waters of the U.S. In situations where the USACE proposes work that involves discharge of dredged or fill material into waters of the U.S., the USACE must comply with the requirements of the Section 404(b)(1) Guidelines, although the USACE would not issue a permit for its own activities. Any discharge under Section 404 must also obtain a Section 401 WQC.

Rivers and Harbors Act of 1899. The Rivers and Harbors Act (RHA) of 1899 was the first federal water pollution act in the U.S. that focused on protecting navigation, protecting waters from pollution, and acted as a precursor to the CWA of 1972. Section 10 of the RHA regulates alteration of, and prohibits unauthorized obstruction of, navigable waters of the U.S. The RHA covers construction, excavation, or deposition of materials in, over, or under navigable waters, or any work that would affect the course, location, condition, or capacity of those waters unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army. Original construction of the federal navigation channels that span the study area was authorized under the RHA and by other Congressional authorities. The USACE maintains the navigability of the channels in accordance with their authorized dimensions. The USACE, as the implementing authority of Section 10 of RHA and ensures its work or structures do not impede navigation in waters of the U.S., and, therefore, does not need to issue itself a permit pursuant to Section 10.

Coastal Zone Management Act. The Coastal Zone Management Act (CZMA) of 1972 is the Congressional program for managing the nation's coasts. It was enacted to encourage the participation and cooperation of state, local, regional, and federal agencies and governments with programs affecting the coastal zone, and it is the only environmental program that requires a balance between economic development and resource protection within the coastal zone.

The provisions of the CZMA are administered by the NOAA's Office of Ocean and Coastal Resource Management. The CZMA allows states to develop a Coastal Zone Management Plan in which they define permissible land and water use within the state coastal zone, which extends 3 miles seaward and inland as far as necessary to protect the coastal zone. Federal agencies are required to carry out their activities in such a way that they conform to the maximum extent practicable with a state's Coastal Zone Management Plan. Construction of the navigation improvements are regulated under the CZMA.

For San Francisco Bay, the San Francisco Bay Conservation and Development Commission (BCDC) is the regional coastal zone management agency, and it is responsible for issuing concurrence with federal consistency determinations under the CZMA. The San Francisco Bay Plan (BCDC 2008), first adopted in 1969 and updated in 2011, is BCDC's policy document specifying goals, objectives, and policies for BCDC jurisdictional areas. Pursuant to the federal CZMA, the USACE is required to be consistent to the maximum extent practicable with the enforceable policies of the Bay Plan.

1.3.2 State Regulatory Setting

Porter-Cologne Act. The California Legislature enacted the Porter-Cologne Water Quality Control Act (Porter-Cologne) (SWRCB 2012) in 1969 to preserve, enhance, and restore the quality of the state's water resources. Porter-Cologne established the SWRCB and nine RWQCBs. These agencies are responsible for setting the state's water quality policy, and enforcing ground and surface water quality standards. The Porter-Cologne Act provides for the adoption of water quality control plans to designate beneficial uses of water, set water quality objectives to protect beneficial uses, and provide for a program to achieve those objectives. The plans may include prohibitions against the discharges of waste or certain types of waste, in specified areas or under specified conditions. The RWQCBs are authorized to issue waste discharge requirements (WDRs) and WQCs for activities that may affect water quality. Dredging and discharge of dredged material throughout the study area would require WDRs under Porter-Cologne, which would be issued by the SFBRWQCB or the CVRWQCB. As the CEQA lead agency, the Port of Stockton must apply for a WDR from the RWQCB.

McAteer-Petris Act. The McAteer-Petris Act (California Government Code Section 66000 et seq.), first enacted in 1965, created BCDC to prepare a plan to protect the San Francisco Bay and shoreline, and provide for appropriate development and public access. The Act directs BCDC to exercise its authority to issue or deny permit applications for placing fill, dredging, or changing the use of any land, water, or structure in the area of its jurisdiction (i.e., San Francisco Bay waters and within 100 feet of the shoreline). The BCDC also carries out determinations of consistency with the CZMA for federally sponsored projects. The Bay Plan is BCDC's policy document specifying goals, objectives, and policies for BCDC jurisdictional areas. Pursuant to the federal CZMA, the USACE is required to be consistent to the maximum extent practicable with the enforceable policies of the Bay Plan.

Local Regulatory Setting D-1641 Water Rights Decision. D-1641, which was passed in 1999, describes the salinity criteria established in the Delta to meet municipal, industrial, agricultural, and biological requirements (SWRCB 2000). D-1641 stipulates salinity requirements as chloride concentration for municipal and industrial uses, and as electrical conductivity (EC) for agricultural and fish and wildlife uses.

Salinity reported as chloride concentration indicates the mass of chloride ion in a unit volume of water (milligrams chloride per liter [mg Cl^-/L]). It is also reported in psu which represents the ratio of the EC of seawater with respect to a standardized salt solution. EC is reported in millimhos per centimeter (mmhos/cm). EC is a measure of the ability of water to conduct electric currents and is directly proportional to the concentration of ions (i.e., the dissolution product of salts, which includes chloride) in water.

1.3.3 Regional Water Quality Control Plans

Each RWQCB is required to develop, adopt, and implement a Basin Plan for the region. The Basin Plan is the master policy document that contains descriptions of the legal, technical, and programmatic bases of water quality regulation in the region. The plan must include:

- A statement of beneficial water uses that RWQCB will protect;
- The water quality objectives needed to protect the designated beneficial water uses; and
- The strategies and time schedules for achieving the water quality objectives.

The basin plan provides a definitive program of actions designed to preserve and enhance water quality and to protect beneficial uses in a manner that will result in maximum benefit to the people of California. Implementation would be required to comply with the applicable plans of their respective regions. The basin plans applicable to the study area are discussed in the following sections.

San Francisco Bay Basin. The San Francisco Bay Basin Plan is applicable throughout the study area. Water quality objectives specific to San Francisco Bay are contained in SFBRWQCB's Water Quality Control Plan for the San Francisco Bay Basin (San Francisco Bay Basin Plan; SFBRWQCB 2010). The San Francisco Bay Basin Plan identifies measures for protecting beneficial uses of the Bay, water quality objectives, and implementation plans. It also identifies the LTMS strategy as the key process for addressing dredging operations in San Francisco Bay, and for achieving the LTMS goals. The San Francisco Bay Basin Plan implements the LTMS Management Plan by setting a long-term overall target for in-Bay disposal of dredged material at designated disposal sites of 1.25 million cubic yards (or less) per year.

Central Valley Basin. Water quality objectives specific to the Delta are contained in the CVRWQCB's Water Quality Control Plan for the Sacramento River Basin and the San Joaquin River Basin (Central Valley Basin Plan) (CVRWQCB 1998). The Central Valley Basin Plan identifies beneficial uses, water quality objectives, and implementation programs for waters within the Central Valley Basin. The Central Valley Basin Plan is applicable to the study area.

San Francisco Bay/Sacramento-San Joaquin Delta Estuary. The Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (SWRCB 2006) consists of: (1) beneficial uses to be protected; (2) water quality objectives for the reasonable protection of beneficial uses; and (3) a program of implementation for achieving the water quality objectives and standards of the CWA. The plan provides reasonable protection for the estuary's beneficial uses that require control of salinity (caused by saltwater intrusion, municipal discharges, and agricultural drainage) and water project operations (flows and diversions). Most of the plan objectives are implemented by assigning responsibilities to water right holders because the parameters to be controlled are primarily impacted by flows and diversions. The SWRCB will consider, in future water rights proceedings, the nature and extent of water right holders' responsibilities to meet these objectives. Implementation of certain water quality objectives may require action in concert with other agencies. This plan is relevant throughout the study area.

1.4 Air quality

1.4.1 Federal

Clean Air Act (CAA). The CAA and its subsequent amendments form the basis for the national air pollution control effort. The USEPA is responsible for implementing most aspects of the CAA. Basic elements of the act include the National Ambient Air Quality Standards (NAAQS or "national standards") for major air pollutants, hazardous air pollutant standards, attainment plans, motor vehicle emission standards, stationary source emission standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

Criteria Pollutants. The 1970 CAA (last amended in 1990) required the USEPA to identify NAAQS, which are the concentrations of pollutants (with an adequate margin of safety) to which the public can be exposed without adverse health effects. They are designed to protect those segments of the public most susceptible to respiratory distress, including asthmatics, the very young, the elderly, people weak from other illness or disease, or persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollution levels that are somewhat above ambient air quality standards before adverse health effects are observed. Pursuant to the 1990 CAA amendments, the USEPA classifies air basins (or portions thereof) as “attainment” or “nonattainment” for each criteria air pollutant based on whether or not the NAAQS had been achieved.

Table 1 shows the current national and state ambient air quality standards and the health effects that can result when the standards are exceeded. ***Table 2*** shows the current attainment status for the SFBAAB, SVAB, and SJVAB. All three air basins are classified as nonattainment for the federal and state ozone and PM2.5 standards.

Toxic Air Contaminants (TACs). TACs are regulated under both state and federal laws. Federal laws use the term “Hazardous Air Pollutants” (HAPs) to refer to the same types of compounds that are referred to as TACs under state law. Both terms encompass essentially the same compounds. The 1977 CAA amendments required the USEPA to identify National Emission Standards for Hazardous Air Pollutants to protect public health and welfare. These substances include certain volatile organic compounds (VOCs), pesticides, herbicides, and radionuclides that present a tangible hazard, based on scientific studies of exposure to humans and other mammals. Under the 1990 CAA amendments, 189 substances are regulated as HAPs.

State Implementation Plan. The CAA requires each state to prepare an air quality control plan referred to as the State Implementation Plan (SIP). The CAA amendments added requirements for states containing areas that violate the NAAQS to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is a living document that is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of air basins as reported by the agencies with jurisdiction over them. The USEPA has responsibility to review all SIPs to determine if they conform to the mandates of the CAA amendments and will achieve air quality goals when implemented. If the USEPA determines a SIP to be inadequate, it may prepare a Federal Implementation Plan for the nonattainment area and may impose additional control measures. Failure to submit an approvable SIP or to implement the plan within mandated timeframes can result in sanctions being applied to transportation funding and stationary air pollution sources in the air basin.

The 1977 federal CAA amendments require that regional planning and air pollution agencies prepare a regional air quality plan to outline the measures by which both stationary and mobile sources of pollutants can be controlled in order to achieve all standards specified in the CAA. The 1988 California Clean Air Act (CCAA) also requires development of air quality plans and strategies to meet state air quality standards in areas designated as nonattainment (with the exception of areas designated as nonattainment for the state PM standards). Maintenance plans are required for attainment areas that had previously been designated nonattainment in order to ensure continued attainment of the standards. In California, these air quality plans are developed by the air districts and approved by CARB for inclusion in the SIP.

General Conformity Rule. Section 176(c) of the CAA states that a federal agency cannot issue a permit for or support an activity unless the agency determines it will conform to the most recent USEPA approved SIP. This means that projects using federal funds or requiring federal approval must not: (1) cause or contribute to any new violation of a NAAQS; (2) increase the frequency or severity of any existing violation, or (3) delay the timely attainment of any standard, interim emission reduction, or other milestone. General conformity requirements were adopted by Congress as part of the CAA and were implemented by USEPA regulations in the November 30, 1993, Federal Register (40 Code of Federal Regulations [CFR] Sections 6, 51, and 93: "Determining Conformity of General Federal Actions to State or Federal Implementation Plans; Final Rule"). General conformity requires that all federal actions conform to the SIP as approved or promulgated by the USEPA by determining that the action is either exempt from the General Conformity Rule requirements or subject to a formal conformity determination.

Table 1. Ambient Air Quality Standards.

Pollutant	Averaging Time	State Standard	Federal Primary Standard	Major Pollutant Sources
Ozone	8-hour	0.070 ppm	0.075 ppm	Formed when ROG and NO_x react in the presence of sunlight. Major sources include on-road motor vehicles, solvent evaporation, and commercial/ industrial mobile equipment
	1-hour	0.090 ppm	---	
Carbon Monoxide	8-hour	9.0 ppm	9.0 ppm	Internal combustion engines, primarily gasoline-powered motor vehicles
	1-hour	20 ppm	35 ppm	
Nitrogen Dioxide	Annual Average	0.030 ppm	0.053 ppm	Motor vehicles, petroleum refining operations, industrial sources, aircraft, ships, and railroads
	1-hour	0.180 ppm	0.100 ppm	
Sulfur Dioxide	Annual Average	---	0.03 ppm	Fuel combustion, chemical plants, sulfur recovery plants and metal processing
	24-hour	0.04 ppm	0.14 ppm	
	1-hour	0.25 ppm	0.075 ppm	
Particulate Matter (PM10)	Annual Arithmetic Mean	20 $\mu g/m^3$	---	Dust- and fume-producing industrial and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g., wind-raised dust and ocean sprays)
	24-hour	50 $\mu g/m^3$	150 $\mu g/m^3$	
Particulate Matter (PM2.5)	Annual Arithmetic Mean	12 $\mu g/m^3$	12 $\mu g/m^3$	Fuel combustion in motor vehicles, equipment, and industrial sources; residential and agricultural burning; also, formed from photochemical reactions of other pollutants, including NO_x, sulfur oxides, and organics
	24-hour	---	35 $\mu g/m^3$	
Lead	Calendar Quarter	---	1.5 $\mu g/m^3$	Present sources: lead smelters, battery manufacturing and recycling facilities. Past source: combustion of leaded gasoline
	30-Day Average	1.5 $\mu g/m^3$	---	
Hydrogen Sulfide	1-hour	0.03 ppm	No federal standard	Geothermal Power Plants, Petroleum Production and refining
Visibility Reducing Particles	8-hour	Extinction of 0.23/km; visibility of 10 miles or more	No federal standard	See PM2.5

Notes:

NOx = oxides of nitrogen; PM2.5 = fine particulate matter; PM10 = respirable particulate matter; ROG = reactive organic gases

Table 2. Air Quality Attainment Status of SFBAAB, SVAB, and SJVAB.

Pollutant	SFBAAB Attianment Status		SVAB Attainment Status		SJVAB Attainment Status	
	California Standard	Federal Standard	California Standard	Federal Standard	California Standard	Federal Standard
Ozone –8-hr	Non-Attainment	Non-Attainment	Non-Attainment	Non-Attainment	Non-Attainment	Non-Attainment
Ozone 1-hr	Non-Attainment	N/A	Non-Attainment	N/A	Non-Attainment	N/A
CO 8-hr	Attainment	Attainment, maintenance	Attainment	Attainment, maintenance	Attainment	Attainment, maintenance
CO 1-hr	Attainment	Attainment	Attainment	Attainment	Attainment	Attainment
NO_2 Annual	Attainment	Attainment	Attainment	Attainment	Attainment	Attainment
NO_2 1-hr	Attainment	Unclassified	Attainment	Unclassified	Attainment	Unclassified
SO_2 Annual	Attainment	Attainment	Attainment	Attainment	Attainment	Attainment
SO_2 24-hour	Attainment	Attainment	Attainment	Attainment	Attainment	Attainment
SO_2 1-hour	Attainment	Attainment	Attainment	Attainment	Attainment	Attainment
PM10 Annual	Non-Attainment	N/A	Non-Attainment	N/A	Non-Attainment	N/A
PM10 24-hr	Non-Attainment	Unclassified	Non-Attainment	Unclassified	Non-Attainment	Unclassified
PM2.5 Annual	Non-Attainment	Attainment	Non-Attainment	Attainment	Non-Attainment	Attainment

Emission Standards for Marine Diesel Engines. To reduce emissions from Category 1 (at least 50 horsepower [hp] but less than 5 liters per cylinder displacement) and Category 2 (5 to 30 liters per cylinder displacement) marine diesel engines, the USEPA has established emission (tier) standards for new engines. Tier 2 standards were phased in from 2004 to 2007 (year of manufacture), depending on the engine size. Tier 3 and 4 emission standards for marine diesel engines were introduced in 2008. Tier 3 standards are designed to harmonize with international standards (IMO Marpol Annex VI). The Tier 4 standards are modeled after the 2007/2010 highway engine program and the Tier 4 nonroad rule, with an emphasis on the use of emission after treatment technology. For the purposes of this analysis, engine rules are assumed to affect harbor craft but not oceangoing vessels, as the latter would likely be manufactured overseas and therefore would be exempt from the rule. To enable catalytic after treatment methods, the USEPA established a sulfur cap in marine fuels, limiting sulfur to 15 ppm in marine diesel fuel by June 2012. California also currently requires the use of diesel fuel with a sulfur content of 15 ppm or less, which is applicable to all marine vessels.

1.4.2 State

California Clean Air Act. Although the CAA established national ambient air quality standards, individual states retained the option to adopt standards that are more stringent and to include other pollution sources. California passed the CCAA in 1988 (California Health and Safety Code Sections 39600 et seq.), which, like its federal counterpart, called for the designation of areas as attainment or nonattainment, but based on state ambient air quality standards rather than the federal standards. ***Table 1*** above shows there is considerable diversity between California's and the NAAQS, with the state ambient standards being at least as protective as national ambient standards and often more stringent.

Toxic Air Contaminants. The State Air Toxics Program was established in 1983 under Assembly Bill (AB) 1807 (Tanner). A total of 243 substances have been designated TACs under California law, including the 189 (federal) HAPs adopted in accordance with AB 2728. The Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588) seeks to identify and evaluate risk from air toxics sources; however, AB 2588 does not regulate air toxics emissions. In August 1998, CARB identified DPM emissions from diesel-fueled engines as TACs. CARB subsequently developed the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles (CARB 2000). The document represents proposals to reduce diesel particulate emissions, with the goals of reducing emissions and associated health risks by 75 percent in 2010 and by 85 percent in 2020.

CARB Regulation to Reduce Emissions from Diesel Engines on Commercial Harbor Craft. In November 2007, CARB adopted a regulation to reduce DPM and NO_X emissions from new and in-use commercial harbor craft. Under CARB's definition, commercial harbor craft include tug boats, tow boats, ferries, excursion vessels, work boats, crew boats, and fishing vessels. The regulation implemented stringent emission limits on harbor craft auxiliary and propulsion engines. In 2010, CARB amended the regulation to add specific in-use requirements for barges, dredges, and crew/supply vessels.

CARB California Diesel Fuel Regulation 28. With this rule, CARB set sulfur limitations for diesel fuel sold in California for use in on-road and off-road motor vehicles (CCR Title 13, Sections 2281–2285; CCR Title 17, Section 93114). Harbor craft and intrastate locomotives were originally excluded from the rule, but were later included by a 2004 rule amendment (CARB 2005). Under this rule, diesel fuel used in motor vehicles, except harbor craft and intrastate locomotives, has been limited to 500-ppm sulfur since 1993. The sulfur limit was reduced to 15 ppm on September 1, 2006. A federal diesel rule similarly limited sulfur content nationwide to 15 ppm by October 15, 2006.

CARB Regulations for Fuel Sulfur and Other Operational Requirements for OGVs within California Waters and 24 Nautical Miles of the California Baseline. In 2008, CARB adopted a Clean Fuel Regulation for Ocean Going Vessels within 24 nautical miles of the California coast to further reduce emissions from shipping. Since then, the permitted sulfur content of marine gas oil and marine diesel oil has been progressively lowered and since 2014 may not exceed 0.1 percent. CARB passed a rule in 2014 that allows marine vessels to be considered in compliance with the California Ocean Going Fuel Regulation when they are complying with the North American Emission Control Area using alternative emission control technologies or non-distillate low sulfur (less than or equal to 0.1 percent sulfur) marine fuels.

1.4.3 Regional

California's air quality is monitored and regulated at the state level by CARB and at the local and regional level by air pollution control authorities known as Air Pollution Control Districts (APCD) or Air Quality Management Districts (AQMD). The air districts roles include developing clean air plans and CEQA guidance.

BAAQMD Rules, Regulations, and CEQA Guidelines. BAAQMD is the regional agency responsible for rulemaking, permitting, and enforcement activities affecting stationary sources in the Bay Area. BAAQMD does not have the authority to regulate emissions from personal motor vehicles. Specific rules and regulations adopted by BAAQMD limit the emissions that can be generated by emission sources and identify specific pollution reduction measures that must be implemented in association with various activities. These rules regulate not only emissions of the six criteria air pollutants, but also TAC emission sources, which are regulated through BAAQMD's permitting process and standards of operation.

BAAQMD adopted updated CEQA Air Quality Guidelines, including new thresholds of significance in June 2010, and revised them in May 2011. The CEQA Air Quality Guidelines advise lead agencies on how to evaluate potential air quality impacts, including establishing quantitative and qualitative thresholds of significance. The thresholds BAAQMD adopted were set aside by an Alameda County Superior Court ruling in March 2012. In May 2012, BAAQMD updated its CEQA Air Quality Guidelines to continue to provide direction on recommended analysis methodologies, but without recommended quantitative significance thresholds (BAAQMD 2012). On August 13, 2013, the First District Court of Appeal ordered the trial court to reverse the judgment and upheld BAAQMD's CEQA thresholds. This case is now pending before the California Supreme Court, and BAAQMD has not formally re-instated the thresholds. While the 2011 significance thresholds are not currently recommended by the BAAQMD, these thresholds are based on substantial evidence identified in BAAQMD's 2009 Justification Report (BAAQMD 2009) and are, therefore, used within the analysis presented in this report.

YSAQMD's Applicable Rules, Regulations, and CEQA Guidelines. The YSAQMD is the regional agency responsible for rulemaking, permitting and enforcement activities affecting stationary sources in the Yolo and Solano County portion of the SVAB. Its authority and specific rules and regulations and permitting processes mirror those of the BAAQMD. YSAQMD adopted its Handbook for Assessing and Mitigating Air Quality Impacts, including new thresholds of significance, in July 2007 (YSAQMD 2007). The guidelines advise lead agencies on how to evaluate potential air quality impacts, including establishing quantitative and qualitative thresholds of significance.

SJVAPCD's Applicable Rules, Regulations, and CEQA Guidelines. The SJVAPCD is the regional agency responsible for rulemaking, permitting, and enforcement activities affecting stationary sources throughout the San Joaquin Valley Air Basin. Its authority and specific rules and regulations and permitting processes mirror those of the BAAQMD and YSAQMD. SJVAPCD updated its Guidance for Assessing and Mitigating Air Quality Impacts, including new thresholds of significance, in March 2015 (SJVAPCD 2015). The guidelines advise lead agencies on how to evaluate potential air quality impacts, including establishing quantitative and qualitative thresholds of significance.

1.5 Climate change

1.5.1 Federal Regulatory Setting

The federal government administers a wide array of programs designed to reduce the United States' GHG emissions. These programs focus on energy efficiency, renewable energy, non-CO_2 gases, and implementation of technologies designed to achieve GHG reductions.

Greenhouse Gas Endangerment Finding (December 7, 2009). The 2007 U.S. Supreme Court decision (*Massachusetts et al. v. Environmental Protection Agency et al. 2007*), gave the USEPA the authority to regulate GHGs as air pollutants under the federal Clean Air Act (CAA).

GHG Tailoring Rule (adopted May 13, 2010; 40 CFR, Parts 51, 52, 70, and 71). The USEPA set GHG emissions thresholds to define when permits under the New Source Review Prevention of Significant Deterioration (PSD) and Title V Operating Permit programs are required for new and existing industrial facilities. This final rule tailors the requirements of these CAA permitting programs to limit covered facilities to the nation's largest GHG emitters: power plants; refineries; and cement production facilities. Although not directly applicable, this rule highlights the USEPA's effort to regulate GHG emissions.

Council on Environmental Quality (CEQ) NEPA Guidance on Consideration of Effects of Climate Change and GHG Emissions. In February 2010, the CEQ released a guidance memorandum on the ways in which federal agencies can improve their consideration of the effects of GHG emissions and climate change in their evaluation of proposals for federal actions under NEPA (CEQ 2010). The guidance was intended to help explain how agencies of the federal government should analyze the environmental effects of GHG emissions and climate change when they describe the environmental effects of a proposed agency action in accordance with Section 102 of NEPA and the CEQ Regulations for Implementing the Procedural Provisions of NEPA, 40 CFR parts 1500-1508. The guidance affirmed the requirements of the statute and regulations and their applicability to GHGs and climate change impacts. The CEQ proposed to advise federal agencies that they should consider opportunities to reduce GHG emissions caused by proposed federal actions, adapt their actions to climate change impacts throughout the NEPA process, and address these issues in their agency NEPA procedures.

The guidance advised federal agencies to consider whether analysis of the direct and indirect GHG emissions from their proposed actions may provide meaningful information to decision makers and the public. Specifically, if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons per year (mtpy) or more of CO_2-equivalent GHG emissions, agencies should consider this an indicator that a quantitative and qualitative effects assessment may be meaningful to decision makers and the public. The guidance identified a reference point of 25,000 mtpy of direct CO_2-equivalent GHG emissions as an indicator that the proposed federal action's anticipated GHG emissions warrant detailed consideration in a NEPA review. The guidance did not propose this reference point as an indicator of a level of GHG emissions that may significantly affect the quality of the human environment, but rather as a minimum standard for reporting emissions under the CAA.

In 2014, CEQ released revised draft guidance updating how federal departments and agencies should consider the effects of GHG emissions and climate change in NEPA reviews (CEQ 2014). The revised draft guidance supersedes the draft GHG and climate change guidance released by CEQ in February 2010. This guidance explains that agencies should consider both the potential effects of a proposed action on climate change, as indicated by its estimated GHG emissions, and the implications of climate change on the environmental effects of a proposed action. The guidance also emphasizes that agency analyses should be commensurate with projected GHG emissions and climate impacts, and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available to inform the public and the decision-making process in distinguishing between alternatives and mitigation. It recommends that agencies consider 25,000 mtpy of CO_2-equivalent emissions as a reference point below which a quantitative analysis of GHGs is not recommended unless it is easily accomplished based on available tools and data. Unlike the 2010 draft guidance, the revised draft guidance applies to all proposed federal agency actions.

1.5.2 State Regulatory Setting

Assembly Bill 32 - California Global Warming Solutions Act of 2006, Scoping Plan (2008), and Scoping Plan Update (2014). The California Global Warming Solutions Act of 2006, widely known as Assembly Bill (AB) 32, required the California Air Resources Board (CARB) to develop and enforce regulations for the reporting and verification of statewide GHG emissions. CARB was directed to set a GHG emission limit, based on 1990 levels, to be achieved by 2020. The bill set a timeline for adopting a scoping plan for achieving GHG reductions in a technologically and economically feasible manner. AB 32 also required CARB to adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective GHG reductions.

On December 11, 2008, CARB adopted the AB 32 Scoping Plan, which set forth the framework for facilitating the state's GHG goal as described in Executive Order (EO) S-3-05 (CARB 2008). On October 20, 2011, CARB adopted the final cap-and-trade regulation. As part of finalizing the regulation, CARB considered the related environmental analysis (i.e., functional equivalent document) and written responses to environmental comments. CARB also approved an adaptive management plan to monitor progress of reductions and recommend corrective actions if progress is not as planned or if there are unintended consequences in other environmental areas (e.g., concentration of local criteria pollutants). In 2014, CARB adopted an update to the 2008 Scoping Plan that builds upon the initial Scoping Plan with new strategies and recommendations (CARB 2014b). The 2008 Scoping Plan and 2014 Scoping Plan Update requires that reductions in GHG emissions come from virtually all sectors of the economy and be accomplished from a combination of policies, planning, direct regulations, market approaches, incentives and voluntary efforts. These efforts target GHG emission reductions from cars and trucks, construction equipment, maritime vessels, electricity production, fuels, and other sources. The Scoping Plan includes recommendations for reducing GHG emissions from most sectors of the California economy; many of the Scoping Plan reduction measures can be advanced through local government actions.

Executive Order (EO) S-3-05. EO S-3-05, signed on June 1, 2005, established the following GHG reduction targets for California:

- By 2010, reduce GHG emissions to 2000 levels;
- By 2020, reduce GHG emissions to 1990 levels; and
- By 2050, reduce GHG emissions to 80 percent below 1990 levels.

EO S-3-05 also called for the California EPA to prepare biennial reports on: (1) progress made towards achieving these goals; (2) impacts to California from global warming; and (3) mitigation and adaptation plans to combat these impacts.

California Senate Bill 97 and Amendments. Senate Bill (SB) 97, enacted in 2007, directed the State Office of Planning and Research to develop CEQA Guidelines "for the mitigation of GHG emissions or the effects of GHG emissions." In December 2009, the Office of Planning and Research adopted amendments to the CEQA Guidelines, Appendix G Environmental Checklist, which created a new resource section for GHG emissions and indicated criteria that may be used to establish significance of GHG emissions.

1.5.3 Air District Climate Action Plans

California's air quality is monitored and regulated at the state level by the CARB and at the local and regional level by air pollution control authorities known as Air Pollution Control Districts (APCD) or Air Quality Management Districts (AQMD). Air districts are responsible for permitting all, except for vehicular, sources of air pollution. Under AB 32, air districts must develop plans to reduce regional GHG emissions in compliance with the state's GHG goal.

Bay Area Air Quality Management District: In November 2013, the Bay Area Air Quality Management District (BAAQMD) adopted a resolution to reduce GHG emissions. The resolution establishes three points of action: (1) a goal for the Bay Area region to reduce GHG emissions by 2050 to 80 percent below 1990 levels; (2) a Regional Climate Protection Strategy to make progress towards the 2050 goal using the BAAQMD's Clean Air Plan to initiate the process; and (3) a 10-point work program to guide the BAAQMD's climate protection activities in the near-term.

San Joaquin Valley Air Pollution Control District: The San Joaquin Valley Air Pollution Control District (SJVAPCD) adopted the Climate Change Action Plan (CCAP) in August 2008 to assist lead agencies in assessing and reducing the impacts of project-specific GHG emissions on global climate change. The CCAP relies on the use of performance-based standards, otherwise known as Best Performance Standards (BPS), to assess the significance of project-specific GHG emissions on global climate change. Projects implementing BPS are determined to have a less than significant impact. Otherwise, demonstration of a 29 percent reduction in GHG emissions from business-as-usual is required to classify a project's impact as less than significant.

In 2009, the SJVAPCD adopted its "Final Staff Report Climate Change Action Plan: Addressing GHG Emissions Impacts under CEQA." The SJVAPCD was not able to determine a specific quantitative level of GHG emissions increase above which a project would have a significant impact on the environment, and below which it would have an insignificant impact. SJVAPCD staff concluded that impacts of project-specific emissions on global climatic change are cumulative in nature, and that the significance of impacts should, therefore, be examined in that context. SJVAPCD requires all projects (including dredging) to reduce their GHG emissions, whether through project design elements or mitigation. Projects achieving performance-based standards that have been demonstrated to be BPSs would be considered to have a less than significant cumulative impact on global climate change (SJVAPCD 2008, 2009).

1.5.4 County Climate Plans

Under AB 32, counties must also develop plans to achieve the AB 32 mandate. The following plans would include those developed for the counties of Contra Costa, Marin, and Solano.

A summary of various climate action plans is as follows:

- **Contra Costa County**: In 2015, the County adopted its Climate Action Plan (CAP) (Contra Costa County 2015b). The draft Plan identifies specific measures to achieve a GHG reduction target of 15 percent below baseline levels by the year 2020.
- **Marin County**: The County Board of Supervisors adopted a Final CAP (Update 2015) and updated their emissions reduction target of 30 percent below 1990 levels by 2020 on November 10, 2015 (Marin County 2015).
- **Solano County**: The County adopted its CAP in June 2011 (Solano County 2011). The Plan establishes a GHG emissions reduction goal of 20 percent below 2005 levels by 2020, which exceeds guidance provided in the Scoping Plan and BAAQMD CEQA Guidelines.

1.6 Biological Resources

1.6.1 Federal Regulatory Setting

Fish and Wildlife Coordination Act. Under the Fish and Wildlife Coordination Act, any federal agency that proposes to control or modify any body of water must first consult with the USFWS or the NMFS, as appropriate, and with the head of the appropriate state agency exercising administration over wildlife resources of the affected state.

Endangered Species Act (16 United States Code [USC] 1531 et seq.), as amended. The federal ESA protects threatened and endangered species and their designated critical habitat from unauthorized take. Section 9 of the ESA defines take as to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” Take incidental to otherwise lawful activities can be authorized under Section 7 of the ESA when there is federal involvement and under Section 10 when there is no federal involvement. The USFWS and the NMFS share responsibilities for administering the ESA. The ESA consultation would occur under Section 7. The outcome of the consultation would determine whether a “take authorization” would be required.

Magnuson-Stevens Fishery Conservation and Management Act (16 USC Section 1801 et seq.; Pub. L. 104-297; Pub. L. 109-479). The 1996 amendments to the Magnuson-Stevens Act require federal agencies that fund, permit, or carry out activities that may adversely impact EFH of commercial fishery managed species to consult with the NMFS on the potential adverse effects of their actions on EFH. The NMFS is required to comment and provide conservation recommendations for any activity (either federal or state agency-sponsored) that could impact EFH. The USACE, acting as the federal nexus, would consult with the NMFS for actions. Through the consultation process, the NMFS will provide the USACE with Conservation Recommendations to avoid, offset, or compensate for impacts to EFH and EFH-managed species. Conservation Recommendations agreed upon by the USACE and the NMFS will be incorporated into the Final EIS/EIR.

Marine Mammal Protection Act (16 USC 1361 et seq.). The Marine Mammal Protection Act (MMPA) was enacted on October 21, 1972, and was reauthorized by the MMPA amendments of 1994 (Public Law 103-238). Under the MMPA, all species of marine mammals are protected. The MMPA prohibits, with certain exceptions, the “take” of marine mammals. Under the MMPA, take is defined as the means “to hunt, harass, capture, or kill, or attempt to hunt, harass, capture, or kill.” Harassment is defined as:

> "…any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild; or that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering."

Under Section 101(a)(5)(D), an incidental harassment permit may be issued for activities other than commercial fishing that may impact small numbers of marine mammals. The project is not expected to result in impacts to marine mammals.

Executive Order 11990: Protection of Wetlands. This order (42 FR 26961, May 25, 1977) requires federal agencies to minimize destruction of wetlands when managing lands, when administering federal programs, or when undertaking construction. Agencies are also required to consider the effects of federal actions on the health and quality of wetlands. The dredge footprint does not include wetlands and placement sites have been pre-approved for use. Therefore, wetlands would not be directly affected by the project.

Executive Order 13112: Invasive Species. The purpose of this order is to prevent the introduction of invasive species and to provide control for the spread of invasive species that have already been introduced. This order states that the federal government:

> "…shall, to the extent practicable and permitted by law, not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

The project would need to manage ballast water in consideration of invasive species effects.

1.6.2 State Regulatory Setting

California Endangered Species Act of 1974, as amended. The CESA provides for the protection of CDFG-recognized rare, threatened, and endangered plants and animals and prohibits take of such species without CDFG authorization under Section 2081 of the Fish and Game Code. The lead agencies must consult with the CDFG during the CEQA process if state listed threatened or endangered species are present and could be affected by a project. For projects that could affect both state and federally listed species, compliance with the federal ESA satisfies the CESA as long as the CDFG determines that the federal incidental take authorization is consistent with the CESA under the Fish and Game Code Section 2080.1. The CESA includes a requirement for full mitigation for take of listed species, and no net impacts to listed species may occur under the CESA. The CESA defines impacts that must be minimized and fully mitigated as "all impacts on the species that result from any act that would cause the proposed taking (CESA Sec. 2081[b][2])." It goes on to require mitigation measures be "roughly proportional" to the impacts caused by a project (CESA 2052.1 Sec. 2081[b]). The CESA consultation would need to occur for both Phases I and II to obtain approval and develop mitigation strategies for effects to CESA listed species.

D-1641 Water Rights Decision. The D-1641 water rights decision (hereafter referred to as D-1641), which was passed in 1999, describes the salinity criteria established for the Delta to meet municipal, industrial, agricultural, and biological requirements. D-1641 is based on observations that the abundance or survival of several estuarine biological populations in the San Francisco Estuary is positively related to freshwater flow (Jassby et al. 1995; Kimmerer et al. 2009, 2013). D-1641 stipulates salinity requirements as chloride concentration for municipal and industrial uses, and as electrical conductivity (EC) for agricultural and fish and wildlife uses. The abundance or survival of several estuarine biological populations in the San Francisco Estuary have historically been positively related to freshwater flow, as indexed by the position of the daily averaged 2 practical salinity unit (psu) near-bed (i.e., bottom) salinity, referred to as X2 (Jassby et al. 1995). In 1995, the State Water Resources Control Board adopted X2 as a water quality standard to help restore the relationship between springtime precipitation and the geographic location and extent of estuarine habitat. As implemented in D-1641, this standard requires freshwater inflows to the Bay sufficient to maintain X2 at specific locations for specific numbers of days each month during the spring (February through June). The objective of this "Spring X2" requirement is to help restore the relationship between springtime precipitation and the geographic location and the extent of estuarine habitat.

1.6.3 Local Regulatory Setting

Suisun Marsh Habitat Management, Preservation, and Restoration Plan. The Suisun Marsh Habitat Management, Preservation, and Restoration Plan is a 30-year plan being led by a consortium of federal and state agencies that is intended to balance tidal wetland restoration values among environmental benefits such as salt marsh harvest mouse habitat, managed wetlands, public use, and upland habitat. This is achieved through ESA and CESA compliance, managed wetland activities, restoration activities, and maintenance activities related to certain SWP and CVP mitigation commitments. The principal component of the plan is the restoration of 7,000 acres of tidal salt marsh in Suisun Bay. The project would not conflict with this plan.

Regional Habitat Conservation Plans. The study area is within the coverage area of several Habitat Conservation Plans (HCPs). HCPs provide a pathway forward to balance wildlife conservation with development. The primary objective of the HCP program is to conserve species and the ecosystems they depend on while streamlining permitting for economic development. Regional HCPs are developed in order to anticipate, prevent, and resolve controversies and conflict associated with project-by-project permitting.

City and County General Plans. Most county and city General Plans within the study area contain a conservation element outlining policies and goals for preservation of natural resources. These may include policies such as preservation of heritage trees, protection of sensitive habitat types, and protection of sensitive flora and fauna, among others.

1.7 Land Use and Planning

1.7.1 Federal Regulatory Setting

Coastal Zone Management Act. The Coastal Zone Management Act, established in 1972 and administered by NOAA's Office of Ocean and Coastal Resource Management, provides for management of the nation's coastal resources. The overall purpose is to balance competing land and water use issues in the coastal zone. The Coastal Zone Management Act encourages states to develop coastal management programs. Under the Coastal Zone Management Act, any federal agency conducting or supporting activities directly affecting the coastal zone must proceed in a manner consistent with the federally approved state coastal zone management programs, to the maximum extent practicable.

Commerce Clause of the Constitution. Navigable servitude is a United States constitutional doctrine that gives the federal government the right to regulate navigable waterways as an extension of the Commerce Clause of the United States Constitution. The federal navigational servitude entitles the government to exert a dominant servitude in all lands below the ordinary high water mark of navigable waters.

Submerged Lands Act. The Submerged Lands Act of 1953 (43 USC § 1301 et seq.) grants states title to all submerged navigable lands within their boundaries. This includes navigable waterways, such as rivers, as well as marine waters within the state's boundaries, generally three geographical miles from the coastline. In compliance with this Act, the California State Land Commission (CSLC) will receive a copy of this EIS/EIR and will have the opportunity to comment on its potential impacts to submerged lands.

1.7.2 State Regulatory Setting

California Environmental Quality Act. The California Environmental Quality Act (CEQA- California Public Resources Code Sections 21000-21178) and the CEQA Guidelines (14 California Code of Regulations 15000-15387) are the primary policies that require projects to analyze potential impacts to land use, as well as to analyze a project's consistency with land use planning policies applicable to that project. This report fulfills the requirements of CEQA and the CEQA Guidelines.

Public Trust Doctrine. The CSLC manages lands in California according to the Public Trust Doctrine. Several of the guiding principles of the Public Trust are:

I. Lands under the ocean and under navigable streams are owned by the public and held in trust for the people by the government. These are referred to as public trust lands, and include filled lands formerly under water. Public trust lands cannot be bought and sold like other state-owned lands. Only in rare cases may the public trust be terminated, and only when consistent with the purposes and needs of the trust.

II. Uses of trust lands, whether granted to a local agency or administered by the state directly, are generally limited to those that are water-dependent or related, and include commerce, fisheries, and navigation, environmental preservation and recreation. Public trust uses include, among others, ports, marinas, docks and wharves, buoys, hunting, commercial and sport fishing, bathing, swimming and boating. Public trust lands may also be kept in their natural state for habitat, wildlife refuges, scientific study, or open space. Ancillary or incidental uses are also permitted—that is, uses that directly promote trust uses such as those directly supportive and necessary for trust uses or those that accommodate the public's enjoyment of trust lands.

III. Because public trust lands are held in trust for all citizens of California, they must be used to serve statewide, as opposed to purely local, public purposes.

California Coastal Act. The California Coastal Act includes specific policies (Division 20 of the California Public Resources Code) for planning and regulatory decisions made by the California Coastal Commission and local governments. The California Coastal Act regulates development activities, such as the construction of buildings, division of lands, and activities that change the intensity of use of land or public access to coastal waters. The coastal zone established by the California Coastal Act does not include San Francisco Bay. Development in the Bay system is regulated by the San Francisco Bay Conservation and Development Commission (BCDC). The San Francisco BCDC is responsible for reviewing consistency determinations under the Coastal Zone Management Act in San Francisco Bay. For activities outside of the Golden Gate National Recreation Area, consistency determinations are reviewed by the California Coastal Commission.

McAteer-Petris Act. The McAteer-Petris Act (California Government Code Section 66000, et seq.), first enacted in 1965, created the San Francisco BCDC to prepare a plan to protect the San Francisco Bay and shoreline, and provide for appropriate development and public access. This Act directs San Francisco BCDC to exercise its authority to issue or deny permit applications for placing fill; dredging; or changing the use of any land, water, or structure in the area of its jurisdiction. The San Francisco BCDC also reviews determinations of consistency with the Coastal Zone Management Act for federally sponsored projects. The San Francisco Bay Plan (BCDC 2008) is the San Francisco BCDC's policy document specifying goals, objectives, and policies for the BCDC's jurisdictional areas. Pursuant to the federal Coastal Zone Management Act, the USACE is required to be consistent to the maximum extent practicable with the enforceable policies of the San Francisco Bay Plan.

1.7.3 Local Regulatory Setting

General Plans for each County contain a land use element, which functions as a blueprint for short- and long-term community goals and policies for development and conservation.

1.8 Mineral Resources

1.8.1 Federal Regulatory Setting

There are no applicable federal regulatory requirements with regards to mineral resources.

1.8.2 State Regulatory Setting

California Surface Mining and Reclamation Act. The California Surface Mining and Reclamation Act (SMARA) of 1975 mandates mineral resource zone classifications by the State Geologist in order to help identify and protect mineral resources in areas within the State subject to urban expansion or other irreversible land uses that would preclude mineral extraction. SMARA also allows the State Mining and

Geology Board to designate lands containing mineral deposits of regional or statewide significance after receiving classification information from the State Geologist. The law provides for significant mineral resources to be recognized and considered before land use decisions are made that compromise the availability of these resources.

1.8.3 Local Regulatory Setting

General Plans for each county have established mineral resource policies to ensure the continued viability of mineral extraction operations while minimizing impacts on surrounding land uses and the environment.

1.9 Agriculture

1.9.1 Federal Regulatory Setting

The Farmland Protection Policy Act of 1981 (CFR, 1990). This Act ensures that federal programs are compatible with state, local and private programs and policies to protect farmland. It calls for the use of the Land Evaluation and Site Assessment system developed by the NRCS in 1981.

1.9.2 State Regulatory Setting

California Land Conservation Act of 1965. The California Land Conservation Act or, the Williamson Act, allows owners of agricultural lands and open space to pay lower property tax on those lands in exchange for a ten-year agreement that the land will not be developed or otherwise converted to another use (California Farm Bureau Federation 2015) [CFBF]. The purpose of the Williamson Act is to control urban sprawl and protect valuable farmland and open space.

California Public Resources Code Section 21095. Section 21095 seeks “to provide lead agencies with an optional methodology to ensure that significant effects on the environment of agricultural land conversions are quantitatively and consistently considered in the environmental review process” (CDC 1997). The California Agricultural Land Evaluation and Site Assessment Model (Model) provides a quantitative methodology to assure that goal is met.

1.9.3 Local Regulatory Setting

County General Plans often include goals and policies regarding the protection of land used for agricultural production, such as a right-to-farm ordinance. General Plans include those developed for the counties of Contra Costa, Marin, and Solano; and the cities of Richmond, Pinole, Hercules, Martinez, Tiburon, and Vallejo. Dredging activities would occur in navigable waters outside of these plan areas.

1.10 Aesthetics

1.10.1 Federal Regulatory Setting

Currently no federal policies and/or mandates related to aesthetics exist.

1.10.2 State Regulatory Setting

Currently no state policies and/or mandates related to aesthetics exist.

1.10.3 Local Regulatory Setting

The General Plans of the cities and counties occurring within the study area may include goals and policies regarding aesthetics and urban design of structures and development. Since the proposed navigation project would not include the construction or alteration of any structures, the General Plan goals and policies regarding aesthetics and structural design would not be applicable.

1.11 Cultural Resources and Native American Trust Assets

1.11.1 Federal Regulatory Setting

Applicable federal laws regarding cultural resources are summarized below:

Executive Order 13158. This EO requires federal agencies to: (1) identify actions that affect natural or cultural resources occurring within a Marine Protected Area (MPA); and (2) avoid harm to the natural and cultural resources that are protected by a MPA when taking actions in such areas.

National Historic Preservation Act (NHPA) (16 USC 470 et seq.). The 1966 National Historic Preservation Act (NHPA) set forth national policy for recognizing and protecting historic properties. It established the National Register of Historic Places (NRHP), State Historic Preservation Officers and programs, and the Advisory Council on Historic Preservation. Under Section 106 of the Act, federal agencies are required to take into account the effects of their undertakings on historic properties and provide the Advisory Council on Historic Preservation an opportunity to comment on those undertakings.

The NRHP is the nation's master inventory of historic places deemed worthy of preservation. It is administered by the U.S. National Parks Service and includes listings of buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archaeological, or cultural significance at the national, state, or local level.

Such resources over 50 years of age can be listed in the NRHP as significant historic resources. However, properties under 50 years of age that are of exceptional importance, or are contributors to a district, can also be included in the NRHP.

The significance of cultural resources is defined in 36 Code of Federal Regulations (CFR) 60.4 as follows:

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and

1. that are associated with events that have made a significant contribution to the broad patterns of history;
2. that are associated with the lives of persons significant in our past;

3. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

4. that have yielded or may likely yield information important in prehistory or history.

Integrity refers to a property's ability to convey its historical significance. There are seven aspects of integrity: location, design, setting, materials, workmanship, feeling and association. The importance and applicability of these qualities depend upon the historical significance of the resource and the nature of its character-defining features (U.S. National Parks Service 1997).

Under federal regulations (36 CFR 800.5), an adverse effect occurs when a project alters directly or indirectly, any of the characteristics of a historic property that qualifies that property for inclusion on the NRHP in a way that diminishes the integrity of the property. Adverse effects on historic properties include, but are not limited to, the following:

- physical destruction of all or part of the property;
- alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, and hazardous material remediation, that is not consistent with the Secretary of the Interior's Standards for the Treatment of Historic Properties;
- removal of the property from its historic location;
- change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance; or
- introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features (36 CFR 800.5).

1.11.2 State Regulatory Setting

Applicable state laws regarding cultural resources are found below:

California Environmental Quality Act (CEQA). State historic preservation regulations that apply to this analysis include the statutes and guidelines contained in CEQA, under Public Resources Code (PRC), Sections 20183.2 and 21084.1 and Section 15064.5 of the CEQA Guidelines. Per CEQA, public agencies must consider the effects of their actions on both "historical resources" and "unique archaeological resources." Pursuant to PRC Section 21084.1, a "…project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment."

"Historical resource" is a term with a defined statutory meaning (PRC, Section 21084.1). Under CEQA Guidelines Section 15064.5(a), historical resources include the following:

1. A resource listed in, or determined to be eligible by the State Historical Resources Commission, for listing in the California Register of Historical Resources (CRHR) (PRC, Section 5024.1).

2. A resource included in a local register of historical resources, as defined in Section 5020.1(k) of the PRC or identified as significant in a historical resource survey meeting the requirements of Section 5024.1(g) of the PRC, will be presumed to be historically or culturally significant. Public agencies must treat any such resource as significant unless the preponderance of evidence demonstrates that it is not historically or culturally significant.

3. Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be a historical resource, provided the lead agency's determination is supported by substantial evidence in light of the whole record. Generally, a resource will be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing in the CRHR (PRC, Section 5024.1), including the following:

    a. is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;

    b. is associated with the lives of persons important in our past; or

    c. embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or may be likely to yield, information important in prehistory or history.

4. The fact that a resource is not listed in, or determined to be eligible for listing in the CRHR, not included in a local register of historical resources (pursuant to Section 5020.1(k) of the PRC), or identified in a historical resources survey (meeting the criteria in Section 5024.1(g) of the PRC) does not preclude a lead agency from determining that the resource may be an historical resource as defined in PRC Section 5020.1(j) or 5024.1.

Properties listed, or formally designated as eligible for listing, on the NRHP are automatically listed on the CRHR, as are certain State Landmarks and Points of Interest.

CEQA also requires lead agencies to consider whether projects will impact "unique archaeological resources." Public Resources Code Section 21083.2, subdivision (g), states that a unique archaeological resource is an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:

1. contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information;

2. has a special and particular quality such as being the oldest of its type or the best available example of its type; or

3. is directly associated with a scientifically recognized important prehistoric or historic event or person.

Public Resources Code § 5097.9. Section 5097.9 of the California PRC states that:

"…No public agency, and no private party using or occupying public property, or operating on public property, under a public license, permit, grant, lease, or contract made on or after July 1, 1977, shall in any manner whatsoever interfere with the free expression or exercise of Native American religion as provided in the U.S. Constitution and the California Constitution; nor shall any such agency or party cause severe or irreparable damage to any Native American sanctified cemetery, place of worship, religious or ceremonial site, or sacred shrine located on public property, except on a clear and convincing showing that the public interest and necessity so require."

According to Section 15064.5 of the CEQA Guidelines, all human remains are a significant resource. That Section also assigns special importance to human remains and specifies procedures to be used when Native American remains are discovered. These procedures are spelled out under PRC Section 5097.

Health and Safety Code § 7050.5. Section 7050.5 of the California Health and Safety Code states that it is a misdemeanor to knowingly disturb a human grave. In the event that human graves are encountered, work should halt in the vicinity and the County Coroner should be notified immediately. At the same time, an archaeologist should be contacted to evaluate the situation. If human remains are of Native American origin, the Coroner must notify the Native American Heritage Commission within 24 hours of this identification.

1.11.3 Local Regulatory Setting

The General Plans of the cities and counties occurring within the study area may include goals and policies regarding cultural resources. Since the proposed navigation project would not include the construction or alteration of any structures or the alteration of any historic settings, General Plan goals and policies regarding historic buildings or structures would not be applicable.

1.12 Environmental Justice and Community Effects

1.12.1 Federal Regulatory Setting

Presidential Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. EO 12898 requires all federal agencies to "…make achieving environmental justice part of [their] mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

The EO directs federal agencies to perform the following activities:

- Analyze the environmental effects, including human health, economic, and social effects, of federal actions, including the effects on minority and low-income communities, when required by the NEPA,
- Provide opportunities for community input during the NEPA process, including potential effects and mitigation measures, and

- Ensure that the public, including minority and low-income communities, have adequate access to public information relating to human health or environmental planning, regulations, and enforcement.

Title VI of the Civil Rights Act of 1964 (42 U.S. Code 2000). Title VI prohibits discrimination based on race, color, sex, and national origin in the provision of benefits and services resulting from federally assisted programs and activities.

Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks. EO 13045 requires federal agencies to prioritize the identification and assessment of environmental health risks and safety risks that may disproportionately affect children and ensure that policies, programs, and standards address disproportionate environmental health or safety risks to children that result from a project (68 FR 19931).

1.12.2 State Regulatory Setting

California Public Resources Code Section 71113. On the state level, Public Resources Code Section 71113 states that the mission of the California Environmental Protection Agency includes ensuring that any activities substantially affecting human health or the environment are conducted in a manner guaranteeing the fair treatment of people of all races, cultures, and income levels, including minority and low income populations. This state statute is applicable because both require CEQA review.

1.13 Navigation, Transportation, and Circulation

1.13.1 Federal Regulatory Setting

Navigational Rules. Under Title 14 and Title 33 of the United States Code (USC), the USCG has authority for maritime law enforcement and rule-making with regard to navigation, as well as responsibility for search and rescue on the navigable waters of the United States.

USCG Vessel Traffic Service, San Francisco (Vessel Traffic Service) implements this authority in the study area. Located on Yerba Buena Island, Vessel Traffic Service designates traffic lanes for inbound and outbound vessel traffic, specifies separation zones between vessel traffic lanes, and governs vessels entering and leaving ports (USCG 2015). Although small and private vessels are not required to coordinate their movements by contacting Vessel Traffic Service, the USCG monitors all commercial, U.S. Navy, and most private marine traffic in San Francisco Bay from local coastal waters to the Ports of Stockton and Sacramento.

The Inland Navigational Rules Act of 1980 (Public Law 96-591, 94 Statute 3415, 33 CFR 83), more commonly known as the Inland Rules, governs many rivers, lakes, harbors, and inland waterways. The International Regulations for Preventing Collision at Sea have also been incorporated into federal regulations (Public Law 95-75, 91 Statute 308, 33 USC 1-8). Together, these regulations (known as the Rules of the Road) govern open bodies of water to promote navigational safety, including requirements for steering and sailing practices, navigation lights and day-shapes, and sound signals for both good and restricted visibility.

These navigational rules govern marine transportation throughout the shipping channels in the study area.

America's Marine Highways Program. The Energy Independence and Security Act of 2007 established the America's Marine Highways Program, a U.S. Department of Transportation (USDOT) initiative to expand the use of waterborne transportation to relieve landside congestion and to reduce carbon emissions. America's Marine Highways are defined as navigable waterways that have demonstrated the ability to provide additional capacity to relieve congested landside routes serving freight and passenger movement (USDOT 2015a).

Section 405 of the Coast Guard and Maritime Transportation Act of 2012 further expanded the scope of the program beyond reducing landside congestion to efforts that generate public benefits by increasing the use or efficiency of domestic freight or passenger transportation on Marine Highway Routes between ports in the United States. Sponsors in the private sector or state/local governments develop and operate marine highway services.

The study area includes the Marine Highway 580 Connector, a spur of Marine Highway 5, which serves the entire West Coast. Marine Highway 580 begins in Oakland, California, includes the San Joaquin and Sacramento rivers, and connects commercial navigation channels, ports, and harbors in Central California. Using Marine Highway 580 to its full capacity has the potential to save 7 million gallons of fuel and reduce congestion between the Port of Oakland and destinations in the San Joaquin Valley (USDOT 2015b).

1.13.2 State Regulatory Setting

California Harbors and Navigation Code. The California Harbors and Navigation Code vests authority with the Department of Boating and Waterways (DBW) to regulate matters of navigational safety for the state's boating public. The code establishes laws and regulations governing the equipment and operation of vessels on waters of the state, including the study area.

1.14 Noise

1.14.1 Federal Regulatory Setting

Noise Control Act (42 USC 4910). This Act required the USEPA to establish noise emission criteria, as well as noise testing methods (40 CFR Chapter 1, Subpart Q). These criteria generally apply to interstate rail carriers and to some types of construction and transportation equipment. Guidelines published by the USEPA (1974) contained recommendations for acceptable noise level limits affecting residential land use of 55 dBA (L_{dn}) for outdoors and 45 dBA (L_{dn}) for indoors.

Department of Housing and Urban Development Environmental Standards (24 CFR Part 51). These regulations set forth the following exterior noise standards for new home construction:

- 65 L_{dn} or less – Acceptable
- 65 L_{dn} to < 75 L_{dn} – Normally unacceptable (appropriate sound attenuation measures must be provided)

- 75 L_{dn} – Unacceptable

For interior noise levels, a goal of 45 dBA is set forth and attenuation requirements are geared to achieve that goal.

Federal Transit Administration's (USFTA) Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06). These guidelines provide a commonly accepted industry standard for analysis of construction noise impacts.

National Technical Information Service (NTIS) 550\9-74-004, 1974 ("Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety"). Commonly referenced as the, "Levels Document," this USEPA guidance established an L_{dn} of 55 dBA as the safe level of environmental noise exposure for areas of outdoor uses including residences and recreation areas. The USEPA guidance should not be construed as standards or regulations because technical or economic feasibility or other potentially relevant considerations may need to be taken into account for a particular project or activity.

1.14.2 State Regulatory Setting

Currently no state policies and/or mandates related to noise exist.

1.14.3 Local Regulatory Setting

City and county General Plans include goals and policies regarding noise. However, local noise regulations are not applicable to navigation improvements, because they apply only to development projects on land within the jurisdiction of the cities and counties.

1.15 Public Health and Environmental Hazards

1.15.1 Federal Regulatory Setting

Comprehensive Environmental Response, Compensation and Liability Act/Superfund Amendments and Reauthorization Act (CERCLA). CERCLA authorizes removal and remedial actions to clean up sites contaminated by hazardous substances. The National Oil and Hazardous Substances Pollution Contingency Plan outlines CERCLA's implementing regulations and provides the guidelines and procedures needed to respond to releases and threatened releases of hazardous substances at identified sites on the National Priority List. CERCLA regulations apply if the National Priority List sites would be affected by the alternatives.

Resource Conservation and Recovery Act (RCRA). RCRA provides for cradle-to-grave regulation of hazardous waste and addresses used oil management and recycling, storage of hazardous materials, underground storage tanks, handling of medical wastes, and disposal of hazardous waste. RCRA requires federal agencies to establish programs to procure recovered or recycled materials. Like CERCLA, RCRA regulations apply to projects that involve hazardous waste sites or are sites used for the storage of hazardous materials.

Toxic Substances Control Act. The Toxic Substances Control Act limits or prohibits the manufacture, processing, distribution, use and disposal of certain toxic substances. The Toxic Substances Control Act contains requirements specific to asbestos, indoor radon abatement and lead exposure reduction. Hazardous materials transported through the study area would be subject to these regulations.

Oil Pollution Act. The Oil Pollution Act (Title 33 USC Section 2701 et seq.) establishes a liability system for oil spills into navigable waters or adjacent shorelines that injure or are likely to injure natural resources and/or the services that those resources provide to the ecosystem or humans. Pursuant to this act, federal and state agencies and Native American tribes may act as trustees on behalf of the public to assess the injuries, scale restoration to compensate for those injuries, and implement restoration. Liability and restoration activities for oil spills in the study area would be determined based on this act.

Transportation of Hazardous Materials and Waste. Transportation of hazardous materials and hazardous waste is regulated by Title 40 CFR Section 260.10, which establishes Hazardous Waste Manifest System requirements. This includes requirements for forms, reports, and procedures to track movement of hazardous waste from the time it leaves the generator facility until it reaches the receiving waste management facility. Hazardous materials transported through the study area would be subject to these regulations.

Hazardous Materials Transportation Act. Enacted in 1975, the Hazardous Materials Transportation Act's (HMTA's) primary objective is to provide adequate protection against risks to life and property inherent in commercial transportation of hazardous materials. Hazardous materials, as defined by the Secretary of Transportation are any "particular quantity or form" of a material that "may pose an unreasonable risk to health and safety or property." HMTA governs safety aspects, including security, of the transportation of hazardous materials that the Secretary of the USDOT considers appropriate. Enforcement responsibility for the HMTA is shared by several agencies, including the Federal Highway Administration for motor carriers and the U. S. Coast Guard for shipments by water. Hazardous materials transported through the study area would be subject to these regulations.

1.15.2 State Regulatory Setting

California Hazardous Substance Account Act. The Carpenter-Presley-Tanner Hazardous Substance Account Act (California Health and Safety Code, Chapter 6.8), adopted in 1999, is the state equivalent of CERCLA. It requires past and present owners and operators to assume liability for the remediation of hazardous waste sites within California. Existing hazardous waste sites within and surrounding the study area are mandated to complete remediation in compliance with these requirements.

California Hazardous Waste Control Law. Administered by the CDTSC, the California Hazardous Waste Control Law (California Health and Safety Code Chapter 6.5 of Division 20) is the basic hazardous waste statute in California. It requires recycling and waste reduction programs for a range of hazardous wastes, with more stringent requirements than the similar federal RCRA requirements. This law applies to projects that involve hazardous waste sites or are sites used for the storage of hazardous materials.

California Department of Toxic Substances Control (CDTSC). The CDTSC administers laws and regulations related to hazardous waste and hazardous substances pursuant to Division 20, Chapters 6.5

and 6.8 of the California Health and Safety Code and Title 22 of the California Code of Regulations (CCR), which are the state equivalents of RCRA and CERCLA, respectively.

Regional Water Quality Control Board. The Regional Water Quality Control Board enforces laws and regulations governing releases of hazardous substances and petroleum pursuant to Division 20, Chapters 6.7, 6.75, and 6.8 of the California Health and Safety Code and the Porter-Cologne Water Quality Control Act (Division 7, Section 13100 et seq. of the California Water Code) and CCR Title 23. In particular, the Regional Water Quality Control Board focuses on all petroleum releases and those hazardous substance releases that may impact groundwater or surface water.

California Division of Occupational Safety and Health. The California Division of Occupational Safety and Health is responsible for assuring worker safety and assumes primary responsibility for developing and enforcing standards for safe workplaces and work practices. Regulations that specifically address protection of construction workers from exposure to hazardous substances are found in Title 8 of the CCR. These regulations would apply to any workers involved with dredging or placement of dredged materials.

California Office of Emergency Services. The California Office of Emergency Services administers the emergency response plan to coordinate emergency services provided by federal, state, and local government and private agencies. This includes responding to hazardous materials incidents. The California Office of Emergency Services is also the state administering agency for the California Accidental Release Prevention Program and California's Hazardous Materials Release, Response, and Inventory Law. In the event of an emergency during implementation of alternatives, emergency response plans developed by the California Office of Emergency Services would be implemented.

Oil Spill Prevention and Response Programs in California. Passed in 1990, the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act (California Government Code 8670.1 et seq.; California Public Resources Code 8750 et seq.) requires all marine facilities and vessels to comply with an integrated system of statewide regulations, operation manuals, inspections, training and drill programs. Compliance is aimed at providing the "best achievable protection" of the state's coastal and marine resources through the use of "best achievable technologies" and practices. Vessels and facilities operating within the study area would be required to comply with these requirements.

1.15.3 Local Regulatory Setting

Individual Certified Uniform Program Agencies. Certified Uniform Program Agencies are local government agencies responsible for implementing administrative requirements, permits, inspections and enforcements pertaining to hazardous waste and materials as required through the California Environmental Protection Agency Unified Program (a consolidation of six environmental programs at the local level). The Certified Uniform Program Agencies program streamlines and provides consistent regulatory activities, including inspections, permitting and enforcement related to hazardous materials management. ***Table 4*** identifies the Certified Uniform Program Agencies for each county in the study area.

Table 4. Certified Uniform Program Agencies for Study Area Counties

County	Certified Uniform Program Agencies

Contra Costa	Hazardous Materials Program
Marin	Public Works Department
Solano	Health Services Division
San Joaquin	Environmental Health Department
Sacramento	Environmental Management Department

San Francisco Bay Area Water Emergency Transportation Authority. In 2007, the California State Legislature authorized the San Francisco Bay Area Water Emergency Transportation Authority to oversee and operate a public water transit system in the San Francisco Bay Area. This resulted in the Authority creating and adopting in 2009 the Emergency Water Transportation System Management Plan for the San Francisco Bay Area. This plan integrates and complements the emergency plans of other agencies to ensure mobility in the San Francisco Bay Area following a major disaster.

San Francisco Bay Area Water Emergency Transportation Authority. City and county General Plans typically include a safety element that identifies and establishes policies and goals for minimizing exposure to local hazards. This often includes maps of hazard areas, general policies for minimizing hazards, and requirements to adhere to state and federal regulations. General Plans developed for Contra Costa, Marin, and Solano Counties and the cities of Richmond, Pinole, Hercules, Martinez, Tiburon, and Vallejo would apply. Dredging activities would occur in navigable waters outside of the areas covered by these plans.

Emergency Response Plans. Each of the counties within the study area maintains and implements its own emergency operations plans. This includes the Marin (Marin County Sheriff 2006), Contra Costa (2015), Solano (2012), Sacramento (2012) and San Joaquin (2012) Counties. These plans generally identify potential emergency hazards, prescribe emergency avoidance measures and outline response actions for emergencies. Several cities within the study area also coordinate their own emergency management services, often led by the police or fire departments.

1.16 Recreation

The federal, state, and local regulations discussed under Land Use and Planning also apply to recreational resources. These management plans, policies, and acts describe management guidelines for multiple land uses including recreation.

1.17 Socioeconomics

There are no known federal, state, or local regulatory requirements specifically related to socioeconomics.

1.18 Utilities and Public Services

1.18.1 Federal Regulatory Setting

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300). Authorized under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 USC 9605, as amended by the Superfund Amendments and Reauthorization Act of 1986, Public Law 99-499; and by the CWA Section 311(d), as amended by the Oil Pollution Act of 1990 (OPA), Public Law 101-380. The NCP outlines requirements for responding to both oil spills and releases of hazardous substances, including spills from underwater pipelines. It specifies compliance, but does not require the preparation of a written plan. It also provides a comprehensive system for reporting, spill containment, and cleanup. The U.S. Coast Guard and the USEPA co-chair the National Response Team. In accordance with 40 CFR 300.175, the U.S. Coast Guard has responsibility for oversight of regional response for oil spills in "coastal zones," as described in 40 CFR 300.120.

49 USC Section 60101 et seq. and 49 CFR Section 190.1. The U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration regulates interstate and intrastate hazardous liquids transmission pipelines. The Office of Pipeline Safety ensures safety in the design, construction, operation and maintenance, and spill response planning of oil, natural gas and hazardous liquid transportation per the duties regarding pipeline safety set forth in 49 USC Section 60101 et seq. and 49 CFR Section 190.1. The regulations apply to the owners and operators of the facilities and they cover the design, installation, inspection, emergency plans and procedures, testing, construction, extension, operation, replacement, and maintenance of pipeline facilities transporting oil, gas, and hazardous liquid. The regulations require operators of gas pipelines to participate in a public safety program, such as a one-call system to notify the operator of any proposed demolition, excavation, tunneling, or construction that would take place near or affect the facility.

1.18.2 State Regulatory Setting

State Fire Marshal, Pipeline Safety Division. The Office of the State Fire Marshal, Pipeline Safety Division, regulates the safety of approximately 5,500 miles (8,851 kilometers) of intrastate hazardous liquid (e.g., oil, gas) transportation pipelines and acts as an agent of the Federal Office of Pipeline Safety concerning the inspection of more than 2,000 miles (3,219 kilometers) of interstate pipelines. Pipeline safety staff inspects, tests, and investigates to ensure compliance with all federal and state pipeline safety laws and regulations. All spills, ruptures, fires, or similar incidents are responded to immediately and are investigated for cause.

California Code of Regulations: Title 23, Division 1, Article 8, Sections 111- 137. These standards govern the design and construction of encroachments that would affect flood control works and floodways, including limitations or approval requirements for placement of dredged material and channel excavation. Dredging of material from channel waterways generally must be confined to the area beyond 100 feet of the toe of the bank, and the slope of the borrow perimeter nearest the toe of the bank generally may not exceed five feet horizontal to one-foot vertical. Before any borrow operation (including dredging) is permitted within one mile of a bridge or 1,000 feet of any pipeline or cable crossing beneath any channel, a study must be submitted to show that the borrow operation will not adversely affect such facilities.

1.18.3 Local Regulatory Setting

There are no local regulatory requirements regarding utilities.

Appendix G – Attachment 4
United States Fish and Wildlife Coordination

Species List Request
Biological Assessment
Draft Fish and Wildlife Coordination Act Report (Draft CAR)
Final Fish and Wildlife Coordination Act Report (Final CAR)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
Phone: (916) 414-6600 Fax: (916) 414-6713

In Reply Refer To: November 27, 2017
Consultation Code: 08ESMF00-2018-SLI-0501
Event Code: 08ESMF00-2018-E-01377
Project Name: San Francisco Bay to Stockton Navigation Improvement Project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, under the jurisdiction of the U.S. Fish and Wildlife Service (Service) that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

Please follow the link below to see if your proposed project has the potential to affect other species or their habitats under the jurisdiction of the National Marine Fisheries Service:

http://www.nwr.noaa.gov/protected_species/species_list/species_lists.html

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

San Francisco Bay-Delta Fish And Wildlife
650 Capitol Mall
Suite 8-300
Sacramento, CA 95814
(916) 930-5603

Project Summary

Consultation Code: 08ESMF00-2018-SLI-0501

Event Code: 08ESMF00-2018-E-01377

Project Name: San Francisco Bay to Stockton Navigation Improvement Project

Project Type: DREDGE / EXCAVATION

Project Description: Deepen portions of the John F. Baldwin channel to 38 feet mean lower low water (MLLW), plus up to 2 feet of overdepth (for a total of 40 feet MLLW); this includes the Pinole Shoal and Bulls Head Reach Channels. The West Richmond Channel is also included in this project; however, it is currently below 38 feet MLLW and will not require deepening. Deepen a sediment basin in a portion of the Bulls Head Reach to 42 feet MLLW, plus up to 2 feed of overdepth (for a total of 44 feet MLLW). Beneficially use the dredged material at Cullinan Ranch, Montezuma Wetlands, or other permitted beneficial use site. Should sites not be able to take portions of the dredged material, the deep ocean disposal site, SF-DODS would be available as a back-up placement site. Deepening would be conducted with a mechanical clamshell dredge to reduce entrainment risk to species. Continue to maintenance dredge the deepened navigation channels on annual basis. Future maintenance dredging would use the respective project's federal standard dredge plant and placement site. The current federal standard for Pinole Shoal is dredging with a hopper dredge and placing material at SF-10. The federal standard for Bulls Head Reach is currently dredging with a clamshell and placing material at SF-16; however, a hopper dredge has been the federal standard in the past.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/37.894739958149756N122.40543628193376W

Counties: Alameda, CA | Contra Costa, CA | Marin, CA | Sacramento, CA | San Francisco, CA | Solano, CA | Sonoma, CA

Endangered Species Act Species

There is a total of 45 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse *Reithrodontomys raviventris* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/613	Endangered
San Joaquin Kit Fox *Vulpes macrotis mutica* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2873	Endangered
Southern Sea Otter *Enhydra lutris nereis* No critical habitat has been designated for this species. ***This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements.*** Species profile: https://ecos.fws.gov/ecp/species/8560	Threatened

Birds

NAME	STATUS
California Clapper Rail *Rallus longirostris obsoletus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern *Sterna antillarum browni* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8104	Endangered
Marbled Murrelet *Brachyramphus marmoratus* Population: U.S.A. (CA, OR, WA) There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/4467	Threatened
Northern Spotted Owl *Strix occidentalis caurina* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1123	Threatened
Short-tailed Albatross *Phoebastria (=Diomedea) albatrus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/433	Endangered
Western Snowy Plover *Charadrius alexandrinus nivosus* Population: Pacific Coast population DPS-U.S.A. (CA, OR, WA), Mexico (within 50 miles of Pacific coast) There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8035	Threatened
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **proposed** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Reptiles

NAME	STATUS
Alameda Whipsnake (=striped Racer) *Masticophis lateralis euryxanthus* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5524	Threatened
Giant Garter Snake *Thamnophis gigas* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4482	Threatened
Green Sea Turtle *Chelonia mydas* Population: East Pacific DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened

Amphibians

NAME	STATUS
California Red-legged Frog *Rana draytonii* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander *Ambystoma californiense* Population: U.S.A. (Central CA DPS) There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/321	Threatened
Tidewater Goby *Eucyclogobius newberryi* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/57	Endangered

Insects

NAME	STATUS
Bay Checkerspot Butterfly *Euphydryas editha bayensis* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2320	Threatened
Callippe Silverspot Butterfly *Speyeria callippe callippe* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3779	Endangered
Delta Green Ground Beetle *Elaphrus viridis* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2319	Threatened
Lange's Metalmark Butterfly *Apodemia mormo langei* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/4382	Endangered
Mission Blue Butterfly *Icaricia icarioides missionensis* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/6928	Endangered
San Bruno Elfin Butterfly *Callophrys mossii bayensis* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3394	Endangered
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7850 Habitat assessment guidelines: https://ecos.fws.gov/ipac/guideline/assessment/population/436/office/11420.pdf	Threatened

Crustaceans

NAME	STATUS
California Freshwater Shrimp *Syncaris pacifica* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7903	Endangered
Conservancy Fairy Shrimp *Branchinecta conservatio* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8246	Endangered
Vernal Pool Fairy Shrimp *Branchinecta lynchi* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/498	Threatened
Vernal Pool Tadpole Shrimp *Lepidurus packardi* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2246	Endangered

Flowering Plants

NAME	STATUS

Antioch Dunes Evening-primrose *Oenothera deltoides ssp. howellii* — Endangered

There is **final** critical habitat for this species. Your location is outside the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/5970

Colusa Grass *Neostapfia colusana* — Threatened

There is **final** critical habitat for this species. Your location is outside the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/5690

Contra Costa Goldfields *Lasthenia conjugens* — Endangered

There is **final** critical habitat for this species. Your location is outside the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/7058

Contra Costa Wallflower *Erysimum capitatum var. angustatum* — Endangered

There is **final** critical habitat for this species. Your location is outside the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/7601

Franciscan Manzanita *Arctostaphylos franciscana* — Endangered

There is **final** critical habitat for this species. Your location overlaps the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/5350

Keck's Checker-mallow *Sidalcea keckii* — Endangered

There is **final** critical habitat for this species. Your location is outside the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/5704

Marin Dwarf-flax *Hesperolinon congestum* — Threatened

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/5363

Marsh Sandwort *Arenaria paludicola* — Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/2229

Presidio Clarkia *Clarkia franciscana* — Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/3890

Presidio Manzanita *Arctostaphylos hookeri var. ravenii* — Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/7216

San Francisco Lessingia *Lessingia germanorum (=L.g. var. germanorum)* Endangered
No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/8174

Showy Indian Clover *Trifolium amoenum* Endangered
No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/6459

Soft Bird's-beak *Cordylanthus mollis ssp. mollis* Endangered
There is **final** critical habitat for this species. Your location overlaps the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/8541

Tiburon Jewelflower *Streptanthus niger* Endangered
No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/4187

Tiburon Mariposa Lily *Calochortus tiburonensis* Threatened
No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/2858

Tiburon Paintbrush *Castilleja affinis ssp. neglecta* Endangered
No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/2687

White-rayed Pentachaeta *Pentachaeta bellidiflora* Endangered
No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/7782

Critical habitats

There are 2 critical habitats wholly or partially within your project area under this office's jurisdiction.

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* https://ecos.fws.gov/ecp/species/321#crithab	Final
Franciscan Manzanita *Arctostaphylos franciscana* https://ecos.fws.gov/ecp/species/5350#crithab	Final

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay-Delta Fish And Wildlife
650 Capitol Mall
Suite 8-300
Sacramento, CA 95814
Phone: (916) 930-5603 Fax: (916) 930-5654
http://kim_squires@fws.gov

In Reply Refer To: November 27, 2017
Consultation Code: 08FBDT00-2018-SLI-0050
Event Code: 08FBDT00-2018-E-00097
Project Name: San Francisco Bay to Stockton Navigation Improvement Project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

San Francisco Bay-Delta Fish And Wildlife
650 Capitol Mall
Suite 8-300
Sacramento, CA 95814
(916) 930-5603

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

Project Summary

Consultation Code: 08FBDT00-2018-SLI-0050

Event Code: 08FBDT00-2018-E-00097

Project Name: San Francisco Bay to Stockton Navigation Improvement Project

Project Type: DREDGE / EXCAVATION

Project Description: Deepen portions of the John F. Baldwin channel to 38 feet mean lower low water (MLLW), plus up to 2 feet of overdepth (for a total of 40 feet MLLW); this includes the Pinole Shoal and Bulls Head Reach Channels. The West Richmond Channel is also included in this project; however, it is currently below 38 feet MLLW and will not require deepening. Deepen a sediment basin in a portion of the Bulls Head Reach to 42 feet MLLW, plus up to 2 feed of overdepth (for a total of 44 feet MLLW). Beneficially use the dredged material at Cullinan Ranch, Montezuma Wetlands, or other permitted beneficial use site. Should sites not be able to take portions of the dredged material, the deep ocean disposal site, SF-DODS would be available as a back-up placement site. Deepening would be conducted with a mechanical clamshell dredge to reduce entrainment risk to species. Continue to maintenance dredge the deepened navigation channels on annual basis. Future maintenance dredging would use the respective project's federal standard dredge plant and placement site. The current federal standard for Pinole Shoal is dredging with a hopper dredge and placing material at SF-10. The federal standard for Bulls Head Reach is currently dredging with a clamshell and placing material at SF-16; however, a hopper dredge has been the federal standard in the past.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/37.894739958149756N122.40543628193376W

Counties: Alameda, CA | Contra Costa, CA | Marin, CA | Sacramento, CA | San Francisco, CA | Solano, CA | Sonoma, CA

Endangered Species Act Species

There is a total of 42 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse *Reithrodontomys raviventris* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/613	Endangered
San Joaquin Kit Fox *Vulpes macrotis mutica* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2873	Endangered
Southern Sea Otter *Enhydra lutris nereis* No critical habitat has been designated for this species. ***This species is also protected by the Marine Mammal Protection Act, and may have additional consultation requirements.*** Species profile: https://ecos.fws.gov/ecp/species/8560	Threatened

Birds

NAME	STATUS
California Clapper Rail *Rallus longirostris obsoletus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern *Sterna antillarum browni* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8104	Endangered
Northern Spotted Owl *Strix occidentalis caurina* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/1123	Threatened
Western Snowy Plover *Charadrius alexandrinus nivosus* Population: Pacific Coast population DPS-U.S.A. (CA, OR, WA), Mexico (within 50 miles of Pacific coast) There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8035	Threatened
Yellow-billed Cuckoo *Coccyzus americanus* Population: Western U.S. DPS There is **proposed** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3911	Threatened

Reptiles

NAME	STATUS
Alameda Whipsnake (=striped Racer) *Masticophis lateralis euryxanthus* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5524	Threatened
Giant Garter Snake *Thamnophis gigas* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4482	Threatened

Amphibians

NAME	STATUS
California Red-legged Frog *Rana draytonii* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2891	Threatened
California Tiger Salamander *Ambystoma californiense* Population: U.S.A. (Central CA DPS) There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2076	Threatened

Fishes

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/321	Threatened

Insects

NAME	STATUS
Bay Checkerspot Butterfly *Euphydryas editha bayensis* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2320	Threatened
Callippe Silverspot Butterfly *Speyeria callippe callippe* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3779	Endangered
Delta Green Ground Beetle *Elaphrus viridis* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2319	Threatened
Lange's Metalmark Butterfly *Apodemia mormo langei* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/4382	Endangered
Mission Blue Butterfly *Icaricia icarioides missionensis* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/6928	Endangered
Myrtle's Silverspot Butterfly *Speyeria zerene myrtleae* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6929	Endangered
San Bruno Elfin Butterfly *Callophrys mossii bayensis* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3394	Endangered
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7850	Threatened

Crustaceans

NAME	STATUS
California Freshwater Shrimp *Syncaris pacifica* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7903	Endangered
Conservancy Fairy Shrimp *Branchinecta conservatio* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/8246	Endangered
Vernal Pool Fairy Shrimp *Branchinecta lynchi* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/498	Threatened
Vernal Pool Tadpole Shrimp *Lepidurus packardi* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2246	Endangered

Flowering Plants

NAME	STATUS
Antioch Dunes Evening-primrose *Oenothera deltoides ssp. howellii* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5970	Endangered
California Seablite *Suaeda californica* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6310	Endangered
Colusa Grass *Neostapfia colusana* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5690	Threatened
Contra Costa Goldfields *Lasthenia conjugens* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7058	Endangered
Contra Costa Wallflower *Erysimum capitatum var. angustatum* There is **final** critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7601	Endangered
Franciscan Manzanita *Arctostaphylos franciscana* There is **final** critical habitat for this species. Your location overlaps the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5350	Endangered
Marsh Sandwort *Arenaria paludicola* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2229	Endangered
Pallid Manzanita *Arctostaphylos pallida* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8292	Threatened
Presidio Clarkia *Clarkia franciscana* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/3890	Endangered
Presidio Manzanita *Arctostaphylos hookeri var. ravenii* No critical habitat has been designated for this species.	Endangered

Species profile: https://ecos.fws.gov/ecp/species/7216

San Francisco Lessingia *Lessingia germanorum (=L.g. var. germanorum)* — Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/8174

Sebastopol Meadowfoam *Limnanthes vinculans* — Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/404

Soft Bird's-beak *Cordylanthus mollis ssp. mollis* — Endangered

There is **final** critical habitat for this species. Your location overlaps the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/8541

Sonoma Sunshine *Blennosperma bakeri* — Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/1260

Suisun Thistle *Cirsium hydrophilum var. hydrophilum* — Endangered

There is **final** critical habitat for this species. Your location is outside the critical habitat.

Species profile: https://ecos.fws.gov/ecp/species/2369

Tiburon Jewelflower *Streptanthus niger* — Endangered

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/4187

Tiburon Mariposa Lily *Calochortus tiburonensis* — Threatened

No critical habitat has been designated for this species.

Species profile: https://ecos.fws.gov/ecp/species/2858

Critical habitats

There are 3 critical habitats wholly or partially within your project area under this office's jurisdiction.

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* https://ecos.fws.gov/ecp/species/321#crithab	Final
Franciscan Manzanita *Arctostaphylos franciscana* https://ecos.fws.gov/ecp/species/5350#crithab	Final
Soft Bird's-beak *Cordylanthus mollis ssp. mollis*	Final

https://ecos.fws.gov/ecp/species/8541#crithab

BIOLOGICAL ASSESSMENT/ESSENTIAL FISH HABITAT ASSESSMENT

SAN FRANCISCO BAY TO STOCKTON, CALIFORNIA NAVIGATION IMPROVEMENT STUDY

April 2019

US Army Corps
of Engineers ®
San Francisco District

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Appendices

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 San Francisco Bay to Stockton Navigation Improvement Project (proposed action) on ESA-listed threatened and endangered species, designated critical habitat within the project's action area, and EFH. Although not required by the ESA, this BA also analyzes the potential effects of the proposed action on federal candidate species that have the potential to become federally-listed prior to or during construction of the proposed action.

1.1 Document Organization

As discussed, this document is intended to comply with two separate laws, ESA and Magnuson-Stevens Act. In addition, it provides the effects analysis and determination for ESA-protected resources managed by both the USFWS and NMFS. As such, the document is organized such that there are separate sections for USFWS-managed ESA resources, NMFS-managed ESA resources, and EFH, as described below.

- Section 2.0: Consultation history. This section provides an overview of the consultation history for the proposed project and maintenance dredging of the channels proposed for deepening.
- Section 3.0: Project location and action area. This section discusses the project location and action area. The action area is limited to the aquatic environmental that could be affected by dredging and dredged material transport to upland beneficial use site.
- Section 4.0: Pinole Shoal Channel, Bulls Head Reach, and Project Description. This section provides an overview of the existing uses of the channels proposed for dredging, as well as the ongoing maintenance dredging.
- Section 5.0: Environmental Baseline and General Effects Analysis. This section discusses the environmental baseline of the action area and the effects of the proposed action on aquatic resources. This section also discussed the types of projects which could result in cumulative effect on aquatic resources. This section is limited to the impacts on aquatic resources that may result in impacts to ESA and EFH protected resources.
- Section 6.0: USFWS-managed ESA Species and Critical Habitat and Effects Determination. This section provides a description of the USFWS-managed species and critical habitat, as well as the effects determination and conclusions.
- Section 7.0: NMFS-managed ESA Species and Critical Habitat and Effects Determination. This section provides a description of the NMFS-managed species and critical habitat, as well as the effects determination and conclusions.
- Section 7.0: Essential Fish Habitat Assessment.
- Section 8.0: Literature Cited.

2.0 Consultation History

This section provides an overview of the consultation history for dredging the Pinole Shoal and Bulls Head Reach channels.

<u>U.S. Fish and Wildlife Service:</u>

- This project will follow the applicable best management practices (BMPs) and reasonable and prudent measures (RPMs) of the Long Term Management Strategy for the Placement of Dredge Material in the San Francisco Bay Region (LTMS) for which USFWS issued a biological opinion (BO) on March 12, 1999.
- On November 27, 2017, USACE requested and received a species list from USFWS.
- On March 6 and 22, 2018, USACE and USFWS staff discussed the biological assessment and potential effects of the project. On December 5, 2018 USACE presented a summary of project effects including updated salinity modeling results to several resource agencies; USFWS staff were in attendance.

National Marine Fisheries Service:

- This project will follow the applicable BMPs and RPMs of the LTMS for which NMFS most recently issued a BO on July 9, 2015, and a clarification on July 20, 2015.
- On November 28, 2017, USACE requested a species list from NMFS. On February 20, 2018, NMFS confirmed that all species and critical habitat assessed for the LTMS should be considered in the consultation for the San Francisco Bay to Stockton Navigation Improvement Project.
- On December 5, 2018 USACE presented a summary of project effects including updated salinity modeling results to several resource agencies; NMFS staff were in attendance.

3.0 Project Location and Action Area

The San Francisco Bay to Stockton Navigation Improvement Project was originally authorized by Congress in the Rivers and Harbors Act of 1965. The authorization allowed for deepening the John F. Baldwin Channels to 45 foot MLLW from the Golden Gate to approximately Chipps Island, and the Stockton Deep Water Ship Channel to 35 foot MLLW from Chipps Island to the Port of Stockton. The Sacramento District completed deepening the Stockton DWSC to 35 feet MLLW in 1988. Construction of the remaining portions of the channel was not conducted. The current project investigates dredging approximately 13.2 miles in the Pinole Shoal Channel and Suisun Bay Channel, terminating in Avon.

The project area also includes the dredging material placement transportation corridor within San Pablo and Suisun Bays, from the deep draft navigation channels to the upland beneficial use sites, Cullinan Ranch and Montezuma Wetlands, respectively (***Figure 1***). The project, including the beneficial use sites, is located in Marin, Sonoma, Napa, Alameda, and Contra Costa counties, California. The Pinole Shoal Channel is located in San Pablo Bay. It begins off the north shore of North Richmond and terminates at the western end of the Carquinez Strait near the mouth of Mare Island Strait. The Bulls Head Reach channel is located in Suisun Bay and is a sub-reach of the larger Suisun Bay Channel. It extends from the eastern portion of Carquinez Strait, north of Martinez, to just north of the town of Avon. A detailed project description is provide in ***Section 4.3*.**

Figure 1: **San Francisco Bay to Stockton Navigation Improvement Project Location—Pinole Shoal Channel, Bulls Head Reach, and Beneficial Reuse Sites**

3.1 Action Area

The action area is defined as all areas directly or indirectly affected by the proposed action (50 C.F.R. § 402.02). The proposed project's action area (***Figure 1***) includes:

- Pinole Shoal Channel and Bulls Head Reach;
- The dredged material transportation corridor between the locations of proposed dredging and the dredged material offloading sites at Cullinan Ranch and Montezuma Wetlands;
- The waters within the embayments where dredging would occur (i.e., San Pablo Bay and Suisun Bay);
- The waters immediately surrounding the dredged material transportation corridors; and
- The maximum upstream limit of salinity intrusion that could result from construction of the proposed project.

The dredged material placement sites, Cullinan Ranch and Montezuma Wetlands, are excluded from this ESA/EFH analysis and action area because these sites are fully permitted to accept dredged material for wetland restoration, including compliance with the ESA and MSFCMA.

4.0 Pinole Shoal Channel, Bulls Head Reach, and Project Description

This section provides a discussion of the existing Pinole Shoal Channel and Bulls Head Reach, including an overview of the navigation channel use and maintenance dredging activities; as well as a detailed project description and description of future maintenance dredging.

4.1 Existing Use of the Pinole Shoal and Bulls Head Reach Channels

Pinole Shoal Channel provides deep draft navigation accessibility through San Pablo Bay to the Carquinez Strait. The Bulls Head Reach channel continues navigation access from the eastern portion of the Carquinez Strait and continues underneath the Benicia-Martinez Bridge and Amtrak Bridge to the Town of Avon. The channels provide deep draft navigation access to the six oil refineries in the vicinity of the Carquinez Strait, beginning in Rodeo and ending in Avon (***Figure 1****,* inset). They are part of a series of channels that provide deep draft navigation access extending from the San Francisco Main Channel, located outside of the Golden Gate, all the way to the Port of West Sacramento to the northeast and Port of Stockton to the southeast.

Given that the Pinole Shoal and Bulls Head Reach channels are maintained at 35 feet mean lower low water (MLLW), most vessels must be "light-loaded", or less than fully loaded with cargo, to navigate the channels with sufficient under-keel clearance (i.e., 2 feet for non-hazardous cargo, and 3 feet for hazardous cargo such as petroleum). Light-loading increases the cost of transportation and, in turn, the cost of the shipped products because more trips must be made to carry the same volume of cargo.

The channels are used heavily under current conditions. According to data from the Waterborne Commerce Statistics Center, 20 - 27 million tons of commodities (primarily crude oil) moved through the Carquinez Straight annually between 2005 and 2013.

4.2 Existing Operations and Maintenance Dredging of the Pinole Shoal and Bulls Head Reach Channels

To facilitate safe and efficient deep draft navigation to ports and facilities along and beyond the Pinole Shoal and Bulls Head Reach channels, USACE maintains these navigation channels annually, according to the project's federal standard. Maintenance dredging includes dredging to the permitted depth of 35 feet MLLW, plus up to 2 feet of overdepth (for a total allowable depth of 37 feet MLLW). Existing maintenance dredging of Pinole Shoal Channel and Bulls Head Reach is discussed below.

4.2.1 Pinole Shoal Channel

The Pinole Shoal Channel was historically dredged annually with a hydraulic hopper dredge and, at times, a clamshell dredge was used. However, as a requirement of the 5-year water quality certification for federal maintenance dredging in San Francisco Bay (California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB) 2015), dredging with a hopper dredge is limited to one in-bay channel each year. Since 2015, the USACE has dredged the Pinole Shoal Channel with a hopper dredge every other year. Dredged material is typically placed at the project's federal standard placement site, the SF-10 in-bay disposal site, located approximately 3.0 miles northeast of Point San Pedro in Southern San Pablo Bay, Marin County. SF-10 is a 1,500-foot by 3,000-foot rectangular, open-water disposal site located in water depths of approximately 30 to 45 feet. The annual disposal limitation is 500,000 cubic yards (cy). Approximately 150,000 cy annually requires maintenance dredging; however, in wet years, this volume can be higher. Sediment composition of dredged material varies along the channel, with a majority of the material being at least 80 percent sand, particularly in the western and eastern portions of the channel. Since 2010, the USACE has conducted fish entrainment monitoring aboard the federal *Essayons* hydraulic hopper dredge when it dredges the Pinole Shoal Channel to document any take of special status fishes.

4.2.2 Bulls Head Reach

Bulls Head Reach is dredged annually with a hydraulic hopper dredge or clamshell dredge. Since 2015, dredging Bulls Head Reach has occurred using a clamshell dredge exclusively to reduce the potential risk for entrainment of the federally-threatened delta smelt (*Hypomesus transpacificus*). Approximately 25,000 cy of sediment is dredged from the Bulls Head Reach portion of the Suisun Bay Channel each year. Material dredged from this channel is typically placed at the project's federal standard sites, SF-16 or SF-9 (SF-9 is used as a backup site when SF-16 is at capacity). SF-16 is a 500-foot by 11,200-foot open-water placement site located adjacent to the Suisun Bay Channel, approximately 1 mile upstream of the Interstate 680 Bridge in Suisun Bay. The annual disposal limitation at SF-16 is 200,000 cy and only material from the federal Suisun Bay and New York Slough Channels can be placed at this site. SF-9 is a 1,000-foot by 2,000-foot open water rectangle located in approximately 10 to 55 feet of water, approximately 0.9 mile west of the entrance of Mare Island Strait in Carquinez Strait. Past maintenance dredging at Bulls Head Reach has included dredging up to 4 feet of advance maintenance material or emergency maintenance dredging outside of normal maintenance dredging to accommodate rapid shoaling. Since 2000, nine emergency dredging episodes have occurred in Bulls Head Reach. There is a half-mile section that shoals rapidly, and has become a routine navigation hazard. The shoaling occurs as a result of the proximity of channel to the Benicia-Martinez Railroad Drawbridge Regulated Navigation Area where vessels must stay in the center of the navigation channel to safely transit under the bridge (USACE 2014). As a result, the U.S. Coast Guard has asked USACE to declare an emergency in the past and conduct maintenance dredging in this reach in spring and early summer, which is outside of the LTMS work window (i.e., August 1 – November 30; USACE 2014). This area is now dredged annually to help avoid emergency dredging.

4.3 Project Description

The San Francisco Bay to Stockton Navigation Improvement project proposes to deepen approximately 10.3 miles (stations 0+00 to 548+00) of the Pinole Shoal Channel, located in San Pablo Bay (***Figure 2***), and 2.9 miles of Bulls Head Reach to Avon (stations 0+00 62+00 and 88+00 to 159+00), located in Suisun Bay (***Figure 3***). The proposed action would deepen these channels from 35 feet MLLW, plus 2 feet of allowable overdepth, to 38 feet MLLW, plus 2 feet of allowable overdepth. Most of the deepening in Bulls Head Reach includes constructing a 0.5 mile long (located between stations 62+00 and 88+00) that would be deepened to 42 feet MLLW, plus 2 feet of overdepth to reduce the advanced maintenance dreding or need for emergency dredging in the high shoaling area. Deepening the entire prism, including the sediment basin and overdepth, would result in approximately 1.6 million cy being dredged from the Pinole Shoal and Bulls Head Reach channels. ***Figures 2 and 3*** provide an overview of the deepening proposed for the navigation channels. ***Table 1*** provides an overview of the proposed project for each component of the deepening project (i.e., Pinole Shoal Channel, Bulls Head Reach sediment basin, and the remanding portions of Bulls Head Reach).

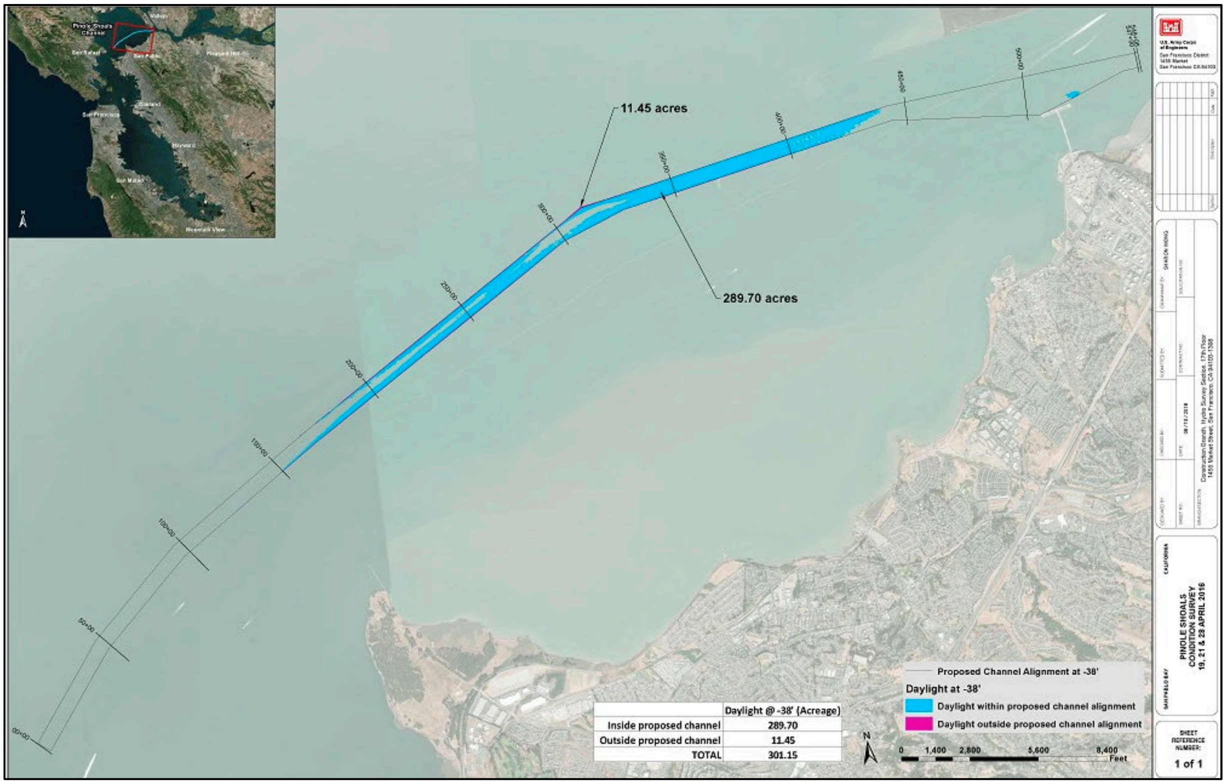

Figure 2: **Project impacts to physical habitat in Pinole Shoal Channel.**

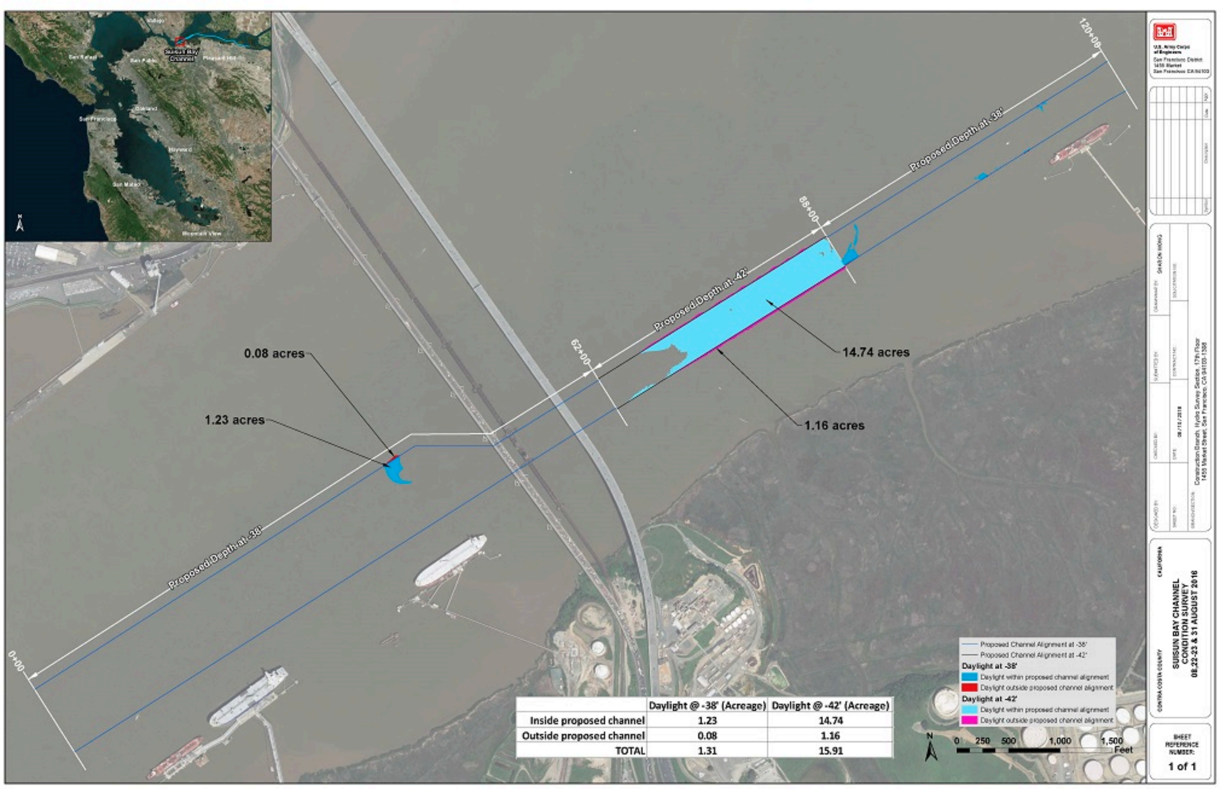

Figure 3: **Project impacts to physical habitat in Bulls Head Reach.**

Deepening would occur between the existing channel toes; widening the channel is not part of the project. However, the channel side slopes require a 3-foot horizontal to 1-foot vertical (3:1) side slope to ensure slope stability. Therefore, dredging would occur on the side slopes of the channel to ensure the side slopes maintain stability following construction. ***Figure 4*** provides a typical cross section of the navigation channel showing where dredging would occur in the channel toes and along the side slopes.

Mechanical clamshell dredging (up to three dredges) is the proposed dredge type for this project in order to minimize and reduce the potential risk of entrainment of special-status fishes. Dredged material would be placed in shallow-bottom scows and, once full, transported by tugs to the dredged material placement site(s). The project proposes to maximize the use of the dredged material by placing the dredged sediment at two wetland restoration beneficial use sites. Specifically, Pinole Shoal Channel sediments would be placed at Cullinan Ranch and Bulls Head Reach sediments would be placed at Montezuma Wetlands. 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, 2010a, 2011, 2015a; USFWS 2001, 2003, 2004a, 2010a, b).

4.3.1 Construction Timing and Duration

It is expected that the project would be completed in one dredging season and, to the extent feasible, be completed during the existing work windows. Dredging timing and duration is discussed below. Section 4.3.2 provides a detailed discussion of the environmental work windows for each channel.

- Pinole Shoal: it is expected that Pinole Shoal would be dredged within the existing 6-month work window (June 1 through November 30). However, should deepening not be completed during the first 6-month work window, the USACE proposes to dredge outside the work window complying with the terms and conditions of the SF Bay LTMS programmatic maintenance dredging biological opinion (NMFS 2015b) by dredging with a clamshell dredge and beneficially using dredged material to create habitat which benefits listed species present in the action area. Should dredging outside of the work window not be allowed through this consultation, dredging would resume during the following work window.
- Bulls Head Reach: dredging Bulls Head Reach, including the sediment trap, would take approximately 1 month.

4.3.2 Environmental Work Windows

All dredging would be conducted during the existing LTMS environmental work windows for San Pablo Bay and Suisun Bay, 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. The environmental work windows for each channel are discussed below.

4.3.2.1 Pinole Shoal Channel Work Window

The environmental work window for the Pinole Shoal Channel is from June 1 through November 30, with specific conditions for dredging outside of the work window (i.e., dredging December 1 through May 31). This work window is designed to protect ESA-listed salmonids and green sturgeon (NMFS 2015). However, the current NMFS biological opinion (No. WCR-2014-1599) for LTMS (NMFS 2015) allows for maintenance dredging of the Pinole Shoal Channel beyond the November 30 work window under the following conditions: dredging occurs with a mechanical clamshell dredge and dredged material is placed at wetland restoration beneficial use sites that benefit ESA-protected salmonids and green sturgeon. Although the NMFS LTMS biological opinion specifically addresses maintenance dredging projects in San Francisco Bay and is not intended to address new work, this deepening project proposes to comply with all terms and conditions provided therein, within the proposed action. Therefore, this project proposes to dredge Pinole Shoal outside the work windows (i.e., between December 1 and May 31) only with a clamshell dredge and dredged material would be beneficially reused at wetland restoration sites that would benefit listed salmonids (NMFS 2000).

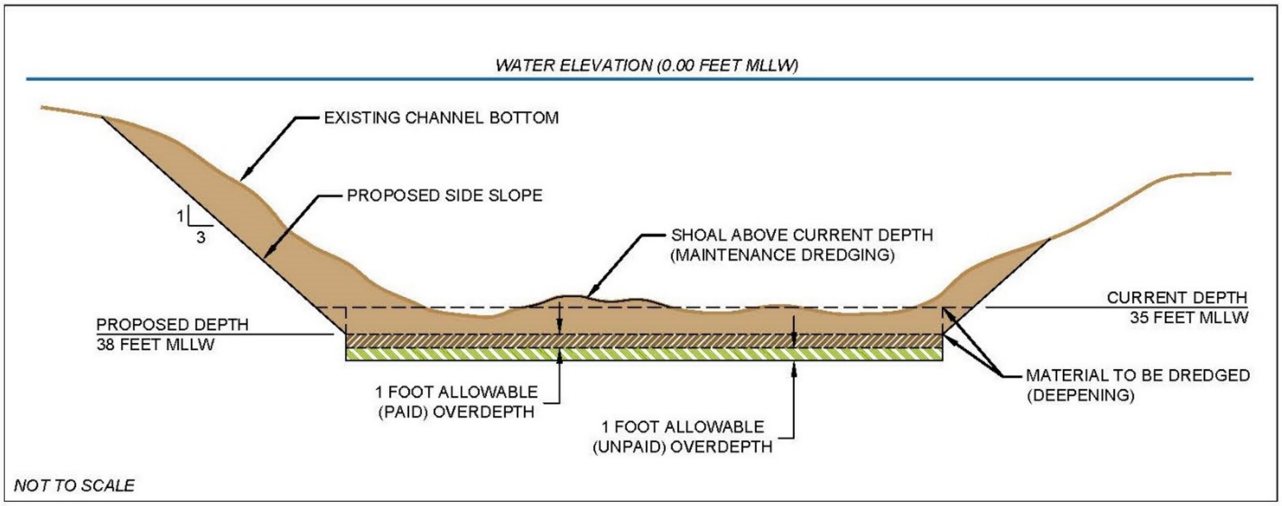

Figure 4: **Typical Cross Section of a Navigation Channel Where Dredging Would Occur**

4.3.2.2 Bulls Head Reach Work Window

The environmental work window for Bulls Head Reach is from August 1 through November 30 (***Table 1***). This environmental work window is designed to reduce the potential impacts of in-water work on delta smelt, but also would be protective of ESA-listed salmonids and green sturgeon. The project will comply with these work windows during dredging activities to avoid and minimize any potential impacts on listed species.

4.3.3 Construction Methods

This section discusses details regarding the construction methods that would be employed to deepen the navigation channels and transport and place dredged material.

4.3.3.1 Dredging

The following construction assumptions were used for cost estimating purposes for the channel deepening elements of the proposed action:

- Two dredge plants will be used with 21-CY clamshell buckets in the Pinole Shoal Channel
- Four 2,000 CY scows and two 1,800 HP tug boats will be used for dredged material placement at Cullinan Ranch from Pinole Shoal Channel
- One 21-CY clamshell dredge plant will be used in the Bull's Head Reach Channel

- Two 4,000 CY scows and one 1,800 HP tug boat for placement at Montezuma Wetlands Restoration Project From the Bull's Head Reach Channel

The dredged material will be hauled by scow from the Pinole Shoal channel to the Cullinan Ranch beneficial use placement site, and dredged material from the Bulls Head Reach channelwill be hauled to the Montezuma Wetlands Restoration Project site where offloaders will be stationed to unload scows and pump the dredged material into both sites. The Napa River that leads to the Cullinan Ranch site is too shallow for fully loaded 4,000 CY scows, so it is assumed that the scows will be loaded to only 65 percent of their capacity, or less, in order to transitto the offloader location. It is also possible that the contractor may use 2,000 CY scows that can be fully loaded.

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 5***). 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.

Table 1: **Pinole Shoal Channel and Bulls Head Reach Dimensions and Project Features**									
Channel	**Engineering Stations**	**Length [(a)]**	**Width [(a)] (channel toe)**	**Existing Channel Area (acre)**	**Proposed Depth (feet MLLW)**	**Channel Toe Area Proposed for Dredging (acre)**	**Channel Side Slopes Proposed for Dredging (acre)**	**Volume Proposed for Dredging (cubic yards)**	**Work Window**
Pinole Shoal Channel	0+00 to 547+00	54,700 feet (10.36 miles)	600 feet	753	38 + 2 feet overdepth (up to 40 feet MLLW)	281.65	19.5	1,443,860	Jun 1 – Nov 30 a
Bulls Head Reach (not including the sediment basin)	0+00 to 62+00 and 88+00 to 150+00	12,400 feet (2.35 miles)	300 - 700 feet	119	38 + 2 feet overdepth (up to 40 feet MLLW)	1.11	0.2	38,747	Aug 1 – Nov 30
Sediment Basin (in Bulls Head Reach)	62+00 to 88+00	2,600 feet (0.49 mile)	300 feet	15	42 + 2 feet overdepth (up to 44 feet MLLW)	15.01	0.9	120,549	Aug 1 – Nov 30

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 will need to be relocated approximately every 3 hours. In addition, the dredge would need to be moved out of the shipping channel to allow deep draft vessels to transit the channel.

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, up to the capacity of the scow, 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 dredging continues.

Although the clamshell is raised from and lowered to the channel bottom using a system of cables, due to its weight it falls through the water column into the channel 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

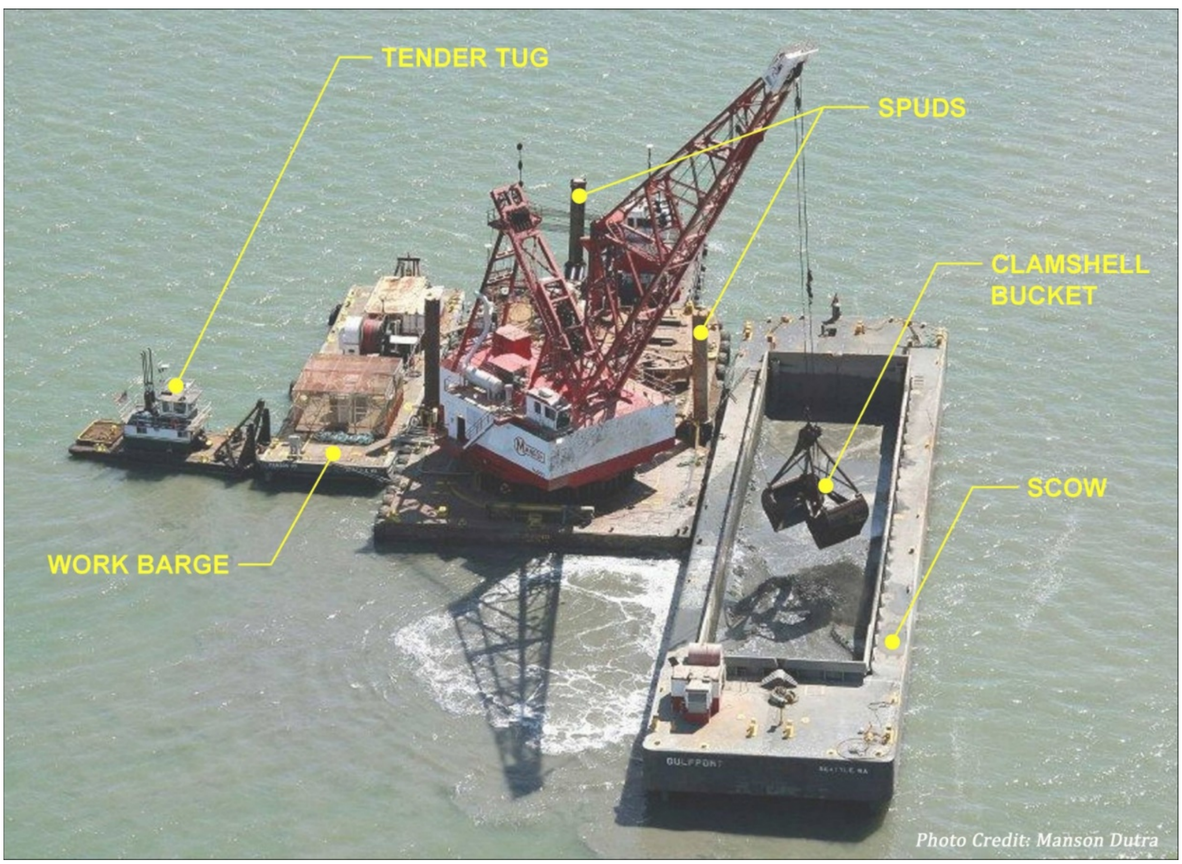

Figure 5: **Typical Mechanical Clamshell Dredge and Scow**

dredging, hydrographic surveys are 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 5.0 milligrams per liter (mg/L) in the Pinole Shoal Channel and 7.0 mg/L in Bulls Head Reach, or result in the pH going below 6.5 or above 8.5.

Sediment proposed for dredging is classified as sand (including gravel) and fine-grained (silt and clay). In Pinole Shoal Channel, the content physical composition of the sediment changed from finer grained sediment at the very western end of the channel (>70 percent silt and clay), to predominately sandy material in much of the central portion of the channel (>70 percent sand and gravel), back to fine-grained sediment near the very eastern end of the channel (25 to 90 percent fine grained). In the Bulls Head Reach Channel, the sediment proposed for dredging is predominately sand, with pockets of fine-grained material. In general, sand ranges from 19 to 98 percent throughout the channel, with small areas of less than 54 percent silt and clay. 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. In addition, an overflow turbidity monitoring plan approved by the RWQCB would be required.

4.3.3.2 Removal of Rock Obstruction in Pinole Shoal

A small rock outcrop is present immediately north of the downstream portion of the Suisun Bay Channel (***Figures 6 and 7***). The top of the outcrop is currently at a depth of 39.7 feet MLLW. While coordinating with the San Francisco Bay Bar Pilots, the Bar Pilots expressed safety concerns as the outcrop poses a threat to safe navigation. Even though this rock formation is not in the federal channel, it is located in the shipping lane and will need to be addressed as part of this project to provide safe navigation. The rock formation will be lowered so that there is a minimum of 3-ft of additional clearance below the 2-ft of overdepth tolerance. As part of the project, the outcrop would be lowered by approximately 3.3 feet, to a depth of 43 feet MLLW.

Following discussions with the Bar Pilots, the outcrop was surveyed to determine the depth of the outcrop and if the outcrop was actually rock or a sunken ship. The surveys indicated that the formation is a rock outcrop. The formation is presumed to be associated with the San Franciscan formation on the San Pablo Bay bottom. Lowering of the outcrop would occur using a pneumatic jackhammer attachment mounted to an excavator (***Figure 8***). The excavator would be secured on a floating work barge. The jackhammer would chisel the rock down to a depth of 43 feet MLLW over a period of up to 20 hours spanning 1-2 days. As the material is chiseled from the outcrop, it would fall through the water column to the bay floor where it would remain. Lowering the outcrop would result in approximately 40 cy of material being removed from the top of the outcrop, affecting approximately 950 square feet (0.02 acres) of benthic habitat.

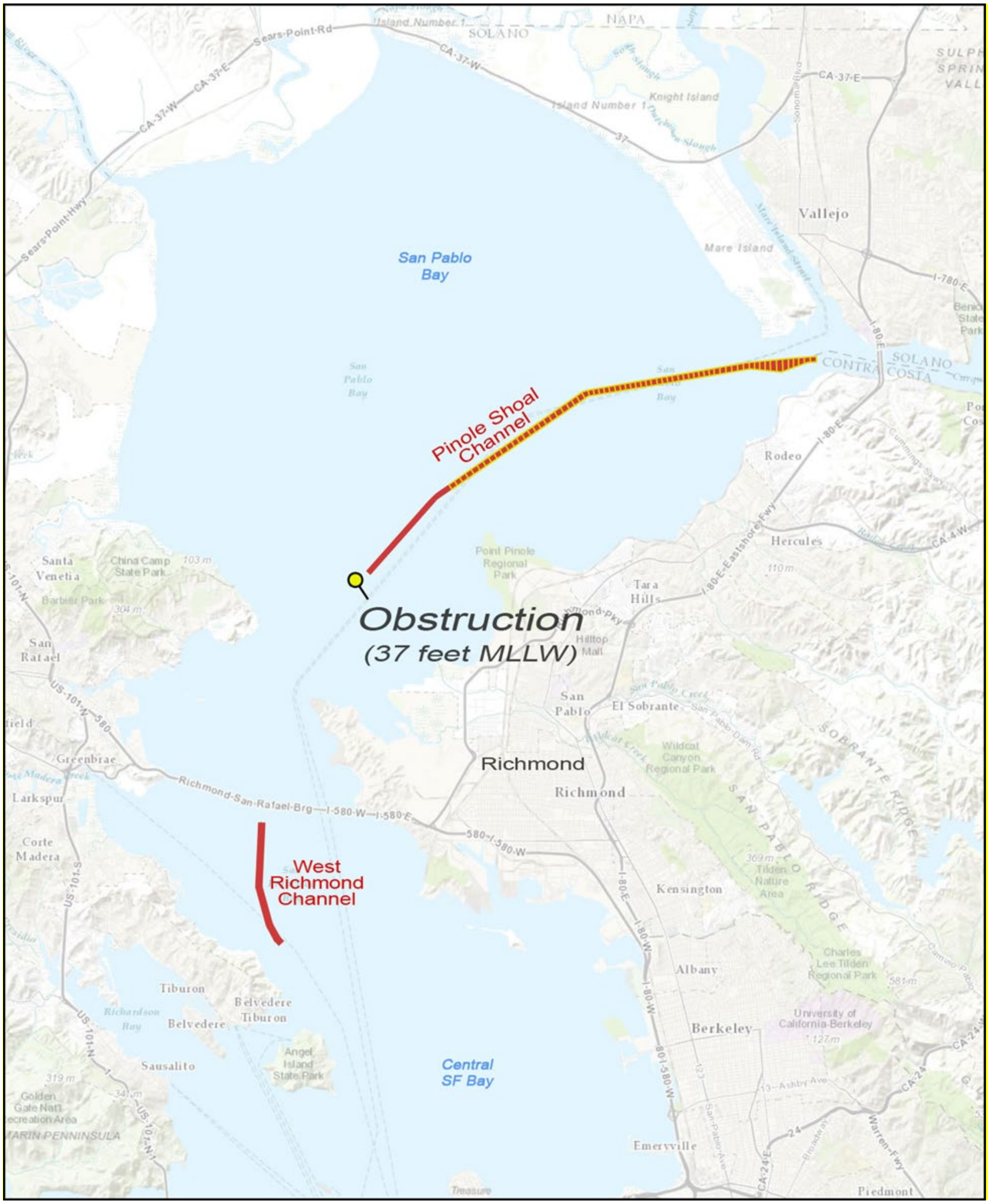

Figure 6: **Pinole Shoal Channel Obstruction.**

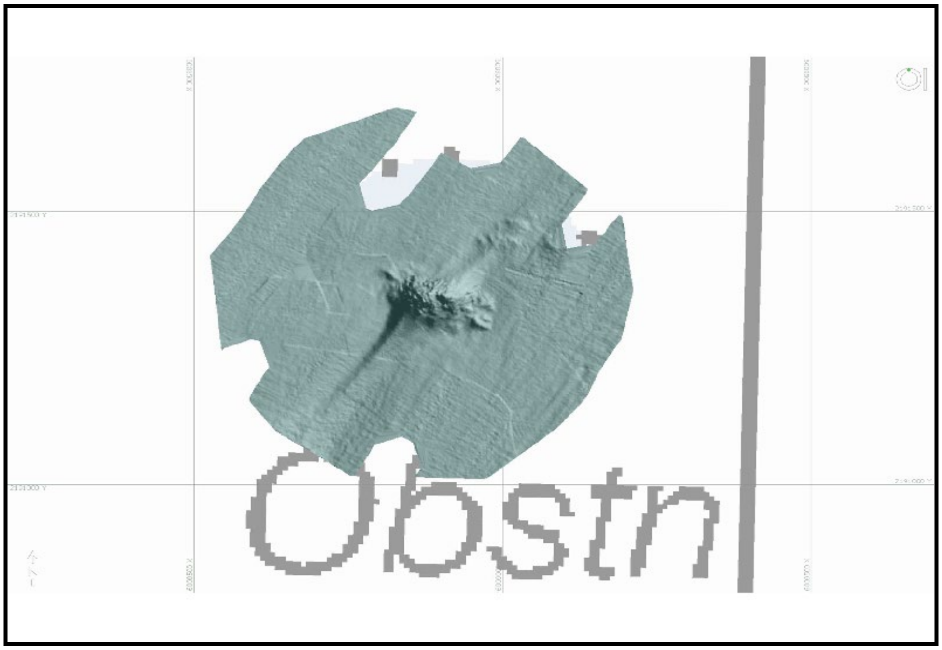

Figure 7: **Side Scan Sonar of the Obstruction near the Western End of the Pinole Shoal Channel, San Pablo Bay**

Figure 8: **Excavator with a Jackhammer.**

4.3.3.3 Dredge Material Transport and Placement

When scows are full, they are transported to the dredged material placement site by diesel-powered tug boats. Scows transporting dredged material to the beneficial use sites would moor to an offloader at the respective site such that sediment can be pumped out of the scow and onto the restoration site. Pumping the sediment out of the scow, 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 9***), which is secured on a floating barge. Cullinan Ranch uses an offloader that is land-based (***Figure 10***). Once moored, the offloader would insert a snorkel into the scow, simultaneously injecting water into the scow to create a water-sediment slurry and pump 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.

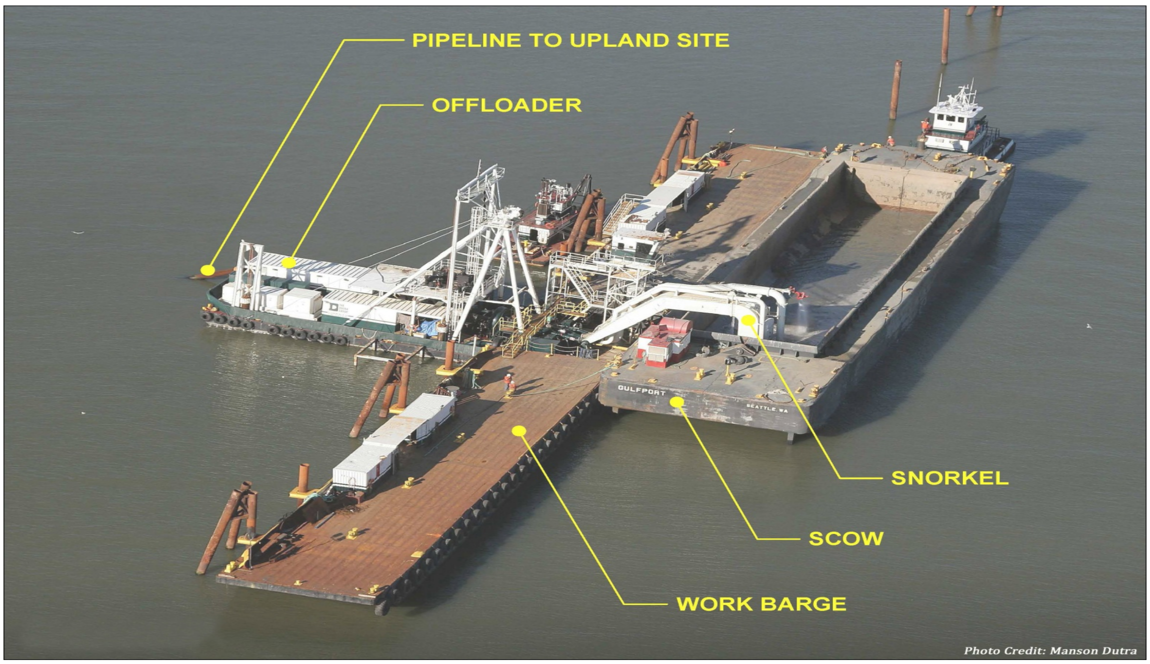

Figure 9: **Liberty Offloader—Typically Offloading at Montezuma Wetlands Restoration Project**

It takes approximately 2 hours to completely offload dredged sediment from a scow. Scows-tugs transporting dredged material from the Pinole Shoal Channel would travel an average of 10 miles one-way from dredging locations to Cullinan Ranch. Scows transporting material from Bulls Head Reach to Montezuma Wetlands would travel an average of 13 miles one-way. 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 environmental approvals to accept dredged material, including biological opinions, incidental take permits, and EFH conservation recommendations. The intent is to maximize the use of dredged material for construction/enhancement of wetlands. Dredged material placement sites included in the project description are discussed below.

4.3.3.4 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 the land 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

Figure 10: **Modified Offloader Currently Offloading Dredged Material at Cullinan Ranch (Dutchman Slough)**

USFWS' recovery plan for salt marsh harvest mouse and California clapper rail. In addition, it is believed that the restored marsh will 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. 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, 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 (USFWS 2010b); NMFS 2015a)

4.3.3.5 Montezuma Wetlands

Montezuma Wetlands Restoration Project 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 and dredged material is being used to raise site elevations for wetland restoration. Once completed, Montezuma Wetlands is expected to restore 1,820 acres of tidal, seasonal, and managed wetlands. 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 (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 (NMFS 2001, 2011; USFWS 2001, 2003, 2004a, 2010a)

Based on the above information for Cullinan Ranch and Montezuma Wetlands, 9000 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 1.6 million cy of dredged sediment resulting from the proposed project is expected to create 160 acres of wetland habitat due to it being beneficial reused at the restoration sites.

4.4 Future Operations and Maintenance Activities

Once deepened, the navigation channels would be maintained to their new regulatory depths of 38 feet MLLW in Pinole Shoal Channel and in a majority of Bulls Head Reach, and to 42 feet MLLW in the sediment basin. Maintenance dredging, including placement of dredged material, would be conducted, in accordance with each channel's federal standard. Maintenance dredging will occur as part of the San Francisco Bay federal navigation channel maintenance dredging program, and would include dredging up to 2 feet of overdepth. It is expected that the volume of material requiring dredging would increase by approximately 15 percent compared to current conditions. Dredged material would be placed at the respective project's federal standard site or base plan (least costly, environmentally acceptable placement site); typically SF 10 for the Pinole Shoal Channel and SF-16 for Bulls Head Reach. Maintenance dredged material could be beneficially reused if the beneficial site is as cost efficient as the federal standard placement site.

5.0 Environmental Baseline and General Effects Analysis

This section discusses the existing environmental baseline and aspects of the proposed project that could result in effects to listed species, critical habitat, and/or EFH. The proposed action is located entirely within the aquatic habitat of San Pablo and Suisun Bay; therefore, effects of the action analyzed herein are anticipated to be in the aquatic environment affecting special status fishes and their habitats. This section discusses the general impact mechanisms of the project which would be similar for all special status species and habitat analyzed herein. The determinations of effects on listed species, critical habitat, and

EFH and conclusions are provided in **Section 6.0** (USFWS-ESA managed species and critical habitat), **Section 7.0** (NMFS-managed ESA species and critical habitat), and **Section 8.0** (essential fish habitat).

The environmental baseline includes current on-going federal and non-federal projects which operate and are maintained in the San Francisco Bay-Delta region. These include, but are not limited to on-going maintenance dredging of existing federal and non-federal navigation channels, deep draft and shallow draft navigation, operations of the Central Valley Project and State Water Projects, other water exports in, and existing outfalls, urban runoff, and other sources of contaminants.

The federal ESA defines effects as wholly beneficial, direct (i.e., effects occurring during construction of the project), indirect (i.e., effects caused by the proposed action at a later time), interrelated (i.e., effects caused by actions that depend on the larger action for justification), or interdependent (i.e., effects caused by actions that have no independent utility apart from the proposed action), as required by 50 C.F.R § 402.14(14) and defined at § 50 C.F.R. 402.02).

The Magnuson-Stevens Act defines adverse effects on EFH as "any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions" (50 CFR § 600.810).

A summary of the types of impacts and resources expected to be impacted are provided below.

- Wholly beneficial impacts: beneficial reuse of dredged material would result in long-term beneficial impacts to both USFWS and NMFS managed ESA species, as well as EFH.
- Direct impacts: direct impacts could occur through dredging and dredged material transportation. These impacts include increased hydrodynamic noise, increased concentrations of suspended sediment and turbidity during dredging activities, which may result in release of constituents of concern. 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.
- Indirect impacts: indirect impacts could result exposure to constituents of concern, changes in habitat, including loss of shallow habitat, loss of benthic or other prey resources, salinity intrusion and resulting alterations to the low salinity zone. These effects could result in alterations in behavior or sub-lethal effects resulting in alterations to habitat and foraging resources.
- Interrelated and interdependent effects: interrelated and interdependent effects could include vessel traffic already existing in the federal navigation channels. However, vessel traffic and use of the channels is not expected to increase compared to baseline conditions. Therefore, these impacts are not discussed further in this document.
- Cumulative effects: the federal ESA defines cumulative effects as effects resulting from the proposed action combined with any future state, Tribal, local, or private actions that are reasonably certain to occur in the area (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in a biological opinion. While the scope of cumulative effects are not defined for EFH, cumulative effects are included in the definition of adverse effects.

5.1 Impacts Associated with Clamshell Dredging and Dredged Material Transportation

Maintenance dredging in San Francisco Bay is a regular occurrence that removes an annual average of about 3.0 to 3.5 million cubic yards from navigation channels, with the federal dredging assuming 1.5 to 2.0 million cubic yards. Methods of maintenance dredging include hopper, clamshell-bucket, and cutterhead-pipeline dredging. Disposal sites include aquatic in-bay placement sites; offshore sites, such as SF-DODS and SF-17; and beneficial reuse locations, such as wetland restoration sites. Dredging and dredged material placement is regulated by the inter-agency San Francisco Bay LTMS (USACE et al. 1998; 2001). The LTMS includes several avoidance and minimization measures to protect ESA-listed species, such as environmental work windows, which were developed through ESA consultations. Additionally, clamshell dredging has been employed in the Suisun Bay in recent years to reduce the entrainment risk to delta smelt (USACE 2018). This project proposes to use a clamshell dredge for Pinole Shoal and Bulls Head Reach.

Special status fishes have the potential to be directly injured by construction equipment through contact with the dredge clamshell bucket or contact with the tugs and scows. In addition, fish may become entrained in propeller 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 propeller wash.

While individual fish have the potential to be struck or entrained by clamshell bucket as it falls through the water column to the channel 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 (Reine and Clarke 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.

5.2 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. Pinole Shoal Channel is surrounded by extensive mudflats and wetland restoration projects to the north of the channel, as well as 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 2014).

The proposed project would remove several feet of substrate and deepen an estimated 318 acres of bay floor, including 301 acres of benthic habitat in Pinole Shoal Channel and 1.3 acres in Bulls Head Reach from 35 feet MLLW to 38 feet MLLW plus 2 feet of overdraft. Additionally, the sediment basin in Bulls Head Reach would be deepened to 42 feet, which would impact an additional 16 acres of habitat. 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). Of the total acreage disturbed, approximately 12 acres would be on the side slopes of the channel. However, there would be no disturbance to shallow water habitat, which is defined as < 10 feet deep.

5.3 Water and Sediment Quality

The project has the potential to affect water and sediment quality by temporarily increasing suspended sediment during dredging. This could also result in releases of constituents of concern attached to sediment particles, salinity intrusion, and changing the sediment quality of the channel bed following dredging (e.g., the z-layer). Salinity intrusion could affect the quantity and quality of habitat available for fishes that 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.

5.3.1 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 ranging up to more than 200 mg/L (Rich 2010). However, sediment plumes would be generated from excess sediment and other entrained material (e.g. air bubbles) being discharged back into the water column during dredging, thus elevating turbidity concentrations. The degree of sediment re-suspension depends on the physical composition of the material, with fine-grained material remaining in suspension longer and sandy material falling through the water column and resettling much faster. Plume size, concentration, and duration also depend on environmental and operational specific factors. During dredging, sediments may become suspended as a result of the clamshell bucket's impact to the channel 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 of scows. In addition, the movement of water associated with tides, river outflow, wind, and waves also determine turbidity plumes, all of which can disperse suspended particles and turbidity plumes around the Bay.

Sediment proposed for dredging is considered Young Bay Mud and further classified as sand (including gravel) and fine-grained (silt and clay). 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. In Pinole Shoal Channel, the content physical composition of the sediment changes from finer grained sediment at the very western end of the channel (>70 percent silt and clay), to predominately sandy material in much of the central portion of the channel (>70 percent sand and gravel), back to fine-grained sediment near the very eastern end of the channel (25 to 90 percent fine grained). In the Bulls Head Reach Channel, the sediment proposed for dredging is predominately sand, with pockets of fine-grained material. In general, sand ranges from 19 to 98 percent throughout the channel, with small areas of less than 54 percent silt and clay. Dredging in areas with fine-grained material, such as the western and eastern portions of the Pinole Shoal Channel could result in turbidity plumes with higher concentrations remaining in the water column longer and traveling farther from the dredging or overflow source. Dredging in areas of sandy material would likely result in turbidity plumes settling out of the water column faster.

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 or overflowing of scows exceeded the turbidity requirements in the projects' water quality certification. The San Francisco Bay federal navigation channel maintenance dredging 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). During the scow overflow monitoring, ambient turbidity was measured at a reference site 200 feet up current from dredging operations, in areas that were not affected by the turbidity plume, 200 feet down current from the dredge (referred to as the early warning location), and at the point of compliance 500 feet down current from the dredge. 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 during various tidal cycles, represented the range of tides in the bay. Measurements were taken every 10 minutes at each location. Exceedances of the water quality turbidity standards at the point of compliance occurred periodically for all channels, with most exceedances occurring in the Richmond Inner Harbor, where sediment is very fine-grained.

Sediment in the Oakland Harbor and Richmond Inner Harbors are predominately fine-grained, with much less sand, compared to the sediments proposed for dredging in Pinole Shoal and Bulls Head Reach. It is expected that overflowing scows during the deepening project would result in plumes with less concentrations of suspended sediment and turbidity. However, tides and river outflow through Bulls Head Reach, the Carquinez Strait, and Pinole Shoal could be greater than those found in Oakland Harbor and Richmond Inner Harbor, possibly carrying plumes farther. Regardless, as mentioned, should scow overflow be allowed, turbidity monitoring would be conducted in compliance with anticipated requirements of a water quality certification, biological opinion, or other regulatory permits.

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 (Sherk 1972; O'Connor et al. 1976; Newcombe and Jensen 1996). Short-duration exposure to elevated suspended sediment concentration could result in sublethal effects; however, potential exposure and dosage of suspended sediment concentrations drops exponentially from the source of the plume. Exposure to excessive suspended sediment concentrations generated during dredging operations could result in behavioral avoidance and exclusion from otherwise suitable habitat, disrupt movement and migration patterns, reduce feeding rates and growth, 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). Physiological stresses could include clogged gills, eroded gill and epithelial tissues, impaired foraging activity and feeding success, and altered movement and migration patterns of juvenile and adult fishes (Clarke and Wilber 2000; Newcombe and Jensen 1996; Newcombe and MacDonald 1991).

5.3.2 Exposure to Constituents of Concern and Bioaccumulation

To address the potential for exposure to constituents of concern and bioaccumulation, sediment sampling and testing analyses were reviewed and summarized in detail in Appendix A, with a condensed summary of the results pertaining to elevated constituents of concern and toxicity and bioaccumulation provided below.

The USACE initially studied deepening the Pinole Shoal and Bulls Head Reach channels to a depth of 45 feet MLLW in the early 1990s and 2000s. As part of this study, sediment was sampled throughout the Pinole Shoal Channel and Bulls Head Reach. Sampled sediment underwent physical, chemical, and bioaccumulation analyses, as well as studies to determine if the sediment is suitable for wetland creation. In all studies, sediment was sampled to a depth of 45 feet MLLW, plus 2 feet of overdepth, for a total sampled depth of 47 feet MLLW. This represents sampling an additional 7 feet of sediment in Pinole Shoal Channel and Bulls Head Reach, and an additional 5 feet in the sediment basin, compared to the proposed action. While the sampling represents a deeper depth than what is currently proposed, the sediment has remained in place and the chemical and biological composition has not been altered. Therefore, the previous sediment sampling and analysis studies can be used to evaluate the suitability of dredged material for aquatic placement and wetland creation, as well as whether dredging and dredging material placement would pose a contamination or bioaccumulation risk to special status species in the action area.

Although these early studies are being used for planning purposes, the USACE proposes to conduct confirmatory sediment sampling and analysis to the depths proposed for this project, plus the required overdepth, prior to construction deepening. Confirmatory testing will verify that that the sediment layers in the shallower depths are suitable for placement at Cullinan Ranch, Montezuma Wetlands, and SF-DODS, and that the z-layer sediment that would form the new channel bottom would not result in contamination surrounding ecosystem.

Physical and chemical properties were analyzed for sediment grain size, total organic compounds, total volatile solids, oil and grease, total petroleum hydrocarbons, percentage of petroleum, polynuclear aromatic hydrocarbons, chlorinated pesticides and polychlorinated biphenyls, and ten metals (Battelle Marine Sciences Laboratory 1990, 1993). Full Tier III testing included suspended-particulate-phase toxicity test, solid-phase toxicity tests, and bioaccumulation tests, as well as grain and chemistry analyses (Battelle Marine Sciences Laboratory 1993). Suspended-particulate-phase toxicity tests test for the effects of dissolved contaminants and contaminates associated with particles suspended in the water column after during dredging and aquatic placement. Solid-phase toxicity tests are benthic toxicity and bioaccumulation tests that examine the effects of dredged sediment on sensitive benthic organism.

Pinole Shoal Sediment Sampling and Analysis: Sediment proposed for dredging in the northeast portion of Pinole Shoal had elevated levels of aluminum, arsenic, and mercury that were not correlated to the concentration of total organic carbon or grain size. In addition, pockets of elevated chromium (i.e., exceeding in-bay reference samples by 20 to 35 mg/kg) were detected in three composite samples. Total organic compounds were generally higher in the western portion of Pinole Shoal, and decreased moving eastward. Total volatile solids increased slightly moving eastward. Total organic compounds and total volatile solids were well correlated with sediment size, with the fine-grained sediment contained higher total organic compounds. Oil and grease and total petroleum hydrocarbons were generally low throughout the channel. However, PAHs did not exceed any in-bay reference sites. Overall, sediment proposed for dredging are suitable for wetland cover material.

Pinole Shoal sediment toxicity tests indicated that there were some acute toxicity to larvae; however, LC50s could not be calculated because mortality did not exceed 50 percent of the population. The results showed some increased abnormal growth and development in larval echinoderm (*Dendraster excentricus*). However, toxicity tests did not show effects to mysid (*Holmesimysis sculpta*) or juvenile sanddab (*Citharichthys stigmaeus*). Overall, survival rate of species was exposed to Pinole Shoal sediment for 10 to 28 days was 93 percent.

Bulls Head Reach Sediment Sampling and Analysis: Chemical analysis showed that the sediments were relatively uncontaminated. Organic compounds were present in low concentrations, including PAHs, butyltins, and 4'4-DDD. Sediment total organic compounds, total volatile solids, total petroleum hydrocarbons, and sulfides were well correlated with grain size; with fine-grained sediment tending to have higher concentrations. Overall, the analysis indicates that the material is suitable for in-bay and ocean disposal, as well as beneficial use.

Toxicity tests indicated that survival rates ranged from 81 to 98 percent for the amphipod *Rhepoxynius abronius* and 74 to 98 percent for *Echaustorius estuaries*. Longer-term exposure (i.e., 28 days) showed some toxicity and reduced development when exposed to one composite sample. It is believed that the toxicity was due to elevated concentrations of ammonia. Many advances were made regarding reducing ammonia input from sources in the San Francisco Bay area and tributaries. However, confirmatory sediment sampling and analyses during the PED phase will provide further investigation as to the source of toxicity.

Post-deepening Z-Layer Sediment Quality: Although sediment sampling and analysis was conducted to depths deeper than proposed, it is assumed that the sediment sampling and analysis conducted to 45 feet (plus 2 feet overdepth) is characteristic of deepening to 38 foot MLLW channel and 42 foot MLLW sediment basin (plus 2 feet overdepth). The assumption is based on a thorough review of the sediment sampling data, which indicates that the sediment proposed for dredging did not result in significant toxicity to test species and it can be used for wetland cover. However, as discussed, confirmatory testing would be conducted during PED to ensure validate this assumption. Although unlikely, if the confirmatory analysis indicates that the z-layer left behind would be contaminated, appropriate over-excavation and disposal of sediment would be required or the sediment would be left in place and appropriate environmental analysis and consultation would occur at that time.

5.3.3 Hydrology and Salinity Intrusion

This section discusses the existing hydrodynamics and salinity intrusion (defined as the movement of X2 further east into the Delta) in the action area and potential effects that may result from deepening and selective widening of the proposed project. A discussion of the low salinity zone (LSZ) is also included in this section because of its importance to delta smelt and a variety of juvenile fishes.

5.3.3.1 Overview of Delta Hydrodynamics and Salinity Intrusion in the Delta

The San Francisco Bay-Delta region comprises a large network of estuarine embayments, river channels, smaller sloughs, and canals that convey water from approximately 60 percent of California to the San Francisco Bay and Delta watershed. Two major factors that affect hydraulics in the Delta are tides and river flow. During flood tides, the direction of flow is into the Delta, and the river stage increases. During ebb tides, water from the Sacramento and San Joaquin Rivers and their tributaries flow out of the Delta, and the river stage falls. River inflow in the Delta is largely controlled by upstream reservoir releases.

The mixing of freshwater with salt water from the Pacific Ocean results in an estuary-wide horizontal salinity gradient, with salinity varying from full marine conditions (more than 30 practical salinity units [psu]) near the Golden Gate Bridge to freshwater conditions (less than 0.1 psu) in the Sacramento River (https://sfbay.wr.usgs.gov/access/wqdata/yearsdata/charts/sal9395.html). Ideally, there is a net westward water flow from the Delta through the San Francisco Bay resulting from the freshwater outflow from the Delta. However, inflows into the Delta are controlled by upstream dams and reservoirs, which restrain peak flows in the winter and spring for flood control and water storage. At times, flows in Old and Middle rivers in the south Delta can be reversed toward the U.S. Bureau of Reclamation's Central Valley Project and the California Department of Water Resources' State Water Project. Releases in the summer and fall are tailored to meet agricultural and municipal demands. Outflows from the American, Feather, and Sacramento rivers in particular also are used intentionally to reduce salinity to acceptable levels at diversion locations in the Delta (SWRI 2004).

As precipitation-induced channel inflows increase in the winter months, flows in some Delta channels can become one-directional (i.e., downstream). During this period, the tidal influence is minimal and overshadowed by the inflows. During the summer months, the flow patterns more closely correspond with the flood/ebb tidal cycles because net inflows to the Delta and San Francisco Bay tend to be lower during the summer months.

5.3.3.2 X2 and the Low Salinity Zone

The LSZ is the region in the estuary where the average daily salinity ranges from about 0.5 to 6 psu. The X2 is the region within the LSZ where the daily-averaged 2 psu isohaline near the channel bed exists, and is measured in kilometers east of the Golden Gate (***Figure 11***; Jassby et al. 1995; Kimmerer et al. 2009). The X2 fluctuates east and west within the western delta region in the vicinity of Suisun Bay and the confluence of the Sacrament and San Joaquin rivers, depending on Delta freshwater outflow and tides. Within the study area, salinity varies significantly both geographically and seasonally. At the western end of the project area near the West Richmond Channel, salinity is typically around 30 psu, except during periods of very high Delta outflow. At the eastern end of the study area near Avon, salinity levels can be less than 1 psu during very high Delta outflows, but are generally more than 10 psu during periods of lower Delta outflow. Salinity gradients are also pushed seasonally westward into San Pablo Bay during typical periods of high Delta outflow in the winter and spring. In turn, salinity levels in Suisun Bay and the western Delta gradually increase in the summer and fall during periods of generally low Delta outflow.

During critically low water years, Delta outflows can remain low throughout the year, leading to higher salinity in Suisun Bay and the western Delta than during wet water years.

A change in salinity distribution (which could result from a change in freshwater inflows, change in operations of the delta, dredging, etc.) affects the location of the X2 and hence the location of the LSZ habitat and its availability to fishes. A change in the location of the X2 could affect water supply reliability during periods of the year when the position of X2 is managed by regulating (i.e., increasing) Delta outflow to push the X2 farther west. The abundance or survival of several estuarine biological populations in the San Francisco Estuary have historically been positively correlated with freshwater flow and the LSZ. When the X2 is located in Suisun Bay, the area and quality of LSZ habitat available for species that rely on the LSZ (including delta smelt) is increased. As the X2 moves farther east, habitat quantity and quality appear to diminish.

Because of the correlation between the location of the X2 and LSZ habitat quality and quantity, the State Water Resources Control Board (SWRCB) included X2 in the 1995 Water Quality Control Plan (https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/1995wqcp/1995_plan.shtml) as a water quality standard to help restore the relationship between springtime precipitation and the geographic location and extent of LSZ habitat. The biological opinion assessing the impacts of the long-term operations criteria and plan (OCAP) of the Central Valley Project (CVP) and State Water Project (SWP) on delta smelt (https://www.fws.gov/sfbaydelta/CVP-SWP/index.htm) furthered the efforts to increase the quantity and quality of LSZ habitat. Both the Water Quality Control Plan and the biological opinion manage the location of X2 and thus the area of LSZ habitat by regulating Delta outflow. The X2 has been a water quality standard since 1995 and is used by resource agencies to quantify effects to ESA-listed species related to changes in salinity.

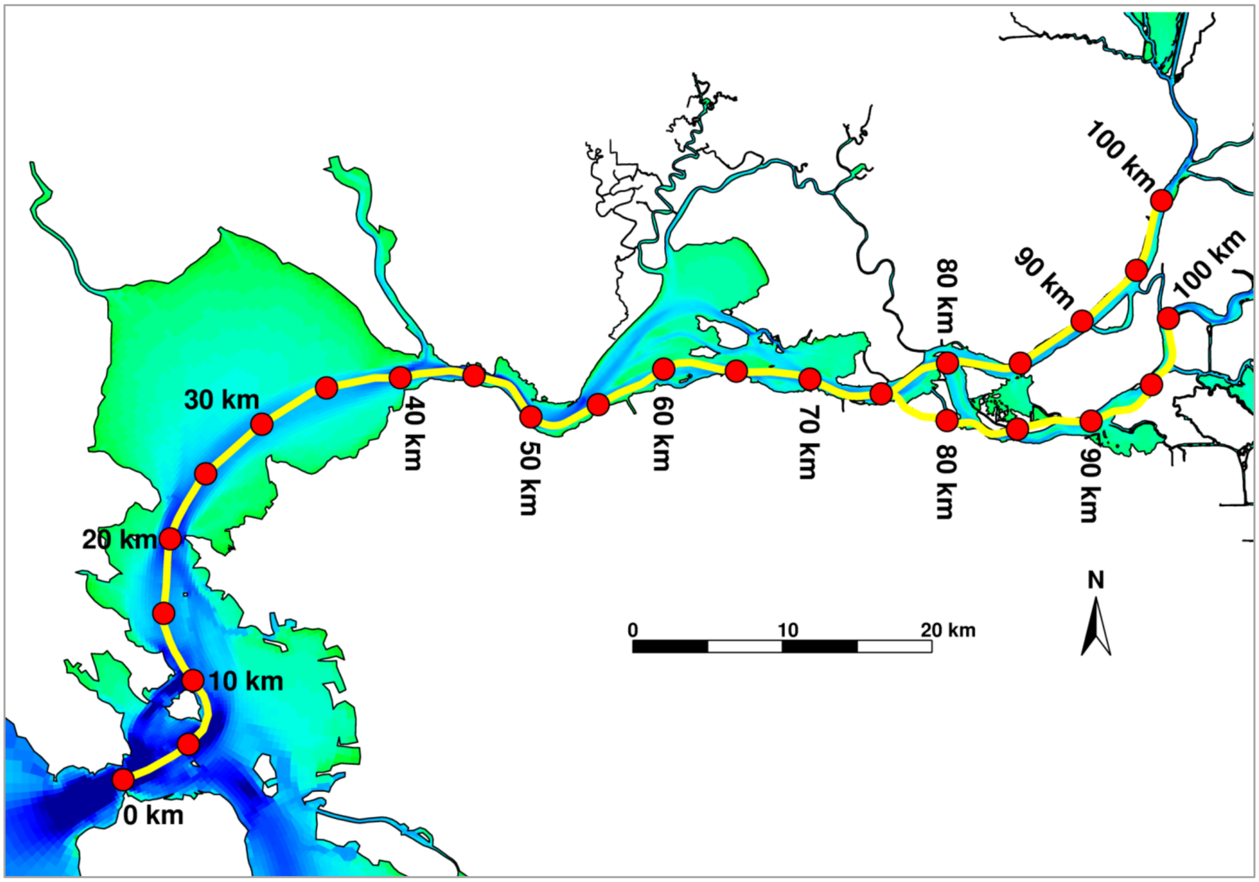

***Figure 11:* Transects Along Axis of Northern San Francisco Bay Used to Measure X2.**

5.3.3.3 Delta Outflow and X2 Requirements

The 1995 Water Quality Control Plan requires the X2 to be maintained at certain locations for a specified number of days each month. Specific locations include 81 kilometers (at Collinsville), 75 kilometers (at Chipps Island), and 64 kilometers (at Port Chicago) from the Golden Gate. The biological opinion further included requirements during fall months following wet or above normal water years. The current X2 requirements from both the Water Quality Control Plan and biological opinion are discussed in detail below.

A significant fraction of inflow is exported out of the Delta by the Central Valley Project and State Water Project for agricultural and urban use. Together, these two projects divert approximately 40 percent of the freshwater river inflows to the Delta and supply two-thirds of the state with drinking water. These alterations have removed much of the variation in through-estuary outflow creating lower outflow in the winter and higher outflow in the summer compared to historical values. Both the CVP and the SWP are considered part of the baseline conditions for hydraulics and salinity concentrations in the action area.

The 2008 USFWS OCAP BO concluded that operations of these projects would jeopardize the continued existence of delta smelt and adversely modify delta smelt critical habitat. The OCAP BO Reasonable and Prudent Alternative (RPA) to avoid jeopardy from operations of the CVP and SWP identified several reasonable and prudent measures, including implementing a fall X2 standard. Specifically, the RPA calls for Delta outflow to be adaptively managed such that the monthly fall X2 must average either 74 kilometers (west of Chipps Island) following a wet year or 81 kilometers (at Collinsville) following an above normal year upstream from the Golden Gate during September and October. In addition, a storage-related requirement to enhance Delta outflow in November was identified; however, a specific X2 target was not. The objective of the fall X2 standard is to improve fall habitat for rearing delta smelt when the preceding water year is above normal or wet, as there appears to be an association in delta smelt abundance and the summer and fall LSZ habitat conditions.

In order to meet the fall X2 standard, the CVP and SWP curtails exports such that the outflow from the Old and Middle Rivers is enough to maintain the required average fall X2. The first fall X2 standard was implemented in fall 2011, which followed the spring 2011 wet year, and was maintained at 75 (September) and 74 (October) kilometers. The years in between 2011 and 2017 did not require use of the RPA because they did not follow above normal or wet years. The second time the fall X2 standard was implemented occurred in fall 2017 when it was maintained at 74 kilometers in September and October.

The 1995 Bay-Delta Water Quality Control Plan established the D1641 flow and X2 standards, including the spring X2 standard, which regulates the degree to which salinity can intrude into the Delta during the spring months. The spring X2 standard requires that the location of X2 be west of Port Chicago (X2 = 64 kilometers) during February through June. The spring X2 requirement must only be met in a respective month if the 14-day average electrical connectivity is less than 2.64 mmhos/cm (approximately 2 ppt) on the last day of the month prior. This 14-day average trigger is intended to avoid large, sudden gyrations in Delta outflows. However, when X2 is less than 64 km, there are no current regulatory requirements that address the position of X2. The objective of the spring X2 requirement is to help restore the relationship between springtime precipitation and the geographic location and extent of the LSZ estuarine habitat.

According to the 1999 and updated 2000 SWRCB Decision 1641, diversion at the Central Valley Project is not authorized when the Delta salinity standards are not met. The salinity standards are considered exceeded when the upstream reservoir releases and unregulated natural flow exceed Sacramento Valley in-basin uses, plus exports, and additional diversions from the Central Valley Project would cause X2 to shift upstream so far that:

- It is east of Chipps Island (75 river kilometers upstream of the Golden Gate) during the months of February through May; or
- It is east of Collinsville (81 river kilometers upstream of the Golden Gate) during the months of January, June, July, or August; or
- During December, it is east of Collinsville and delta smelt are present at the Contra Costa Water District's point of diversion.

Other water diversions also may impact X2. In 1997, the CDFW initiated a study to document all water diversions in the Delta and within the Sacramento and San Joaquin River Basins (Herren and Kawasaki 2001). Of these, 424 were documented along the Sacramento River above I Street Bridge in Sacramento, 298 were found within the San Joaquin River Basin, 2,209 were within the Delta, and 366 were in Suisun Marsh. Although not as big as the CVP or the SWP, together these diversions consume water that would flow to the San Francisco Bay and may have resulted in cumulative salinity intrusion in the Delta (Herren and Kawasaki 2001).

5.3.3.4 Potential Impacts to X2 and the LSZ Resulting From Salinity Intrusion

To analyze the potential hydrodynamic and salinity intrusion that could result from deepening the channel, the three-dimensional hydrodynamic model UnTRIM San Francisco Bay-Delta Model (Anchor QEA, LLC 2019 – salinity model report available upon request) was used. The UnTRIM San Francisco Bay-Delta model (UnTRIM Bay-Delta model) is a 3-D hydrodynamic model of San Francisco Bay and the Sacramento-San Joaquin Delta, which was developed using the UnTRIM hydrodynamic model (Casulli and Zanolli 2002, 2005; Casulli 2009). The model provides a detailed evaluation of the effect of the proposed action under both wet and critically dry conditions, representing the range of possible conditions. The analysis was conducted for both base year (year 0) and future (year 50) conditions for the project, and included sea level rise.

Modeling indicates that the average annual predicted shift in X2 would be 0.17 km during a critical water year and 0.27 km during a wet water year (***Table 2***). In wet years, the slightly larger shifts in X2 corresponds to the periods when the salinity gradients were pushed west into San Pablo Bay. Consequently, the effects on species such as delta and longfin smelt would be expected to be greatest during critical water years because available LSZ habitat in Suisun Bay would be more likely to be reduced. However, these predicted shifts in X2 are on the same order of magnitude as the accuracy to which X2 can be measured operationally, and hence would be insignificant (i.e., not detectable).

Additional modeling for a below normal water year indicates that upstream movement of X2 caused by the project may actually result in LSZ area being either gained or lost due to the large variance in the shoreline, primarily in Suisun Bay (i.e., average monthly change from -556 to 446 acres; Anchor QEA, LLC 2019). However, the area gained would be at the upstream end of the LSZ, whereas the area lost would be at the downstream end where more desirable habitat is likely to be located. Still, the overall monthly average area of the LSZ would range from 13,966 to 26,807 acres with the project versus 14,083 acres to 26,705 acres without the project. These small differences again may not be detectable and hence insignificant.

The effect of the proposed project on salinity was also evaluated for a critical water year representative of possible year 50 conditions, which included 2.38 feet of sea level rise based on the USACE high curve (http://corpsclimate.us/ccaceslcurves.cfm). Under year 50 conditions, the predicted annual average increase in X2 resulting from the project deepening is expected to be 0.17 km, which is identical to what was predicted for year 0 conditions for a critical water year (***Table 2***). This suggests that the project effects on X2 are likely to be nearly identical under future conditions as under existing conditions for a given hydrology and outflow regime. Modeled year 50 conditions did not include changes to Delta water operations to offset the increased salinity intrusion resulting from sea level rise, so the baseline X2 (i.e., without the project) under year 50 was on average 4.31 km higher than under year 0 baseline conditions resulting in higher baseline salinity conditions in the Delta under year 50. Therefore, the effects of the proposed project in year 50 would be expected to be, on average, 0.17 km divided by 4.31 km, or less than 4 percent of the total upstream change in the location of X2.

Water Year Type	Change in X2 (km)	
	Annual Average	Change for X2 > 64
Critically Dry (Year 0)	0.17	0.17
Wet (Year 0)	0.27	0.23
Critically Dry (Year 50)	0.17	0.17

Table 2: **Predicted change in X2 from the proposed project in a critically dry and wet water year in year 0 (i.e., under baseline conditions), and a critically dry water year in year 50 (i.e., including sea level rise) based on the modeling results of Anchor QEA, LLC (2019). Port Chicago is located at X2 = 64. Fish habitat upstream of this location is of special concern, and salinities measured at this location trigger spring X2 water quality requirements.**

5.4 Noise

Underwater sound pressure waves can harass and harm fish species (Teachout 2012, Caltrans 2015). 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 changes in behavior and physiological damage such as rupture of the swim bladder or 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 (Dickerson et al. 2001). In that analysis, the most extreme SPLs measured in decibels root-mean-square (dB rms) were produced by the dredge bucket striking the channel 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 of 124.0 dB rms, 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 those of Cook Inlet Alaska. Therefore the SPLs at 150 meters are expected to be higher than ambient.

As discussed, a pneumatic jackhammer (***Figure 8***) mounted to an excavator would be used to remove the small rock outcrop at the downstream end of Pinole Shoal (***Figure 6***). Maximum sound levels of jackhammers and excavator-mounted hoe rams used for rock-breaking activities measure about 90 dBA in air at a distance of 50 feet (Washington State Department of Transportation [WSDOT] 2018). Adding the sound conversion factor of 61.5 dB used by the U.S. Navy (Katz et al. 2010) accounts for both the weighting of the original measurement toward human hearing (i.e., dBA vs. dB), and the higher impedance of water vs. air (Collins 2018). Subtracting an additional 10 dB provides a conservative estimate of 145.5 dB rms at 50 feet underwater; accounting for noise attenuation can be done by subtracting 4.5 dB per doubling of distance (WSDOT 2018). Therefore, for comparison with the clamshell dredge noise described above, the removal of the rock outcrop would create additional noise of approximately 132 dB rms at 400 feet for a short period of time (i.e., for up to 20 hours spanning 1-2 days). Note that noise from multiple sources is not expected to greatly impact results because decibels are measured on a logarithmic scale. The overall noise output would be that of the loudest noise source plus the addition of a maximum of 3 dB (WSDOT 2018).

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 SPL 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, NMFS uses 150 dB rms as the threshold for adverse behavioral effects (ICF Jones & Stokes and Illingworth and Rodkin, Inc. 2009). The proposed project is expected to produce SPLs of 124.0 dB rms from clamshell dredging as determined in the Cook Inlet study, and 132 dB rms from removal of the rock outcrop. These noise values are 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.

5.5 San Francisco Bay-Delta Climate Change

The effects of climate change, particularly sea level rise and increased water temperatures, are anticipated to exacerbate existing threats to special status fishes. This biological assessment considered the potential effects of climate change based on projections derived from various modeling scenarios. Temperature increases are likely to lead to a continued rise in sea level, further increasing salinity intrusion (Feyrer et al. 2011; Cloern et al. 2011; Brown et al. 2013). Higher air temperatures will reduce snowpack, melt snow earlier in the winter or spring, and increase water temperatures. These changes will likely alter freshwater flows, possibly shifting and condensing the timing of various life histories of special status fishes (Brown et al. 2013).

Projections indicate that temperature and precipitation changes will diminish snowpack, changing the availability of natural water supplies (USBR 2016). Warming may result in more precipitation falling as rain and less storage as snow. This would result in increased rain on snow events and increase winter runoff with an associated decrease in runoff for the remainder of the year (USBR 2016). Sacramento Valley Ecoregion projections include a 27 percent decrease in annual freshwater flows and earlier snowmelts, with increased freshwater flows in January and February but reduced throughout the rest of the year (PRBO Conservation Science 2011). Earlier seasonal warming increases the likelihood of rain-on-snow events, which are associated with mid-winter floods. Smaller snowpack that melt earlier in the year may result in increased drought frequency and severity (Rieman and Isaak 2010). Thus overall, these changes may lead to increased frequency of flood and drought cycles during the 21st century (USBR 2016).

Sea level rise is likely to increase the frequency and range of saltwater intrusion. Salinity within the northern San Francisco Bay is projected to rise by 4.5 by the end of the century (Cloern et al. 2011). Elevated salinity levels could push the position of X2 farther up the estuary if outflows were not increased to compensate for it. Fall X2 mean values are projected to increase by a mean of about 7 km to the area of Antioch for a distance of approximately 90 km from the golden gate bridge by 2100 (Brown et al. 2013). This increase in the position of X2 in the fall is expected to result in a decrease in suitable physical habitat for fishes (Brown et al. 2013) if current levees and channel structures are maintained. A decrease in spring habitat due to the movement of X2 upstream due to sea level rise is also expected to result from climate change.

It is expected that warmer estuary temperatures to be yet another significant conservation challenge based on climate change models. Mean annual water temperatures within the upper Sacramento River portion of the Bay-Delta estuary are expected to approach or exceed 14 °C during the second half of this century (Cloern et al. 2011).

5.6 Future Foreseeable Projects and Cumulative Effects

Cumulative effects considered in this BA/EFH assessment include the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the area. Projects that may result in cumulative effects include:

- Future foreseeable changes in operations of the CVP and SWP which are not currently implemented (see USBR's 2008 Operations Criteria and Plan (OCAP) BA, USFWS' 2008 OCAP BO, and NOAA Fisheries 2009 OCAP BO). Cumulative effects could result could result hydraulics and salinity intrusion alterations in the action area.
- The current project would be interrelated with the potential deepening of the shipping channel all the way to the Port of Stockton, should it occur. Cumulative effects could result in additional salinity intrusion within the action area.
- Future habitat restoration associated with the CVP and SWP. Cumulative effects could include adverse effects during construction and beneficial effects upon completion.
- Other restoration efforts not yet completed (e.g., Montezuma Wetlands) or planned in the future. Cumulative effects could include adverse effects during construction and beneficial effects upon completion.
- Projects which would increase concentrations of constituents of concern or clean up areas or sources of contamination. 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.
- Projects that alter riparian habitat along sloughs, channels, and other aquatic habitat. Reduction of riparian habitat could result in reduced shading of migratory corridors, increased water temperatures, and increased predation. Whereas, projects that increase and improve riparian habitat could have the opposite effect.

Together with the proposed project, these projects may result in lethal, sub-lethal, or beneficial impacts to special status species, critical habitat, and EFH. For example, projects that increase salinity intrusion could result in reducing the quality and quantity of LSZ habitat in the Suisun Bay and Delta, which could result in decreased prey resources, increased completion affecting critical habitat. Projects that restore wetland and other aquatic habitat with a hydrological connection to the Bay and Delta could offset or increase salinity intrusion into the Delta (though, most restoration projects are designed to reduce the salinity wedge intruding into the Delta). Additional restoration projects could provide additional spawning, rearing, foraging, and resting habitat for sensitive species.

6.0 USFWS-Managed ESA Species and Effects Determinations

This section presents the impact assessment for threatened and endangered species, as well as critical habitat managed by the USFWS. The most recent official USFWS-species list was generated from the USFWS's IPaC website on November 27, 2017 (**Appendix A**). This species list will be updated prior to submitting this biological assessment to the USFWS requesting consultation. The species list identified 46 threatened and endangered species, including three mammals, seven birds, three reptiles, two amphibians, two fishes, seven insects, four crustaceans, and seventeen plants. Two critical habitats were also identified. Of the species and critical habitats identified, only one fish, delta smelt and delta smelt critical habitat are likely to occur in the proposed project area. In addition, this analysis considers the potential effects of the proposed project on the candidate species longfin smelt (*Spirinchus thaleichthys*). Should longfin smelt be proposed for listing prior to or during construction of the proposed project, USACE will request a conference opinion, pursuant to 50 C.F.R § 402.10.

All species identified in the official list are provided in **Appendix A**, 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 by the proposed action is also provided below.

6.1 USFWS-Managed Special Status Species Descriptions

This section discusses the listing status, distribution, life history and biology, habitat, stressors, and status of special status species in the action area. This section focuses only on USFWS-managed special status species and critical habitat that may be affected by the proposed action.

The impacts on delta smelt and longfin smelt are expected to be similar; with some differences being that within the action area, longfin smelt inhabit a larger range of the San Francisco Bay, including San Pablo Bay, and delta smelt are generally confined to the areas Suisun Bay and Napa River/Mare Island Strait. As such, the effects of the action on both species are discussed together in ***Section 6.2***. Where impacts are different, they are discussed separately.

6.1.1 Delta Smelt (*Hypomesus transpacificus*) (FT) (CH) (SE)

The delta smelt is a euryhaline species endemic to the San Francisco Bay and Sacramento-San Joaquin River Delta. It is a small, slender fish that reaches approximately 2 to 3 inches in length (***Figure 14***). It is a relatively short-lived species that is nearly translucent with a blue sheen on the sides of the body. It is one of seven species of smelt native to California. Its range generally is confined to the fresh and low salinity waters of the Delta and Suisun Bay, but periods of high outflow may move fish westward into San Pablo Bay. Critical habitat is designated for delta smelt, which is discussed in ***Section 6.3***.

6.1.1.1 Listing Status and Range

The USFWS listed the delta smelt as threatened on March 5, 1993 (58 FR 12854), and designated critical habitat for this species on December 19, 1994 (59 FR 65256). On April 7, 2010, the USFWS submitted a 12-month petition finding to reclassify the delta smelt as endangered. They found that reclassification is warranted, but precluded by other higher priority listing actions (75 FR 17667).

Delta smelt are endemic to the Sacramento–San Joaquin Delta and utilize areas as far upstream as Verona in the Sacramento River, and Mossdale in the San Joaquin River. They occur downstream to San Pablo Bay, in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties, California (73 FR 74674). Moyle (2002) notes that 'spawning has…been recorded in Montezuma Slough near Suisun Bay…and may occur in Suisun Slough in Suisun Marsh in some years or in the Napa River "estuary."'

6.1.1.2 Life Cycle and Habitat Use

Delta smelt are pelagic fish that are weakly anadromous. They complete most of their 1-year life cycle in the LSZ—salinities ranging from about 0.5 to 6 parts per thousand (ppt; which is equivalent to psu) (Kimmerer et al. 1998; Moyle 2002), but can inhabit a range of salinities from completely fresh water to 14 ppt. They migrate to fresher water to spawn in the late winter through early spring.

Generally, delta smelt are found along the freshwater edge of the salinity mixing zone (The Bay Institute 2007). Other than delta smelt eggs, all life stages are pelagic—found in the water column—and are not associated with the shoreline.

In early winter, between December and April, adults migrate to freshwater to spawn. It is thought that upstream migration is triggered by abrupt changes in flow and turbidity associated with the first flush of freshwater. Spawning occurs during the late winter and spring in waters with temperatures ranging from 12 to 18 °Celsius (°C); however, spawning may occur in temperatures up to 22 °C. Although not documented in the wild, it is assumed that spawning takes place in shallow sloughs and channel edge waters over sand and cobble. Females produce approximately 1,200 to 2,600 eggs. Most delta smelt die after spawning; however, some individuals live to spawn one more year (59 FR 65256; 75 FR 17667; 73 FR 74674).

Eggs are negatively buoyant and adhesive, sinking to the bottom and attaching to hard substrates, such as sand particles, cobble, rocks, tree roots, and submerged branches. Eggs incubate for 10 to 14 days before hatching in water temperatures ranging from 15 to 17 °C (75 FR 17667; 73 FR 74674). Generally, hatching success is low in higher temperatures.

Larvae are most abundant between April and May. Recently hatched larvae are buoyant and swim actively near the surface of the water. As larvae continue to develop, they become semi-buoyant and sink in the water column (75 FR 17667). Studies indicate that larvae exhibit reverse vertical migration, i.e., they use the upper portions of the water column during the day and randomly disperse at night (Lenny Grimaldo (ICF), et al. unpublished data) or move to deeper water (Bennett et. al. 2002 and Hobbs et al. 2006). Larvae gradually move to rearing grounds downstream in the LSZ, near X2. They reside in shallow, open waters ranging from 2 to 7 ppt. Swim bladders begin to form 60 to 70 days post-hatch and at around 70 days most delta smelt are no longer larvae (73 FR 74674).

Young delta smelt rear in the LSZ from late spring through early fall, sexually maturing and reaching adult size by about September through October. They begin gradually migrating upstream to spawning grounds in early winter.

Larval delta smelt begin to feed 5 to 6 days post-hatch. Feeding may be triggered by turbidity, in areas with high densities of prey. Larvae are visual feeders that may feed during the day in the upper portion of the water column (Lenny Grimaldo (ICF), et al. unpublished data). Larvae generally feed on larval stages of copepods, including *Eurytemora affinis*, *Pseudodiaptomus forbesi,* and members of the Cyclopidae family (58 FR 12854). To a lesser extent, larvae also feed on the introduced copepods, *Limnithona tetraspina* and *Acartiella sinenisi* (75 FR 17667).

Juvenile delta smelt feed on copepods (*Pseudodiaptomus forbesi* and *E. affinis*), cladocerans, amphipods, and insect larvae. Historically, the main prey included larval stages of *E. affinis* and the mysid *Neomysis mercedis*. Adults also consume opossum shrimp *(Neomysis mercedid*), *Daphnia spp.*, and *Bosmina spp.* seasonally (58 FR 12854).

6.1.1.3 Threats

Delta smelt populations are threatened by several factors, many of which are compounding, and some that are not fully understood. Threats include entrainment in water diversions, habitat degradation, changes in abundance and composition of prey, contamination, and, to a lesser degree, predation and competition (59 FR 65256).

One of the biggest threats to delta smelt are the large SWP and CVP water export facilities (i.e., pumping facilities located in Banks and Jones) located in the south Delta near Tracy (73 FR 74674; 75 FR 17667). The Jones facility is part of the CVP, operated by the United States Bureau of Reclamation, and the Banks facility is part of the Department of Water Resources’ SWP. The pumping facilities convey water from the northern portion of the state to farms and municipalities in the southern parts of the state. Water exports can directly entrain delta smelt in the Central and South Delta by creating reverse flows—changing the flow of rivers and sloughs from towards the San Francisco Bay to the pumping facilities—and also have affected Delta hydrology and ecology in several ways. Smelt are at higher risk when the flows in the Old and Middle Rivers become more negative (73 FR 74674).

Entrainment of adult delta smelt in the pumping facilities predominantly occurs during their upstream migration to spawning grounds between December and April in the central and south Delta (73 FR 74674). It appears that adults are more susceptible to entrainment during drier years or when exports are higher (73 FR 74674). Hydraulic dredging has also been shown to entrain and take delta smelt, albeit in much smaller numbers.

Alteration of habitat, including loss of shallow water habitat, loss of spawning habitat, and salinity intrusion, is another threat to delta smelt (Nobriga et al. 2008; Sommer and Mejia 2013). They utilize LSZ habitat from spring through early winter. Factors that alter the position of the LSZ, moving it farther east into the delta, may adversely affect delta smelt habitat. Water diversions in the Delta, especially at the pumping facilities, and reduced upstream water releases have reduced delta outflow significantly, which has resulted in salinity intrusion into the fresher waters of the Delta. Salinity intrusion has moved the LSZ habitat further into the Delta, which is thought to constrict habitat, concentrating delta smelt in a smaller area (75 FR 17667). When the LSZ is further west, especially when in Suisun Bay, juvenile and adult delta smelt are more widely dispersed and have access to shallow water and marsh habitat, which may have higher zooplankton productivity than when shifted east (59 FR 65256; 73 FR 74674).

Loss of and changes to delta smelt prey community has also stressed this species. Historically, the predominant prey of delta smelt included the copepod *Eurytemora affinis* and the mysid *Neomysis mercedis* (Moyle et al. 1992). These prey resources were replaced by *Pseudodiaptomus forbesi* and *Limnoithona tetraspina*, which are now the major prey of delta smelt (Baxter et al. 2008; Bouley and Kimmerer 2006). It is believed that these species provide inferior nutritional value to delta smelt, compared to the historically preferred species.

Non-native submerged aquatic vegetation may also alter habitat components required for delta smelt to complete their life cycle. Introduced *Egeria densa,* among other non-native aquatic vegetation*,* grows rapidly in many parts of the Delta, reduces turbidity, and could reduce spawning habitat in intertidal shoals and beaches (73 FR 74674).

6.1.1.4 Status in the Action Area

Delta smelt juveniles and adults typically are present in the action area in April through December. Juveniles and adults utilize the action area during the existing delta smelt work windows (August 1 – November 30). Juveniles begin their downstream migration to rear in the Suisun Bay region where they mature. Adults slowly begin their upstream migration to spawning grounds in late fall/early winter. Over the past 15 years, the delta smelt population has declined rapidly and reached record low numbers in the last few years.

The 2017 population estimate was extremely low (48,000 individuals; USFWS 2018), despite being 200 percent higher than 2016 (16,000 individuals). The 2017 estimate is 92 percent lower than the highest recorded abundance (i.e., 48,000 compared to 600,000).

Only two delta smelt were collected during the 4 months of fall mid-water trawl surveys (September-December 2017), the lowest number ever recorded (Hobbs and Moyle 2018). The 2018 population estimate based on spring Kodiak trawl surveys in January and February 2018 is just 18,000 individuals, the second lowest (following 2016) since these surveys began in 2002 (Kim Squires, USFWS, personal communication, May 16, 2018).

Because delta smelt no longer can be reliably detected using the survey methods above (Wilcox 2017), the Enhanced Delta Smelt Monitoring (EDSM) program recently began. The most recent USFWS Enhanced Delta Smelt Monitoring data abundance estimate is the lowest on record, at just 2,721 Delta Smelt estimated to be in the Bay as of February 8, 2019 (Kim Squires, USFWS, personal communication, February 12, 2019).

6.1.2 Longfin Smelt (*Spirinchus thaleichthys*) (FC) (SE)

Longfin smelt is a short-lived, estuarine-anadromous, euryhaline, nektonic, small (90 to 110 mm standard length) osmerid fish that inhabit estuaries and coastal waters along the Pacific Coast, with San Francisco Estuary being the southern extent of its range (Moyle 2002).

6.1.2.1 Listing Status and Range

On April 2, 2012, the USFWS determined that the San Francisco Bay-Delta Distinct Population Segment (DPS) of longfin smelt warrants consideration for protection under the federal ESA, but was precluded from formally listing longfin smelt due to the need to address other higher priority species (77 FR 19755). Longfin smelt remains a federal candidate for listing and is included in this biological assessment with the understanding that if they were to be listed before or during construction of this project, a conference opinion would be requested.

Historically, longfin smelt populations were found in the Klamath, Eel, and San Francisco estuaries, and in Humboldt Bay. Current sampling indicates that populations reside at the mouth of the Klamath River and the Russian River estuary. Scattered populations also occur in estuaries and bays from Oregon to Alaska. In the Central Valley, longfin smelt are rarely found upstream of Rio Vista or Medford Island in the Delta. Adults concentrate in Suisun, San Pablo, and North San Francisco bays (Moyle 2002).

6.1.2.2 Life Cycle and Habitat Use

Longfin smelt largely exhibit a 2-year life cycle and generally die after spawning. However, some individuals delay spawning until age 3, and repeat spawning may be possible (Baxter 2018).

Adult longfin smelt inhabit bays, estuaries, and near shore coastal habitats; including Suisun, San Pablo, Central, and South San Francisco bays (CDFW 2009). During the late fall, adults migrate from these areas to the LSZ of the lower estuary where they congregate prior to spawning. Adults become sexually mature towards the end of their second year. Sexually mature adults migrate upstream to freshwater—ranging from 0.5 to 2 psu—in Suisun Bay and the western Delta. Spawning may start as early as November and extend through July (Baxter 1999); peaking in February through April (Moyle 2002) in freshwater less than 16 °C (CDFW 2009). Fecundity depends on the size of the fish; with smaller fish producing about 1,900 eggs and larger fish producing 18,000 eggs. Longfin smelt eggs are negatively buoyant and adhesive and attach to sand or cobble particles. Eggs take approximately 30 to 40 days to incubate.

Embryos hatch between January through March and are buoyant (CDFW 2009). They move into the upper part of the water column and are transported to Suisun, San Pablo, Central, and South San Francisco bays with high spring and winter flows to waters with salinities ranging from 15 to 30 psu. In low outflow years, larvae move into Suisun Bay and the western Delta, up to the Cache Slough Complex. As larvae grow, they migrate to the lower two-thirds of the water column and continue to vertically migrate over tidal cycles (CDFW 2009).

Juvenile longfin smelt rear in brackish waters with salinities ranging from 2 to 8 psu in waters less than 20 °C, and are rarely found in waters greater than 22 °C. They are generally found farther downstream than larvae, depending on Delta outflow. During years of low flow, juveniles are also found in the Delta (CDFW 2009). Rosenfield and Baxter (2007) indicate that post-larval longfin smelt display a depth-stratified distribution and seem to aggregate in deep-water habitats (catch per unit effort was consistently, although not significantly, higher at channel stations versus shoal stations). Juveniles generally disperse to more saline and deeper water habitats. High winter/spring outflow appears to improve recruitment success (Baxter 2018). Eggs and larvae tend to be more widely distributed and occur farther downstream under such conditions, and juveniles tend to disperse farther downstream and may enter the ocean earlier (Baxter 2018). In addition, feeding success may be greater and freshwater predators such as largemouth bass would be avoided.

Longfin smelt larvae begin feeding on copepods and cladocerans, and as they grow; they also feed on mysids and amphipods (CDFW 2009). Juveniles predominately feed on mysids, amphipods, copepods and daphnia, with fish making up a smaller portion. Adult longfin smelt feed primarily on opossum shrimp, *Acanthomysis* spp. and *Neomysis mercedis*, when available. Longfin smelt feed throughout the day and into the night, which suggests that turbidity may not hamper feeding success. They have well developed olfactory organs that aid in finding prey (CDFW 2009).

6.1.2.3 Threats

Similar to delta smelt, threats to longfin smelt include entrainment in state and federal water projects, spawning habitat loss, contaminants, predation by birds and fish, bycatch in fisheries, scientific collections, and food limitation. A longfin smelt Management and Synthesis Team was formed in 2017 to assess the species biology and status in a more focused manner, including the development of a conceptual model of the longfin smelt life cycle (Baxter 2018; Hobbs 2018; Tobias 2018).

6.1.2.4 Status in the Action Area

Longfin smelt juveniles and adults typically are present in the action area from April through December. Larval and juvenile fish move downstream and rear in Suisun and San Pablo bays or farther west where they mature and then slowly begin their upstream migration to spawning grounds as adults in late fall/early winter. Since about 2000, the abundance of longfin smelt in the San Francisco Bay-Delta has steadily declined (Hobbs et al. 2017; Baxter 2018).

6.2 Delta Smelt and Longfin Smelt Effects Determinations

A detailed discussion of the general direct, indirect, interrelated, and cumulative impact mechanisms are provided in ***Section 5.0***. This section focuses on how these mechanisms would specifically affect delta smelt and longfin smelt. The proposed action has the potential to directly and indirectly affect delta and longfin smelt through crushing or hitting individuals with dredge equipment; entrainment in dredging equipment; exposure to increased hydroacoustic noise, suspended sediment, constituents of concern; changes to physical habitat (e.g., changing shallow water habitat to deeper water habitat), and salinity intrusion (i.e., movement of the LSZ and X2 farther upstream). Most effects would be related to construction of the project, which would be short-lived (i.e., up to 1 month in Bulls Head Reach and approximately 6 months in Pinole Shoal) impacts that occur during or shortly after active dredging. The impacts would be similar to those that occur during maintenance dredging, with the exception of the relatively minor bathymetry alterations, including converting shallower water habitat (-35 feet to -38 feet in Pinole and Bulls Head Reach, with addition of the sediment trap to -42 feet in Bulls Head Reach) to deeper water habitat, and salinity intrusion caused by deepening the channel.

Dredging Bulls Head Reach would be conducted during the existing delta smelt work windows. Longfin smelt are present in the action area year round. However, working within the delta smelt work windows in Bulls Head Reach (Suisun Bay), would limit exposure of longfin smelt to dredging activities and be protective of sensitive life stages, such as spawning adults and larvae.

To the extent practicable, dredging Pinole Shoal would also occur during the work windows. However, should deepening not be completed within one dredging season, the project proposes to expand the work windows in compliance with the NMFS LTMS maintenance dredging biological opinion (i.e., expanded work windows which are allowed for maintenance dredging if dredging is conducted with a clamshell dredge and sediment is beneficially reused for aquatic habitat restoration). In addition, the project proposes to use a clamshell dredge for all work, which would minimize entrainment and physical injury to delta smelt and longfin smelt. The project proposes to use all dredged material for beneficial reuse which would contribute to restoration of smelt habitat.

6.2.1 Direct Contact with Dredging Equipment and Entrainment

The presence of both delta smelt and longfin smelt in the Pinole Shoal Channel and Bulls Head Reach during the environmental work windows is documented. Therefore, there is a potential for smelt to be directly injured or killed by dredging equipment. The most likely cause of injury would be from the clamshell bucket falling through the water column until reaching the substrate. However, as mechanical equipment travels through the water column, it generates a pressure wave that would likely force small fish away from the falling bucket. General disturbance from barges, dredging crew and tugs is expected to disturb any delta or longfin smelt in the surrounding area and likely cause the fish to exhibit a startled response, followed by escapement from the area.

Very limited data exist regarding potential entrainment effects of clamshell dredging on small fish such as delta or longfin smelt (see Reine and Clarke 1998). The entrainment of aquatic organisms may be possible with a mechanical clamshell dredge. As the bucket of a mechanical clamshell dredge collects material from the bottom, aquatic organisms can be physically collected within the water and sediment material. However, mechanical clamshell dredging is considered to have a very low risk of fish entrainment, and for large fish typically the lowest of all dredge types (Reine and Clarke 1998).

As mentioned previously, general disturbance from barges, dredging crew and tugs is expected to cause delta smelt and longfin smelt to avoid the areas where active dredging is occurring. It is expected that direct contact with dredge equipment or entrainment will be minimal because delta and longfin smelt would likely avoid dredging activities. Overall, the potential to entrain or physically injure or kill delta smelt or longfin smelt is very low.

6.2.2 Exposure to Increased Suspended Sediment and Turbidity

Dredging and scow overflow would result in increased concentrations of sediment. The increased concentrations would be continuous during active dredging, with the highest concentrations within a 200-foot radius of dredging and overflow (USACE 2014). As discussed in ***Section 5.3.1***, sediment proposed for dredging in the Pinole Shoal Channel ranges from fine-grained at the western and eastern portions of the channel and sand in the center. Sediment proposed for dredging in Bulls Head Reach is predominately sand with small pockets of fine-grained material. Dredging would result in increased turbidity plumes, which would be greatest in areas of fine-grained sediment (e.g., eastern and western portions of the Pinole Shoal Channel). Dredging in areas of sand would result in plumes with less concentration of suspended sediment because sand would fall out of the water column rather quickly and settle to the bottom of the channel. The range of temporary turbidity increases is expected to be within a 200-foot radius from dredging operations and disposal area, and is expected to persist during active and settle within 20 minutes following active dredging (USACE 2014).

Dredging activities are generally centered within the navigation channel, outside of the intertidal areas associated with the delta smelt's shallow water habitat minimizing the potential for adverse effects. Longfin smelt, on the other hand, are believed to congregate in deeper waters and would be exposed to increased suspended sediment concentrations.

Elevated concentrations of turbidity could expose delta smelt and longfin smelt to the turbidity plumes. It is expected that the harm would be sub-lethal effects to fish anatomy (e.g., damage to gills), or behavioral (avoidance of plumes). The behavioral avoidance response of delta smelt and longfin smelt is expected to substantially reduce or eliminate the risk of exposure the farther they are from the plume source.

6.2.3 Salinity Intrusion

Delta smelt spend most of their life cycle in the LSZ, which ranges from 0.5 to 6 psu (Bennett et al. 2002; Kimmerer et al. 2013). Longfin smelt inhabit a range of salinities, from freshwater to seawater. However, longfin smelt juvenile survival also is strongly linked to the location of X2 (Moyle 2002). Modelling indicates that the location of X2 would increase on average by 0.17 km in a critically dry year and 0.27 km in a wet year (see section 5.3.2. for a detailed discussion).

The maximum salinity intrusion impacts would be the synergistic effects of the proposed project with sea level rise. When sea level rise is included in the model, the baseline conditions for salinity and location of X2 increase. Specifically, the location of X2 would increase by 4.31 km if no increased outflow occurs (Anchor QEA, LLC 2019). The effects of the proposed project in year 50 would be expected to be, on average, 0.17 km divided by 4.31 km, or less than 4 percent of the total upstream change in the location of X2. Since this predicted shift in X2 is on the same order of magnitude as the accuracy to which X2 can be measured operationally, it is not expected that deepening the existing channel would result in a significant shift in the timing or magnitude of exports in order to maintain water quality conditions.

The maximum impact (i.e., including sea level rise) of the proposed project on salinity estimated for five D-1641 sampling locations near water diversions was 6.4 ppm (Anchor QEA, LLC 2019), which is very small given that the psu used to describe delta smelt habitat are approximated by measurements in ppt. Swanson et al. (2000) investigated salinity tolerances in delta smelt; in that study, salinity values were measured to the nearest 0.1 ppt, and salinity challenges were conducted using 2 ppt step increases. The results indicate that delta smelt could not detect small salinity changes. Presumably it would be difficult to detect the impacts of 6.4 ppm maximum increase on delta smelt; 6.4 ppm = 0.0064 ppt.

While delta smelt and longfin smelt may not be able to detect the minor changes in salinity resulting from the proposed project, LSZ habitat could be affected. Low salinity zone habitat alteration resulting from a shift in X2 is discussed in ***Section 6.2.4***.

6.2.4 Habitat Loss

The proposed project could result in impacts to two key components of delta smelt and longfin smelt habitat, alterations to the LSZ resulting from salinity intrusion and bathymetry changes resulting from conversion of shallow water to deeper water. The key modeled impact of the proposed project on X2 is the upstream shift by 0.17 km in a critically dry year, when delta and longfin smelt would be most intensely subjected to other stressors related to their habitat both contracting and shifting upstream (e.g., increased predation, reduced quantity and quality habitat, etc.). The California Data Exchange Center shows that critically dry years in the Sacramento Valley occurred 16 times during 112 years (i.e., 14 percent of years) from 1906 to 2017 (http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST; see Anchor QEA, LLC 2019 for a discussion). The modeled X2 shifted upstream 0.27 km during a wet year scenario, but because the baseline X2 was located down-bay, the impact to delta and longfin smelt habitat would be less severe. Limited additional modeling showed that other water year types (i.e., below normal and dry) would be intermediate in the upstream shift of X2, and that the overall monthly average area of the LSZ for a below normal year would range from 13,966 to 26,807 acres with the project versus 14,083 acres to 26,705 acres without the project (Anchor QEA, LLC 2019). Overall the modelling suggests that these small changes in habitat location and area may not be detectable and hence would be insignificant.

The USFWS defines delta smelt shallow water habitat as "all waters between the mean high water and 3 meters below the mean high water mark. All waters with depths less than 3 meters (9.84 feet) at any given time are within the photic zone and are highly productive. These areas are considered suitable habitat for delta smelt and are both vegetated and un-vegetated, including where riprap rock may have been once applied. Critical habitat for delta smelt encompasses this definition but is not exclusive of shallow water habitat" (USFWS 2004b).

An analysis was conducted to determine the extent the proposed action would convert waters shallower than 3 meters to deeper water. The analysis indicated that all direct impacts resulting from dredging excavation of sediment would occur at waters deeper than 3 meters and that the conversion of shallow water habitat, as defined by the USFWS, would not occur.

As discussed, the project proposes to reuse dredged sediment at Montezuma Wetlands and Cullinan Ranch, thereby contributing to wetland restoration which would increase the quantity and quality of delta smelt and longfin smelt habitat in Suisun Bay, Mare Island Strait/Napa River, and San Pablo Bay. Specifically, the dredged material from this project is expected to result in the creation or restoration of 160 acres of tidal wetland habitat that would benefit delta and longfin smelt, helping to offset temporary impacts to habitat resulting from increased turbidity and changes to the LSZ.

6.2.5 Exposure to Noise

As discussed in ***Section 5.4.***, noise from the proposed project would be generated primarily from clamshell dredging, tugs working in the vicinity of the dredge and along the dredged material transport corridor, and for a short period from a pneumatic jackhammer required to remove a small rock outcrop. The project is expected to produce peak SPLs at a distance of approximately 150 meters of 124 dB rms from clamshell dredging and 132 dB rms from removal of the rock outcrop. These noise values are below all of the thresholds that would result in direct injury to most fish, including delta smelt and longfin smelt. However, fish could experience minor temporary behavior disturbances, such as decreased foraging or avoidance of areas with increased noise.

6.2.6 San Francisco Bay-Delta Climate Change

A series of publications (Feyrer et al. 2011; Cloern et al. 2011; Brown et al. 2013) have modeled future impacts of climate change in the delta and projected how this will affect delta smelt. These models used the B1 and A2 scenarios from the 2007 Intergovernmental Panel on Climate Change (IPCC) report. Each scenario included both a warmer-wetter and warmer-dryer sub scenario. Modeled predictions presented in these publications are based on current baseline conditions (no increased outflow, no breeching of levees) which may or may not change in the future. Temperature increases are likely to lead to a continued rise in sea level, further increasing salinity which will increasingly restrict delta smelt's already limited geographic range (Feyrer et al. 2011; Cloern et al. 2011; Brown et al. 2013). These changes will likely alter freshwater flows, possibly shifting and condensing the timing and location of delta smelt reproduction (Brown et al. 2013).

Warmer water temperatures could reduce delta smelt growth, increase delta smelt mortality and constrict suitable habitat within the estuary during the summer months. Due to warming temperatures, delta smelt are projected to spawn an average of 25 days earlier in the season depending on the location (Brown et al. 2013). Also due to expected temperature increases, total number of high mortality days is expected to increase for all IPCC climate change scenarios (Brown et al. 2013). The number of stress days is expected to be stable or decrease partly because many stress days will become high mortality days. This could lead to delta smelt being forced to grow under highly stressful conditions during summer and fall with less time to mature because of advanced spawning (Brown et al. 2013). Growth rates have been shown to slow as water temperatures increase therefore requiring delta smelt to consume more food to reach growth rates that are normal at lower water temperatures (Rose et al. 2013a). Delta smelt are already often smaller than they used to be (Sweetnam 1999; Bennett 2005) and expected temperature increases due to climate change will likely further slow growth rates.

At the same time, warmer water will tend to move the spawning season earlier in the year (Brown et al. 2013). That means the smelt will have to grow faster still to compensate for that shorter growing season to produce even as many eggs as they do now, and that may already be a serious limitation on their population fecundity (Rose et al. 2013b). Higher temperatures may restrict delta smelt distribution into the fall, limiting their presence in Suisun Bay for more than just salinity reasons and force greater inhabitation of cooler high salinity waters (Brown et al. 2013). Water temperatures are already presently above 20°C for most of the summer in core habitat areas, sometimes even exceeding 25 °C for short periods. The delta smelt is currently at the southern limit of the inland distribution of the family *Osmeridae* along the eastern Pacific coast. That indicates that this region is already about as warm as that fish family can handle. Increased temperatures associated with climate change may result in a habitat in the Bay-Delta that is outside of the species ecological tolerance limits.

6.2.7 Cumulative Effects

Section 5.6 provides an overview of the types of foreseeable future projects and resulting cumulative impacts on special status fishes and habitat. These impacts range from adverse effects from additional delta exports or potential increases in contaminants in Bay/Delta waters, and beneficial effects from habitat restoration. These projects can either enhance or reduce prey quality and quantity; the quality and area of LSZ habitat, including spawning and rearing habitat; and/or directly injure or kill delta smelt and longfin smelt. While nebulous and difficult to predict, both species are in peril, especially delta smelt, as evidenced by the Bay Study. While difficult to tease out and beyond the scope of this analysis, the baseline conditions and anticipated future conditions of the Bay/Delta may include synergistic effects that cannot be accurately known, regardless of habitat restoration efforts.

6.2.8 Delta Smelt Critical Habitat and Potential Effects of the Proposed Action on Primary Constituent Elements

Delta smelt critical habitat was designated on December 19, 1994 (59 FR 65256). Critical habitat for this species includes: all water and submerged lands below the ordinary high water and the entire water column bounded by and including the Suisun Bay (including Grizzly and Honker Bays); Good Year, Suisun, Cutoff, First Mallard, and Montezuma Sloughs; and the water contained within the Sacramento–San Joaquin Delta in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties, California.

The location of the X2 and resulting LSZ habitat is identified as one of the most important features of delta smelt habitat, including critical habitat. Depending on the water-year type (i.e., wet, above normal, normal, below normal, dry, critically dry), each of the habitat conditions specified below requires fluctuation (within-year and between-year) in the placement of the X2 at three historical reference points. These three historical reference points are the Sacramento-San Joaquin River confluence, the upstream limit of Suisun Bay at Chipps Island, and in the middle of Suisun Bay at Roe Island. The actual number of days that the X2 is maintained at the three points varies according to water-year type (discussed in ***Section 5.3.3***). As previously discussed, the location of the X2 at or west of the confluence of the Sacramento and San Joaquin rivers results in increased quality and quantity of the LSZ habitat important for delta smelt populations. Further, the naturally-occurring spatial variability of the X2 and resulting LSZ habitat is typically found in healthy estuarine ecosystems, resulting in an effective deterrent to further invasion of newly introduced species and continued competition by those that are already established; produces higher densities of phytoplankton and zooplankton characteristic of healthy estuarine ecosystems; and simulates natural processes and historical conditions present when delta smelt thrived.

Primary constituent elements (PCEs) essential to the conservation of delta smelt include physical habitat, water, river flow, and salinity concentrations that are required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (59 FR 65256). Details of delta smelt critical habitat PCEs and the potential effects of the proposed action on these PCEs are further discussed below.

PCE 1—*Physical habitat for spawning:* Adult delta smelt seek shallow, fresh, or slightly brackish backwater sloughs and edge-waters for spawning. These areas must have clean water and substrates that allow the attachment of eggs. Delta smelt broadcast spawn over sandy or cobble substrate; eggs are negatively buoyant and sink to the bottom where they attach to the substrate. The rest of the delta smelt's life cycle is spent in open pelagic waters. Areas identified as important spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore Sloughs and the Sacramento River in the Delta, and the Suisun Marsh.

Effects of the proposed action on PCE 1: Clamshell dredging would occur in the open, deep water areas of San Pablo Bay or Suisun Bay and would not adversely affect physical habitat for spawning. However, it is the project could increase spawning habitat by beneficially reusing dredged material for creation of wetland habitat at Montezuma Wetlands and Cullinan Ranch. Montezuma Wetlands will have direct intertidal connections with Montezuma Slough (i.e., Suisun Marsh) as early as 2019 (Jim Levine, Montezuma Wetlands, pers. comm., July 23, 2018) and thus could increase the physical habitat for spawning. Cullinan Ranch would have direct intertidal connections with Mare Island Strait/Napa River and could also provide spawning habitat for delta smelt. In addition, both Montezuma Wetlands and Cullinan Ranch are expected to be productive wetland habitats and thus will increase the food supply for delta smelt.

PCE 2—Suitable water quality for all life stages**:** Adult delta smelt migrating to spawning grounds require low-salinity and freshwater water quality, with spawning typically occurring in freshwater with sandy substrate for spawning (USFWS 2008). Eggs require water with low concentrations of constituents of concerns and temperatures ranging from 14 to 17 °C to ensure successful hatching (59 FR 65256). Newly hatched larvae require intertidal freshwater in the upper parts of the LSZ, approximately 5 to 20 kilometers upstream of the X2 (see PCE 4, salinity) with temperatures ranging between 10 to 20 °C to develop. As larvae grow, they move to open pelagic waters and move farther towards the X2 in areas with higher salinities. Larvae also require high turbidities to elicit feeding responses and adequate prey. Juveniles require open pelagic waters with temperatures less than 24 °C and a preference for waters with high turbidities (Secchi disk depths < 0.5 meters) (USFWS 2008) and adequate prey (59 FR 65256).

Effects of the proposed action on PCE 2: Clamshell dredging is expected to increase suspended sediment in the water column in the immediate area surrounding the equipment. However, the sediment plumes caused by these activities are expected to be temporary and localized, with most sediment settling out of the water column within the mixing zone. Specifically, they are expected to dissipate over several hours and be relatively small compared to the over size of Suisun Bay.

As previously discussed and shown on ***Table 2***, the deepening of the channel is expected to increase salinity intrusion only by a small amount as X2 is predicted to move upstream by 0.17 during critically dry years to 0.27 km during wet years. When X2 is greater than 64 km, this would result in X2 shifting up to 0.23 km, which may require additional water releases. This could slightly shift the LSZ habitat upstream, which in turn could affect the rearing habitat of juvenile delta smelt and result in slight increase in competition for resources of both juveniles and adults. However, the predicted shifts in X2 are on the same order of magnitude as the accuracy to which X2 can be measured operationally, and hence are not expected to be measureable. Although it is unknown if the additional 160 acres of wetland habitat generated at Montezuma Wetlands and Cullinan Ranch would offset the salinity intrusion, it would increase habitat available for spawning and larval development. It would also result in increased nutrient production that could be exported to the Napa River/Mare Island Strait and Suisun Bays, habitat used by juvenile and adult delta smelt. It is expected that these habitat benefits would offset the impacts on PCE 2.

PCE 3—River flow: Adequate river flow, both inflow and outflow from the Delta, influence the movement of migrating adults, larvae and juveniles. Adequate flow required to elicit upstream adult spawning migration, as adults are attracted to pulses of freshwater that are cooler and more turbid (USFWS 2008). River flows also transport larvae and juveniles downstream to LSZ rearing habitats (59 FR 65256). In addition, river flow greatly influences the extent and location of X2 and the LSZ, which is the primary habitat for delta smelt, and the vulnerability of delta smelt entrainment into pumping facilities (59 FR 65256; USFWS 2008).

Effects of the proposed action on PCE 3: An important aspect of PCE 3 is suitable river flow to ensure high quality and increased quantity of suitable LSZ rearing habitat. Suitable river outflow pushes the X2 (and LSZ) farther west, which improves habitat quality. This PCE is closely linked to the position of the X2; therefore, when X2 is located in or near Suisun Bay, the LSZ includes the shallow water estuarine habitat in areas of Suisun Bay, and at times, portions of San Pablo Bay.

The proposed project is expected to increase salinity intrusion only by a small amount; X2 is predicted to move upstream by 0.17 to 0.27 km. As discussed above, the shift in X2 is not expected to be measureable, and the beneficial reuse of dredged material should restore or create approximately 160 acres of wetland habitat, which would increase delta smelt access to shallow water habitat and may increase the food supply for rearing delta smelt. It is expected that these habitat benefits would offset the impacts on PCE 3.

PCE 4—Salinity for rearing: This PCE primarily is related to the position of X2 and the protection of the LSZ. Delta smelt spend most of their life cycle in the LSZ; as such, the salinity PCE for delta smelt is defined as the LSZ, which ranges from 0.5 to 6 psu. As discussed, as river outflow increases, the X2 shifts towards the west which is thought to increase the quantity and quality of the LSZ habitat (USFWS 2008). Due to the importance of the location of X2 for delta smelt habitat, flows in the Old and Middle Rivers are managed during certain times of the year to keep X2 from moving too far east towards the Delta.

When X2 is farther west in the Suisun Bay region, it is thought that the habitat quality increases because delta smelt have access to shallow waters and wetlands in Suisun and Grizzly bays, which could provide additional food resources. It is believed that when delta smelt habitat includes Suisun Bay, food resources increase, thereby decreasing competition for prey; individuals are less prone to predation, are less constricted; and able to disperse farther. As previously mentioned, they are also less prone to entrainment in pumping facilities as they are not affected by reverse flows in the south Delta.

Effects of the proposed action on PCE 4: Deepening of the channel is expected to affect the location of X2 by a small amount, which may shift the LSZ slightly upstream. However, this shift is not expected to be measureable. As discussed, it is expected that the beneficial reuse of the dredge material should restore or create 160 acres of wetland habitat would offset these minor shifts in the LSZ by creating additional spawning and rearing habitat adjacent to Suisun Bay and Mare Island Strait/Napa River, and also increasing the food supply for delta smelt. Dredged material would be placed on one of two beneficial reuse sites that will contribute to the construction of several different types of wetland habitats adjacent to Suisun and San Pablo Bays. Specifically, beneficially reusing dredged material would result in the creation of 160 of wetland habitat that could provide shallow freshwater spawning habitat, larval and juvenile rearing habitat, and increase the quantity and quality of prey resources both at the restoration sites and exported into the bay.

6.2.9 Delta and Longfin Smelt Effect Determinations and Conclusions

The USACE acknowledges the probable existence of federally-listed threatened or endangered species within the action area. This biological assessment was prepared with the best available scientific and commercial information to determine potential effects on listed species.

This biological assessment analyzes the effects of deepening the Pinole Shoal Channel and portions of Bulls Head Reach from 35 foot MLLW to 38 feet MLLW (plus 2 feet of overdepth). The project also includes creating a sediment trap in Bulls Head Reach by deepening from 35 feet MLLW to 42 feet MLLW (plus 2 feet of overdepth) to decrease shoaling events that have resulted in emergency dredging in this area, outside of the regular yearly maintenance dredging. The rock outcrop that will be removed is relatively small and currently does not protrude above the bottom sediment. Its removal is not expected to produce noises above levels known to adversely impact fish or other organisms.

The project would occur within the existing delta smelt work windows for Suisun Bay and, to the extent practicable, the salmonid work windows in Suisun Bay. Although adherence to work windows in the Bulls Head Reach would occur, delta smelt are known to be present in this channel during the work windows albeit to a lesser extent. Longfin smelt may be present year-round, with numbers decreasing later in the work windows. Regardless, the work windows are protective of the most sensitive life stages of delta and longfin smelt, including spawning adults, eggs, larvae, and juveniles.

Injury or death could result from direct contact with dredging equipment, particularly from entrainment. This project proposes to use clamshell dredging in lieu of hopper dredging to minimize known effects, which would greatly reduce the risk of entrainment. Sub-lethal physiological or behavioral effects could result from exposure to increased concentrations of suspended sediment, contaminants released from suspended particles, and noise. However, these impacts would be temporary, only persisting during active dredging, and generally avoided due to the use of appropriate work windows.

No shallow water habitat important to delta and longfin smelt (i.e., habitat less than 3 m in depth at MLLW) will be altered due to the deepening of the navigation channels. Additionally, alterations of habitat due to the location of the X2 are expected to be minor, with a maximum projected upstream shift of 0.17 km likely to affect the important habitat in Suisun Bay only during critically dry years. Modeling indicates that upstream movement of X2 caused by the project may actually result in LSZ area being either gained or lost due to the large variance in the shoreline primarily in Suisun Bay (i.e., average monthly change for a below normal year from -556 to 446 acres; Anchor QEA, LLC 2019). Furthermore, the modeling showed that the overall monthly average area of the LSZ would range from 13,966 to 26,807 acres with the project versus 14,083 acres to 26,705 acres without the project. The small changes to habitat area are not expected to be detectable and hence insignificant. Also, the alterations and potential loss of shallow water and LSZ habitat should be offset by beneficially reusing dredged sediment for wetland restoration, thereby contributing to the creation or restoration of approximately 160 acres of wetland habitat, including tidal and intertidal wetland habitat. This habitat could be used by smelt for spawning and rearing, and would contribute to their prey base; consequently beneficial reuse of dredging material would be a beneficial impact. The Cullinan Ranch and Montezuma Wetlands Environmental Impact Statements and Biological Opinions provide information on the amount of habitat each species would likely benefit from based on the respective restoration projects. The habitat restoration would occur approximately 2 years earlier than expected due to the contributions of sediment from this project.

Based on the analysis herein, the proposed project ***may affect, but is not likely to adversely affect*** threatened delta smelt and its critical habitat and candidate longfin smelt primarily due to the use of both appropriate work windows and clamshell dredging instead of hopper dredging. Turbidity and noise effects would be temporary and localized. Deepening the shipping channels would not remove shallow water habitat, and the upstream shift of X2 and the LSZ is expected to be minor and often within measurement error. The beneficial reuse of sediment is expected to accelerate the creation of approximately 160 acres of tidal and intertidal wetland habitat by approximately 2 years.

7.0 NMFS-Managed ESA Species and Effects Determinations

This section presents the impacts assessment for the threatened and endangered species and their respective critical habitats managed by NMFS. Species identified in the official list are provided in **Table 3**, 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 provided herein.

Table 3: **Special Status Species and Critical Habitat Included on the NMFS Official Species List (February 20, 2018)**

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

7.1 NMFS-managed ESA Species Descriptions

Five special status fishes managed by the NMFS inhabit the action area, including four salmonid species and green sturgeon. These species, along with the effects of the proposed action on these species, are discussed below.

7.1.1 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)

7.1.1.1 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).

7.1.1.2 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). However, the migration and spawning timing for each species differs, as discussed below.

Spring-run Chinook salmon: Adult spring-run Chinook salmon migrate upstream between late January and early February. They hold in freshwaters over the summer, spawning in the fall. Spawning typically occurs between September and October, depending on water temperature. Larvae emerge from the gravel as fry from November to March, and juveniles typically spend 3 to 15 months rearing in freshwater before migrating toward the ocean. Juveniles outmigrate from mid-March through mid-May. It is unlikely that adult or juvenile spring-run Chinook would be present in the action area during dredging. *Winter-run Chinook salmon:* Adult winter-run adults migrate to spawning grounds between November and June (Hallock and Fisher 1985). Adults begin upstream migration sexually immature and typically hold in freshwater over the summer and fall, delaying spawning until spring or early summer. Spawning typically occurs from mid-April to mid-August, peaking in May and June. Fry emerge from the gravel in late June through early July, with juveniles spending 4 to 7 months rearing in freshwater prior to migrating to the ocean as smolts. Juveniles outmigrate from October through early May. Adult winter-run Chinook salmon may be present in the action area if they migrate to spawning grounds in June. Outmigrating juveniles may be present in the action area starting in October; but, are likely to be absent in June.

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 spent from approximately 1-17 days transiting from the Benicia Bridge to the Golden Gate Bridge (Chapman et al. 2009). MacFarlane and Norton *(*2002) found that out-migrating juvenile salmon required up to 40 days to pass through the San Francisco Bay to the ocean. Hearn et al. (2013) found that smolts generally transited the Bay rapidly in 2 to 4 days, yet also made repeated upstream movements, coinciding with incoming tidal flows, and that smolts utilize habitat located over deep, channelized portions of the Bay. Smolts detected at nearshore, shallow sites such as marinas, or up tributaries generally returned to the main channel to finish their migration.

During the course of their downstream migration, juveniles 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. 2013). 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.

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.

7.1.1.3 Threats

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

7.1.1.4 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 and may be present in the action area during the late fall, winter, and spring, typically October through June. 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.

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

7.1.2.1 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).

7.1.2.2 Life Cycle and Habitat Use in the Action Area

Steelhead are the anadromous form of rainbow trout; however, because of their ecological requirements, their life history more closely resembles Pacific salmon. Unlike Chinook salmon, 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). After spending approximately 2 years rearing in freshwater, steelhead migrate to marine waters where they reside for 2 or 3 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; NMFS 2014).

Once sexually mature, adult steelhead return to their natal stream to spawn, usually at the age four or five. Generally, the Central Valley and CCC steelhead migrate to spawning grounds between December and April, peaking in January and February (Fukushima and Lesh 1998). Spawning typically occurs from early March through July, peaking in May through June (NMFS 2014). 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 from January through May, peaking in April and May (Fukushima and Lesh 1998). Studies indicate that steelhead move through the Bay rather quickly, spending only 2 to 4 days outmigrating (Hearn et al. 2013 and Sandstrom et al. 2013).

7.1.2.3 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).

7.1.2.4 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.

7.1.3 Southern DPS Green Sturgeon (*Acipenser medirostris*) (FT) (CH)

7.1.3.1 Listing Status and Range

April 7, 2006, the Southern DPS of the North American green sturgeon (*Acipenser medirostris*) was listed as threatened by NMFS (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 (see Moyle et al. 2015).

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; Adams et al. 2002). 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 (Lindley et al. 2008, Huff et al. 2012). San Francisco Bay and its tributaries are thought to contain a majority of the Southern DPS green sturgeon population.

7.1.3.2 Life Cycle and Habitat Use in the Action Area

Green sturgeon are long-lived, slow growing and iteroparous. 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.

Green sturgeon spawn every 3 to 5 years. Adults typically migrate to freshwater in the upper Sacramento River, beginning in late February through early May (Heublein et al. 2009). 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 (Adams et al. 2002). Spawning occurs in deep pools with large cobble substrate; however, spawning also occurs on clean sand and bedrock substrate.

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. Preliminary results from tagged adult sturgeon suggest travel time through the Bay, from the Golden Gate to Rio Vista is generally 1 to 2 weeks. Post-spawning adults display two outmigration strategies; outmigrating from Sacramento River prior to September 1 and outmigration during the onset of fall/winter stream flow increases. The transit time for post-spawning adults is similar to upstream migration, spending approximately 1 to 2 weeks in the Bay before entering the ocean (Heublein et al. 2009). During the summer and fall, some non-spawning adults and subadults enter the Bay from the ocean for periods ranging from a few days to 6 months (Lindley et al. 2011). Some fish are detected only near the Golden Gate, while others move as far inland as Rio Vista in the Delta. Therefore, it is likely that post-spawning adults could be present in the action area during construction; however, adults migrating to spawning grounds are not likely to be present. Additionally, non-spawning adults may enter the estuary and be present in the action area during construction.

Green sturgeon larvae begin feeding approximately 10 to 15 days after hatching, and approximately 35 days later metamorphose into juveniles. Juveniles spend their first few years Bay-Delta waters before migrating to the ocean as subadults, with juveniles spending their first several months to a year in Delta freshwaters before migrating to the Bay (Adams et al. 2002). Although juveniles are present in the Bay year-round, Kelly et al. (2007) found that sub-adults typically remain in shallower depths (less than 30 feet) and show no preference for temperature, salinity, dissolved oxygen, or light levels. Therefore, juveniles are likely to be present in the action area year-round; however, it is likely that they are present over the shallower depths adjacent to the ship channel.

Juvenile green sturgeon forage primarily in soft-bottom intertidal areas (Dumbauld et al. 2008), feeding 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).

7.1.3.3 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.

7.1.3.4 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.

7.2 NMFS-managed Special Status Fishes Effects Determinations

This section provides the effects determination of the proposed action on listed salmonids and green sturgeon. Section 5 provides a detailed discussion of the impact mechanisms 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, as well as rearing habitat for juvenile salmonids and green sturgeon.

Adult and juvenile spring-run Chinook are not likely to be present in the action area during dredging. Adult winter-run Chinook salmon may be present in the action area if they migrate to spawning grounds in June. Outmigrating juveniles may be present in the action area in October through January and, therefore, could be affected by dredging activities in October and also in December and January, should dredging be conducted outside the salmonid work window.

During construction of the proposed action, it is unlikely that adult or juvenile Central Valley or CCC steelhead would be present in the action area. However, should construction of Pinole Shoal extend into December (outside of the salmonid work windows), adults migrating to spawning grounds could be present.

Green sturgeon may be more likely than juvenile salmonids to use the action area for foraging and rearing habitat. As discussed, it is likely that post-spawning adults could be present in the action area during construction; however, adults migrating to spawning grounds are not likely to be present. Non-spawning adults may enter the estuary and be present in the action area during construction. Juveniles are likely to be present in the action area year-round.

To the extent practicable, dredging Pinole Shoal would also occur during the work windows. However, should deepening not be completed within one dredging season, the project proposes to expand the work windows into December and possibly January, in compliance with the NMFS LTMS maintenance dredging biological opinion (i.e., expanding work windows are allowed for maintenance dredging if dredging is conducted with a clamshell dredge and sediment is beneficially reused for aquatic habitat restoration). In addition, the project proposes to use a clamshell dredge, which would avoid or minimize entrainment and physical injury to salmonids and green sturgeon.

7.2.1 Direct Contact with Dredging Equipment and Entrainment

As discussed, adult and juvenile winter run Chinook salmon, juvenile spring-run Chinook salmon, non-spawning adult green sturgeon, and juvenile green sturgeon may be present in the action area during dredging. The presence of these species in the navigation channel during dredging results in a potential for individuals to be directly injured or killed. The most likely cause of injury would be from the clamshell bucket falling through the water column until reaching the substrate. However, as mechanical equipment travels through the water column, it generates a pressure wave that would likely force fish away from the falling bucket.

Very limited data exist regarding potential entrainment effects of clamshell dredging on fishes (Reine and Clarke 1998). The entrainment of aquatic organisms may be possible with a mechanical clamshell dredge. As the bucket of a mechanical clamshell dredge collects material from the bottom, aquatic organisms can be physically collected within the water and sediment material. However, mechanical clamshell dredging is considered to have a very low risk of fish entrainment, and for large fish typically the lowest of all dredge types (Reine and Clarke 1998).

As mentioned previously, general disturbance from barges, dredging crew and tugs is expected to cause salmonids and green sturgeon to avoid the areas where active dredging is occurring. Overall, the potential to entrain or physically injure or kill salmonids or green sturgeon is very low.

7.2.2 Exposure to Increased Suspended Sediment and Turbidity

Dredging and scow overflow, should overflow be permitted, would result in increased concentrations of sediment. The increased concentrations would continuous during active dredging, with the highest concentrations within a 200-foot radius of dredging and overflow (USACE 2014). As discussed in Section 5.3.1, sediment proposed for dredging in the Pinole Shoal Channel ranges from fine-grained at the western and eastern portions of the channel and sand in the center. Sediment proposed for dredging in Bulls Head Reach is predominately sand with small pockets of fine-grained material. Dredging would result in increased turbidity plumes, which would be greatest in areas of fine-grained sediment (e.g., eastern and western portions of the Pinole Shoal Channel). Dredging in areas of sand would result in plumes with less concentration of suspended sediment because sand would fall out of the water column rather quickly and settle to the bottom of the channel. The range of temporary turbidity increases is expected to be within a 200-foot radius from dredging operations and disposal area, and is expected to persist during active and settle within 20 minutes following active dredging (USACE 2014).

Elevated concentrations of turbidity could affect salmonids and green sturgeon if they are in the vicinity of dredging and exposed to the turbidity plumes. It is expected that the harm could include sub-lethal effects to fish anatomy (e.g., damage to gills), or behavioral (avoidance of plumes). Adult and juvenile salmonids are expected to generally avoid sediment plumes, utilizing clearer open waters adjacent to the plumes (NMFS 2015b). Green sturgeon are benthic fish that can tolerate high levels of suspended sediment and are less likely to be disturbed by the sediment plumes; however, green sturgeon may not alter their direction of travel or other behaviors to avoid turbidity plumes (NMFS 2015b).

7.2.3 Salinity Intrusion

Salmonids and green sturgeon are anadromous fishes, inhabiting both saltwater and freshwater during various points of their life histories. Both species osmoregulate to adjust to salinity gradients as they begin their upstream and downstream migrations. It is important that salinity gradients support the physiological transition of juveniles and adults as they transition between fresh- and saltwater. Laboratory studies conducted by Allen and Cech (2007) indicated juveniles approximately 6-months old were tolerant of saltwater, but approximately 1.5-year old green sturgeon appeared more capable of successful osmoregulation in salt water. The minor movement of salinity into the delta could shift salinity gradients slightly farther east compared to baseline conditions; however, these small shifts are not expected to affect migrating adult and juvenile salmonids and green sturgeon.

7.2.4 Habitat Loss

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 0.17 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 expected to be brief.

Salmonids are pelagic fish and forage in the water column. Green sturgeon, on the other hand, are benthic fish and forage on the benthos. Dredging the side slopes would result in removal of approximately 298 acres of benthic habitat between the toes of the navigation channels and 21 acres of benthic habitat along the side slopes, which would directly remove foraging habitat for green sturgeon. Sediment removed between the toes of the channel bottom are disturbed regularly through maintenance dredging and deep-draft navigation and would continue to be disturbed similar to the baseline disturbance following deepening the channels. Therefore, it is expected that the channel bottom would provide limited food resources, compared to the side slopes, which are typically not disturbed. Removal of benthic prey resources could adversely affect green sturgeon, particularly juveniles, which rear in the action area year-round. However, the expected creation or restoration of 160 acres of tidal wetland habitat from beneficially reusing material dredged from the channels could result in a net export of nutrients to the surrounding bay waters, thereby improving the quality and quantity of benthic prey resources. Additionally, the benthic resources along the side slopes are expected to recovery shortly, within months to a year.

7.2.5 Exposure to Noise

As discussed in ***Section 5.4.***, noise from the proposed project would be generated primarily from clamshell dredging, tugs working in the vicinity of the dredge and along the dredged material transport corridor, and for a short period from a pneumatic jackhammer required to remove a small rock outcrop. The project is expected to produce peak SPLs at a distance of approximately 150 meters of 124 dB rms from clamshell dredging and 132 dB rms from removal of the rock outcrop. These noise values are below all of the thresholds that would result in direct injury to most fish, including salmonids and green sturgeon. However, fish could experience temporary behavior disturbances, such as decreased foraging or avoidance of areas with increased noise.

7.2.6 San Francisco Bay-Delta Climate Change

As discussed, climate change is expected to result in mean annual water temperatures within the upper Sacramento River portion of the Bay-Delta to approach or exceed 14 °C during the second half of this century (Cloern et al. 2011). Higher air temperatures will reduce snowpack, melt snow earlier in the winter or spring, and increase water temperatures. Additionally, elevated salinity levels could push the position of X2 farther up the estuary if outflows were not increased to compensate for it.

Higher water temperatures are likely to severely affect salmonids, which depend on cool water for successful spawning and rearing. Higher temperatures could result in delayed migrations to spawning grounds, reduced spawning success, and other sub-lethal and lethal effects from elevated temperature. Green sturgeon may experience similar impacts. In general, increased temperatures associated with climate change may result in a habitat in the Bay-Delta that is outside of the species ecological tolerance limits.

7.2.7 Cumulative Effects

Section 5.6 provides an overview of the types of foreseeable future projects and resulting cumulative impacts on special status fishes and habitat. These impacts range from adverse effects from additional delta exports or potential increases in contaminants in Bay/Delta waters, and beneficial effects from habitat restoration. While nebulous and difficult to predict, cumulative effects on listed salmonids and green sturgeon could be significant, particularly with the inclusion of climate change. While difficult to tease out and beyond the scope of this analysis, the baseline conditions and anticipated future conditions of the Bay/Delta may include synergistic effects that cannot be accurately known, regardless of habitat restoration efforts.

7.2.8 Salmonid and Green Sturgeon Critical Habitat and Potential Effects of the Proposed Action on Primary Constituent Elements

7.2.8.1 Central Valley Winter-Run Chinook and Central California Coast Steelhead Critical Habitat

Critical habitat for Central Valley winter-run Chinook salmon and CCC 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.

Effects of the Proposed Action on Salmonid PCEs: With the exception of estuarine habitat and water quality conditions that support salmonid physiological transitions between freshwater and saltwater, the proposed action occurs outside of freshwater PCEs and, therefore, would not affect these PCEs. As previously discussed, the extent of salinity intrusion into the Delta are not expected to affect aquatic habitat where migration and rearing habitat where adults and juveniles would be transitioning between fresh and saltwater. The minor increase of salinity gradients in the Delta would likely not be perceptible to transitioning salmonids.

Construction would temporarily affect estuarine habitat, resulting in temporary obstructions in the navigation channel from dredging equipment, increased turbidity, and possibly noise. However, during construction, adult and juvenile salmonids are expected to generally avoid sediment plumes, utilizing clearer open waters adjacent to the plumes (NMFS 2015b). Following construction, these obstructions would be eliminated.

7.2.8.2 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 include 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 and, therefore, would not be affected by the proposed action.

Nearshore Coastal Marine Areas: Green sturgeon require nearshore coastal marine areas with adequate migratory corridors, water quality, and food resources. This PCE does not occur in the action area and, therefore, would not be affected by the proposed action.

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 PCEs, 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 1 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.

The proposed action may affect green sturgeon estuarine PCE. Specifically, food resources and water quality. Removal of approximately 320 acres of benthic foraging habitat, of which 21 acres along the side slope is considered undisturbed habitat, could reduce prey resources important for green sturgeon. It is expected that the removal of approximately 298 acres of benthic habitat within channel toes would have limited benthic foraging value as these areas are dredged regularly and are exposed to propeller wash from the deep draft navigation. Beneficial reuse of the dredged material from the proposed project would contribute to 160 acres of wetland habitat, which would offset effects to removal of the habitat from -35 feet to -38 feet in the channel toes.

Water quality would be temporarily affected by dredging activities. Water quality surrounding dredging activities would experience increased concentrations of turbidity resulting from re-suspension of sediments. Additionally, there is a potential for constituents of concern to be released from sediment particles during resuspension. These impacts would be temporary, persisting only during dredging operations. It is expected that these impacts would be offset by the creation/enhancement of approximately 160 acres of wetland habitat adjacent to green sturgeon estuarine habitat. The wetlands would indirectly support green sturgeon foraging by exporting nutrients to the Bay.

7.2.9 Effects Analysis and Conclusions

As discussed above, adverse effects from this project to all listed species would largely be avoided or minimized due to the use of both appropriate work windows and clamshell dredging instead of hopper dredging. Turbidity and noise effects would be temporary and localized. Adult and juvenile Central Valley spring-run Chinook salmon are not expected to be present in the action area during dredging. However, though unlikely, there is a slight chance that late outmigrating juveniles may be present. Minor alterations to salmonid habitat could occur; however, any resulting impacts would be insignificant. Therefore, the proposed action ***may affect, but is not likely to adversely affect*****,** Central Valley spring-run Chinook salmon.

Adult winter-run Chinook salmon may be present in the action area if they migrate to spawning grounds in June. Outmigrating juveniles may be present in the action area starting in October, and could be affected by the proposed action. Additionally, should the work windows be extended into December and January, the likelihood of juveniles being present in the action area would increase. As a result of limited presence in the action area, it is expected that proposed action ***may affect, but is not likely to adversely affect***, Central Valley winter-run Chinook salmon.

Should construction of the proposed project be contained to the existing salmonid work windows, it is unlikely that adult or juvenile Central Valley or CCC steelhead would be present in the action area. However, should deepening the Pinole Shoal Channel extend into December (outside of the salmonid work windows), adults migrating to spawning grounds could be present. Because the likelihood of steelhead being present in the action area during construction is minimal, it is expected that construction of the project ***may affect, but not likely to adversely affect***, listed steelhead.

As discussed, juvenile green sturgeon are present in the action area year-round, and forage in the shallow waters adjacent to the navigation channels. Although work windows are not established for green sturgeon, the use of work windows will reduce the exposure of sturgeon to dredging activities. Further, the use of clamshell dredges would reduce the risk of entrainment. The loss of benthic foraging habitat could temporarily reduce prey resources. However, it is expected that restoration of wetland habitat adjacent to the Bay would increase the quality and quantity of sturgeon prey resources in the Bay. The beneficial reuse of sediment from this project is expected to accelerate the creation of approximately 160 acres of tidal and intertidal wetland habitat at Montezuma Wetlands and Cullinan Ranch by approximately 2 years. Based on this analysis, it is expected that the proposed action ***may affect, but is not likely to adversely affect*** threatened green sturgeon. Similarly, while temporary impacts to green sturgeon and salmonid estuarine PCEs of critical habitat are expected, these impacts would be temporary and offset in part by restoration of 160 acres of wetland habitat adjacent to the Bay, which would increase food supply.

8.0 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 2010b). HAPCs do not qualify for additional protection beyond that provided for EFH in general; however, project impacts on HAPCs will 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:

- Pacific Groundfish FMP – various rockfish, sole and sharks
- Pacific Salmon FMP – Chinook salmon
- Coastal Pelagic FMP – northern anchovy, Pacific sardine, mackerel, squid

8.1 Potential Effects of the Proposed Action on Essential Fish Habitat

The HAPCs described in the 2010 LTMS programmatic EFH consultation for maintenance dredging in San Francisco Bay (NMFS 2010b) as potentially affected by LTMS activities include San Francisco Bay and seagrass habitats. The proposed project falls within the LTMS area, but neither of these HAPCs occur within the proposed project footprint. In accordance with the habitat categorizations provided by NMFS (2010b), the proposed project dredging activities would disturb a total of 318 acres of soft bottom habitat (***Table 1***) which may be considered either sand or fine-grained habitat. 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 eelgrass habitat would be affected. Sandy and some fine-grained benthic habitat, is expected to comprise most of the dredge area of Pinole Shoal Channel, which 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 2010b).

Dredged sediment from the proposed project would be used for beneficial reuse, specifically wetland creation. The project proposes to utilize dredged material at Cullinan Ranch and Montezuma Wetlands, thereby creating approximately 160 acres of aquatic habitat that would benefit EFH. 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 will provide food and nutrients for aquatic species in the adjacent Napa River Estuary and San Pablo Bay (USFWS 2010b). Once completed, Montezuma Wetlands is expected to restore 1,820 acres of tidal, seasonal, and managed wetlands. 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 (https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/dredging.html.

Based on the above information for Cullinan Ranch and Montezuma Wetlands, 9000 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 1.6 million cy of dredged sediment resulting from the proposed project is expected to create 160 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 (2010b) 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 1.6 million cy of sediment covering 318 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 Cullinan Ranch and Montezuma Wetlands where they will die. Benthic recolonization rates are expected to be months or years (see NMFS 2010b for a review).

Sediment proposed for dredging in the Pinole Shoal and Bulls Head Reach channels 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. In Pinole Shoal Channel, the content of fine-grained material is anticipated to range from 9 to 94 percent and clay fraction ranges from 5 to 50 percent. In the Bulls Head Reach Channel, the content of fine-grained material ranges from 1 to 97 percent, and clay ranges from 1 to 54 percent. Still, the majority of the sediment in the Pinole Shoal Channel is expected to be greater than 80 percent sand where benthic organisms would be relatively less abundant. Overall, the area of benthic habitat affected by the proposed project would be very small compared to the total size of San Pablo Bay and Suisun Bay which have surface areas of approximately 58,000 and 40,000 acres, respectively.

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 (Rich 2010). 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.

Sampled sediment from the Pinole Shoal and Bulls Head Reach channels underwent physical, chemical, and bioaccumulation analyses, as well as studies to determine if the sediment is was suitable for wetland creation (see section 5.3.4). In all studies, sediment was sampled to a depth of 45 feet MLLW, plus 2 feet of overdepth, for a total sampled depth of 47 feet MLLW. Results were somewhat variable, but in general toxins were similar to control sites, and the survival of exposed invertebrates was affected in only a few cases. Use of Pinole Shoal 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 and 132 dB rms from removal of the small rock outcrop (which currently does not protrude above the bottom sediment), both of which are below the sound thresholds described by Fisheries Hydroacoustic Working Group (2008) and ICF Jones & Stokes and Illingworth and Rodkin, Inc. (2009). Therefore, the noise from the proposed project is not expected to adversely affect listed species greater than 150 m from dredge plant or rock outcrop. Effects on fish closer than 150 m are unclear, but likely would involve behavioral avoidance of the area.

8.1.1 Future Maintenance Dredging

On January 22, 2019, the USACE issued new guidance regarding compliance with EFH requirements of the MSFCMA for maintenance dredging projects. This guidance requires that new work projects (i.e., deepening) include analysis of future maintenance dredging such that future EFH consultation is not required, in the absence of substantially new information requiring a revised EFH consultation. Currently, all federal navigation channel maintenance dredging in San Francisco Bay, including the Pinole Shoal Channel and Bulls Head Reach, are covered under the LTMS programmatic EFH consultation and conservation recommendations (NMFS 2010b). The LTMS programmatic EFH consultation provides the following language allowing for future maintenance dredging to be included in the programmatic consultation following deepening”

> "Program activities are described in detail below, with certain limitations and restrictions. Specifically, this programmatic consultation will not cover the following: (1) any new or previously unauthorized dredging...maintenance dredging of new or deepened areas following completion of initial work may be considered part of this consultation pending NMFS approval."

Based on this language, it is expected that future maintenance dredging will be included in the programmatic EFH consultation once the new work deepening is completed.

8.1.2 Conclusions and Determination of Effects

Pacific Groundfish EFH: *Adverse effect* under the Magnuson-Stevens Act “means any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH” (50 CFR § 600.810). The proposed action is *likely to adversely affect EFH for Pacific Groundfish*. This would occur due to the removal of sediment and benthic organisms with a clamshell dredge, which is unavoidable. 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 318 acres soft-bottom habitat and removal of sediment containing benthic invertebrates from dredging may be partially offset through the beneficial reuse of the dredged sediment, which is expected to be used to create 160 acres of wetland habitat and would increase food production in adjacent Bay waters.

Pacific Salmonid EFH: Potential effects to pacific salmonid EFH are expected to be similar to those discussed under the ESA impacts to listed salmonid habitat and critical habitat (Sections 7.2.5 and 7.3.1). As discussed in those sections, the proposed action would temporarily affect estuarine habitat and water quality during dredging. Additionally, salinity intrusion may slightly increase the salt content of water near the eastern portion of the salinity wedge; however, this is not likely to be perceptible to migrating and rearing salmonids transitioning between freshwater and saltwater. Therefore, the proposed action is *not likely to adversely affect Pacific Salmonid EFH*.

Coastal Pelagic EFH: Northern anchovy is one of the most abundant fishes in the San Francisco Bay and an important commercial fish and prey resource other commercial fisheries. During construction, the proposed action has the potential to temporarily increase noise and suspended sediment in the surrounding water column. However, these impacts would be localized and not permanently affect coastal pelagic EFH. Restoration of wetland habitat resulting from beneficial reuse of dredged material would ultimately benefit coastal pelagic EFH by improving the quality and quantity of food resources. Because of the localized and temporary impacts, it is expected that the proposed action is *not likely to adversely affect Coastal Pelagic EFH*.

9.0 Literature Cited

Adams, P. B., C. B. Grimes, J. E. Hightower, S. T. Lindley, and M. L. Moser. 2002. Status Review for North American Green Sturgeon, Acipenser medirostris. NMFS, SWFSC, USGS, North Carolina State University, NWFSC, Santa Cruz, Raleigh, Seattle.

Allen, P.J., and J.J. Cech, Jr. 2007. Age/size effects on juvenile green sturgeon, *Acipenser medirostris*, oxygen consumption, growth, and osmoregulation in saline environments. Environmental Biology of Fishes 79:211-229.

AMOG Consulting. 2010. Olympic Dam EIS Project: Assessment of Waves and Propeller Wash Associated with Shipping. Final Report. October 19, 2010.

Anchor QEA, LLC. 2019. San Francisco Bay to Stockton Navigation Improvement project: Hydrodynamic and salinity intrusion monitoring report. Final report prepared for USACE. April 2019. 207 pages.

Battelle Marine Sciences Laboratory. 1990. Chemical evaluations of John F. Baldwin Ship Channel Ship Channel sediment. Report prepared for USACE. September 1990.

Battelle Marine Sciences Laboratory. 1993. Ecological evaluation of proposed dredged material from the John F. Baldwin Ship Channel Ship Channel (Phase III – Biological Testing). Report prepared for USACE. October 1993.

Baxter, R. 2018. Introduction and overview of longfin smelt conceptual model. Presented paper at the Interagency Ecological Program 2018 annual workshop. March 6-8, 2018, Folsom, CA.

Baxter, R., R. Breuer, L. Brown, M. Chotkowski, F. Feyrer, M. Gingras, B. Herbold, A. Mueller-Solger, M. Nobriga, T. Sommer, and K. Souza. 2008. Pelagic organism decline progress report: 2007 synthesis of results: Stockton, Calif., Interagency Ecological Program for the San Francisco Estuary, Technical Report 227, 86 p., http://www.water.ca.gov/iep/docs/pod/synthesis_report_031408.pdf.

Bennett, W.A. 2005. Critical assessment of the delta smelt population in the San Francisco Estuary, California. San Francisco Estuary and Watershed Science 3:http://repositories.cdlib.org/jmie/sfews/vol3/iss2/art1.

Bennett, W.A., W.J. Kimmerer, and J.R. Burau. 2002. Plasticity in vertical migration by native and exotic estuarine fishes in a dynamic low-salinity zone. Limnology and Oceanography 47(5): 1496-1507.

Bouley, P. and Kimmerer, W.J., 2006. Ecology of a highly abundant, introduced cyclopoid copepod in a temperate estuary. Marine Ecology Progress Series, 324:219-228.

Brown, L., W.A. Bennett, R.W. Wagner, T. Morgan-King, N. Knowles, F. Feyrer, D.H. Schoellhamer, M.T. Stacey, and M. Dettinger. 2013. Implications for future survival of delta smelt from four climate change scenarios for the Sacramento–San Joaquin Delta, California. Estuaries and Coasts 36:754–774.

Caltrans. 2015. Technical guidance for assessment and mitigation of the hydroacoustic effects of pile driving on fish. November 2015, Sacramento, CA. 92 pages plus appendices. http://www.dot.ca.gov/hq/env/bio/files/bio_tech_guidance_hydroacoustic_effects_110215.pdf

Casulli, V., 2009. A high-resolution wetting and drying algorithm for free surface hydrodynamics. International Journal for Numerical Methods in Fluids 60(4):391-408.

Casulli, V., and P. Zanolli, 2002. Semi-implicit numerical modelling of non-hydrostatic free-surface flows for environmental problems. Mathematical and Computer Modelling 36:1131–1149.

Casulli, V., and P. Zanolli, 2005. High resolution methods for multidimensional advection-diffusion problems in free-surface hydrodynamics. Ocean Modelling 10(1-2):137–151.

CDFW. 2009. California Department of Fish and Game report to the Fish and Game Commission: A status review of the longfin smelt *Spirinchus thaleichthys* in California. January 23, 2009.

Chapman, E.D., A.R. Hearn, M. Buckhorn, A.P. Klimley, P.E. LaCivita, W.N. Brostoff, and A.M. Bremner. 2009. Juvenile salmonid outmigration and green sturgeon distribution in the San Francisco Estuary: 2008-2009. University of California Davis and US Army Corp of Engineers. 90 pages.

Clarke, D.G., and D.H. Wilber. 2000. Assessment of potential impacts of dredging operations due to sediment resuspension. DOER Technical Notes Collection (ERDC TN-DOER-E9), U.S. Army Engineer Research and Development Center, Vicksburg, MS. 14 pages.

Cloern J.E., N. Knowles, L.R. Brown, D. Cayan, M.D. Dettinger, et al. 2011. Projected evolution of California's San Francisco Bay-delta-river system in a Century of Climate Change. PLoS ONE 6(9):e24465. doi:10.1371/journal.pone.0024465

Collins, A.R. 2018. Sound pressure levels. Miscellaneous technical articles. https://www.arc.id.au/SoundLevels.html

Dickerson, C., K.J. Reine, and D.G. Clarke. 2001. Characterization of underwater sounds produced by bucket dredging operations. DOER Technical Notes Collection (ERDC TN-DOER-E14), U.S. Army Engineer Research and Development Center, Vicksburg, MS. 17 pages.

Dumbauld, B.R., D.L. Holden, and O.P. Langness. 2008. Do sturgeon limit burrowing shrimp populations in Pacific Northwest estuaries? Environmental Biology of Fishes 83:283–296.

Feyrer, F., K. Newman, M. Nobriga, and T. Sommer. 2011. Modeling the effects of future outflow on the abiotic habitat of an imperiled estuarine fish. Estuaries and Coasts 34: 120-128.

Fisher, F.W. 1994. Past and present status of Central Valley Salmon. Conservation Biology 8:870-873.

Fisheries Hydroacoustic Working Group. 2008. Agreement in principal for interim criteria for injury to fish from pile driving activities. Memorandum dated June 12, 2008.

Fukushima, L., and E. W. J. Lesh. 1998. Adult and juvenile anadromous salmonid migration timing in California streams. California Fish and Game 84(3):133-145.

Hallock, R.J., and F.W. Fisher. 1985. Status of winter-run Chinook salmon, *Oncorhynchus tshawytscha*, in the Sacramento River. California Department of Fish and Game, Anadromous Fisheries Branch Office Report. January 25, 1985. 29 pages.

Healey, M.C. 1991. Life history of Chinook salmon (Oncorhynchus tshawytscha). Pages 311-394 in C. Groot and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver.

Hearn A.R., E.D. Chapman, G.P. Singer, W.N. Brostoff, P.E. LaCivita, and P.A. Klimley. 2013. Movements of out-migrating late-fall run Chinook salmon (*Oncorhynchus tshawytscha*) smolts through the San Francisco Estuary. Environ. Biol. Fish (October):13.

Herren, J.R., and S.S. Kawasaki. 2001. Inventory of water diversions in four geographic areas in California's Central Valley. Pages 343-355 *in* RL Brown, editor. Fish Bulletin 179. Contributions to the biology of Central Valley salmonids, vol. 2. California Department of Fish and Game, Sacramento.

Hobbs, J. 2018. Re-evaluating the life history of longfin smelt. Presented paper at the Interagency Ecological Program 2018 annual workshop. March 6-8, 2018, Folsom, CA.

Hobbs, J., and P. Moyle. 2018. Will delta smelt have a happy new year? Posted on January 14, 2018 to the California WaterBlog. https://californiawaterblog.com/2018/01/14/will-delta-smelt-have-a-happy-new-year/.

Hobbs, J.A., W.A. Bennett, and J.E. Burton. 2017. Assessing nursery habitat quality for native smelts (Osmeridae) in the low-salinity zone of the San Francisco estuary. Journal of Fish Biology 69:907-922.

Heublein, J. C., J. T. Kelly, C. E. Crocker, A. P. Klimley, and S. T. Lindley. 2009. Migration of green sturgeon, Acipenser medirostris, in the Sacramento River. Environmental Biology of Fishes 84:245–258.

Huff D.D., S.T. Lindley, B.K. Wells, and F. Chai. 2012. Green sturgeon distribution in the Pacific Ocean estimated from modeled oceanographic features and migration behavior. PLoS ONE 7(9): e45852. https://doi.org/10.1371/journal.pone.0045852

ICF Jones & Stokes and Illingworth and Rodkin, Inc. 2009. Technical guidance for assessment and mitigation of the hydroacoustic effects of pile driving on fish. Final report prepared for Caltrans, February 2009. 83 pages plus appendices. http://www.dot.ca.gov/hq/env/bio/files/Guidance_Manual_2_09.pdf

Jassby et al. 1995 Isohaline Position as a Habitat Indicator for Estuarine Populations. Ecological Applications 5: 272-289.

Katz, R.A., N.J. Cipriano, S.R. Dunkleberger, and D.J. Pearson. 2010. The decibel report: acoustic sound measurement, modeling, and the effects of sonar on marine mammals. NUWC-NPT Technical Report 11,980. June 21, 2010. 71 pages plus appendix.

Kelly, J. T., A. P. Klimley, and C. E. Crocker. 2007. Movements of green sturgeon, *Acipenser medirostris*, in the San Francisco Bay estuary, California. Environmental Biology of Fishes 79:281-295.

Kimmerer, W., J.R. Burau, and W.A. Bennett. 1998. Tidally oriented vertical migration and position maintenance of zooplankton in a temperate estuary. Limnology and Oceanography 43:1697-1709.

Kimmerer W.J., E.S. Gross, and M.L. MacWilliams. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco Estuary explained by variation in habitat volume? Estuaries and Coasts 32: 375-389.

Kimmerer W.J., M.L. MacWilliams, and E.S. Gross. 2013. Variation of fish habitat and extent of the low-salinity zone with freshwater flow in the San Francisco Estuary. San Francisco Estuary and Watershed Science, 11(4). https://escholarship.org/uc/item/3pz7x1x8

Lindley S.T., M.L. Moser, D.L. Erickson, M. Belchik, D.W. Welch, et al. 2008. Marine migration of North American green sturgeon. Transactions of the American Fisheries Society 137: 182–194.

Lindley S.T., D.L. Erickson, M.L. Moser, G. Williams, M. Belchik, O.P. Langness, et al. 2011. Electronic tagging of green sturgeon reveals population structure and movement among estuaries. Transactions of the American Fisheries Society 140: 108–122.

MacFarlane, R.B., and E.C. Norton. 2002. Physiological ecology of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) at the southern end of their distribution, the San Francisco Estuary and Gulf of Farallones. California Fish Bulletin 100:244–257.

Moyle, P.B. 2002. Inland Fishes of California. University of California Press, Berkeley. 502 pages.

Moyle, P.B., B. Herbold, D.E. Stevens, and L.W. Miller. 1992. Life history and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 77:67-77.

Moyle, P.B., R.M. Quiñones, J.V. Katz, and J. Weaver. 2015. Fish species of special concern in California, 3rd edition. California Department of Fish and Wildlife, Sacramento. July 2015. 842 pages. https://www.wildlife.ca.gov/Conservation/SSC/Fishes

Newcombe, C.P., and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management 11:72–82.

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16:693–727.

NMFS. 2001. Biological opinion/formal section 7 consultation/EFH consultation for the proposed Montezuma Wetlands Restoration Project – Waste Discharge. Tracking #: SWR-1999-2322/July 11, 2001.

NMFS. 2010a. Concurrence letter/informal section 7 consultation for the proposed Cullinan Ranch Restoration Project, Napa and Solano Counties, CA. Tracking #: SWR-2009-6112/April 5, 2010.

NMFS. 2010b. Magnuson-Stevens Fishery Conservation and Management Act essential fish habitat consultation: Operations and maintenance dredging in the San Francisco Bay area and associated dredged material placement. NMFS tracking number 2009/06769. July 13, 2010. 122 pages.

NMFS. 2011. Biological opinion/formal section 7 consultation/EFH consultation for the proposed Montezuma Wetlands Restoration Project, 2009 reinitiation. Tracking #: SWR-2008-2876/April 22, 2011.

NMFS. 2014. Recovery plan for the evolutionarily significant units of Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon, and the distinct population segment of California Central Valley steelhead. West Coast Region, Sacramento, California. July 2014. 427 pages.

NMFS. 2015a. Concurrence letter/informal section 7 consultation/EFH consultation for the proposed Cullinan Ranch Restoration Project, Napa and Solano Counties, CA. Tracking #: WCR-2014-1738/January 21, 2015.

NMFS. 2015b. Biological opinion/programmatic section 7 consultation for the Long-term Management Strategy for the Placement of Dredge Material in the San Francisco Bay Region. Tracking #: WCR-2014-1599/July 9, 2015.

NMFS. 2016a. 5-year status review: summary and evaluation of Central Valley spring-run Chinook salmon Evolutionarily Significant Unit. California Central Valley Recovery Domain. West Coast Region, April 2016. 41 pages.

NMFS. 2016b. 5-year status review: summary and evaluation of Sacramento River winter-run Chinook salmon ESU. California Central Valley Recovery Domain. West Coast Region, December 2016. 41 pages.

Nobriga, M.L., T.R. Sommer, F. Feyrer, and K. Fleming. 2008. Long-term trends in summertime habitat suitability for delta smelt (*Hypomesus transpacificus*). San Francisco Estuary ad watershed Science 6(1): 1-13.

O'Connor, J. M., D. A. Neumann, and J. A. Sherk. 1976. Lethal effects of suspended sediment on estuarine fish. U.S. Army Engineer Coastal Engineering Research Center, Technical paper 76-20, Fort Belvoir, Virginia.

Oliver, J. S., P. N. Slattery, L. W. Hulberg & J. W. Nybakken 1977. Patterns of succession in benthic infaunal communities following dredging and dredged material disposal in Monterey Bay. U.S. Army Corps of Engineers. Technical Report D-77-27.

PRBO Conservation Science. 2011. Projected effects of climate change in California: Ecoregional summaries emphasizing consequences for wildlife. Version 1.0. February 10, 2011. 59 pages. http://data.prbo.org/apps/bssc/uploads/Ecoregional021011.pdf

Reine, K., and D. Clarke. 1998. Entrainment by hydraulic dredges—a review of potential impacts. Technical Note DOER-E1. U.S. Army Corps of Engineers, Vicksburg, MS. 14 pages.

Rich, A.A. 2010. Potential impacts of resuspended sediments associated with dredging and dredge material placement on fishes in San Francisco Bay, California. Literature review and identification of data gaps. Report prepared for USACE. July 20, 2010. 75 pages plus appendices.

Rieman B.E., and D.J Isaak. 2010. Climate change, aquatic ecosystems and fishes in the Rocky Mountain West: implications and alternatives for management. USDA Forest Service, Rocky Mountain Research Station, GTR-RMRS-250, Fort Collins, CO.

Robinson, A., and B.K. Greenfield. 2011. LTMS Longfin Smelt Literature Review and Study Plan. SFEI Contribution XXX. San Francisco Estuary Institute, Oakland, CA. 40 pp.

Rose, K. A., W. J. Kimmerer, K. P. Edwards, and W. A. Bennett. 2013a. Individual-based modeling of delta smelt population dynamics in the upper San Francisco Estuary. I. Model description and baseline results. Transactions of the American Fisheries Society 142:1238-1259.

Rose, K. A., W. J. Kimmerer, K. P. Edwards, and W. A. Bennett. 2013. Individual-based modeling of delta smelt population dynamics in the upper San Francisco Estuary. II. Alternative baselines and good versus bad years. Transactions of the American Fisheries Society 142:1260–1272.

Rosenfield, J.A., and R.D. Baxter. 2007. Population dynamics and distribution patterns of longfin smelt in the San Francisco Estuary. Transactions of the American Fisheries Society 136:1577–1592.

RWQCB. 2015. Reissued waste discharge requirements for U.S. Army Corps of Engineers, San Francisco District, San Francisco Bay Federal Channel Maintenance Dredging Program, 2015 through 2019. Order No. R2-2015-0023. 44 pages.

Sandstrom, P. T., T. Keegan, and G. Singer. 2013. Survival and movement patterns of central California coast native steelhead trout (*Oncorhynchus mykiss*) in the Napa River. Environmental Biology of Fishes 96(2-3):287-302.

Sherk, J. A. 1972. Current status of the knowledge of the biological effects of suspended and deposited sediments in Chesapeake Bay. Chesapeake Science 13:137–144.

Sommer T. and Mejia F. 2013. A place to call home: A synthesis of delta smelt habitat in the upper San Francisco Estuary. San Francisco Estuary and Watershed Science 11(2): https://escholarship.org/uc/item/32c8t244

Swanson, C., T. Reid, P.S. Young, and J.J. Cech Jr. 2000. Comparative environmental tolerances of threatened delta smelt (*Hypomesus transpacificus*) and introduced wakasagi (*H. nipponensis*) in an altered California estuary. Oecologia 123:384–390.

Sweetnam DA. 1999. Status of delta smelt in the Sacramento-San Joaquin Estuary. California Fish and Game 85:22-27.

SWRI. 2004. Impacts on lower American River salmonids and recommendations associated with Folsom Reservoir operations to meet delta water quality objectives and demands. Draft report prepared for the Sacramento Water Forum. December 2004. 20 pages plus appendices.

Teachout, E. 2012. Evaluating the effects of underwater sound from pile driving on the marbled murrelet and the bull trout. Revised document dated January 4, 2012. Washington Fish and Wildlife Office, Lacey. 35 pages. https://www.fws.gov/wafwo/Documents/EffectsofAction/Underwater%20Effects%20of%20Pile%20Driving%201.pdf

The Bay Institute. 2007. Petition to the State of California Fish and Game Commission and supporting information for listing of delta smelt (*Hypomesus transpacificus*) as an endangered species under the California Endangered Species Act. February 7, 2007. 57 pages. https://www.biologicaldiversity.org/species/fish/Delta_smelt/pdfs/DS-State-Endangered-Petition-02-07-2007.pdf

Tobias, V. 2018. Data-driven patterns of longfin smelt occupancy in the San Francisco Estuary. Presented paper at the Interagency Ecological Program 2018 annual workshop. March 6-8, 2018, Folsom, CA.

USACE. 2014. Draft Environmental Assessment/Environmental Impact Report. Maintenance dredging of the Federal navigation channels in San Francisco Bay fiscal years 2015 – 2024. Prepared for USACE and RWQCB. December 2014. 326 pages plus appendix.

USACE. 2018. Biological assessment: fiscal years 2019-2023 maintenance dredging of Suisun Bay Channel, Contra Costa and Solano County, California. December 2018. 25 pages.

USACE, U.S. Environmental Protection Agency (USEPA), San Francisco Bay Conservation and Development Commission (BCDC), RWQB, and State Water Resources Control Board. 1998. Long Term Management Strategy (LTMS) for the placement of dredged material in the San Francisco Bay Region, Final Policy Environmental Impact Statement/Programmatic Environmental Impact Report. USAED, San Francisco. Loose-leaf pub. n.p.

USACE, USEPA, BCDC, and RWQB. 2001. Long Term Management Strategy (LTMS) for the placement of dredged material in the San Francisco Bay Region, Management Plan 2001. 174 pp.

USBR. 2016. SECURE Water Act Section 9503(c) — Reclamation Climate Change and Water 2016. Chapter 8: Sacramento and San Joaquin River Basins.

USFWS. 2001. Formal consultation for the Montezuma Wetlands project, Solano County, California. USFWS File Number 1-1-99-F12. Letter dated March 21, 2001 from Cay C. Goude of USFWS to Calvin C. Fong of USACE. 36 pages.

USFWS. 2003. Formal conference and reinitiation of formal consultation for the Montezuma Wetlands project, Solano County, California, Corps of Engineers Permit Number 19405N. USFWS File Number 1-1-02-F-0175. Letter dated March 19, 2003 from Cay C. Goude of USFWS to Calvin C. Fong of USACE. 15 pages.

USFWS. 2004a. Reinitiation of formal consultation for the Montezuma Wetlands project, Solano County, California, Corps of Engineers Permit Number 19405N. USFWS File Number 1-1-04-F-0270. Letter dated August 20, 2004 from Cay C. Goude of USFWS to Calvin C. Fong of USACE. 4 pages.

USFWS. 2004b. Formal programmatic consultation on the issuance of section 10 and 404 permits for projects with relatively small effects on the delta smelt (*Hypomesus transpacificus*) and its critical habitat within the jurisdiction of the Sacramento Fish and Wildlife Office of the U.S. Fish and Wildlife Service, California. USFWS File Number 1-1-04-F-0345. Letter dated December 1, 2004 from Cay C. Goude of USFWS to Lt. Col. Philip T. Feir and Lt. Col. Ronald N. Light of USACE. 29 pages.

USFWS. 2008. Formal Endangered Species Act consultation on the proposed coordinated operations of the Central Valley Project (CVP) and State Water Project (SWP). USFWS File Number 81420-2008-F-1481-5. Memorandum from Regional Director, Fish and Wildlife Service, Region 8, Sacramento, California to Operation Manager, Bureau of Reclamation, Central Valley Operations Office, Sacramento, California. 410 pages. https://www.fws.gov/sfbaydelta/documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf

USFWS. 2010a. Reinitiation of consultation for proposed modifications at the Montezuma Wetlands project, Solano County, California. USFWS File Number 81420-2008-F-1861. Letter dated November 29, 2010 from Susan K. Moore of USFWS to Jane M. Hicks of USACE. 4 pages.

USFWS. 2010b. Biological opinion/intra-Service section 7 consultation on implementation of the proposed Cullinan Ranch Restoration Project, Napa and Solano Counties, CA. Tracking #: SFB-2010-01/May 7, 2010.

USFWS. 2018. Delta smelt Q & A. Bay-Delta Fish & Wildlife Office. https://www.fws.gov/sfbaydelta/EndangeredSpecies/Species/Accounts/DeltaSmelt/DeltaSmeltQandA.htm

Wilcox, C. 2017. CDFW update to the Delta Stewardship Council for Water Year 2017. Item 12 Presentation. Meeting Date: October 26, 2017.

WSDOT. 2018. Biological Assessment Preparation. Advanced Training Manual Version 01-2018. Chapter 7.0 Construction Noise Impact Assessment. http://www.wsdot.wa.gov/sites/default/files/2018/01/18/Env-FW-BA_ManualCH07.pdf

Appendix A. Species Lists

Appendix B. Summary of Sediment Sampling and Analysis

1.0 Introduction

Sediment sampling and analysis studies conducted during the project's early planning phases are described below. Studies conducted include:

- Chemical Evaluations of John F. Baldwin Ship Channel Ship Channel Sediment. September 1990. Prepared by Battelle/Marine Sciences.
- Ecological Evaluation of Proposed Dredged Material from the John F. Baldwin Ship Channel Ship Channel (Phase III – Biological Testing). October 1993. Prepared by Battelle/Marine Sciences.
- Ecological Evaluation of Proposed Dredged Material from Bulls Head Channel (Lower Suisun Bay). July 1994. Prepared by USACE Engineer Research and Development Center.
- *Evaluation of Wetland Creation with John F. Baldwin Ship Channel Sediment*. November 2000. Prepared by USACE Engineer Research and Development Center.

2.0 San Pablo Bay Sediments

Sediments were evaluated for proposed deepening along a 28-mile long portion of the John F. Baldwin Channel in 1990 (physical and chemical analyses), 1993 (full Tier III physical, chemical, toxicity, and bioaccumulation analyses), and 2000 (wetland creation analyses). The channels sampled included the West Richmond Channel, located downstream of the Pinole Shoal Channel; Pinole Shoal Channel; and Carquinez Strait. The study did not include Bulls Head Reach. The objectives of these studies was to identify and quantify sediment contamination in the channels, whether identified contamination would result in acute toxicity or bioaccumulation in organisms during dredging and aquatic dredged material placement, and whether the sediment was suitable for wetland creation. The results of the analysis were compared to similar analysis conducted with sediment from reference sites. The references sites used in this study include the Bay Farm site in the South Bay and a deep ocean site approximately 50 miles west of the Golden Gate.

Physical and chemical properties were analyzed for sediment grain size, total organic compounds, total volatile solids, oil and grease, total petroleum hydrocarbons, percentage of petroleum, polynuclear aromatic hydrocarbons, chlorinated pesticides and polychlorinated biphenyls, and ten metals (Battelle 1990, 1993). Full Tier III testing, including suspended-particulate-phase (SPP) toxicity test, solid-phase toxicity tests, and bioaccumulation tests, as well as grain and chemistry analyses (Battelle 1993). Suspended-particulate-phase (SPP) toxicity tests evaluates the effects of dissolved contaminants and contaminates associated with particles suspended in the water column during dredging and aquatic placement. Solid-phase toxicity tests are benthic toxicity and bioaccumulation tests that examine the effects of dredged sediment on sensitive benthic organism. The results are compared to similar tests conducted with sediment from a reference site and proposed dredged material placement sites.

2.1 Pinole Shoal Channel Sediments

During the 1990 sampling and analysis study, 37 sediment cores were collected from Pinole Shoal Channel sediment. Sediment collected in the samples represented only young bay mud. In general, sediment sampled showed little contamination. Sediment in the northeast portion of Pinole Shoal had elevated levels of aluminum, arsenic, and mercury that were not correlated to the concentration of total organic carbon or grain size. During the 1993 Tier III testing, 26 sediment cores were sampled to depths of 47 feet MLLW (45 feet MLLW plus 2 feet of overdepth). Four composite samples were generated from the 26 samples and used in the analyses. The first composite was from the western-most 16,000 feet of the channel and included three separate samples. The second composite was from the next approximate 15,000 feet and included ten separate samples. The third composite was from the next 13,000 feet and contained five samples. The final composite was from the final 10,700 feet and included eight samples.

2.1.1 Pinole Shoal Channel Physical and Chemical Sediment Sampling and Analyses

The results of the physical and chemical analysis are summarized in Table 1 through Table 5, with the exception of chlorinated pesticides and polychlorinated biphenyls. Chlorinated pesticides and polychlorinated biphenyls were either undetected or below the method detection limits for all samples, and therefore, are not reported herein. In addition, results of butyltin analyses showed that tri-, di-, and monobutyltin were undetected in all but one sample. Tributyltin was detected at a level of 4.1 µg/kg at one station at the eastern most border of composite PS-3.

Table 1: Conventional Parameters Measured in Pinole Shoal Channel Sediments

Composite	Gravel (> 2000 µm)	Sand (62.5-2000 µm)	Silt (3.9 – 63 µm)	Clay (<3.9 µm)	TOC (% dry weight)	TVS (% dry weight)	Oil and Grease (mg/kg)	TPH (mg/kg)	Petroleum Fraction (%)
PS-1	1	24	42	33	0.90	5.50	24.1	20.4	85
PS-2	0	53	26	21	0.62	4.18	37.0	29.3	79
PS-3	0	85	7	8	0.20	2.26	16.7	13.5	<81
PS-4	0	42	29	29	0.48	5.58	43.2	24.0	56
In-bay RS	*0*	*4*	*54*	*42*	*1.10*	*7.60*	*155.8*	*119.4*	*77*
Ocean RS	*0*	*50*	*29*	*21*	*0.75*	*3.59*	*29.2*	*17.2*	*<59*

TOC: Total organic compounds
TVS: Total volatile solids
TPH: Total petroleum hydrocarbons

Table 2 summarizes the sediment composition, as well as the total organic compounds, total volatile solids, and petroleum products found in the sediment composites. Pinole Shoal Channel exhibited a trend of predominately fine-grained sediments (>70 percent silt and clay) at the west end of the channel, with sediment decreasing in fine grain through section PS-3, where sediment were predominately coarse-grained (>70 percent sand and gravel). Continuing east, the sediment composition increased to between 25 and 90 percent fine-grained. Total organic compounds were generally high in the western portion of Pinole Shoal, and decreased moving eastward. Total volatile solids was ranged from 25 percent dry weight in PS-1 to 85 percent in PS-3. Total organic compounds and total volatile solids were well correlated with sediment size; the fine-grained sediment contained higher total organic compounds. Oil and grease and total petroleum hydrocarbons were generally low throughout the channel, except near the eastern edge of PS-4, where two samples within the composite both exceed 100 mg/kg oil and grease.

Ten metals were measured in the Pinole Shoal Channel; Table 2 summarizes the concentration of metals measured. All composite samples exceeded the ocean reference site for arsenic and two (PS-2 and PS-3 exceed the in-bay reference site. PS-2, PS-3, and PS-4 all exceeded the in-bay and ocean reference sites for chromium by approximately 20 to 35 mg/kg. All composites exceed the ocean reference site for copper; however, the in-bay site was not exceeded. PS-2 and PS-4 exceeded the ocean reference site for mercury. All composites exceeded the ocean reference site for nickel; however, only PS-1 exceeded the in-bay reference site. All composites exceeded the ocean reference site for lead. PS-4 exceeded the in-bay reference site for selenium. Finally, PS-1, PS-2, and PS-4 exceeded the reference site for Zinc.

Table 2: Concentrations of Metals Measured in Pinole Shoal Composite Samples (mg/kg dry weight)

Composite	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
PS-1	0.11	7.57	0.20	184.0	37.8	0.050	109.7	12.4	0.16	93.9
PS-2	0.15	10.43	0.21	227.0	39.8	0.089	99.5	11.7	0.37	97.6
PS-3	0.05	7.97	0.12	235.0	23.1	0.032	90.0	11.3	0.16	73.0
PS-4	0.11	15.00	0.24	216.0	48.0	0.270	93.0	20.4	0.46	89.6
In-bay RS	*0.52*	*10.40*	*0.21*	*198.0*	*54.5*	*0.345*	*104.9*	*34.1*	*0.37*	*142*
Ocean RS	*0.42*	*3.86*	*0.52*	*198.0*	*21.9*	*0.055*	*67.4*	*8.8*	*1.23*	*76.1*

Ag: Silver
As: Arsenic
Cd: Cadmium
Cr: Chromium
Cu: Copper
Hg: Mercury
Ni: Nickel
Pb: Lead
Se: Selenium
Zn: Zinc
RS: reference site

Table 3 provides the range of measured PAH for the samples that comprise each composite, as well as the concentration measured in each composite. In the Pinole Shoal Channel, composites PS-1 and PS-3 were low in PAH; however, PS-2 samples ranged between 100 and 300 µg/kg. Composite PS-4 had low PAH; with higher concentrations in the eastern most edge of the channel, near Carquinez Strait. PS-2 and PS-4 composites exceeded the concentrations of the ocean reference site for low molecular PAH and PS-2, PS-3, and PS-4 composites exceeded the ocean reference site for high molecular PAH and total PAH. The in-bay site concentrations were not exceeded.

Table 3: Polynuclear Aromatic Hydrocarbons in Pinole Shoal Channel Sediments (µg/kg dry weight)

Composite	Low Molecular PAH		High Molecular PAH		Total PAH		Percent High Molecular PAH
	Range	Composite	Range	Composite	Range	Composite	Composite
PS-1	18.0 – 20.5	14.6	28.2 – 38.5	28.5	46 – 59	41	64.4
PS-2	14.7 – 36.6	17.0	64.5 – 247.5	159.1	79 – 337	176	90.4
PS-3	2.5 – 12.1	6.8	8.7 – 74.7	100.6	11 – 87	107	93.7
PS-4	4.5 – 36.4	16.3	29.6 – 296.5	106.7	30 - 338	123	86.8

Table 3: Polynuclear Aromatic Hydrocarbons in Pinole Shoal Channel Sediments (µg/kg dry weight)							
Composite	**Low Molecular PAH**		**High Molecular PAH**		**Total PAH**		**Percent High Molecular PAH**
	Range	**Composite**	**Range**	**Composite**	**Range**	**Composite**	**Composite**
In-bay RS	--	*255.7*	--	*2,345.7*	--	*2,610*	*90.2*
Ocean RS	--	*14.9*	--	*44.9*	--	*60*	*75.1*

2.1.2 Pinole Shoal Channel Sediment Toxicity and Bioaccumulation

Suspended-particulate-phase toxicity and solid-phase toxicity tests were conducted on all four composite samples. Three separate tests were conducted using three different species: the mysid, *Holmesimysis sculpta*; sanddab, *Citharichthys stigmaeus*; and echinoderm, *Dendraster excentricus*. In addition, three concentrations of SPP were used, 10, 50, and 100 percent, along with a seawater control, 0 percent SPP.

Estimates of toxicity in the water column were evaluated by exposing three sensitive marine species (*H. sculpta*, *C. stigmaeus*, and *D. excentricus*) to three concentrations of SPP and a dilution seawater control. Results showed that there was no acute toxicity to *H. sculpta* and *C. stigmaeus*; but, that 100 percent of the four composites was acutely toxic to *D. excentricus* larvae. Despite those instances of significant toxicity, no LC50s could be calculated because mortality did not exceed 50 percent of the population relative to control. In addition, some sediment composites from the Pinole Shoal Channel did result in significant increased abnormal growth and development of the *D. excentricus.* The results of each test are described below and data is summarized in Table 4.

The 96-hour mysid (*H. sculpta*) test showed no reduction in survival when exposed to various concentrations of SPP prepared from sediment composites. In fact, some survival was higher with SPP, compared to controls. The 96-hour sanddab (*C. stigmaeus*) test showed survival rates ranging from 92.5 to 100 percent and, in PS-1, SPP had no effect on survival at any concentration. For both *H. sculpta* and *C. stigmaeus*), LC50 concentrations (percent SPP expected to cause 50 percent reduction in survival) were determined to be greater than 100 percent SPP.

Table 4: Results of the Suspended-Particulate Phase Test for Pinole Shoal Composite Sediments

Composite	Concentration (percent SPP)	96-hour *H. Sculpta*		96-hour *C. stigmaeus*		72-hour *D. excentricus*			
		Mysid Survival		Sanddab Survival		Embryo Development		Embryo Survival	
		Mean Percent Surviving (10 mysids)	96-hour LC50 (percent SPP)	Mean Percent Surviving (10 sanddabs)	96-hour LC50 (percent SPP)	Proportion Normal Development (252 embryos)	EC50 (percent SPP)	Proportion Survival	LC50 (percent SPP)
PS-1	0 (control)	95.0	>100	100.0	>100	0.84	22.5	0.88	>100
	10	77.5		100.0		0.85		0.88	
	50	92.5		100.0		0.00		0.96	
	100	95.0		100.0		0.00		0.49	
PS-2	0 (control)	92.5	>100	100.0	>100	0.84	29.0	0.88	>100
	10	92.5		97.5		0.84		0.87	
	50	97.5		100.0		0.19		0.89	
	100	95.0		100.0		0.00		0.50	
PS-3	0 (control)	82.5	>100	97.5	>100	0.89	>100	0.92	>100
	10	95.0		97.5		0.88		0.91	
	50	97.5		100.0		0.85		0.91	
	100	95.0		97.5		0.56		0.80	
PS-4	0 (control)	87.5	>100	100.0	>100	0.88	71.6	0.90	>100
	10	97.5		100.0		0.89		0.92	
	50	97.5		100.0		0.81		0.84	
	100	90.0		92.5		0.09		0.80	

The 72-hour SPP test with larval *Dendraster excentricus* indicated that embryo survival and development in 100 percent SPP treatment showed statistically different survival rates in PS-1, PS-2, and PS-3, compared to controls (0 percent SPP). However, LC50 could not be calculated, as there was never a 50 percent reduction in embryo survival. Therefore, the LC50s for all treatments were determined to be greater than 100 percent. The SPP treatments did affect normal embryo development more than embryo survival. The normal development endpoint is more indicative of the organisms that are likely to survive into adulthood; therefore, this metric is more useful for assessing environmental impacts. All 100 percent SPP treatments resulted in significant differences in normal development, relative to controls. PS-1, PS-2, and PS-4 all had more than a 50 percent reduction in normal development and the following median effective concentrations (EC50s), or concentrations effecting a 50 percent decrease in normal development relative to a control, were calculated: PS-1, 22.5 percent SPP; PS-2, 29.0 percent SPP; and PS-4, 71.6 percent SPP.

Ten-day tests of the acute toxicity of 11 solid-phase sediment treatments were conducted on the amphipod *Rhepoxynius abronius*. 28-day bioaccumulation toxicity of solid-phase treatments were conducted the polychaete *Nephtys caecoides* and the bentnose clam *Macoma nasuta.* The results of the solid-phase toxicity tests are summarized in Table 5. Mean survival for all tests were generally high. Statistical analysis of the 10-day *R. abronius* acute toxicity test indicate that no statistically significant differences in response and increase in mortality occurred between the four test composites and the ocean reference site. While statistical analysis of the 28-day bioaccumulation tests were not conducted; survival rates for each of the composite treatments are all greater than 90 percent, and close to the survival rates for both reference sites.

Table 5: 10-day and 28-day Solid-phase Test for Composite Sediments From Pinole Shoal Channel

Composite	10-day *R. abronius* Mean Percent Survival (n = 20)	28-day *M. nasuta* Mean Percent Survival (n = 25)	28-day *N. caecoides* Mean Percent Survival (n = 40)
PS-1	82.0	90.0	95.0
PS-2	88.0	98.0	95.0
PS-3	96.0	93.0	95.0
PS-4	94.0	97.0	94.0
In-bay RS	*92.0*	*96.0*	*94.0*
Ocean RS	*87.0*	*99.0*	*95.0*

Contaminants of concern were measured in tissues of *M. nasuta* and *N. caecoides* after the 28-day solid-phase exposure tests in composite, reference, and control sediments. Contaminants measured include PAHs, chlorinated pesticides, PCBs, metals, and butyltins. Each category of contaminants is discussed below. *M. nasuta* and *N. caecoides* tissue contaminant concentrations were orders of magnitude below the Food and Drug Administration action limits after exposure to Pinole Shoal Channel sediments. However, although the majority of the contaminants were not bioaccumulated by either species, statistically significant elevations of several contaminants were detected, compared to the ocean reference site. The contaminants which showed a statistically significant higher concentration in tissue exposed to Pinole Shoal Channel composite samples are discussed.

Polynuclear Aromatic Hydrocarbons: Two PAHs showed statistically significant *M. nasuta* concentrations in composite sediments, compared to the ocean reference site, pyrene and fluoranthene, as discussed below. The magnitude and significance of elevated concentrations of both these contaminants was relatively low, with test treatment concentrations two to four times the ocean reference concentration. In general, the in-bay reference site had higher concentrations of sediment PAH levels.

- Pyrene in *M. nasuta*: tissue concentrations of pyrene were significantly greater in composite sediments from PS-2 (19.5 µg/kg), PS-3 (10.0 µg/kg), and PS-4 (24.2 µg/kg), compared to the ocean reference site (6.0 µg/kg).
- Pyrene in *N. caecoides:* tissue concentrations of pyrene were significantly greater in composite sediments from PS-2 (14.9 µg/kg) and PS-4 (16.2 µg/kg), compared to the ocean reference site (4.6 µg/kg).
- Fluoranthene in *M. nasuta*: tissue concentrations of fluoranthene were significantly greater in composite sediments from PS-2 (15.0 µg/kg) and PS-4 (23.4 µg/kg), compared to the ocean reference site (9.9 µg/kg).
- Fluoranthene in *N. caecoides*: tissue concentrations of fluoranthene were significantly greater in composite sediments from PS-4 (7.3 µg/kg), compared to the ocean reference site (4.4 µg/kg).

Chlorinated Pesticide and Polychlorinated Biphenyl: 4.4'-DDD was found to be significantly greater in *M. nasuta* and *N. caecoides* exposed to sediments from the Pinole Shoal Channel. Concentrations in *M. nasuta* was statistically greater in composites PS-2 (12.5 µg/kg), PS-3 (7.2 µg/kg), PS-4 (15.8 µg/kg); with mean concentrations 3 to 7 times higher than the ocean reference site (2.3 µg/kg) and in-bay reference site (4.8 µg/kg). However, the actual contaminant concentrations were very low. All were below the in-bay reference site.

Bioaccumulation of 4.4'-DDD in *N. caecoides* was found statistically significant for composites PS-2 (8.9 µg/kg) and PS-4 (10.0 µg/kg), compared to the ocean reference site (2.1 µg/kg) and in-bay reference site (3.1 µg/kg). Trans-chlordane was also statistically different for PS-1 (9.4 µg/kg), compared to the ocean reference site (6.2 µg/kg).

Metals: Lead in composite sediment PS-4 (3.39 µg/kg) was the only compound found at higher concentrations in *M. nasuta* tissue at statistically greater concentrations compared to the ocean reference site (1.18 µg/kg), and was also higher than the in-bay reference site (2.62 µg/kg). It appeared that the significance was due to only one sediment sample in the composite being elevated, at 10.0 µg/kg.

Butyltins: Tributyltin in composite sediment PS-3 (88.7 µg/kg), compared to the ocean reference site (11.4 µg/kg) and the in-bay reference site (13.6 µg/kg). *M. nasuta* exposed to composite PS-3 had consistently higher Tributyltin concentrations (79.1 to 108.8 µg/kg dry weight in individual replicates) than any of the other treatments, suggesting that any tributyltin in PS-3 sediment is readily bioavailable.

2.1.3 Pinole Shoal Channel Wetland Creation Suitability

In 2000, USACE Engineer Research and Development Center (ERDC) conducted sediment sampling and analyses to determine if sediments from the Pinole Shoal Channel would result in toxicity or contamination to wetland plants and animals. Laboratory tests included two coastal saltmarsh grasses, smooth cordgrass (*Spartina alterniflora*) and salt couch grass (*Sporobolus virginicus*), and three sediment compositions. Three animals were used, including nassa mud snails (*Nassarius* spp.), annelids (*Nephthys* spp.), and ribbed mussels (*Modious*). Three local plant species were used California cordgrass (*Spartina foliosa*), Parish's pickleweed (*Salicornia subterminalis*)*,* and chairmaker's bulrush (*Scirpus olvnyi*). A field survey of plants, animals and sediments from existing naturally occurring wetland around the San Francisco Bay area was conducted to provide a reference data base with which results of the Pinole Shoal Channel sediment testing could be compared.

In general, the study found that sediment in the Pinole Shoal Channel had concentrations of PAHs, butyltin, arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium, and zinc similar to those found naturally occurring in Bay Area wetlands. Plant bioassays indicated that leaf tissue concentrations of heavy metals were equal to or below those found naturally occurring in wetlands. However, data suggests a potential for migration of lead from plant tissues into food webs.

Wetland animal bioassays showed a mixed result when both plants and animals were grown in mesocosms with channel sediment. *Salicornia* grew well in sediments, whereas *S. foliosa* and *S. olvenyi* grew poorly. This could be because the plants were collected during the fall dormant stage for *S. foliosa* and *S. olvenyi*. The mud snails and mussels grew well and survived in the mesocosms; however, all annelids died, likely a result of a thick algae mat forming on sediment surfaces, which suffocated the annelids.

Overall, the wetland mesocosms tests indicated that creating wetlands with Pinole Shoal Channel sediments will produce plants or animals with tissue metal concentrations in the range of those found in existing San Francisco Bay area wetlands; PAH concentrations were negligible; PCBs and butyltins were not detected in mesocosms organisms. Use of Pinole Shoal sediments for wetland creation would produce wetlands comparable to existing wetlands in the Bay area.

With the most recent 2009 sediment testing data from -37 to -39 feet, Chromium concentrations range from 51 to 61. The threshold criteria for wetland placement at surface is 112 mg/kg. Therefore, the material would be suitable for cover or wetland placement at the beneficial reuse sites. Confirmatory testing will be completed prior to placement at the reuse sites.

3.0 Bulls Head Reach Sediments

Bulls Head Reach sediments were sampled and analyzed in 1994. Sediment from this reach was analyzed to determine if the sediment was suitable for placement at SF-DODS, in-bay disposal aquatic disposal sites, and for beneficial use. Core samples were taken from 38 location (28 within the channel, 8 outside of the channel, and 2 from reference sites) to depths of 47 feet MLLW (45 feet MLLW plus 2 feet of overdepth); in addition, 8 composite samples were used. Sediment analyses included physical, chemical, toxicity, and bioaccumulation tests. Reference sites included the SF-11 Alcatraz in-bay disposal site and Bay Farms in-bay site in the South Bay.

Similar to Pinole Shoal Channel, the depths proposed for dredging would only penetrate young bay mud. Bulls Head Reach sediments are characterized as mostly sandy, or as silt and clay with varying amounts of sand. Chemical analysis showed that the sediments were relatively uncontaminated. Organic compounds were present in low concentrations, including PAHs, butyltins, and 4'4-DDD. Overall, the analysis indicates that the material is suitable for in-bay and ocean disposal, as well as beneficial use.

3.1 Bulls Head Reach Sediments Conventional Parameters and Metals

Conventional parameters measures include grain size, total organic compounds, total petroleum hydrocarbons, total volatile solids, and total and water soluble sulfides (Table 6). Sediment total organic compounds, total volatile solids, total petroleum hydrocarbons, and sulfides were well correlated with grain size; smaller grains tended to have higher concentrations of the afore-mentioned compounds.

Table 6: Conventional Parameters Measured in Bulls Head Reach Sediments

Composite	Gravel (> 2000 µm)	Sand (62.5-2000 µm)	Silt (3.9 – 63 µm)	Clay (<3.9 µm)	TOC (% dry weight)	TVS (% dry weight)	TPH (mg/kg)	Total Sulfide (mg/kg)	Water Soluble Sulfide (mg/kg)
BHR-A (upper)	1	97	0	2	0.17	01.40	12 U	1.41 U	0.16 U
BHC-A (lower)	0	46	31	23	0.76	3.18	22	1.18 U	0.20 U
BHC-B	0	21	48	31	2.02	3.97	20	1.96 U	0.20 U
TB-C	0	97	1	2	0.18	1.30	14	1.36 U	0.14 U
TB-D (upper)	0	80	12	8	0.29	1.95	13 U	1.50 U	0.18 U
TB-D (lower)	0	79	16	5	0.35	1.69	13 U	1.50 U	0.15 U
TB-E (upper)	0	87	9	4	0.11	1.82	14	1.46 U	0.17 U
TB-E (lower)	0	19	54	27	1.42	3.39	16	9.50	0.19 U
Alcatraz RS	*0*	*97*	*1*	*2*	*0.04*	*0.69*	*20*	*1.31 U*	*0.15 U*
Bay Farm RS	*0*	*7*	*39*	*54*	*1.28*	*2.11*	*54*	*91.9*	*0.39 U*

TOC: Total organic compounds
TVS: Total volatile solids
TPH: Total petroleum hydrocarbons
U: Analyte undetected above given concentration.

Ten metals were measured in the Bulls Head Reach sediment samples and reference samples (Table 7). Silver concentrations ranged from 0.024 to 0.059 mg/kg in sandy sediments and 0.048 to 0.132 mg/kg in finer-grained sediments. Concentrations in the silt/clay composites exceeded concentrations at the Alcatraz reference site; but not the Bay Farm site. Copper values ranged from 11.7 to 68.4 mg/kg, which is similar to concentrations found in Pinole Shoal Channel sediments. Copper was lower in sandy samples, compared to finer-grained concentrations; but, copper in all composite samples were higher than the Alcatraz reference site (11.0 mg/kg). Arsenic, cadmium, chromium, nickel, lead and zinc concentrations were similar to those of the Pinole Shoal Channel; however, in silt/clay samples, concentrations often exceeded both reference site samples, but not by more than a factor of two to three.

Mercury concentrations were generally low, except for in composite BHC-A lower, which included sampling sites closest to the Benicia-Martinez Bridge. Mercury was strongly associated with fine-grained sediments and mercury in the silt/clay composites generally exceeded the Alcatraz reference site by up to two times. Selenium concentrations were similar to those of the Pinole Shoal Channels, and was also positively associated with silt/clay sediments.

Table 7: Concentration of Metals Measured in Bulls Head Reach Samples (mg/kg dry weight)									
Composite	**Ag**	**As**	**Cd**	**Cr**	**Cu**	**Hg**	**Ni**	**Pb**	**Se**	**Zn**
BHR-A (upper)	0.035	7.6	0.084	258	17.0	0.031	83.3	12.1	0.10 U	74.1
BHC-A (lower)	0.079	11.0	0.167	204	46.3	0.138	106	11.9	0.18	91.1
BHC-B	0.099	10.1	0.171	171	64.3	0.051	122	12.3	0.24	102
TB-C	0.027	8.8	0.084 U	230	19.2	0.015	83.5	9.1	0.10 U	71.7
TB-D (upper)	0.045	7.3	0.086	304	23.7	0.021	94.9	7.8	0.18	74.2
TB-D (lower)	0.054	6.5	0.089	210	30.6	0.021	101	8.3	0.10 U	77.6
TB-E (upper)	0.042	6.2	0.093	334	29.4	0.018	106	7.3	0.10 U	76.6
TB-E (lower)	0.104	11.6	0.179	181	60.2	0.048	116	8.4	0.24	102
Alcatraz RS	*0.048*	*8.0*	*0.084 U*	*386*	*11.0*	*0.026*	*42.8*	*14.3*	*0.10 U*	*43.7*
Bay Farm RS	*0.423*	*10.8*	*0.146*	*164*	*56.0*	*0.368*	*103*	*34.1*	*0.29*	*146*
Ag: Silver As: Arsenic Cd: Cadmium Cr: Chromium			Cu: Copper Hg: Mercury Ni: Nickel Pb: Lead			Se: Selenium Zn: Zinc RS: reference site U: Analyte undetectable above given limit				

3.2 Bulls Head Reach Sediments Organic Compounds

Organic compounds measured in Bulls Head Reach Channel included polynuclear aromatic hydrocarbons, phthalates, chlorinated pesticides, polychlorinated biphenyls, and butyltins (Table 8). As shown, Bulls Head Reach sediments are relatively uncontaminated with organic pollutants. Phthalates were not detected in any of the sediment samples. Polynuclear aromatic hydrocarbon concentrations are very low, and in all cases, lower than both reference sites. The pesticide 4,4'-DDD was detected in a few Bulls Head Reach samples, but also in reference samples. Polychlorinated biphenyls were not detected in any Bulls Head Reach or reference samples.

Table 8: Polynuclear Aromatic Hydrocarbons, Pesticides, and Butyltins in Bulls Head Reach Sediments (µg/kg dry weight)										
Composite	**Low Molecular PAH**		**High Molecular PAH**		**Total PAH**		**4,4-DDD**	**Tributyltin**	**Dibutyltin**	**Monobutyltin**
	Range	**Composite**	**Range**	**Composite**	**Range**	**Composite**	**Composite**	**Composite**	**Composite**	**Composite**
BHR-A (upper)	20 – 167	20	27 – 275	27	47 – 442	47	0.13 U	0.25 U	0.41 U	0.43 U
BHC-A (lower)	4 – 93	26	6 – 400	79	10 – 493	105	0.14 U	0.25 U	0.41 U	0.43 U
BHC-B	4 – 93	18	6 – 21	12	11 – 58	30	0.16 U	0.25 U	1.96	1.88
TB-C	5 – 19	10	5 – 38	9	10 – 57	19	0.12 U	0.25 U	0.41 U	0.43 U
TB-D (upper)	6 – 12	5	8 – 11	6	16 – 20	11	0.13 U	0.25 U	0.41 U	0.43 U
TB-D (lower)	11	3	10	5	21	8	0.12 U	0.25 U	0.41 U	0.43 U
TB-E (upper)	6 – 8	1	6	3	12 – 14	4	0.12 U	0.25 U	0.41 U	0.43 U
TB-E (lower)	12 – 30	23	11 – 26	13	23 – 53	36	0.14 U	0.25 U	0.41 U	0.43 U
Alcatraz RS	--	*574*	--	*1039*	--	*1613*	*0.53*	*0.25 U*	*0.41 U*	*0.71*
Bay Farm RS	--	*217*	--	*1444*	--	*1661*	*1.63*	*3.63*	*11.5*	*3.00*
U: Analyte undetectable above given limit										

3.3 Bulls Head Reach Toxicity and Bioaccumulation

Solid phase sediment toxicity tests were conducted with eight Bulls Head Reach sediment composites, two reference sediment samples, and once control. The tests measured survival rates of two amphipods, *Rhepoxynius abronius* and *Echaustorius estuaries*, as well as the effective survival rate of *R. abronius* (Table 9). The effective survival of *R. abronius* was assessed by counting the number of survivors that were able to rebury in clean sediment. Three sediment composites had had relatively high preliminary porewater ammonia levels (BCH-A lower, 70 mg/l; BCH-B, 100 mg/l; and TB-E lower, 110 mg/l). These samples were aerated for 1 to 2 days and overlying water was replaced to reduce porewater ammonia to acceptable levels (<30 mg/l for *R. abronius*). *R. abronius* survival ranged from 81 to 97 percent for all test composites; with the exception of the low survival of TB-E lower. TB-E lower porewater ammonia was not manipulated. Both sediment composites TB-E lower and BHC-B had statistically significant reduced survival relative to the Alcatraz reference site; but, not by more than 20 percent.

The effective survival of *R. abronius* was used to assess the sublethal endpoint of the solid-phase test. Most individuals that survived exposure to Bulls Head Reach composite samples were able to rebury in clean sediment.

E. estuarius survival ranged from 74 to 98 percent, and was lower than 68 percent in the un-manipulated TB-E lower composite. In composites BHC-B and TB-E lower (both with reduced porewater ammonia), *E. estuaries* survival was statistically significant and more than 20 percent lower, compared to the Alcatraz reference site. This suggests that either this species is sensitive to something other than ammonia (e.g., grain size).

Table 9: 10-Day Solid Phase Test for Composite Sediment Samples from Bulls Head Reach

Composite	10-day R. abronius Mean (± SD) Percent Survival (n = 20)	10-day R. abronius Mean (± SD) Percent Effective Survival (n = 20)	10-day E. estuarius Mean (± SD) Percent Survival (n = 20)
BHR-A (upper)	94 ± 5	94 ± 5	94 ± 4
BHC-A (lower) [(a)]	94 ± 4	94 ± 4	81 ± 34 / 96 ± 3 [(f)]
BHC-B [(a)]	81 ± 9 [(b)]	77 ± 12 [(b)]	74 ± 7 [(b) (c)]
TB-C	97 ± 4	97 ± 4	98 ± 3
TB-D (upper)	97 ± 3	92 ± 6	95 ± 4
TB-D (lower)	91 ± 5	88 ± 10	94 ± 5
TB-E (upper)	94 ± 4	77 ± 10	97 ± 4
TB-E (lower) [(a)]	83 ± 8 [(b)]	77 ± 10 [(b)]	77 ± 18 [(b) (c)]
TB-E (lower)	12 ± 8 [(b) (c) (d) (e)]	11 ± 8 [(b) (c) (d) (e)]	68 ± 9 [(b) (c)]
Alcatraz RS	96 ± 4	94 ± 9	98 ± 3
Bay Farm RS	85 ± 7	85 ± 12	74 ± 13
Control	98 ± 12	98 ± 4	99 ± 2

Table 9: 10-Day Solid Phase Test for Composite Sediment Samples from Bulls Head Reach			
Composite	10-day R. abronius Mean (± SD) Percent Survival (n = 20)	10-day R. abronius Mean (± SD) Percent Effective Survival (n = 20)	10-day E. estuarius Mean (± SD) Percent Survival (n = 20)
Notes: (a) Samples were manipulated to reduce porewater ammonia before adding animals. (b) Survival significantly lower than lower than Alcatraz reference site. (c) Survival > 20 percent lower than Alcatraz reference site. (d) Survival significantly lower than Bay Farm reference site. (e) Survival > 20 percent lower than Bay Farm reference site.			

Forty-eight-hour suspended-particulate-phase tests were conducted with larvae of the bivalve *Mytilus galloprovincialis*. Larvae were exposed to five concentrations of ten treatments (eight composites, two reference); results are presented in Table 10. A statistically significant difference is survival between the 0 percent and 100 percent SPP was observed in composite TB-E lower. The LC50 for composite TB-E was estimated to be 85.3 percent SPP. All other treatments had LC50s greater than 100 percent SPP.

EC50s, which is considered a more sensitive indicator of water column toxicity, are based on the normal development of larvae. A statistically significant difference in mean normal development between the 0 and 100 percent SPP was calculated for six of the eight composite samples. The other four compositions (TB-C, BHC-A Upper, and the two reference sites) showed no significant difference in normal development between the 0 and 100 percent SPP, thus EC50s are considered > than 100 percent SPP. EC50s for the other six composites ranged between 18.8 and 22.4 percent SPP.

The level of response for both survival and normal development corresponded well with measured ammonia levels in the SPP treatments. The highest ammonia concentration (23.7 mg/l total ammonia) was measured in SPP from composite TB-E lower, the treatment to which larvae were the most sensitive. It is likely that the toxicity and reduced development was due to ammonia, rather than suspended sediment contaminants. Many advances were made regarding reducing ammonia input from sources in the San Francisco Bay area and tributaries. However, confirmatory sediment sampling and analyses during the pre-construction, engineering, and design phase will provide further investigation as to the source of toxicity.

Table 4: Results of the 48-Hour Suspended-Particulate-Phase Test for Bulls Head Reach Composite Samples					
Composite	Concentration (percent SPP)	48-hour *M. Galloprovinciatis*		Normal Development *M. Galloprovinciatis*	
		Larval Survival		Embryo Development	
		Mean Percent Surviving	96-hour LC50 (percent SPP)	Proportion Normal Development	EC50 (percent SPP)
BHR-A (upper)	0 (control)	94	>100	0.91	22.5
	1	92		0.85	
	10	98		0.94	
	50	94		0.89	
	100	97		0.00	
BHC-A (lower)	0 (control)	100	>100	1.00	22.3
	1	98		0.97	
	10	100		1.00	
	50	90		0.00	
	100	84		0.00	
BHC-B	0 (control)	100	>100	1.00	22.4
	1	100		1.00	
	10	100		1.00	
	50	100		0.00	
	100	63		0.00	
TB-C	0 (control)	97	>100	0.96	>100
	1	94		0.93	
	10	98		0.97	
	50	99		0.98	
	100	100		1.00	
TB-D (upper)	0 (control)	96	>100	0.92	22.3
	1	99		0.96	
	10	94		0.90	
	50	97		0.03	
	100	96		0.00	
TB-D (lower)	0 (control)	97	>100	0.97	20.0
	1	98		0.97	
	10	93		0.92	
	50	94		0.00	
	100	86		0.00	
TB-E (upper)	0 (control)	98	>100	0.97	40.7
	1	98		0.98	
	10	100		0.99	
	50	91		0.50	
	100	85		0.00	

Table 4: Results of the 48-Hour Suspended-Particulate-Phase Test for Bulls Head Reach Composite Samples					
Composite	Concentration (percent SPP)	48-hour *M. Galloprovinciatis*		Normal Development *M. Galloprovinciatis*	
		Larval Survival		Embryo Development	
		Mean Percent Surviving	96-hour LC50 (percent SPP)	Proportion Normal Development	EC50 (percent SPP)
TB-E (lower)	0 (control)	99	>100	0.98	18.8
	1	98		0.97	
	10	97		0.89	
	50	92		0.00	
	100	37		0.00	
Alcatraz RS	0 (control)	99	>100	0.99	>100
	1	96		0.95	
	10	99		0.99	
	50	99		0.99	
	100	98		0.96	
Bay Farm RS Control	0 (control)	95	>100	0.92	>100
	1	98		0.96	
	10	93		0.88	
	50	94		0.88	
	100	97		0.95	

3.4 Bull's Head Reach Wetland Creation Suitability

The 2009 sampling at Suisun (Suisun Bay Channel_New York Slough SAR 2009 Jul.pdf) included some overdepth sampling at Bulls head Shoal (37 to 39 ft). The samples were not analyzed for total solids content of metals. Instead, they were tested for elutriate concentrations which are reported in ug/L (dissolved metals in solution) instead of mg/Kg for comparison with drinking water standards, leaching standards, and RWQCB standards to determine suitability for inwater placement and upland placement instead of wetland placement.

Based on the 2009 sampling results, it appears the material would be acceptable for inwater placement and upland placement. However, the 1990 upper samples in Suisun Bay showed chromium concentrations that exceeded 250 mg/Kg and hence the wetland placement criteria. This suggests that sediment from 38-40 feet may be suitable for cover material on the beneficial reuse placement sites, whereas sediment depths below that may only be suitable for foundation material. The Bulls Head Reach portion of the project would generate 0.28 acres of material, which could easily be accommodated as foundation material over the 160 total acres of wetlands created by this project. Confirmatory testing will occur prior to placement.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
Mammals						
Saltmarsh harvest mouse [(a)]	Reihrodontomys raveiventris	FE, SE	No	na	Endemic to salt and brackish marshes of the San Francisco Bay area. They predominately utilize areas of dense pickleweed stands; however, to a lesser extent, they are known to forage and find shelter in saltgrass and other vegetated areas found in salt and brackish marshes.	ESA consultation for upland beneficial use sites is already completed.
San Joaquin kit fox	Vulpes macrotis mutica	FE, ST	No	na	San Joaquin kit fox requires dens for shelter, protection, and reproduction. It prefers annual grasslands with scrub and shrub vegetation. Its current range southern and western San Joaquin Valley and foothills (USFWS 1998).	No effect. The proposed project is outside of kit fox range.
Southern sea otter [(b)]	Enhydra lutris neresis	FT	No	na	The southern sea otter utilizes nearshore habitat ranging from San Mateo County to Santa Barbara County and San Nicolas Island, Ventura County (USFWS 2015).	No effect. The proposed project is outside of southern sea otter range.
Birds						
California clapper rail [(a)]	Rallus longirostris obsoletus	FE, SE	No	na	Prefers intertidal zones and sloughs of salt and brackish marshes dominated by pickleweed, Pacific cord grass, gumplant, saltgrass (*Distichlis spicta*), jaumea and adjacent upland refugia.	ESA consultation for upland beneficial use sites is already completed.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
California least tern [a]	Sterna antillarum browni	FE, SE	No	na	California least tern inhabit coastal areas from the San Francisco Bay area south to Baja, California. They nest on open beach free of vegetation and migrate south in the fall (USFWS 2006). In the Bay Area, the LTMS has developed work windows from the Berkeley Marina to south of the Highway Bridge; however, these areas our outside of the project area.	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Marbled murrelet	Brachyramphus marmoratus	FT, SE	Yes	No	Marbled murrelet spend a majority of their lives foraging in near-shore marine environments. Breeding occurs in near-shore environments in large, old-growth forests with limited edge habitat and fragmentation, and close proximity to the marine environment (76 FR 61599).	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Northern spotted owl	Strix occidentalis caurina	FT, ST	Yes	No	The northern spotted owl inhabits structurally complex older-growth forests, with large trees and snags for nesting. This species nests, roosts and forages in forested habitat with high canopy cover and multilayered understory with limited fragmentation (77 FR 71,885).	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Short-tailed albatross	Phoebastria albatrus	FE	No	na	Albatross nesting occurs on flat or sloped coastal area, with sparse or full vegetation, on isolated windswept offshore islands. They utilize marine	No effect.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
					and coastal waters adjacent to nesting areas (65 FR 46,645) Vol. 65, No. 147 / Monday, July 31, 2000)	Habitat not present in the action area; therefore, individuals will not be present.
Western snowy plover	Charadrius alexandrius nivosus	FT	Yes	No	Western snowy plover breeds above the high tide line on flat, sandy substrates on coastal beaches, sand spits, dunes, beaches at creeks and river mouths adjacent to coastal beaches, and salt pans at lagoons and estuaries. Coastal populations can either be year-round or migrants, with migrants arriving in California as early as January, but typically nesting occurs between early March and mid-June. Migrating plovers typically migrate either north or south during the winter between June and October (USFWS 2007).	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Western yellow-billed cuckoo	Coccyzuz americanus	FT, SE	Proposed	No	Yellow-billed cuckoos are migratory birds that breed in large, relatively un-fragmented blocks of riparian woodland habitat, primarily consisting of cottonwoods and willows with dense understory. Nesting pairs typically require about 25 acres or more of riparian habitat. It is believed that the Sacramento Valley is the northern limit of this species breeding range (66 FR 38,611).	No effect. Suitable habitat not present in the action area.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
Reptiles						
Alameda whipsnake	Masticophis lateralis euryxanthus	FT, ST	Yes	No	Alameda whipsnake typically inhabit chaparral and coastal sage scrub communities. Rock outcrops, rock crevices and mammal burrows are important habitat features. Its current range includes the inner coast range of California, primarily in most of them in Contra Costa and Alameda counties.	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Giant garter snake	Thamophis gigas	FT, ST	No	N/A	The giant garter snake is endemic to wetlands of the Sacramento-San Joaquin Valley. Specifically, they inhabit marshes, sloughs, ponds, small lakes, low gradient streams, and other waterways (e.g., drainage ditches, rice fields, agricultural canals; 58 FR 54053).	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Green sea turtle	Chelonia mydas	FT	No	N/A	Habitat includes waters off the coast of California.	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Amphibians						
California red-legged frog	Rana draytonii	FT	Yes	No	California red-legged frogs inhabit aquatic, riparian, and upland habitat for forage, shelter,	No effect.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
					cover, and non-dispersal movements (75 FR 12,816).	Habitat not present in the action area; therefore, individuals will not be present.
California tiger salamander	Ambystoma californiense	FT, CH, ST	Yes	No	They inhabit subterranean refugia, especially burrows of ground squirrels, and breed in shallow wetlands or ponds. Migrations between breeding grounds and upland habitats generally occur at night during periods of sustained rainfall. During breeding migrations, individuals can be found under rocks, logs, or other objects (69 FR 47,212).	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Fishes						
Delta smelt	Hypomesus transpacificus	FT, SE	Yes	Yes	Inhabits estuarine and delta waters	Likely to adversely affect; see additional analysis in narrative below
Tidewater goby	Eucyclogobius newberryi	FE	Yes	No	This species is considered extirpated from San Francisco Bay.	No effect.
Longfin smelt	Spirinchus thaleichthys	FC, SE	No	N/A		Likely to adversely affect; see additional analysis in narrative below
Insects						

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
Bay checkerspot butterfly	Euphydryas editha bayensis	FT	Yes	No	Habitat not present in the action area.	No effect.
Callippee silverspot butterfly	Speyeria callippe	FE	Proposed	No	Habitat not present in the action area.	No effect.
Delta green ground beetle	Elaphurs viridis	FT	Yes	No	Habitat not present in the action area.	No effect.
Lange's metalmark butterfly	Apodemia mormo langei	FE	Proposed	No	Habitat not present in the action area.	No effect.
Mission blue butterfly	Icaricia icarioides missionensis	FE	Proposed	No	Habitat not present in the action area.	No effect.
San Bruno elfin butterfly	Callophrys mossii bayensis	FE	Proposed	No	Habitat not present in the action area.	No effect.
Valley elderberry longhorn beetle	Desmocerus californicus dimorphus	FT	Yes	No	Valley elderberry longhorn beetle is associated with the valley elderberry (*Sambucus*) bush during its entire life cycle; the beetles feed on *Sambucus* leaves and use the plant stems that are	No effect. Habitat not present in the action area; therefore, individuals will not be present.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	**Scientific Name**	**Status**	**Designated Critical Habitat**	**Critical Habitat in the Action Area**	**Habitat Requirements**	**Effects Determination**
					greater than or equal to one inch in diameter for larval development and pupation.	
Crustaceans						
California freshwater shrimp	Syncaris pacifica	FE, SE	No	N/A	Habitat not present in the action area.	No effect.
Conservancy fairy shrimp	Branchinecta conservatio	FE	Yes	No	Habitat not present in the action area.	No effect.
Vernal pool fairy shrimp	Branchinecta lynchi	FT	Yes	No	Habitat not present in the action area.	No effect.
Vernal pool tadpole shrimp	Lepidurus packardi	FE	Yes	No	Habitat not present in the action area.	No effect.
Plants						
Antioch Dunes evening-primrose	Oenothera deltoides ssp. howellii	FE	Yes	No	Habitat not present in the action area.	No effect.
Colusa grass	Neostapfia colusana	FT	Yes	No	Habitat not present in the action area.	No effect.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
Contra Costa Goldfields	Lasthenia conjugens	FE	Yes	No	Habitat not present in the action area.	No effect.
Contra Costa Wallflower	Erysimum capitatum var. angustatum	FE	Yes	No	Habitat not present in the action area.	No effect.
Franciscan Manzanita	Arctostaphylos franciscana	FE	Yes	No	Habitat not present in the action area.	No effect.
Keck's Checker-mallow	Sidalcea keckii	FE	Yes	No	Habitat not present in the action area.	No effect.
Marin Dwarf-flax	Hesperolinon congestum	FT	No	N/A	Habitat not present in the action area.	No effect.
Marsh Sandwort	Arenaria paludicola	FE	No	N/A	Habitat not present in the action area.	No effect.
Presidio Clarkia	Clarkia franciscana	FE	No	N/A	Habitat not present in the action area.	No effect.
Presidio Manzanita	Arctostaphylos hookeri var. ravenii	FE	No	N/A	Habitat not present in the action area.	No effect.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
San Francisco Lessingia	Lessingia germanorum	FE	No	N/A	Habitat not present in the action area.	No effect.
Showy Indian Clover	Trifolium amoenum	FE	No	N/A	Habitat not present in the action area.	No effect.
Soft Bird's-beak	Cordylanthus mollis ssp. mollis	FE	No	N/A	Habitat not present in the action area.	No effect.
Tiburon Jewelflower	Streptanthus niger	FE	No	N/A	Habitat not present in the action area.	No effect.
Tiburon Mariposa Lily	Calochortus tiburonensis	FT	No	N/A	Habitat not present in the action area.	No effect.
Tiburon Paintbrush	Castilleja affinis ssp. neglecta	FE	No	N/A	Habitat not present in the action area.	No effect.
White-rayed Pentachaeta	Pentachaeta bellidiflora	FE	No	N/A	Habitat not present in the action area.	No effect.

Appendix C: Special Status Species and Critical Habitat Included on the USFWS Official Species List (November 27, 2017)						
Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination

FT: Federal threatened

FE: Federal endangered

FC: Federal candidate

SE: State endangered

ST: State threatened

(a) Species may be present in the upland beneficial use sites. Placing dredged material at these sites may affect, and is likely to adversely affect these species, should individuals stray from protected areas into dredged material placement cells. However, the projects have already undergone ESA consultation and have biological opinions and incidental take statements. Therefore, this project does not analyze the potential impacts of placing material at the permitted upland beneficial sites.

(b) This species is also protected under the Marine Mammal Protection Act.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay Delta Fish and Wildlife Office
650 Capitol Mall 8th floor 8-300
Sacramento, California 95814

In Reply Refer to:
08-FBDT00-
2019-F-0202

MAY 21 2019

Angela E. Dunn
Chief, Environmental Branch
U. S. Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, FL 95814

Subject: Letter of non-concurrence with not likely to adversely affect determination and initiation of formal consultation for the San Francisco Bay to Stockton Navigation Improvement Project

Dear Ms. Dunn:

We are writing in response to your May 10, 2019, letter requesting consultation under the Endangered Species Act for the San Francisco Bay to Stockton Navigation Improvement (project). Your letter with supportive materials (Biological Assessment (BA) and draft General Reevaluation Report and Environmental Impact Statement, both dated April 2019) was received in our office on May 9, 2019. According to your letter, the project includes deepening the Pinole Shoal Channel and Bulls Head Reach sections of the J. F. Baldwin ship channel to -38 feet mean lower low water (MLLW), dredging a 2,600-foot-long sediment trap in the Bulls Head Reach to -42 feet MLLW, transport and placement of 1.6 million cubic yards of dredged material at two permitted beneficial reuse sites for the purpose of habitat restoration (Cullinan Ranch and Montezuma Wetlands), and leveling of a small rock outcrop to the west of the Pinole Shoal Channel to -43 feet MLLW. The project is expected to take about 4.6 months to complete. The Corps of Engineers (Corps) has determined that the project may affect but is not likely to adversely affect the listed delta smelt (*Hypomesus transpacificus*) (smelt) and its critical habitat, and has requested the Fish and Wildlife Service's (Service) concurrence with that finding.

Based on our initial review, the Service does not concur with the Corps' finding of not likely to adversely affect the smelt and its critical habitat. The BA (p. 29, Table 2) estimates a 0.17 kilometer eastward shift in X2 (the position of the 2 practical salinity unit near the bed isohaline) with the project in a critically dry year. The quantity and quality of the low salinity zone (LSZ), the region of habitat used by smelt, varies with the position of X2, and could be adversely affected, albeit modestly so, by this eastward shift. We also examined a salinity modeling report which the Corps provided at the same time as the BA (San Francisco Bay to Stockton Navigation Improvement Project, Hydrodynamic and Salinity Intrusion Modeling Report, prepared by Anchor QEA, April 2019; electronic mail received May 10, 2019, from Elizabeth Campbell, San

Francisco District). That salinity modeling report (p. 168, Table 701; p. 171, Figure 7.2-4) indicates a monthly average reduction in the LSZ on the order of -200 to -290 acres, slightly more than 1% of the total, in February to May of a critical water year. Such critical years have occurred about 14 times in the last century. While it may be true that it would not be possible to measure this effect in the field, it can be evaluated with reasonable accuracy by modeling as was done in this case, and is of a size, frequency, and scale which could result in take. Therefore, a finding of not likely to adversely affect is not appropriate in this case and formal consultation is necessary. In that regard, we find that the materials provided in your letter are sufficient to initiate formal consultation. Accordingly, we anticipate providing a Biological Opinion within 135 days of receipt of your May 10, 2019, letter.

If you have questions on this response, please contact Steven Schoenberg of my staff at (916) 930-5672, or at Steven_Schoenberg@fws.gov.

Sincerely,

For
Kaylee Allen
Field Supervisor

cc:
Stacie Auvenshine, Corps of Engineers, Jacksonville, Florida
Pam Castens, Corps of Engineers, Wilmington, North Carolina
Elizabeth Campbell, Corps, San Francisco, California

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay Delta Fish and Wildlife Office
650 Capitol Mall 8th floor 8-300
Sacramento, California 95814

In Reply Refer to:
08-FBDT00-
2019-CPA-0002

FEB 28 2019

Eric Bush
Chief, Planning and Policy
Director, Deep Draft Navigation Planning Center of Expertise
U.S. Army Corps of Engineers, South Atlantic Division
60 Forsyth Street SW
Atlanta, GA 30303

Thomas Kendall
Chief of Planning
U.S. Army Corps of Engineers
San Francisco District
450 Golden Gate Avenue, 4th Floor
San Francisco, CA 94102

Dear Sirs:

We have enclosed our draft Fish and Wildlife Coordination Act (FWCA) report on the U.S. Army Corps of Engineers' (Corps) proposed San Francisco Bay to Stockton Navigation Improvement Project. Please provide any comments or concurrence with this report, or otherwise indicate that you will have no comment, by April 30, 2019.

If you have questions on this draft report, please contact Steven Schoenberg of my staff at (916) 930-5672, or at Steven_Schoenberg@fws.gov.

Sincerely,

for Kaylee Allen
Field Supervisor

Enclosure

cc:
Stacie Auvenshine, Corps of Engineers, Jacksonville, Florida

Elizabeth Campbell, Corps of Engineers, San Francisco, California
Pam Castens, Corps of Engineers, Wilmington, North Carolina
David Doak, Corps of Engineers, San Francisco, California
Brian Ross, EPA, San Francisco, California
Sara Azat. NOAA Fisheries, Santa Rosa, California
Becky Ota, California Department of Fish and Wildlife, Belmont, California
Michael MacWilliams, Anchor QEA, San Francisco, California
Ryan Hernandez, Contra Costa County Water District, Martinez, California

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

DRAFT FISH AND WILDLIFE COORDINATION ACT REPORT FOR THE SAN FRANCISCO BAY TO STOCKTON NAVIGATION IMPROVEMENT PROJECT

PREPARED BY:

Steven Schoenberg, Senior Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
Habitat Conservation Division
Bay Delta Fish and Wildlife Office
Sacramento, California

PREPARED FOR

U.S. Army Corps of Engineers
Wilmington District
Wilmington, North Carolina

February 2019

SUMMARY

The Corps of Engineer's preferred alternative for the San Francisco Bay to Stockton Navigation Improvement Project involves deepening the Pinole Shoal, Suisun Bay, and Bulls Head channels to -38 feet below Mean Lower Low Water (MLLW) to improve access by tankers to oil refineries, and conducting advance maintenance dredging in a sediment trap area of the Bulls Head channel to -42 feet MLLW. The 1.72 million cubic yards (mcy) of dredged material from project construction would be beneficially used for tidal habitat restoration at two permitted sites, Cullinan Ranch (1.45 mcy) and Montezuma Wetlands (0.28 mcy). Project construction would cause temporary impacts to about 429 acres of deep subtidal benthic habitat. Due to changes in circulation patterns associated with this increased channel depth, the project is predicted to result in an annual average eastward change in the position of the 2 practical salinity units isohaline near the bed, or X2, of 0.17 and 0.23 km during critical dry and wet years, respectively, for portions of the year in which X2 > 64 km. This could result in a modest reduction in the range of the low salinity zone considered important for production and concentration of food organisms that support native fishes, including the listed delta smelt. We conclude that this potential adverse effect on X2 is minimized, while the indirect beneficial effect of accelerating tidal wetland restoration is significant. Accordingly, we recommend the project proceed as designed.

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INTRODUCTION

This document represents the United States Fish and Wildlife Service's (Service) Fish and Wildlife Coordination Act (FWCA) report on the U.S. Army Corps of Engineer's (Corps) San Francisco Bay to Stockton Navigation Improvement Project (project). The project study area is within part of the San Francisco Bay to Stockton Ship Channel, also known as the J. F. Baldwin Ship Channel, which spans a distance of about 75 miles from outside the Golden Gate to the Port of Stockton. The ship channel is intended to allow the access and efficient transport of goods by deep draft vessels. It has been partially constructed in increments or phases from 1965 - 1986. Phase III of the project as it was originally designed has an authorized depth of 45 feet below MLLW, and would have included dredging in the West Richmond, Pinole Shoal, and Suisun Bay Channels, and associated manuevering areas. Increasing the channel depth to this extent has previously raised concerns about salinity intrusion which may affect water quality and certain ecological processes in the estuary. The currently proposed project involves dredging to -38 feet MLLW as its Tentatively Selected Plan (TSP), with additional dredging of a sediment trap, and maximum beneficial re-use of dredged material for tidal restoration (Figure 1). This shallower depth limits the overall volume and spatial extent of dredging to portions of the Pinole Shoal and Bulls Head Reach, because the water of the West Richmond Channel is naturally at least this deep, and also reduces environmental concerns about salinity intrusion. The proposed work would still be sufficient to improve access and efficiency by tankers which service a number of oil refineries in the vicinity of the Carquinez Strait.

Figure 1. Study area and tentatively selected plan element locations for the San Francisco Bay to Stockton Navigation Improvement Project.

Previous coordination activities for this ship channel involved various FWCA reports or Planning Aid Letters on the prior designs of the project, dredging and dredged material disposal impacts, or updates to the project (1963-1986). For the last 20 years or so, dredged material from channel or harbor projects has been increasingly used beneficially, often to accelerate habitat restoration by raising the elevation of subsided diked baylands and opening them to tidal action. A number of restoration sites that involved accepting dredged material were evaluated by the Service in the 1990s as a part of other Corps projects, such as the Oakland Harbor, Richmond Harbor, and J.F. Baldwin phase III ship channel projects, and more recently for the Corps' South San Francisco Bay Shoreline Study, Redwood City Harbor, and Central Basin CAP 107 Navigation Improvement projects. Our earlier FWCA reports on these projects often included some level of quantification of the benefits of such beneficial re-use for habitat restoration, such as with Habitat Evaluation Procedures accounting models, or the relationship between the volume dredged and the habitat restored. The most recent FWCA report on the channels that are part of the currently proposed project was our 1997 revised draft FWCA report on the phase III channels, in which the Corps examined needs for a ship channel and an alternative involving an oil pipeline and associated facilities for the pipeline (Service 1997). The most recent coordination activities for the project have included regular conference calls with the Corps to discuss information needs and progress on this report, and attendance at a workshop in December 2018 with other Federal agencies and local interests. Information used in the preparation of this report included preliminary project descriptions, bathymetry, draft sections of environmental documents, discussion with experts, and salinity modeling reports.

DREDGING ALTERNATIVES

The Corps has retained 2 alternatives for evaluation in addition to the no-action alternative: (1) deepening to -37 feet MLLW; and (2) deepening to -38 feet MLLW. Both action alternatives would include beneficial use of dredged material at existing permitted sites, and a sediment trap at the Bulls Head Reach. Under the no-action alternative, no deepening of any channels would occur.

The -37-foot MLLW alternative involves deepening the Pinole Shoal, Suisun Bay, and Bulls head channels to that depth. A portion of the Bulls Head Reach would be deepened to -41 feet MLLW as a sediment trap. Dimensions and disposal sites would be the same as the -38-foot MLLW alternative, described in detail below. Dredging would be done in an area of 200 acres (ac) and generate 0.86 million cubic yards (mcy) of dredged material, assuming allowances for 2 feet of overdepth are used.

The -38-foot MLLW alternative is the TSP and involves deepening the same channels to -38 feet MLLW, and the sediment trap area to -42 feet MLLW. Dredging would be done over a larger area of 429 ac, and generate 1.72 mcy of dredged material, assuming 2 feet of overdepth. Dredging would be accomplished with one or more mechanical clamshell dredges, except for a small rock obstruction in the Pinole Shoal - about 40 cubic yards - that will require a pneumatic jackhammer to remove. Some of the work in the Pinole Shoal Channel may be outside of the June 1 through November 30 work window for that reach to protect listed anadromous fish but would be in compliance with terms and conditions of the 2015 Long Term Management Strategy Biological Opinion. Work in the Bulls Head Reach would be within the August 1 through November 30 work window for that reach to avoid impacts to that reach. Dredged materials would be placed in scows and transported to two permitted wetland restoration sites, Cullinan Ranch and Montezuma Wetlands. The material dredged from Pinole Shoal Channel, about 1.44

mcy, would be placed at Cullinan Ranch and the 0.28 mcy dredged from the Bulls Head Reach would be placed at Montezuma Wetlands. It is expected the project would take from 8 months to 2 years to complete, depending on the number and size of scows used, and would commence in the year 2023. Annual maintenance dredging would continue at about a 20% increase in volume compared to existing conditions.

DREDGED MATERIAL PLACEMENT SITES

Cullinan Ranch: Cullinan Ranch is another tidal restoration project site on about 1,500 ac located on the north side of San Pablo Bay just west of the Napa River between State Highway 37 and Dutchman Slough. It is also a subsided former diked bayland intended to be restored to tidal marsh. It is within the San Pablo Bay National Wildlife Refuge and a restoration plan involving restoring it to tidal action which would have general tidal ecosystem benefits in a location that would specifically assist the recovery of the Salt Marsh Harvest Mouse and Ridgway's Rail. The restoration project is permitted and has a capacity to receive at least 3 mcy of dredged material on the easternmost 290 ac of the site, which have been isolated from the rest of the site and subdivided into 5 cells for placement of material when it is available. The current plan is to complete dredged material import before opening this area to tidal action. To date, about 0.86 mcy of material has been placed and filled 2 of the 5 cells. Both cover and non-cover quality sediment can be accepted at this site. Travel distances are 5-16 miles and 11-14 miles from the Pinole Shoal and Bulls Head Channels, respectively. Clamshell dredged material would be barged to a land-based offloader and then pumped onto the site.

Montezuma Wetlands: This site is a privately owned, permitted, and operational wetland restoration project site located on about 2,400 ac of moderately subsided, diked baylands at the eastern edge of Suisun Marsh. The location of this project is such that it would provide benefits to native fishes in the low salinity region of the delta, including longfin smelt and the federally-listed Delta smelt. Dredged material from various projects is transported and used here to raise elevations of the site so it can be opened up to tidal action to restore tidal marshlands, and the owner charges for receipt of this material. The site can accept both wetland cover ("non-foundation") and non-cover ("foundation") quality materials. All offloading and pump facilities are currently in place and fully operational, sufficient to accept full-sized barges (~10,000 cubic yard capacity). The site is divided into four phases, of which the first phase has been under construction since late 2003, is nearly filled, and is expected to be complete and breached in 2019. When complete, phase I will have received roughly 8 mcy of dredged material and restored about 600+ ac of all wetland habitat. Phase II, which could receive material from the proposed project, has an approximate capacity to receive about 4.5 mcy. When complete, phase II will restore about 400 ac of tidal wetland. The Montezuma Wetlands site is 24-34 and 14-17 miles, respectively, from the Pinole Shoal and Bulls Head Channels. Material would be transported by scow to an offloader, which would pump the material onto the site.

BIOLOGICAL RESOURCES

Dredging Locations (Pinole Shoal, Suisun Bay, and Bulls Head Channels): The shipping channels are within an expanse of relatively deep subtidal waters that are all subject to wind and tidal energy and vary somewhat in biological resources with location and hydrologic conditions.

The bottom is mostly sand, with some mud and cobble. Depths vary with location with a range of -30 to -50 feet MLLW. The surrounding lands include developed areas, uplands and hills, as well as some significant seasonal and tidal wetlands, most notably tidal marsh along the northern margin of San Pablo Bay including the National Wildlife Refuge there, and non-tidal and tidal marshes in Suisun Marsh (along Suisun Bay). These wetlands provide important habitat for wildlife, including resident marsh birds and mammals as well as migratory waterfowl and shorebirds.

The biological resources vary with habitat type and location. The dredging location in the Pinole Shoal Channel, in San Pablo Bay, is west and more saline, whereas the dredging location to the east in Suisan Bay and Bulls Head Channels, is less saline. The fish community in San Pablo Bay would include a number of saltwater game species like sturgeon, salmon, halibut and striped bass, as well as other fishes like Pacific herring, English sole, jacksmelt, topsmelt, and others. The brackish waters of Suisun Bay and farther to the east have increasing numbers of freshwater species like silversides, bass, sunfish, delta smelt, juvenile salmon, sturgeon, and bass, and longfin smelt. Invertebrate fauna include planktonic copepods, rotifers, and cladocerans, in the water column, and various worms, crustaceans, and molluscs within or near the benthic interface, appropriate to the local salinity.

At least a portion of the dredging to the east would occur in (or affect, via salinity intrusion due to the channel deepening) open waters with an increased concentration of phytoplankton and associated food organisms, known as the “entrapment zone” or “low salinity zone” (LSZ). The location of the LSZ is typically cited as the distance from the Golden Gate, in km, of the daily averaged near bottom 2 practical salinity unit (psu) isohaline, commonly known as “X2”, because it corresponds to the estuarine turbidity maximum and peak abundance of estuarine organisms (Jassby et al. 1995). The full aerial extent of the LSZ encompasses a region of 0.5-6 psu. This is a zone where fresh and salt waters meet, and particles are concentrated by estuarine circulation patterns that are sensitive to depth, topography, and wind mixing. This region has the most productivity and benefit to resources when X2 is positioned in the shallow waters at the upstream end of Suisun Bay. This productivity and the position of X2 are affected by net delta outflow, becoming less productive and less valuable to fishes when it is moved east into confined channels at times of low net outflow.

The Sacramento San Joaquin Delta through which the ship channel passes, including the LSZ and interconnected marshlands, is considered an extremely important area for natural resources. Not only does it support several rare, endemic species, such as the Federally-listed delta smelt and State-listed longfin smelt, but it is a migratory corridor and juvenile rearing area for important salmon, steelhead, sturgeon, and striped bass. The Delta is affected by water operations that regulate freshwater flows, and other factors such as non-native fish and invertebrate species, contaminants, sea-level rise, and other influences.

Cullinan Ranch: This site, located on the north shore of San Pablo Bay just west of the Napa River, is a former diked bayland, subsided about 6 feet, and until recently had been farmed for oats and hay for the last century. Sometime after it was acquired by the Service in 1991, the pumping used to keep it in this agricultural state ceased, and it became a complex of non-tidal seasonal and perennial wetlands with some open water and a small amount of upland. This type of habitat mosaic is often used by wading birds. In the last few years there has been considerable disturbance of this site to develop the elements needed to open it up to tidal action. In 2015, most of the site was opened to tidal action, and it is now primarily open water. Post breach surveys show the site is used by many species of waterfowl during fall and spring migration periods, particularly dabbling and diving ducks (Washburn 2018). However, the 280 ac of the site reserved for dredged material placement remains as a combination fallow fields, which provide some residual seasonal and some perennial wetlands value (unfilled cells), together with the areas disturbed by material placement with low value (filled cells). This area has received about 860,000 cy of dredged material thus far, and has about 2 mcy capacity remaining. This capacity may be revised upwards to accelerate revegetation and allow for sea level rise.

Montezuma Wetlands: This site is diked and subsided up to 11 feet. It was formerly characterized as grazing land with some bare areas and wetlands in the form of ditches, saline basins, and seasonally flooded areas (Levine-Fricke 1995). Currently, phase I of the Montezuma Wetlands project is still in development and receiving dredged materials. The rest of the site not yet in development. Within these uplands, seasonally flooded areas probably receive some winter use by wading birds and waterfowl during periods of high precipitation and extreme tides. There is also pickleweed and saltgrass in some areas. Pre-breach surveys have been ongoing from 2000 to the present in accordance with a monitoring plan for the project as part of its permits, which is overseen and updated as necessary by a technical review team (Acta 2018). In phase I, there is considerable interim use during dredged material placement by shorebirds and ducks when ponded water is present, as well as by the listed California least tern. Salt marsh harvest mice have been regularly detected in the pickleweed areas of phases that have not yet been constructed. Vernal pool crustaceans, both listed and common, have been noted in vernal pools created as part of the project. Otherwise, wildlife use of the area would be by common upland species.

MITIGATION POLICY AND COVER TYPES

The Service's Mitigation Policy (Policy) (FR 46:15 January 23, 1981) provides general guidance in making recommendations to conserve fish and wildlife resources. Under the Policy, resources are assigned to one of four Resource Categories, with a mitigation goal consistent with the values provided to fish and wildlife and the rarity of that habitat (cover-type). A mitigation goal is assigned ranging from "no loss of existing habitat value" (Resource Category 1) for the most valuable kinds of habitat to "minimize loss of habitat value" (Resource Category 4) for the less valuable and most common kinds of habitat. Application of the Policy involves designating cover-types which may be affected and assigning evaluation species based on the sensitivity of those species to the project action, their role in the ecosystem, or association with Service-wide resource management issues such as conservation of anadromous fish and migratory birds. We then state the Resource Category, the rationale for that selection, and the corresponding mitigation goal.

For this project area, we have designated seven basic cover-types within the project area and adjacent areas affected by the project. Due to differences in water depth and/or salinity in tidal and non-tidal ponds, there may be several more specific habitats within these cover-types, as noted below.

Open water (bay): This cover type is considered those waters within San Francisco Bay which are permanently inundated, deeper than MLLW and usually more than 18 feet below MLLW. Areas affected by the project include the waters in the channels to be dredged, the region of the low salinity zone affected by this deepening, and the sites of any sediment offloading facilities that might be needed, depending on the disposal/placement option selected. Pelagic plankton, fish, and macroinvertebrates are produced in these waters, which are prey organisms for some seabirds and waterfowl. An appropriate evaluation species would be juvenile fishes. Such open waters are relatively abundant in the planning area and are not expected to be lost or significantly degraded by the proposed action, although there may be some temporary effects of dredging and a small increment of permanent effect on salinity. The planning goal varies with location. Waters west of the Bulls Head Shoal are more abundant, deeper, and of moderate value to the evaluation species; these waters are designated Resource Category 4, with a mitigation planning goal to minimize loss of habitat value. Waters east of the Bulls Head Shoal include shallower areas (i.e., less than 10 feet deep) which would not be dredged but could be affected by salinity. These waters encompass a critical rearing area for juvenile and native fishes; as such, they are designated Resource Category 2, with a goal of no net loss of in-kind habitat value.

Subtidal benthic (bay): This cover type includes permanently inundated, unvegetated bottom substrate deeper than MLLW, such as the channels to be dredged, and any new sediment offloading facilities constructed in deep waters. This cover type supports food organisms like shrimp, benthic fish, and other macroinvertebrates. Bottom dwelling fishes such as sturgeon, flatfishes such as juvenile halibut, and rays, would be appropriate evaluation species. Most such habitat affected by the proposed project is already regularly dredged, although there may be some slightly shallower subtidal benthic habitat on the margin of the channels that would be deepened, and the frequency and/or extent of dredging may slightly increase beyond current levels. With a depth range of -26 to -41 feet MLLW, the areas designated for dredging are deeper than the 10-foot criterion used to assess shallow water habitat effects for species like the delta smelt. This cover type is also relatively abundant. Due to this abundance, regular disturbance, depth, and medium value to the evaluation species, this benthos is designated Resource Category 4, with a mitigation planning goal to minimize loss of habitat value.

Non-tidal pond waters: This cover-type includes permanently inundated, unvegetated waters separated from tidal action, and is represented by any ponds within Montezuma Wetlands or Cullinan Ranch which could receive dredged material from the proposed project. These ponds vary in depth, circulation, and water chemistry depending on management. They support some species of saltwater or freshwater fish, and benthic or pelagic macroinvertebrates that can provide forage. They may be used by waterfowl, or other bird groups, depending on salinity. For the lower salinity ponds, we would select a duck such as the northern shoveler as an evaluation species. For higher salinities, the American avocet would be an appropriate evaluation species. Non-tidal ponds are moderately abundant and are used for foraging and roosting by the evaluation species. We designate these as Resource Category 3, with a mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value.

Tidal emergent marsh: This cover-type includes areas which are vegetated, generally between Mean Higher High and Mean Low Water that are subject to unrestricted tidal inundation and drained by slightly deeper, unvegetated channels. For this project, it includes areas which could become vegetated in the future through placement of dredged material and exposure to tidal action at Montezuma Wetlands or Cullinan Ranch, or vegetated margins of sloughs which may be affected locally by offloading facilities and pipes needed to transport dredged material. Species composition varies with salinity and elevation with respect to mean tide level. It provides habitat for mammals including the listed salt marsh harvest mouse, tidal marsh birds such as the listed Ridgway's Rail, macroinvertebrates, and juvenile fishes. Marshes also produce and export organic matter that support the food web throughout estuaries and bays. Evaluation species would be a marsh specialist like the marsh wren. The unvegetated tidal channel component of tidal marsh is considered to be an important breeding and nursery area for fishes, and foraging area for shorebirds. Most historical tidal marsh in the Bay area has been lost due to industrial salt production or coastal development and fill. Due to this regional scarcity, importance to the ecosystem, and very high value to the evaluation species, we designate tidal emergent marsh as Resource Category 2, with a goal of no net loss of in-kind habitat value.

Mudflat: Mudflats are unvegetated tidal areas between Mean Low Water and MLLW that are exposed during low tide. A limited amount of mudflat could be locally disturbed at least temporarily by construction and operation of an offloader and/or pipeline needed to deliver sediment to Cullinan Ranch. Depending on initial elevation and subsequent revegetation rate, some expanses of mudflat could form initially at either Cullinan Ranch or Montezuma Wetlands. Mudflats produce diatoms, worms, and shellfish, which provide forage for numerous shorebirds, gulls, terns, and larger wading birds. During higher tide stages, fish enter the mudflats and forage. Shorebird species which specialize on exposed mud such as the western sandpiper would be an appropriate evaluation species. Although there has been some loss of mudflat due to development and fill, it remains moderately abundant in the Bay. Due to this abundance and high importance to the evaluation species, mudflat is designated Resource Category 2, with a goal of no net loss of in-kind habitat value.

Seasonal Wetland: Seasonal wetlands include low areas of Cullinan Ranch or Montezuma Wetlands that regularly pond during the winter. The more open wetlands can support vernal pool crustaceans, while the vegetated areas include some pickleweed and saltgrass known to support the listed salt marsh harvest mouse. An evaluation species would be a marsh specialist like the marsh wren. This particular cover-type is largely a consequence of historical diking, and is of low-to-moderate abundance and value to the evaluation species. Restoration actions would result in eventual replacement with tidal emergent marsh that is considered of greater value. Due to the moderate abundance and importance, relative to the restored cover-types, seasonal wetland is designated Resource Category 2, with a goal of no net loss of in-kind habitat value.

Upland: Upland in the project area occurs mostly as non-native annual grassland habitat on dike slopes surrounding several placement sites (Montezuma Wetlands, Cullinan Ranch). Limited portions could be temporarily affected by construction of offloading facilities or pipelines needed to deliver dredged material. Upland supports common small mammals and passerine birds, many of which are non-native. A native species like the California vole would be an appropriate evaluation species. A modest area of upland adjacent to tidal emergent marsh does have value as roosting habitat for birds during high tides, and as refugium for the listed Ridgway's rail and salt marsh harvest mouse during tidal flood events. Considering both the regional abundance as well as the importance of preserving some uplands near tidal habitats, we designate upland as Resource Category 4, with a mitigation goal to minimize loss of habitat value.

FUTURE WITHOUT THE PROJECT

Without the Project and with shipping channel depths remaining at -35 feet MLLW, petroleum product shipping volume would increase but would be shipped on an increased number of smaller draft vessels. Maintenance dredging would continue at about the same frequency and amounts as in the past. There could be a need for emergency dredging in the Bulls Head reach due to rapid shoaling in some locations. The dredging would result in temporary, localized impacts on the water column during dredge operations manifested by increased turbidity and some loss of benthic organisms within the removed materials, but fish would likely be displaced and not suffer increased mortality.

The placement sites at Cullinan Ranch and Montezuma Wetlands would continue to receive dredged materials when available from projects other than the proposed project.

The distribution and location of the low salinity zone and position of X2 would be variable and predominantly affected by water year type and operations that either release freshwater to or export it from the Delta.

FUTURE WITH THE PROJECT

With the Project and channel depths deepened to -38 feet MLLW, petroleum product shipping volume would also increase but would utilize a reduced number of trips by deeper draft vessels, and with fewer tidal restrictions. Maintenance dredging would continue at about the same frequency, but with a modest increase in the volume of material, and with less of a need for emergency dredging in the Bulls Head reach due to the sediment trap. The dredging activity would cause a somewhat more continuous localized disturbance of the benthic biotic community in the immediate vicinity of the dredge than just maintenance dredging alone. This could result in a temporary reduction in abundance of benthic organisms on the order of several months more or less. The effects on fish would likely be limited to displacement during operations although there may be some adverse effect on fish exposed to either turbidity plumes in the immediate vicinity of the dredge, or sound from the pneumatic jackhammer. Based on bathymetry, only deeper bay waters and benthos would be directly affected by the dredging, although some shallow waters could be indirectly affected by salinity changes related to the deepened channel.

Cullinan Ranch: Placing the proposed 1.44 mcy volume of dredged material here would be roughly sufficient to complete the needs for restoration of this site. This would modestly accelerate completion of the site in terms of dredged material needs by one or more seasons, based on the current rate of receipt of dredged material (860,000 cy since permitting in 2012). This site is located and designed to specificially benefit the listed salt marsh harvest mouse in the near term. Revegetation would likely begin immediately after breaching, and 5-6 seasons of tidal action is expected to provide the veneer of natural sediment needed to optimize high marsh establishment. About 90% of the site is designed for high marsh that would benefit the listed mouse and Ridgway's rail as well as other high marsh wildlife species, with the other 10% of the area as channels and low marsh providing values to fish and fish-eating wildlife. The current, upland and seasonal wetland habitat would be replaced by tidal marsh and channels. Wading birds may be displaced, however, the current value of the site is likely to be limited owing to recent earthwork in preparation of receipt of dredged material from other projects. Any displaced wading birds would likely relocate to nearby habitat just west of this location.

Montezuma Wetlands: Placement of the proposed 0.28 mcy volume of dredged material here would incrementally contribute to the 4.5 mcy total needed to fill phase II of this project, but would only nominally accelerate the rate of completion of this phase. This restoration would have relatively broad benefits, including to marsh wildlife such as salt marsh harvest mice, and native fish including delta smelt.

Water Quality: For the purposes of this report, we have limited our discussion to those conditions when X2 is greater than 64 kilometers east of the Golden Gate when there is a requirement for freshwater inflow to regulate its position. The effect of the project on X2 is estimated by Corps-provided predictions of a numerical model under representative conditions for a critical dry water year (2014) and a wet water year (2011) (MacWilliams 2018). This model predicts that, with the TSP, the position of X2 would be moved east 0.17 km on average during a critical dry year, with X2>64 from January to mid-December, and would be moved 0.23 km east during a wet water year, with X2>64 from late July through December. The numerical model predicts somewhat larger changes in X2 due to the project at other times of the modeled wet year of up to about 0.9 km when X2 is much farther west (40 km), but this is when the salinity gradient is pushed west into San Pablo Bay, and the Pinole Shoal Channel is stratified.

Changes in water quality due to the channel deepening that could adversely affect fisheries would generally be due to the eastward shift in X2 during the driest water years like the modeled 2014 year. The X2 range for the 2014 modeled year is roughly 70-90 km. The amount and quality of the LSZ change as X2 is shifted to the east, with reduced LSZ surface area and greater depth, together with reduced access by fish to optimum food/turbidity conditions, disconnection of the LSZ to adjacent marshes and sloughs, and greater exposure of small fish to predation in the deeper channels. This is a gross relationship more apparent for X2 changes on the order of several kilometers or more than for the small X2 change associated with deepening of the ship channel. Nevertheless, it is reasonable to conclude that that the eastward shift due to the ship channel deepening could result in a modest increment of loss of habitat quantity and quality (*see* Discussion, below).

DISCUSSION

For the purposes of this report, we assume only the no-project and Corps-preferred TSP deepening alternatives are under consideration. Deepening will result in reduced shipping traffic because refineries can use larger ships with less of a need for lightering. The improved safety from the deepened channel, and the fewer ships, will lessen the risk of potential oil spills and consequent effects on fish and wildlife resources. The extent of dredging disturbance of benthic habitat needed to deepen the channel to 38 feet is a relatively small 429 ac. This will occur over one season, mostly in previously-disturbed portions of the channel. Benthic fauna will be temporarily reduced where dredging is recent, but is expected to recover in a matter of months. Placement of the dredged material from the project at two permitted restoration sites, Cullinan Ranch and Montezuma Wetlands, will contribute to meeting the habitat benefit goals of these sites. Prior testing done in the 1990s showed the material to be predominantly sandy and meeting all or nearly all State criteria for use as cover material in wetland restoration[1]. The quantity of benefit can be expressed in several ways - the benefit associated with the dredged material volume from the project as a fraction of the total volume needed for restoration, or the benefit associated with the acceleration of the restoration.

The dredged material volume from the proposed project is typically calculated from the target depth plus 2 feet of overdepth, which in this case is about 1.72 mcy. This estimate is unlikely to be achieved. The actual volume dredged will probably be the sum of the authorized depth, to 38 feet MLLW, plus a majority of the paid overdepth (38-39 feet MLLW), and a fraction of the unpaid overdepth (39-40 feet MLLW) (Appendix A, termed "likely" dredged volume). As proposed (Pinole Shoal material to Cullinan; Bulls Head and sediment trap material to Montezuma), we estimate the restored tidal areas attributable to this likely volume to be 96.1 ac and 2.8 ac at Cullinan Ranch and Montezuma Wetlands, respectively. If the full volume including all overdepth (1.72 mcy, termed "high" dredged volume in Appendix A) is dredged and placed as proposed, we estimate the restored tidal areas attributable to this volume to be 136.4 ac and 26.4 ac at Cullinan Ranch and Montezuma Wetlands, respectively.

The availability of the proposed project sediments is expected to accelerate completion of Cullinan and Montezuma Wetlands phase II, which will result in greater average habitat value over the period of analysis. Over an assumed 52 year life of the project, we roughly estimate the effect of accelerated completion to be two years, and an increase in value of about 7 Average Annualized Habitat Units (AAHUs) at Cullinan Ranch (Appendix A). The likely volume intended for disposal at Montezuma Wetlands is relatively small, about 0.03 mcy, so there would be little such accelerating effect there as the project is currently proposed. If for some reason Cullinan Ranch cannot accept the material due to capacity or other reasons at the time of construction, and Montezuma Wetlands were used instead, we estimate the effect of accelerating restoration by putting all of the material at Montezuma to be about 18 AAHUs.

The eastward shift in the salinity distribution as a result of the project could have an adverse effect on the productivity of forage organisms used by native fishes in the Delta, but this effect is believed to be minor. The Corps contracted with regional consultant experts to develop an estimate of this shift using a 3-dimensional numerical model (McWilliams 2018). The 0.l7-0.23 km change in X2 due to the project channel deepening which is predicted by the numerical model is a consistent increase for much of the year but is a relatively small change compared to the seasonal fluctuation in X2 of >20 km. Also, this change in X2 assumes all of the material is actually dredged (i.e., to -38 feet MLLW plus 2 feet overdepth). The actual amount of material dredged will likely be less, so the effect will also be reduced. Lastly, creation of the sediment trap will reduce the need for near term emergency dredging in the Bulls Head Reach, thereby reducing the frequency of benthic disturbance in that area.

[1] Some composites showed slight exceedence of wetland criteria for Chromium, which is naturally occurring.

A rough worst case estimate of the effect of the salinity distribution on habitat can be developed from average changes in LSZ as a function of X2. The most rapid changes for X2>64 occur in the X2 region of 74-84 km (e.g., Figure 12 *in* Herbold and Vendlinski 2012; Figure 12 *in* MacWilliams et al. 2015). In these cited analyses, the LSZ parameter is restricted to the 1-2 psu region, probably because it is central to the range of the LSZ and represents the highest value habitat. Within this region, LSZ area declines from about 100 to 65 km² (~25,000 to 16,000 ac), or about 9,000 ac over a 10 km distance. A shift in X2 due to the ship channel of 0.17 km is less than 2% of this distance; if it occurred while X2 is within the 74-84 km region, we calculate that it would cause a LSZ area reduction of roughly 153 ac. During many other year types, and portions of critical dry years, X2 would not be within the 74-84 km region, and LSZ differences would be much less. This worst case scenario of habitat reduction appears modest, comparing favorably to the 162.8 ac habitat increase in the form of restored tidal area attributable to placement of the full volume of dredged material at Cullinan Ranch and Montezuma Wetlands.

Although these placement sites are not the same kind of habitat as that which is impacted, Policy exception to the "no net loss of in-kind habitat value" planning goal for Resource Category 2 is permissible when (FR 46 (15) 7658): "(1) different habitats and species available for replacement are determined to be of greater value than those lost, or (2) in-kind replacement is not physically or biologically attainable in the ecoregion section." In this instance, we believe that the value of the habitat to be created in the proposed placement sites (Cullinan and Montezuma) is of greater value than the LSZ loss. It is difficult to precisely quantify LSZ effects beyond a coarse estimate. Therefore, this finding is based on our best judgement of a comparison of the gains and losses, the range of species affected, and information on the likelihood of benefit. In its ranking of 40 sites based on a variety of likely benefits Corps ranked Montezuma #1 and Cullinan #10, with Montezuma highest based on the benefits to listed species, particularly fishes, in the entrapment zone (Corps 2011). Cullinan will likely have the most benefits to listed marsh wildlife species not specifically recognized in Corps (2011). Further benefits are expected from the production and export of vascular plant and attached algae from restored marsh to bay waters, which we expect to enhance fishery resources.

Placement of material at Cullinan Ranch is currently limited to smaller draft scows that can navigate Dutchman Slough. Larger capacity scows (or more scows and dredges) could be used, and the project could be completed faster if an offloading facility were positioned near the confluence of Dutchman Slough with the Napa River (such a facility is described in the permit for Cullinan Ranch, but is not yet constructed for lack of funds). Faster construction is desireable from the standpoint of completing the restoration, as well as limiting the temporary effects of constructing the ship channel.

CONCLUSION

The proposed San Francisco Bay to Stockton Navigation Improvement project will have localized temporary effects on fish and wildlife resources, including the listed delta smelt, during dredging activities, and a relatively small permanent effect on X2 and the LSZ through the effect of channel depth on salinity distribution. The project will generate a quantity of relatively clean dredged material that is suitable for use at two permitted tidal restoration sites where it would yield near term benefits to wildlife and ecological processes generally, while improving navigation safety and efficiency. Accordingly, we recommend the TSP be implemented as proposed.

RECOMMENDATIONS

We recommend the Corps:

1. Construct the TSP as proposed (-38 feet MLLW channels; -42 feet MLLW sediment trap; 2 feet overdepth; placement at Cullinan Ranch and Montezuma Wetlands); should the Corps be unable to construct the project in the dredge volume allocation described, the Service would support any alternative allocation up to the full volume at either Cullinan or Montezuma.

2. Minimize the timeframe for project construction by reasonable means, such as the use of larger capacity scows, additional scows and dredges, and/or additional offloading equipment;

3. Evaluate effects of the project on listed species and initiate consultation as appropriate with the Service and National Marine Fisheries Service, including incorporating any additional measures needed to minimize or offset these effects into the project.

4. Evaluate placement of dredged material from maintenance of the proposed project for beneficial purposes such as habitat restoration.

REFERENCES

Acta [Acta Environmental, Inc.]. 2018. Report on Biological Surveys, 2015-2017. Montezuma Wetlands Project. Solano County, California. Prepared by Acta Environmental, Inc., San Francisco, California, for Montezuma Wetlands LLC. April 20, 2018. 27 pp + 6 summary tables.

Corps [U.S. Army Corps of Engineers]. 2011. San Francisco Bay Regional DMMP District Review Draft: Beneficial Use Options Screening. U. S. Army Corps of Engineers, San Francisco District. December 2, 2011. 148 pp.

Herbold, B., and T.J. Vendlinski. 2012. Modeling Estuarine Habitat in the Bay Delta. Unifying one and three dimensional approaches to modeling X2 and the low salinity zone. White paper drafted for the Technical Workshop on Estuarine Habitat. March 27, 2012. 14 pp.

Jassby, A.D., W. J. Kimmerer, S.G. Monismith, C. Armor, J.E. Cloern, T.M. Powell, J.R. Schubel and T.J. Vendlinski. 1995. Ecological Applications 5: 272-289

Levine-Fricke. 1995. Montezuma Wetlands Project. Ecological resources mitigation and restoration plan. Submitted to U.S. Army Corps of Engineers, Regulatory Branch, in support of a permit application under Public Notice 19405E26. Emeryville, California. August 10, 1995. 75 pp + figures and appendices.

MacWilliams, M. L. 2018. Salinity Modeling Efforts & Results. Presentation by Dr. MacWilliams. pp. 21-64 *in* San Francisco Bay to Stockton Navitation Study Workshop. Powerpoint presentation by Michael MacWilliams, Principal Engineer, Anchor QEA. San Francisco, California. December 7, 2018.

MacWilliams, M. L. , A. J. Bever, E. S. Gross, G. S. Ketefian, and W. J. Kimmerer. 2015. Three-dimensional modeling of hydrodynamics and salinity in the San Francisco estuary: An evaluation of model accuracy, X2, and the low-salinity zone. San Francisco Estuary and Watershed Science 13(1). April 2015. 37 pp.

Service [U.S. Fish and Wildlife Service]. 1997. San Francisco Bay to Stockton Deepwater Ship Channel (J. F. Baldwin) Phase III. Revised Draft Fish and Wildlife Coordination Act Report prepared by U.S. Fish and Wildife Service, Ecological Services, Sacramento, California, for U.S. Army Corps of Engineers, San Francisco District. May 29, 1997. 87 pp + appendices.

Washburn, N. 2018. Cullinan Ranch Restoration Project Monitoring Report: 2015-2017. Prepared by Ducks Unlimited, Inc., Vallejo, California for San Francisco Bay and Development Commission, U.S. Army Corps of Engineers, and San Francisco Bay Regional Water Quality Control Board. March 31, 2018. 10 pp.

APPENDIX A. Worksheet showing calculation of benefit of accelerating completion of restoration actions at Cullinan Ranch or Montezuma Wetlands phase II and proportion of total benefit (area and habitat value) associated with volume of material placed from SFBSNIP project

1. This part is a test calculation of benefits of habitat restoration acceleration due to availability of dredged material from the SFBSNIP at Cullinan Ranch

Scenario: this calculates benefits assuming that the dredged material from the ship channel accelerates completion of Cullinan Ranch by 2 years
This is a rough calculation given the uncertainty about actual dredged material volume; range of benefit would be 1 to 4 or more years.

TY	0	1	2	3	4	8	10	52	notes:
HSIw/o	0	0	0	0	0.1	0.8	1	1	this scenario finishes in year 4, and reaches maximum value in 6 years
HSI w/	0	0	0.1	0.2	0.3	1	1	1	this scenario finishes in year 2, assumes SFBSNIP accelerates by 2 years and reaches maximum value in year 8
area w/o	280	280	280	280	280	280	280	280	
area w/	280	280	280	280	280	280	280	280	
HUs w/o		0	0	0	14	504	504	11760	
HUs w/		0	14	42	70	728	560	11760	
AAHUs without								245.8	
AAHUs with								253.3	
change due to project								7.5	

Assumptions:
It takes 6 years after breaching to reach full tidal value, assumes rapid vegetation due to filling near vegetation threshold elevation.
it has limited value the first year after breaching
The amount of dredged material is probably on the order of 1 mcy; since in practice about 10-15% of unpaid overdepth is actually dredged.
The 1.45 mcy of material from going from the ship channel to cullinan would take 2 years to obtain from other sources if it isn't available
It would take 2 seasons to complete the ship channel dredging; that is, breaching in TY3.

2. This part is a test calculation of benefits of habitat restoration acceleration due to availability of dredged material from the SFBSNIP at Montezuma Wetlands

Scenario: this calculates benefits of alternatively using the full amount at Montezuma Wetlands, which would accelerate completion there by about 2 years

This is based on the recent (2012-2017) fill rate of that site; of 3.376 mcy over the last 6 years, or about 0.56 mcy/year.

With .56 mcy/yr, it would take about 8 years to fill phase II of that site and breach it, without the project.

If all of the ship channel material were to go to Montezuma it is assumed to take 1 year for that dredging, since Montezuma can take larger scows.

At the time of dredging of the ship channel, 2023, Montezuma is assumed to be half full.

Assume that if the ship channel material were to go to Montezuma, it would be completed in 2 fewer years (TY3), compared to 4 more years without that material.

TY	0	1	2	3	4	12	14	52	notes:
HSIw/o	0	0	0	0	0.1	0.8	1	1	this scenario finishes Montezuma ph II in TY4, reaches maximum value by TY14
HSI w/	0	0	0.1	0.2	0.3	1	1	1	this scenario finishes Montezuma ph II in TY2, assume SFBSNIP accelerates by 2 yrs
area w/o	424	424	424	424	424	424	424	424	
area w/	424	424	424	424	424	424	424	424	
HUs w/o		0	0	0	21.2	1526.4	763.2	16112	
HUs w/		0	21.2	63.6	106	2204.8	848	16112	
AAHUs without								354.3	
AAHUs with								372.2	
change due to project								17.9	

Assumptions:

It takes 10 years after breaching to reach full tidal habitat value, slower than Cullinan due to larger unit size and not filling as close to vegetative threshold elevation.

It has limited value the first year after breaching.

The availability of the 1.45 mcy of material from cullinan would take 2 years to obtain from other sources if it isn't available.

3. this part estimates the restoration benefit, in area or value, associated with the volume of material coming from the ship channel as a fraction of the total benefit for disposal at Cullinan Ranch (CR) and Montezuma Wetlands (MZ) for SFBSNIP sediments.

Range of sediment volume varies from possible (high, includes all overdepth) to likely (lower, with assumptions)
High - 1.72 mcy (assumes full dredging down to 2 feet overdepth; 1.44 mcy PSC, 0.16 mcy BHR, 0.12 mcy sed trap)
Likely - ~1.03 mcy (assumes 85-90% of paid overdepth, i.e., to 1 ft, and 10-15% of unpaid overdepth, i.e., between 1-2 feet below 38 MLLW); would consist of 1 mcy from PSC, and 0.03 mcy (30,000) in BHR + sed trap

Note: the numbers under "high" and "likely" volume were derived from 12/7/18 workshop comments by David Doak, USACE

Proportion of restored AREA benefits under potential scenarios due to ship channel material:

	ACRES	ACRES	ACRES
	As proposed, both		All to
	CR	MZ	MZ
High:	134.4	26.4	243.1
Likely:	96.1	2.8	145.6

note: calculated as ship channel volume/total placement site volume * total placement site area

Proportion of habitat VALUE benefits for ship channel sediments to restoration sites under potential scenarios:

	AAHUs	AAHUs	AAHUs
	As proposed, both		All to
	CR	MZ	MZ
High volume:	1.44	0.28	1.72
Likely volume:	1.00	0.03	1.03
High Benefit:	122.5	23.2	213.4
Likely Benefit:	84.4	2.5	127.8

ACRONYMS:

AAHUs - Average Annualized Habitat Units
BHR - Bulls Head Reach
CR - Cullinan Ranch
HSI - Habitat Suitability Index
HU - Habitat Units
mcy - million cubic yards
MZ - Montezuma Wetlands
PSC - Pinole Shoal Channel
SFBSNIP - San Francisco Bay to Stockton Navigation Improvement Project
TY - Target Year

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay Delta Fish and Wildlife Office
650 Capitol Mall 8th floor 8-300
Sacramento, California 95814

In Reply Refer to:
08-FBDT00-
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JUL 02 2019

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Thomas Kendall
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Dear Sirs:

Please find enclosed our final Fish and Wildlife Coordination Act (FWCA) report on the U.S. Army Corps of Engineers' proposed San Francisco Bay to Stockton Navigation Improvement Project. This final FWCA report supersedes our draft report, which was provided for comment on February 28, 2019. No comments were received.

If you have questions on this report, please contact Steven Schoenberg of my staff at (916) 930-5672, or at Steven_Schoenberg@fws.gov.

Sincerely,

for Kaylee Allen
Field Supervisor

Enclosure

cc:
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UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

FINAL FISH AND WILDLIFE COORDINATION ACT REPORT FOR THE SAN FRANCISCO BAY TO STOCKTON NAVIGATION IMPROVEMENT PROJECT

PREPARED BY:

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U.S. Fish and Wildlife Service
Habitat Conservation Division
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Sacramento, California

PREPARED FOR

U.S. Army Corps of Engineers
Wilmington District
Wilmington, North Carolina

July 2019

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SUMMARY

The Corps of Engineer's Tentatively Selected Plan (TSP) for the San Francisco Bay to Stockton Navigation Improvement Project involves deepening the Pinole Shoal Channel and a portion of the Suisun Bay Channel up to Avon (Bulls Head Reach) to -38 feet Mean Lower Low Water (MLLW) to improve access by tankers to oil refineries, removing a small rock obstruction, and conducting advance maintenance dredging in a sediment trap area of the Bulls Head Reach to -42 feet MLLW. The 1.60 million cubic yards (mcy) of dredged material from project construction would be beneficially used for tidal habitat restoration at two permitted sites, Cullinan Ranch (1.44 mcy) and Montezuma Wetlands (0.16 mcy). Project construction would cause temporary impacts to about 390 acres of deep subtidal benthic habitat. Due to changes in circulation patterns associated with this increased channel depth, the project is predicted to cause an annual average eastward change in the position of the 2 practical salinity units isohaline near the bed, or X2, of 0.17, 0.21, and 0.23 kilometer (km) for modeled critical dry, below normal, and wet years, respectively, for portions of the year in which X2 > 64 km. This will occasionally result in a modest (~2.8% or less) reduction in the extent of the low salinity zone, a region of the estuary considered important for production and concentration of food organisms that support native fishes, including the listed delta smelt. We conclude that the limited extent and depth of dredging chosen for the TSP will minimize potential adverse effects due to salinity intrusion. Accordingly, we recommend the TSP be implemented as proposed.

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INTRODUCTION

This document represents the United States Fish and Wildlife Service's (Service) final Fish and Wildlife Coordination Act (FWCA) report on the U.S. Army Corps of Engineer's (Corps) San Francisco Bay to Stockton Navigation Improvement Project (project). The project study area is within part of the San Francisco Bay to Stockton Ship Channel, also known as the J. F. Baldwin Ship Channel, which spans a distance of about 75 miles from outside the Golden Gate to the Port of Stockton. The ship channel is intended to allow for the access and efficient transport of goods by deep draft vessels. It has been partially constructed in increments or phases from 1965-1986. Phase III of the project as it was originally designed has an authorized depth of 45 feet below MLLW, and would have included dredging in the West Richmond, Pinole Shoal, and Suisun Bay Channels, and associated maneuvering areas. Increasing the channel depth to this extent has previously raised concerns about salinity intrusion which may affect water quality and certain ecological processes in the estuary. To address these concerns, the depth and extent of proposed dredging have been reduced. The currently proposed project involves dredging to -38 feet MLLW to Avon only as its Tentatively Selected Plan (TSP), with additional dredging of a sediment trap and leveling of a rock outcrop, and maximum beneficial re-use of dredged material for tidal restoration (Figure 1). This shallower depth limits the overall volume and spatial extent of dredging to the Pinole Shoal Channel and a portion of the Suisun Bay Channel up to Avon, termed the Bulls Head Reach, because the water of the West Richmond Channel is naturally at least this deep. It also reduces environmental concerns about salinity intrusion. The proposed depth would still be sufficient to improve access and efficiency by tankers which service a number of oil refineries in the vicinity of the Carquinez Strait.

Figure 1. Study area and tentatively selected plan element locations for the San Francisco Bay to Stockton Navigation Improvement Project.

Previous coordination activities for this ship channel involved various FWCA reports or Planning Aid Letters on the prior designs of the project, dredging and dredged material disposal impacts, or updates to the project (1963-1986). For the last 20 years or so, dredged material from channel or harbor projects has been increasingly used beneficially, often to accelerate habitat restoration by raising the elevation of subsided diked baylands and opening them to tidal action. A number of restoration sites that involved accepting dredged material in this manner were evaluated by the Service in the 1990s as a part of other Corps projects such as the Oakland Harbor, Richmond Harbor, and J. F. Baldwin phase III ship channel projects, and more recently for the Corps' South San Francisco Bay Shoreline Study, Redwood City Harbor, and Central Basin CAP 107 Navigation Improvement projects. Our earlier FWCA reports on these projects often included some level of quantification of the benefits of such beneficial re-use for habitat restoration, such as with Habitat Evaluation Procedures accounting models, or the relationship between the volume dredged and the habitat restored. The preceding FWCA report on the channels that are part of the currently proposed project was our 1997 revised draft FWCA report on the phase III channels, in which the Corps examined needs for a ship channel and an alternative involving an oil pipeline and associated facilities for the pipeline (Service 1997). The ship channel alternative has been reduced for the current project, and the pipeline alternative is no longer under consideration.

Coordination activities for the currently-proposed project resumed in 2018, including regular conference calls with the Corps to discuss information needs and progress on this report, and attendance at a workshop in December 2018 with other Federal agencies and local interests. A draft FWCA report was issued in February 2019. Although no comments were received, this final report has been revised to reflect slight revisions to dredged material volumes. The Service met again with the Corps and its consultant in June 2019 to discuss the final salinity modeling report. Additional information used in the preparation of this final report includes preliminary project descriptions, bathymetry, sections of administrative draft environmental documents, the Corps' May 2019 Draft Integrated General Reevaluation Report and Environmental Impact Statement (GRR/EIS), discussion with experts, and salinity modeling reports.

DREDGING ALTERNATIVES

The Corps has retained 2 alternatives for evaluation in addition to the no-action alternative: (1) deepening to -37 feet MLLW; and (2) deepening to -38 feet MLLW. Both action alternatives include beneficial use of dredged material at existing permitted sites, and a sediment trap at the Bulls Head Reach. Under the no-action alternative, no deepening of any channels would occur.

The -37-foot MLLW alternative involves deepening the Pinole Shoal Channel and a portion of the Suisun Bay Channel up to Avon (Bulls Head Reach) to that depth. A portion of the Bulls Head Reach would be further deepened to -41 feet MLLW as a sediment trap. Dimensions and disposal sites would be the same as the -38 feet MLLW alternative, described in detail below. Dredging would be done in an area of 200 acres (ac) and generate 0.86 million cubic yards (mcy) of dredged material, assuming an allowance for 2 feet of overdepth.

The -38-foot MLLW alternative is the TSP and involves deepening the same channels to -38 feet MLLW, and the sediment trap area to -42 feet MLLW. The Pinole Shoal Channel is about 600 feet wide spanning about 10 miles through San Pablo Bay. The Bulls Head Reach, not including the sediment basin, is 300-700 feet wide, extending about 2.35 miles west of Avon, and the

Sediment Basin is another 0.49 mile long and 300 feet wide and within the Bulls Head Reach vicinity at engineering stations 62+00 to 88+00. Dredging for this alternative would be done over an area of 390 ac and generate 1.60 mcy of dredged material, assuming 2 feet of overdepth.

Dredging would be accomplished with one or more mechanical clamshell dredges, except for a small rock obstruction in the Pinole Shoal - about 40 cubic yards - that will require a pneumatic jackhammer to remove down to -43 feet MLLW. Some of the work in the Pinole Shoal Channel may be outside of the June 1 through November 30 work window for that reach to protect listed anadromous fish but would be in compliance with terms and conditions of the 2015 Long Term Management Strategy Biological Opinion. Work in the Bulls Head Reach would be within the August 1 through November 30 work window for that reach to avoid impacts to listed fish. Dredged materials would be placed in scows and transported to two permitted wetland restoration sites, Cullinan Ranch and Montezuma Wetlands. For the TSP, the material dredged from Pinole Shoal Channel, about 1.44 mcy, would be placed at Cullinan Ranch and the 0.16 mcy dredged from the Bulls Head Reach would be placed at Montezuma Wetlands. It is expected the TSP would take about 4.6 months to complete, 3.5 months for the Pinole Shoal Channel and about another month for the Bulls Head Reach, and would commence in the year 2023. Maintenance dredging would be done every 1 to 2 years thereafter, with an estimated 50% increase in average annual volume (additional 78,000 cubic yards) compared to existing conditions.

DREDGED MATERIAL PLACEMENT SITES

Cullinan Ranch: Cullinan Ranch is a tidal restoration project site on about 1,500 ac located on the north side of San Pablo Bay just west of the Napa River between State Highway 37 and Dutchman Slough. It is within the San Pablo Bay National Wildlife Refuge. It is currently subsided diked bayland, which was acquired with the intent to restore it to tidal marsh. Restoring the site to tidal action would have general tidal ecosystem benefits in a location that would specifically assist the recovery of the federally listed Salt Marsh Harvest Mouse and Ridgway's Rail. The restoration project is a permitted action and has a capacity to receive at least 3 mcy of dredged material on the easternmost 290 ac of the site, which has been isolated from the rest of the site and subdivided into 5 cells for placement of material when it is available. The current plan is to complete dredged material import before opening this area to tidal action. To date, about 0.86 mcy of material has been placed and filled 2 of the 5 cells. Both cover and non-cover quality sediment can be accepted at this site. Travel distances are 5-16 miles and 11-14 miles from the Pinole Shoal Channel and Bulls Head Reach, respectively. Clamshell dredged material would be barged to a land-based offloader and then pumped onto the site.

Montezuma Wetlands: This site is a privately owned, permitted, and operated wetland restoration project site located on about 2,400 ac of moderately subsided, diked baylands at the eastern edge of Suisun Marsh. The location is such that it would provide benefits to native fishes in the low salinity region of the Sacramento San Joaquin Delta (Delta), including to longfin smelt and the federally-listed delta smelt. Dredged material from various projects is transported and used here to raise elevations of the site so it can be opened up to tidal action to restore tidal marshlands, and the owner charges for receipt of this material. The site can accept both wetland cover ("non-foundation") and non-cover ("foundation") quality materials. All offloading and pump facilities are currently in place and fully operational, sufficient to accept full-sized barges (~10,000 cubic yard capacity). The site is divided into four phases, of which the first phase has been under construction since late 2003, is nearly filled, and is expected to be complete and breached in 2019. When complete, phase I will have received roughly 8 mcy of dredged material and restored about 600+ ac of all wetland habitat. Phase II, which could receive material from the proposed project, has an approximate capacity to receive about 4.5 mcy. When complete, phase II will yield about 400 ac of restored tidal wetland. The Montezuma Wetlands site is 24-34 and 14-17 miles, respectively, from the Pinole Shoal Channel and Bulls Head Reach. Material would be transported by scow to an offloader, which would pump the material onto the site.

BIOLOGICAL RESOURCES

Dredging Locations (Pinole Shoal Channel and Bulls Head Reach): The shipping channels are within an expanse of relatively deep subtidal waters that are all subject to wind and tidal energy and vary somewhat in biological resources with location and hydrologic conditions. The bottom is mostly sand, with some mud and cobble. Depths vary with location with a range of -30 to -50 feet MLLW. The surrounding lands include developed areas, uplands and hills, as well as some significant seasonal and tidal wetlands, most notably tidal marsh along the northern margin of San Pablo Bay including the National Wildlife Refuge there, and non-tidal and tidal marshes in Suisun Marsh (along Suisun Bay). These wetlands provide important habitat for wildlife, including resident marsh birds and mammals as well as migratory waterfowl and shorebirds.

The biological resources vary with habitat type and location. The dredging location in the Pinole Shoal Channel, in San Pablo Bay, is west and more saline, whereas the dredging location to the east in the Bulls Head Reach, is less saline. The fish community in San Pablo Bay would include a number of saltwater game species like sturgeon, salmon, halibut and striped bass, as well as other fishes like Pacific herring, English sole, jacksmelt, topsmelt, and others. The brackish waters of Suisun Bay and farther to the east have increasing numbers of freshwater species like silversides, bass, sunfish, delta smelt, juvenile salmon, sturgeon, and bass, and longfin smelt. Invertebrate fauna include planktonic copepods, rotifers, and cladocerans, in the water column, and various worms, crustaceans, and mollusks within or near the benthic interface, appropriate to the local salinity.

At least a portion of the dredging to the east would occur in (or affect, via salinity intrusion due to the channel deepening) an open water region with an increased concentration of phytoplankton and associated food organisms known as the “entrapment zone” or “low salinity zone” (LSZ). The central location of the LSZ is typically designated by the distance from the Golden Gate, in kilometers (km), of the daily averaged near bottom 2 practical salinity unit (psu) isohaline, commonly known as “X2”, because it corresponds to the estuarine turbidity maximum and peak abundance of estuarine organisms (Jassby et al. 1995). The full aerial extent of the LSZ encompasses a region of 0.5-6 psu. This is a zone where fresh and salt waters meet, and particles are concentrated by estuarine circulation patterns that are sensitive to depth, topography, and wind mixing. The Delta region has the most productivity and benefit to fishery resources when X2 is positioned in the shallow waters at the upstream end of Suisun Bay. This productivity and the position of X2 are affected by net Delta outflow, becoming less productive and less valuable to fishes when it is moved east into confined channels at times of low net outflow.

The Delta through which the ship channel passes, including the LSZ and interconnected marshlands, is considered an extremely important area for natural resources. Not only does it support several rare, endemic species, such as the Federally-listed delta smelt and State-listed longfin smelt, but it is a migratory corridor and juvenile rearing area for important salmon, steelhead, sturgeon, and striped bass. The Delta is affected by water operations that regulate freshwater flows, and by other factors such as non-native fish and invertebrate species, contaminants, sea-level rise, and other influences.

Cullinan Ranch: This site, located on the north shore of San Pablo Bay just west of the Napa River, is a former diked bayland, subsided about 6 feet, and until recently had been farmed for oats and hay for the last century. Sometime after it was acquired by the Service in 1991, the pumping used to keep it in this agricultural state ceased, and it became a complex of non-tidal seasonal and perennial wetlands with some open water and a small amount of upland. This type of habitat mosaic is often used by wading birds. In the last few years there has been considerable disturbance of this site to develop the elements needed to open it up to tidal action. In 2015, most of the site was opened to tidal action, and that area is now primarily open water. Post breach surveys show the site is used by many species of waterfowl during fall and spring migration periods, particularly dabbling and diving ducks (Washburn 2018). However, the 280 ac of the site reserved for dredged material placement remain as a combination of fallow fields, which provide some residual seasonal and some perennial wetlands value (unfilled cells), together with the areas disturbed by material placement with low value (filled cells). This area has received about 0.86 mcy of dredged material thus far, and has about 2 mcy capacity remaining. This capacity may be revised upwards to accelerate revegetation and allow for sea level rise.

Montezuma Wetlands: This site is diked and subsided up to 11 feet. It was formerly characterized as grazing land with some bare areas and wetlands in the form of ditches, saline basins, and seasonally flooded areas (Levine-Fricke 1995). Currently, phase I of the Montezuma Wetlands project site is still in development and receiving dredged materials. The rest of the site is not yet in development. Within these uplands, seasonally flooded areas receive some winter use by wading birds and waterfowl during periods of high precipitation and extreme tides. There is also pickleweed and saltgrass in some areas. Pre-breach surveys have been ongoing since the year 2000 in accordance with a monitoring plan for the project as part of its permits, a plan which is overseen and updated as necessary by a technical review team (Acta 2018). In phase I, there is considerable interim use during dredged material placement by shorebirds and ducks when ponded water is present, as well as by the listed California least tern. Salt marsh harvest mice have been regularly detected in the pickleweed areas of phases that have not yet been constructed. Vernal pool crustaceans, both listed and common, have been noted in vernal pools created as part of the project. Otherwise, wildlife use of the area would be by common upland species.

MITIGATION POLICY AND COVER TYPES

The Service's Mitigation Policy (Policy) (FR 46:15 January 23, 1981) provides general guidance in making recommendations to conserve fish and wildlife resources. Under the Policy, resources are assigned to one of four Resource Categories, with a mitigation goal consistent with the values provided to fish and wildlife and the rarity of that habitat (cover-type). A mitigation goal is assigned ranging from "no loss of existing habitat value" (Resource Category 1) for the most valuable kinds of habitat to "minimize loss of habitat value" (Resource Category 4) for the less valuable and most common kinds of habitat. Application of the Policy involves designating cover-types which may be affected and assigning evaluation species based on the sensitivity of those species to the project action, their role in the ecosystem, or association with Service-wide resource management issues such as conservation of anadromous fish and migratory birds. We then state the Resource Category, the rationale for that selection, and the corresponding mitigation goal.

For this project area, we have designated seven basic cover-types within the project area and adjacent areas affected by the project. Due to differences in water depth and/or salinity in tidal and non-tidal ponds, there may be several more specific habitats within these cover-types, as noted below.

Open water (bay): This cover type is considered those waters within San Francisco Bay which are permanently inundated, deeper than MLLW and often deeper than 18 feet below MLLW. Areas affected by the project include the waters in the channels to be dredged, the region of the low salinity zone affected by this deepening, and the sites of any sediment offloading facilities that might be needed, depending on the disposal/placement option selected. Pelagic plankton, fish, and macroinvertebrates are produced in these waters, which are prey organisms for some seabirds and waterfowl. An appropriate evaluation species would be juvenile fishes. Such open waters are relatively abundant in the planning area and are not expected to be lost or significantly degraded by the proposed action, although there may be some temporary effects of dredging and a small increment of permanent effect on salinity. The planning goal varies with location. Waters west of the Benicia Bridge, including the Carquinez Strait and San Pablo Bay, are more abundant, deeper, typically more saline, and of moderate value to the evaluation species; these waters are designated Resource Category 4, with a mitigation planning goal to minimize loss of habitat value. Waters east of the Benicia Bridge include shallower areas (i.e., less than 10 feet deep) such as Grizzly and Honker Bays, among others, which would not be dredged but could also be affected by an increment of salinity change due to the project. These waters encompass a critical rearing area for juvenile and native fishes; as such, they are designated Resource Category 2, with a goal of no net loss of in-kind habitat value.

Subtidal benthic (bay): This cover type includes permanently inundated, unvegetated bottom substrate deeper than MLLW, such as the channels to be dredged, and any new sediment offloading facilities constructed in deep waters. This cover type supports food organisms like shrimp, benthic fish, and other macroinvertebrates. Bottom dwelling fishes such as sturgeon, flatfishes such as juvenile halibut, and rays, would be appropriate evaluation species. Most such habitat affected by the proposed project is already regularly dredged, although there may be some slightly shallower subtidal benthic habitat on the margin of the channels that would be deepened, and the frequency and/or extent of dredging may slightly increase beyond current levels. With a depth range of -26 to -41 feet MLLW, the areas designated for dredging are deeper than the criteria used to assess shallow water habitat effects for species like the delta smelt (i.e., Mean High Water to -10 feet MLLW). This cover type is also relatively abundant. Due to this abundance, regular disturbance, depth, and medium value to the evaluation species, subtidal benthic habitat is designated Resource Category 4, with a mitigation planning goal to minimize loss of habitat value.

Non-tidal pond waters: This cover-type includes permanently inundated, unvegetated waters separated from tidal action, and is represented by any ponds within Montezuma Wetlands or Cullinan Ranch which could receive dredged material from the proposed project. These ponds vary in depth, circulation, and water chemistry depending on management. They support some species of saltwater or freshwater fish, and benthic or pelagic macroinvertebrates that can provide forage. They may be used by waterfowl, or other bird groups, depending on salinity. For the lower salinity ponds, we would select a duck such as the northern shoveler as an evaluation species. For higher salinities, the American avocet would be an appropriate evaluation species. Non-tidal ponds are moderately abundant and are used for foraging and roosting by the evaluation species. We designate these as Resource Category 3, with a mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value.

Tidal emergent marsh: This cover-type includes areas which are vegetated, generally between Mean Higher High and Mean Low Water that are subject to unrestricted tidal inundation and drained by slightly deeper, unvegetated channels. For this project, it includes areas which could become vegetated in the future through placement of dredged material and exposure to tidal action at Montezuma Wetlands or Cullinan Ranch, as well as vegetated margins of sloughs which may be affected locally by offloading facilities and pipes needed to transport dredged material. Species composition varies with salinity and elevation with respect to mean tide level. It provides habitat for mammals including the listed salt marsh harvest mouse, tidal marsh birds such as the listed Ridgway's Rail, macroinvertebrates, and juvenile fishes. Tidal marshes also produce and export organic matter that support the food web throughout estuaries and bays. Evaluation species would be a marsh specialist like the marsh wren. The unvegetated tidal channel component of tidal marsh is considered to be an important breeding and nursery area for fishes, and foraging area for shorebirds. Most historical tidal marsh in the Bay area has been lost due to industrial salt production or coastal development and fill. Due to this regional scarcity, importance to the ecosystem, and very high value to the evaluation species, we designate tidal emergent marsh as Resource Category 2, with a goal of no net loss of in-kind habitat value.

Mudflat: Mudflats are unvegetated tidal areas between Mean Low Water and MLLW that are exposed during low tide. A limited amount of mudflat could be locally disturbed at least temporarily by construction and operation of an offloader and/or pipeline needed to deliver sediment to Cullinan Ranch. Depending on initial elevation and subsequent revegetation rate, some expanses of mudflat could form initially at either Cullinan Ranch or Montezuma Wetlands. Mudflats produce diatoms, worms, and shellfish, which provide forage for numerous shorebirds, gulls, terns, and larger wading birds. During higher tide stages, fish enter the mudflats and forage. Shorebird species which specialize on exposed mud such as the western sandpiper would be an appropriate evaluation species. Although there has been some loss of mudflat due to development and fill, it remains moderately abundant in the Bay. Due to this abundance and high importance to the evaluation species, mudflat is designated Resource Category 2, with a goal of no net loss of in-kind habitat value.

Seasonal Wetland: Seasonal wetlands include low areas of Cullinan Ranch or Montezuma Wetlands that regularly pond during the winter. The more open wetlands can support vernal pool crustaceans, while the vegetated areas include some pickleweed and saltgrass known to support the listed salt marsh harvest mouse. An evaluation species would be a marsh specialist like the marsh wren. This particular cover-type is largely a consequence of historical diking, and is of low-to-moderate abundance and value to the evaluation species. Restoration actions would result in eventual replacement with tidal emergent marsh that is considered of greater value. Due to the moderate abundance and importance, relative to the restored cover-types, seasonal wetland is designated Resource Category 2, with a goal of no net loss of in-kind habitat value.

Upland: Upland in the project area occurs mostly as non-native annual grassland habitat on dike slopes surrounding several placement sites (Montezuma Wetlands, Cullinan Ranch). Limited portions could be temporarily affected by construction of offloading facilities or pipelines needed to deliver dredged material. Upland supports common small mammals and passerine birds, many of which are non-native. A native species like the California vole would be an appropriate evaluation species. A modest area of upland adjacent to tidal emergent marsh does have value as roosting habitat for birds during high tides, and as refugium for the listed Ridgway's rail and salt marsh harvest mouse during tidal flood events. Considering both the regional abundance as well as the importance of preserving some uplands near tidal habitats, we designate upland as Resource Category 4, with a mitigation goal to minimize loss of habitat value.

FUTURE WITHOUT THE PROJECT

Without the project and with shipping channel depths remaining at -35 feet MLLW, petroleum product shipping volume would increase but would be shipped on an increased number of smaller draft vessels. Maintenance dredging would continue at about the same frequency and amounts as in the past. There could be a need for emergency dredging in the Bulls Head Reach due to rapid shoaling in some locations. The dredging would result in temporary, localized impacts on the water column during dredge operations manifested by increased turbidity and some loss of benthic organisms within the removed materials, but fish would likely be displaced and not suffer increased mortality.

The placement sites at Cullinan Ranch and Montezuma Wetlands would continue to receive dredged materials when available from projects other than the proposed project.

The distribution and location of the low salinity zone and position of X2 would be variable and predominantly affected by water year type and operations that either release freshwater to or export it from the Delta.

FUTURE WITH THE PROJECT

With the project and channel depths deepened to -38 feet MLLW, petroleum product shipping volume would also increase but would utilize a reduced number of trips by deeper draft vessels, and with fewer tidal restrictions. Maintenance dredging would continue at about the same frequency, but with a modest increase in the volume of material, and with less of a need for emergency dredging in the Bulls Head Reach due to the sediment trap. The dredging activity would cause a somewhat more continuous localized disturbance of the benthic biotic community in the immediate vicinity of the dredge than just maintenance dredging alone. This could result in a temporary reduction in abundance of benthic organisms on the order of several months more or less. The effects on fish would likely be limited to displacement during operations although there may be some adverse effect on fish exposed to either turbidity plumes in the immediate vicinity of the dredge, or to sound from the pneumatic jackhammer. Based on bathymetry, only deeper bay waters and benthos would be directly affected by the dredging, although some shallow waters could be indirectly affected by salinity changes related to the deepened channel.

Cullinan Ranch: Placing the proposed 1.44 mcy volume of dredged material here would be roughly sufficient to complete the needs for restoration of this site. This would modestly accelerate completion of the site in terms of dredged material needs by about two seasons, based on the current rate of receipt of dredged material (0.86 mcy since permitting in 2012). This site is located and designed to specifically benefit the listed salt marsh harvest mouse in the near term. Revegetation would likely begin immediately after breaching, and 5-6 seasons of tidal action is expected to provide the veneer of natural sediment needed to optimize high marsh establishment. About 90% of the site is designed for high marsh that would benefit the listed salt marsh harvest mouse and Ridgway's rail as well as other high marsh wildlife species, with the other 10% of the area as channels and low marsh providing values to fish and fish-eating wildlife. The current upland and seasonal wetland habitat would be replaced by tidal marsh and channels. Wading birds may be displaced, however, the current value of the site is likely to be limited owing to recent earthwork in preparation of receipt of dredged material from other projects. Any displaced wading birds would likely relocate to nearby habitat just west of the site.

Montezuma Wetlands: Placement of the proposed 0.16 mcy volume of dredged material here would incrementally contribute to the 4.5 mcy total needed to fill phase II of this project, but would only nominally accelerate the rate of completion of this phase. This restoration would have relatively broad benefits, including to marsh wildlife such as salt marsh harvest mice, and native fish including delta smelt.

Water Quality: For the purposes of this FWCA report, we have limited our discussion to those conditions when X2 is greater than 64 km east of the Golden Gate when there is a requirement for freshwater inflow to regulate its position. The effect of the project on X2 is estimated by Corps-provided predictions of a numerical model under representative conditions for a critical dry water year (2014), below normal water year (2012), and a wet water year (2011) (MacWilliams 2018; Anchor QEA 2019). This model predicts that, with the TSP, the position of X2 would be moved east 0.17 km on average during a critical dry year, with X2>64 from January to mid-December, 0.21 km during a below normal year, with X2>64 from January through March and June through December, and 0.23 km east during a wet water year, with

X2>64 from late July through December. The numerical model predicts somewhat larger changes in X2 due to the project at other times of the modeled wet year of up to about 0.9 km when X2 is much farther west (40 km), but this is when the salinity gradient is pushed west into San Pablo Bay, and the Pinole Shoal Channel is stratified.

Changes in water quality due to the channel deepening that could adversely affect fisheries would generally be due to the eastward shift in X2 during the driest water years like the modeled 2014 year. The X2 range for the 2014 modeled year is roughly 70-90 km. In general, the amount and quality of the LSZ change as X2 is shifted to the east, with reduced LSZ surface area and greater depth, together with reduced access by fish to optimum food/turbidity conditions, disconnection of the LSZ to adjacent marshes and sloughs, and greater exposure of small fish to predation in the deeper channels. Under certain conditions, the eastward shift of X2 due to the ship channel deepening can result in a modest increment of loss of LSZ habitat quantity and quality (*see* Discussion, below).

DISCUSSION

For the purposes of this report, we assume only the no-project and Corps-preferred TSP deepening alternatives are under consideration. Deepening will result in reduced shipping traffic because refineries can use fewer, larger ships with less of a need for lightering. The improved safety of the deepened channel, and the fewer ships, will lessen the risk of future oil spills and consequent effects on fish and wildlife resources. The extent of dredging disturbance of benthic habitat needed to deepen the channel to 38 feet is a relatively small 390 ac. This will occur over less than one season, mostly in previously-disturbed portions of the channel. Benthic fauna will be temporarily reduced where dredging is recent, but is expected to recover in a matter of months.

Placement of the dredged material from the project at two permitted restoration sites, Cullinan Ranch and Montezuma Wetlands, will contribute to meeting the habitat benefit goals of these sites. Prior testing done in the 1990s, 2000, and 2009, showed the material to be predominantly sandy and most of it meeting all or nearly all State criteria for use as cover (foundation) material in wetland restoration[1]. The quantity of this benefit can be expressed in several ways - the benefit associated with the dredged material volume from the project as a fraction of the total volume needed for restoration, or the benefit associated with the acceleration of the restoration.

The dredged material volume from the proposed project is typically calculated from the target depth plus 2 feet of overdepth, which in this case is about 1.60 mcy. This estimate is unlikely to be achieved. The actual volume dredged will probably be about 1.03 mcy, the sum of the authorized depth, to -38 feet MLLW, plus a majority of the paid overdepth (-38-39 feet MLLW), and a fraction of the unpaid overdepth (-39-40 feet MLLW) (Appendix A, termed “likely” dredged volume). As proposed (Pinole Shoal material to Cullinan; Bulls Head and sediment trap material to Montezuma), we estimate the restored tidal areas attributable to this likely volume to be 96.1 ac and 2.8 ac at Cullinan Ranch and Montezuma Wetlands, respectively. If the full volume including all overdepth (1.60 mcy, termed “high” dredged volume in Appendix A) is

[1] Some composites showed exceedance of wetland criteria for Chromium, which is naturally occurring.

dredged and placed as proposed, we estimate the restored tidal areas attributable to this volume to be 134.4 ac and 15.1 ac at Cullinan Ranch and Montezuma Wetlands, respectively.

The availability of the proposed project sediments is expected to accelerate completion of Cullinan and Montezuma Wetlands phase II, which will result in greater average habitat value over the period of analysis. Over an assumed 51 year life of the project, we roughly estimate the effect of accelerated completion to be two years at Cullinan, resulting in an increase in value of about 7.7 Average Annualized Habitat Units (AAHUs) (Appendix A). The likely volume intended for disposal at Montezuma Wetlands is relatively small, about 0.03 mcy, so there would be little such accelerating effect there as the project is currently proposed. If for some reason Cullinan Ranch cannot accept the material due to capacity or other reasons at the time of construction, and Montezuma Wetlands were used instead, we estimate the effect of accelerating restoration by putting all of the project material at Montezuma to be two years and about 18.3 AAHUs.

The eastward shift in the salinity distribution as a result of the project could have an adverse effect on the productivity of forage organisms used by native fishes in the Delta. The Corps contracted with regional consultant experts to develop an estimate of this shift using a 3-dimensional numerical model (McWilliams 2018; Anchor QEA 2019). The model was run using representative critical dry (2014), below normal (2012) and wet (2011) year conditions. The model output indicated that the magnitude of change in X2 and the geographic extent of the LSZ varied with water year type. A 0.l7-0.23 km eastward shift (increase) in X2 due to the TSP was predicted by the model, with the larger shift occurring in wetter conditions. This would be a consistent increase for much of the year but is a relatively small change compared to the seasonal fluctuation in X2 of >20 km. Also, this change in X2 assumes all of the material is actually dredged (i.e., to -38 feet MLLW plus 2 feet overdepth). The actual amount of material dredged will likely be less, so the effect would also be reduced. Lastly, creation of the sediment trap will reduce the need for near term emergency dredging in the Bulls Head Reach, thereby reducing the frequency of benthic disturbance in that area.

The final salinity modeling report included predicted changes in LSZ area which could result from the effect of the TSP on salinity intrusion (Anchor QEA 2019). This effect varies with water year type because the area and location of the LSZ and X2 also change with year type, with a smaller LSZ and more eastwardly position of X2 in drier years. The effect can also vary month to month, or daily, within a year type, because of differences in modeled response due to the exact position of X2. The worst case effect for a critical dry year would be a reduction in the monthly average LSZ of -200 to -290 acres from March to May (Table 7-1 *in* Anchor QEA 2019), or an average change of about -1.2% of the LSZ area. This is a net effect resulting from slight reductions at the western edge of the LSZ when its margin is in relatively wide areas of Grizzly and Honker Bays not being offset by increases at the eastern edge of the LSZ in relatively confined river channels (Figure 7.2-4 *in* Anchor QEA 2019). Similarly, the worst case effect for a below normal water year was a LSZ reduction of -587 acres in July (Table 7-2 *in* Anchor QEA 2019), which is -2.8% of the overall LSZ of 21,217 acres (Table 7-3 *in* Anchor QEA 2019). In April of a below normal water year, however, the LSZ would increase by 446 acres because X2 is initially located farther west; the project effect in that month and year type is positive, because an eastward shift expands the LSZ area. In a wet water year, the LSZ monthly average changes due to the TSP varied from -284 to +417 acres, with the largest adverse change on a given day being a reduction of several percent. Overall, we consider the worst case negative effect of the TSP on monthly average LSZ area to be limited.

The 159.5 ac habitat increase in restored tidal area, the sum of the portions attributable to placement of the full volume of dredged material at Cullinan Ranch and Montezuma Wetlands, would provide those benefits consistently, throughout all year types. Although these placement sites are not the same kinds of habitat as that which is impacted, including shallow waters east of the Benecia Bridge we have designated Resource Category 2, Policy exception to the "no net loss of in-kind habitat value" planning goal for Resource Category 2 is permissible when (FR 46 (15) 7658): "(1) different habitats and species available for replacement are determined to be of greater value than those lost, or (2) in-kind replacement is not physically or biologically attainable in the ecoregion section." In this instance, we believe that habitat creation in the proposed placement sites (Cullinan and Montezuma) has value to the ecoregion. This finding is based on our best judgement of a comparison of the gains and losses, the range of species affected, and information on the likelihood of benefit. In its ranking of 40 sites based on a variety of likely benefits, the Corps ranked Montezuma #1 and Cullinan #10, with Montezuma highest based on the benefits to listed species, particularly fishes, in the entrapment zone (Corps 2011). Cullinan will likely have the most benefits to listed marsh wildlife species not specifically recognized in Corps (2011). Further benefits are expected from the production and export of vascular plant and attached algae from restored marsh to bay waters, which we expect to enhance fishery resources.

Placement of material at Cullinan Ranch is currently limited to smaller draft scows that can navigate Dutchman Slough. Larger capacity scows (or more scows and dredges) could be used, and the project could possibly be completed faster if an offloading facility were positioned near the confluence of Dutchman Slough with the Napa River (such a facility is described in the permit for Cullinan Ranch, but is not yet constructed for lack of funds). Faster construction is desirable from the standpoint of completing the restoration, as well as limiting the temporary effects of constructing the ship channel. In fact, the process described in the GRR/EIS to achieve the 4.6 month construction timeline assumes 2 dredge plants and tugs, 4 scows, and an offloading facility at Cullinan similar in capability to that at Montezuma (Corps 2019).

CONCLUSION

The proposed San Francisco Bay to Stockton Navigation Improvement project will have localized temporary effects on fish and wildlife resources, including the listed delta smelt, during dredging activities and, under certain conditions depending on water year type and month, a limited permanent effect on X2 and the LSZ through the effect of channel depth on salinity distribution. The project will generate a quantity of relatively clean dredged material that is suitable for use at two permitted tidal restoration sites where it would yield near term benefits to wildlife and ecological processes generally, while improving navigation safety and efficiency. Accordingly, we recommend the TSP be implemented as proposed.

RECOMMENDATIONS

We recommend the Corps:

1. Construct the TSP as proposed (-38 feet MLLW channels; -42 feet MLLW sediment trap; 2 feet overdepth; rock obstruction removal; placement of 1.44 mcy at Cullinan Ranch and 0.16 mcy at Montezuma Wetlands); should the Corps be unable to construct the project in the dredge volume allocation described, the Service would support any alternative allocation up to the full volume at either Cullinan or Montezuma.

2. Minimize the timeframe for project construction by reasonable means, such as the use of larger capacity scows, additional scows and dredges, and/or additional offloading equipment;

3. Evaluate effects of the project on listed species and complete consultation as appropriate with the Service and National Marine Fisheries Service, including incorporating into the project any additional measures required to minimize or offset these effects.

4. Evaluate placement of dredged material from maintenance of the proposed project for beneficial purposes such as habitat restoration.

REFERENCES

Acta [Acta Environmental, Inc.]. 2018. Report on Biological Surveys, 2015-2017. Montezuma Wetlands Project. Solano County, California. Prepared by Acta Environmental, Inc., San Francisco, California, for Montezuma Wetlands LLC. April 20, 2018. 27 pp + 6 summary tables.

Anchor QEA [Anchor QEA, LLC]. 2019. San Francisco Bay to Stockton Navigation Improvement Project. Hydrodynamic and Salinity Intrusion Modeling Report. Final Draft. Prepared by Anchor QEA, LLC, San Francisco, California for U.S. Army Corps of Engineers, Sacramento District. April 2019. 207 pp.

Corps [U.S. Army Corps of Engineers]. 2011. San Francisco Bay Regional DMMP District Review Draft: Beneficial Use Options Screening. U. S. Army Corps of Engineers, San Francisco District. December 2, 2011. 148 pp.

_____. 2019. Draft Integrated General Reevaluation Report and Environmental Impact Statement. San Francisco Bay to Stockton, California, Navigation Improvement Project. U. S. Army Corps of Engineers, Jacksonville District. April 2019 (distributed May 10, 2019). 264 pp (Main Report) + appendices.

Jassby, A.D., W. J. Kimmerer, S.G. Monismith, C. Armor, J.E. Cloern, T.M. Powell, J.R. Schubel and T.J. Vendlinski. 1995. Ecological Applications 5: 272-289

Levine-Fricke. 1995. Montezuma Wetlands Project. Ecological resources mitigation and restoration plan. Submitted to U.S. Army Corps of Engineers, Regulatory Branch, in support of a permit application under Public Notice 19405E26. Emeryville, California. August 10, 1995. 75 pp + figures and appendices.

MacWilliams, M. L. 2018. Salinity Modeling Efforts & Results. Presentation by Dr. MacWilliams. pp. 21-64 *in* San Francisco Bay to Stockton Navigation Study Workshop. Powerpoint presentation by Michael MacWilliams, Principal Engineer, Anchor QEA. San Francisco, California. December 7, 2018.

Service [U.S. Fish and Wildlife Service]. 1997. San Francisco Bay to Stockton Deepwater Ship Channel (J. F. Baldwin) Phase III. Revised Draft Fish and Wildlife Coordination Act Report prepared by U.S. Fish and Wildlife Service, Ecological Services, Sacramento, California, for U.S. Army Corps of Engineers, San Francisco District. May 29, 1997. 87 pp + appendices.

Washburn, N. 2018. Cullinan Ranch Restoration Project Monitoring Report: 2015-2017. Prepared by Ducks Unlimited, Inc., Vallejo, California for San Francisco Bay and Development Commission, U.S. Army Corps of Engineers, and San Francisco Bay Regional Water Quality Control Board. March 31, 2018. 10 pp.

APPENDIX A. Worksheet showing calculation of benefit of accelerating completion of restoration actions at Cullinan Ranch or Montezuma Wetlands phase II and proportion of total benefit (area and habitat value) associated with volume of material placed from SFBSNIP project

1. This part is a test calculation of benefits of habitat restoration acceleration due to availability of dredged material from the SFBSNIP at Cullinan Ranch.

Scenario: this calculates benefits assuming that the dredged material from the ship channel accelerates completion of Cullinan Ranch by 2 years. This is a rough calculation given the uncertainty about actual dredged material volume; range of benefit would be 1 to 4 or more years.

TY	0	1	2	3	4	8	10	51	notes:
HSIw/o	0	0	0	0	0.1	0.8	1	1	This scenario breaches in year 4, and reaches maximum value by year 10.
HSI w/	0	0	0.1	0.2	0.3	1	1	1	This scenario breaches in year 2, assumes SFBSNIP accelerates completion by 2 years, and reaches maximum value in year 8.
area w/o	280	280	280	280	280	280	280	280	
area w/	280	280	280	280	280	280	280	280	
HUs w/o		0	0	0	14	504	504	11480	
HUs w/		0	14	42	70	728	560	11480	
AAHUs without								245.1	
AAHUs with								252.8	
change due to project								7.7	This value represents the benefit of SFBSNIP accelerating completion of Cullinan by 2 years

Assumptions:

It takes 6 years after breaching to reach full tidal value, assuming rapid vegetation due to filling near the vegetation threshold elevation.

The restoration project has limited value the first year after breaching.

The amount of dredged material is probably on the order of 1 mcy; since in practice about 10-15% of unpaid overdepth is actually dredged.

The 1.44 mcy of dredged material going from SFBSNIP to Cullinan with the project would take 2 years to obtain from other sources without the project.

It would take 1 season to complete the ship channel dredging; that is, breaching in TY2.

2. This part is a test calculation of benefits of habitat restoration acceleration due to availability of dredged material if all of the material from SFBSNIP were placed at Montezuma Wetlands.

Scenario: this calculates benefits of alternatively using the full amount at Montezuma Wetlands, which would accelerate completion there by about 2 years.

This is based on the recent (2012-2017) fill rate of Montezuma; of 3.376 mcy over the last 6 years, or about 0.56 mcy/year (Acta 2018).

With .56 mcy/yr, it would take about 8 years to fill phase II of that site and breach it, without the project.

If all of the ship channel material were to go to Montezuma it is assumed to take 1 year or less for that dredging, since Montezuma can take larger scows.

At the time of dredging of the ship channel, 2023, Montezuma phase II is assumed to be half full.

Assume that if the ship channel material were to go to Montezuma, it would be completed in 2 fewer years (TY1), compared to 2 more years without that material (TY3); breaching would occur the year after completion.

TY	0	1	2	3	4	12	14	51
HSIw/o	0	0	0	0	0.1	0.8	1	1
HSI w/	0	0	0.1	0.2	0.3	1	1	1
area w/o	424	424	424	424	424	424	424	424
area w/	424	424	424	424	424	424	424	424
HUs w/o		0	0	0	21.2	1526.4	763.2	15688
HUs w/		0	21.2	63.6	106	2204.8	848	15688
AAHUs without								352.9
AAHUs with								371.2
change due to project								18.3

notes:
This scenario finishes Montezuma ph II in TY4, reaches maximum value by TY14.
This scenario breaches Montezuma ph II in TY2, assume SFBSNIP accelerates by 2 yrs.

Assumptions:

It takes 10 years after breaching to reach full tidal habitat value, slower than Cullinan due to larger unit size and not filling as close to vegetative threshold elevation.

It has limited value the first year after breaching.

The with-project 1.44 mcy of SFBSNIP dredged material going to Montezuma would take 2 years to obtain from other sources without the project.

3. This part estimates the restoration benefit, in area or value, associated with the volume of material coming from the ship channel as a fraction of the total benefit for disposal at Cullinan Ranch (CR) and Montezuma Wetlands (MZ) for SFBSNIP sediments.

Range of sediment volume varies from possible (high, includes all overdepth) to likely (lower, with assumptions)
High - 1.60 mcy (assumes full dredging down to 2 feet overdepth; 1.44 mcy PSC, 0.04 mcy BHR, 0.12 mcy sed trap)
Likely - ~1.03 mcy (assumes 85-90% of paid overdepth, i.e., to 1 ft, and 10-15% of unpaid overdepth, i.e., between 1-2 feet below 38 MLLW)
Would consist of 1 mcy from PSC, and 0.03 mcy (30,000) in BHR + sed trap
Note: the "high" dredged volume is from the May 2019, General Reevaluation Report
and the "likely" volume was derived from 12/7/18 workshop comments by David Doak, USACE, San Francisco District.

Proportion of restored AREA benefits under potential scenarios due to SFBSNIP ship channel dredged material:

	ACRES As proposed, both CR	ACRES MZ	ACRES All to MZ
High:	134.4	15.1	226.1
Likely:	96.1	2.8	145.6

note: calculated as ship channel volume/total placement site volume * total placement site area

Proportion of habitat VALUE benefits for ship channel sediments to restoration sites under potential scenarios:

	AAHUs As proposed, both CR	AAHUs MZ	AAHUs All to MZ
High volume:	1.44	0.16	1.60
Likely volume:	1.00	0.03	1.03
High Benefit:	121.6	13.2	198.5
Likely Benefit:	84.4	2.5	127.8

ACRONYMS:

AAHUs - Average Annualized Habitat Units
BHR - Bulls Head Reach
CR - Cullinan Ranch
HSI - Habitat Suitability Index
HU - Habitat Units
mcy - million cubic yards
MZ - Montezuma Wetlands
PSC - Pinole Shoal Channel
SFBSNIP - San Francisco Bay to Stockton Navigation Improvement Project
TY - Target Year

United States Department of the Interior

FISH AND WILDLIFE SERVICE
San Francisco Bay Delta Fish and Wildlife Office
650 Capitol Mall 8th floor 8-300
Sacramento, California 95814

In Reply Refer to:
08-FBDT00-
2019-F-0202

OCT 03 2019

Angela E. Dunn
Chief, Environmental Branch
U. S. Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, FL 95814

Subject: Biological Opinion on the San Francisco Bay to Stockton Navigation Improvement Project

Dear Ms. Dunn:

We are writing in response to your May 10, 2019, letter requesting consultation under the Endangered Species Act for the San Francisco Bay to Stockton Navigation Improvement Project (proposed project). At issue are the effects of the proposed project on the federally listed as threatened delta smelt (*Hypomesus transpacificus*) (smelt) and its critical habitat. Your letter with supportive materials (Biological Assessment (BA) and draft General Reevaluation Report and Environmental Impact Statement, both dated April 2019) was received in our office on May 9, 2019. The proposed project is a Federal project with the U.S. Army Corps of Engineers (Corps) as the Federal lead agency and the Port of Stockton as the lead non-Federal partner. The proposed project involves deepening the Pinole Shoal Channel and Bulls Head Reach sections of the J. F. Baldwin ship channel to -38 feet mean lower low water (MLLW), dredging a 2,600-foot-long sediment trap in the Bulls Head Reach to -42 feet MLLW, transport and placement of 1.6 million cubic yards of dredged material at two permitted beneficial reuse sites for the purpose of habitat restoration (Cullinan Ranch and Montezuma Wetlands), and leveling of a small rock outcrop to the west of the Pinole Shoal Channel to -43 feet MLLW. The project is expected to take about 4.6 months to complete. In your May 10, 2019 letter, the Corps determined that the project may affect but is not likely to adversely affect the smelt and its critical habitat and requested the U.S. Fish and Wildlife Service's (Service) concurrence. We did not concur for reasons stated in our letter of May 21, 2019, and commenced formal consultation. The findings in this consultation are based on information in the BA, the final salinity modeling report (Anchor QEA 2019), and communications with Corps staff and consultants.

CONSULTATION HISTORY

May 9, 2019: The Service receives Corps May 10, 2019, letter requesting consultation and concurrence with not likely to adversely affect finding for smelt and smelt critical habitat.

May 10, 2019: Corps emails the Service the final salinity modeling report (Anchor QEA 2019).

May 21, 2019: The Service transmits letter explaining that the magnitude of change in the low salinity zone as a result of the proposed project could result in take of smelt and, therefore, the Service does not concur with the Corps' not likely to adversely affect finding, formal consultation is necessary, and the information provided is sufficient to proceed with formal consultation.

June 11, 2019: The Service meets with Corps and its consultant to discuss final salinity modeling report.

BIOLOGICAL OPINION

Description of the Action

The Corps proposes to deepen portions of the J.F. Baldwin Ship Channel, specifically, 10.3 miles of the Pinole Shoal Channel (stations 0+00 to 548+00), located in San Pablo Bay, and 2.9 miles of the Bulls Head Reach to Avon (stations 0+00 to 62+00 and 88+00 to 159+00), located in Suisun Bay. The proposed action would deepen these sections from -35 feet MLLW plus 2 feet of overdepth (OD) to -38 feet MLLW +2 feet OD. Another 0.5 mile long section in the Bulls Head Reach would be deepened to -42 feet MLLW +2 feet OD to function as a sediment basin to provide advance maintenance dredging and reduce the need for emergency dredging of this high shoaling area (stations 62+00 to 88+00). This dredging would yield a total of 1.6 million cubic yards (mcy) of dredged material, which would be transported by scow to two wetland restoration sites, Cullinan Ranch and Montezuma Wetlands, where it would be placed to achieve target elevations needed for restoration. The Pinole Shoal sediments, about 1.44 mcy, would be placed at Cullinan Ranch, and the Bulls Head Reach sediments, about 0.16 mcy, would be placed at Montezuma Wetlands. At the downstream end of the Pinole Shoal Channel, a small rock outcrop would be lowered to -43 feet MLLW with a pneumatic jackhammer (950 square feet; 40 cubic yards). It is expected to take about 4.6 months to complete the project; 3.5 months for the Pinole Shoal Channel dredging (June 1 - November 30 work window), another month plus for the Bulls Head Reach dredging (August 1 - November 30 work window), and several days for the rock outcrop work. The project would commence in about 2023. Maintenance dredging would be done every 1-2 years after completion, with an estimated 50% increase in dredged material volume (an extra 78,000 cubic yards) compared to existing conditions. Emergency dredging is expected to decrease by an unspecified frequency and volume, due to construction of the sediment basin.

Conservation Measures

- The duration of the dredging will be minimized through the use of multiple dredge plants and/or scows where possible;
- Mechanical clamshell dredging is proposed to minimize entrainment risk to listed fishes;
- Dredged material placement will maximize beneficial use for habitat restoration;

- Work windows from the existing LTMS programmatic dredging Biological Opinion will be followed to minimize effects to listed salmonids and green sturgeon;
- Salinity-modeling was done to select an appropriate design depth that would achieve project objectives while minimizing effects on the low salinity zone, a region considered important for listed fishes including delta smelt.

Action Area

The action area is defined in 50 CFR §402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the proposed project, this means all areas directly or indirectly affected by the deepening or maintenance of the deepened ship channel, including the dredge footprint in the shipping channels, the placement sites on Cullinan Ranch and Montezuma Wetlands, and maximum extent of the effect of the deepening on the salinity distribution within the upper San Francisco Estuary.

Analytical Framework for the Jeopardy Determination

Section 7(a)(2) of the Act requires that Federal agencies ensure that any action they authorize, fund or carry out, is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of..." means to engage in an action that would reasonably be expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing reproduction, numbers, or distribution of that species (50 CFR §402.02).

The jeopardy analysis in this biological opinion considers the effects of the proposed Federal action and any cumulative effects on the rangewide survival and recovery of the listed species being consulted on. There are four components of this analysis for each species: (1) the *Status of the Species*, which evaluates the species' range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the species.

Analytical Framework for the Adverse Modification Determination

Section 7(a)(2) of the Act requires that Federal agencies ensure that any action they authorize, fund, or carry out, is not likely to destroy or adversely modify designated critical habitat. A final rule revising the regulatory definition of "destruction or adverse modification" was published on February 11, 2016 (81 **FR** 7214), and became effective March 14, 2016. The revised definition states:

> "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the

> physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features."

The destruction or adverse modification analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of critical habitat providing for the conservation of the listed species, the factors responsible for that condition, and the intended value of the critical habitat overall for the conservation/recovery of the species; (2) the *Environmental Baseline*, which analyzes the condition of the critical habitat in the action area, the factors responsible for that condition, and the value of the critical habitat in the action area for the conservation/recovery of the species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities and how those impacts are likely to influence the conservation value of the affected critical habitat units and; (4) *Cumulative Effects*, which evaluates the effects of future non-Federal activities that are reasonably certain to occur in the action area and how those impacts are likely to influence the conservation value of the affected critical habitat units.

For purposes of the adverse modification determination, the Service evaluates if the effects of the proposed Federal action together with cumulative effects are likely to impair or preclude the capacity of critical habitat in the action area to serve its intended function, to an extent that it appreciably diminishes the range-wide value of that critical habit for conservation of the species. The key to making this finding is understanding the value of the critical habitat in the action area for the conservation/recovery of the listed species based on the *Environmental Baseline* analysis.

Status of the Species and Critical Habitat

<u>Delta Smelt</u>

Legal Status

The Service proposed to list the delta smelt (*Hypomesus transpacificus*) as threatened with proposed critical habitat on October 3, 1991 (Service 1991). The Service listed the delta smelt as threatened on March 5, 1993 (Service 1993), and designated critical habitat for the species on December 19, 1994 (Service 1994). The delta smelt was one of eight fish species addressed in the *Recovery Plan for the Sacramento–San Joaquin Delta Native Fishes* (Service 1996). A 5-year status review of the delta smelt was completed on March 31, 2004 (Service 2004). The 2004 review concluded that delta smelt remained a threatened species. A subsequent 5-year status review recommended uplisting delta smelt from threatened to endangered (Service 2010a). A 12-month finding on a petition to reclassify the delta smelt as an endangered species was completed on April 7, 2010 (Service 2010b). After reviewing all available scientific and commercial information, the Service determined that re-classifying the delta smelt from a threatened to an endangered species was warranted but precluded by other higher priority listing actions (Service 2010c). The Service annually reviews the status and uplisting recommendation for delta smelt during its Candidate Notice of Review (CNOR) process. Each year, the CNOR has recommended the uplisting from threatened to endangered. Electronic copies of these documents are available at http://ecos.fws.gov/docs/five_year_review/doc3570.pdf and http://www.gpo.gov/fdsys/pkg/FR-2013-11-22/pdf/2013-27391.pdf (Service 2010a; Service 2010b; Service 2012).

Description and Life Cycle

The delta smelt is a small fish of the family Osmeridae. It is endemic to the upper San Francisco Estuary where it primarily occupies open-water habitats in Suisun Bay and marsh and the Sacramento-San Joaquin Delta (Delta). The delta smelt is primarily an annual species, meaning that it completes its life cycle in one year which typically occurs from April to the following April plus or minus one or two months. In captivity delta smelt can survive to spawn at two years of age (Lindberg *et al.* 2013), but this appears to be rare in the wild (Bennett 2005). Very few individuals reach lengths over 3.5 inches (90 millimeters [mm]).

Delta Smelt Population Trend

The California Department of Fish and Wildlife's (CDFW) Summer Townet Survey (TNS) (http://www.dfg.ca.gov/delta/data/townet/indices.asp?species=3) and Fall Midwater Trawl (FMWT) Survey (http://www.dfg.ca.gov/delta/data/fmwt/indices.asp) are the two longest running indicators of the delta smelt's abundance trend. Indices of delta smelt relative abundance from these surveys date to 1959 and 1967, respectively (Figures 1 and 2). The FMWT index has traditionally been the primary indicator of delta smelt trend because it samples later in the life cycle, providing a better indicator of annual recruitment than the TNS (Service 1996). It has also sampled more consistently and more intensively than the TNS. The FMWT deploys more than 400 net tows per year over its four-month sampling season (September through December). The highest FMWT index for delta smelt (1,673) was recorded in 1970 and a comparably high index (1,654) was reported in 1980 (Figure 2). The last FMWT index exceeding 1,000 was reported in 1993. The last FMWT indices exceeding 100 were reported in 2003 and 2011. In 2018, the FMWT index was zero for the first time. The TNS index for delta smelt has been zero four times since 2015. Thus, the TNS and FMWT have recorded a 40-50 year decline in which delta smelt went from a minor (but common) species to essentially undetectable by these long-term surveys (Figures 1-3).

Following the ESA listing of the delta smelt, the CDFW launched a 20-mm Survey (1995) and a Spring Kodiak Trawl Survey (SKT; 2002) to monitor the distribution and relative abundance of late larval stage and adult delta smelt, respectively. These newer indices have generally corroborated the trends implied by the TNS and the FMWT. The Service recently completed a new delta smelt abundance indexing procedure using data from all four of these surveys (Polansky *et al.* 2018). The CDFW methods generate abundance indices from each survey but each index is on a different numeric scale. This means the index number generated by a given survey only has quantitative meaning relative to other indices generated by the same survey. Further, the CDFW indices lack estimates of uncertainty (variability) which limits interpretation of abundance changes from year to year even within each sampling program. The Service method improves upon the CDFW method because it generates abundance indices in units of numbers of fish, including attempts to correct for different sampling efficiencies among surveys, and the method includes measures of uncertainty. Service indices of spawner abundance based on combined January and February SKT sampling are listed with their confidence intervals in

Table 1. The estimates show the most recent 18 years of the delta smelt's longer-term decline in numbers of fish as best as they can be approximated with currently available information. The 2019 abundance estimate of 5,610 is the lowest on record, though the upper confidence limit for the 2019 estimate overlaps the lower confidence limits from 2016 and 2018. This indicates there is more than a five percent chance that the 2019 abundance index is not different from 2016 and 2018. Regardless of this recent year uncertainty, the 2019 abundance index is much lower than peak abundance estimates in Table 1 which themselves are all based on data streams that started after the species had already declined considerably (Figures 1-3).

Table 1. Adult delta smelt spawner abundance estimate and SKT catch data for Water Year (WY) 2002-2019.

			95% Confidence Interval			**Number of Delta Smelt Caught in the SKT Survey**		
Year	Abundance Estimate	Standard Error	Lower Bound	Upper Bound		January	February	Year-to-Year Ratio
2002	1,093,244	195,329	760,332	1,523,294		262	394	NA
2003	996,055	261,205	581,197	1,597,198		NA	232	0.91
2004	966,981	262,190	553,729	1,573,002		380	300	0.97
2005	715,858	147,190	470,572	1,044,828		220	218	0.74
2006	272,327	42,400	198,681	364,438		44	84	0.38
2007	449,466	128,731	249,216	749,168		109	107	1.65
2008	509,428	188,396	236,859	963,839		132	36	1.13
2009	1,166,145	523,856	459,083	2,464,804		579	61	2.29
2010	251,863	54,580	161,753	374,582		88	57	0.22
2011	461,599	202,547	185,712	962,088		177	128	1.83
2012	1,177,201	328,682	662,728	1,939,836		320	287	2.55
2013	333,682	89,809	191,886	541,064		100	125	0.28
2014	308,972	91,474	167,858	522,884		148	55	0.93
2015	213,345	76,639	101,434	397,439		21	68	0.69
2016	25,445	9,584	11,661	48,622		7	6	0.12
2017	73,331	23,342	38,010	128,459		18	8	2.88
2018	26,649	21,397	5,215	82,805		10	4	0.36
2019	5,610	4,395	1,138	17,135		1	1	0.21

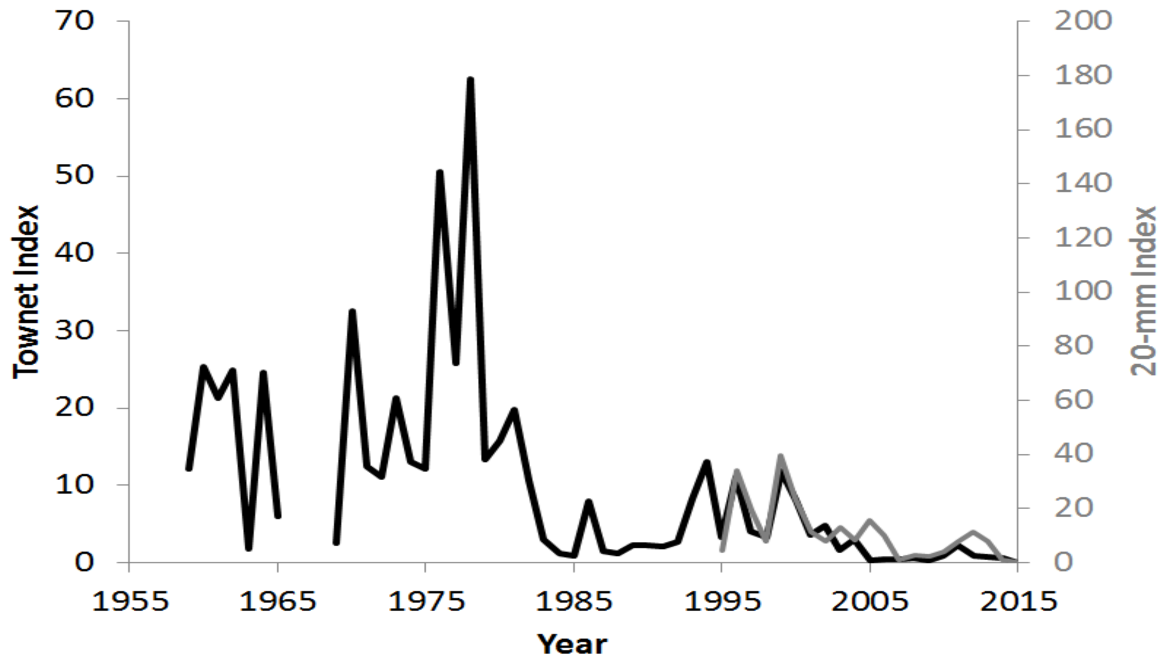

Figure 1. Time series of the CDFW's summer TNS (black line; primary y-axis) and 20-mm Survey (gray line; secondary y-axis) abundance indices for delta smelt.

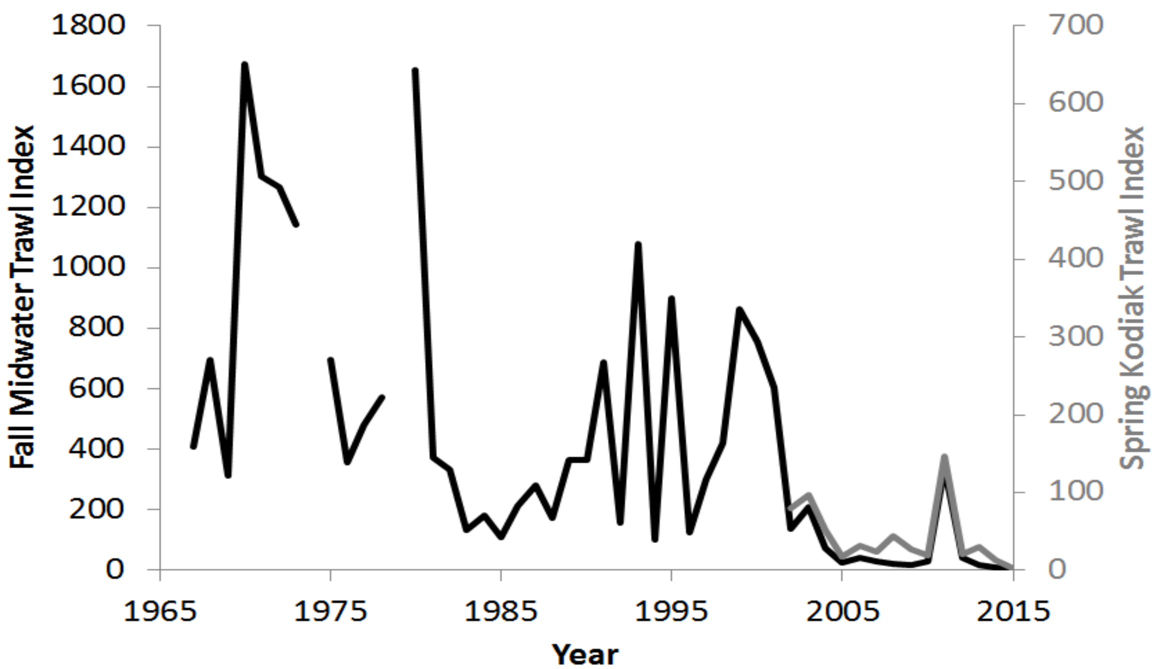

Figure 2. Time series of the CDFW's FMWT (black line; primary y-axis) and SKT (gray line; secondary y-axis) abundance indices for delta smelt.

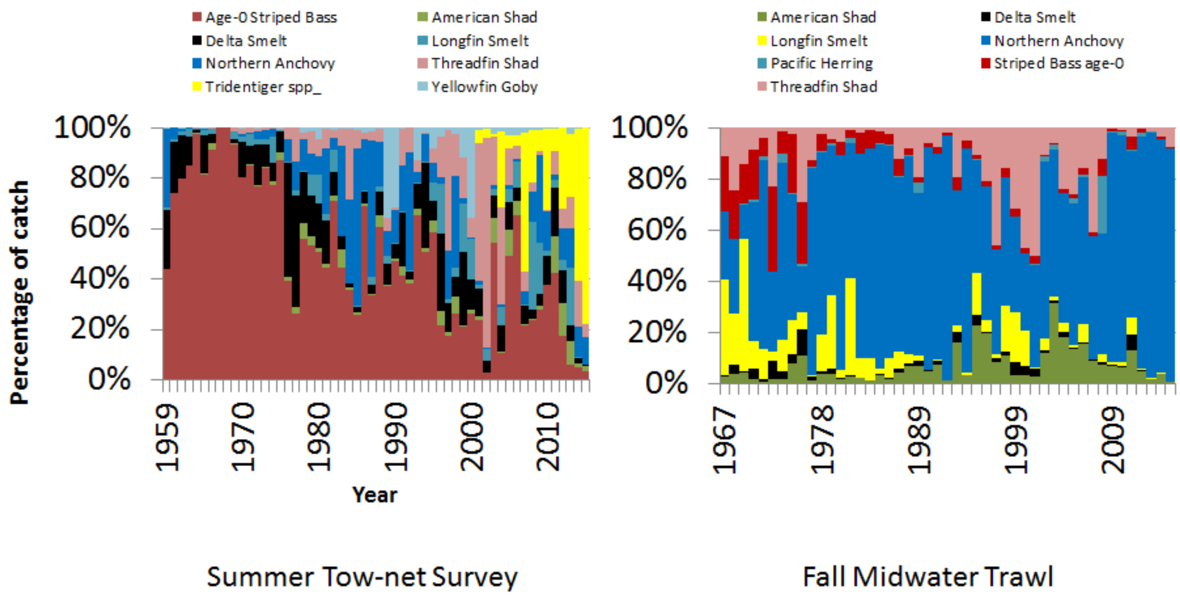

Figure 3. Fractional compositions of the eight most frequently collected fish species in the CDFW's summer TNS (1959-2015), and the seven most frequently collected fish species in the FMWT (1967-2015).

The long-term rarity of the delta smelt has had a consequence for understanding the reasons for their population decline, which generates uncertainty about how resource managers should intervene. Some fishes have shown long-term relationships between Delta inflow, Delta outflow and their abundance or survival (Stevens and Miller 1983; Jassby *et al.* 1995; Kimmerer 2002b; Kimmerer *et al.* 2009). There does seem to be some difference in the likelihood of whether the delta smelt population will increase or decrease in abundance from one year to the next based on hydrology (Figure 4), but there has never been any predictable relationship linking freshwater flow conditions to the relative abundance of delta smelt (Stevens and Miller 1983; Jassby *et al.* 1995; Kimmerer 2002b; Kimmerer *et al.* 2009). Recently, several teams of researchers have built several varieties of conceptual (Interagency Ecological Program [IEP] 2015) and mathematical (Thomson *et al.* 2010; Maunder and Deriso 2011; Miller *et al.* 2012; Rose *et al.* 2013a) life cycle models for the delta smelt that attempt to describe the reasons the population has declined. Some of these models have been able to recreate the trend observed in abundance indices very well (Figure 5), but they have done so using different approaches and different variables. Collectively, these modeling efforts have been helpful in that they generally support water temperature and changes in the estuary's food web as 'universally supported' factors affecting delta smelt. However, they have also come to very different conclusions about the conservation value of more readily manageable factors like water project operations.

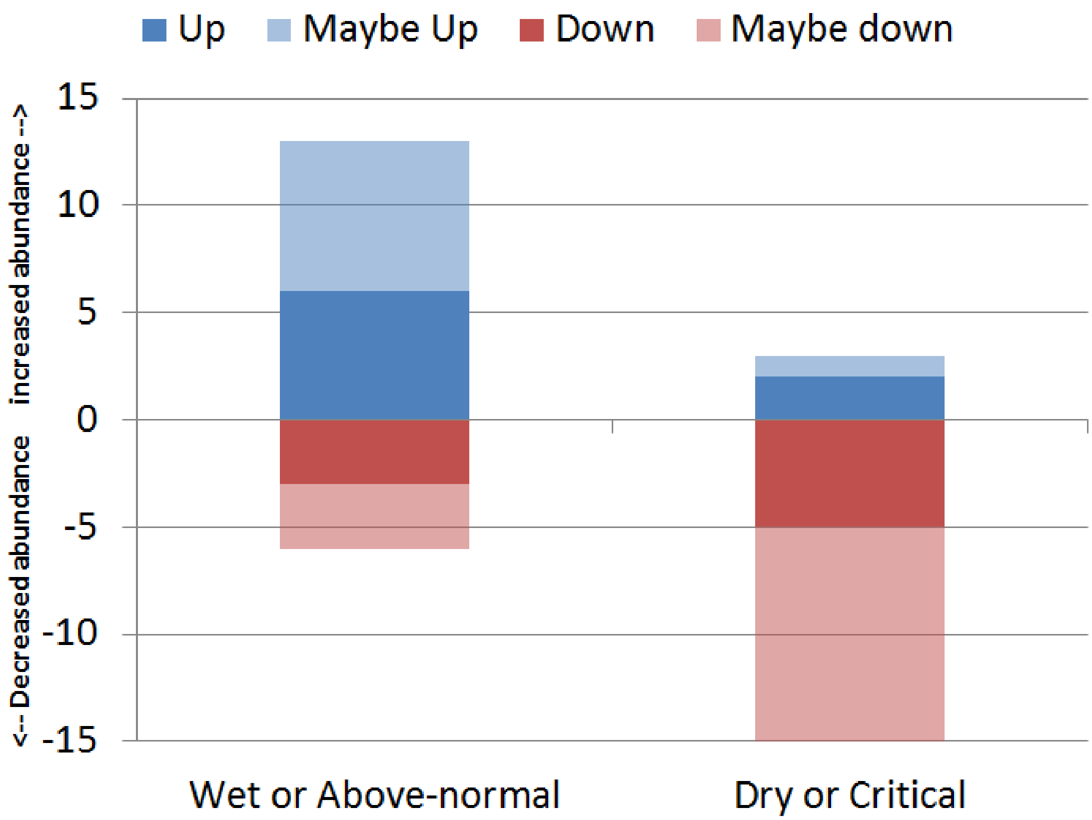

Figure 4. Frequencies of delta smelt population increases or decreases (red colored portions of each bar occurring below zero) based on the CDFW's FMWT Survey, 1967-2015. A population increase reflects an increase in relative abundance over the prior year's index and a population decrease reflects a decrease in relative abundance compared to the prior year's index. The Service performed bootstrap resampling on each year's catch per tow to generate a mean catch per tow with 95 percent confidence intervals. This resulted in four possible outcomes: (1) a statistically significant increase in relative abundance from one year to the next in which the confidence intervals of the two years did not overlap ("Up"; solid blue bar segments), (2) a statistically non-significant increase in relative abundance from one year to the next in which the confidence intervals of the two years overlapped ("Maybe Up"; lighter blue bar segments), (3) a statistically significant decrease in relative abundance from one year to the next in which the confidence intervals of the two years did not overlap ("Down"; solid red bar segments), or (4) a statistically non-significant decrease in relative abundance from one year to the next in which the confidence intervals of the two years overlapped ("Maybe Down"; lighter red bar segments). The counts in each of the four categories were combined by Sacramento Valley WY types except that below-normal years were not plotted. The frequencies of population decline were converted into a negative number so that population increases would count up from the zero line on the y-axis and population decreases would count down from the zero line.

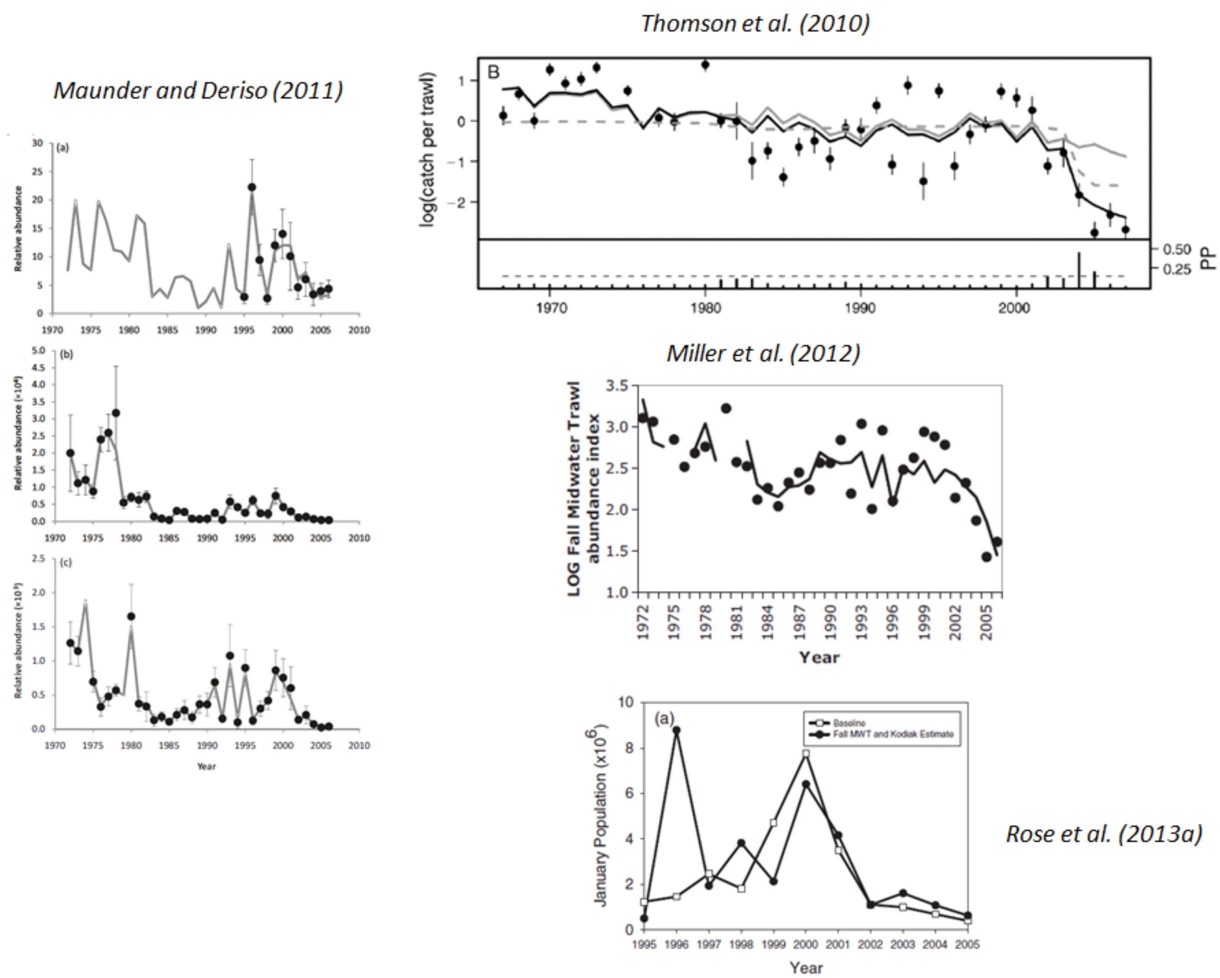

Figure 5. Examples of recent published model fits to time series of delta smelt relative abundance data. The source of each is referenced above or alongside each time series. In each plot, observed catches are depicted as black dots and model predictions of the data as gray or black lines. Model predictions from Rose *et al.* (2013a) are a black line with open symbols. In Maunder and Deriso (2011), the three panels represent the 20-mm Survey, summer TNS, and FMWT Survey from top to bottom, respectively. The other three studies are fit to estimates of adult delta smelt relative abundance (FMWT catch in Thomson *et al.* 2010 and the FMWT index in Miller *et al.* 2012) or absolute abundance (Rose *et al.* 2013a). See each study for further details on Methods, Results, and the authors' interpretations of their results.

Habitat and Distribution

Because the delta smelt only lives in part of one comprehensively monitored estuary, its general distribution is well understood (Moyle *et al.* 1992; Bennett 2005; Hobbs *et al.* 2006, 2007; Feyrer *et al.* 2007; Nobriga *et al.* 2008; Kimmerer *et al.* 2009; Merz *et al.* 2011; Murphy and Hamilton 2013; Sommer and Mejia 2013). There are both location-based (*e.g.*, Sacramento River around Decker Island) and conditions-based (low-salinity zone) habitats that delta smelt permanently occupy. There are habitats that delta smelt occupy seasonally (*e.g.*, for spawning), and there are habitats that delta smelt occupy transiently, which we define here as occasional seasonal use. These include distribution extremes from which delta smelt are not collected every year or even in most years.

Most delta smelt complete their entire life cycle within or immediately upstream of the estuary's low-salinity zone. The low-salinity zone is frequently defined as waters with a salinity range of about 0.5 to 6 parts per thousand (ppt) (Kimmerer 2004). The 0.5 to 6 ppt and similar salinity ranges reported by different authors were chosen based on analyses of historical peaks in phytoplankton and zooplankton abundance, but recent physiological and molecular biological research has indicated that the salinities that typify the low-salinity zone are also optimal for delta smelt (Komoroske *et al.* 2016). The low-salinity zone is a dynamic habitat with size and location that respond rapidly to changes in tidal and river flows. By local convention the location of the low-salinity zone is described as "X2" in terms of the distance from the 2 ppt isohaline to the Golden Gate Bridge. The U.S. Environmental Protection Agency (EPA) recently finished a comprehensive set of maps that show how the low-salinity zone changes in size and shape when freshwater flows change the location of X2[1]. The low-salinity zone expands and moves downstream when river flows into the estuary are high, placing low-salinity water over a larger and more diverse set of nominal habitat types than occurs under low flow conditions. During periods of low outflow, the low-salinity zone contracts and moves upstream. Due to its historical importance as a fish nursery habitat, there is a long research history into the physics and biology of the San Francisco Estuary's low-salinity zone (Kimmerer 2004).

The ecological function of the low-salinity zone also varies depending mainly on freshwater flow (Jassby *et al.* 1995; Kimmerer 2002a; Kimmerer 2004). Low outflow can decrease the capacity of the low-salinity zone and adjacent habitats to support the production of delta smelt by reducing habitat diversity and concentrating the fish with their predators and competitors (Service 1993, 1994). During the past four decades, the low-salinity zone ecosystem has undergone substantial changes in turbidity (Schoellhamer 2011) and food web function (Winder and Jassby 2011) that cannot be undone solely by increasing Delta outflow. These habitat changes, which extend into parts of the Delta where water is fresher than 0.5 ppt, have also decreased the ability of the low-salinity zone and adjacent habitats to support the production of delta smelt (Thomson *et al.* 2010; Rose *et al.* 2013b; IEP 2015).

Delta smelt have been observed as far west as San Francisco Bay, as far north as Knights Landing on the Sacramento River, as far east as Woodbridge on the Mokelumne River and Stockton on the Calaveras River, and as far south as Mossdale on the San Joaquin River. This distribution represents a range of salinity from essentially zero ppt up to about 20 ppt, which represents a salinity range well beyond definitions of the low salinity zone or mixing zone near a salinity of 2 ppt emphasized in the critical habitat rule (Service 1994). It is also well beyond the geographic extent of the critical habitat rule (described below). However, most delta smelt that have been collected in the extensively surveyed San Francisco Estuary have been collected from locations within the bounds defined in the critical habitat rule. In addition, all habitats known to be occupied year-around by delta smelt occur within the bounds defined in the critical habitat rule.

[1]http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_Delta/docs/cmnt081712/karen_schwinn.pdf

Delta smelt permanently occupy the Cache Slough 'Complex', including Liberty Island and the adjacent reach of the Sacramento Deepwater Shipping Channel (Sommer and Mejia 2013), Cache Slough to its confluence with the Sacramento River and the Sacramento River from that confluence downstream to Chipps Island, Honker Bay, and the eastern part of Montezuma Slough (Figure 6). The reasons delta smelt are believed to permanently occupy this part of the estuary are the year-round presence of fresh- to low-salinity water that is comparatively turbid and of a tolerable water temperature. These appropriate water quality conditions overlap an underwater landscape featuring variation in depth, tidal current velocities, edge habitats, and food production (Sweetnam 1999; Nobriga *et al.* 2008; Feyrer *et al.* 2011; Murphy and Hamilton 2013; Hammock *et al.* 2015; Bever *et al.* 2016). Field observations are increasingly supported by laboratory research that explains how delta smelt respond physiologically to variation in salinity, turbidity, water temperature, and other aspects of their habitat that can vary with changes in climate, freshwater flow and estuarine bathymetry (Hasenbein *et al.* 2014; 2016; Komoroske *et al.* 2014; 2016).

Each year, the distribution of delta smelt seasonally expands when adults disperse in response to winter flow increases that also coincide with seasonal increases in turbidity and decreases in water temperature (Figure 6). The annual range expansion of adult delta smelt extends up the Sacramento River to about Garcia Bend in the Pocket neighborhood of Sacramento, up the San Joaquin River from Antioch to areas near Stockton, up the lower Mokelumne River system, and west throughout Suisun Bay and Suisun Marsh. Some delta smelt seasonally and transiently occupy Old and Middle river in the south Delta each year, but face a high risk of entrainment when they do (Grimaldo *et al.* 2009).

The distribution of delta smelt occasionally expands beyond this area (Figure 6). For instance, during high outflow winters, adult delta smelt also disperse west into San Pablo Bay and up into the Napa River (Hobbs *et al.* 2007). Similarly, delta smelt have occasionally been reported from the Sacramento River north of Garcia Bend up to Knights Landing (*e.g.,* Merz *et al.* 2011; Vincik and Julienne 2012).

The expanded adult distribution initially affects the distribution of the next generation because delta smelt eggs are adhesive and not believed to be highly mobile once they are spawned. The distribution of larvae reflects a combination of where spawning occurred and freshwater flow conditions when the eggs hatched. Variation in Delta outflow affects the spatial distribution of the delta smelt population for most of its life. The ecological condition of the estuary's low-salinity zone has historically been indexed using a statistic called X2, a local name for the geographic location of 2 ppt salinity near the bottom of the water column (Jassby *et al*. 1995). During spring, larval delta smelt have centers of distribution in freshwater, typically 20-40 km upstream of X2 (Dege and Brown 2004). By July, as water temperatures in the Delta reach annual peaks, post-larval and juvenile delta smelt have centers of distribution very close to X2 (Dege and Brown 2004), but the fish are broadly distributed around that peak (Sweetnam 1999; Nobriga *et al.* 2008). During the fall, subadult delta smelt still have a center of distribution near X2 (Sommer *et al.* 2011), and remain broadly distributed around that peak (Feyrer *et al.* 2007; 2011). During the winter, maturing adult delta smelt disperse in connection with winter storms following the spread of turbid freshwater (Grimaldo *et al.* 2009; Sommer *et al.* 2011; Murphy and Hamilton 2013). Recent analyses suggest that after an initial dispersal in December, the

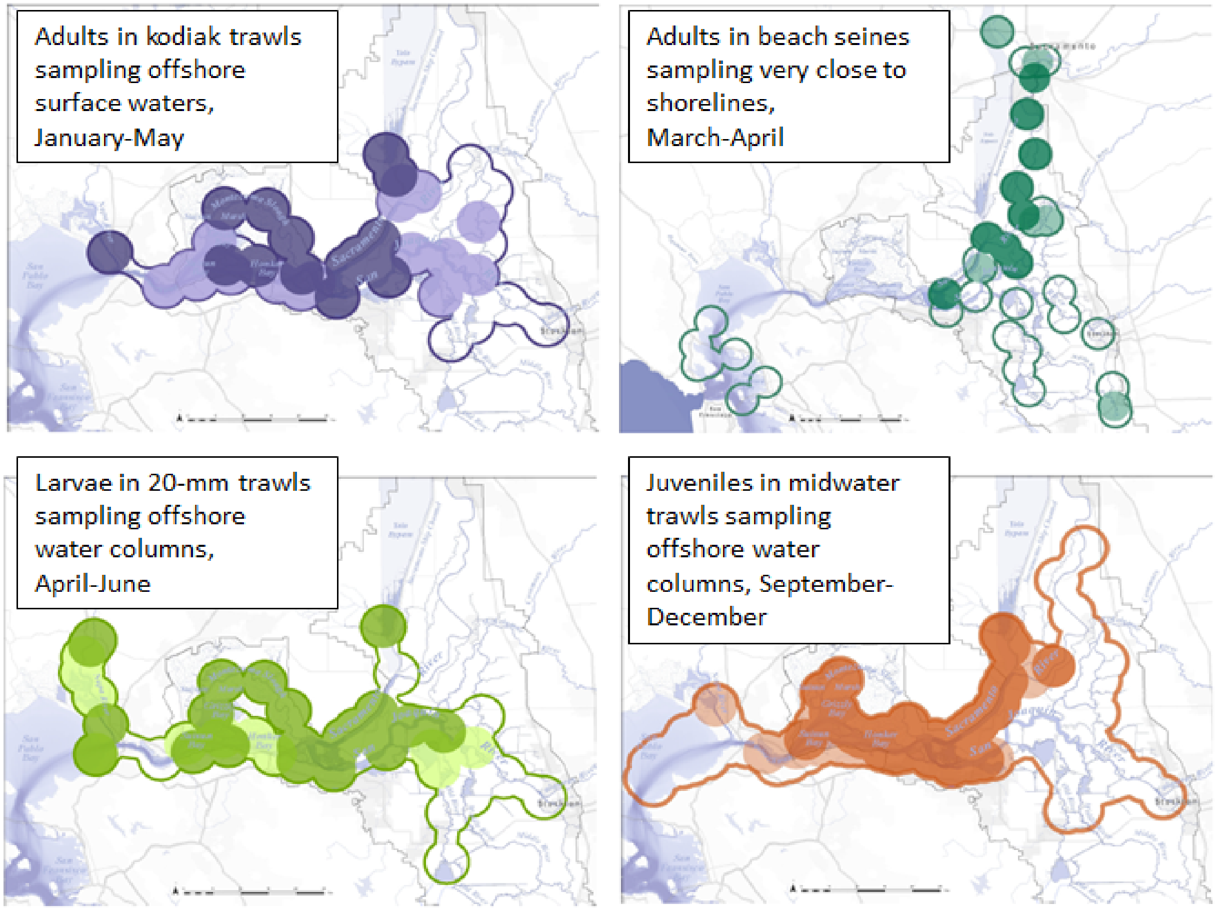

Figure 6. Maps of multi-year average distributions of delta smelt collected in four monitoring programs. The sampling regions covered by each survey are outlined. The areas with dark shading surround sampling stations in which 90 percent of the delta smelt collections occurred, the areas with light shading surround sampling stations in which the next 9 percent of delta smelt collections occurred. Source: Murphy and Hamilton (2013).

adult delta smelt population does not respond strongly to variation in Delta outflow during January to May (Polansky *et al.* 2018), though some individuals continue to move around in response to flow changes associated with storms (Polansky, unpublished analysis of Early Warning Survey data set).

Food

At all life stages, numerous small planktonic crustaceans, especially a group called calanoid copepods, make up most of the delta smelt diet (Nobriga 2002; Slater and Baxter 2014). Small crustaceans are ubiquitously distributed throughout the estuary, but which prey species are present at particular times and locations has changed dramatically over time (Winder and Jassby 2011; Kratina *et al.* 2014). This has likely affected delta smelt feeding success, particularly during Central California's warm summers.

Recovery and Management

Following Moyle *et al.* (1992), the Service (1993) indicated that SWP and CVP exports were the primary factors contributing to the decline of delta smelt due to entrainment of larvae and juveniles and the effects of low flow on the location and function of the estuary mixing zone (now called the low-salinity zone). In addition, prolonged drought during 1987-1992, in-Delta water diversions, reduction in food supplies by nonindigenous aquatic species, specifically overbite clam and nonnative copepods, and toxicity due to agricultural and industrial chemicals were also factors considered to be threatening the delta smelt. In the 2008 Service biological opinion on the CVP and SWP operations (2018 Service BiOP), the Service's Reasonable and Prudent Alternative required protection of delta smelt from entrainment in December through June and augmentation of Delta outflow during the fall of Wet or Above-Normal years as classified by the State of California (Service 2008). The expansion of entrainment protection for delta smelt in the 2008 Service BiOp was in response to large increases in juvenile and adult salvage in the early 2000s (Kimmerer 2008). The fall X2 requirement was in response to increased fall exports that had resulted in greatly reduced variability in Delta outflow during the fall months (Feyrer *et al.* 2011).

Consistent with the 2008 Service BiOp, the Service's (2010c) recommendation to uplist delta smelt from threatened to endangered included reservoir operations and water diversions upstream of the estuary as mechanisms interacting with exports to restrict the low-salinity zone and concentrate delta smelt with competing fish species. In addition, Brazilian waterweed (*Egeria densa*) and increasing water transparency were considered new detrimental habitat changes. Predation was considered a low-level threat linked to increasing waterweed abundance and increasing water transparency. Additional threats considered potentially significant by the Service in 2010 were entrainment into power plant diversions, contaminants, and reproductive problems that can stem from small population sizes. Conservation recommendations included: establish Delta outflows proportionate to unimpaired flows to set outflow targets as fractions of runoff in the Central Valley watersheds; minimize reverse flows in Old and Middle river; and, establish a genetic management plan with the goals of minimizing the loss of genetic diversity and limiting risk of extinction caused by unpredictable catastrophic events. The Service (2012) added climate change to the list of threats to the delta smelt.

Continued protection of the delta smelt from excessive entrainment, improving the estuary's flow regime, suppression of nonnative species, increasing zooplankton abundance, and improving water quality are among the actions needed to recover the delta smelt.

Climate Change

Climate projections for the San Francisco Bay-Delta and its watershed indicate that temperature and precipitation changes will diminish snowpack in the Sierra-Nevada, changing the timing and availability of natural water supplies (Knowles and Cayan 2002; Dettinger 2005). Warming may result in more precipitation falling as rain which will mean less water stored in spring snowpacks. This would increase the frequency of rain-on-snow events and increase winter runoff with an associated decrease in runoff for the remainder of the year (Hayhoe *et al.* 2004). Overall, these and other storm track changes may lead to increased frequency of flood and drought cycles during the 21st century (Dettinger *et al.* 2015). Thus far, the 21st century has been substantially drier than the 20th century (Figure 7) to which the frequency of WY type classifications are compared.

Sea level rise is also anticipated as a consequence of a warming global climate and if it is not mitigated, sea level rise will likely influence saltwater intrusion into the Bay-Delta. Salinity within the northern San Francisco Bay is projected to rise by 4.5 ppt by the end of the century (Cloern *et al.* 2011). Elevated salinity could push X2 further eastward in the estuary if outflows are not increased to compensate. Fall X2 mean values are projected to increase by about 7 km to the area near the City of Antioch approximately 90 km from the Golden Gate Bridge by 2100 (Brown *et al.* 2013). This projected change in the location of X2 in the fall is expected to decrease suitable physical habitat if current levees and channel structures are maintained.

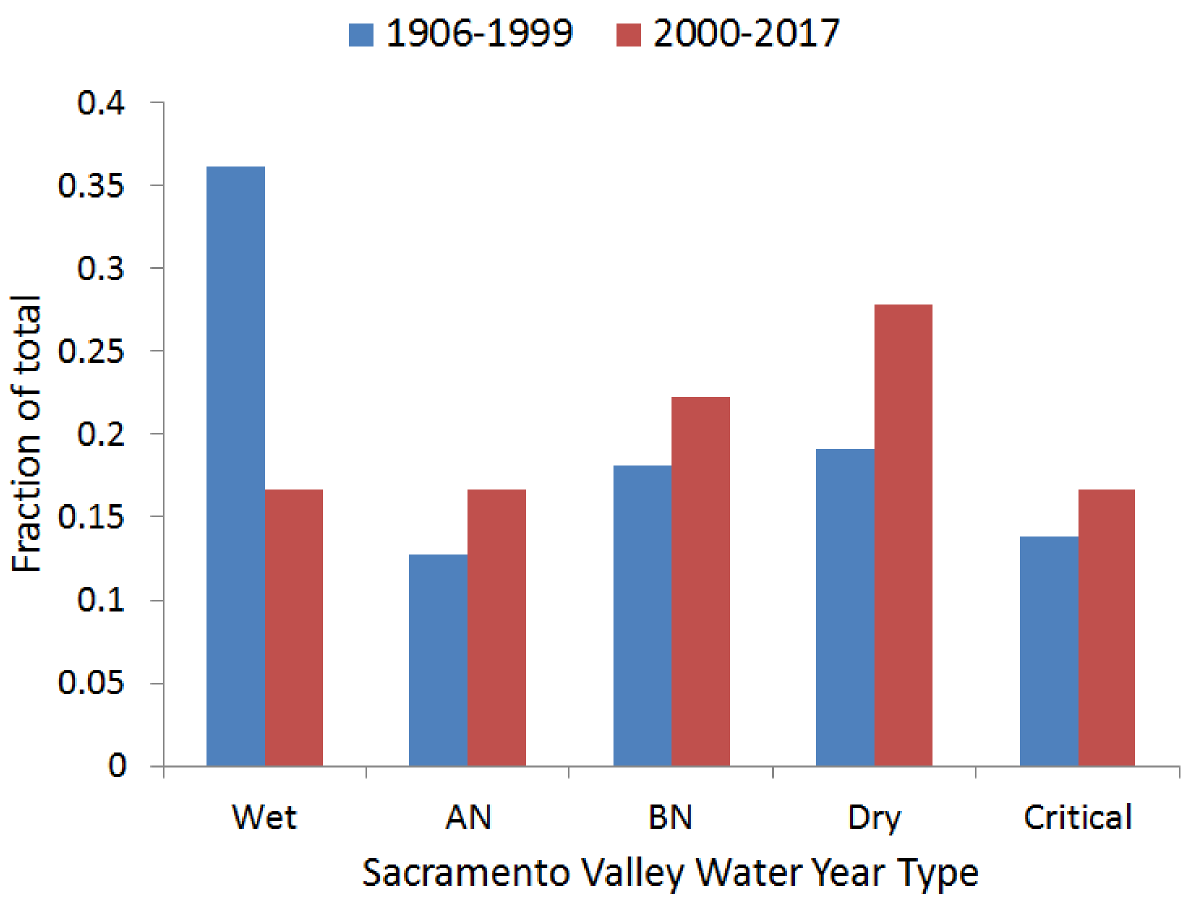

Figure 7. Frequency distribution of Sacramento Valley WY types for: blue=1906-1999 and red=2000-2017.

Central California's warm summers are already a source of energetic stress for delta smelt and warm springs already severely compress the duration of their spawning season (Rose et al. 2013a,b). Central California's climate is anticipated to get warmer (Dettinger 2005). We expect warmer estuary temperatures to present a significant conservation challenge for delta smelt.

Mean annual water temperatures within the Delta are expected to increase steadily during the second half of this century (Cloern *et al.* 2011). Warmer water temperatures could further reduce delta smelt spawning opportunities, decrease juvenile growth during the warmest months, and increase mortality via several food web pathways including: increased vulnerability to predators, increased vulnerability to toxins, and decreased capacity for delta smelt to successfully compete in an estuary that is energetically more optimal for warm-water tolerant fishes.

Recent research into the ecological effects of warming water temperatures suggests that delta smelt, depending on location, may be forced to spawn an average of ten to twenty-five days earlier in the season (Brown *et al.* 2013). The number of high mortality days (cumulative number of days of daily average water temperature >25°C (77°F)) is expected to increase (Brown *et al.* 2013). The number of physiologically stressful days (cumulative number of days of daily average water temperature >20°C (68°F))is expected to be stable or decrease partly because many stressful days will become high mortality days. Thus, current modeling indicates that delta smelt will likely face a shorter maturation window and reduced habitat availability due to increased water temperatures. A shorter maturation window will likely have effects on reproduction (Brown *et al.* 2013). Growth rates have been shown to slow as water temperatures increase above 20°C (68°F), requiring delta smelt to consume more food to reach growth rates that are normal at lower water temperatures (Rose *et al.* 2013a). Delta smelt are smaller, on average, than in the past (Sweetnam 1999; Bennett 2005) and expected temperature increases due to climate change will likely slow growth rates further.

In summary, the delta smelt is currently at the southern limit of the inland distribution of the family Osmeridae along the Pacific coast of North America. Thus, increased temperatures associated with climate change may present a significant conservation challenge if they result in a Bay-Delta that is outside of the delta smelt's competitive limits. For the time being however, water temperatures are cool enough in the delta smelt's range for the species to complete its life cycle.

Summary of the Status of Delta Smelt

The relative abundance of delta smelt has reached very low numbers for a small forage fish in an ecosystem the size of the San Francisco Estuary. The extremely low recent relative abundance reflects decades of habitat change and marginalization by non-native species that prey on and out-compete delta smelt. The anticipated effects of climate change on the San Francisco Estuary and watershed such as warmer water temperatures, greater salinity intrusion, lower snowpack contribution to spring outflows from the Delta, and the potential for frequent extreme drought, which has been experienced for the 21st century thus far, indicate challenges to delta smelt survival will increase. A rebound in relative abundance during the very wet and cool conditions during 2011 indicated that delta smelt retained some population resilience (IEP 2015). However, since 2012, declines to record low population estimates have been broadly associated with the remarkably dry hydrology occurring from 2012 to 2016.

Delta Smelt Critical Habitat

The Service designated critical habitat for the delta smelt on December 19, 1994 (Service 1994). The geographic area encompassed by the designation includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained within the legal Delta (as defined in section 12220 of the California Water Code) (Service 1994).

Conservation Role of Delta Smelt Critical Habitat

The Service's primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful completion of the life cycle, including spawning, larval and juvenile transport, rearing, and adult migration back to spawning sites. Delta smelt are endemic to the Bay-Delta and the vast majority only live one year. Thus, regardless of annual hydrology, the Bay-Delta estuary must provide suitable habitat all year, every year. The primary constituent elements (PCEs) essential to the conservation of the delta smelt are physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (Service 1994). The Service recommended in its designation of critical habitat for the delta smelt that salinity in Suisun Bay should vary according to WY type. For the months of February through June, this element was codified by the State Water Resources Control Board's "X2 standard" described in D-1641 and the Board's current Water Quality Control Plan.

Description of the Primary Constituent Elements

The original descriptions of the primary constituent elements are compared and contrasted with current scientific understanding in Table 2.

Table 2. Comparison of delta smelt primary constituent elements of critical habitat between the 1994 publication of the rule and the present.

Primary Constituent Element	1994 critical habitat rule	2016 state of scientific understanding
Spawning Habitat	Shallow fresh or slightly brackish edgewaters.	No change.
	Backwater sloughs.	Possible, never confirmed. Most likely spawning sites have sandy substrates and need not occur in sloughs. Backwater sloughs in particular tend to have silty substrates that would suffocate eggs.
	Low concentrations of pollutants.	No change.
	Submerged tree roots, branches, emergent vegetation (tules).	Not likely. Unpublished observations of spawning by captive delta smelt suggest spawning on substrates oriented horizontally and a preference for gravel or sand that is more consistent with observations of other osmerid fishes.

	Key spawning locations: Sacramento River "in the Delta", Barker Slough, Lindsey Slough, Cache Slough, Prospect Slough, Georgiana Slough, Beaver Slough, Hog Slough, Sycamore Slough, Suisun Marsh.	All of the locations listed in 1994 may be suitable for spawning, but based on better monitoring from the Spring Kodiak Trawl Survey, most adult fish have since been observed to aggregate around Grizzly Island, Sherman Island, and in the Cache Slough complex including the subsequently flooded Liberty Island.
	Adults could spawn from December-July.	Adults are virtually never fully ripe and ready to spawn before February and most spawning is completed by May (warm years) or June (cool years).
Larval and juvenile transport	Larvae require adequate river flows to transport them from spawning habitats in backwater sloughs to rearing habitats in the open waters of the low salinity zone.	Not likely. Most delta smelt that survive to the juvenile life stage do eventually inhabit water that is in the 0.5 to 6 ppt range, due to either or both of downstream movement or decreasing outflow. However, delta smelt larvae can feed in the same habitats they were hatched in and juvenile fish can rear in water less than 0.5 ppt salinity.
	Larvae require adequate flow to prevent entrainment.	No change.
	Larval and juvenile transport needs to be protected from physical disturbances like sand and gravel mining, diking, dredging, riprapping.	No change, but seems likely to have more impact on spawning habitat than larval transport.
	2 ppt isohaline (X2) must be west of the Sacramento-San Joaquin River confluence to support sufficient larval and juvenile transport.	No change. X2 is generally west of the confluence during February-June due to State Water Resources Control Board X2 standard; however, the standard does have a drought off-ramp.
	Maturation must not be impaired by pollutant concentrations.	No change.
	Additional flows might be required in the July-August period to protect delta smelt that were present in the south and central Delta from being entrained in export pumps.	July-August outflow augmentations may be helpful, but not to mitigate entrainment. Habitat changes in the central and south Delta have rendered it seasonally unsuitable to delta smelt during the summer; entrainment is seldom observed past June.
Rearing habitat	2 ppt isohaline (X2) should remain between Carquinez Strait in the west, Three-Mile Slough on the Sacramento River and Big Break on the San Joaquin River in the east. This was determined to be a range for 2 ppt salinity (including its tidal time scale excursion into the Delta).	No change. X2 generally in this area during February-June due to State Water Resources Control Board X2 standard; however the standard does have a drought off-ramp. Most juvenile delta smelt still rear in this area but it is now recognized that a few remain in the Cache Slough complex as well.

Adult migration	Adults require unrestricted access to spawning habitat from December-July.	Adults disperse faster than was recognized in 1994; most of it is finished by the time Spring Kodiak Trawls start in January, though local movements and possibly rapid longer distance dispersal occurs throughout the spawning season, which as mentioned above is usually February-June or a subset of those months.
	Unrestricted access results from adequate flow, suitable water quality, and protection from physical disturbance.	No change.

Primary Constituent Element 1: "Physical habitat" is defined as the structural components of habitat (Service 1994). The ancestral Delta was a large tidal marsh-floodplain habitat totaling approximately 300,000 acres. During the late 1800s and early 1900s, most of the wetlands were diked and reclaimed for agriculture or other human use. The physical habitat modifications of the Delta and Suisun Bay were mostly due to land reclamation and urbanization. Water conveyance projects and river channelization have had some influence on the regional physical habitat by armoring levees with riprap, building conveyance channels like the Delta Cross Channel, storage reservoirs like Clifton Court Forebay, and by building and operating temporary barriers in the south Delta and permanent gates and water distribution systems in Suisun Marsh.

During the 1930s to 1960`s, the shipping channels were dredged deeper (~12 m) to accommodate shipping traffic from the Pacific Ocean and San Francisco Bay to ports in Sacramento and Stockton. These changes left Suisun Bay and the Sacramento-San Joaquin River confluence region as the largest and most depth-varying places in the typical range of the low-salinity zone. This region remained a highly productive nursery for many decades (Stevens and Miller 1983; Moyle *et al.* 1992; Jassby *et al.* 1995). However, the deeper landscape created to support shipping and flood control requires more freshwater outflow to maintain the low-salinity zone in the large Suisun Bay/river confluence region than was once required. The shipping itself has historically provided a source of non-native organisms, that along with depleted flows and deep channelization, have contributed to the changing ecology of the upper estuary (Winder and Jassby 2011; Kratina *et al.* 2014).

Although the delta smelt is a generally pelagic or open-water fish, depth variation of open-water habitats is an important habitat attribute (Moyle *et al.* 1992; Hobbs *et al.* 2006). In the wild, delta smelt are most frequently collected in water that is somewhat shallow (4-15 ft deep) where turbidity is often elevated and tidal currents exist but are not excessive (Moyle *et al.* 1992; Bever *et al.* 2016). In Suisun Bay, the deep shipping channels are poor quality habitat because tidal velocity is very high (Bever *et al.* 2016), but in the north Delta where tidal velocity is slower, the Sacramento Deepwater Shipping Channel is used to a greater extent, particularly for spawning and by larval fish (CDFW unpublished data). Adult delta smelt also use edge habitats as tidal current refuges and corridors to spawning habitats (Bennett and Burau 2015).

Primary Constituent Element 2: "Water" is defined as water of suitable quality to support various delta smelt life stages that allow for survival and reproduction (Service 1994). Certain conditions of temperature, turbidity, and food availability characterize suitable pelagic habitat for delta smelt and are discussed in detail below. Contaminant exposure can degrade this primary constituent element even when the basic habitat components of water quality are otherwise suitable (Hammock *et al.* 2015).

Turbidity: Delta smelt require turbidity. Even in captivity, clear water is a source of physiological stress (Lindberg *et al.* 2013; Hasenbein *et al.* 2016). The small plankton that delta smelt larvae eat are nearly invisible in clear water. The sediment (or algal) particles that make turbid water turbid, provide a dark background that helps delta smelt larvae see their translucent prey (Baskerville-Bridges *et al.* 2004). Older delta smelt are less reliant on turbidity to see their prey, but older fish still feed more effectively in water of moderate turbidity (Hasenbein *et al.* 2014; 2016) and probably need turbid water to help disguise themselves from predators (Ferrari *et al.* 2014). The turbidity of the Delta and Suisun Bay has been declining for a long time due to dams and riprapped levees, both of which cut off sources of sediment from rivers flowing into the estuary (Arthur *et al.* 1996; Wright and Schoellhamer 2004), and due to the spread of Brazilian waterweed (Hestir *et al.* 2016) which filters the water, increasing clarity. Water exports from the south Delta may also have contributed to the trend toward clearer water by removing resuspended sediment in the exported water (Arthur *et al.* 1996). The primary turbid areas that remain in the upper estuary are the semi-shallow embayments in northern Suisun Bay (Bever *et al.* 2016) and the lower Yolo Bypass region that includes Liberty Island and the upper reach of the Sacramento Deepwater Shipping Channel (Morgan-King and Schoellhamer 2013). Both tidal and river flows, as well as wind speed, affect turbidity in these locations. Many of the estuary's deeper channels tend to have somewhat lower turbidity because water velocity and wind cannot resuspend sediment that sinks into deep water (Ruhl and Schoellhamer 2004).

Water temperature: Water temperature is the primary driver of the timing and duration of the delta smelt spawning season (Bennett 2005). Water temperature also affects delta smelt's growth rate which in turn can affect their readiness to spawn (Rose *et al.* 2013a). Water temperature is not strongly affected by variation in Delta outflow; the primary driver of water temperature variation in the delta smelt critical habitat is air temperature (Wagner *et al.* 2011). Very high flows can transiently cool the upper estuary (*e.g.,* flows in the upper 10^{th} percentile, Kimmerer 2004), but the system rapidly re-equilibrates once air temperatures begin to warm.

Older laboratory based research suggested an upper water temperature limit for delta smelt of about 25°C, or 77°F (Swanson *et al.* 2000). Newer laboratory research suggests delta smelt temperature tolerance decreases as the fish age, but is a little higher than previously reported, up to 28°C or 82°F in the juvenile life stage (Komoroske *et al.* 2014). It should be kept in mind that these are upper *acute* water temperature limits, meaning temperatures in this range will kill, on average, one of every two fish.

In the laboratory and the wild, delta smelt appear to have a physiological optimum temperature near 20°C or 68°F (Nobriga *et al.* 2008; Rose *et al.* 2013a; Jeffries *et al.* 2016); most of the upper estuary exceeds this water temperature from June through September (Wagner *et al.* 2011). Thus, many parts of the estuary are energetically costly and stress delta smelt. Generally speaking, spring and summer water temperatures are cooler to the west and warmer to the east due to the differences in overlying air temperatures between the Bay Area and the warmer Central Valley (Kimmerer 2004). In addition, there is a strong water temperature gradient across the Delta with cooler water in the north and warmer water in the south. The higher flows from the Sacramento River probably explain this north-south gradient. Note that water temperatures in the north Delta near Liberty Island and the lower Yolo Bypass are also typically warmer than they are along the Sacramento River (Sommer *et al.* 2001; Nobriga *et al.* 2005).

Food: Food and water temperature are strongly interacting components of delta smelt health and habitat because the warmer the water, the more food delta smelt require (Rose *et al.* 2013a). If the water gets too warm, then no amount of food is sufficient. The more food delta smelt eat (or must try to eat) the more they will be exposed to predators and contaminants. Water exports can limit the flux of phytoplankton production from the Delta into Suisun Bay (Jassby and Cloern 2000), but the effect of water exports on phytoplankton production appears to be lower than grazing by clams (Jassby *et al.* 2002) and ammonium inhibition of phytoplankton growth from Sacramento's urban wastewater inputs (Dugdale *et al.* 2007).

Historically, prey production occurred when the low-salinity zone was positioned over the shoals of Suisun Bay during late spring through the summer, but this function has been depleted due to grazing by overbite clams (Kimmerer and Thompson 2014), high ammonium concentrations in critical habitat (Dugdale 2012; Dugdale *et al.*; 2016), and water diversions (Jassby and Cloern 2000). Recent research suggests delta smelt occupying Suisun Bay may experience poor nutritional health (Hammock *et al.* 2015). Delta smelt occupying the Cache Slough region in the north Delta are in better nutritional health, but have shown evidence of relatively high contaminant impacts. The southern Delta is among the more productive areas remaining in the upper estuary (Nobriga *et al.* 2005), but delta smelt cannot remain in this habitat during the warmer months of the year (Nobriga *et al.* 2008) and may face a high risk of entrainment when they occupy it during cooler months (Kimmerer 2008; Grimaldo *et al.* 2009). Extensive blooms of the toxin-producing cyanobacteria *Microcystis* in the central and southern Delta became abundant around 1999 and, depending on flow and temperature, blooms can extend westward into the low-salinity zone where delta smelt are rearing (Brooks *et al.* 2012). However, in general delta smelt that occupy Suisun Marsh fare better both in terms of nutrition and in experiencing a lower level of contaminant impacts (Hammock *et al.* 2015).

Primary Constituent Element 3: "River flow" was originally defined as transport flow to facilitate spawning migrations and transport offspring to low-salinity zone rearing habitats (Service 1994). River flow includes both "inflow to" and "outflow from" the Delta, both of which influence the movement of migrating adult, larval, and juvenile delta smelt. Inflows, outflows, and Old and Middle river flows influence the vulnerability of delta smelt larvae, juveniles, and adults to entrainment at the Banks and Jones facilities (Grimaldo *et al.* 2009).

The spawning microhabitats of delta smelt are not known, but whatever they are, it is likely there is more available suitable spawning habitat when Delta outflow is high during spawning than when it is low because more of the estuary is covered in fresh- and low-salinity water when outflow is high (Jassby *et al.* 1995). Most spawning occurs between February and May. Delta outflow during February through May is mainly driven by the climatic effect on the amount and form of precipitation in the watershed, the storage and diversion of water upstream of the Delta, and CVP and SWP water operations in the Delta (Jassby *et al.* 1995; Kimmerer 2002a). Thus far, the 21st Century has tended to be pretty dry (Figure 7) and that could have resulted in some chronic reduction in spawning habitat availability or suitability.

Primary Constituent Element 4: "Salinity" helps define nursery habitat (Service 1994). Older laboratory research suggested that delta smelt have an upper acute salinity tolerance of about 20 ppt (Swanson *et al.* 2000) which is about 60% of seawater's salt concentration of 32-33 ppt. Newer laboratory-based research suggests that some individuals can acclimate to seawater, but that comes at a high energetic cost that is lethal to about one in four individuals (Komoroske *et al.* 2014; 2016). In the wild, delta smelt are nearly always collected at very low salinities, which recent laboratory research has confirmed is nearer to the physiological optimum (Komoroske *et al.* 2016). Few individuals are collected at salinities higher than 6 ppt (about 20% of seawater salt concentration) and very few are collected at salinities higher than 10 ppt (about 30% of seawater salt concentration) (Bennett 2005). This well documented association with fresh to low salinity water is a reason for the scientific emphasis on X2 as a delta smelt habitat indicator (Dege and Brown 2004; Feyrer *et al.* 2011). Recent research combining long-term monitoring data with three-dimensional hydrodynamic modeling shows that the spatial overlap of several of the key habitat attributes described above increases as Delta outflow increases (Bever *et al.* 2016). This means that higher outflow, which lowers the salinity of Suisun Bay and Suisun Marsh, increases the suitability of habitat in the estuary by increasing the overlap of some, but not necessarily all, needed elements. Lower outflows provide less overlap and in fewer places.

Summary of Status of Delta Smelt Critical Habitat

The Service's primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful completion of the life cycle, including spawning, larval and juvenile transport, rearing, and adult migration back to spawning sites. Since the implementation of the RPA in the Service's 2008 BiOp, there has been a lower likelihood of water operations that are highly detrimental to the spawning migration of adult delta smelt, the spawners themselves, or larval transport. Further, recent research suggests that the movement of adult delta smelt to nominal spawning locations is quite similar among years (Polansky *et al.* 2018).

There are very few locations that consistently provide all the needed habitat attributes for larval and juvenile rearing at the same times and in the same places (Table 3; IEP 2015). Larval and juvenile rearing remains most impacted by ecological changes in the estuary since the delta smelt's listing under the Act. As described above, those changes have stemmed from changes in outflow, species invasions and associated changes in how the upper estuary food web functions, declining prey availability, high water temperatures, declining water turbidity, summertime blooms of *Microcystis aeruginosa*, proliferation of submerged aquatic plants, and localized contaminant accumulation by delta smelt.

Table 5. Summary of habitat attribute conditions for delta smelt in six regions of the estuary that are permanently or seasonally occupied in most years.

	Landscape	Turbidity	Salinity	Temperature	Food
Montezuma Slough	Appropriate	Appropriate	Appropriate *when outflow is sufficient*	Usually appropriate	Appropriate
Suisun Bay	Appropriate except in shipping channel	Appropriate, but declining	Appropriate *when outflow is sufficient*	Usually appropriate	Depleted
West Delta	Limited area 4 to 15 ft deep	marginal, declining	Appropriate	Can be too high during summer	Depleted
North Delta (Cache Slough region)	Appropriate	Appropriate	Appropriate	Can be too high during summer	Appropriate, but associated with elevated contaminant impacts
Sacramento River near proposed NDD	Limited area 4 to 15 ft deep; swift currents	Marginal except during high flows, declining	Appropriate	Usually appropriate	Likely low due to swift currents and wastewater inputs
South Delta	Appropriate except too much coverage by submerged plants	Too low	Appropriate	Too high in the summer	Appropriate

Environmental Baseline in the Action Area

Delta Smelt

The delta smelt is an estuarine fish species whose distribution is entirely within the upper San Francisco Estuary, but it moves within this area seasonally, broadening its distribution when freshwater inflows increase due to storms. Spawning occurs during February through May. Delta smelt rear in what is known as the low salinity zone (LSZ), defined as those waters exhibiting a daily averaged near bottom salinity of 0.5 to 6.0 ppt. The LSZ waters characteristically have higher turbidity and food organism density that facilitates successful rearing and growth of delta smelt. The position of the low salinity zone varies depending on water year type and water management but regularly includes the Bulls Head Reach and nearby waters. This position is routinely expressed by the term X2, which is distance, in kilometers from the Golden Gate, of the daily averaged near bottom 2 ppt isohaline. Conditions for smelt are considered most favorable when X2 is located to the west over broad areas of exposed, open water in Suisun Bay. Various regulatory requirements apply to water management that are dependent on X2.

Delta smelt have been detected at sampling stations in the general vicinity of the project area in most years (i.e., adult smelt in the Spring Kodiak Trawl Surveys and larval smelt in the Fall Midwater Trawl Surveys). Delta smelt were regularly detected in the near vicinity of the ship channel in the Bulls Head Reach where dredging would occur, as well as within the larger action area where the salinity distribution would be affected by the dredging. The broad, shallow waters of nearby Suisun, Grizzly, and Honker Bays are considered an important region for the continued survival of the smelt due to the combination of location, wind exposure, and depth that result in optimal foraging conditions for smelt rearing and growth. Delta smelt could also utilize waters in the Montezuma Wetlands restoration site which is within critical habitat, and near the Cullinan Ranch restoration site, where delta smelt are known from the Napa River system. Delta smelt have been detected in the spring of wet years (i.e., 2011, 2017, 2019) in both San Pablo Bay in the vicinity of the Pinole Shoal Channel work, and in the Napa system, which has lower flows than the Delta proper. Because of the presence of the PCEs needed for delta smelt, the location of some project work within critical habitat, and consistency of smelt presence in sampling in areas both within and outside of that critical habitat, we conclude that delta smelt are present in the action area.

Delta Smelt Critical Habitat

The action area of the proposed project includes tidal waterways of the Delta that are wholly within critical habitat for the species. Specifically, the Bulls Head Reach to Avon work within Suisun Bay, and waters within Montezuma Wetlands, are considered smelt critical habitat, but the Pinole Shoal Channel work in San Pablo Bay and Cullinan Ranch are not within critical habitat. These locations contain all of the PCEs described in the critical habitat designation but quality and amount vary depending on conditions as discussed above in the **Status of the Critical Habitat** section.

Effects of the Proposed Action

The types of effects from the proposed project identified in the BA include direct contact with dredging equipment or entrainment, exposure to increased sediment and turbidity, the effects of salinity intrusion with the deepened channel on the extent of the LSZ, noise, and benefit from tidal restoration at the dredged material placement sites. Noise effect is not considered likely owing to the very limited extent of work with a jackhammer (950 square feet), and location of this in San Pablo Bay. Contact with dredging equipment or entrainment is possible, but minimized, through the use of a clamshell dredge, which is believed to have a much lower risk of entrainment than a hydraulic cutterhead dredge. Direct losses are further limited by the temporary nature of this action. Environmental work windows do not necessarily avoid impacts to delta smelt because delta smelt may be present throughout the year at the work locations. Exposure of delta smelt to sediment plumes could occur, but this too is expected to be insignificant. This effect will be confined to the immediate vicinity of the dredge(s), and fish - including delta smelt - are expected to react behaviorally by moving away from such areas.

Salinity Intrusion

For this project, the effects of deepening on salinity distribution were extensively modeled using the LSZ area as an output parameter (Anchor QEA 2019). Within the action area, we consider changes in LSZ area to adequately represent the potential effects of the project.

Anchor QEA (2019) evaluated changes in the position of X2 and the area of the LSZ, among other potential effects, as outputs from a numerical model with and without project, under representative input conditions. The average annual change in X2 with the project was a predicted increase (eastward shift) of X2 of 0.17, 0.21, and 0.23 km for a representative critical dry, below normal, and wet water year, respectively. Within a given year type, this change varied month to month and daily because of differences in the exact position of X2. The worst case project effect for a critical dry year would be a reduction in the monthly average LSZ of -200 to -290 acres from March to May (Table 7-1 *in* Anchor QEA 2019), or a change of about -1.2% of the LSZ area. This is a net effect resulting from slight reductions at the western edge of the LSZ when its margin is in relatively wide areas of Grizzly and Honker Bays not being offset by increases at the eastern edge of the LSZ in relatively confined river channels (Figure 7.2-4 *in* Anchor QEA 2019). Similarly, the worst case project effect for a below normal water year is a LSZ reduction of -587 acres in July (Table 7-2 *in* Anchor QEA 2019), which is -2.8% of the overall LSZ of 21,217 acres (Table 7-3 *in* Anchor QEA 2019). In April of a below normal water year, however, the LSZ would increase by 446 acres because X2 is initially located farther west; the project effect in that month and year type is positive, because an eastward shift expands the LSZ area. In a wet water year, the LSZ monthly average changes due to the project varied from -284 to +417 acres, with the largest monthly adverse change in LSZ being a reduction of several percent. These monthly averages include brief periods of days, when daily difference in LSZ due to the proposed project can be several times larger than the monthly average difference (+/- ~1,000 to 1,600 acres; Figures 7.2.3, 7.3.3, and 7.4.3 *in* Anchor QEA 2019).

The relationship between X2 and LSZ area is not a linear one. The most rapid decrease in LSZ area as a function of X2, when X2>64, occurs in the X2 region of 74-84 km (e.g., Figure 9 *in* Herbold and Vendlinski 2012; Figure 12 *in* MacWilliams et al. 2015). In these cited analyses, the LSZ parameter used is the 1-2 ppt area (compared to 0.5-6 ppt in Anchor QEA 2019). LSZ area declined as a function of X2 about 35%, from 25,000 to 16,000 acres, over this 10 km distance so a 0.17-0.23 km shift in X2 due to the ship channel could reasonably result in 153-209 acres of that decline. However, during portions of the year, in all of these year types, X2 will not be within the 74-84 km region, so a 0.17-0.23 km eastward movement of X2 would likely have less of an effect on the surface area of the LSZ.

We consider the adverse effect on smelt of the project on monthly average LSZ area to be limited. The predicted changes which were noted in modeling were modest, a few percent, and are not considered permanent losses of habitat, losses of access, or complete losses of habitat quality. Rather, these types of changes represent a predicted net reduction in the area of habitat which would meet the 0.5-6 ppt definition of LSZ, due to effects at the peripheries of the LSZ region. These peripheral reductions are calculations based on daily averages. As such, they are not a static feature, as the LSZ must vary considerably within daily tidal cycles. We do not believe that these small changes would result in particular regions or portions of regions being rendered consistently unsuitable for smelt use. Also, as noted above, the predicted changes were not always a reduction within a modeled year, with some months showing decreases and others increases in LSZ area.

We also reviewed the final salinity report for information relating to any project effects on the ability to meet regulatory requirements, specifically: (a) Water Rights Decision D-1641, which specifies the number of days that chloride can exceed 150 mg/L by station and year type, and (b) the Service's Reasonable and Prudent Alternative (RPA) action under our December 15, 2008, BiOp for operation of the Central Valley and State Water Projects, that require water operations following a wet water year to maintain X2 at 74 km in the Fall, and 81 km following an above normal water year. As for project effects to meeting D-1641, under the worst-case scenario of a critical year, the proposed project would result in differences of a few milligrams of chloride and result in 1 additional day each in July and August that the water quality objective would be exceeded. As for potential project effects on differences in RPA action, the effect of the project on X2 during the fall following the wet year was predicted by the model to be 0.20-0.25 km. This change is smaller than the uncertainty in methods used to estimate X2 from field observations (Anchor QEA 2019).

We next examined whether the salinity effect has been avoided and minimized, or if other additional actions could be taken to do so. The Corps' consultant modeled a range of scenarios, including deepening up to 45 and 40 feet for the western and eastern reaches (Anchor QEA 2016). The larger actions would have resulted in substantially greater changes in X2 and chloride. The proposed project depth (38 feet) or lesser scenarios were shown to have minimal impacts on these factors. Accordingly, we conclude that the project design process scaled the project in a manner which minimized effects on smelt.

The placement of dredged material at Cullinan Ranch and Montezuma Wetlands restoration sites could have benefits to smelt at both locations. These restoration sites benefit from the use of dredged material to accelerate restoration by bringing site topography up to elevations that will support colonization by emergent tidal marsh. This emergent tidal marsh and associated channels produce organic matter and food organisms that are carried by tidal action into surrounding waters where they contribute to the forage base of planktonic organisms used by smelt. The tidal channels of the site, either constructed or formed after the sites are completed and breached, are potentially used by adult smelt for spawning, although this varies with location and conditions in a given year. We estimate the area of restored tidal marsh at these sites attributable to the volume of dredged material from the proposed project to be as much as 160 acres (Service 2019). Benefits of this restoration component of the proposed project to fish and wildlife resources, including smelt, would be accrued continuously upon completion of each site. We estimate that completion of Cullinan Ranch, with the project, would be accelerated by as much as 2 years, compared to without the project.

Delta Smelt Critical Habitat

There would be an effect on PCE#4 (salinity) in the form of up to 587 acres of shallow open water habitat, as a monthly average, which would not meet the 0.5-6.0 ppt definition of the LSZ.

As previously mentioned, this amount is a modeled extreme, with other months, or days within that modeled extreme month, being typically less and sometimes positive, and does not imply a total loss of either habitat quality or of the smelt present within that affected area.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. The Service is not aware of specific projects that might affect smelt in the action area that are currently under review by State, county, or local authorities.

Conclusion

After reviewing the current status of delta smelt, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the San Francisco Bay to Stockton Navigation Improvement Project is not likely to jeopardize the continued existence of delta smelt. This conclusion is based on:
(1) implementation of the conservation measures to minimize adverse effects during project activities; (2) the limited effect of the deepened channels on X2 and the area of LSZ, and (3) the positive effects of beneficial use of dredged material from the project at tidal restoration sites.

After reviewing the current status of delta smelt critical habitat, the environmental baseline of critical habitat in the action area, and the effects of the proposed action, and the cumulative effects on the critical habitat, it is the Service's biological opinion that the San Francisco Bay to Stockton Navigation Improvement Project is not likely to result in the destruction or adverse modification of delta smelt critical habitat. This conclusion is based on: (1) the limited effect of the deepened channels on X2 and the area of LSZ, and (2) our determination that the constituent elements of critical habitat would not be altered or destroyed to the extent that the survival and recovery of delta smelt are appreciably reduced.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require an applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any permit or grant document related to the San Francisco Bay to Stockton Navigation Improvement Project, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

Amount or Extent of Take

Delta Smelt

The Service expects that incidental take of delta smelt will be difficult to detect or quantify for the following reasons: the small size of adults and larvae, the difficulty of detecting delta smelt in their turbid aquatic habitat, very low densities of delta smelt, and the low likelihood of finding dead or impaired specimens. In addition to low numbers, the potential for smelt in the work areas varies with the particular conditions of the water year type in which the work is done. Due to the difficulty in quantifying the number of delta smelt that will be taken as a result of the proposed action, the number of acres of affected habitat becomes a surrogate for the species that will be taken. The total footprint of channel which would be dredged is estimated at 318 acres, all of which would be considered a temporary effect to the overlying water column. However, the area impacted at any one time by physical disturbance and nearby turbidity would be limited to the immediate vicinity of each of a maximum of two dredge plants and associated operations. The project duration is also limited, about 4.6 months total. We estimate this maximum area of water column temporarily disturbed at any one time to be 10 acres.

The LSZ could be incrementally diminished in extent (area) by the deepened channels. This diminished extent could result in some modest reduction in the overall food base for smelt and/or total area of optimal rearing habitat. As previously discussed, that change can vary considerably with month and year type, however, the worst case scenario would be a monthly average difference of -587 acres (July, below normal water year; Table 7-2 *in* Anchor QEA 2019).

For the purposes of this BiOp, we estimate the level of take of delta smelt associated with all construction and management activities will be in the form of harm or kill of all those delta smelt present in 10 acres of water column in the vicinity of active dredging or in up to 587 acres of area removed from the LSZ (maximum reduction of monthly average amount). Low fish mortality is anticipated because of the current low abundance of smelt, the limited spatial extent of dredging at any one time, the use of the clamshell dredging technique, and the anticipated limited consequence of changes in the salinity distribution on the LSZ.

Effect of the Take

In the accompanying biological opinion, the Service determined that the level of anticipated take is not likely to result in jeopardy to the delta smelt.

Reasonable and Prudent Measure

1. The Corps shall minimize the impact of take of delta smelt.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with, or ensure compliance with, the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These Terms and Conditions are nondiscretionary.

The following Terms and Conditions implement the Reasonable and Prudent Measures:

1. Implement the conservation measures as described in this biological opinion.

Reporting Requirements

In order to monitor whether the amount or extent of incidental take anticipated from implementation of the project is approached or exceeded, the Corps shall adhere to the following monitoring requirements. Should this anticipated amount or extent of incidental take be exceeded, the Corps must reinitiate formal consultation as per 50 CFR 402.16.

1. The Service must be notified within one (1) working day of the finding of any injured or dead listed species or any unanticipated damage to its habitat associated with the proposed project. Notification will be made to the Assistant Field Supervisor of the Endangered Species Program at the Bay Delta Fish and Wildlife Office at (916) 930-2664, and must include the date, time, and precise location of the individual/incident clearly indicated on a U.S. Geological Survey 7.5 minute quadrangle or other maps at a finer scale, as requested by the Service, and any other pertinent information. When an injured or dead individual of the listed species is found, the Corps (during construction) or the local sponsor (during maintenance) shall follow the steps outlined in the Disposition of Individuals Taken section below.

Disposition of Individuals Taken

Injured listed species must be cared for by a licensed veterinarian or other qualified person(s), such as the Service-approved biologist. Dead individuals must be sealed in a resealable plastic bag containing a paper with the date and time when the animal was found, the location where it was found, and the name of the person who found it, and the bag containing the specimen must be frozen in a freezer located in a secure site, until instructions are received from the Service regarding the disposition of the dead specimen. The Service contact persons are the Assistant Field Supervisor of the Endangered Species Program at the Bay Delta Fish and Wildlife Office at

(916) 930-2664; and the Resident Agent-in-Charge of the Service's Office of Law Enforcement, 5622 Price Way, McClellan, California 95562, at (916) 569-8444.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following actions:

1. Develop and implement restoration measures in areas designated in the Delta Fishes Recovery Plan (Service 1996).

REINITIATION—CLOSING STATEMENT

This concludes formal consultation on the San Francisco Bay to Stockton Navigation Improvement Project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; (4) a new species is listed or critical habitat designated that may be affected by the action; or (5) the status of the delta smelt changes. In instances where the amount or extent of incidental take is exceeded, any additional take will not be exempt from the prohibitions of section 9 of the Act, pending reinitiation.

If you have any questions regarding this biological opinion on the proposed San Francisco Bay to Stockton Navigation Improvement Project, please contact Steven Schoenberg of my staff at (916) 930-5672.

Sincerely,

Kaylee Allen
Field Supervisor

cc:
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REFERENCES

Arthur, J. F., M. D. Ball, and S. Y. Baughman. 1996. Summary of Federal and State Water Project environmental impacts in the San Francisco Bay–Delta estuary, California. Pages 445– 495 *in* J. T. Hollibaugh, editor. The San Francisco Bay: the ecosystem; further investigations into the natural history of San Francisco Bay and Delta with reference to the influence of man. Friesen Printers, Altona, Manitoba.

Anchor QEA [Anchor QEA, LLC]. 2016. San Francisco Bay to Stockton Navigation Improvement Project. Hydrodynamic and Salinity Intrusion Modeling Report. Draft. Prepared by Anchor QEA, LLC, San Francisco, California for U.S. Army Corps of Engineers, Sacramento District. January 2016. 81 pp.

_____. 2019. San Francisco Bay to Stockton Navigation Improvement Project. Hydrodynamic and Salinity Intrusion Modeling Report. Final Draft. Prepared by Anchor QEA, LLC, San Francisco, California for U.S. Army Corps of Engineers, Sacramento District. April 2019. 207 pp.

Bennett, W.A. 2005. Critical assessment of the delta smelt population in the San Francisco Estuary, California. San Francisco Estuary and Watershed Science 3(2). Available on the internet at <http://repositories.cdlib.org/jmie/sfews/vol3/iss2/art1>.

Bennett, W.A. and J.R. Burau. 2015. Riders on the storm: selective tidal movements facilitate the spawning migration of threatened Delta Smelt in the San Francisco Estuary. Estuaries and Coasts 38(3):826-835. doi: http://dx.doi.org/10.1007/s12237-014-9877-3

Baskerville-Bridges, B., J.C. Lindberg and S.I. Doroshov. 2004. The effect of light intensity, alga concentration, and prey density on the feeding behavior of delta smelt larvae. Pages 219-228 *in* F. Feyrer, L.R. Brown, R.L. Brown and J.J. Orsi, eds. Early fife history of fishes in the San Francisco Estuary and watershed. American Fisheries Society Symposium 39, Bethesda, MD, USA.

Bever, A.J., M.L. MacWilliams, B. Herbold, L.R. Brown and F.V. Feyrer. 2016. Linking hydrodynamic complexity to delta smelt (*Hypomesus transpacificus*) distribution in the San Francisco Estuary, USA. San Francisco Estuary and Watershed Science 14(1). doi: http://dx.doi.org/10.15447/sfews.2016v14iss1art3

Brooks, M., E. Fleishman, L. Brown, P. Lehman, I. Werner, N. Scholz, C. Mitchelmore, J. Lovvorn, M. Johnson, D. Schlenk, S. van Drunick, J. Drever, D. Stoms, A. Parker, and R. Dugdale. 2012. Life Histories, Salinity Zones, and Sublethal Contributions of Contaminants to Pelagic Fish Declines Illustrated with a Case Study of San Francisco Estuary, California, USA. Estuaries and Coasts 35(2):603-621. doi: http://dx.doi.org/10.1007/s12237-011-9459-6

Brown, L. R., W. A. Bennett, R. W. Wagner, T. Morgan-King, N. Knowles, F. Feyrer, D. H. Schoelhamer, M.T. Stacey, and M. Dettinger. 2013. Implications for future survival of delta smelt from four climate change scenarios for the Sacramento-San Joquin Delta, California. Estuaries and Coasts. DOI 10.1007/s12237-013-9585-4. Available on the internet at < http://link.springer.com/article/10.1007%2Fs12237-013-9585-4#>.

Cloern, J. E., Morinaka, N. Brown, R. L., Cayan, D., Dettinger, M.D., Morgan, T. L., Schoellhammer, D. H., Stacey, M. T., van der Wegen, M., Wagner, R. W., and A.D. Jassby. 2011. Projected evolution of California's San Francisco Bay-Delta-River system in a century of climate change. PLoS ONE 6(9): e24465. DOI: 10.371/journal.pone.0024465.

Dege, M. and L.R. Brown. 2004. Effect of outflow on spring and summertime distribution and abundance of larval and juvenile fishes in the upper San Francisco Estuary. American Fisheries Society Symposium 39: 49-65

Dettinger, M.D. 2005. From climate-change spaghetti to climate-change distributions for 21st Century California. San Francisco Estuary and Watershed Science Available on the internet at <http://repositories.cdlib.org/jmie/sfews/vol3/iss1/art4>.

Dettinger, M., B. Udall and A. Georgakakos. 2015. Western water and climate change. Ecological Applications 25(8): 2069-2093. doi: http://dx.doi.org/10.1890/15-0938.1

Dugdale, R.C., F.P. Wilkerson, V.E. Hogue and A. Marchi. 2007. The role of ammonium and nitrate in spring bloom development in San Francisco Bay. Estuarine, Coastal, and Shelf Science 73:17-29.

Ferrari, M.C.O., L. Ranaker, K. Weinersmith, M. Young, A. Sih and L. Conrad. 2014. Effects of turbidity and an invasive waterweed on predation by introduced largemouth bass. Environmental Biology of Fishes 97: 79-90. https://doi.org/10.1007/s10641-013-0125-7

Feyrer, F., K. Newman, M.L. Nobriga and T.R. Sommer. 2011. Modeling the effects of future outflow on the abiotic habitat of an imperiled estuarine fish. Estuaries and Coasts: 34(1):120-128. DOI 10.1007/s12237-010-9343-9.

Feyrer, F., M.L. Nobriga and T. R. Sommer. 2007. Multi-decadal trends for three declining fish species: habitat patterns and mechanisms in the San Francisco Estuary, California, USA. Canadian Journal of Fisheries and Aquatic Sciences 64:723-734.

Gewant, D. and S.M. Bollens. 2012. Fish assemblages of interior tidal marsh channels in relation to environmental variables in the upper San Francisco Estuary. Environmental biology of fishes 94(2):483-499. doi: http://dx.doi.org/10.1007/s10641-011-9963-3

Grimaldo, L.F., T. Sommer, N. Van Ark, G. Jones, E. Holland, P.B. Moyle, P. Smith and B. Herbold. 2009. Factors affecting fish entrainment into massive water diversions in a freshwater tidal estuary: can fish losses be managed? North American Journal of Fisheries Management 29(5) 1253-1270. First published online on: 09 January 2011 (iFirst).

Hammock, B.G., J.A. Hobbs, S.B. Slater, S. Acuña and S.J. Teh. 2015. Contaminant and food limitation stress in an endangered estuarine fish. Science of the Total Environment 532:316-326. doi: http://dx.doi.org/10.1016/j.scitotenv.2015.06.018

Hasenbein, M., I. Werner, L.A. Deanovic, J. Geist, E.B. Fritsch, A. Javidmehr, C, Foe, N.A. Fangue and R.E. Connon. 2014. Transcriptomic profiling permits the identification of pollutant sources and effects in ambient water samples. Science of the Total Environment 468: 688-698. doi: http://dx.doi.org/10.1016/j.scitotenv.2013.08.081

Hasenbein, M., N.A. Fangue, J.P. Geist, L.M. Komoroske and R.E. Connon. 2016. Physiological stress biomarkers reveal stocking density effects in late larval Delta Smelt (*Hypomesus transpacificus*). Aquaculture 450:108-115. doi: http://dx.doi.org/10.1016/j.aquaculture.2015.07.005

Hayhoe, K., D. Cayan, C.B. Field, P.C. Frumhoff, E.P. Maurer, N.L. Miller, S.C. Moser, S.H. Schneideri, K.N. Cahill, E.E. Cleland, L. Dale, R. Drapek, R.M. Hanemann, L.S. Kalkstein, J. Lenihan, C.K. Lunch, R.P. Neilson, S.C. Sheridan, and J.H. Verville. 2004. Emissions pathways, climate change, and impacts on California. Proceedings of the National Academy of Sciences of the United States of America 101(34):12422-12427. doi: http://dx.doi.org/10.1073/pnas.0404500101

Hestir, E. L., D.H. Schoellhamer, J. Greenberg, T. Morgan-King and S.L. Ustin. 2016. The effect of submerged aquatic vegetation expansion on a declining turbidity trend in the Sacramento-San Joaquin River Delta. Estuaries and Coasts 1-13. doi: http://dx.doi.org/10.1007/s12237-015-0055-z

Hobbs, J.A., W.A. Bennett. and J. Burton. 2006. Assessing nursery habitat quality for native smelts (Osmeridae) in the low-salinity zone of the San Francisco Estuary. Journal of Fish Biology 69: 907-922.

Hobbs, J.A., Bennett, W.A., Burton, J. and M. Gras. 2007. Classification of larval and adult delta smelt to nursery areas by use of trace elemental fingerprinting. Transactions of the American Fisheries Society 136:518-527.

(IEP) Interagency Ecological Program. 2015. An updated conceptual model of Delta Smelt biology: our evolving understanding of an estuarine fish. IEP Management, Analysis and Synthesis Team. Interagency Ecological Program for the San Francisco Bay/Delta Estuary. Technical Report 90. California Department of Water Resources. http://www.water.ca.gov/iep/docs/Delta_Smelt_MAST_Synthesis_Report_January%202015.pdf

Jassby, A.D., W.J. Kimmerer, S.G. Monismith, C. Armor, J.E. Cloern, T.M. Powell, J.R. Schubel and T.J. Vendlinski. 1995. Isohaline position as a habitat indicator for estuarine populations. Ecological Applications 5(1): 272-289.

Jassby, A.D. and J.E. Cloern. 2000. Organic matter sources and rehabilitation of the Sacramento-San Joaquin Delta (California, USA). Aquatic Conservation: Marine and Freshwater Ecosystems 10(5):323-352. https://sfbay.wr.usgs.gov/publications/pdf/jassby_2000_organic.pdf

Jassby, A.D., Cloern, J.E. and B.E. Cole. 2002. Annual primary production: patterns and mechanisms of change in a nutrient-rich tidal ecosystem. Limnology and Oceanography 47:698-712.

Jeffries, K.M., R.E. Connon, B.E. Davis, L.M. Komoroske, M.T. Britton, T. Sommer, A. Todgham and N.A. Fangue. 2016. Effects of high temperatures on threatened estuarine fishes during periods of extreme drought. Journal of Experimental Biology 219(11):1705-1716. doi: http://dx.doi.org/10.1242/jeb.134528

Kimmerer, W.J. 2002a. Physical, biological and management responses to variable freshwater flow into the San Francisco Estuary. Estuaries 25: 1275-1290.

_____. 2002b. Effects of freshwater flow on abundance of estuarine organisms: physical effects or trophic linkages. Marine Ecology Progress Series 243:39-55.

_____. 2004. Open water processes of the San Francisco Estuary: from physical forcing to biological processes. San Francisco Estuary and Watershed Science. Available on the internet at <http://repositories.cdlib.org/jmie/sfews/vol2/iss1/art1>.

Kimmerer, W.J. 2008. Losses of Sacramento River Chinook salmon and delta smelt to entraiment in water diversioins in the Sacramento-San Joaquin Delta. San Francisco Estuary and Watershed Science, 6:2 (2). Available on the internet at <http://repositories.cdlib.org/jmie/sfews/vol6/iss2/art2>.

Kimmerer, W. J., E.S. Gross, and M.L MacWilliams. 2009. Is the response of estuarine nekton to freshwater flow in the San Francisco Estuary explained by variation in habitat volume? Estuaries and Coasts 32(2):375. http://www.jstor.org/stable/40663547

Kimmerer, W. and J. Thompson. 2014. Phytoplankton Growth Balanced by Clam and Zooplankton Grazing and Net Transport into the Low-Salinity Zone of the San Francisco Estuary. Estuaries and Coasts. 37. 10.1007/s12237-013-9753-6.

Knowles, N. and D.R. Cayan. 2002. Potential effects of global warming on the Sacramento/San Joaquin watershed and the San Francisco estuary. Geophysical Research Letters 29(18). doi: http://dx.doi.org/10.1029/2001GL014339

Komoroske, M., K.M. Jeffries, R.E. Connon, J. Dexter, M. Hasenbein, C. Verhille and N.A. Fangue. 2016. Sublethal salinity stress contributes to habitat limitation in an endangered estuarine fish. Evolutionary Applications. doi: http://dx.doi.org/10.1111/eva.12385

Komoroske, L.M., R.E. Connon, J. Lindberg, B.S. Cheng, G. Castillo, M. Hasenbein, and N. A. Fangue. 2014. Ontogeny influences sensitivity to climate change stressors in an endangered fish. Conservation Physiology 2. http://conphys.oxfordjournals.org/content/2/1/cou008.short

Kratina, P., R. Mac Nally, W.J. Kimmerer, J.R. Thomson, M. Winder. 2014. Human-induced biotic invasions and changes in plankton interaction networks. Journal of Applied Ecology 51(4):1066-1074. doi: http://dx.doi.org/10.1111/1365-2664.12266

Latour, R.J. 2016. Explaining Patterns of Pelagic Fish Abundance in the Sacramento-San Joaquin Delta. Estuaries and Coasts 39(1):233-247. doi: http://dx.doi.org/10.1007/s12237-015-9968-9

Lenihan, J. R., Drapek, D. Bachelet, and R. Neilson. 2003. Climate change effects on vegetation distribution, carbon and fire in California. Ecological Applications 13(6) 1667-1681.

Lindberg, J.C., G. Tigan, L. Ellison, T. Rettinghouse, M.M. Nagel and K.M. Fisch. 2013. Aquaculture methods for a genetically managed population of endangered Delta Smelt. North American Journal of Aquaculture 75(2):186-196. doi: http://dx.doi.org/10.1080/15222055.2012.751942

Loarie, S.R., B.E. Carter, K. Hayhoe, S. McMahon, R. Moe, C.A. Knight, and D.D. Ackerly. 2008. Climate change and the future of California's endemic flora. PLoS ONE 3(6): e2502.

Loarie, S., P. Duffy, H. Hamilton, G. Asner, C. Field, and D. Ackerly. 2009. The velocity of climate change. Nature 462(24/31): 1052-1055.

Matern, S.A., P.B. Moyle and L.C. Pierce. 2002. Native and alien fishes in a California estuarine marsh: twenty-one years of changing assemblages. Transactions of the American Fisheries Society 131(5):797-816. doi: http://dx.doi.org/10.1577/1548-8659(2002)131<0797:NAAFIA>2.0.CO;2

Maunder, M.N. and R. B. Deriso. 2011. A state–space multistage life cycle model to evaluate population impacts in the presence of density dependence: illustrated with application to delta smelt (*Hyposmesus transpacificus*). Canadian Journal of Fisheries and Aquatic Science 68: 1285–1306 DOI:10.1139/F2011-071

McMenamin, S.K., E.A. Hadley, and C.K. Wright. 2008. Climatic change and wetland desiccation cause amphibian decline in Yellowstone National Park. Proceedings of the National Academy of Sciences. 105(44): 16988-16993.

Merz, J.E., S. Hamilton, P.S. Bergman and B. Cavallo. 2011. Spatial perspective for delta smelt: a summary of contemporary survey data. California Fish and Game 97(4):164-189. http://www.genidaqs.net/reports/2011/CA_Fish-Game_97_164-189.pdf

Miller, L.W. 2000. The tow-net survey abundance index for delta smelt revisited. Interagency Ecological Program for the San Francisco Estuary (Newsletter)13(1):37-44. http://www.water.ca.gov/iep/newsletters/2000/2000winter.pdf

Miller, W.J., B.F.J. Manly, D.D. Murphy, D. Fullerton and R.R. Ramey. 2012. An investigation of factors affecting the decline of delta smelt (*Hypomesus transpacificus*) in the Sacramento-San Joaquin Estuary. Reviews in Fisheries Science (20)1:1-19. doi: http://dx.doi.org/10.1080/10641262.2011.634930

Mitchell, N.J., M.R. Kearney, N.J. Nelson, W.P. Porter. 2008. Predicting the fate of a living fossil: how will global warming affect sex determination and hatching phenology in tuatara? Proceedings of the Royal Society, Biological Sciences 275: 2185-2193.

Morgan-King, T.L. and D.H. Schoellhamer. 2013. Suspended-sediment flux and retention in a backwater tidal slough complex near the landward boundary of any estuary. Estuaries and Coasts 36: 300-318.

Moyle, P. B., R. AA.A. Daniels, B. Herbold, and D.M. Baltz. 1986. Patterns in distribution and abundance of a noncoevolved assemblage of estuarine fishes in California. Fishery Bulletin 84(1):105-117. http://fishbull.noaa.gov/841/moyle.pdf

Moyle, P.B., Herbold, B., Stevens, D.E. and L.W. Miller. 1992. Life history and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 121:67-77.

Murphy, D.D. and S.A. Hamilton. 2013. Eastern migration or marshward dispersal: exercising survey data to elicit an understanding of seasonal movement of delta smelt. San Francisco Estuary and Watershed Science 11(3). https://escholarship.org/uc/item/4jf862qz

Nobriga, M.L. 2002. Larval delta smelt diet composition and feeding incidence: environmental and ontogenetic influences. California Department of Fish and Wildlife 88:149-164.

Nobriga, M.L., F. Feyrer, R.D. Baxter and M. Chotkowski. 2005. Fish community ecology in an altered river delta: spatial patterns in species composition, life history strategies and biomass. Estuaries 28:776-785.

Nobriga, M.L., T.R. Sommer, F. Feyrer and K. Fleming. 2008. Long-term trends in summertime habitat suitability for delta smelt. San Francisco Estuary and Watershed Science 6(1). http://escholarship.org/uc/item/5xd3q8tx

Nobriga, M. L., Z. Matica, and Z.P. Hymanson. 2004. Evaluating Entrainment Vulnerability to Agricultural Irrigation Diversions: A Comparison among Open-Water Fishes. Pages 281-295 in F. Feyrer, L.R. Brown, R.L. Brown, and J.J. Orsi, editors. Early Life History of Fishes in the San Francisco Estuary and Watershed. American Fisheries Society, Symposium 39, Bethesda, Maryland.

Polansky, L., K.B. Newman and M.L. Nobriga and Lara Mitchell. 2018. Spatiotemporal models of an estuarine fish species to identify patterns and factors impacting their distribution and abundance. Estuaries and Coasts 41(2): 572-581

Riley, F. and S. Finlayson. 2003 (estimated). Acute toxities of herbicides used to control water hyacinth and Brazilian elodea on larval delta smelt and Sacramento splittail. Elk Grove, California Department of Fish and Game, Aquatic Toxicology Laboratory. 10pp.

Rose K.A., W.J. Kimmerer, K.P. Edwards and W.A. Bennett. 2013a. Individual-based modeling of Delta Smelt population dynamics in the upper San Francisco Estuary: I. Model description and baseline results. Transactions of the American Fisheries Society 142(5):1238-1259. doi: http://dx.doi.org/10.1080/00028487.2013.799518

Rose, K.A., W.J. Kimmerer, K.P. Edwards and W.A. Bennett. 2013b. Individual-based modeling of Delta Smelt population dynamics in the upper San Francisco Estuary: II. Alternative baselines and good versus bad years. Transactions of the American Fisheries Society 142(5):1260-1272. doi: http://dx.doi.org/10.1080/00028487.2013.799519

Ruhl, C.A. and D.H. Schoellhamer. 2004. Spatial and temporal variability of suspended-sediment concentration in a shallow estuarine environment. San Francisco Estuary and Watershed Science [online serial]. Vol. 2., Issue 2 (May 2004), Article 1. http://repositories.cdlib.org/jmie/sfews/vol2iss2/art1

Schoellhamer, D. H. 2011. Sudden clearing of estuarine waters upon crossing the threshold from transport as an erodible sediment pool is depleted: San Francisco Bay, 1999. Estuaries and Coasts 34: 885-899.

[Service] U.S. Fish and Wildlife Service. 1991. Endangered and threatened wildlife and plants; proposed threatened status for the delta smelt. Federal Register 56: 50075-50082.

_____. 1993. Endangered and threatened wildlife and plants; final rule, determination of threatened status of the delta smelt. Federal Register 58: 12854-12864.

_____. 1994. Endangered and threatened wildlife and plants; final rule critical habitat determination for the delta smelt. Federal Register 59: 65256-65277.

_____. 1996. Sacramento-San Joaquin Delta Native Fishes Recovery Plan. Portland, Oregon.

_____. 2004. 5-year review of the delta smelt. Available on the internet at: <http://www.fws.gov/sacramento/es/documents/DS%205-yr%20rev%203-31-04.pdf>. Accessed August 27, 2010.

_____. 2008. Formal Endangered Species Act Consultation on the Proposed Coordinated Operations of the Central Valley Project (CVP) and State Water Project (SWP), Service File No. 81420-2008-F-1481-5. Available on the internet at: <http://www.fws.gov/sfbaydelta/ocap/>.

_____. 2010a. 5-year review delta smelt (*Hypomesus transpacificus*). http://ecos.fws.gov/docs/five_year_review/doc3570.pdf

_____. 2010b. Endangered and threatened wildlife and plants; 12-month finding on a petition to reclassify the delta smelt from threatened to endangered throughout its range. Federal Register 75:17667-17680. https://www.gpo.gov/fdsys/pkg/FR-2010-04-07/pdf/2010-7904.pdf

_____. 2010c. Notice of Findings on Delta Smelt uplisting. Federal Register 75:69222-69294. https://www.gpo.gov/fdsys/pkg/FR-2010-11-10/pdf/2010-27686.pdf#page=2

_____. 2012. Candidate Notice of Review (CNOR) for Delta Smelt. November 21, 2012. Federal Register 77:69994-70060. https://www.gpo.gov/fdsys/pkg/FR-2012-11-21/pdf/2012-28050.pdf

_____. 2019. Final Fish and Wildlife Coordination Act Report for the San Francisco Bay to Stockton Navigation Improvement Project. Prepared by Bay Delta Fish and Wildlife Office for U.S. Army Corps of Engineers, Wilmington District. July 2019. 14 pp. + appendix.

Slater, S.B. and R.D. Baxter. 2014. Diet, prey selection, and body condition of age-0 delta smelt, in the Upper San Francisco Estuary. San Francisco Estuary Watershed Science 12(3). doi: http://dx.doi.org/10.15447/sfews.2014v12iss3art1

Sommer, T.R., M. L .Nobriga, W.C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain rearing of juvenile chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58(2): 325-333. https://doi.org/10.1139/f00-245

Sommer, T. C., Mejia, F., Nobriga, M. L., Feyrer, F., and L. Grimaldo. 2011. The Spawning Migration of Delta Smelt in the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science, 9(2). San Francisco Estuary and Watershed Science, John Muir Institute of the Environment, UC Davis. Available on the internet at <http://escholarship.org/uc/item/86m0g5sz>.

Sommer, T. and F. Mejia. 2013. A place to call home: a synthesis of Delta Smelt habitat in the upper San Francisco Estuary. San Francisco Estuary and Watershed Science 11(2). https://escholarship.org/uc/item/32c8t244

Stevens, D.E. 1977. Striped bass (*Morone saxatilis*) year class strength in relation to river flow in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 106(1):34-42. doi: http://dx.doi.org/10.1577/1548-8659(1977)106<34:SBMSYC>2.0.CO;2

Stevens, D.E. and L.W. Miller. 1983. Effects of river flow on abundance of young Chinook salmon, American shad, longfin smelt, and delta smelt in the Sacramento-San Joaquin River system. North American Journal of Fisheries Management 3:425-437.

Swanson C., Reid T., Young P.S., and Cech J.J. .2000. .Comparative environmental tolerances of threatened delta smelt (*Hypomesus transpacificus*) and introduced Wakasagi (*H. nipponensis*) in an altered California estuary. Oecologia 123:384-390.

Sweetnam, D.A. 1999. Status of delta smelt in the Sacramento-San Joaquin Estuary. California Fish and Wildlife 85:22-27.

Thomson, J.R., W.J. Kimmerer, L.R. Brown, K.M. Newman, Mac Nally, R., Bennett, W.A., Feyrer, F. and E. Fleishman. 2010. Bayesian change point analysis of abundance trends for pelagic fishes in the upper San Francisco Estuary. Ecological Applications 20(5): 1431–1448.

Turner, J.L. and H.K. Chadwick. 1972. Distribution and abundance of young-of-the-year striped bass, *Morone saxatilis*, in relation to river flow in the Sacramento-San Joaquin estuary. Transactions of the American Fisheries Society 101(3):442-452. doi: http://dx.doi.org/10.1577/1548-8659(1972)101<442:DAAOYS>2.0.CO;2

Vincik, R.F. and J.M. Julienne. 2012. Occurrence of delta smelt (*Hypomesus transpacificus*) in the lower Sacramento River near Knights Landing, California. California Fish and Game 98(3):171-174. https://www.wildlife.ca.gov/Publications/Journal

Wagner, W., M. Stacey, L. Brown and M. Dettinger. 2011. Statistical models of temperature in the Sacramento-San Joaquin Delta under climate-change scenarios and ecological implications. Estuaries and Coasts 34(3): 544-556.

Winder, M. and AD. Jassby. 2011. Shifts in Zooplankton Community Structure: Implications for Food Web Processes in the Upper San Francisco Estuary. Estuaries and Coasts. 34(4): 675-690.

Winder, M., A. D. Jassby, and R. Mac Nally. 2011. Synergies between climate anomalies and hydrological modifications facilitate estuarine biotic invasions. Ecology Letters 14(8): 749-757. DOI: 10.1111/j.1461-0248.2011.011635.x.

Wright S.A. and D.H. Schoellhamer DH. 2004. Trends in the sediment yield of the Sacramento River, California, 1957-2001. San Francisco Estuary and Watershed Science [online serial]. Vol. 2, Issue 2 (May 2004), Article 2.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

December 6, 2019 **Refer to NMFS No:** WCRO-2019-00460

Angela E. Dunn
Chief, Environmental Branch
U.S. Department of the Army
Jacksonville District, Corps of Engineers
701 San Marco Boulevard
Jacksonville, Florida 32207-8915

Re: Endangered Species Act Section 7(a)(2) Concurrence Letter and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the San Francisco Bay to Stockton Navigation Improvement Project

Dear Ms. Dunn:

On May 10, 2019, NOAA's National Marine Fisheries Service (NMFS) received your request for a written concurrence that U.S. Army Corps of Engineers' (Corps) proposed deepening of the existing navigational channel from San Francisco Bay to Stockton is not likely to adversely affect (NLAA) species listed as threatened or endangered or critical habitats designated under the Endangered Species Act (ESA). This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402, and agency guidance for preparation of letters of concurrence.

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on October 28, 2019 [84 FR 44976]. This consultation was pending at that time, and we are applying the updated regulations to the consultation. As the preamble to the final rule adopting the regulations noted, "[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and consistency, streamlines consultations, and codifies existing practice." We have reviewed the information and analyses relied upon to complete this letter of concurrence in light of the updated regulations and conclude the letter is fully consistent with the updated regulations.

NMFS also reviewed the proposed action for potential effects on essential fish habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), including conservation measures and any determination made regarding the potential effects of the action. This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554).

The document will be available within two weeks at NMFS' Environmental Consultation Organizer (ECO) at this link: [https://www.fisheries.noaa.gov/resource/tool-app/environmental-consultation-organizer-eco]. A complete record of this consultation is on file at the NMFS North-Central Coast Office in Santa Rosa, California.

Consultation History

By letter dated May 9, 2019, the Corps requested informal consultation with NMFS for the San Francisco Bay to Stockton Navigation Improvement Project. The consultation initiation package included the *San Francisco Bay to Stockton Navigation Improvement Project Biological Assessment and Essential Fish Habitat Assessment,* (BA) dated May 3, 2019. The Corps also provided, via email, the NMFS with the web link to the *Draft Integrated General Reevaluation Report and Environmental Impact Statement for San Francisco Bay to Stockton, California Navigation Study* (DEIS) on May 14, 2019. The Corps and NMFS met in person on June 12, 2019 to discuss the DEIS, proposed work windows, and the Corps' EFH determination. NMFS requested additional information, via email on August 7, 2019, regarding the proposed removal of a rock outcropping and beneficial re-use sites for disposal of dredged materials. The Corps provided this information on August 8, 2019. NMFS and Corps discussion regarding the proposed removal of the rock outcropping continued via email and telephone between August 28 and September 26, 2019.

Proposed Action and Action Area

The Corps proposes to deepen existing navigational channels from 35 feet to 38 feet (plus 2 foot overdepth) mean lower low water (MLLW) to facilitate shipping within the San Francisco Estuary from Central San Francisco Bay to Avon (just east of the Benicia-Martinez Bridge). The proposed deepening will allow vessels to transit the navigational channels more heavily loaded; however the Corps does not anticipate an increase in vessel trips as a result of channel deepening. The number of vessel trips may potentially decrease due to the ability for vessels to operate while loaded more closely to their design capacity.

The navigational channels to be deepened span from the northern portion of San Francisco Bay to Avon, and consist of approximately 10.3 miles of the Pinole Shoal Channel in San Pablo Bay and 2.9 miles of the Bulls Head Reach in Suisun Bay, California. The 2.9 mile length of channel in the Bulls Head Reach includes the dredging of a 2,600-foot long sediment trap to a depth of 42 feet MLLW, plus 2 foot overdepth. In total, the project would remove 1.6 million cubic yards of substrate to deepen an estimated 318 acres of bay floor (301 acres of benthic habitat in Pinole Shoal Channel, 1.3 acres in Bulls Head Reach, and 16 acres in the sediment trap). Dredged material will be disposed at Montezuma Wetlands Restoration Project (MWRP) or Cullinan Ranch Tidal Marsh Restoration Project, or the Corps may elect to use both sites for disposal.

All project activities will occur between June 1 and November 30. Dredging will be performed with a mechanical clamshell dredge. Up to three dredges may be operated simultaneously to complete the dredging within in one work season. To increase the probability of completing the channel deepening within one environmental work window, the Corps may conduct this project's channel deepening concurrently with routine maintenance dredging. Dredged material from channel deepening will be placed in shallow-bottom scows for transport to beneficial re-use sites. Dredging at Pinole Shoal may take up to six months, dredging at Bulls Head Reach would take approximately 1 month.

Dredging and disposal of dredged materials will be conducted in cooperation with the San Francisco Bay Dredged Materials Management Office (DMMO). To facilitate the DMMO review, the Corps has developed a sediment sampling plan, sediment characterization plan, a sediment removal plan, and proposes to perform disposal in accordance with the Long Term Management Strategy (LTMS) for the placement of dredged material in San Francisco Bay.

In addition to dredging, the Corps proposes to level a rocky outcrop located to the west of Pinole Shoal from a peak of 39.7 feet MLLW to 43 feet MLLW to facilitate future maintenance dredging and assure shipping safety. The rocky substrate/obstruction, currently buried by sediment, is located approximately 200 yards south of the Pinole Shoal Channel. Removal of the rock will occur using a pneumatic jackhammer attachment mounted to an excavator, which will be operated from a floating work barge. The rock substrate will be chiseled to a depth of 43 feet MLLW, and chiseled rock will remain on the bay floor. Approximately 40 cubic yards of material will be removed from the top of the outcrop, affecting 950 square feet (0.02 acres) of benthic habitat.

We considered whether or not the proposed action would cause any other activities and determined that it would not.

The action area is located within existing navigation channels in San Pablo and Suisun Bays, as well as the dredged material disposal sites. The navigation channel portions of the action area consist of 10.3 miles of the Pinole Shoal Channel in San Pablo Bay and 2.9 miles of the Bulls Head Reach in Suisun Bay. The rocky outcrop portion of the action area is approximately 0.02 acres and is located approximately 200 yards south of the Pinole Shoal Channel in San Pablo Bay. The navigational channel reaches are dredged annually to a depth of 35 feet and serve as the primary shipping channel for large vessel transit. Substrate in the channels consists of fine sediments and sand. The rocky outcrop to be lowered is currently buried in fine sediment.

The disposal portion of the action area is located at two dredged material beneficial re-use sites. MWRP is located along the eastern edge of Suisun Marsh in Solano County, California. MWRP consists of a 1,880-acre site of existing diked baylands where surface elevations at the site have subsided up to 10 feet since the historical marshes were isolated by levees. The restoration project continues to place dredged material within the diked areas to restore the bottom elevation. Once sediment placement has achieved target elevations, sites are re-vegetated and tidal action restored through levee breaching. NMFS and the Corps completed formal consultation for the MWRP in December 2000. No effects to listed fish are expected during this project's disposal of dredged sediments at the MWRP site because the disposal location is currently isolated from tidal waters by dikes and levees.

The Cullinan Ranch Tidal Restoration Project site may also be used for disposal of materials dredged by the project. Cullinan Ranch is located along the northern edge of San Pablo Bay spanning Solano and Napa Counties. Cullinan Ranch consists of a 1,549-acre area of diked-tidal wetlands within the San Pablo Bay National Wildlife Refuge. Restoration of the tidal connection to Cullinan Ranch aims to alleviate flooding of the adjacent Highway 37 and aid in the recovery of listed species. NMFS and USFWS completed section 7 consultation for the Cullinan Ranch Tidal Restoration Project in April 2010. As with the MWRP, dredged material disposed at Cullinan Ranch would be placed within diked areas. No effects to listed fish is expected during the Corps' disposal of dredged materials at Cullinan Ranch because the locations are currently isolated from tidal waters of San Francisco Bay.

Action Agency's Effects Determination

The Corps determined the proposed project may affect, but is not likely to adversely affect (NLAA) Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, Central California Coast (CCC) steelhead, threatened southern Distinct Population Segment (DPS) of North American green sturgeon and their designated critical habitats. The Corps' finding of NLAA listed species and designated critical habitat is based on the use of a clamshell dredge, dredging during environmental work windows, and the disposal of dredged sediments at a beneficial reuse site.

Available information indicates the following listed species (Evolutionarily Significant Units [ESU] or DPS) under the jurisdiction of NMFS may be affected by the proposed project:

Sacramento River winter-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
endangered (70 FR 37160; June 28, 2005);
critical habitat (58 FR 33212; June 16, 1993);
Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
threatened (70 FR 37160; June 28, 2005);
Central California Coast steelhead DPS (*Oncorhynchus mykiss*)
threatened (71 FR 834; January 5, 2006);
critical habitat (70 FR 52488; September 2, 2005);
Central Valley steelhead DPS (*Oncorhynchus mykiss*)
threatened (71 FR 834; January 5, 2006); and
North American green sturgeon southern DPS (*Acipenser medirostris*)
threatened (71 FR 17757; April 7, 2006);
critical habitat (74 FR 52300; October 9, 2009).

The life history of steelhead is summarized in Busby *et al.* (1996) and Chinook salmon life history is summarized in Myers *et al.* (1998). CCC steelhead, Central Valley steelhead, Sacramento River winter-run Chinook salmon, and Central Valley spring-run Chinook salmon pass through the San Francisco Bay estuary to rear as juveniles or to upstream areas to spawn as adults. Their migrations take place in the winter and spring months.

The life history of threatened green sturgeon in California is summarized in Adams *et al.* (2002) and NMFS (2005). The southern DPS of North American green sturgeon are anadromous, making migrations through San Francisco Bay to the Sacramento River in the spring, with peaks in April-June (Moyle *et al.* 1995). Green sturgeon spawn in the deep turbulent sections of the upper reaches of the Sacramento River, and as juvenile green sturgeon age, they migrate downstream and live in the lower delta and bays. Green sturgeon juveniles spend three to four years in the estuary, before entering the ocean, and likely optimize their growth opportunities in summer by foraging in the relatively warm estuarine water (Moser and Lindley 2007). Green sturgeon forage on benthic prey items throughout the estuary, notably shallow tidal flats dominated by burrowing shrimp and other benthic prey items (Dumbauld *et al.* 2008). Green sturgeon juveniles, subadults, and adults (pre-and post-spawning) are present in San Francisco Bay at various times throughout the entire year.

Regarding EFH, the Corps has determined that the proposed project may adversely affect EFH, but that adverse effects would be localized and offset by the disposal of dredged sediments at a beneficial reuse site. Additionally, fish will be able to return to the area once dredging is completed. The project area is located within an area identified as EFH for various life stages of fish species managed within the Pacific Coast Salmon Fishery Management Plan (FMP), the Pacific Groundfish FMP, and the Coastal Pelagic FMP. The project area is also within an area designated as Habitat Areas of Particular Concern (HAPC) for various federally-managed fish species within the Pacific Groundfish FMP and Pacific Coast Salmon FMP. HAPC are described in the regulations as subsets of EFH that are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under MSA, however, federal projects with potential adverse impacts to HAPC are more carefully scrutinized during the consultation process. As defined in the Pacific Groundfish and Salmon FMPs, San Francisco Bay, including the project area, is identified as estuary HAPC and within San Francisco Bay, both seagrass (submerged aquatic vegetation) and rocky reef HAPC occur.

ENDANGERED SPECIES ACT

Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b). When evaluating whether the proposed action is not likely to adversely affect listed species or critical habitat, NMFS considers whether the effects are expected to be completely beneficial, insignificant, or discountable. Completely beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

The effects of the proposed action include entrainment by the clamshell dredge, degradation of water quality during dredging activities, increases in underwater sound, exposure to contaminants, changes in salinity intrusion, and disturbance of benthic habitat. By restricting dredging activities to the period between June 1 and November 30, the proposed work schedule avoids the migration periods of listed anadromous salmonids in San Pablo and Suisun Bays. Thus, NMFS anticipates listed salmonids will not be present in the action area during project activities. As presented below, impacts associated with dredging will be temporary and fully dissipate prior to the salmonid migration period; therefore, any dredging-related effects to listed anadromous salmonids are anticipated to be discountable.

Potential effects to green sturgeon present during dredging activities are entrainment and exposure to degraded water quality. The mechanical dredge has the potential to entrain green sturgeon if fish come in contact with the bucket. Many factors influence the vulnerability of a species to entrainment, including reaction time, swimming capability (*i.e.*, speed), and flight response. In general, smaller fish and young life stages have poorer swimming capabilities and are more vulnerable to entrainment. As fish grow and mature, their swimming abilities improve and their ability to avoid entrainment increases. The life stages of green sturgeon that occur in San Pablo Bay and Suisun Bay are of sufficient size to possess a relatively strong swimming ability and they are unlikely to be entrained by the dredge bucket. Additionally, their abilities to detect noise, turbidity, water velocities and other environmental cues are expected to provide an effective protection against entrainment during dredging. If green sturgeon are present in the action area during dredging, they would likely be startled and temporarily leave the immediate area of project activities. Green sturgeon that react behaviorally would have adequate aquatic habitat in adjacent areas in San Francisco Bay to disperse and this disturbance would not affect their fitness. For these reasons, the risk of entrainment of green sturgeon by the dredge bucket equipment is considered discountable and the effects of disturbance are anticipated to be insignificant.

Disturbance of bottom sediments during dredging activities is expected to cause degradation of water quality in the form of increased turbidity, which can affect fish in a variety of ways. High levels of turbidity can affect fish by disrupting normal feeding behavior, reducing growth rates, increasing stress levels, and reducing respiratory functions. If sediment loads remain high for an extended period of time, the primary productivity of an aquatic area may be reduced (Cloern 1987) and fish may suffer reduced feeding ability and be prone to fish gill injury (Benfield and Minello 1996, Nightingale and Simenstad 2001). Sediment plumes that occur as a result of dredging by this project will likely increase turbidity to concentrations above ambient levels, but these increases are anticipated to mix with tidal currents and become indistinguishable within one tidal cycle. As a benthic dwelling species, green sturgeon are adapted to living in estuaries with fine sediment bottoms and, thus, are tolerant of high levels of turbidity. Specifically, green sturgeon are tolerant of levels of turbidity that exceed levels expected to result from this project's construction activities. For these reasons, the potential effects of localized areas of elevated turbidity associated with this project are expected to be insignificant for threatened green sturgeon.

As presented above, the project's disposal of dredged sediments at MWRP and Cullinan Ranch is expected to have no effects on listed fish. MWRP is an upland site and placement of material would be within the diked wetland area. The placement of dredged material at Cullinan Ranch is also within diked wetlands with no current tidal connection to San Francisco Bay.

The project's proposed use of a pneumatic jackhammer to reduce the height of the rock outcrop is likely to cause elevated levels of underwater sound. Increased underwater noise can result in sound pressure levels that cause behavioral and physiological stress, internal hemorrhage, auditory damage and even death (Buehler *et. al* 2015). NMFS utilizes a dual metric criteria that includes a threshold for peak sound pressure (206 dB) and a cumulative sound exposure level (187 dB for fishes 2 grams or larger and 183 dB for fishes smaller than 2 grams) to determine if underwater sound levels may injure or kill fish (Fisheries Hydroacoustic Working Group, 2008). Based on this criteria, elevated levels of underwater sound associated with the operation of the pneumatic jackhammer by this project are expected to be considerably lower than those identified as causing injury or mortality of fish. The Corps estimates underwater sound levels will be approximately 145 decibels root-mean-square during use of the pneumatic jackhammer. Therefore green sturgeon will not be exposed to sound levels that result in injury or mortality. Noise from the jackhammer could potentially startle green sturgeon and cause green sturgeon to temporarily disperse from the area. If sturgeon were to react behaviorally to the sound, work is anticipated to be for a relatively short period, 1-2 days, and adequate water depths and area within the adjacent San Pablo Bay are expected to provide sufficient area to disperse. Therefore, the effects of the short-term increase in underwater noise are expected to be insignificant to green sturgeon.

The action area is located within designated critical habitat for Sacramento River winter-run Chinook salmon, CCC steelhead, and the southern DPS of green sturgeon. The designation of critical habitat for these species uses the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). This shift in terminology does not change the approach used in conducting our analysis, whether the original designation identified primary constituent elements, physical or biological features, or essential features. In this letter of concurrence, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The PBFs essential for the conservation of Sacramento River winter-run Chinook salmon are: (1) access from the Pacific Ocean to appropriate areas in the upper Sacramento river, (2) availability of clean gravel for spawning substrate, (3) adequate river flows for spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles, (4) water temperatures between 42.5 and 57.5 °F (5.8 and 14.1 °C) for successful spawning, egg incubation, and fry development, (5) habitat areas and adequate prey that are not contaminated, (6) riparian habitat that provides for successful juvenile development and survival, and (7) access downstream so that juveniles can migrate from spawning grounds to San Francisco Bay and the Pacific Ocean. PBFs of designated critical habitat for CCC steelhead include estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. PBFs of critical habitat for the southern DPS of green sturgeon in estuarine areas include food resources, water flow, water quality, migratory corridor, water depth, and sediment quality.

Sediment sampling and analysis, including contaminant testing, was conducted during the project's early planning stage and is summarized in Appendix B of the BA. Preliminary testing of sediment indicates that dredged material will be suitable for placement at beneficial re-use as well as in-bay and ocean disposal. Post-dredging, the z-layer will be tested to confirm that exposed sediment will not result in contaminated benthic environment. Available core sampling results indicate that the z-layer sediment is either below or at current ambient levels for contaminants in the Bay. For these reasons, the project activities are not expected to result in an increased level of exposure to contaminants.

Critical habitat could also be affected by the changes in vessel traffic. By deepening the Pinole Shoal Channel and Bulls Head Reach, larger vessels will have access to these channels and potentially increasing the amount of vessel traffic. However, given that the existing fleet does not currently operate at capacity, *i.e.* vessels currently carry less fuel than the vessel's loading capacity, the Corps' analysis concluded channel deepening will not translate to more vessel trips. It may, however, result in fewer trips because vessels will be able to provide more product per trip. The Corps' analysis of the existing and projected vessel traffic is presented in Appendix D of the DEIS (USACE 2019). NMFS does not anticipate that the project will result in changes to the number of vessel trips that would affect designated critical habitat.

As part of the Corps' evaluation of the bathymetric changes that could result from the channel deepening of this project, a three-dimensional hydrodynamic and salinity model was used to simulate salt water intrusion under the current channel conditions and under the channel deepening proposed as part of the project (Anchor QEA, 2019). The magnitude and geographic shift of salt water intrusion will vary with dry and wet water year conditions. A 0.17-0.23 kilometer shift eastward of salinity conditions is anticipated to result due to the project's implementation. This relatively small shift in conditions is not expected to result in degraded PBF's of designated critical habitat.

During dredging activities, critical habitat will be temporarily affected by potential increases in turbidity and disturbance of benthic invertebrates. As discussed above, water quality effects on listed fish, in the form of increased turbidity, are expected to be temporary and insignificant. Disturbance of the benthic community is expected from the removal of invertebrate prey items with the dredged materials. The removal of benthic invertebrates can reduce the foraging value of the dredged area for fish (Newell *et al.* 1998). However, the areas to be deepened by the project are existing shipping channels that are subject to frequent traffic by large vessels and annual dredging. Additionally, the channels are currently about 35 feet deep. Foraging by green sturgeon typically occurs within tidal flats and shallow subtidal areas (Kelly *et al.* 2007, Dumbauld *et al.* 2008) and estuarine foraging by salmonids typically occurs within the upper portion of the water column or within shallow wetland channels (Dunford 1975, Bottom *et al.* 2011). Therefore, the deep dredge footprint of the project provides poor foraging habitat for green sturgeon and listed anadromous salmonids. Following dredging, recolonization of disturbed areas by macroinvertebrates is expected to occur. For these reasons, NMFS expects that project activities will not significantly affect PBFs associated with foraging by listed fish in the action area.

The leveling of the rock obstruction will result is the loss of 950 square feet (0.02 acres) of rocky benthic habitat. The benthic community structure, and therefore its function, may be altered as a result of changes in the physical habitat. Rocky habitat are considered relatively scarce within San Francisco Bay, and forage opportunities are limited. However, the rock to be removed is largely buried in fine sediment and located at a water depth of approximately 40 feet. Thus, the rock substrate under current conditions does not provide PBFs associated with foraging and cover for listed fish; thus, effects associated with the leveling of the rock outcrop are considered insignificant.

Conclusion

Based on this analysis, NMFS concurs with the Corps that the proposed action is not likely to adversely affect the subject listed species and designated critical habitats.

Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by the Corps or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) the proposed action causes take; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16). This concludes the ESA portion of this consultation.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Under the MSA, this consultation is intended to promote the protection, conservation and enhancement of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the associated physical, chemical, and biological properties that are used by fish (50 CFR 600.10), and "adverse effect" means any impact which reduces either the quality or quantity of EFH (50 CFR 600.910(a)). Adverse effects may include direct, indirect, site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

Based on information provided by the Corps, NMFS determined the proposed action would adversely affect EFH for various life stages of fish species managed under the Pacific Groundfish FMP and Coastal Pelagic FMP through increased turbidity and loss of benthic habitat. As discussed above, disturbance during dredging activities may re-suspend bottom sediments into the water column, causing increased turbidity, which reduces light penetration and lowers the rate of photosynthesis for subaquatic vegetation (Dennison 1987). If sediment loads remain high for an extended period of time, the primary productivity of an aquatic area may be reduced (Cloern 1987). For this project, increased levels of suspended sediment are expected to be temporary as turbidity increase will subside once dredging is complete each day. Placement of dredged material at MWRP or Cullinan Ranch will occur within diked areas and isolated from tidal waters, therefore impacts from disposal will not affect EFH. The use of dredge material at MWRP and Cullinan Ranch will ultimately benefit EFH through the restoration of tidal habitat.

Dredging is also expected to degrade EFH through disturbance of benthic organisms and foraging by fish may be affected. As noted above, the dredged area is expected to re-colonize following dredging events, and the forage area that will be altered by the project is located in waters approximately 35 feet deep and will be a relatively small proportion of the total forage area available for fish foraging in San Francisco Bay. However, this project will impact an estimated 318 acres of benthic habitat, while disposal of dredged material at beneficial re-use sites is estimated to contribute to the creation of 160 acres of wetland habitat, resulting in an offset for approximately half of the impacted area.

The proposed removal of the rock obstruction will result is the loss of 950 square feet (0.02 acres) of rocky benthic habitat. Benthic community structure and function, as noted above, may be affected by changes in the physical substrate or depth. Though not well studied in San Francisco Bay, hard substrate provides habitat for invertebrate attachment and refugia and foraging for fishes and invertebrates (Consentino-Manning 2007). Benthic invertebrates associated with hard substrates are a valuable prey resource for fish managed under the Pacific Groundfish FMP.

NMFS determined that the following conservation recommendations are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH.

1. Provide additional mitigation for the impacts to benthic habitat though the disposal of dredged material from future Corps dredge projects at beneficial reuse sites within the San Francisco Bay Estuary.

2. Provide mitigation for the loss of 950 square feet of rocky habitat within the San Francisco Bay Estuary. Appropriate mitigation for loss of rocky habitat may be provided by habitat restoration or enhancement projects which contribute to increased function of benthic habitat for fish species within San Francisco Bay.

Within 30 days after receiving these recommendations, you must provide NMFS with a detailed written response (50 CFR 600.920(k)(1)). The number of conservation recommendations accepted should be clearly identified in that response. If your response is inconsistent with the EFH conservation recommendations, you must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects.

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600. 920(l)). This concludes the MSA portion of this consultation.

Please direct questions regarding this letter to Sara Azat, North Central Coast Office in Santa Rosa, California at (707) 575-6067 or sara.azat@noaa.gov.

Sincerely,

Gary Stern
San Francisco Bay Branch Chief
North-Central Coast Office

cc: Elizabeth Campbell, USACE
Copy to ARN File #151422WCR2019SR00097

REFERENCES

Adams, P.B., C.B. Grimes, J.E. Hightower, S.T. Lindley, and M.L. Moser. 2002. Status Review for North American Green Sturgeon, *Acipenser medirostris*. National Marine Fisheries Service, Southwest Fisheries Science Center. 49 pages. [Document available at: Status Review of North American Green Sturgeon 2002].

Anchor QEA, LLC. 2019. San Francisco Bay to Stockton Navigation Improvement Project, Hydrodynamic and Salinity Intrusion Modeling Report Final Draft. Prepared for U.S. Army Corps of Engineers, San Francisco District. 207 pages.

Benfield, M.C., and T.J. Minello. 1996. Relative effects of turbidity and light intensity on reactive distance and feeding of an estuarine fish. Environmental Biology of Fish 46:211-216.

Bottom, Daniel L., Antonio Baptista, Jennifer Burke, Lance Campbell, Edmundo Casillas, Susan Hinton, David A. Jay, Mary Austill Lott, George McCabe, Regan McNatt, Mary Ramirez, G. Curtis Roegner, Charles a. Simenstad, Sarah Spilseth, Liea Stamatiou, David Teel, and Jeannette E. Zamon. 2011. Estuarine Habitat and Juvenile Salmon: Current and Historical Linkages in the Lower Columbia River and Estuary. Report of the NMFS Northwest Fisheries Science Center, Seattle, WA to U.S. Army Corps of Engineers, Portland District, Portland OR. 216 pages.

Buehler, D., R. Oestman, J. Reyff, K. Pommerenck, and B. Mitchell. 2015 Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Prepared for California Department of Transportation, 1120 N Street, Sacramento, California 95814. November 2015.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-27. 261 pages. [Document available at: West Coast Steelhead Status Review 1996].

Cloern, J.E. 1987. Turbidity as a control on phytoplankton biomass and productivity in estuaries. Continental Shelf Research 7(11/12):1367-1381.

Cosentino-Manning, N., Janet Thompson, Katie McGourty, Susan Wainwright-De La Cruz, Sarah Allen. 2007. Habitat type and associated biological assemblages: hard bottom substrate. In: Schaeffer, K., McGourty, K., and Cosentino-Manning, N., eds. Report on the Subtidal Habitats and Associated Biological Taxa in San Francisco Bay. Santa Rosa, CA, US. National Oceanic and Atmospheric Administration, August 2007, p. 46-50

Dennison, W. C., R.S Alberte. 1987. Photoadaptation and growth of *Zostera marina* L.(eelgrass) transplants along a depth gradient. Journal of Experimental Marine Biology and Ecology, 98(3), 265-282.

Dumbauld, B.R., D.L. Holden, and O.P. Langness. 2008. Do sturgeon limit burrowing shrimp populations in Pacific Northwest estuaries. Environmental Biology of Fishes 83:283-296.

Dunford, W. E. 1975. Space and food utilization by salmonids in marsh habitats in the Fraser River Estuary. M.S. Thesis. University of British Colombia, Vancouver.

Fisheries Hydroacoustic Working Group. 2008. Agreement in principal for interim criteria for injury to fish from pile driving activities. Memorandum dated June 12, 2008.

Kelly, J. T., A. P. Klimley, and C. E. Crocker. 2007. Movements of green sturgeon, *Acipenser medirostris*, in the San Francisco Bay estuary, California. Environmental Biology of Fishes 79:281-295.

Kritzer, J., M. B. DeLucia, E. Greene, C. Shumway, M. F. Topolski, J. Thomas-Blate, L. A. Chiarella, K. B. Davy, and K. Smith. The Importance of Benthic Habitats for Coastal Fisheries. BioScience 66, 4 (2016): 274-284.

Moser, M.L., and S.T. Lindley. 2007. Use of Washington Estuaries by Subadult and Adult Green Sturgeon. Environmental Biology of Fishes 79(3):243-253.

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, and E.D. Wikramanayake. 1995. Fish species of special concern in California. California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, California.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grand, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS NWFSC 35. 443 pages.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, JACKSONVILLE DISTRICT
701 SAN MARCO BLVD
JACKSONVILLE, FL 32207-8175

January 6, 2020

SUBJECT: Response to Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Conservation Recommendations for the San Francisco Bay to Stockton Navigation Improvement Project (NMFS No: WCRO-2019-00460)

Mr. Gary Stern
San Francisco Bay Branch Chief
National Marine Fisheries Service (NMFS)
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

Dear Mr. Stern:

This is in response to your letter dated December 6, 2019 concurring with our determination that the proposed deepening of the existing navigational channel from San Francisco Bay to Stockton is not likely to adversely affect species listed as threatened or endangered or critical habitats designated under the Endangered Species Act (ESA; section 7(a)(2)), and providing Essential Fish Habitat (EFH) conservation recommendations as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA; section 305(b)(4)(A)).

In your letter, NMFS determined that the following conservation recommendations are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH:

a. Provide additional mitigation for the impacts to benthic habitat through the disposal of dredged material from future Jacksonville District, U.S. Army Corps of Engineers (Corps) dredge projects at beneficial reuse sites within the San Francisco Bay Estuary.

b. Provide mitigation for the loss of 950 square feet of rocky habitat within the San Francisco Bay Estuary. Appropriate mitigation for loss of rocky habitat may be provided by habitat restoration or enhancement projects which contribute to increased function of benthic habitat for fish species within San Francisco Bay.

This response is in accordance with 305(b)(4)(B) of the MSA and its implementing regulations (50 C.F.R. §600.920(k)(1)). The Corp's position is that "mitigation" for project impacts to benthic habitat is not warranted as the habitat will be disturbed, but not lost. The rock obstruction, though reduced in volume by 40 cubic yards, should continue to provide habitat for benthic invertebrates. That said, Corps accepts both EFH conservation recommendations as described below.

Regarding conservation recommendation #1, Corps has no legal or fiscal mechanism to bind other/future Corps dredging projects to specific material placement requirements. However, Corps will continue to work with NMFS to minimize impacts by finding cost-effective strategies to place dredge material at beneficial reuse sites within the San Francisco Bay Estuary, consistent with existing guidance relative to identification of the Federal Standard for material placement and non-federal sponsor coordination. The Corps is aware of the high level of interest in beneficial reuse of dredged material in maintaining the long-term ecological integrity of the San Francisco Bay and remains an engaged participant in regional efforts to support long-term restoration objectives.

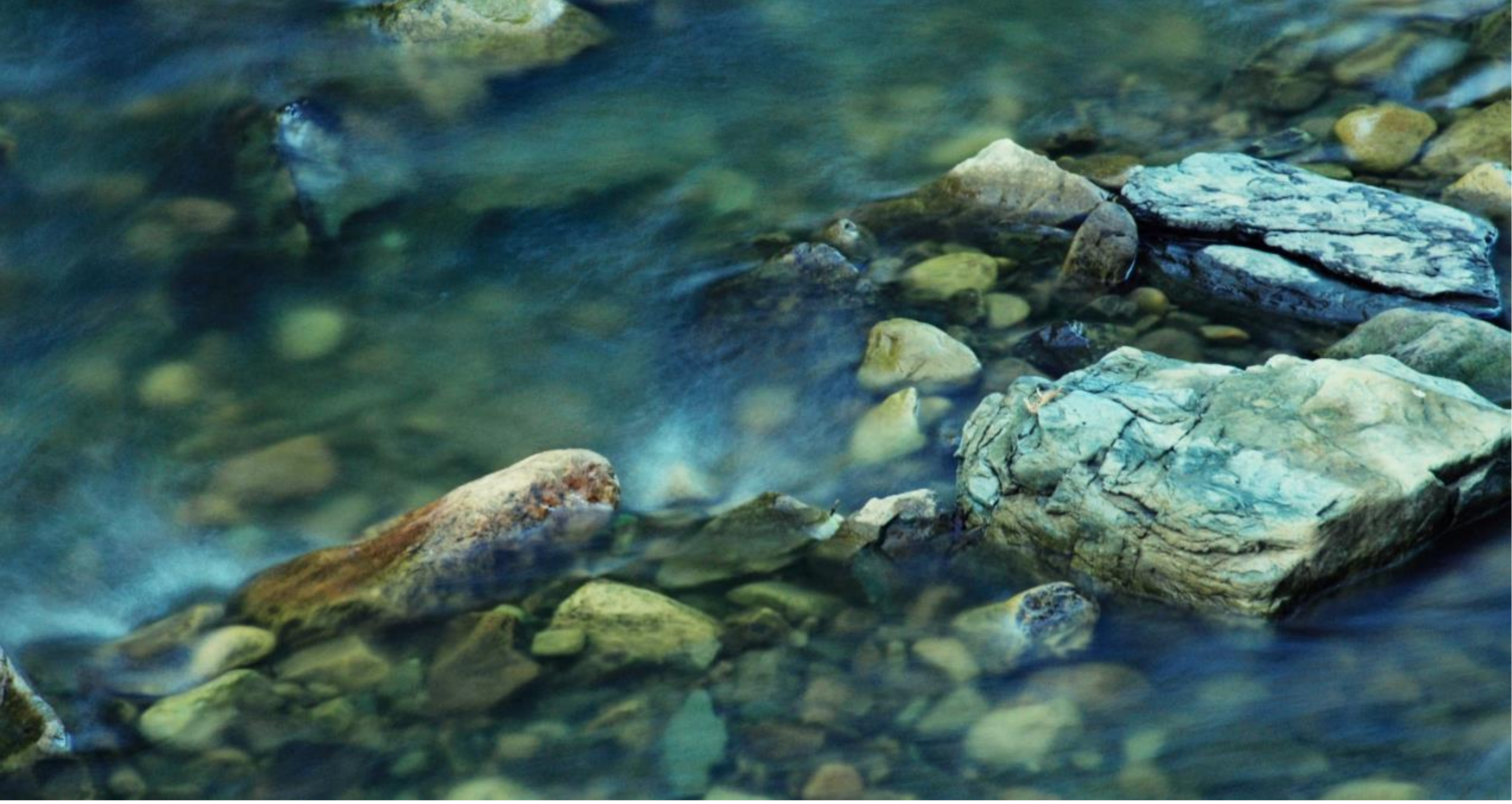
Regarding conservation recommendation #2, Corps intends to leave the rock pieces removed from the obstruction in place to minimize impacts to benthic invertebrates that may prefer rocky substrate, and hence minimize impacts to EFH. The Corps will verify in the design phase of the project that the rock obstruction is buried in sediment. If the rock obstruction is found to protrude from the sediment and hence directly provide cover habitat for fish, Corps will compensate for this loss by contributing to an appropriate habitat restoration or enhancement project.

Please contact Ms. Beth Campbell of the San Francisco District at elizabeth.a.campbell@usace.army.mil, or at (415) 503-6845 if you have any questions.

Sincerely,

Angela E. Dunn
Chief, Environmental Branch

Appendix G – Attachment 5
Air Quality Report



October 2019
San Francisco Bay to Stockton Navigation Improvement Project

ANCHOR QEA

Air Quality Technical Report to Support NEPA Analysis

Prepared for the U.S. Army Corps of Engineers

October 2019
San Francisco Bay to Stockton Navigation Improvement Project

Air Quality Technical Report to Support NEPA Analysis

Prepared for
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Prepared by
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San Francisco, California 94111

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APPENDICES

ABBREVIATIONS

--	not applicable
$\mu g/m^3$	micrograms per cubic meter
AB	Assembly Bill
ARB	California Air Resources Board
BAAQMD	Bay Area Air Quality Management District
CAA	Clean Air Act
CAP	Climate Action Plan
CCAA	California Clean Air Act
CCR	California Code of Regulations
CO	carbon monoxide
Conc.	concentration
cy	cubic yard
DPM	diesel particulate matter
EIR	Environmental Impact Report
HAP	Hazardous Air Pollutant
hp	Horsepower
hr	hour
MLLW	mean lower low water
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NO_2	Nitrogen dioxide
NOP	Notice of Preparation
NO_X	Nitrogen oxides
PM	particulate matter
PM_{10}	particles less than 10 microns in diameter
$PM_{2.5}$	particles less than 2.5 microns in diameter
ppb	parts per billion
ppd	parts per day
ppm	parts per million
ROG	reactive organic gases
SFBAAB	San Francisco Bay Area Air Basin
SIP	State Implementation Plan
SO_2	sulfur dioxide
SVAB	Sacramento Valley Air Basin
TAC	toxic air contaminant
tpy	tons per year

TSP	Tentatively Selected Plan
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
YSAQMD	Yolo-Solano Air Quality Management District

1 Introduction

This report describes the air quality analysis conducted for the San Francisco Bay to Stockton Navigation Improvement Project, which involves deepening portions of federal navigation channels located in the San Francisco Bay: the Pinole Shoal Channel and the western portion of the Suisun Bay Channel. This report describes the potential effects of criteria air pollutants, toxic air contaminants (TACs), diesel particulate matter (DPM), and odors that would result from construction and implementation of the project.

Chapter 2 of this report describes the existing air quality conditions and air basins applicable to the project and presents an overview of the regulatory setting in the project area.

Chapter 3 presents the air quality impacts resulting from the TSP. Three alternatives: the 37-Foot Mean Lower Low Water (MLLW) Alternative (deepening throughout the project area to -37 feet MLLW with upland placement/beneficial reuse of dredged sediment); the 38-Foot MLLW Alternative (deepening throughout the project area to -38 feet MLLW with upland placement/beneficial reuse of dredged sediment); and the No Action Alternative were initially considered through project scoping. These analyses were used for preliminary screening of alternatives and to further develop the Tentatively Selected Plan (TSP). The TSP is identified as the 38-foot MLLW depth with widening footprint alternative, under which the existing maintained Pinole Shoal Channel and the western portion of the Suisun Bay Channel would be deepened from -35 feet MLLW to -38 feet MLLW, with approximately 13.2 miles of new regulatory depths. Air Quality impacts resulting from the TSP are presented in Section 3.1.

Chapter 4 summarizes the findings presented in this report.

2 Affected Environment

Air quality is affected by the rate, amount, and location of pollutant emissions and the meteorological conditions that influence pollutant movement and dispersal. Atmospheric conditions, including wind speed, wind direction, and air temperature, in combination with local surface topography (i.e., geographic features such as mountains, valleys, and large water bodies), determine the effect of air pollutant emissions on local air quality.

The following sections describe concepts and terms relevant to the air quality analysis as well as the regional air quality setting within the study area.

2.1 Criteria Air Pollutants

As required by the federal Clean Air Act (CAA) of 1970, the U.S. Environmental Protection Agency (USEPA) has identified six criteria air pollutants that are pervasive in urban areas and for which state and national health-based ambient air quality standards have been established. USEPA calls these pollutants "criteria air pollutants" because they are regulated by developing specific public health- and welfare-based criteria as the basis for setting permissible levels. Ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM), and lead are the six criteria air pollutants regulated by USEPA. PM is measured in two size ranges: PM_{10} for particles less than 10 microns in diameter, and $PM_{2.5}$ for particles less than 2.5 microns in diameter. Table 1 lists the criteria pollutants and their major health effects.

2.2 Toxic Air Contaminants

TACs are air pollutants that may lead to serious illness or increased mortality, even when present in relatively low concentrations. Potential human health effects of TACs include birth defects, neurological damage, cancer, and death. There are hundreds of different types of TACs with varying degrees of toxicity. Individual TACs vary greatly in the health risk they present. At a given level of exposure, one TAC may pose a hazard that is many times greater than another.

Table 1
Criteria Pollutants and Health Effects

Pollutant	Description	Health Effect
Ozone	Ozone is a secondary air pollutant produced in the atmosphere through a complex series of photochemical reactions involving ROG (also sometimes referred to as volatile organic compounds by some regulating agencies) and NO_X. The main sources of ROG and NO_X, often referred to as ozone precursors, are combustion processes (including motor vehicle engines) and the evaporation of solvents, paints, and fuels. Ozone is referred to as a regional air pollutant because its precursors are transported and diffused by wind concurrently with ozone production through the photochemical reaction process.	Ozone causes eye irritation, airway constriction, and shortness of breath, and can aggravate existing respiratory diseases such as asthma, bronchitis, and emphysema.
Carbon Monoxide	CO is an odorless, colorless gas usually formed as the result of the incomplete combustion of fuels. The single largest source of CO is motor vehicles; the highest emissions occur during low travel speeds, stop-and-go driving, cold starts, and hard acceleration. CO concentrations have declined dramatically in California due to existing controls and programs and most areas of the state, including the study area, have no problem meeting the state and federal CO standards.	Exposure to high concentrations of CO reduces the oxygen-carrying capacity of the blood and can cause headaches, nausea, dizziness, and fatigue, impair central nervous system function, and induce angina (chest pain) in persons with serious heart disease. Very high levels of CO can be fatal.
Particulate Matter (PM_{10} and $PM_{2.5}$)	PM_{10} and $PM_{2.5}$, also termed respirable particulate matter and fine particulate matter, respectively, are a class of air pollutants consisting of heterogeneous solid and liquid airborne particles from manmade and natural sources.	These particulates are small enough to be inhaled into the deepest parts of the human lung and can cause adverse health effects. Among the criteria pollutants that are regulated, particulates represent a serious ongoing health hazard.
Nitrogen Dioxide (NO_2)	NO_2 is a reddish-brown gas that is a byproduct of combustion processes. Automobiles and industrial operations are the main sources of NO_2. NO_2 may be visible as a coloring component on high pollution days, especially in conjunction with high ozone levels.	Aside from its contribution to ozone formation, NO_2 can increase the risk of acute and chronic respiratory disease and reduce visibility.
Sulfur Dioxide (SO_2)	SO_2 is a colorless acidic gas with a strong odor. It is produced by the combustion of sulfur-containing fuels such as oil, coal, and diesel.	SO_2 has the potential to damage materials and can cause health effects at high concentrations. It can irritate lung tissue and increase the risk of acute and chronic respiratory disease (BAAQMD 2012).

Pollutant	Description	Health Effect
Lead	Leaded gasoline (phased out in the United States beginning in 1973), lead-based paint (on older houses and cars), smelters (metal refineries), and manufacturing of lead storage batteries have been the primary sources of lead released into the atmosphere.	Lead has a range of adverse neurotoxic health effects, of which children are at special risk. Some lead-containing chemicals cause cancer in animals. Lead levels in the air have decreased substantially since leaded gasoline was eliminated. Ambient lead concentrations are only monitored on an as-warranted, site-specific basis in California.

2.3 Diesel Particulate Matter

The California Air Resources Board (ARB) identified DPM as a TAC in 1998, primarily based on evidence demonstrating cancer effects in humans. The exhaust from diesel engines includes hundreds of different gaseous and particulate components, many of which are toxic. Mobile sources, such as trucks and buses, are among the primary sources of diesel emissions, and concentrations of DPM are higher near heavily traveled highways and rail lines with diesel locomotive operations. The estimated lifetime cancer risk from exposure to diesel exhaust is much higher than the risk associated with any other toxic air pollutant routinely measured in the region. The risk from DPM as determined by ARB declined from 750 in one million in 1990 to 570 in one million in 1995; by 2000, ARB estimated the average statewide cancer risk from DPM to be 540 in one million (ARB 2009). This calculated cancer risk value from ambient air exposure in the Bay Area can be compared against the lifetime probability of being diagnosed with cancer in the United States from all causes, which is more than 40% (based on a sampling of 17 regions nationwide), or greater than 400,000 in one million, according to the National Cancer Institute (NCI 2012).

TACs do not have ambient air quality standards, but are regulated by California air districts using a risk-based approach. This approach uses a health risk assessment to determine which sources and pollutants to control, as well as the degree of control. A health risk assessment is an analysis in which human health exposure to toxic substances is estimated and considered together with information regarding the toxic potency of the substances to provide quantitative estimates of health risks. In general, a health risk assessment is required if the air district concludes that projected emissions of a specific air toxic compound from a proposed new or modified source suggest a potential public health risk. Such an assessment generally evaluates chronic, long-term effects, calculating the increased risk of cancer as a result of exposure to one or more TACs.

2.4 Odors

Odors are generally regarded as an annoyance rather than a health hazard. Manifestations of a person's reaction to odors can range from psychological (e.g., irritation, anger, or anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, and headache). The ability to detect odors varies considerably among the population and overall is quite subjective. People may have different reactions to the same odor. An odor that is offensive to one person may be perfectly acceptable to another. An unfamiliar odor is more easily detected and is more likely to cause complaints than a familiar one. A person can become desensitized to almost any odor and recognition only occurs with an alteration in the intensity. The occurrence and severity of odor impacts depends on the nature, frequency, and intensity of the source; wind speed and direction; and the sensitivity of receptors. Odor impacts should be considered for any proposed new odor sources located near existing receptors, as well as any new sensitive receptors located near existing odor sources. Increasing the distance between the receptor and the odor source will generally mitigate odor impacts.

2.5 Sensitive Receptors

Air quality does not affect every individual in the population in the same way, and some groups are more sensitive to adverse health effects than others. Population subgroups sensitive to the health effects of air pollutants include the elderly and the young, those with higher rates of respiratory disease such as asthma and chronic obstructive pulmonary disease, and those with other environmental or occupational health exposures (e.g., indoor air quality) that affect cardiovascular or respiratory diseases.

Land uses such as schools, children's day care centers, hospitals, and nursing and convalescent homes are considered to be more sensitive than the general public to poor air quality because the population groups associated with these uses have increased susceptibility to respiratory distress. Parks and playgrounds are considered moderately sensitive to poor air quality because persons engaged in strenuous work or exercise also have increased sensitivity to poor air quality. However, exposure times are generally far shorter in parks and playgrounds than in residential locations and schools. Residential areas are considered more sensitive to air quality conditions compared to commercial and industrial areas because people generally spend longer periods of time at their residences, with associated greater exposure to ambient air quality conditions.[1]

Sensitive receptors include children, adults, and seniors occupying or residing in residential dwellings, schools, colleges and universities, daycares, hospitals, and senior-care facilities. Workers are not considered sensitive receptors because all employers must follow regulations set forth by the Occupational Safety and Health Administration to ensure the health and well-being of their employees.

2.6 Regional Setting

The geographic scope of the study area includes the waters within the North San Francisco Bay, San Pablo and Suisun Bays, covering the counties of Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, and San Francisco. The majority of the project area is located within the boundaries of the San Francisco Bay Area Air Basin (SFBAAB), though portions extend into the Sacramento Valley Air Basin (SVAB).

[1] The factors responsible for variation in exposure are also often similar to the factors associated with greater susceptibility to air quality health effects. For example, poorer residents may be more likely to live in crowded substandard housing and be more likely to live near industrial or roadway sources of air pollution.

2.6.1 San Francisco Bay Area Air Basin

The SFBAAB encompasses a nine-county region, including all of Alameda, Contra Costa, Santa Clara, San Francisco, San Mateo, Marin and Napa counties, and the southern portions of Solano and Sonoma counties. The Bay Area Air Quality Management District (BAAQMD) has jurisdiction over air quality within the SFBAAB. The climate of the SFBAAB is determined largely by a high-pressure system that is almost always present over the eastern Pacific Ocean off the west coast of North America. During winter, the Pacific high-pressure system shifts southward, allowing more storms to pass through the region. During summer and early fall, when few storms pass through the region, emissions generated within the Bay Area can combine with abundant sunshine under the restraining influences of topography and subsidence inversions to create conditions that are conducive to the formation of photochemical pollutants such as ozone and secondary particulates such as nitrates and sulfates.

2.6.2 Sacramento Valley Air Basin

The SVAB encompasses an eleven-county region, including all of Butte, Colusa, Glenn, Sacramento, Shasta, Sutter, Tehama, Yolo, and Yuba counties, and portions of Placer and Solano counties. The Yolo-Solano Air Quality Management District (YSAQMD) is responsible for Yolo County and the eastern portion of Solano County. Other counties within the SVAB are outside of the study area. The climate in the SVAB is Mediterranean. Prevailing winds originate offshore of San Francisco Bay and flow through the Carquinez Strait, then north through the Sacramento Valley. Elevations of the broad valley floor range from 60 to 500 feet above mean sea level. The valley is bordered to the north by the Sierra Cascade Mountains, to the east by the Sierra Nevada, and to the west by the Coast Ranges. The topography and climate of the air basin create a high potential for air inversions. Inversions occur frequently during all seasons. The most stable of these inversions occurs in the late summer and early fall, when cool coastal air is trapped beneath a warm air mass. Photochemical smog (i.e., ozone) trapped in these inversions is often exacerbated when preceded by sunny days with relatively high temperatures. During late fall and winter, air inversions occurring at ground level often result in low-lying fog when valley air becomes trapped and does not mix with coastal air. It is during these periods that the air basin experiences the highest concentrations of CO, NO_X, and PM.

2.6.3 Existing Air Quality

BAAQMD, YSAQMD, and ARB all monitor regional air quality through a network of monitoring stations, which record ambient concentrations of non-attainment criteria air pollutants. Probable future levels of air quality in the study area can generally be inferred from ambient air quality measurements conducted at the nearest monitoring stations by examining trends over time. The data gathered at these monitoring stations present the nearest available benchmark reference point as to what the pollutants of greatest concern are in the region and the degree to which the area is out of attainment with specific air quality standards.

The two closest monitoring stations to the study area in the SFBAAB are in Vallejo and San Pablo. Table 2 shows a 3-year (2015 through 2017) summary of monitoring data for ozone, PM_{10}, and $PM_{2.5}$ recorded at these stations. These stations recorded no violations of ozone or PM_{10} standards but identified violations of state and federal 24-hour $PM_{2.5}$ standards.

Table 3 shows a 3-year (2015 through 2017) summary of monitoring data for ozone, PM_{10}, and $PM_{2.5}$ recorded at the Vacaville and Davis air monitoring stations, which are the stations closest to the study area within the SVAB. These stations recorded violations of the ozone federal standards, but no violations of the state or federal $PM_{2.5}$ standards. Neither station monitors PM_{10} concentrations.

YSAQMD currently meets USEPA's health standards for five pollutants. YSAQMD is part of the SVAB regional non-attainment area for ground-level ozone and fine particulate pollution.

Table 2
Summary of Air Quality Monitoring Data within the SFBAAB (2015–2017)

Pollutant	Applicable Standard	Number of Days Standards Were Exceeded and Maximum Concentrations Measured[a]		
		2015	2016	2017
Ozone				
Vallejo – 304 Tuolumne Street				
Days 1-hour State Std. Exceeded	>0.09 ppm[b]	0	**1**	**1**
Max. 1-hour Conc. (ppm)	--	0.085	**0.097**	**0.105**
Days 8-hour National Std. Exceeded	>0.070 ppm[c]	0	**1**	**2**
Days 8-hour State Std. Exceeded	>0.070 ppm[b]	**1**	**1**	**2**
Max. 8-hour Conc. (ppm)	--	**0.071**	**0.072**	**0.088**
San Pablo – Rumrill Blvd.				
Days 1-hour State Std. Exceeded	>0.09 ppm[b]	0	0	**3**
Max. 1-hour Conc. (ppm)	--	0.084	0.094	**0.104**
Days 8-hour National Std. Exceeded	>0.070 ppm[c]	0	0	**2**
Days 8-hour State Std. Exceeded	>0.070 ppm[b]	0	0	**2**
Max. 8-hour Conc. (ppm)	--	0.062	0.061	**0.080**
Suspended Particulates (PM_{10})				
San Pablo – Rumrill Blvd.				
Days Over 24-hour National Std.	>150 μg/m^3 [c]	0	0	0
Days Over 24-hour State Std.	>50 μg/m^3 [b]	0	0	**25.8**
Max. 24-hour Conc. (μg/m3)	--	43.0	33.0	95.3
Annual Average (μg/m3)	>20 μg/m^3 [b]	18.1	14.9	19.8

Pollutant	Applicable Standard	Number of Days Standards Were Exceeded and Maximum Concentrations Measured[a]		
		2015	2016	2017
Suspended Particulates ($PM_{2.5}$)				
Vallejo – 304 Tuolumne Street				
Days Over 24-hour National Std.	>35 μg/m^3 [c]	**3**	0	**9**
Max. 24-hour Conc. (μg/m3)	--	**41.4**	23.0	**101.9**
Annual Average (μg/m3)	>12 μg/m^3 [b]	9.6	7.3	11.5
San Pablo – Rumrill Blvd.				
Days Over 24-hour National Std.	>35 μg/m^3 [c]	0	0	**9.3**
Max. 24-hour Conc. (μg/m3)	--	33.2	19.5	**71.2**
Annual Average (μg/m3)	>12 μg/m^3 [b]	8.9	8.0	10.7

Notes:
Bold values are in excess of applicable standard.
a. Number of days exceeded is for all days in a given year, except for particulate matter. PM_{10} and $PM_{2.5}$ are monitored every 6 days.
b. state standard, not to be exceeded.
c. federal standard, not to be exceeded.
Source: ARB 2018

Table 3
Summary of Air Quality Monitoring Data within the SVAB (2015-2017)

Pollutant	Applicable Standard	Number of Days Standards Were Exceeded and Maximum Concentrations Measured[a]		
		2015	2016	2017
Ozone				
Vacaville – Ulatis Drive				
Days 1-hour State Std. Exceeded	>0.09 ppm[b]	0	0	0
Max. 1-hour Conc. (ppm)	--	0.085	0.092	0.089
Days 8-hour National Std. Exceeded	>0.070 ppm[c]	0	**1**	**2**
Days 8-hour State Std. Exceeded	>0.070 ppm[b]	**1**	**1**	**2**
Max. 8-hour Conc. (ppm)	--	0.070	**0.072**	**0.079**
Davis – UCD Campus				
Days 1-hour State Std. Exceeded	>0.09 ppm[b]	0	0	0
Max. 1-hour Conc. (ppm)	--	0.081	0.083	0.078
Days 8-hour National Std. Exceeded	>0.070 ppm[c]	**1**	**1**	**1**
Days 8-hour State Std. Exceeded	>0.070 ppm[b]	**1**	**1**	**1**
Max. 8-hour Conc. (ppm)	--	**0.071**	**0.072**	**0.071**
Suspended Particulates ($PM_{2.5}$)				
Davis – UCD Campus				
Days Over 24-hour National Std.	>150 μg/m^3 [c]	NA	NA	NA

Pollutant	Applicable Standard	Number of Days Standards Were Exceeded and Maximum Concentrations Measured[a]		
		2015	2016	2017
Days Over 24-hour State Std.	>50 μg/m^3 [b]	NA	NA	NA
Max. 24-hour Conc. (μg/m3)	--	36.3	30.5	**59.2**
Annual Average (μg/m3)	>20 μg/m^3 [b]	10.1	NA	NA

Notes:
Bold values are in excess of applicable standard.
Source: ARB 2018

a. Number of days exceeded is for all days in a given year, except for particulate matter. PM_{10} and $PM_{2.5}$ are monitored every 6 days.
b. state standard, not to be exceeded.
c. federal standard, not to be exceeded.

2.7 Regulatory Setting

Development within the study area must comply with federal, state, regional, and local air quality regulations. This section discusses the effects of these regulatory requirements on development of the project.

2.7.1 Federal

2.7.1.1 Clean Air Act

The CAA and its subsequent amendments form the basis for the national air pollution control effort. USEPA is responsible for implementing most aspects of the CAA. Basic elements of the act include the National Ambient Air Quality Standards (NAAQS or "national standards") for major air pollutants, hazardous air pollutant standards, attainment plans, motor vehicle emission standards, stationary source emission standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

2.7.1.2 Criteria Pollutants

The 1970 CAA (last amended in 1990) required USEPA to identify NAAQS, which are the concentrations of pollutants (with an adequate margin of safety) to which the public can be exposed without adverse health effects. They are designed to protect those segments of the public most susceptible to respiratory distress, including asthmatics, the very young, the elderly, people weak from other illness or disease, or persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollution levels that are somewhat above ambient air quality standards before adverse health effects are observed. Pursuant to the 1990 CAA amendments, USEPA classifies air basins (or portions thereof) as "attainment" or "nonattainment" for each criteria air pollutant based on whether or not the NAAQS have been achieved.

Table 4 shows the current national and state ambient air quality standards and the health effects that can result when the standards are exceeded. Table 5 shows the current attainment status for the SFBAAB and SVAB. Both air basins are classified as nonattainment for the federal and state ozone and $PM_{2.5}$ standards.

Table 4
Ambient Air Quality Standards

Pollutant	Averaging Time	State Standard	Federal Primary Standard	Major Pollutant Sources
Ozone	8-hour	0.070 ppm	0.075 ppm	Formed when ROG and NO_X react in the presence of sunlight. Major sources include on-road motor vehicles, solvent evaporation, and commercial/industrial mobile equipment.
	1-hour	0.090 ppm	--	
Carbon Monoxide	8-hour	9.0 ppm	9.0 ppm	Internal combustion engines, primarily gasoline-powered motor vehicles
	1-hour	20 ppm	35 ppm	
Nitrogen Dioxide	Annual Average	0.030 ppm	0.053 ppm	Motor vehicles, petroleum refining operations, industrial sources, aircraft, ships, and railroads
	1-hour	0.180 ppm	0.100 ppm	
Sulfur Dioxide	Annual Average	--	0.03 ppm	Fuel combustion, chemical plants, sulfur recovery plants and metal processing
	24-hour	0.04 ppm	0.14 ppm	
	1-hour	0.25 ppm	0.075 ppm	Dust- and fume-producing industrial and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g., wind-raised dust and ocean sprays)
Particulate Matter (PM_{10})	Annual Arithmetic Mean	20 µg/m^3	--	
	24-hour	50 µg/m^3	150 µg/m^3	
Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 µg/m^3	12 µg/m^3	Fuel combustion in motor vehicles, equipment, and industrial sources; residential and agricultural burning; also, formed from photochemical reactions of other pollutants, including NO_X, sulfur oxides, and organics
	24-hour	--	35 µg/m^3	
Lead	Calendar Quarter	--	1.5 µg/m^3	Present sources: lead smelters, battery manufacturing and recycling facilities. Past source: combustion of leaded gasoline
	30-Day Average	1.5 µg/m^3	--	
Hydrogen Sulfide	1-hour	0.03 ppm	No federal standard	Geothermal power plants, Petroleum production and refining
Visibility Reducing Particles	8-hour	Extinction of 0.23/km; visibility of 10 miles or more	No federal standard	See $PM_{2.5}$

Table 5
Air Quality Attainment Status of the SFBAAB and SVAB

	SFBAAB Attainment Status		SVAB Attainment Status	
Pollutant	**California Standard**	**Federal Standard**	**California Standard**	**Federal Standard**
Ozone 8-hr	Non-Attainment	Non-Attainment	Non-Attainment	Non-Attainment
Ozone 1-hr	Non-Attainment	--	Non-Attainment	--
CO 8-hr	Attainment	Attainment, maintenance	Attainment	Attainment, maintenance
CO 1-hr	Attainment	Attainment	Attainment	Attainment
NO_2 Annual	Attainment	Attainment	Attainment	Attainment
NO_2 1-hr	Attainment	Unclassified	Attainment	Unclassified
SO_2 Annual	Attainment	Attainment	Attainment	Attainment
SO_2 24-hour	Attainment	Attainment	Attainment	Attainment
SO_2 1-hour	Attainment	Attainment	Attainment	Attainment
PM_{10} Annual	Non-Attainment	--	Non-Attainment	--
PM_{10} 24-hr	Non-Attainment	Unclassified	Non-Attainment	Unclassified
$PM_{2.5}$ Annual	Non-Attainment	Attainment	Non-Attainment	Attainment

2.7.1.3 Toxic Air Contaminants

TACs are regulated under both state and federal laws. Federal laws use the term "Hazardous Air Pollutants" (HAPs) to refer to the same types of compounds that are referred to as TACs under state law. Both terms encompass essentially the same compounds. The 1977 CAA amendments required USEPA to identify National Emission Standards for HAPs to protect public health and welfare. These substances include certain volatile organic compounds, pesticides, herbicides, and radionuclides that present a tangible hazard, based on scientific studies of exposure to humans and other mammals. Under the 1990 CAA amendments, 189 substances are regulated as HAPs.

2.7.1.4 State Implementation Plan

The CAA requires each state to prepare an air quality control plan referred to as the State Implementation Plan (SIP). The CAA amendments added requirements for states containing areas that violate the NAAQS to revise their SIPs to incorporate additional control measures to reduce air pollution. A SIP is a living document that is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of air basins as reported by the agencies with jurisdiction over them. USEPA has responsibility to review all SIPs to determine whether they conform to the mandates of the CAA amendments and will achieve air quality goals when implemented. If USEPA determines a SIP to be inadequate, it may prepare a Federal Implementation Plan for the nonattainment area and impose additional control measures. Failure to submit an approvable SIP or to implement the plan within mandated timeframes can result in sanctions being applied to transportation funding and stationary air pollution sources in the air basin.

The 1977 CAA amendments require that regional planning and air pollution agencies prepare a regional air quality plan to outline the measures by which both stationary and mobile sources of pollutants can be controlled in order to achieve all standards specified in the CAA. The 1988 California Clean Air Act (CCAA) also requires development of air quality plans and strategies to meet state air quality standards in areas designated as nonattainment (except for areas designated as nonattainment for the state PM standards). Maintenance plans are required for attainment areas that had previously been designated nonattainment in order to ensure continued attainment of the standards. In California, these air quality plans are developed by the air districts and approved by ARB for inclusion in the SIP.

2.7.1.5 General Conformity Rule

Section 176(c) of the CAA states that a federal agency cannot issue a permit for or support an activity unless the agency determines it will conform to the most recent USEPA-approved SIP. This means that projects using federal funds or requiring federal approval must not: 1) cause or contribute to any new violation of a NAAQS; 2) increase the frequency or severity of any existing violation; or 3) delay the timely attainment of any standard, interim emission reduction, or other milestone. General conformity requirements were adopted by Congress as part of the CAA and were implemented by USEPA regulations on November 30, 1993, in "Determining Conformity of General Federal Actions to State or Federal Implementation Plans; Final Rule" (58 Federal Register 62235, 1993). General conformity requires that all federal actions conform to the SIP as approved or promulgated by USEPA by determining that the action is either exempt from the General Conformity Rule requirements or subject to a formal conformity determination.

2.7.1.6 Emission Standards for Marine Diesel Engines

To reduce emissions from Category 1 (at least 50 horsepower [hp] but less than 5 liters per cylinder displacement) and Category 2 (5 to 30 liters per cylinder displacement) marine diesel engines, USEPA has established emission tier standards for new engines. Tier 2 standards were phased in from 2004 to 2007 (year of manufacture), depending on the engine size. Tier 3 and 4 emission standards for marine diesel engines were introduced in 2008. Tier 3 standards are designed to harmonize with international standards.[2] The Tier 4 standards are modeled after the 2007/2010 highway engine program and the Tier 4 nonroad rule, with an emphasis on the use of emission after treatment technology. For the purposes of this analysis, engine rules are assumed to affect harbor craft but not oceangoing vessels, as the latter would likely be manufactured overseas and therefore would be exempt from the rule. To enable catalytic after treatment methods, USEPA established a sulfur cap in

[2] International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI

marine fuels, limiting sulfur to 15 parts per million (ppm) in marine diesel fuel by June 2012. California also currently requires the use of diesel fuel with a sulfur content of 15 ppm or less, which is applicable to all marine vessels.

2.7.2 State

2.7.2.1 California Clean Air Act

Although the CAA established national ambient air quality standards, individual states retained the option to adopt standards that are more stringent and to include other pollution sources. California passed the CCAA in 1988 (California Health and Safety Code Sections 39600 et seq.), which, like its federal counterpart, called for the designation of areas as attainment or nonattainment, but based on state ambient air quality standards rather than the federal standards. Table 4 shows there is considerable diversity between California's and the NAAQS, with the state ambient standards being at least as protective as national ambient standards and often more stringent.

2.7.2.2 Toxic Air Contaminants

The State Air Toxics Program was established in 1983 under Assembly Bill (AB) 1807. A total of 243 substances have been designated TACs under California law, including the 189 (federal) HAPs adopted in accordance with AB 2728. The Air Toxics "Hot Spots" Information and Assessment Act of 1987 (AB 2588) seeks to identify and evaluate risk from air toxics sources; however, AB 2588 does not regulate air toxics emissions. In August 1998, ARB identified DPM emissions from diesel-fueled engines as TACs. ARB subsequently developed the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles* (ARB 2000). The document represents proposals to reduce diesel particulate emissions, with the goals of reducing emissions and associated health risks by 75% in 2010 and 85% in 2020.

2.7.2.3 California Air Resources Board Regulation to Reduce Emissions from Diesel Engines on Commercial Harbor Craft

In November 2007, ARB adopted a regulation to reduce DPM and NO_X emissions from new and in-use commercial harbor craft. Under ARB's definition, commercial harbor craft include tug boats, tow boats, ferries, excursion vessels, work boats, crew boats, and fishing vessels. The regulation implemented stringent emission limits on harbor craft auxiliary and propulsion engines. In 2010, ARB amended the regulation to add specific in-use requirements for barges, dredges, and crew/supply vessels.

2.7.2.4 California Air Resources Board California Diesel Fuel Regulation 28

With this rule, ARB set sulfur limitations for diesel fuel sold in California for use in on-road and off-road motor vehicles (California Code of Regulations [CCR] Title 13, Sections 2281–2285; CCR Title 17, Section 93114). Harbor craft and intrastate locomotives were originally excluded from the rule but were later included by a 2004 rule amendment (ARB 2005). Under this rule, diesel fuel used in motor vehicles, except harbor craft and intrastate locomotives, has been limited to 500 ppm of sulfur since 1993. The sulfur limit was reduced to 15 ppm on September 1, 2006. A federal diesel rule similarly limited sulfur content nationwide to 15 ppm by October 15, 2006.

2.7.2.5 California Air Resources Board Regulations for Fuel Sulfur and Other Operational Requirements for Ocean Going Vessels within California Waters and 24 Nautical Miles of the California Baseline

In 2008, ARB adopted a Clean Fuel Regulation for Ocean Going Vessels within 24 nautical miles of the California coast to further reduce emissions from shipping. Since then, the permitted sulfur content of marine gas oil and marine diesel oil has been progressively lowered and may not exceed 0.1% since 2014. ARB adopted a regulation in 2014 that allows marine vessels to be considered in compliance with the California Ocean Going Fuel Regulation when they are complying with the North American Emission Control Area using alternative emission control technologies or non-distillate low sulfur (less than or equal to 0.1% sulfur) marine fuels.

2.7.3 Regional

California's air quality is monitored and regulated at the state level by ARB and at the local and regional level by air pollution control authorities known as Air Pollution Control Districts or Air Quality Management Districts. The role of the air districts includes developing clean air plans.

2.7.3.1 Bay Area Air Quality Management District Rules, Regulations

BAAQMD is the regional agency responsible for rulemaking, permitting, and enforcement activities affecting stationary sources in the Bay Area. BAAQMD does not have the authority to regulate emissions from personal motor vehicles. Specific rules and regulations adopted by BAAQMD limit the emissions that can be generated by emission sources and identify specific pollution reduction measures that must be implemented in association with various activities. These rules regulate not only emissions of the six criteria air pollutants, but also TAC emission sources, which are regulated through BAAQMD's permitting process and standards of operation.

2.7.3.2 Yolo-Solano Air Quality Management District Applicable Rules, Regulations,

YSAQMD is the regional agency responsible for rulemaking, permitting and enforcement activities affecting stationary sources in the Yolo and Solano County portion of the SVAB. Its authority and specific rules and regulations and permitting processes mirror those of BAAQMD.

3 Environmental Consequences

This chapter presents project-specific air quality impacts resulting from the TSP and the No Action Alternative.

Two alternatives were preliminarily considered by the U.S. Army Corps of Engineers (USACE): the 37-Foot MLLW Alternative (deepening throughout the project area to -37 feet MLLW with upland placement/beneficial reuse of dredged sediment); the 38-Foot MLLW Alternative (deepening throughout the project area to -38 feet MLLW with upland placement/beneficial reuse of dredged sediment). No locally preferred plan (LPP) has been identified. Therefore, the recommended plan is the National Economic Development Plan, identified as the 38-foot MLLW depth. Under the TSP, the existing maintained Pinole Shoal Channel and western portion of the Suisun Bay Channel would be deepened from -35 feet to -38 feet MLLW, with approximately 13.2 miles of new regulatory depths. There will also be a rock outcrop removed, and a sediment trap at Bull's Head Reach that will be -44 feet MLLW (as described further in Chapter 3 of the integrated General Reevaluation Report/Environmental Impact Statement.

3.1 Methods

Using the assumptions and models discussed in Sections 3.3 and 3.4, air pollutant emissions from the proposed construction and operational activities were calculated using the most current emission factors and methods, then compared to the thresholds identified in Section 3.5 to determine their significance. For impacts that exceeded a significance criterion, measures were evaluated for their ability to mitigate the impacts to insignificance. The analysis also considered impacts to sensitive receptors. Sensitive receptors are children, elderly, asthmatics, and others who are at a heightened risk of negative health outcomes due to exposure to air pollution. The locations where these sensitive receptors congregate for periods of time are considered sensitive receptor locations (CARB 2018). No sensitive receptors or land uses are located within 1,000 feet of the proposed dredging footprints, placement sites, or the docking locations for ships.

3.2 NEPA Baseline

The NEPA baseline condition for determining the significance of impacts of a federal action is defined by examining the full range of construction and operational activities likely to be implemented absent the federal action. The NEPA baseline can change if environmental conditions at the site would change over time in the absence of a federal action. The NEPA baseline for the study is identical to the No Action Alternative. Under the No Action Alternative, there would be neither new construction nor changes to operations, however, maintenance dredging would continue.

3.3 Assumptions

3.3.1 Construction Assumptions

The following assumptions were used to assess air quality emissions from construction of the TSP (USACE 2015a, updated 2019):

- Dredging would begin in June 2023 and would last 5.5 months. Dredging would occur 15 hours per day, 7 days per week. There are 20 hours total in each work day.
- Dredging would use a 21-cubic-yard (cy) clamshell dredging plant powered by a 2,500-hp engine and a 1,900-hp auxiliary engine; 150-hp tugs; 100-hp survey boat; and a 150-hp derrick barge.
- Dredging would occur at two locations: Pinole Shoal Channel and Suisun Bay Channel.
  - *Pinole Shoal Channel:* Dredging in Pinole Channel would last 4 months and use two clamshell dredgers. The dredging rate would be 9,000 cy per day.
  - *Suisun Bay Channel*: Dredging in Suisun Bay would last 1.5 months and use one clamshell dredger. The dredging rate would be 7,300 cy per day.
- There are two placement sites: Cullinan, which would receive material from Pinole Shoal, and Montezuma, which would receive material from Suisun Bay Channel. Both sites would use electrified pumps.
  - *Cullinan:* Placement at Cullinan would require two 2,000-cy scows using two tug boats because the Napa River is too shallow for a fully loaded 4,000-cy scow. The distance of travel is 10.5 miles to Cullinan from Pinole Shoal. All work would be within BAAQMD.
  - *Montezuma:* Two 4,000-cy scows using one tug boat would be used to haul dredged material. The distance of travel between Montezuma and Suisun Bay Channel is 17 miles, with 14 miles in BAAQMD and 3 miles in YSAQMD.
- Eight workers would be needed for the dredge plant, and two workers would be needed for the tugboats.
- Emissions from worker trips are estimated using ARB's EMFAC2017 modeling software.
- Emission factors for this equipment are based on ARB's 2011 California Harbor Craft Emissions Inventory.

3.3.2 Operational Assumptions

The Economics Evaluation prepared for the project (USACE 2015b) estimates that the volume of petroleum products (the dominant cargo in the project area) will grow at the same rate whether or not the TSP is implemented. The vessel mix, however, is projected to change if TSP deepening is implemented. The predicted increase in petroleum product volumes is expected to be shipped primarily in vessels of the Panamax medium class. The deeper channel depth would allow those vessels to avoid some of the costly operational strategies currently in use, such as transporting smaller volumes and making more frequent trips, making them a more efficient option than the larger vessels. Therefore, the air quality analysis focuses on the change of Panamax vessels over time as shown in Table 6. As shown, because the Panamax-sized vessels would not need to make more frequent trips, overall trips would be less than under the No Action Alternative, even as more product is moved by vessels of this size class.

Table 6
Projected Annual Panamax Ship Calls Over Time

Vessel Type	No Action Alternative			TSP		
Year	**2023**	**2030**	**2040**	**2022**	**2030**	**2040**
Panamax	127	151	179	113	136	165

The following assumptions were used to assess air quality emissions from operations:

- Annual ship calls are based on 2014 data from the USACE Waterborne Commerce Statistics Center (USACE 2015a).
- The maximum tugboat engine size is assumed to be 3,600 hp for main engines and 235 hp for auxiliary engines, based on the maximum values in ARB's OFFROAD2014 model. A load factor of 50% for main engines and 31% for tugboats is assumed based on OFFROAD2014.
- Two tugboats would accompany each Panamax vessel (Port of Los Angeles 2008).
- Marine vessel emissions are based on ARB's Emission Estimation Methodology for Ocean-Going Vessels (2011). ARB's estimation procedure uses separate calculations for main and auxiliary engines.
- Average vessel characteristics for tankers assumes main engine power of 13,034 kilowatts and auxiliary power of 2,339 kilowatts (ARB 2011). Estimates assume a load factor of 83% for main engines and 26% for auxiliary engines (ARB 2011). Emission factors for main engines and auxiliary engines are based on medium marine distillate (0.1% sulfur) (ARB 2011). Main engines are assumed to operate for 2 hours per ship call and auxiliary engines for 34 hours per ship call.

3.4 Thresholds

3.4.1 National Environmental Policy Act

The purpose of the general conformity program is to ensure that actions taken by the federal government do not undermine state or local efforts to achieve and maintain NAAQS. Before a federal action is taken, it must be evaluated for conformity with the SIP. All reasonably foreseeable emissions, both direct and indirect, predicted to result from the action are taken into consideration and must be identified with respect to location and quantity. Direct emissions occur at the same time and place as the action. Indirect emissions are reasonably foreseeable emissions that may occur later in time and/or farther removed from the action. The emissions are subject to conformity if the federal agency can practicably control them and maintain control through a continuing program responsibility. If it is found that the action would create emissions above de minimis threshold levels specified in USEPA regulations, the action cannot proceed unless mitigation measures are specified that would bring the project into conformance.

General conformity applies in both federal nonattainment and maintenance areas. In these areas, it applies to any federal action not specifically exempted by the CAA or USEPA regulations. General conformity does not apply to projects or actions that are covered by the transportation conformity rule. If a federal action falls under the general conformity rule, the federal agency responsible for the action is responsible for making the conformity determination. In some instances, a state will make the conformity determination under delegation from a federal agency. Private developers are not responsible for making a conformity determination, but they can be directly affected by a determination.

The significance criteria used to evaluate NEPA air quality effects are based on the federal general conformity thresholds. Currently, the SFAAB is classified as moderate nonattainment for the federal 8-hour ozone standard, nonattainment for the 24-hour $PM_{2.5}$ standard, and maintenance for the federal CO standards. Because sulfur dioxide is considered a precursor to $PM_{2.5}$, the conformity threshold for SO_2 also applies. The portion of the SVAB under jurisdiction of YSAQMD is currently classified as severe non-attainment for the federal 8-hour ozone standard, non-attainment for the 24-hour $PM_{2.5}$ standard, and maintenance for the federal CO standards. Table 7 shows the applicable general conformity thresholds that apply to the TSP in both air basins.

Table 7
General Conformity de minimis Thresholds for Projects in the SFBAAB and SVAB

Pollutant	SFBAAB Threshold (tpy)	SVAB Threshold (tpy)
CO	100	100
NO_X	100	25
ROG	50	25
$PM_{2.5}$	100	100
PM_{10}	--	100
SO_2	100	100

Source: USEPA 2016

3.4.2 *Summary of Significance Thresholds*

Considering the specific NEPA threshold methodologies presented above, an alternative would be considered to have a significant impact on air quality if it would cause the following:

- Impact AQ-01: Conflict with or obstruct implementation of the applicable air quality plan
- Impact AQ-02: Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard
- Impact AQ-03: Expose sensitive receptors to substantial pollutant concentrations
- Impact AQ-04: Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people

3.5 Impact Evaluation

3.5.1 *Impact AQ-01: Would the Alternative Conflict with or Obstruct Implementation of the Applicable Air Quality Plan?*

Impacts. As discussed in Section 3.4.1, the applicable federal air quality plan is the general conformity program, which is to ensure that actions taken by the federal government do not undermine state or local efforts to achieve and maintain NAAQS. Before a federal action is taken, it must be evaluated for conformity with the SIP. Table 10 shows the annual construction emissions for the TSP. As shown, construction emissions would not exceed the applicable general conformity thresholds for any of the applicable criteria pollutants in the SFBAAB or SVAB under the TSP.

Table 10
Annual Construction Emissions for the TSP as Compared to Conformity Thresholds

Construction Activities	Air Pollutant					
	ROG	**NO_X**	**CO**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**
Year 2023 Within BAAQMD						
Dredging (tpy)	0.89	6.29	14.37	0.35	0.34	0.04
Worker Transport (tpy)	0.06	0.35	0.29	0.01	0.01	0.00
Sediment Transport (tpy)	1.46	29.43	9.64	0.21	0.2	0.05
Total Emissions (tpy)	**2.41**	**36.07**	**24.3**	**0.57**	**0.54**	**0.09**
SFBAAB de minimis Threshold (tpy)	50	100	100	--	100	100
Exceed?	No	No	No	No	No	No
Year 2023 Within YSAQMD						
Dredging (tpy)	0.0	0.0	0.0	0.0	0.0	0.0
Worker Transport (tpy)	0.0	0.0	0.0	0.0	0.0	0.0
Sediment Transport (tpy)	0.0	0.3	0.1	0.0	0.0	0.0

Construction Activities	Air Pollutant					
	ROG	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_2
Total Emissions (tpy)	**0.0**	**0.3**	**0.1**	**0.0**	**0.0**	**0.0**
SVAB de minimis Threshold (tpy)	25	25	100	--	100	100
Exceed?	No	No	No	No	No	No

Table 11 shows the No Action Alternative (NEPA Baseline) and TSP emissions and Table 12 shows the annual operational emissions for the TSP as compared to the No Action Alternative (NEPA baseline). As shown, for the years 2022, 2030, or 2040, emissions would not exceed the applicable thresholds for any of the applicable criteria pollutants in the SFBAAB. This comparison uses BAAQMD thresholds because: 1) most of the impacts would occur in the SFBAAB; and 2) BAAQMD has more stringent thresholds than YSAQMD.

Table 11
Annual Operational Emissions for the No Action Alternative (NEPA Baseline) and TSP

Operational Activities	Air Pollutant			
	ROG	NO_X	PM_{10}	$PM_{2.5}$
No Action Alternative				
2022				
Vessels (tpy)	3.85	91.42	2.24	2.07
Tugs (tpy)	1.63	7.99	0.39	0.27
Total Emissions (tpy)	5.48	99.41	2.63	2.34
2030				
Vessels (tpy)	4.58	108.69	2.67	2.46
Tugs (tpy)	1.94	11.46	0.47	0.4
Total Emissions (tpy)	6.52	120.15	3.14	2.86
2040				
Vessels (tpy)	5.43	128.85	3.16	2.91
Tugs (tpy)	2.3	14.55	0.55	0.5
Total Emissions (tpy)	7.73	143.4	3.71	3.41
TSP				
2022				
Vessels (tpy)	3.43	81.34	0.88	0.82
Tugs (tpy)	1.45	6.85	0.35	0.23
Total Emissions (tpy)	4.87	88.19	1.23	1.05
2030				
Vessels (tpy)	4.12	49.53	2.4	2.22
Tugs (tpy)	1.75	10.24	0.42	0.35

Operational Activities	Air Pollutant			
	ROG	NO_X	PM_{10}	$PM_{2.5}$
Total Emissions (tpy)	5.87	59.77	2.83	2.57
2040				
Vessels (tpy)	5.01	118.77	2.91	2.68
Tugs (tpy)	2.12	13.41	0.51	0.46
Total Emissions (tpy)	7.12	132.18	3.42	3.14

Table 12
Annual Operational Emissions for the TSP Compared to the No Action Alternative (NEPA Baseline)

Operational Activities	Air Pollutant			
	ROG	NO_X	PM_{10}	$PM_{2.5}$
2022				
Vessels (tpy)	-0.42	-10.08	-1.36	-1.25
Tugs (tpy)	-0.18	-1.14	-0.04	-0.04
Total Emissions (tpy)	**-0.61**	**-11.22**	**-1.4**	**-1.29**
BAAQMD Thresholds (tpy)	50	100	100	100
Exceed?	No	No	No	No
2030				
Vessels (tpy)	-0.46	-59.16	-0.27	-0.24
Tugs (tpy)	-0.19	-1.22	-0.05	-0.05
Total Emissions (tpy)	**-0.65**	**-60.38**	**-0.31**	**-0.29**
BAAQMD Thresholds (tpy)	50	100	100	100
Exceed?	No	No	No	No
2040				
Vessels (tpy)	-0.42	-10.08	-0.25	-0.23
Tugs (tpy)	-0.18	-1.14	-0.04	-0.04
Total Emissions (tpy)	**-0.61**	**-11.22**	**-0.29**	**-0.27**
BAAQMD Thresholds (tpy)	50	100	100	100
Exceed?	No	No	No	No

Because emissions would not exceed applicable NEPA thresholds, the TSP would result in less-than-significant impacts.

Mitigation Measures. No mitigation required.

Residual Impacts after Mitigation. Less than significant.

Cumulative Impacts. Construction and operational emissions associated with the TSP would be less than the conformity thresholds. Consequently, the air quality increases would not contribute to any cumulative impacts related to potential violations of air quality standards when considered in combination with other past, present, and reasonably foreseeable future activities within the study area.

3.5.2 Impact AQ-02: Would the Alternative Result in a Cumulatively Considerable Net Increase of Any Criteria Pollutant for Which the Project Region Is Nonattainment Under an Applicable Federal or State Ambient Air Quality Standard?

Impacts. As shown in Tables 25 and 27, construction and operations under the TSP would not result in substantial emission increases. Consequently, the TSP would not cause or contribute to significant increases in air quality criteria pollutants as compared to the NEPA baseline.

Mitigation Measures. No mitigation required.

Residual Impacts after Mitigation. None.

Cumulative Impacts. Because the No Action Alternative would be unchanged from present and anticipated future conditions with respect to this resource, it would not contribute to cumulative impacts related to the potential increase in any air quality criteria pollutant for which the project region is in nonattainment status, when considered in combination with other past, present, and reasonably foreseeable future activities within the study area.

3.5.3 Impact AQ-03: Would the Alternative Expose Sensitive Receptors to Substantial Pollutant Concentrations?

Impacts. The TSP includes construction and operations. The number of ship calls is lower (113) than it would be without the project (127). However, emissions associated with construction and ship calls are not expected to expose sensitive receptors to substantial pollutant concentrations because emissions would occur in the existing ship channel, more than 1,000 feet from sensitive receptors. This impact is considered less than significant under NEPA.

Mitigation Measures. No mitigation required.

Residual Impacts after Mitigation. None.

Cumulative Impacts. Construction and ship emissions associated with the No Action Alternative would be located more than 1,000 feet from sensitive receptors. Consequently, such emissions would not contribute to cumulative impacts related to exposing sensitive receptors to substantial pollutant concentrations and no cumulatively considerable impacts are expected under NEPA from this alternative.

3.5.4 Impact AQ-04: Would the Alternative Result in other Emissions (such as those leading to odors) Adversely Affecting a Substantial Number of People?

Impacts. The TSP would include construction and a decrease in ship calls as compared to the No Action Alternative (NEPA baseline). Both activities would generate odors from diesel fuel combustion. However, construction dredging would occur in the ship channel, which is located at substantial distances from sensitive receptors. Similarly, the placement sites are also located at considerable distances from sensitive receptors. Operationally, fewer ships would travel in the ship channel than under the No Action Alternative, and these ships would dock at industrial locations, distant from sensitive receptors. Therefore, there would be no incremental odor impacts as a result of the TSP.

Mitigation Measures. No mitigation required.

Residual Impacts after Mitigation. None.

Cumulative Impacts. Due to the substantial distance of construction and operational odor emissions from sensitive receptors, the TSP would not contribute to cumulative impacts in odors when considered in combination with other past, present, and reasonably foreseeable future activities within the study area.

4 References

ARB (California Air Resources Board), 2000. *Risk Reduction Plan for Diesel-Fueled Engines and Vehicles*. October 2000.

ARB, 2005. *Air Quality and Land Use Handbook: A Community Health Perspective*. April 2005.

ARB, 2009a. "Chapter 5: Toxic Air Contaminant Emissions, Air Quality, and Health Risk." *The California Almanac of Emissions and Air Quality – 2009 Edition*. Available at: http://www.arb.ca.gov/aqd/almanac/almanac09/chap509.htm.

ARB, 2009b. "ARB Fact Sheet: Air Pollution Sources, Effects and Control." Accessed December 2009. Available at: http://www.arb.ca.gov/research/health/fs/fs2/fs2.htm.

ARB, 2015. "Commercial Harbor Craft Regulatory Activities." Available at: http://www.arb.ca.gov/ports/marinevess/marinevess.htm.

BAAQMD (Bay Area Air Quality Management District), 2009. *Revised Draft Options and Justification Report California Environmental Quality Act Thresholds of Significance*. October 2009.

BAAQMD, 2012a. *Bay Area Air Quality Management District California Environmental Quality Act Air Quality Guidelines*. May 2012.

BAAQMD, 2012b. *Recommended Methods for Screening and Modeling Local Risks and Hazards*. May 2012.

BAAQMD, 2016. *Air Quality Standards and Attainment Status*.

BAAQMD, 2017. *Bay Area Air Quality Management District California Environmental Quality Act Air Quality Guidelines*. May 2017. Available at: http://www.baaqmd.gov/~/media/files/planning-and-research/ceqa/ceqa_guidelines_may2017-pdf.pdf?la=en.

IMO (International Maritime Organization), 2016. "Greenhouse Gas Emissions." Available at: http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/GHG-Emissions.aspx.

NCI (National Cancer Institute), 2012. "Table 1.14: Lifetime Risk (Percent) of Being Diagnosed with Cancer by Site and Race/Ethnicity, Both Sexes: 18 SEER Areas, 2007-2009." Accessed June 27, 2013. Available at: http://seer.cancer.gov/csr/1975_2009_pops09/results_merged/topic_lifetime_risk_diagnosis.pdf.

Port of Los Angeles, 2008. *Pacific L.A. Marine Terminal LLC, Pier 400, Berth 408 Final Environmental Impact Report*. November 14, 2008.

USACE (U.S. Army Corps of Engineers), 2015a. *Stockton and Sacramento Deep Water Ship Channel Maintenance Dredging and Dredge Material Placement Projects 2014 Fish Community, Entrainment, and Water Quality Monitoring Report*. May 2015.

USACE, 2015b. *Draft Economics Analysis for the John F. Baldwin Ship Channel Western Reach San Francisco, CA*. September 2015.

USEPA (U.S. Environmental Protection Agency), 2016. *Green Book: Nonattainment Areas for Criteria Pollutants*. Available at: https://www.epa.gov/green-book.

YSAQMD (Yolo-Solano Air Quality Management District), 2007. *Handbook for Assessing and Mitigating Air Quality Impacts*. Adopted July 11, 2007.

Appendix A
Air Quality Modeling Files

Project: Stockton Channel Deepening

CEQA Impacts **38-ft Alternative**
Emissions (lb/day)

Activity	ROG	NOx	PM10 exhaust	PM2.5 exhaust
Within BAAQMD				
Dredging	13	210	5	5
Sediment Transport and Placem	21	142	3	3
Worker Vehicles	1	4	0	0
Total	35	356	8	8
BAAQMD Threshold	54	54	82	54
Exceed?	No	Yes	No	No
Within YSAQMD				
Dredging	0	0	0	0
Sediment Transport and Placem	0	2	0	0
Worker Vehicles	0	0	0	0
Total	0	2	0	0
YSAQMD Threshold	54	54	82	54
Exceed?	No	No	No	No

NEPA Impacts **38-ft Alternative**
Emissions (ton/yr)

Activity	ROG	CO	NOx	PM10	PM2.5	SO2
Year 2023 Within BAAQMD						
Dredging	0.89	6.29	14.37	0.35	0.34	0.04
Sediment Transport and Placem	1.46	29.43	9.64	0.21	0.20	0.05
Worker Vehicles	0.06	0.35	0.29	0.01	0.01	0.00
Total	2	36	24	1	1	0
SFBAAB de minimis Threshold	100	100	100	-	100	100
Exceed?	No	No	No	No	No	No
Year 2023 Within YSAQMD						
Dredging	0	0	0	0	0	0
Sediment Transport and Placem	0.0	0.3	0.1	0.0	0.0	0.0
Worker Vehicles	0	0	0	0	0	0
Total	0	0	0	0	0	0
SVAB de minimis Threshold	100	100	100	-	100	100
Exceed?	No	No	No	No	No	No

Greenhouse Gas Emissions (metric tons/yr)

Activity	CO2	CH4	N20	CO2e
Year 2023				
Dredging	2,623	0.0	0.2	2,684
Sediment Transport and Placem	3,326	0.0	0.3	3,402
Worker Vehicles	51	0.0	0.0	52
Total	6,000	0	1	6,138
GHG Emissions Threshold				25,000
Exceed Threshold?				No

Emission Factors

Construction Equipment Zero Emission Factors (g/hp-hr)

Equipment	Engine Type	HP Range	Model Year	ROG	CO	Nox	PM	BSFC	SOx	CO2	CH4	N2O
21 CY Dredge Plant	Main	1000-9999	2018	0.12	0.92	2.36	0.06	186.0	0.0056	486	0.007	0.04
21 CY Dredge Plant	Auxiliary	1000-9999		0.12	0.92	2.36	0.06	186.0	0.0056	486	0.007	0.04
Work Tug	Main	121-175	2018	0.68	3.73	3.80	0.09	184.2	0.0055	486	0.007	0.04
Work Tug	Auxiliary	50		0.81	3.73	3.80	0.09	184.2	0.0055	486	0.007	0.04
Survey Boat	Main	51-120	2018	0.99	3.73	5.32	0.22	184.2	0.0055	486	0.007	0.04
Survey Boat	Auxiliary			1.18	3.73	5.32	0.22					
Derrick Barge	Main	120-175	2018	0.11	2.70	2.27	0.01	213.2	0.0064	486	0.007	0.04
Derrick Barge	Auxiliary			0.11	2.70	2.27	0.01					
Tug Boat	Main	1901-3300	2018	0.18	3.73	1.30	0.03	184.2	0.0055	486	0.007	0.04
Tug Boat	Auxiliary	100		0.18	3.73	1.30	0.03	184.2	0.0055	486	0.007	0.04
Pump		electric	2018									

Sources:

Dredger equipment characteristics: CARB, California Barge and Dredge Emissions Inventory. Version 10072011.

Harbor craft characteristics: CARB, California Harbor Craft Emissions Inventory. Version 10072011.

SOx calculated based on sulfur content of fuel.

CO2 and N20 emission factors are from IVL: Methodology for Calculating Emissions from Ships: Update on Emission Factors, 2004. CH4 is 2% of HC, per IVL study.

Corrected Emission Factors (g/hp-hr)

ROG	CO	Nox	PM	BSFC	SOx	CO2	CH4	N2O
0.14	0.99	2.38	0.06		0.01	486	0	0
0.14	0.99	2.38	0.06		0.01	486	0	0
0.73	3.87	3.72	0.08		0.01	486	0	0
0.90	4.06	3.65	0.08		0.01	486	0	0
1.06	3.87	5.21	0.19		0.01	486	0	0
1.31	4.06	5.11	0.19		0.00	0	0	0
0.14	3.49	2.94	0.01		0.01	486	0	0
						0	0	0
0.20	3.95	1.29	0.03		0.01	486	0	0
0.19	3.86	1.27	0.03		0.01	486	0	0

SOx Emission Factor

SOx (gms/hp-hr) = (S content in X/1,000,000) x (MW SO2/ MW S) x BSF	
Where:	
X = S content in parts per million (ppm)	15
S MW = Molecular Weight	32
SO2 MW = Molecular Weight	64

GHG Emission Factors (kg/gal)

CO2	CH4	N2O
10.210	0.001	0.000

Source: The Climate Registry 2018. Tables 13.1 and 13.7

Engine Deterioration Factors

Horsepower Range	NOx	PM	HC	CO
25-50	0.060	0.310	0.510	0.410
51-250	0.140	0.440	0.280	0.160
>251	0.21	0.67	0.44	0.25

Source: California Air Resources Board (CARB), *Emissions Estimation Methodology for Commercial Harbor Craft Operating in California.* Appendix B, Table II-5. October 2011.

Fuel Corrections Factors

Horsepower Range	Model Years	NOx	PM
176+	1996-2010	0.948	0.800

Source: California Air Resources Board (CARB), *Emissions Estimation Methodology for Commercial Harbor Craft Operating in California.* Appendix B, Table II-4. October 2011.

Useful life (years)

Vessel Type	Propulsion	Auxiliary
Dredge	17	16
Tugboats	21	23
Crew and Supply	22	22
Derrick Barge	17	

Source: California Air Resources Board (CARB), *Emissions Estimation Methodology for Commercial Harbor Craft Operating in California.* Appendix B, Table II-2. October 2011.

Source: Dredge and Derrick Barge - CARB, California Barge and Dredge Emissions Inventory. Version 10072011.

Source: Tugboats and Crew vessels - CARB, California Harbor Craft Emissions Inventory. Version 10072011.

Equation for estimating emissions from construction equipment:

$E = [EF_0 + (DR \times HR \times A)] \times F \times HP \times HR \times LF$

Where:
E is the emissions of a pollutant emitted during one period
EF_0 is the zero hour emission factor (g/hp-hr)
DR is the deterioration rate (g/hp-hr^2)
HR is the number of annual operating hours of the engine (hr/yr)
A is the equipment age when emissions are estimated (yr)
F is the fuel correction factor
HP is the rated horsepower of the engine (hp)
LF is the load factor

Habor Craft Load Factor

Type		Main Engine	Auxiliary Engine
Assist tugboat		0.31	0.43
Commercial fishing		0.27	0.43
Crew boat		0.38	0.32
Excursion		0.42	0.43
Ferry		0.42	0.43
Government		0.51	0.43
Ocean tug		0.68	0.43
Tugboat		0.31	0.43
Dive boat	Work boat	0.38	0.32

Source:
2013 POLA Emissions Inventory, Table 4.7

GHG Emission Factors

	CO2	CH4	N2O	Fuel
	kg CO2/gal	kg/MMBtu	kg/MMBtu	
non-transport fuel combustion[1],[2]	10.35	0.003	0.0006	diesel

Notes:

[1] CO2 emission factors: 2018 Climate Registry Default Emission Factors, Table 12.1, Default Factors for Calculating

[2] CH4 and N2O emission factors: 2018 Climate Registry Default Emission Factors, *Table 12.9.1, Default CH4 and*

Fuel density

Diesel (lb/gal)	7.04
Gasoline (lb/gal)	6.15

Dredging

Dredging Activity

Location	Months in 2023	Days in 2023
Pinole	4	121
Suisan	0.5	16

Equipment and Activity: Dredging

Equipment	Engine	Quantity	Number of Engines	Engine (hp)	LF	Activity (hr/day)	Activity (hr/week)	Work (hp-hr/day)
21 CY Dredge Plant	Main	1	1	2,500	70%	15	7	26,250
21 CY Dredge Plant	Auxiliary	1	1	1,900	43%	15	7	12,255
Work Boat	Main	1	1	150	38%	6	7	342
Work Boat	Auxiliary	1	1	50	32%	6	7	96
Survey Boat	Main	1	1	100	38%	4	7	152
Survey Boat	Auxiliary	1	1	50	32%	4	7	64
Derrick Barge	Main	1	1	150	50%	4	7	300
Derrick Barge	Auxiliary							0

Source:

Activity: USACE San Francisco District Engineers, Basis of Cost Estimate Mod 2 2-14-19.docx.

Dredger equipment characteristics: CARB, California Barge and Dredge Emissions Inventory. Version 10072011.

Harbor craft characteristics: CARB, California Harbor Craft Emissions Inventory. Version 10072011.

Dredging Emissions (lb/day)

Equipment	Engine	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O
21 CY Dredge Plant	Main	7.91	57.14	137.43	3.32	3.22	0.42	28,129	0.39	2.41
21 CY Dredge Plant	Auxiliary	3.72	26.79	64.39	1.57	1.52	0.20	13,132	0.18	1.12
Work Boat	Main	0.55	2.92	2.81	0.06	0.06	0.01	366	0.01	0.03
Work Boat	Auxiliary	0.19	0.86	0.77	0.02	0.02	0.00	103	0.00	0.01
Survey Boat	Main	0.35	1.30	1.75	0.07	0.06	0.00	163	0.00	0.01
Survey Boat	Auxiliary	0.18	0.57	0.72	0.03	0.03	0.00	0	0.00	0.00
Derrick Barge	Main	0.09	2.31	1.94	0.01	0.01	0.01	321	0.00	0.03
Derrick Barge	Auxiliary	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00
Total		**12.99**	**91.89**	**209.81**	**5.07**	**4.92**	**0.63**	**42,215**	**0.58**	**3.61**

PM2.5 is 97% of PM10.

Dredging Emissions (ton/yr)

Equipment	Engine	ROG	CO	NOx	PM10	PM2.5	SOx	CO2 (mton/yr)	CH4	N2O	CO2e
Pinole											
21 CY Dredge Plant	Main	0.48	3.46	8.31	0.20	0.20	0.03	1,544	0.02	0.13	1579
21 CY Dredge Plant	Auxiliary	0.22	1.62	3.90	0.09	0.09	0.01	721	0.01	0.06	737
Work Boat	Main	0.03	0.18	0.17	0.00	0.00	0.00	20	0.00	0.00	21
Work Boat	Auxiliary	0.01	0.05	0.05	0.00	0.00	0.00	6	0.00	0.00	6
Survey Boat	Main	0.02	0.08	0.11	0.00	0.00	0.00	9	0.00	0.00	9
Survey Boat	Auxiliary	0.01	0.03	0.04	0.00	0.00	0.00	0	0.00	0.00	0
Derrick Barge	Main	0.01	0.14	0.12	0.00	0.00	0.00	18	0.00	0.00	18
Derrick Barge	Auxiliary	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0
Suisan											
21 CY Dredge Plant	Main	0.06	0.46	1.10	0.03	0.03	0.00	204	0.00	0.02	209
21 CY Dredge Plant	Auxiliary	0.03	0.21	0.52	0.01	0.01	0.00	95	0.00	0.01	98
Tugboat	Main	0.00	0.02	0.02	0.00	0.00	0.00	3	0.00	0.00	3
Tugboat	Auxiliary	0.00	0.01	0.01	0.00	0.00	0.00	1	0.00	0.00	1
Survey Boat	Main	0.00	0.01	0.01	0.00	0.00	0.00	1	0.00	0.00	1
Survey Boat	Auxiliary	0.00	0.00	0.01	0.00	0.00	0.00	0	0.00	0.00	0
Derrick Barge	Main	0.00	0.02	0.02	0.00	0.00	0.00	2	0.00	0.00	2
Derrick Barge	Auxiliary	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0
Total		**0.89**	**6.29**	**14.37**	**0.35**	**0.34**	**0.04**	**2,623**	**0.04**	**0.22**	**2,684**

Sediment Transport

Sediment Transport Activity

Channel	Disposal Site	Months in 2023	Days in 2023	BAAQMD Trip Length 1-way trip (miles)	YSAQMD Trip Length 1-way trip (miles)	BAAQMD Percent	YSAQMD percent
Year 2023							
Pinole Shoal	Cullinan	4	121	10.5	0	100%	0%
	Montezuma	0	0				
Suisun Bay	Cullinan	0	0				
	Montezuma	0.5	16	14	3	82%	18%
2023 Total		4.5	136				

Notes:

Total project duration is 5.5 months. There is 1 month during which the electric offloading pump is transferred from Cullinan to Montezuma.

Equipment and Activity: Sediment Transport and Placement

Equipment	Engine	Quantity	Number of Engines	Engine (hp)	LF	Activity (hr/day)	Activity (days/week)	BAAQMD Work (hp-hr/day)	YSAQMD Work (hp-hr/day)
Pinole/Cullinan									
Tugboat	Main	2	2	2,000	31%	20	7	49,600	0
Tugboat	Auxiliary	2	2	100	43%	20	7	3,440	0
Pump									
Suisan/Montezuma									
Tugboat	Main	1	2	2,000	31%	20	7	20,424	4,376
Tugboat	Auxiliary	1	2	100	43%	20	7	1,416	304
Pump									

Source:

USACE San Francisco District Engineers, Basis of Cost Estimate Mod 2 2-14-19.docx.

Electrified offloader pumps used at both Cullinan and Montezuma per USACE San Francisco District Engineers, Basis of Cost Estimate Mod 2 2-14-19.docx.

Sediment Transport and Placement Emissions (lb/day) **Within BAAQMD**

Equipment	Engine	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O
Pinole/Cullinan										
Tugboat	Main	21.41	432.03	141.46	3.04	2.95	0.78	53,150	0.73	4.54
Tugboat	Auxiliary	1.43	29.26	9.63	0.20	0.19	0.05	3,686	0.05	0.32
Pump										
Suisan/Montezuma										
Tugboat	Main	8.82	177.89	58.25	1.25	1.22	0.32	21,885	0.30	1.87
Tugboat	Auxiliary	0.59	12.05	3.96	0.08	0.08	0.02	1,518	0.02	0.13
Pump										
Total		**21.43**	**432.76**	**141.74**	**3.04**	**2.95**	**0.78**	**53,321**	**0.74**	**4.56**

PM2.5 is 97% of PM10.

Sediment Transport and Placement Emissions (ton/yr) **Within BAAQMD** **(mton/yr)**

Equipment	Engine	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Pinole/Cullinan											
Tugboat	Main	1.30	26.14	8.56	0.18	0.18	0.05	2,917.14	0.04	0.25	2984
Tugboat	Auxiliary	0.09	1.77	0.58	0.01	0.01	0.00	202.32	0.00	0.02	207
Pump											
Suisan/Montezuma											
Tugboat	Main	0.07	1.42	0.47	0.01	0.01	0.00	158.83	0.00	0.01	162
Tugboat	Auxiliary	0.00	0.10	0.03	0.00	0.00	0.00	11.02	0.00	0.00	11
Pump											
Total		**1.46**	**29.43**	**9.64**	**0.21**	**0.20**	**0.05**	**3,289**	**0.05**	**0.28**	**3,365**

Sediment Transport and Placement Emissions (lb/day) **Within YSAQMD**

Equipment	Engine	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O
Pinole/Cullinan										
Tugboat	Main	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tugboat	Auxiliary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pump										
Suisan/Montezuma										
Tugboat	Main	1.89	38.12	12.48	0.27	0.26	0.07	4,689.73	0.06	0.40
Tugboat	Auxiliary	0.13	2.58	0.85	0.02	0.02	0.00	325.26	0.00	0.03
Pump										
Total		**0.24**	**4.79**	**1.57**	**0.03**	**0.03**	**0.01**	**590**	**0.01**	**0.05**

PM2.5 is 97% of PM10.

Sediment Transport and Placement Emissions (ton/yr) **Within YSAQMD** **(mton/yr)**

Equipment	Engine	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Pinole/Cullinan											
Tugboat	Main	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Tugboat	Auxiliary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Pump											
Suisan/Montezuma											
Tugboat	Main	0.02	0.30	0.10	0.00	0.00	0.00	34.04	0.00	0.00	35
Tugboat	Auxiliary	0.00	0.02	0.01	0.00	0.00	0.00	2.36	0.00	0.00	2
Pump											
Total		**0.02**	**0.33**	**0.11**	**0.00**	**0.00**	**0.00**	**36**	**0.00**	**0.00**	**37**

Worker Transport

Activity

Location	Months in 2023	Days in 2023
Pinole	4	121
Suisan	0.5	16

Worker Vehicles VMT

Personnel	Round Trips per day	VMT (mi/day) 1-way
Dredge Plant	8	320
Tug Boats	2	80
Salaried Labor	2	80
Total	12	480

Notes:
20 miles 1-way trip
Source: USACE San Francisco District Engineers, Basis of Cost Estimate Mod 2 2-14-19.docx.

Equipment and Activity: Used to Transport Workers to Dredge Site

Equipment	Engine	Quantity	Number of Engines	Engine (hp)	LF	Activity (hr/day)	Activity (hr/week)	Work (hp-hr/day)
Work Boat	Main	1	2	150	38%	4	7	456
Work Boat	Auxiliary	1	1	50	32%	4	7	64

Source:
Activity: USACE San Francisco District Engineers, Basis of Cost Estimate Mod 2 2-14-19.docx.
Harbor craft characteristics: CARB, California Harbor Craft Emissions Inventory. Version 10072011.

Emissions: Worker Transport to Dredge Site (lb/day)

Equipment	Engine	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O
Work Boat	Main	0.73	3.89	3.74	0.08	0.08	0.01	488.64	0.01	0.04
Work Boat	Auxiliary	0.13	0.57	0.51	0.01	0.01	0.00	68.58	0.00	0.01
Total		**0.86**	**4.46**	**4.26**	**0.09**	**0.09**	**0.01**	**557**	**0.01**	**0.05**

PM2.5 is 97% of PM10.

Emissions: Worker Transport to Dredge Site (ton/yr)

								(mton/yr)			
Equipment	Engine	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
Work Boat	Main	0.05	0.27	0.26	0.01	0.01	0.00	30.37	0.00	0.00	31.06
Work Boat	Auxiliary	0.01	0.04	0.04	0.00	0.00	0.00	4.26	0.00	0.00	4.36
Total		**0.06**	**0.31**	**0.29**	**0.01**	**0.01**	**0.00**	**35**	**0.00**	**0.00**	**35.42**

Emissions: Worker Vehicles Onroad Transit (lb/day)

Vehicle Type		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O
LDA	90%	0.01	0.53	0.03	0.00	0.00	0.00	235.79	0.00	0.00
LDT	10%	0.00	0.10	0.01	0.00	0.00	0.00	31.37	0.00	0.00
Total		**0.01**	**0.64**	**0.04**	**0.00**	**0.00**	**0.00**	**267.15**	**0.00**	**0.00**

Notes:
90% LDA and 10% LDT, per EMFAC 2017

Emissions: Worker Vehicles Onroad Transit (ton/yr)

								(mton/yr)			
Vehicle Type		ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4	N2O	CO2e
LDA	90%	0.00	0.04	0.00	0.00	0.00	0.00	14.65	0.00	0.00	14.66
LDT	10%	0.00	0.01	0.00	0.00	0.00	0.00	1.95	0.00	0.00	1.95
Total		**0.00**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**16.60**	**0.00**	**0.00**	**16.61**

EMFAC Output

Worker Vehicle Emission Rates (g/mile)

Type	ROG	CO	NOx	PM10	PM2.5	SOx	CO2	CH4
LDA	0.0077171	0.5613541	0.0341676	0.0013941	0.0012843	0.0024497	247.64256	0.0020228
LDT	0.0190969	0.9664259	0.0823489	0.0017733	0.0016318	0.0029339	296.4880653	0.0044469

Source: EMFAC2017 for all pollutants except N2O. EMFAC does not provide N2O emission factors.
PM reflects exhaust only.

EMFAC2017 (v1.0.2) Emission Rates
Region Type: County
Region: CONTRA COSTA
Calendar Year: 2023
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/day for VMT, trips/day for Trips, g/mile for RUNEX, PMBW and PMTW, g/trip for STREX, HTSK and RUNLS, g/vehicle/day for IDLEX, RESTL and DIURN

Region	Calendar Ye	Vehicle Cat	Model Year	Speed	Fuel	Population	VMT	Trips	ROG_RUNE	ROG_IDLEX	ROG_STREX	ROG_HOTS	ROG_RUNL	ROG_RESTL
CONTRA CC	2023	LDA	Aggregated	Aggregated	GAS	415473.55	15421746.18	1949194.7	0.0078762	0	0.2360403	0.1039571	0.2248268	0.1934287
CONTRA CC	2023	LDA	Aggregated	Aggregated	DSL	4583.4538	173065.8983	21477.781	0.0123251	0	0	0	0	0
CONTRA CC	2023	LDA	Aggregated	Aggregated	ELEC	10231.124	421213.1392	50489.415	0	0	0	0.004888	0	0.0050371
CONTRA CC	2023	LDT1	Aggregated	Aggregated	GAS	42903.228	1560070.346	196335.47	0.0192421	0	0.3560989	0.1917807	0.6933616	0.383096
CONTRA CC	2023	LDT1	Aggregated	Aggregated	DSL	23.39799	398.9985164	77.630459	0.1761213	0	0	0	0	0
CONTRA CC	2023	LDT1	Aggregated	Aggregated	ELEC	347.95733	15147.12	1746.2048	0	0	0	0.004888	0	0.0050371
		LDA				*91%*	*16016025.2*		*0.007717*					
		LDT1				*9%*	*1575616.46*		*0.019097*					

ROG_DIURN	TOG_RUNE	TOG_IDLEX	TOG_STREX	TOG_HOTS	TOG_RUNL	TOG_RESTL	TOG_DIURN	CO_RUNEX	CO_IDLEX	CO_STREX	NOx_RUNE	NOx_IDLEX	NOx_STREX	CO2_RUNE
0.1974842	0.0114911	0	0.2584337	0.1039571	0.2248268	0.1934287	0.1974842	0.580789	0	2.3077851	0.0347538	0	0.1929438	254.91414
0	0.0140314	0	0	0	0	0	0	0.1957606	0	0	0.0650907	0	0	202.39894
0.0163404	0	0	0	0.004888	0	0.0050371	0.0163404	0	0	0	0	0	0	0
0.4285379	0.0280723	0	0.3898827	0.1917807	0.6933616	0.383096	0.4285379	0.9757566	0	2.4521248	0.0828944	0	0.2587673	299.33502
0	0.2005024	0	0	0	0	0	0	1.1718891	0	0	1.0758461	0	0	420.5154
0.0163404	0	0	0	0.004888	0	0.0050371	0.0163404	0	0	0	0	0	0	0
								0.561354			*0.034168*			*247.6426*
								0.966426			*0.082349*			*296.4881*

CO2_IDLEX	CO2_STREX	CH4_RUNE)	CH4_IDLEX	CH4_STREX	PM10_RUN	PM10_IDLE	PM10_STRE	PM10_PMT	PM10_PMB	PM2_5_RUI	PM2_5_IDL	PM2_5_STF	PM2_5_PM	PM2_5_PM
0	54.393893	0.0020943	0	0.0525128	0.001379	0	0.001864	0.008	0.03675	0.0012679	0	0.0017139	0.002	0.01575
0	0	0.0005725	0	0	0.0061358	0	0	0.008	0.03675	0.0058704	0	0	0.002	0.01575
0	0	0	0	0	0	0	0	0.008	0.03675	0	0	0	0.002	0.01575
0	64.204712	0.0044892	0	0.0719789	0.0017576	0	0.0023691	0.008	0.03675	0.0016161	0	0.0021784	0.002	0.01575
0	0	0.0081805	0	0	0.1304154	0	0	0.008	0.03675	0.1247737	0	0	0.002	0.01575
0	0	0	0	0	0	0	0	0.008	0.03675	0	0	0	0.002	0.01575
		0.002023			*0.001394*			*0.008*	*0.03675*	*0.001284*			*0.002*	*0.01575*
		0.004447			*0.001773*			*0.008*	*0.03675*	*0.001632*			*0.002*	*0.01575*

SOx_RUNEX	SOx_IDLEX	SOx_STREX	N2O_RUNE	N2O_IDLEX	N2O_STREX
0.0025226	0	0.0005383	0.0041925	0	0.0263143
0.0019134	0	0	0.0318143	0	0
0	0	0	0	0	0
0.0029622	0	0.0006354	0.0068751	0	0.029443
0.0039754	0	0	0.0660992	0	0
0	0	0	0	0	0
0.00245			*0.004381*		
0.002934			*0.006824*		

Global Warming Potentials (GWP)

CO_2	CH_4	N_2O
1	28	265

IPCC 2015. Intergovernmental Panel on Climate Change. *5th Assessment Report.*