UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

OCT 11 2011

In response refer to:
2011/06605

Lieutenant Colonel Torrey A. DiCiro
District Engineer
U.S. Army Corps of Engineers
San Francisco District
1455 Market Street
San Francisco, California 94103-1398

Dear Lt. Colonel DiCiro:

Thank you for your letter of December 7, 2010, requesting a programmatic consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to the essential fish habitat (EFH) provisions of the Magnuson Stevens Fishery Conservation and Management Act (MSA). This consultation pertains to construction and maintenance of overwater structures in the San Francisco Bay area authorized by the San Francisco District of the U.S. Army Corps of Engineers' (USACE) Regulatory Program under section 10 of the Rivers and Harbors Act of 1899 (33 USC §401-413) and section 404 of the Clean Water Act (33 USC §1251 *et seq.*).

Section 305(b)(2) of the MSA requires federal action agencies to consult with NMFS for any action they authorize, fund, or undertake that may adversely affect EFH. Programmatic consultation provides an efficient and effective means for NMFS and a federal agency to consult regarding a potentially large number of similar individual actions occurring within a given geographic area. NMFS has determined that in accordance with 50 CFR 600.920(j) of the EFH regulations, programmatic consultation is appropriate for construction and maintenance of overwater structures in the San Francisco Bay area, because all activities are routinely undertaken or authorized by USACE, and sufficient information is available to develop EFH Conservation Recommendations that will address reasonable foreseeable adverse impacts to EFH.

This programmatic EFH consultation applies to new or replacement overwater structure construction, modification, maintenance, and associated indirect activities as described in the enclosed consultation. This programmatic consultation will not cover any dredging activities or fill activities (*e.g.*, breakwaters, boat ramps) other than pilings to support overwater structures. The geographic scope of this consultation includes the estuarine waters of the San Francisco Bay region and portions of the Sacramento-San Joaquin Delta west of Sherman Island.

In the enclosed programmatic EFH consultation, NMFS has evaluated the potential adverse effects to EFH pursuant to Section 305(b)(2) of the MSA. As described in enclosed effects analysis, NMFS has determined that the programmatic activities would adversely affect EFH and Habitat Areas of Particular Concern (HAPC) for various federally-managed fish species within the Pacific Groundfish, Pacific Salmon, and Coastal Pelagic Fishery Management plans. Adverse effects include: increased shading, wave energy regime and substrate effects, water quality degradation, elevated levels of sound pressure waves, support or spread of non-indigenous species, and cumulative effects. Therefore, pursuant to section 305 (b)(4)(A) of the MSA, NMFS offers the enclosed Programmatic EFH Conservation Recommendations to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

Please be advised that regulations (50 CFR 600.920(k)) to implement the EFH provisions of the MSA require your office to provide a written response to this programmatic consultation within 30 days of its receipt and prior to its use. A preliminary response indicating the anticipated submission date of the final response is acceptable if a final response cannot be completed within 30 days. Your final response must include a description of how the EFH Conservation Recommendations will be implemented and any other measures that will be required to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with any of our EFH Conservation Recommendations, you must provide an explanation for not implementing the recommendation(s) at least 10 days prior to final approval of the action. This explanation must include scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects.

Once NMFS and USACE reach agreement on the programmatic EFH Conservation Recommendations, an individual overwater structure project must implement all of the EFH Conservation Recommendations relevant to that project in order to be covered with this programmatic EFH consultation. If relevant EFH Conservation Recommendations are not implemented, USACE must initiate a separate EFH consultation for that project.

This programmatic EFH consultation will be in effect for 10 years from the date of issuance. At any time, NMFS may revoke or revise this programmatic consultation if it is determined that it is not being implemented as intended or if new information becomes available indicating a significant discrepancy in either the effects analysis or effectiveness of EFH Conservation Recommendations.

Please note that Public Notices will no longer need to initiate EFH consultation for overwater structure projects that are covered by this programmatic EFH consultation, but should instead state that projects are covered by the programmatic EFH consultation and indicate which EFH Conservation Recommendations are being implemented relevant to the project.

If you have any questions regarding this programmatic consultation or require additional information, please contact Korie Schaeffer of my staff at (707) 575-6087, or by electronic mail at Korie.Schaeffer@noaa.gov.

Sincerely,

Robert S. Hoffman
Assistant Regional Administrator
for Habitat Conservation

Enclosure

cc: Chris Yates, NMFS, Long Beach, California
Bryant Chesney, NMFS, Long Beach, California
Dick Butler, NMFS, Santa Rosa, California
Christina Cavett-Cox, USACE, San Francisco, California
Cameron Johnson, USACE, San Francisco, California
Copy to File Administrative Record # 1501316SWR2011SR00174

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT
ESSENTIAL FISH HABITAT CONSULTATION

ACTION AGENCIES	United States Army Corps of Engineers, South Pacific Division, San Francisco District (USACE)
ACTION	Construction of New and Replacement Overwater Structures in the San Francisco Bay Area
CONDUCTED BY	National Marine Fisheries Service, Southwest Region
TRACKING NUMBER	2011/06605
DATE ISSUED	OCT 11 2011

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I. STATUTORY AND REGULATORY INFORMATION

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, establishes a national program to manage and conserve the fisheries of the United States through the development of federal Fishery Management Plans (FMPs), and federal regulation of domestic fisheries under those FMPs, within the 200-mile U.S. Exclusive Economic Zone ("EEZ"). 16 USC §1801 *et seq.* To ensure habitat considerations receive increased attention for the conservation and management of fishery resources, the amended MSA required each existing, and any new, FMP to "describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 1855(b)(1)(A) of this title, minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat." 16 U.S.C. §1853(a)(7). Essential Fish Habitat (EFH) is defined in the MSA as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" 16 USC §1802(10). The components of this definition are interpreted at 50 CFR §600.10 as follows: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Pursuant to the MSA, each federal agency is mandated to consult with NOAA's National Marine Fisheries Service (NMFS) (as delegated by the Secretary of Commerce) with respect to any action authorized, funded, or undertaken, or proposed to be, by such agency that may adversely affect any EFH under this Act. 16 USC §1855(b)(2). The MSA further mandates that where NMFS receives information from a Fishery Management Council or federal or state agency or determines from other sources that an action authorized, funded, or undertaken, or proposed to be, by any federal or state agency would adversely affect any EFH identified under this Act, NMFS has an obligation to recommend to such agency measures that can be taken by such agency to conserve EFH. 16 USC §1855(4)(A). The term "adverse effect" is interpreted at 50 CFR §600.810(a) as any impact that reduces quality and/or quantity of EFH and 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 quantity and/or quality of EFH. In addition, adverse effects to EFH may result from actions occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

If NMFS determines that an action would adversely affect EFH and subsequently recommends measures to conserve such habitat, the MSA proscribes that the federal action agency that receives the EFH Conservation Recommendation must provide a detailed response in writing to NMFS within 30 days after receiving EFH Conservation Recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS' EFH

Conservation Recommendations, the federal agency must explain its reasons for not following the recommendations. 16 USC §1855(b)(4)(B).

Consultation can be addressed programmatically to broadly consider as many adverse effects as possible through programmatic EFH Conservation Recommendations. 50 CFR 600.920 (j) states that programmatic consultation is appropriate for specified activities, if sufficient information is available that will allow NMFS to develop EFH Conservation Recommendations, which address reasonable and foreseeable adverse impacts to EFH resulting from activities of a program. The purpose of a programmatic consultation is to implement the EFH consultation requirements efficiently and effectively by incorporating many individual actions that may adversely affect EFH into one consultation.

II. BACKGROUND AND CONSULTATION HISTORY

NMFS routinely consults with U.S. Army Corps of Engineers (USACE) on both new and replacement overwater structure projects in the San Francisco Bay area. Due to the similarity in permitted projects impacts on EFH and the Conservation Recommendations offered, NMFS determines that consulting on these activities programmatically would improve NMFS' protection of trust resources, provide certainty in the regulatory requirements for applicants, and streamline the permitting process.

October 2010	NMFS and USACE began discussions for Programmatic EFH consultation.
December 2010	USACE issued request for Programmatic EFH consultation for Overwater Structures in San Francisco Bay.
December 2010 - February 2011	NMFS and USACE coordinated meetings to discuss the scope of projects covered and to determine project size thresholds.
April 21, 2011	NMFS provides a first draft of this document to USACE for preliminary review.
June 2011 - July 2011	NMFS received comments on first draft and provides USACE with revisions.
September 2011	Final programmatic consultation issued.

III. PROPOSED ACTION

A. Overview of Programmatic Consultation

This Programmatic Consultation applies to permit applications for (standard permits, letters of permission, nationwide permits, or general permits of those types of authorization) under the San Francisco District of the USACE' Regulatory Program within the defined geographic area (see section IV.A below). The following permits are considered together as they are administered together by the USACE' Regulatory Branch through a single permit application.

RIVERS AND HARBORS ACT OF 1899 (SECTION 10)
Authorities: 33 U.S.C. § 401-413: Rivers and Harbors Act of 1899; 33 CFR 323: Permits for Structures or Work Affecting Navigable Waters of the United States.

CLEAN WATER ACT (SECTION 404)
Authorities: 33 U.S.C. §1251 et seq.: Federal Water Pollution Control Act; 33 FCR 322: Permits for Discharges of Dredged or Fill Material into the Waters of the United States.

A Section 10 permit is required for all work, including structures, within waters subject to the ebb and flow of the tide shoreward to the mean high water mark and/or presently used, or have been used in the past, or are susceptible for use to transport interstate or foreign commerce. The term includes coastal and inland waters, lakes, rivers and streams that are navigable, and the territorial seas. A Section 404 permit is required for activities that involve the discharge of dredged or fill material into waters of the United States, including not only navigable waters, but also coastal waters, inland rivers, lakes, streams, and wetlands.

The San Francisco District routinely permits (Section 10 and 404) a variety of projects that occur in estuarine and near shore waters designated as EFH. These projects include constructing, maintaining, replacing and expanding various structures including piers, wharves, bulkheads, dolphins, marinas, floating docks and floats.

B. Actions

Due to the similarity of activity effects on EFH, NMFS determines that a category of activities authorized by the San Francisco District of USACE may be covered under a single programmatic consultation. This programmatic consultation applies to new or replacement overwater structure construction, modification, maintenance, and associated indirect activities as described below. The scope of activities covered in this programmatic consultation includes the following and will NOT cover any dredging activities or fill activities (*e.g.*, breakwaters, boat ramps) other than pilings to support overwater structures:

1. Piers/Docks – Covers all activities associated with upgrade/retrofit, expansion, reconfiguration and new construction of piers and docks (including associated ramps and floating docks) with less than 10,000 square feet (sq ft) of overwater coverage. This includes pile removal, replacement, and installation. All projects proposing overwater

coverage's in excess of 10,000 sq ft, new or existing, will require individual consultation with NMFS and will not be covered under this programmatic consultation.

2. Wharves/Marinas – Covers all activities associated with upgrade/retrofit, expansion and reconfiguration and new construction of wharfs and marinas with less than 50,000 sq ft of overwater coverage. This includes pile removal, replacement, and installation. All projects proposing new or existing, overwater coverage's in excess of 50,000 sq ft, will require individual consultation with NMFS and will not be covered under this programmatic consultation.

3. Bank stabilization – Covers those activities that are proposed in association with the construction or demolition of an associated overwater structure and meets the size limits for bank stabilizations covered by the not likely to adversely affect (NLAA) programmatic (NMFS tracking #2007/07427). Activity is limited to 500 linear feet of shoreline for repair of existing structures, 200 linear feet for new structures, or 1,000 sq ft in area (for details, see http://swr.nmfs.noaa.gov/hcd/HCD_webContent/EFH/Programmatic_EFH%20NLAA_Consultation_122107.pdf). Individual bank stabilization or breakwater projects that are not connected to the construction or demolition of an associated overwater structure are not covered by this programmatic consultation.

4. Moorings/Floats/Buoys – Covers all activities associated with temporary and permanent mooring, float, and buoy placement.

C. Effective Date and Duration

This programmatic EFH consultation will be in effect for 10 years from the date of issuance. At any time, NMFS may revoke or revise this programmatic consultation if it is determined that it is not being implemented as intended or if new information becomes available indicating a significant discrepancy in either the effects analysis or effectiveness of EFH Conservation Recommendations.

IV. ACTION AREA

The proposed activities occur within areas identified as EFH for various life stages of fish species managed with the following Fishery Management Plans (FMP) under the MSA:

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

In addition, some activities will occur within areas designated as Habitat Areas of Particular Concern for various federally managed fish species within the Pacific Groundfish FMP. Habitat Areas of Particular Concern (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 FMP San Francisco Bay is designated as estuary HAPC. Submerged aquatic vegetation (SAV), such as eelgrass and widgeon grass, occurs within the project footprint and is also designated as HAPC.

Because SAV distribution fluctuates and can expand, contract, disappear, and recolonize, SAV presence within the action area may not always be consistent. Therefore, this programmatic EFH consultation references suitable SAV habitat, which are those habitats generally definable based on history of SAV presence, and/or physical characteristics.

A. Geographic Scope

The action area spans 10 counties, including Marin, Sonoma, Napa, Solano, San Joaquin, Contra Costa, Alameda, Santa Clara, San Mateo, and San Francisco counties. The geographic scope of potential impacts included in this consultation comprises the estuarine waters of the San Francisco Bay region and portions of the Sacramento-San Joaquin Delta (Delta) west of Sherman Island. It also includes the wetlands and shallow intertidal areas that form a margin around the estuary and the tidal portion of its tributaries. It includes the Napa River, Petaluma River, and other freshwater tributaries up to the limit of tidal exchange. It does not include waters west of the Golden Gate Bridge or the mountainous or inland areas far removed from navigable waters. See Figure 1 for detailed representation of the action area and the geographic scope covered by this programmatic.

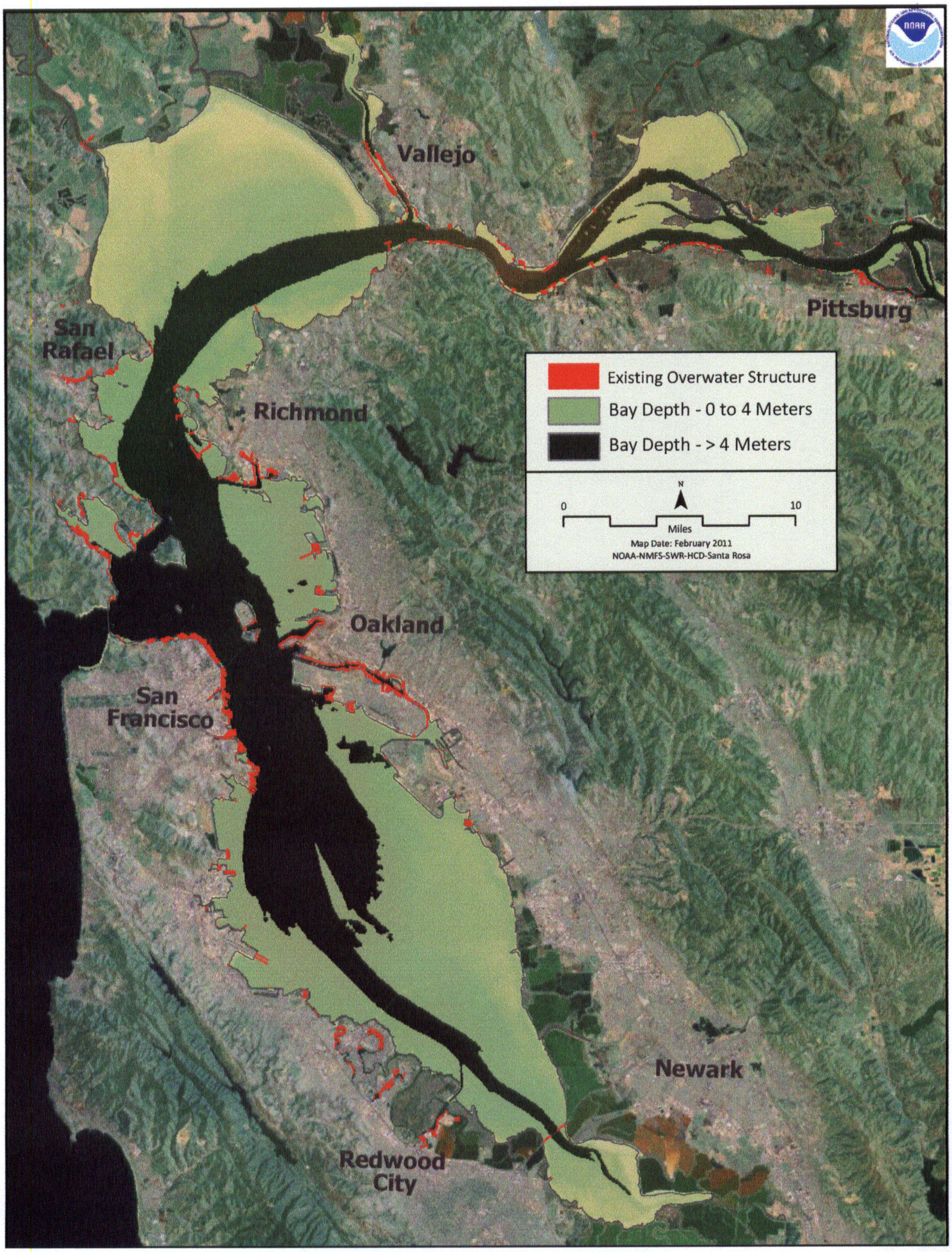

Figure 1. Action area covered by the EFH Programmatic Consultation for Overwater Structures in San Francisco Bay.

B. Habitat Types

For the purposes of this programmatic consultation, habitats within the geographic scope of the proposed project are categorized and described as follows:

Soft bottom habitat

Soft bottom substrates are the most common substrate types in San Francisco Bay. They are characterized by a lack of large stable surfaces for plant and animal attachment. Exposure to wave and current action, temperature, salinity, and light penetration determine the composition and distribution of organisms within the sediments (USGS 1998). Soft bottom substrates do provide habitat for epibenthic microalgae, and a diverse assemblage of invertebrate epifauna and infauna, and therefore provide important habitat for fish to forage, reproduce, rear, and grow (NMFS 2007).

Wetland habitat

There are numerous definitions for the term "wetland" with 19 definitions recently identified by the San Francisco Estuary Institute (SFEI 2009). At the federal level, both the U.S. Fish and Wildlife Service (USFWS) and USACE have specified unique definitions. USFWS' definition includes the following language:

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

USACE defines wetlands as follows:

> The term "wetlands" means those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

USACE established identification and delineation procedures for wetlands, specifically the USACE 1987 Wetland Manual and subsequent regional supplements (USACE 2010). According to USACE' definition and delineation methodology, areas that are not dominated by hydrophytes but that provide wetland beneficial uses and ecological services, such as tidal flats, are not necessarily identified as wetlands. However, tidal flats are known to provide productive shallow water habitat for epibenthic fishes (Sogard and Able 1991).

While all areas of a properly functioning wetland benefit fish in some way, there are specific components that are directly considered fish habitat. For the purposes of this document, the following wetland components are considered fish habitat: tidal marsh, tidal flats, and tidal sloughs. Given the varying definitions for the term "wetland", these wetland components that are important for fish survival, reproduction, and growth to maturity will be collectively referred to as "marsh complex" in subsequent sections.

Tidal marshes, which include brackish and salt marshes, are vegetated wetlands subject to tidal action that occur throughout much of the Bay extending from approximately Mean Sea Level to the maximum height of the tides. Established tidal marshes provide an essential and complex habitat for many species of fish, other aquatic organisms and wildlife. Tidal marshes provide foraging habitat and refugia for fish (Boesch and Turner 1984). In the early 1800s, tidal marshes covered some 190,000 acres on the fringes of the Bay. Tidal marsh bordering the Bay now totals approximately 40,000 acres, a loss of approximately 80 percent of the Bay's historic tidal marshes.

Tidal flats occur from the elevation of the lowest tides to approximately Mean Sea Level and include mudflats, sandflats and shellflats. Mudflats comprise the largest area of tidal flat areas and support an extensive community of invertebrate aquatic organisms, such as diatoms, worms and shellfish, as well as fish that feed during higher tides, and plants such as algae and eelgrass. Of the 50,000 acres of tidal flats that historically occurred around the margins of the Bay, approximately 30,000 acres remain, a reduction of approximately 40 percent (Goals Project 1999).

Sloughs/channels are the primary paths of moving water through wetlands, providing fish access to productive foraging habitat. Sloughs are subtidal, allowing fish permanent access and offering a haven between tidal inundations of salt marshes. Slough habitat is used for more than just transit to productive wetlands as demonstrated by observations of greater species diversity in sloughs than in associated shallow tidal creeks (Desmond *et al.* 2000). Sloughs occur throughout the San Francisco Bay, for example, Montezuma and Suisun Sloughs in Suisun Bay, branches off the lower portions of the Napa and Petaluma rivers in the North Bay, branches off Corte Madera Creek in the Central Bay, and Redwood, Alviso, and Guadalupe sloughs in the South Bay.

Submerged Aquatic Vegetation

Submerged Aquatic Vegetation (SAV) collectively refers to the vascular plants that grow rooted in the sediments of marine, estuarine, and freshwater systems, and which grow completely submerged during some part of the tidal cycle. SAV species that are known to occur in the action area include eelgrass, widgeon grass, and sago pondweed.

Eelgrass (*Zostera marina*) is a flowering vascular plant that grows both subtidally and intertidally in estuaries and in shallow coastal areas. Studies have shown that seagrasses, including eelgrass, are among the areas of highest primary productivity in the world (Herke and Rogers 1993, Hoss and Thayer 1993). In San Francisco Bay, eelgrass beds are considered to be a valuable shallow-water habitat, providing shelter, feeding, or breeding habitat for many species of invertebrates, fishes, and some waterfowl. Eelgrass beds supply organic material to nearshore environments, and their root systems stabilize area sediments. Intermittent eelgrass surveys suggest eelgrass abundance has varied greatly in San Francisco Bay in the last several decades. In the late 1920s, eelgrass was reported as an abundant species along the shores of San Francisco Bay (Setchell 1929). In 1987, a survey of the Bay found only 128 hectares of eelgrass, with much of the existing habitat exhibiting conditions of environmental stress (Wyllie-Echeverria and Rutten 1989, Wyllie-Echeverria 1990). In 2003 and 2009, hydroacoustic surveys documented 1,061 and 1,500 hectares of eelgrass, respectively, covering approximately 1 percent of San Francisco Bay (Merkel & Associates 2004, 2010a). Monitoring in 2010 resulted in a baywide eelgrass estimate of 1,522 hectares (Merkel & Associates 2010b).

As discussed above, eelgrass is designated as EFH for various federally-managed fish species within the Pacific Groundfish and Pacific Salmon Fisheries Management Plans (FMP) (PFMC 2008 and PFMC 1999). Eelgrass is designated HAPC for various species within the Pacific Groundfish FMP, and considered a special aquatic site under the 404 (b)(1) guidelines of the Clean Water Act (40 CFR Part 230.43). Under these guidelines, special aquatic sites are subject to greater protection than other waters of the United States, because of their significant contribution to the overall environment.

Two additional native SAV species, widgeon grass (*Ruppia sp.*) and sago pondweed (*Stuckenia* or *Potamogeton*) occur within San Francisco Bay. While less is known about these species than is known about eelgrass, they provide primary productivity and organic material to nearshore environments and provide shelter for invertebrates and fishes. Native submerged aquatic vegetation is designated as EFH for various federally-managed fish species within the Pacific Groundfish and Pacific Salmon FMPs and is designated HAPC for various species within the pacific Groundfish FMP (PFMC 2008 and PFMC 1999).

Rock Habitat

Rock habitats are generally categorized as either near shore or offshore in reference to the proximity of the habitat to the coastline. Rock habitat may be composed of bedrock, boulders, or smaller rocks, such as cobble and gravel. Hard substrates are one of the least abundant benthic habitats in the action area, yet they are among the most important habitats for groundfish species. Rock habitats provide the appropriate substratum for colonization of diverse algal and invertebrate assemblages creating a complex physical and biogenic habitat that provides important shelter and foraging opportunities for many species of groundfish. NMFS expects very few overwater structures will adversely affect natural rocky reef communities given their predominantly open coast distribution. Most overwater structure projects occur within protected waters. Therefore, a detailed description of rock habitat does not seem warranted for this programmatic consultation.

V. EFFECTS OF THE ACTION

A. Types of Effects

Alterations to the near shore light, wave energy, and substrate regimes affect the nature of

EFH and near shore food webs that are important to a wide variety of marine finfish and shellfish (Armstrong *et al.* 1987; Beal 2000; Burdick and Short 1995; Cardwell and Koons 1981; Fresh and Williams 1995; Kenworthy and Haunert 1991; Olson *et al.* 1996; Parametrix and Battelle 1996; Penttila and Doty 1990; Shafer 1999; Simenstad *et al.* 1978, 1979, 1980, 1998; Thom and Shreffler, 1996; Weitkamp 1991).

Overwater structures and associated activities can impact the ecological functions of habitat by altering habitat controlling factors. These alterations can, in turn, interfere with habitat processes supporting the key ecological functions of fish spawning, rearing, and refugia. The matrix presented in Table 1, adapted from Nightingale and Simenstad (2001), identifies the potential mechanisms of impact overwater structures can pose to near shore habitats. Whether any of these impacts occur and to what degree they occur at any one site depends upon the nature of site-specific habitat controlling factors and the type, characteristics, and use patterns of a given overwater structure located at a specific site.

Each of the types of effects discussed below in considered in terms of their direct, indirect, and cumulative effects. NMFS defines the impacts as follows (modified from The National Environmental Policy Act (NEPA) Regulations):

1. Direct - Direct effects are caused by the action and occur at the same time and place.

2. Indirect - Indirect effects are caused by the action or associated actions and may occur later in time or farther removed in distance, but are still reasonably foreseeable.

3. Cumulative - Cumulative impacts are the impacts on the environment, which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Table 1. Overwater structure near shore habitat impact mechanisms (modified from Nightingale and Simenstad 2001)

Habitat Controlling Factors	Overwater Structure and Activities	Direct Impacts	Indirect Impacts
Light Regime and Shading Effects	• Piers/Docks • Wharves/Marinas • Floats/Moored Vessels • Pilings	• Reduced light levels • Altered ambient light patterns	• Limited plant growth and recruitment • Altered plant and animal assemblages • Altered animal behavior

Wave Energy Regime	• Piers/Docks • Wharves/Marinas • Floats/Moored Vessels • Pilings	• Altered wave and tidal energy patterns	• Altered plant and animal assemblages • Altered substrate type • Altered sediment transport and distribution
Substrate Effects	• Propeller and anchor scour • Floats and moored vessels (grounding) • Piling install/removal	• Substrate disturbance and smothering	• Altered plant and animal assemblages • Altered substrate type • Altered sediment transport and distribution
Water Quality Effects	• Discharges from marinas/wharves • Boat and upland run-off • Piling install/removal	• Increased Non-indigenous species • Increased toxics • Increased nutrients and bacterial introductions	• Altered plant and animal assemblages • Limited growth and recruitment • Exotic species replacement of natives
Noise Effects	• Pile install/removal	• Physical injury to fish	• None anticipated
Non-indigenous Species	• Piers/Docks • Wharves Marinas • Floats/Moored Vessels • Pilings	• Increased Non-indigenous species	• Altered plant and animal assemblages • Exotic species replacement of natives

1. <u>Shading Effects</u>

a.) Direct Impacts

The underwater light environment is a naturally light-reduced ecosystem. Light is attenuated with depth as a result of refraction at the water's surface and through scatter and absorption of light by phytoplankton, detritus and dissolved organic matter in the water column. Depending on the biological, physical, and chemical properties of the water, the light available at depth may be dramatically reduced from that available at the surface. Because light energy drives the photosynthetic process controlling plant growth and survival, it is one of the principal limiting factors of primary productivity (Govindjee and Govindjee 1975, Underwood and Kromkamp 1999, MacIntyre *et al.* 1996). Marine and estuarine primary producers, including seagrass, salt marsh plants, and algae are particularly susceptible to light limitation (Kearny *et al.* 1983, Dennison *et al.* 1993, Shafer 1999, Shafer and Robinson 2001, Whitcraft and Levin 2007, Shafer *et al.* 2008).

Seagrasses have unusually high light requirements ranging from 10 percent to 37 percent of in-water surface irradiance (Kenworthy and Fonseca 1996). One explanation for the high light requirements of seagrass is the optical properties of the leaves. Optically active pigments (Chlorophylls *a* and *b*) are arranged in a complex manner within the chloroplasts in the cells, effectively reducing the light harvesting efficiency of the chlorophyll within the leaves (Larkum *et al.* 2006). These high light requirements make seagrasses particularly vulnerable to deteriorated water quality and light competition from micro- and macroalgal blooms induced by eutrophication, and shading from overwater structures (Zimmerman 2006).

Minimum light requirements for seagrass growth vary among species, due to physiological and morphological differences, and within species due to photoacclimation of populations to local light conditions (Duarte 1991, Lee *et al.* 2007). Thom *et al.* (2008) determined that eelgrass in the Pacific Northwest requires an average of at least 7 moles per square meter per day (mol/m^2/day) throughout the summer months, and an overall average of 3 mol/m^2/day for long term survival. In San Francisco Bay, similar results were described by Zimmerman *et al.* (1991), where eelgrass depth limits were strongly correlated with turbidity and light requirements. At the most turbid site, eelgrass maximum depth was only 0.5 meter, and plants required a period of light saturation of 11.1 hours. At the least turbid site eelgrass maximum depth was 2 meters, and plants there required only 6.7 hours of light saturation. Merkel's (2000) study in San Diego Bay examined the effects of light and temperature on eelgrass, and determined that eelgrass distribution and abundance in San Diego Bay was not temperature limited, but was light limited. Light conditions monitored at sites with and without eelgrass demonstrated significantly different levels of photosynthetically active radiation (PAR). The sites where eelgrass occurred typically had higher mean PAR values than the sites where eelgrass was absent. This study identified the threshold for eelgrass growth in San Diego Bay was 8.5mol/m^2/day.

In the already reduced light environment where marine and estuarine primary producers occur, the addition of overwater structures further reduces underwater light penetration through shading. Under-structure light levels can fall below the threshold for the photosynthesis of diatoms, algae, and eelgrass (Kenworthy and Haunert 1991). Thus, shading by such structures may adversely affect vegetation, habitat complexity, and overall net primary production (Haas *et al.* 2002, Struck *et al.* 2004).

Shading by overwater structures has empirically been demonstrated to decrease shoot density and biomass in temperate, tropical, and subtropical seagrass species, including *Zostera marina* L., *Thalassia testudinum, Halodule wrightii*, and *Posidonia australis* (Walker *et al.* 1989, Czerny and Dunton 1995, Loflin 1995, Burdick and Short 1999, Shafer 1999). Burdick and Short (1995, 1999) found that 75 percent of the floating docks in and around eelgrass beds resulted in complete seagrass loss underneath the dock, while the remainder resulted in significantly reduced cover. Given the variety of ecological functions associated with eelgrass, reductions in its extent may adversely affect estuarine and nearshore ecosystems.

Whitney and Darley (1983) found that microalgal communities in shaded areas are generally less productive than unshaded areas, with productivity positively correlated with ambient irradiance. Stutes *et al.* (2006) found a significant effect of shading on both sediment primary production and metabolism (*i.e.*, sediment respiration). Intertidal salt marsh plants are also impacted by shading. The density of *Spartina alterniflora* was significantly lower under docks than adjacent to docks in South Carolina estuaries, with stem densities decreased by 71 percent (Sanger *et al.* 2004). Kearny *et al.* (1983) found the *S. alterniflora* was shaded out completely under docks that were less than 40 centimeter high and that the elimination of the macrophytic communities under the docks ultimately led to increased sediment erosion.

Reductions in benthic primary productivity may in turn adversely affect invertebrate distribution patterns. For example, Struck *et al.* (2004) observed invertebrate densities under bridges at 25-52 percent of those observed at adjacent unshaded sites. These results were found to be correlated with diminished macrophyte biomass, a direct result of increased shading. Overwater structures that attenuate light may adversely affect estuarine marsh food webs by reducing macrophyte growth, soil organic carbon, and altering the density and diversity of benthic invertebrates (Whitcraft and Levin 2007). Reductions in primary and invertebrate productivity may additionally limit available prey resources for federally managed fish species and other important commercial and recreational species. Prey resource limitations likely impact movement patterns and the survival of many juvenile fish species. Adverse impacts to estuarine productivity may therefore have effects that cascade through the near shore food web.

Fishes rely on visual cues for spatial orientation, prey capture, schooling, predator avoidance, and migration. Juvenile and larval fish are primarily visual feeders with starvation being the major cause of larval mortality in marine fish populations. Early life history stages are likely critical determining factors for recruitment and survival, with survival linked to the ability to locate and capture prey and to avoid predation (Britt 2001). The reduced-light conditions found under an overwater structure limit the ability of fishes, especially juveniles and larvae, to perform these essential activities. For example, Able *et al.* (1999) found that caged fish under piers had growth rates similar to those held in a laboratory setting without food. In contrast, growth rates of fish caged in pile fields and open water were significantly higher. Able *et al.* (1998) also demonstrated that juvenile fish abundance and species richness was significantly lower under piers in an urban estuary. Although some visual predators may use alternative modes of perception, feeding rates sufficient for growth in dark areas usually demand high prey concentrations and encounter rates (Grecay and Targett 1996).

The shadow cast by an overwater structure may increase predation on federally managed species by creating a light/dark interface that allows ambush predators to remain in a darkened area (barely visible to prey) and watch for prey to swim by against a bright background (high visibility) (Helfman 1981). Prey species moving around the structure are unable to see predators in the dark area under the structure and are more susceptible to predation. Furthermore, the reduced vegetation (*i.e.*, eelgrass) densities associated with overwater structures decrease the available refugia from predators, and prey availability. As coastal development and overwater structure expansion continues, the underwater light environment will continue to degrade resulting in adverse effects to EFH and near shore ecosystems.

The overall morphology of the shadow cast by a structure is dependent on the height, width, construction material, and polar orientation of the structure. Work by Battelle Marine Science Laboratory in Washington determined that shading influence from docks can range from four to ten times the total surface area of the dock depending upon dock orientation and season (Washington DNR, 2005). Therefore, the extent and the magnitude of shading impacts to primary producers and subsequently to the upper trophic levels in the system is both sites specific and directly influenced by the specific design of the overwater structure.

A number of studies have determined that modifications to the design of overwater structures can significantly increase the quantity of light transmitted through or around these structures to the underlying habitat, decreasing the impacts of shading and the size of the shaded footprint (Beal *et al.* 1999, Burdick and Short 1999, Blanton *et al.* 2002, Steinmetz *et al.* 2004, Fresh *et al.* 2006, Landry *et al.* 2008). Burdick and Short (1999) demonstrated that orientating docks along a north-south plane minimized the shading affect on eelgrass. Several studies have demonstrated that structures at least 5 feet above mean higher high water (MHHW) have a significantly reduced impact on primary producers (Beal *et al.* 1999, Burdick and Short 1999, Shafer *et al.* 2008). Docks built no wider than 4 feet in width have also been found to reduce shading impacts (Shafer *et al.* 2008). The use of light transmitting material and increased spacing between deck boards has also been found to increase the light transmitted through overwater structures, helping to decrease shading impacts resulting from these structures (Blanton *et al.* 2002, Fresh *et al.* 2006, Landry *et al.* 2008, Shafer *et al.* 2008). Dock construction guidelines following these principles have been developed and implemented with success in other regions (NMFS and USACE 2001).

b.) Indirect Impacts

Although shading impacts from overwater structures is considered the primary factor affecting primary producers, several other factors may also result in indirect impacts to these communities. Indirect effects may be associated with construction and maintenance of the overwater structure, or resulting from the long-term associated uses of the structure. As most overwater structures are designed to support boating activities, impacts from boats are a primary source of indirect effects, especially for seagrasses. For example, the presence of the boat itself increases the shading impact footprint. Simenstad *et al.* (1998) demonstrated that indirect effects from construction of overwater structures and boating activities contributed to the elimination of eelgrass, but also appeared to prohibit recruitment back to the area in the long-term.

c.) Cumulative Impacts

Although the area of primary producers directly impacted by an individual overwater structure may seem relatively small, the cumulative impacts resulting from all of the overwater structures throughout a geographic area, especially in highly developed areas, is substantial. In addition to the direct impact of shading on the primary producers in the footprint of the individual structure, many overwater structures in an area contribute to the overall fragmentation of marine and estuarine macrophytes, seagrasses and saltmarshes. Fragmentation of eelgrass beds in particular may cause further destabilization of these habitats, making them more susceptible to other stressors or disturbances, such as eutrophication, disease or severe storms (Burdick and Short 1999). Reductions in macrophytic vegetation may compromise the physical integrity of remaining habitat by decreasing the attenuation of wave energy and sediment stabilization, leaving shaded, unvegetated, or sparsely vegetated areas more susceptible to further habitat loss by erosion (Knutson 1988, Walker *et al.* 1989).

2. Wave Energy Regime and Substrate Effects

a.) Direct Impacts

Changes to wave energy and water transport from overwater structures may have substantial impacts to near shore detrital foodwebs through alterations in substrate size, distribution and abundance (Hanson *et al.* 2003). Altering sediment transport can create barriers to natural processes that build spits and beaches as well as provide substrate necessary for plant propagation, animal rearing and spawning (Thom *et al.* 1994, 1997).

Structures, such as pilings, used to support the majority of overwater structures have been found to have adverse effects to EFH through alterations of wave energy, and substrate composition (Nightingale and Simenstad 2001, Thom and Shreffler 1996, Williams 1988). When placed in moving water, pilings may disrupt the water's flow, either increasing flow rates immediately around their base, or by slowing the flow of water over the area of the dock. The increased flow may cause scour and erosion around the base of the pilings and the decreased flow may result in increased sedimentation across a larger area (Kelty and Bliven 2003). For example, three dimensional sediment and current transport modeling has indicated that multi-slip docks increase sedimentation, reduce flushing and subsequently increase concentrations of contaminants (Edinger and Martin 2010). The resulting changes in sediments caused by scour or deposition may affect fish, shellfish or habitat (Bowman and Dolan 1982).

Placement of pilings in seagrass beds results in the direct physical removal of seagrass during dock construction. However different piling installation and removal techniques themselves may influence the extent and magnitude of the impact. Jetting uses high-pressure water pumps to blow a deep hole in the bottom for placement or removal and can have adverse impacts to the substrate, while increasing turbidity and potentially suspending contaminants. When jetting is used, the new pilings are set into the hole and sand is back-filled around the base of the piling. Jetting tends to cause greater disruption than driving piles with a drop hammer. Jetting may disrupt adjacent vegetation resulting in bare areas around pilings that are subject to scour. Using a low pressure pump to produce a starter hole and subsequent insertion of a sharpened pile with a drop hammer in a sandy area "reduces the physical removal and disturbance" of seagrasses in the area of the piling and results in little to no sand deposition around the pilings. Regardless of the technique employed for driving piles, these activities directly impact the substrate and associated biota.

Depending on the piling material, the number of piles, and their spacing, the chronic impacts may be significant. The long-term presence of pilings, with and without associated overwater decking, may impact adjacent seagrass communities by altering currents, sediment accumulation or scouring, attracting bioturbators, and leaching from chemically treated timber (Beal *et al.* 1999). Bare areas around the base of pilings placed in seagrass beds ranged between 35-78 inches in diameter in St. Andrews Bay, Florida (Shafer and Robinson 2001). Dock pilings have been found to alter adjacent substrates with increased shellhash deposition from piling communities and changes to substrate bathymetry. The accumulation of debris and shell from barnacles, molluscs, and other marine organisms at the base of the pilings may inhibit the ability of seagrasses to recolonize the area surrounding the pilings (Fresh *et al.* 1995; Shafer and Lundin 1999). The presence of pilings can alter sediment distribution and bottom topography, creating small depressions that preclude eelgrass growth (Fresh *et al.* 1995). These changes may alter the plant and animal communities within a given site (Penttila and Doty 1990, Thom and Shreffler 1996).

Just as pile installation may adversely impact EFH, similar impacts may be observed in pile removal. The primary effects of pile removal are the resuspension of sediments and release of contaminants that may be contained within the pile and associated substrate. Direct pull or use of a clamshell to remove broken or old piles may suspend large amounts of sediment and contaminants. When the piling is pulled from the substrate using these two methods, sediments clinging to the piling will slough off as it is raised through the water column, producing a potentially harmful plume of turbidity and/or contaminants. Using a clamshell may suspend additional sediment if it penetrates the substrate while grabbing the piling. The associated turbidity plumes of suspended particulates may reduce light penetration and lower the rate of photosynthesis for submerged aquatic vegetation (Dennison 1987) and the primary productivity of an aquatic area if turbid conditions persist (Cloern 1987). If suspended sediments loads remain high, fish may suffer reduced feeding ability (Benfield and Minello 1996) and be prone to fish gill injury (Nightingale and Simenstad 2001).

While EFH may be adversely affected as a result of removing piles, many of those removed are old creosote-treated timber piles. In some cases, the long-term benefits to EFH from removing a consistent source of contamination may outweigh the temporary adverse effects of turbidity.

Mooring buoys are a common method for anchoring boats; however their chains can drag across the seafloor tearing up vegetation. In addition to uprooting seagrass, mooring chains can alter sediment composition ultimately impacting the benthic biota (Ostendorp *et al.* 2008). Walker *et al.* (1989) investigated the impacts of mooring buoys in Western Australia and found that 5.4 hectares of seagrass had been lost to mooring. The location of the damage within the bed may influence the extent of damage, with more significant impacts associated with mooring in the center of the bed versus along the edge. The trend of seagrass loss from boat moorings is increasing, which correlates with increased vessel use (Hastings *et al.*

1995). Examples of mooring chain damages are evident throughout the world (Jackson *et al.* 2002, Hiscock *et al.* 2005, Otero 2008)

Williams and Bechter (1996) examined the effects of 5 different mooring systems on marine vegetation. Their study concluded that mid-line float systems and all-rope lines had the least impact on substrate and aquatic vegetation. Disturbance impact of the remaining mooring types (*e.g.*, swinging chain moorings) ranged from 86 percent to 100 percent disturbance.

Other regions have begun incorporating best management practices (BMPs) for moorings in order to reduce impacts to eelgrass beds (Short 2009). Examples include clumping mooring lines together to minimize the extent of eelgrass damage (Herbert *et al.* 2009), the use of cyclone moorings that prevent swinging of chains (Shafer 2002), and elastic lines that stretch instead of requiring long lengths of chain.

b.) Indirect Impacts

As most overwater structures are designed to support boating activities, impacts from boats are a primary source of indirect effects, especially for seagrasses. At low tide, grounded floating docks and moored vessels have also been documented to damage benthic communities (Kennish 2002). Grounding of large objects poses the risk of smothering and destroying shellfish populations, scouring vegetation, and potentially lowering the levels of dissolved oxygen (Nightingale and Simenstad 2001). Simenstad *et al.* (1998) demonstrated that indirect effects from construction of overwater structures and boating activities contributed to the elimination of eelgrass, but also appeared to prohibit recruitment back to the area in the long-term.

By their very design, the majority of overwater structures originates on land above mean higher high water (MHHW), cross over the intertidal zone, and continue over shallow water in order to permit pedestrian access to boats from land. As a result, boats are drawn into these shallow waters for temporary and permanent docking, anchoring, and mooring. Furthermore, a large majority of recreational boating activities, including fishing, waterskiing, tubing, jet skiing, etc., occurs in these shallow waters adjacent to the shoreline. Therefore, it is not surprising that with increases in coastal populations, and boat ownership, has come an increase in damage to shallow water habitats, especially SAV, from boat groundings and propeller scarring.

When a vessel strays from marked channels or its operator is unable to visualize the shallow banks due to impaired water quality, entering into waters too shallow for the draft of the boat, the propeller comes in contact with the sediment surface, scouring the sediments, disturbing benthic biota, and increasing turbidity in the area. If seagrass is present, the plant canopy may be cropped or the plants may be uprooted entirely, forming what is referred to as a propeller scar (or prop scar). At the extreme, a boat may run completely aground. Commonly, when a boat begins to run aground operators will attempt to use the propeller to motor off the bed, resulting in even greater damage. Damage resulting from both prop scars and boat groundings involve the physical removal of seagrass, algae, and the benthic fauna. Unfortunately, once the sediment-trapping seagrass rhizome network is removed, the sediments may be further scoured and eroded, possibly causing an expansion of the scar into the surrounding area and preventing successful recruitment of seagrasses back into the scar (Rasheed 2004). Several studies have shown that natural recovery of propeller scarred seagrass may take over 60 years (Rasheed 1999, Fonseca *et al.* 2004).

Another indirect effect to sensitive marine and estuarine habitats from boat use is increased shoreline erosion associated with boat wakes. Many studies have related boat wakes with shore erosion (*e.g.*, Zabawa *et al.* 1980, Camfield *et al.* 1980, Hagerty *et al.* 1981). Larger vessels with deeper draft in particular can generate problematic wakes. As these waves travel to shore and eventually contact the shoreline, the energy transfer may scour and erode sediments and cause damage to seagrass and saltmarsh vegetation.

In addition, boat anchoring impacts the substrate. Though overwater structures including single-family docks, wharfs, and marinas are most often designed for use as boat landings, these structures are associated with other boating activities that encourage boats to anchor or moor in their vicinity. A single anchoring may have minor, localized effects, but the cumulative effect of multiple anchoring in high traffic areas can have long-term effects on seagrass beds. Francour *et al.* (1999) found that approximately 20 shoots of *Posidonia oceanica* were removed when an anchor was set and another 14 during retrieval, resulting in reduced cover and overall bed fragmentation. Further damage may result after an anchor is set in high wind or sea conditions when the boat drags the anchor along the bottom, and especially when the anchor is dragged through sensitive seagrass habitat (Sargent *et al.* 1995). Hall type anchors tend to disturb seagrass beds the least, though even minimal disturbances can have lasting effects (Milazzo *et al.* 2004). Permanent moorings in Sausalito Marina Bay have resulted in visible scars within the eelgrass beds in Richardson Bay within San Francisco Bay.

Anchor damage is common in seagrass beds worldwide and has been implicated in many studies of global seagrass decline. During a period of two decades, anchor scars fragmented and reduced seagrass coverage in the U.S. Virgin Islands, causing a reduction in the carrying capacity for sea turtles to just 11-31 individuals. When scars were fenced off to exclude boats and prevent further anchoring, scars were found to recover much faster (Williams 1988b). The Whitsunday Islands adjacent to the Great Barrier Reef in Australia are heavily impacted by recreational boating and tourism. Subsequently, extensive seagrass communities there have been significantly impacted by anchor damage (Campbell *et al.* 2002). Port Townsend Bay has implemented a voluntary no-anchoring zone to protect their eelgrass from additional scarring (Jefferson County Marine Resources Committee 2010). And in California, several construction projects in the vicinity of eelgrass have been required to submit anchoring plans to minimize loss of eelgrass (California Coastal Commission 2003).

c.) Cumulative Impacts

Although not directly attributed to construction of overwater structures, the associated use of such structures by vessels may adversely affect benthic habitat. For example, propeller scarring has been documented to adversely impact benthic habitats (Burdick and Short 1999, Shafer 1999, Thom *et al.* 1996). Sargent *et al.* (1995) conducted a state-wide survey in Florida to examine the cumulative extent of seagrass propeller scarring. The study found that approximately 1.7 out of 2.7 million acres of seagrass were scarred to a certain degree. The impacts were directly linked to increased human population and increased boating activity. New and/or expanded overwater structures may facilitate additional impacts given the associated use of such structures. In 2008, scientists at Everglades National Park surveyed aerial imagery of Florida Bay and analyzed results with Geographic Information Systems (GIS) to determine the effects of boat scarring on seagrass beds. Their efforts found over 12,000 scars ranging from 6.6 to 5,250 feet for a total length of 325 miles. Because more scars were found in this survey than when previously conducted in 1995, the authors concluded that propeller scarring was on the rise. A separate analysis showed both studies may have underestimated the number of propeller scars. Factors that correlated with high scarring rates were high vessel traffic and insufficient channel markings (SFNRC Technical Series 2008). This problem is not confined to Florida (Fonseca 1998, Shafer 2002, Kelty and Bliven 2003, Thom *et al.* 1996, Burdick and Short 1999) and is likely a significant issue along coastal estuaries of the Pacific coast.

Pilings, grounding of floating structures, and scours associated with mooring anchors and propellers, have indirect adverse impacts to submerged vegetation and benthic substrates. Each pile, scour or grounding creates an impacted space in the habitat, functionally separating a biological community, and creating patches of viable habitat separated by low quality, impacted habitat. The fragmentation of continuous habitats is arguably one of the most important factors contributing to loss of biological diversity (Wilcox and Murphy 1985). A study conducted in the United Kingdom (Frost *et al.* 1999) made faunal comparisons between fragmented and continuous eelgrass habitat. The study identified significant differences in the macrofaunal community composition via modification of both the physical nature of the habitat and possible the biological interactions that took place within them. The cumulative impacts of these activities will be dependent upon the duration, frequency, and distribution of impact. As habitat patches become more sparsely distributed the ability of the native biological community to recover from disturbance becomes less likely, and the likelihood of non-indigenous species (NIS) becoming established increases.

3. <u>Water Quality Effects</u>

a.) Direct Impacts

As discussed above (sectionV.A.2), pile installation and removal activities related to construction of overwater structures may result in greatly elevated levels of fine-grained mineral and organic particles in the water column, or suspended sediment concentration (SSC). Turbidity plumes of suspended particulates reduce light penetration through the water column, resulting in temporary shading impacts to primary producers (discussed in further details in section V.A.1), and potential behavioral impacts to fish.

While fish in San Francisco Bay are exposed to naturally elevated concentrations of suspended sediments resulting from storm flow runoff events, wind and wave action, and benthic foraging activities of other aquatic organisms (Schoellhammer 1996), dredging induced concentrations of suspended sediments may be significantly elevated to have direct effects on fish behavior. If suspended sediment loads remain high for an extended period of time, fish may suffer increased larval mortality (Wilber & Clarke 2001), reduced feeding ability (Benfield & Minello 1996) and be prone to fish gill injury (Nightingale & Simenstad 2001a). Additionally, the contents of the suspended material may react with the dissolved oxygen in the water and result in short-term oxygen depletion to aquatic resources (Nightingale & Simenstad 2001).

Pile installation and removal can disturb aquatic habitats by resuspending bottom sediments and, thereby, recirculating toxic metals, hydrocarbons, hydrophobic organics, pesticides, pathogens, and nutrients into the water column (USEPA 2000, SFEI 2008). Any toxic metals and organics, pathogens, and viruses, absorbed or adsorbed to fine-grained particulates in the sediment, may become biologically available to organisms either in the water column or through food chain processes.

Activities associated with overwater structures (marinas, wharves, piers, *etc.*) and treated wood used to support overwater structures have been found to have adverse effects on water quality. Research has demonstrated that contaminants introduced into marine environments and taken up by marine organisms, are generally passed or magnified through the foodweb subsequently affecting animal reproduction and population viability (Johnson *et al.* 1991, 1993, O'Neill *et al.* 1995, West 1997). In addition, sediment re-suspension associated with overwater structures have resulted in alteration of temperature regimes, levels of dissolved oxygen, and pH of the water.

Treated wood used in the construction of many overwater structures has been found to have adverse effects on EFH (particularly groundfish) and marine ecosystems as a whole. In treated wood products, the main active ingredients of concern affecting fishery resources are copper, in metal treated wood products, and polycyclic aromatic hydrocarbons (PAHs), in creosote treated wood. Copper leaches from treated wood products in a dissolved state. Once in the aquatic system, it can rapidly bind to organic and inorganic materials in suspension. The adsorbed material may then settle and become incorporated into the sediments. Resuspension of these sediments is of great concern because the copper can be made available for uptake by other organisms (Hecht *et al.* 2007). Copper has been found to have significant effects on fish behavior and olfaction (Baldwin *et al.* 2003, Sandhal *et al.* 2007). Creosote is a distillate of coal tar and is a variable mixture of 200-250 compounds consisting of simple PAHs, multi-aromatic fused rings, cyclic nitrogen-containing heteronuclear compounds and phenolic substances (USEPA 2008). PAHs are released from wood treated with creosote and are known to cause cancer, reproductive anomalies, immune dysfunction, and to impair growth and development, and to cause other impairments in fish exposed to sufficiently high concentrations over periods of time (Johnson *et al.* 1999, Karrow *et al.* 1999).

b.) Indirect Impacts

In addition to the direct impacts resulting from the use of treated wood, several indirect sources of contaminants are associated with overwater structures. Nutrient and contaminant loading from vessel discharges, engine operations, boat scraping/painting, boat washdowns, haulouts, paint sloughing, and vessel maintenance pose threats to water quality and sediment contamination (Cardwell and Koons 1981, Hall 1988, Krone *et al.* 1989). Boat motors have been associated with contamination of waterways resulting from discharges of oil and gasoline (Milliken and Lee 1990).

Copper based paints are frequently used on boat hulls in marine environments as an antifouling agent. These pesticidal paints slowly leach copper from the hull to in order to deter attachment of fouling species which may slow boats and increase fuel consumption. Copper that is leached into the marine environment does not break down and may accumulate in aquatic organisms, particularly in systems with poor tidal flushing. Many of the 303(d) listed water bodies in California are listed due to high levels of copper (USEPA 2001). At low concentrations metals such as copper may inhibit development and reproduction of marine organisms, and at high concentrations they can directly contaminate and kill fish and invertebrates. These metals have been found to adversely impact phytoplankton (NEFMC 1998), larval development in haddock, and reduced hatch rates in winter flounder (Bodammer 1981, Klein-MacPhee *et al.* 1984). Other animals can acquire elevated levels of copper indirectly through trophic transfer, and may exhibit toxic effects at the cellular level (DNA damage), tissue level (pathology), organism level (reduced growth, altered behavior and mortality) and community level (reduced abundance, reduced species richness, and reduced diversity) (Weis *et al.* 1998, Weis and Weis 2004, Eisler 2000). San Diego Bay is recognized as having some of the highest copper levels in a natural waterbody. Ninety-two percent of the 2,163 kilograms of copper that enter the waters at the Shelter Island Yacht Basin, in San Diego Bay, has been attributed to passive leaching of copper from antifouling paints (Neira *et al.* 2009).

c.) Cumulative Impacts

None anticipated

Noise Effects

a.) Direct Impacts

Pile driving generates intense underwater sound pressure waves that may adversely affect the ecological functioning of EFH. These pressure waves have been shown to injure and kill fish. Injuries associated directly with pile driving are poorly studied, but include rupture of the swimbladder and internal hemorrhaging. Sound pressure levels (SPL) 100 decibels (dB) above the threshold for hearing are thought to be sufficient to damage the auditory system in many fishes. Short-term exposure to peak SPL above 190 dB (re: 1 μPa) are thought to injure fish. However, 155 dB (re: 1 μPa) may be sufficient to temporarily stun small fish. Of the reported fish kills associated with pile driving, most have occurred during use of an impact hammer on hollow steel piles.

The California Department of Transportation (Caltrans) (2001) examined fish that died during exposure to underwater sound waves associated with pile driving. The results demonstrated that mortality was caused by the exposure to the pile-driving sound. Dead fish from several species were found within 50 meters from the impact location. Subsequent necropsy determined that internal bleeding and swim bladder damage was the primary cause of mortality. In 2004, Caltrans conducted a similar study to determine the effectiveness of air-bubble curtains used during pile driving in minimizing impacts to fish. In general, the study found that air-bubble curtains decreased overall trauma to exposed fish.

b.) Indirect Impacts

None anticipated

c.) Cumulative Impacts

None anticipated

Non-indigenous Species

a.) Direct Impacts

None anticipated

b.) Indirect Impacts

Non-indigenous species (NIS) are a significant environmental threat to biological diversity (Vitousek *et al.* 1996, Simberloff *et al.* 2005). The cost of NIS to the United States' economy was estimated to be in excess of $137 billion in 2005 (Pimentel *et al.* 2005). With the expansion of worldwide shipping, the transport of marine NIS via ballast water tanks on ships is now the most significant pathway of introduction of aquatic invasive species into marine ecosystems. Large scale surveys in California (CDFG 2008) found that each commercial harbor area had significant numbers of NIS. The San Francisco Bay estuary has one of the highest rates of invasion by non-native species of any water body on earth (Cohen 1997, Cohen and Moyle 2004). As of the mid-1990s, the estuary supported more than 200 non-native species (Cohen 1998). In some areas of the estuary these non-native species account for up to 100 percent of the common species encountered during sampling. San Francisco Bay and its tributaries have been found by the Regional Board, State Board, and the U.S. Environmental Protection Agency (USEPA) to be impaired by non-native species (see CWA section 303(d) list).

Although not the direct cause of introductions, artificial overwater structures and associated substrate may provide increased opportunity for NIS colonization and exacerbate the increase in abundance and distribution of NIS (Bulleri and Chapman 2010). In a survey of NIS within sheltered waters of CA, the largest numbers of exotic species were found on floating piers and associated structures (Cohen *et al.* 2002). Glasby *et al.* (2007) argue that artificial structures, such as floating docks and pilings, provide entry points for invasion and increase the spread and establishment of NIS in estuaries. Within Elkhorn Slough, Wasson *et al.* (2005) found that hard substrate harbored significantly more exotic species than soft substrate. In Maine, Tyrell and Byers (2007) found that exotic tunicates were disproportionately abundant on artificial surfaces. Dafforn *et al.* (2009b) found that, overall, native species were disproportionally less numerous than NIS on shallow moving surfaces. These results would implicate floating structures, such as floating docks, pontoons, mooring balls, and vessel hulls as potential "hotspots" for NIS. Dafforn *et al.* (2009a) also found NIS were more abundant on artificial substrates exposed to copper and/or anti-fouling paints, indicating that artificial structures associated with overwater structures such as vessel hulls may also promote NIS. Given the relative lack of natural hard bottom habitat in estuaries, the addition of artificial hard structures within this type of habitat may provide an invasion opportunity for non-indigenous hard substratum species (Glasby *et al.* 2007, Wasson *et al.* 2005, Tyrell and Byers 2007). Therefore, NMFS believes that artificial substrate in estuaries may contribute to further proliferation of NIS. Some researchers have recommended that coastal managers should consider limiting the amount of artificial hard substrates in estuarine environments (Wasson *et al.* 2005, Tyrell and Byers 2007).

Silva *et al.* (2002) documented the presence of the Asian kelp *Undaria pinnatifida,* a non-native alga in Los Angeles and Long Beach harbors, Channel Islands Harbor, Port Hueneme, Santa Barbara Harbor, and Catalina Island. It was discovered in southern California in the spring of 2000, and by the summer of 2001 had been collected at several California sites from Los Angeles to Monterey Harbor. It was discovered and removed from docks in San Francisco Bay in 2009. With the exception of the Catalina site, all observations were found on floating docks, piers, pilings, or other artificial substrate in a protected environment. More recent observations made by various site-specific surveys in southern California continue to observe this trend. For example, a site-specific survey conducted at port of Los Angeles Berths 145-147 indicated that the dominant flora in the project vicinity was *Undaria pinnatifida*, which was found exclusively on pilings (Merkel and Associates, 2009). The most recent biological baseline survey conducted in the Ports of Los Angeles and Long Beach documented *Undaria* at all eight inner harbor sites and at 7 of 12 outer harbor locations, indicating an expanded distribution since 2000 (SAIC 2010). Another recent example in the Long Beach Harbor is the occurrence of a non-native, brown seaweed (*Sargassum horneri*). It was first found in 2003, but by 2004, it moved to both sides of the harbor's back channel. Since then, this non-native species has been found in Orange County, the Channel Islands, and as far south as San Diego Bay.

Peeling (1974) noted the dominance of various hydroids and tunicates in deeper portions of pilings in San Diego Bay. Specifically, *Bugula neritina*, a colonial bryozoan, and two tunicate species, *Styela barnharti* (more commonly known as *Styela clava*) and *S. plicata*, were identified. *B. neritina* is a common member of fouling communities in harbors and bays on the Pacific Coast, from intertidal to shallow subtidal depths. It is common on dock sides, buoys, pilings and rocks, settling often on shells and sometimes on seaweeds, sea grasses, sea squirts and other bryozoans (Cohen 2005). *Styela plicata* is an exotic species reported on harbor floats and pilings from Santa Barbara to San Diego (Cohen 2005). *Styela clava* is common on rocks, floats and pilings in protected waters, and on oyster and mussel shells, and is occasionally found on seaweeds. It mainly occurs in the low intertidal to shallow subtidal zones. At high densities and/or abundance, these non-native species may adversely affect other native organisms by competing for space, food, or by consuming planktonic larvae, thus reducing rates of settlement (Cohen 2005).

Long-term impacts of NIS can change the natural community structure and dynamics, lower the overall fitness and genetic diversity of natural stocks, and pass and/or introduce disease. Overall, exotic species introductions create five types of negative impacts to EFH and associated federally management fish species: 1) habitat alteration, 2) trophic alteration, 3) gene pool alteration, 4) spatial alteration, and 5) introduction of diseases/pests.

Non-native plants and algae can degrade coastal and marine habitats by changing natural habitat qualities. Habitat alteration includes the excessive colonization of exotic species (*e.g.*, *Caulerpa taxifola*) which preclude the growth of native organisms (*e.g.*, eelgrass). *Caulerpa taxifolia* is a green alga native to tropical waters that typically grows in limited patches. A particularly cold tolerant clone (tolerant of temperatures at least as low as 10 °C for a period of three months) of this species has already proven to be highly invasive in the Mediterranean Sea and efforts to control its spread have been unsuccessful. In areas where the species has become well established, it has caused ecological and economic devastation by overgrowing and eliminating native seaweeds, seagrasses, reefs, and other communities. In the Mediterranean, it is reported to have harmed tourism and pleasure boating, devastated recreational diving, and had a significant impact on commercial fishing both by altering the distribution of fish as well as creating a considerable impediment to net fisheries. *C. taxifolia* had been detected, but eradicated in two locations in southern California (Huntington Harbor and Agua Hedionda), which alone cost over 7 million dollars.

The introduction of NIS may also alter community structure by preying on native species or by population explosions of the introduced species (Byers 1999). Introduced NIS increases competition with indigenous species or forage on indigenous species, which can reduce fish and shellfish populations. Although hybridization is rare, it may occur between native and introduced species and can result in gene pool deterioration (Currant *et al.* 2008). Spatial alteration occurs when territorial introduced species compete with and displace native species (Blossey and Notzold 1995). The introduction of bacteria, viruses, and parasites is another severe threat to EFH as it may reduce habitat quality. New pathogens or higher concentrations of disease can be spread throughout the environment resulting in deleterious habitat conditions, impact species survival and overall fitness.

c.) Cumulative Impacts

Scientists, academics, leaders of industry, and land managers are realizing that invasive species are one of the most serious environmental threats of the 21st century (Mooney and

Hobbs 2000). The economic impacts of NIS alone are significant. Pimentel *et al.* (2000, 2005) estimated the annual cost to Americans as 137 billion dollars. Ecologically, the impacts of NIS are also significant and are still being understood.

The San Francisco Bay/Delta Estuary is an example of how species invasions can change an entire ecosystem. It is possibly the most invaded estuary in the entire world (Cohen and Carlton 1998). More than 230 NIS have become established in the system, and there are an additional 100-200 species that may be nonindigenous but whose origin cannot yet be determined. The known invasive species cover a wide range of taxonomic groups: 69 percent of the species are invertebrates such as mollusks, crustaceans, and tubeworms; 15 percent are fish and other vertebrates; 12 percent are vascular plants; and 4 percent are microbial organisms. NIS dominates many estuarine habitats, accounting for 40 to 100 percent of the common species at many sites in the estuary, whether calculated as a percentage of the number of species present, the number of individuals, or of total biomass (Cohen and Carlton 1995).

Established populations of NIS may also facilitate the invasion of other NIS that would otherwise be unable to invade. For example, Heiman *et al.* (2008) found that non-native tubeworm reefs in Elkhorn Slough created non-native structural habitat, which in turn provided the hard substrate necessary for the invasion of other NIS. These types of invasions are an example of an 'invasional meltdown' in which NIS facilitate ongoing and subsequent invasions by increasing survival, population size, or the magnitude of ecological impacts of other NIS (Simberloff and Von Holle 1999).

NIS introductions have dramatically reduced some native populations, altered habitat structure and energy flows, and caused billions of dollars in economic damage (Cohen and Carlton 1995). The pace of invasion is apparently accelerating. Roughly half of the NIS in California arrived in the last 35 years. Between 1851 and 1960, a new species was established in the San Francisco Bay every 55 weeks. The primary means of introduction can be attributed to the shipping and boating industry.

Overall Cumulative Impacts

As a result of California's large population and intense economic and recreational activity, a large proportion of our shoreline has been subject to construction, mineral extraction, or other forms of resource utilization and habitat alteration. Dredging, fill, shoreline armoring, and overwater structures are the primary causes of habitat alteration within San Francisco Bay. At the ports of San Francisco, Richmond, Oakland, and Redwood City, increasing global economic pressures have resulted in the need for larger, deeper draft ships to transport cargo. Thus increasing demand for new construction dredging to widen and deepen channels, turning basins, and slips to accommodate these larger vessels. These activities result in permanent loss of shallow water habitats and chronic effects on water quality. In addition to the ports, the rest of the Bay has experienced significant adverse impacts associated with shoreline, intertidal, and shallow subtidal development.

Coupled with overwater structure expansion and modification, San Francisco Bay has experienced high levels of ecological stress, modification, and continual decline in valuable shallow water habitats. These habitats are designated EFH for many federally managed fish species and essential for many recreational fish, and need to be managed rigorously and carefully. As coastal development continues these necessary habitats are increasingly stressed, degraded and eliminated. The challenge of the future will be to manage these systems in a responsible and sustainable manner that will foster economic stability and growth, while protecting and conserving valuable marine resources.

Throughout California, human activities associated with urban development, recreational boating, fishing, and commercial shipping continue to degrade, disturb, and/or destroy important near shore and protected embayment habitats. Halpern *et al.* (2009) mapped cumulative impacts at the scale of the California Current marine ecosystem and found that intertidal and near shore ecosystems are most heavily impacted because of exposure to stressors from both land- and ocean-based human activities. Furthermore, Central California, including San Francisco Bay, ranked as one of the highest areas for cumulative impacts.

Most recent estimates have the current world population at approximately 6.8 billion humans with a predicted increase to 8.9 billion by 2050. Presently, 40 percent of the world's population resides within 100 kilometers of the coast. Since 1990 the San Francisco Bay area's population has grown from 6.0 million to 7.4 million, a growth of at least 19 percent (CA Census Data 2009). As the population increases, so does the need for development. Infrastructure such as bridges, roads, and highways must be reconfigured and expanded. Shipping and cargo capacities of ports and harbors will increase, which will require expansion and modification of overwater port facilities. As the population directly along the coast increases, recreational needs will increase, likely requiring the expansion of marina and recreational dock facilities. Increasing the number of overwater structures with adverse effects to the marine environment magnifies the extent of adverse impacts.

Global climate change and population growth over the next century will likely add more environmental stress to eelgrass habitat from anticipated increases in seawater temperature and sea level, with secondary changes to tidal range, current circulation patterns and velocities, salinity intrusion, ocean acidification, storm activity, frequency and magnitude of flooding, as well as coastal development (Short and Neckles 1999). While it is difficult to predict specific impacts to eelgrass in different areas of California, available information indicates that individual elements of climate change will affect seagrass productivity, distribution, and function throughout its range (Short and Neckles 1999). Sea levels are expected to rise over 3 feet by 2100. While this may seem relatively benign as it relates to eelgrass distribution, many eelgrass beds in California are at or very near their lower depth limits. The importance of eelgrass both ecologically and economically, coupled with ongoing human pressure and potentially increasing degradation and loss from climate change, highlights the need to protect, maintain, and, where feasible, enhance eelgrass habitat.

Phytoplankton populations are decreasing globally (Boyce *et al.* 2010). These changes are likely related to climatic and oceanographic variability and to increasing sea surface temperature over the past century. Global marine productivity may constrain some fisheries (Chassot 2010). For example, poor ocean productivity and the associated disruptions of the pelagic food chain were cited as principal reasons for the sudden collapse of the Sacramento River Chinook salmon fishery (Lindley *et al.* 2009). Longstanding and ongoing degradation of freshwater and estuarine habitats were also considered likely contributing factors to the collapse of the stock. Overwater structures are likely not affecting the same drivers of offshore plankton productivity, but the influence of estuarine and near shore sources of primary productivity may become more critical. Although the coastal zone represents only 8 percent of the earth, it provides 20 percent of the oceanic production (Liu *et al.* 2000).

B. Effects Analysis

In order to quantify the spatial extent of existing overwater structures in San Francisco Bay, an analysis was performed using GIS. Spatial data representing the shoreline of San Francisco Bay at Mean Sea Level was used to calculate the total two dimensional area of the Bay in acres. Polygons representing existing overwater structures (docks, piers, wharfs, marinas, floating breakwaters, *etc.*) were drawn manually in Google Earth. These polygons were imported into ArcGIS, and the total area of these polygons was calculated. It must be acknowledged that calculated areas are estimates only and do not represent exact acreages. In some instances polygons representing specific projects may have covered a larger area than is actually shaded and in some instances a smaller area than is actually shaded. Calculated values were determined merely to provide a rough estimate of in-Bay disturbance caused by existing overwater structures.

From the spatial analysis, total area of the Bay was calculated to be 285,786 acres. The total area of existing overwater structure in San Francisco Bay was estimated to be 770 acres. Because the acreage of the Bay includes large expanses of open water not likely to support overwater structures, we calculated the area of shallow water habitat (less than 4 meters depth) that was shaded by existing overwater structure. Approximately 180,100 acres of San Francisco Bay were less than 4 meters deep, or 63 percent of the total acreage. This analysis estimated that 460 acres of shallow water habitat is currently shaded by existing overwater structures.

In addition to the spatial analysis, NMFS staff evaluated records of EFH consultations on overwater structure projects permitted by USACE during the previous 4-year authorization period (*i.e.*, 2007-2010) and the area associated with each of these projects. During the previous 4-year period, NMFS consulted on 37 projects with an overwater structure component, 21 of which were for new structures or for replacements with an expanded footprint. For these 21 projects, the average increase in project footprint was 3,195 sq ft. The maximum project footprint consulted on was 37,480 sq ft, however, only 2 of the 21 projects had footprints that exceeded 10,000 sq ft. NMFS anticipates that a similar number of permits will be issued over the next five years with reasonably similar project footprints.

VI. EFH CONSERVATION RECOMMENDATIONS

As described in the above effects analysis, NMFS determines that the proposed action would adversely affect EFH for various federally managed fish species within the Pacific Groundfish, Coastal Pelagic, and Pacific Salmonid FMPs. Moreover, increases in overwater structures will adversely affect estuary and seagrass HAPC. Given the significant alteration of existing shoreline habitat, NMFS believes additional impacts to EFH associated with expanded overwater coverage would be substantial. Therefore, pursuant to section 305(b)(4)(A) of the MSA, NMFS offers the following EFH Conservation Recommendations to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

A. General Recommendations

1. All overwater structure construction (including in-kind replacement) that would occur within 45 meters of eelgrass (see NMFS' Programmatic EFH Consultation for Maintenance Dredging in San Francisco Bay Area) should be required to follow eelgrass monitoring requirements put forth in the Southern California Eelgrass Mitigation Policy (SCEMP) unless superseded by another NMFS' eelgrass mitigation policy. Exceptions may be granted for areas that USACE and NMFS believe are highly unlikely to support eelgrass habitat.

2. Given the significant alteration of existing shoreline and shallow water habitats in some regions of San Francisco Bay, all overwater structures should be water dependent (e.g., could not be constructed over land). Proposed projects should clearly explain their water dependency and why the project is in the public's best interest.

3. As part of the project application, the proponent should describe how their proposal addresses the specific conservation recommendations identified below. NMFS recognizes that not all conservation recommendations will be relevant in all situations. Therefore, the proponent should clearly articulate when a particular recommendation is not applicable to the proposed project. Based on the project application, USACE should determine if the project implements appropriate conservation recommendations and, therefore, can be covered by this programmatic consultation.

B. Mooring Anchors and Persistently Moored Vessels

For all projects, the project proponent should strive to implement avoidance measures to the extent feasible. When avoidance measures are not feasible, minimization measures should be implemented.

Avoidance:

1. All new anchored moorings and persistently moored vessel should be placed in areas in which suitable submerged aquatic vegetation (SAV) habitat is absent. This will prevent adverse shading impacts to SAV.

2. Persistently moored vessels should be placed in waters deep enough so that the bottom of the vessel remains a minimum of 18 inches off the substrate during extreme low tide events. This will prevent adverse grounding impacts to benthic habitat.

Minimization:

1. Mooring anchors placed within SAV or habitat suitable for SAV should be of the type which use midline floats to prevent chain scour to the substrate. This will prevent adverse impacts to SAV and other benthic habitat.

2. Persistently moored vessels that are moored over SAV or rocky reef habitats with less than 18 inches between the bottom of the vessel and the substrate at low tides should utilize float stops. This will prevent adverse grounding impacts to benthic habitat.

C. Pile Removal and Installation

Minimization:

1. Remove piles with a vibratory hammer rather than a direct pull or clamshell method.

2. Slowly remove pile to allow sediment to slough off at or near the mudline.

3. Hit or vibrate the pile first to break the bond between the sediment and the pile to minimize the likelihood of the pile breaking and to reduce the amount of sediment sloughed.

4. Encircle the pile with a silt curtain that extends from the surface of the water to the substrate, where appropriate and feasible, if within suitable SAV habitat.

5. If contaminated sediment occurs in the footprint of the proposed project, cap all holes left by the piles with clean native sediments.

6. Drive piles during low tide periods when substrates are exposed in intertidal areas. This minimizes the direct impacts to fish from sound waves and minimizing the amount of sediments resuspended in the water column.

7. Use a vibratory hammer to install piles, when possible. Under those conditions where impact hammers are required (*i.e.*, substrate type and seismic stability) the pile should be driven as deep as possible with a vibratory hammer prior to the use of the impact hammer. This will minimize noise impacts.

D. Pile-supported Overwater Structures

For all projects, the project proponent should strive to implement avoidance measures to the extent feasible. When avoidance measures are not feasible, minimization measures should be implemented. Although it may not be feasible to implement all the recommendations below, when used in combination, impacts to EFH will be greatly minimized. **In order to determine which avoidance and, or minimization measures are applicable on a project-specific basis see the "Keys for Construction Conditions" in Appendix A-C.**

Avoidance:

1. To the maximum extent practicable, site overwater structure (OWS) in areas not occupied by or determined to be suitable for sensitive habitat (*e.g.*, SAV, salt marsh, intertidal flats).

2. To the maximum extent practicable, any cross or transverse bracing should be placed above the mean higher high water line (MHHW) to avoid impacts to water flow and circulation.

Minimization:

1. Minimize, to the maximum extent practicable, the footprint of the OWS. The OWS should be the minimum size necessary to meet the water-dependent purpose of the project.

2. Design structures in a north-south orientation, to the maximum extent practicable, to minimize persistent shading over the course of a diurnal cycle.

3. For all OWS, excluding ramps, terminal platforms, and floating docks, the height of the structure above water should be a minimum of 5 feet above MHHW.

4. For all OWS, the width of the structure should be limited to a maximum of 4 feet wide. In situations where it is necessary to construct a dock walkway wider than 4 feet to comply with Americans and Disabilities Act (ADA, P.L. 110-325), the structure height should be increased by a corresponding amount to offset the increased shading effects of the wider structure (*e.g.*, a 1-foot increase in width above the 4-feet maximum should be accompanied by a 1-foot increase in height above MHHW—a 5-foot-wide walkway should be elevated at least 6 feet above MHHW). Additional exceptions may be provided to comply with ADA requirements.

5. For all OWS, turnarounds should not exceed 60 square feet, and for single-family docks and similar OWS, only one turnaround is permitted not exceeding 10 feet in length and 6 feet wide. The turnaround is intended to accommodate efficient unloading/loading of boating equipment and is not intended to be used for non-water dependent uses.

6. For all OWS, a terminal platform should not exceed 5 feet long by 20 feet wide, or 100 square feet.

7. Place the structure's terminal platform into nearest adjacent deep water to minimize the need for dredging and to minimize the likelihood of boat grounding, propeller scar/scour in shallow water habitat.

8. Use the fewest number of piles as practicable for necessary support of the structure to minimize pile shading, substrate impacts, and impacts to water circulation. Pilings should be spaced a minimum of 10 feet apart on center.

9. Gaps between deck boards should be a minimum of ½ inch. If the OWS is placed over SAV or salt marsh habitat, 1 inch deck board spacing or use of light transmitting material with a minimum of 40 percent transmittance should be used. Exceptions may be provided to comply with Americans with Disabilities Act (P.L. 110-325), requirements.

10. The use of floating dock structures should be minimized to the extent practicable and should be restricted to terminal platforms placed in the deepest water available at the project site.

11. Incorporate materials into the OWS design to maximize light transmittance. When suitable SAV habitat is within the project vicinity, the use of appropriate grating or light transmitting material should be used to permit sufficient light for SAV production.

E. Reporting Requirement

1. To avoid adverse effects to EFH that may occur from improper utilization of this programmatic consultation, NMFS recommends that USACE provide annual reports to NMFS on all activities conducted under this programmatic consultation. Reports should be submitted to NMFS within 90 days of the end of each calendar year. Reports should include a summary of annual overwater structure activities (total number of projects, and total acreages of new overwater coverage, summary of conservation recommendations implemented).

2. To avoid adverse effects to EFH that may occur from improper utilization of this programmatic consultation, NMFS recommends that USACE notify NMFS of the following:

a. When a project will indirectly impact eelgrass and which BMP is being used (inclusion of BMP in Public Notice and submission of notice to NMFS is satisfactory);

b. When a project will directly impact eelgrass and what mitigation is proposed.

At any time, NMFS may revoke or revise this programmatic consultation if it is determined that it is not being implemented as intended or if new information becomes available indicating a significant discrepancy in either the effects analysis or effectiveness of EFH Conservation Recommendations.

F. Compensatory Mitigation

As discussed above (*See* B. Effects Analysis), OWS shade an estimated 460 acres of shallow water habitat and modify an undetermined length of associated shoreline in San Francisco Bay. Continued modification of shallow water and estuarine shorelines as a result of overwater structures will further reduce the ecological functions and services provided by these unique habitats. In addition, the cumulative impacts associated with reduced tidal circulation and expanded boat use may degrade water quality. NMFS is not recommending compensatory mitigation to offset these impacts in this programmatic EFH consultation. However, NMFS and USACE should evaluate annual reports developed as part of this programmatic EFH consultation to determine if cumulative adverse impacts to EFH and aquatic resources in San Francisco Bay from on-going OWS development warrant compensatory mitigation, such as an in-lieu fee program, in the future.

VII. STATUTORY RESPONSE REQUIREMENT

Please be advised that regulations (50 CFR 600.920(k)) to implement the EFH provisions of the MSA require your office to provide a written response to this letter within 30 days of its receipt and prior to the final action. A preliminary response is acceptable if final response cannot be completed within 30 days. Your final response must include a description of how the EFH Conservation Recommendations will be implemented and any other measures that will be required to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with our EFH Conservation Recommendations, you must provide an explanation for not implementing this recommendation at least 10 days prior to final approval of the action. This explanation must include scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects. If the final response is inconsistent with our project-specific EFH Conservation Recommendations, projects to which these recommendations apply will not be covered by the programmatic consultation and must be consulted on individually. However, USACE and USEPA may propose and develop alternative EFH Conservation Recommendations subject to NMFS' approval, to compensate for outstanding adverse effects.

VIII. SUPPLEMENTAL CONSULTATION

This concludes programmatic EFH consultation for construction and maintenance of overwater structures in the San Francisco Bay area and associated indirect activities. Pursuant to 50 CFR 600.920(l) of the EFH regulations, USACE and USEPA 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.

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APPENDIX A

Key for Construction Conditions for Single-Family Docks and Similar Overwater Structures Constructed in Essential Fish Habitat (EFH), Southwest Region

1a. The construction site is not within designated EFH for Federally managed species in the Southwest region. *No construction conditions required by NMFS.*

1b. The construction proposed is a replacement of an existing structure with no expansion in surface area. The construction site is within designated EFH but sensitive species (SAV or saltmarsh) or their suitable habitat are not in the vicinity. *No construction conditions required by NMFS.*

1c. The construction proposed is a replacement of an existing structure with no expansion in surface area. The construction site is within designated EFH and sensitive species (SAV or saltmarsh) or their suitable habitat are in the vicinity. *Go to 2.*

1d. The construction proposed is for a new structure or an expansion of an existing structure. The construction site is within EFH and sensitive species (including SAV and/or saltmarsh vegetation) or their suitable habitat are not in the vicinity, and. *Go to 2.*

1e. The construction proposed is for a new structure or an expansion of an existing structure. The construction site is within EFH and sensitive species (including SAV and/or saltmarsh vegetation) or their suitable habitat are in the vicinity. *Go to 4.*

2a. The new or replacement structure meets all of the following conditions: is built with north-south orientation (within 45 degrees), at a minimum of 5 feet over mean higher high water (MHHW), not wider than 4 feet, no more than one turnaround exceeding 60 square feet, not more than one uncovered boat lift, terminal end not exceeding 100 square feet, pilings spaced at a minimum of 10 feet on center, and gaps between deck boards minimum of ½ inch apart. *No additional construction conditions required by NMFS.*

2b. The new or replacement structure does not meet all of the following conditions: is built with north-south orientation (within 45 degrees), at a minimum of 5 feet over MHHW, not wider than 4 feet, no more than one turnaround exceeding 60 square feet, not more than one uncovered boat lift, terminal end not exceeding 100 square feet, pilings spaced at a minimum of 10 feet on center, and gaps between deck boards spaced ½ inch or greater. *Go to 3.*

3a. The new or replacement structure will be constructed with gaps between deck boards a minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *No additional construction conditions required by NMFS.*

3b. The new or replacement structure cannot be constructed with gaps between deck boards a minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *Go to 5.*

4a. The new or replacement structure meets all of the following conditions: is built with north-south orientation (within XX degrees), at a minimum of 5 feet over MHHW, not wider than 4 feet, no more than one turnaround exceeding 60 square feet, not more than one uncovered boat lift, terminal end not exceeding 100 square feet, pilings spaced at a minimum of 10 feet on center, and either the gaps between deck boards are minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *No additional construction conditions required by NMFS.*

4b. The new or replacement structure does not meet all of the following conditions: is built with north-south orientation (within XX degrees), at a minimum of 5 feet over MHHW, not wider than 4 feet, no more than one turnaround exceeding 60 square feet, not more than one uncovered boat lift, terminal end not exceeding 100 square feet, pilings spaced at a minimum of 10 feet on center, and either the gaps between deck boards are minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *Go to 5.*

5. Consultation required.

APPENDIX B

Key for Construction Conditions for Multi-Family Docks, Marinas, and Similar Overwater Structures Constructed in Essential Fish Habitat (EFH), Southwest Region

1a. The construction site is not within designated EFH for Federally managed species in the Southwest region. *No construction conditions required by NMFS.*

1b. The construction proposed is a replacement of existing structures with no expansion in surface area. The construction site is within designated EFH but sensitive species (SAV or saltmarsh) or their suitable habitat are not in the vicinity. *No construction conditions required by NMFS.*

1c. The construction proposed is a replacement of existing structures with no expansion in surface area. The construction site is within designated EFH and sensitive species (SAV or saltmarsh) or their suitable habitat are in the vicinity. *Go to 2.*

1d. The construction proposed is for new structures or an expansion of existing structures. The construction site is within EFH and sensitive species (including SAV and/or saltmarsh vegetation) or their suitable habitat are not in the vicinity, and. *Go to 2.*

1e. The construction proposed is for new structures or an expansion of existing structures. The construction site is within EFH and sensitive species (including SAV and/or saltmarsh vegetation) or their suitable habitat are in the vicinity. *Go to 4.*

2a. The new or replacement structures meets all of the following conditions: all solid structure is elevated at a minimum of 5 feet over mean higher high water (MHHW), individual surfaces are not wider than 4 feet, turnarounds do not exceed 60 square feet, no covered structures such as dry docks or boat houses, terminal ends do not exceed 100 square feet, pilings spaced at a minimum of 10 feet on center, and gaps between deck boards are minimum of ½ inch apart. *No additional construction conditions required by NMFS.*

2b. The new or replacement structure does not meet all of the following conditions: all solid structure is elevated at a minimum of 5 feet over mean higher high water (MHHW), individual surfaces are not wider than 4 feet, turnarounds do not exceed 60 square feet, no covered structures such as dry docks or boat houses, terminal ends do not exceed 100 square feet, pilings spaced at a minimum of 10 feet on center, and gaps between deck boards are minimum of ½ inch apart. *Go to 3.*

3a. The new or replacement structure will be constructed with gaps between deck boards a minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *No additional construction conditions required by NMFS.*

3b. The new or replacement structure cannot be constructed with gaps between deck boards a minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *Go to 5.*

4a. The new or replacement structure meets all of the following conditions: all solid structure is elevated at a minimum of 5 feet over mean higher high water (MHHW), individual surfaces are not wider than 4 feet, turnarounds do not exceed 60 square feet, no covered structures such as dry docks or boat houses, terminal ends do not exceed 100 square feet, pilings spaced at a minimum of 10 feet on center, and gaps between deck boards are minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *No additional construction conditions required by NMFS.*

4b. The new or replacement structure does not meet all of the following conditions: all solid structure is elevated at a minimum of 5 feet over mean higher high water (MHHW), individual surfaces are not wider than 4 feet, turnarounds do not exceed 60 square feet, no covered structures such as dry docks or boat houses, terminal ends do not exceed 100 square feet, pilings spaced at a minimum of 10 feet on center, and gaps between deck boards are minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *Go to 5.*

5. Consultation required.

APPENDIX C

Key for Construction Conditions for Large, Industrial Overwater Structures Constructed in Essential Fish Habitat (EFH), Southwest Region

1a. The construction site is not within designated EFH for Federally managed species in the Southwest region. *No construction conditions required by NMFS.*

1b. The construction proposed is a replacement of existing structures with no expansion in surface area. The construction site is within designated EFH but sensitive species (SAV or saltmarsh) or their suitable habitat are not in the vicinity. *No construction conditions required by NMFS.*

1c. The construction proposed is a replacement of existing structures with no expansion in surface area. The construction site is within designated EFH and sensitive species (SAV or saltmarsh) or their suitable habitat are in the vicinity. *Go to 2.*

1d. The construction proposed is for new structures or an expansion of existing structures. The construction site is within EFH and sensitive species (including SAV and/or saltmarsh vegetation) or their suitable habitat are not in the vicinity, and. *Go to 2.*

1e. The construction proposed is for new structures or an expansion of existing structures. The construction site is within EFH and sensitive species (including SAV and/or saltmarsh vegetation) or their suitable habitat are in the vicinity. *Go to 4.*

2a. The new or replacement structures meets all of the following conditions: all solid structure is elevated at a minimum of 5 feet over mean higher high water (MHHW), individual surfaces are not wider than 4 feet, turnarounds do not exceed 60 square feet, no covered structures such as dry docks or boat houses, and terminal ends do not exceed 100 square feet. *No additional construction conditions required by NMFS.*

2b. The new or replacement structure does not meet all of the following conditions: all solid structure is elevated at a minimum of 5 feet over mean higher high water (MHHW), individual surfaces are not wider than 4 feet, turnarounds do not exceed 60 square feet, and terminal ends do not exceed 100 square feet. *Go to 3.*

3a. The new or replacement structure will be constructed with gaps between deck boards a minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *No additional construction conditions required by NMFS.*

3b. The new or replacement structure can not be constructed with gaps between deck boards a minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *Go to 5.*

4a. The new or replacement structure meets all of the following conditions: all solid structure is elevated at a minimum of 5 feet over mean higher high water (MHHW), individual surfaces are not wider than 4 feet, turnarounds do not exceed 60 square feet, terminal ends do not exceed 100 square feet, and gaps between deck boards are minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *No additional construction conditions required by NMFS.*

4b. The new or replacement structure does not meet all of the following conditions: all solid structure is elevated at a minimum of 5 feet over mean higher high water (MHHW), individual surfaces are not wider than 4 feet, turnarounds do not exceed 60 square feet, terminal ends do not exceed 100 square feet, and gaps between deck boards are minimum of 1 inch apart or using light transmitting material with 40 percent transmittance. *Go to 5.*

5. Consultation required.