STATE OF CALIFORNIA
REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

STAFF SUMMARY REPORT (Fred Hetzel)
MEETING DATE: February 14, 2018

ITEM: **6B**

SUBJECT: **Construction and Maintenance of Overwater Structures, San Francisco Bay Region –**
Issuance of Waste Discharge Requirements and Water Quality Certification

CHRONOLOGY: The Board has not considered this item before.

DISCUSSION: This Revised Tentative Order (Appendix A) would issue general waste discharge requirements and water quality certification for certain construction and maintenance activities in San Francisco Bay. The Board will consider this item only after it has adopted an Initial Study and Mitigated Negative Declaration for the Revised Tentative Order. This item, including the Board's consideration of a Tentative Resolution that would adopt the Initial Study and Mitigated Negative Declaration, is fully described in Item 6A, which also includes comment letters on the Revised Tentative Order and staff 's response.

RECOMMEN-DATION: Adoption of the Revised Tentative Order

APPENDIX A: Revised Tentative Order

Appendix A
Revised Tentative Order

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN FRANCISCO BAY REGION

REVISED TENTATIVE ORDER NO. R2-2018-XXXX

GENERAL WASTE DISCHARGE REQUIREMENTS AND WATER QUALITY CERTIFICATION for:

CONSTRUCTION AND MAINTENANCE OF OVERWATER STRUCTURES SAN FRANCISCO BAY

The California Regional Water Quality Control Board, San Francisco Bay Region (Regional Water Board), finds that:

1. The Regional Water Board regulates the construction and maintenance of overwater structures in San Francisco Bay, as well as associated bank and shoreline stabilization projects, because these activities discharge or have the potential to discharge sediment and other wastes into waters of the State. The Regional Water Board issues up to 20 Clean Water Act (CWA) section 401 water quality certifications/WDRs annually for the construction and maintenance of overwater structures. This general order will streamline the CWA section 401 permitting process for projects below certain size limits that are not expected to have significant water quality impacts and will reduce the number of individual water quality certifications issued by the Regional Water Board.
2. Section 13260(a) of the California Water Code (Water Code) requires any person discharging waste or proposing to discharge waste where it could affect the quality of the waters of the State to file a report of waste discharge. The activities regulated under this Order constitute a discharge of waste that could affect the quality of waters of the State. Every person (Permittee) proposing such an activity shall file a report of waste discharge (Application) with the Regional Water Board.
3. CWA section 401 (33 U.S.C. § 1341) requires Permittees to obtain "water quality certification" from the State of California that the project will comply with State water quality standards before the U.S. Army Corps of Engineers (Corps) may issue a Clean Water Act section 404 dredge and fill permit or a Rivers and Harbor Act section 10 permit for structures affecting navigable waters. (33 USC §§ 401-413; 1251 *et seq.).*
4. Water Code section 13263(a) requires that waste discharge requirements (WDRs) be prescribed as to the nature of any proposed discharge, existing discharge, or material change in an existing discharge. Such WDRs must implement any relevant water quality control plans, taking into consideration beneficial uses to be protected, the water quality objectives reasonably required for those purposes, other waste discharges, the need to prevent nuisance, and the provisions of Water Code section 13241.
5. Water Code section 13263(i) authorizes the Regional Water Board to prescribe general WDRs for a category of discharges if the discharges are produced by the same or similar operations; the discharges involve the same or similar types of waste; the discharges require the same or similar treatment standards; and the discharges are more appropriately regulated under general discharge requirements than individual discharge requirements. Here, general WDRs are warranted because construction and maintenance of similarly-sized overwater structures generate similar types and amounts of wastes and are subject to similar treatment standards. General WDRs will simplify the application and oversight management process.

Program Description, Impacts, and Mitigation

6. This Order applies to the construction and maintenance of certain overwater structures in San Francisco Bay, including intertidal, tidal, and subtidal habitats from the Golden Gate to the Region's boundary near Pittsburg, within the jurisdiction of the Regional Water Board. The Order applies to the following Bay segments: Sacramento and San Joaquin Delta, Suisun Bay, Carquinez Strait, San Pablo Bay, Richardson Bay, Central Bay, Lower Bay, and South Bay.
7. This Order refers to Project proponents authorized for coverage under the Order as Permittees.
8. "Overwater structure" is an umbrella term encompassing a of number of types of buildings, structures, and apparatuses built in or over water, generally for purposes of facilitating vessel mooring, loading, or navigation. Common overwater structures include piers, docks,[1] wharves,[2] marinas,[3] floats, and buoys.
9. The Order covers activities associated with construction or maintenance, including upgrades, retrofit, expansion, demolition, and reconfiguration of piers and docks (including associated ramps and floating docks) where the Permittee owns or operates a facility of less than 10,000 square feet (sq. ft.) of overwater coverage, including any expanded areas. This includes pile removal, replacement, and installation. The General WDRs do not cover such activities by owners or operators of piers and docks greater than 10,000 sq. ft.
10. The Order covers activities associated with upgrade, retrofit, expansion, demolition, and reconfiguration and new construction of wharves and marinas where the Permittee owns or operates a facility of less than 50,000 sq. ft. of overwater coverage. This includes pile removal, replacement, and installation. The General WDRs do not cover such activities by owners or operators of wharves and marinas greater than 50,000 sq. ft.
11. The Order covers bank and shoreline stabilization activities associated with the construction, maintenance, demolition, and reconfiguration of an associated overwater structure. Bank stabilization activities covered by the Order are limited to 500 linear feet of shoreline for repair of existing structures, 200 linear feet for new structures, and 1,000 sq. ft. in area. Bank stabilization or breakwater projects not connected to the construction, maintenance, or demolition of an overwater structure are not covered by this Order.
12. The Order covers the placement and replacement of temporary and permanent floats and buoys, when that replacement is part of the construction and maintenance of overwater structures.
13. Most of the shoreline covered by this Order is highly urbanized. Most of the projects authorized by this Order are expected to take place in areas where overwater structures have been historically present.
14. The Order requires the potential impacts of construction, maintenance and demolition activities to be avoided, minimized, and mitigated in accordance with mitigation and monitoring plans. Unavoidable temporary and permanent impacts to beneficial uses are required to be offset with

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[1] "Pier" and "dock" are used interchangeably for purposes of this order to mean a structure, often wooden, used for the loading or unloading of materials or as a moorage for boats.

[2] A "wharf" has a very similar definition to "pier" and "dock," in that it is also "a structure built along or at an angle from the shore of navigable waters so that ships may lie alongside to receive and discharge cargo and passengers."

[3] A "marina" for the purposes of this order refers "a basin providing secure moorings for pleasure boats and often offering supply, repair, and other facilities."

appropriate compensatory mitigation, including creation, restoration, and enhancement of waters of the State.

15. This Order is effective only if the Permittee proposing such an activity pays all fees required under Title 23, California Code of Regulations (23 CCR).

Regulatory Framework

16. The Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) is the Regional Water Board's master water quality control planning document. It designates beneficial uses and water quality objectives for waters of the State, including surface waters and groundwater. It also includes implementation plans to achieve water quality objectives. The Basin Plan was duly adopted by the Regional Water Board and approved by the State Water Resources Control Board (State Water Board), the Office of Administrative Law, and U.S. EPA, where required.

17. The Basin Plan lists the following existing and potential beneficial uses for surfaces waters in San Francisco Bay:

    (a) Ocean, Commercial, and Sport Fishing (COMM);
    (b) Estuarine Habitat (EST);
    (c) Industrial Service Supply (IND);
    (d) Fish Migration (MIGR);
    (e) Navigation (NAV);
    (f) Industrial Process Supply (PROC);
    (g) Preservation of Rare and Endangered Species (RARE);
    (h) Water Contact Recreation (REC-1);
    (i) Non-water Contact Recreation (REC-2);
    (j) Shellfish Harvesting (SHELL);
    (k) Fish Spawning (SPWN); and
    (l) Wildlife Habitat (WILD).

18. State Water Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California" (Antidegradation Policy), states that discharges to existing high quality waters will be required to meet WDRs that will result in the best practicable treatment or control of the discharge necessary to assure that (a) a condition of pollution or nuisance will not occur, and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained. These General WDRs are consistent with Resolution No. 68-16 because implementation of the proposed activities as mitigated is not expected to adversely affect existing or potential beneficial uses of the waters of the State, and existing water quality will be maintained or improved. Any impacts to beneficial uses that do occur must be offset by mitigation.

19. Pursuant to 23 CCR sections 3857 and 3859, the Regional Water Board is issuing General WDRs for the construction and maintenance of overwater structures, including associated bank stabilization projects, in San Francisco Bay. Water Code section 13260(d)(1) requires that the Permittees for whom WDRs have been prescribed pursuant to section 13263 submit a fee according to a reasonable schedule. The fee shall be in accordance with the current fee schedule, per 23 CCR, Division 3, Chapter 9, Waste Discharge Reports and Requirements Article 1 Fees, section 2200(a)(2).

20. The following California- and federally-listed species and designated critical habitat are present at the project location:

(a) Delta smelt (*Hypomesus transpacificus)*;
(b) Longfin smelt (*Spirinchus thaleichthys*);
(c) Green sturgeon (*Acipenser medirostris*);
(d) Steelhead trout, central California coast evolutionarily significant unit (ESU) (*Oncorhynchus mykiss*);
(e) Steelhead trout, California central valley ESU (*Oncorhynchus mykiss*); and
(f) Chinook salmon, Central Valley (Sacramento) spring-run (*Oncorhynchus tshawytscha*).

21. The following Federal Fisheries Management Plans (FMP) are applicable at the project location: the *Pacific Groundfish FMP*, the *Coastal Pelagic FMP*, and the *Pacific Coast Salmon FMP*.

22. On October 11, 2011, the National Marine Fisheries Services (NMFS) issued an Essential Fish Habitat Consultation (2011 NMFS Consultation) (Attachment A) for the construction and maintenance of overwater structures in San Francisco Bay. The purpose of the Consultation is to expedite the formal federal section 7 consultation process for such projects. The Consultation analyzes the potential adverse effects to federally-listed species resulting from all anticipated construction and maintenance of overwater structures in the San Francisco Bay Area.

23. In October 2014, NMFS issued the California Eelgrass Mitigation Policy and Implementation Guidelines (Eelgrass Guidelines) (Attachment B). The purpose of the Eelgrass Guidelines is to implement NMFS' policy of no net loss of eelgrass habitat function in California.

24. Filling of waters of the U.S. and State may cause partial or complete loss of the beneficial uses provided by those waters. This Order requires Permittees to complete and implement mitigation and monitoring plans to ensure that impacts are mitigated through avoidance and minimization and that unavoidable loss of beneficial uses is offset with appropriate compensatory mitigation, including creation, restoration, or (in exceptional cases) preservation of other waters of the State, or a combination thereof. These mitigation requirements are consistent with those adopted by U.S. EPA and the Army Corps for regulation of dredged or fill discharges to federal waters under CWA section 404.

25. Title to all abandoned archaeological sites and historic or cultural resources on or in the submerged lands of California is vested in the State and under the jurisdiction of the California State Lands Commission (Pub. Resources Code, § 6313).

26. Projects authorized by this Order may still require authorizations from other local, State, or federal agencies.

27. Potential dischargers and all other known interested parties have been notified of the intent to adopt these General WDRs.

28. The Regional Water Board, in a public meeting, heard and considered all comments pertaining to this Order.

California Environmental Quality Act

29. The Regional Water Board is the lead agency for these General WDRs (Project) under the California Environmental Quality Act (CEQA) (Public Resources Code Section 21000 *et seq*.). The Regional Water Board prepared and circulated an Initial Study/Mitigated Negative Declaration (IS/MND) for the Project for public review. The Regional Water Board adopted the IS/MND as Resolution No. R2-2018-XXXX finding that the IS/MND reflects the independent judgment and analysis of the Regional Water Board and that there is no substantial evidence that

these General WDRs will have a significant effect on the environment with implementation of mitigation measures identified in the IS/MND and required by this Order (Cal. Code Regs., tit. 14, § 15074). The Regional Water Board further finds that the mitigation measures identified in the Mitigated Negative Declaration to keep impacts to less-than-significant levels, as well as a program for monitoring and reporting on such mitigation measures, are required as conditions of these General WDRs. The Regional Water Board's decision is based on the record as a whole for the Project, which is available at the Regional Water Board's offices.

30. This Order authorizes the permitting of the construction and maintenance of overwater structures, such as piers and docks, wharves and marinas, mooring, floats and buoys, and associated bank stabilization projects subject to the limits set forth in this Order. The Order is designed to enhance the protection of surface water resources.

31. The Regional Water Board has satisfied its obligation to address tribal cultural resources under AB 52. The notification and consultation provisions of AB 52 were triggered and completed, and no comments were received on the Project.

Public Notice

32. The Regional Water Board has reviewed the contents of this Order and all evidence concerning this matter, written public comments, and testimony provided at the public hearing on February 14, 2018, in Oakland, California, and hereby finds that the adoption of this Order is consistent with the Basin Plan and is in the public interest.

33. The Regional Water Board has publicly notified interested agencies and persons of its intent to issue this Order for discharges of wastes from the construction and maintenance of overwater structures, has provided them with an opportunity for a public meeting and an opportunity to submit comments, and has considered all comments and testimony on the Order.

IT IS HEREBY ORDERED that the Permittees under this Order shall comply with the following. The Regional Water Board certifies that the overwater activities described herein comply with CWA sections 301, 302, 303, 306, and 307 and with applicable provisions of State law, provided that the Permittees comply with the following:

A. Discharge Prohibitions

1. The direct or indirect discharge of wastes, as defined in Water Code section 13050(d), within or outside of an active project site, to surface waters or surface water drainage courses is prohibited, except as authorized in this Order.
2. Maintenance activities subject to these requirements shall not cause a condition of pollution or nuisance as defined in Water Code section 13050 (l) and (m), respectively.
3. No unauthorized construction-related materials or wastes shall be allowed to enter into or be placed where they may be washed by rainfall or runoff into waters of the State. When operations are completed, any excess material shall be removed from the work area and any areas adjacent to the work area where such material may be washed into waters of the State.
4. Existing creosote piles in the project area shall be completely removed or cut/broken at least three feet below the mud-line and disposed at appropriate upland disposal sites. No new creosote piles shall be installed. Any chemically-treated wood material (e.g., pilings, decking) shall comply with the 2011 NMFS Consultation.

5. Construction and maintenance activities shall not occur within tidal marshes.

B. Discharge Specifications

1. Effective erosion and sediment control best management practices (BMPs) shall be undertaken and maintained to prevent discharge of sediment to waters of the State.
2. Excavated material shall be fully contained to prevent any transport by wind, surface runoff, or other means into waters of the State.
3. All staging must occur on adjacent access roads or previously-disturbed areas.
4. For construction and maintenance of overwater structures within 150 feet of mapped eelgrass beds, Permittees must perform pre-construction eelgrass surveys of the project area during the active growth period for eelgrass in San Francisco Bay.
5. The discharge of any hazardous, designated or non-hazardous waste as defined in 27 CCR, Division 2, Subdivision 1, Chapter 2 must be conducted in accordance with applicable State and federal regulations.
6. The Permittees shall clean up, remove, and relocate any wastes discharged in violation of the General WDRs/Certification.
7. Projects that include placing rock rip-rap or other hardscape materials for bank protection may be allowed, where those materials are replacing existing rip-rap or other hardscape materials. Gabions, concrete mats, tires, and rubble are prohibited.
8. In accordance with Water Code section 13260, the Permittees shall file with the Regional Water Board a report of any material change in the character, location, or quantity of this waste discharge that is beyond the scope of this Order. Any proposed material change in the discharge requires approval by the Regional Water Board after a hearing under Water Code section 13263.
9. No later than within 24 hours of occurrence of an adverse condition, the Permittees shall notify Regional Water Board staff by telephone or e-mail. An adverse condition includes, but is not limited to, a violation or threatened violation of the conditions of this Order, spill of petroleum products or toxic chemicals, or damage to control facilities that could affect compliance. A written notification of the adverse condition shall be submitted to the Regional Water Board within five days of occurrence of an adverse condition. The written notification shall identify the adverse condition, describe the actions taken or necessary to remedy the condition, and if applicable, specify a timetable for the remedial actions that follow any initial response to the adverse condition and any further reporting of the effectiveness of the remedy for the adverse condition.

C. Receiving Water Limitations

1. Construction and maintenance of overwater structures shall not cause the following conditions to exist in waters of the State at any place:
    a. Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses.
    b. Waters shall not contain oils, greases, waxes, or other materials in concentrations that result in a visible film or coating on the surface of the water or on objects in the water, that cause nuisance, or that otherwise adversely affect beneficial uses.

c. Waters shall not contain bio-stimulatory substances in concentrations that promote aquatic growth to the extent that such growth cause nuisance or adversely affect beneficial uses.

d. Waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.

e. There shall be no alteration of temperature beyond present natural background levels.

f. *Dissolved Oxygen:*
For all tidal waters, the following objectives shall apply:

- Downstream of Carquinez Bridge 5.0 mg/l minimum
- Upstream of Carquinez Bridge 7.0 mg/l minimum

g. *pH:*
The pH shall not be depressed below 6.5 nor raised above 8.5. Controllable water quality factors shall not cause changes greater than 0.5 units in normal ambient pH levels.

h. *Turbidity:*
Waters shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. Increases from normal background light penetration or turbidity relatable to waste discharge shall not be greater than 10 percent in areas where natural turbidity is greater than 50 NTU.

2. Activities shall not cause a violation of any particular water quality standard for receiving waters adopted by the Regional Water Board or the State Water Board as required by the CWA and regulations adopted there under. If more stringent applicable water quality standards are promulgated or approved pursuant to CWA section 303, or amendments thereto, the Regional Water Board will revise and modify this Order in accordance with more stringent standards.

D. Provisions

Overwater Activities

1. Construction and maintenance activities shall incorporate effective BMPs to ensure that no debris, cement, concrete, or washings thereof, or other construction-related materials or wastes, petroleum products, or other organic or earthen materials shall be allowed to enter into or be placed where it may discharge to waters of the State.
2. All staging shall occur on adjacent access roads or previously-disturbed areas. Soil and riprap shall be staged in areas that have been previously disturbed (e.g., service roads and turnouts). Alternative staging options shall be submitted with the NOI to the Regional Water Board and may not be implemented until approved by the Regional Water Board Executive Officer.
3. The discharge of any hazardous, designated or non-hazardous waste as defined in 27 CCR, Division 2, Subdivision 1, Chapter 2 shall be conducted in accordance with applicable State and federal regulations.
4. The Permittees shall clean up, remove, and relocate any wastes that are discharged in violation of this Order.

Avoidance, Mitigation, and Monitoring

1. If the proposed project is within 150 feet of a mapped eelgrass bed,[4] then prior to construction, the Permittees shall perform an eelgrass survey of the project area during the months of May through September (i.e., the active growth period for eelgrass in San Francisco Bay). All eelgrass surveys shall be performed in accordance with the latest version of NMFS' California Eelgrass Mitigation Policy and Implementing Guidelines.[5] The survey is valid for either 60 days from the survey date or until the next active growth period if construction occurs after the end of the active growth period.
2. If the results of the pre-construction survey indicate that the proposed project is located within an eelgrass bed, the Permittees shall modify the project to avoid placing any portion of the overwater structure in or over eelgrass unless the Permittees submit an assessment of alternatives that demonstrates that it is infeasible to avoid placing the structure in or over eelgrass.
3. If it is infeasible to avoid placing the structure in or over eelgrass, the Permittees shall design the project to minimize impacts to eelgrass beds to the maximum extent feasible. At a minimum, decking materials above eelgrass shall be comprised of slotted materials or spaced to provide a minimum 40 percent transparency, thereby minimizing impacts from shading of eelgrass by allowing light penetration below the structure.
4. If it is not feasible to avoid placement of the structure in or over eelgrass, the Permittees shall submit to the Regional Water Board a mitigation and monitoring plan (MMP) that shall be implemented to compensate for unavoidable impacts to eelgrass. Construction of the proposed project shall not commence until the Executive Officer provides written approval of the MMP.
5. To compensate for any remaining unavoidable impacts to eelgrass beds, the Permittees shall prepare an MMP that includes:
   a. A post-construction eelgrass survey and assessment of impacts, which shall be completed in the same month as the preconstruction survey during the next growing season immediately following the completion of the project, or within the first 30 days of completion of construction if within the active growth period. The post-construction survey shall document adverse impacts to eelgrass and any changes in density and extent of vegetative cover. The post-construction survey and impact assessment shall be conducted in compliance with all recommendations of Section II.D., "Assessing Impacts to Eelgrass Habitat," of the California Eelgrass Mitigation Policy and Implementing Guidelines prepared by NMFS West Coast Region, dated October 2014.
   b. The affected area shall be monitored for a period of no less than 2 years following construction.
   c. Eelgrass beds shall reach a minimum recovery of 100 percent aerial coverage and 85 percent density compared to preconstruction levels.

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[4] Maps of eelgrass beds in the San Francisco Bay are available on the Department of Fish and Wildlife's MarineBIOS website at http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html. To access the eelgrass layers, click on the habitat drop down menu of the layers tab.

[5] NOAA Fisheries. October 2014. *California Eelgrass Mitigation Policy and Implementing Guidelines*. Available on-line at http://www.westcoast.fisheries.noaa.gov/publications/habitat/california_eelgrass_mitigation/Final%20CEMP%20October%202014/cemp_oct_2014_final.pdf.

d. If the affected eelgrass mitigation areas have not met the recovery criteria described above at the end of the 2-year monitoring period, additional mitigation will be required at a minimum mitigation ratio of areal coverage of 1.2:1.

The MMP shall be prepared by a qualified biologist with experience in surveying, monitoring, and implementing eelgrass mitigation plans.

6. To compensate for impacts not related to eelgrass impacts, the Permittee shall propose mitigation commensurate with the impacts.

7. The purpose of the required monitoring is to evaluate the success or failure of avoidance, minimization, and compensatory mitigation for eelgrass impacts. The level of detail of the MMP and associated reporting shall be commensurate with the scope and size of the restoration.

8. New anchored moorings and persistently moored vessels shall be placed in areas in which submerged aquatic vegetation habitat is ordinarily absent.

9. Persistently moored vessels shall 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 to prevent adverse grounding impacts to benthic habitat.

10. Piles shall be removed with a vibratory hammer whenever practicable.

11. Piles shall be installed during low tide periods using a vibratory hammer, unless the Permittee demonstrates that it is infeasible.

12. Impact hammer use with wood piles shall be limited to projects using only one hammer, and no more than 20 piles shall be installed per day.

13. Impact hammer use with concrete piles shall be limited to piles less than 18 inches in diameter, and no more than 20 piles shall be installed per day.

14. Impact hammer use with steel piles shall be limited to piles less than 12 inches in diameter, and the hammer must be 3000 pounds or smaller and must use a wood or nylon (plastic) cushion block between hammer and pile. Projects shall be limited to using only one hammer, and no more than 20 piles shall be installed per day.

15. In-water construction periods shall be restricted to environmental work windows protective of aquatic species (June 1 – November 30).

16. Project activities within 700 feet of tidal marsh or suitable Ridgway's Rail (formerly California Clapper Rail) or California Black Rail habitat are prohibited during rail breeding season (January 15 – August 31 for Ridgway's Rail, February 1 – August 31 for California Black Rail).

17. No project activities shall occur within 50 feet of suitable Ridgway's Rail or California Black Rail habitat during extreme high tide events or when adjacent tidal marsh is flooded. Extreme high tides events are defined as a tide forecast of 6.5 feet or higher measured at the Golden Gate Bridge and adjusted to the timing of local high tides.

Application Requirements

18. The Order covers activities associated with construction or maintenance, including upgrades, retrofit, expansion, demolition, and reconfiguration of piers and docks (including associated ramps and floating docks) where the Permittee owns or operates a facility of less than 10,000 sq. ft. of overwater coverage, including any expanded areas. This includes pile removal, replacement, and

installation. The General WDRs do not cover such activities by owners or operators of piers and docks greater than 10,000 sq. ft.

19. This Order covers activities associated with upgrade, retrofit, expansion, demolition, and reconfiguration and new construction of wharves and marinas where the Permittee owns or operates a facility of less than 50,000 sq. ft. of overwater coverage. This includes pile removal, replacement, and installation. The General WDRs do not cover such activities by owners or operators of wharves and marinas greater than 50,000 sq. ft.
20. This Order covers bank and shoreline stabilization activities associated with the construction, maintenance, demolition, and reconfiguration of an associated overwater structure. Bank stabilization activities covered by the Order are limited to 500 linear feet of shoreline for repair of existing structures, 200 linear feet for new structures, and 1,000 sq. ft. in area. Bank stabilization or breakwater projects not connected to the construction, maintenance, or demolition of an overwater structure are not covered by this Order.
21. This Order covers the placement and replacement of temporary and permanent floats and buoys, when that replacement is part of the construction and maintenance of overwater structures.
22. Permittees shall submit to the Regional Water Board a project plan along with a completed Notice of Intent to Comply with the Terms of the WDRs/WQC Form (NOI) (Attachment C), which will serve as a report of waste discharge, indicating the intent to discharge in compliance with the terms and conditions of this Order.
23. The NOI must be signed by the Permittee or the Permittee's authorized agent. The NOI must include a statement that the submitted information is complete and describe why the project is water dependent. Pre-project photographs shall also be included with a descriptive title, date taken, photographic site, and photographic orientation.
24. The NOI shall indicate whether the project area contains eelgrass beds and the result of any pre-construction eelgrass survey(s).
25. The NOI shall indicate whether Ridgway’s Rail or California Black Rail are present, if work is proposed within their breeding season.
26. The NOI shall include an alternative analysis consistent with the specifications of U.S. EPA’s Clean Water Act Section 404(b)(1) Guidelines (Alternatives Analysis) demonstrating that the Permittee will sequentially avoid and minimize any adverse impacts to waters of the State and U.S. resulting from the project to the maximum extent practicable, The thoroughness of the alternatives analysis shall be commensurate with the purpose of the discharge, the value and sensitivity of the receiving water(s), and the extent, severity, and duration of the effect on the quality of waters. The Alternatives Analysis shall demonstrate the following:
    a. Avoidance - No discharge shall be permitted if there is a practicable alternative[6] to the proposed discharge, which would have less adverse impact to the aquatic ecosystem, as long as the alternative does not have other significant adverse environmental consequences.

[6] An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the Permittees which could reasonably be obtained, utilized, expanded, or managed in order to fulfil the basic purpose of the proposed activity may be considered (this definition is the same as presented in federal regulations at section 230.10(a)(2) of Title 33 of the CFR).

b. Minimization – Unavoidable temporary impacts shall be mitigated by restoring waterbodies and vegetation to pre-discharge conditions as quickly as practicable and by taking other practicable measures to reduce the severity and duration of such impacts.

27. If the Alternatives Analysis demonstrates that it is not practicable to avoid all adverse impacts to waters of the State and U.S., the NOI shall include a MMP that, when implemented, will compensate for any unavoidable adverse impacts to waters of the State and U.S. Specifically, the MMP shall demonstrate that discharges resulting in unavoidable permanent impacts to waters of the State and U.S. shall result in "no net loss" of area (acreage), functions, and beneficial use values by providing appropriate compensatory mitigation including creation, restoration, enhancement, or (in exceptional cases) preservation of waters of the State and U.S. The Executive Officer will consider, at a minimum, the following when reviewing the adequacy of compensatory mitigation:

- Highest potential condition of habitat onsite;
- Value of project site for habitat connectivity;
- Ratio of area of proposed compensation to proposed loss;
- Certainty of successfully implementing the compensatory mitigation proposal;
- Monitoring methods and performance criteria for determining success of the compensatory mitigation proposal;
- Contingency plan for failure to meet performance criteria; and
- Any other information requested by the Regional Water Board or State Water Board.

- Upon finding that a Permittee has submitted a complete and acceptable NOI, the Executive Officer may issue a Notice of Applicability (NOA) to the Permittee, indicating that the project activities are authorized under this Order. If project activities do not qualify for coverage, the Executive Officer shall issue a Notice of Exclusion (NOE) stating the project is not authorized under the Order. If a project does not comply with State water quality standards, the Executive Officer may issue a denial of certification for the project. If the State or Regional Water Board does not issue a NOA or NOE to the Permittee within 30 days of receipt of the Application, the Permittee may proceed with the discharge.

28. Notice of Completion - Permittees shall provide the Regional Water Board a Notice of Completion (NOC) no later than 30 days after project completion and shall demonstrate that the project has been carried out in accordance with the project's description as provided in the Application. The NOC shall include a map of the project location(s), including the final boundaries of the project area(s) and post-project photographs. Each photograph shall include a descriptive title, date taken, and photographic site identification.

General Provisions

29. All Provisions in this Order apply to all waters located within San Francisco Bay.

30. Permittees shall comply with all the Discharge Prohibitions, Discharge Specifications, Receiving Water Limitations, and Provisions of this Order immediately as provided in the Order.

31. Permittees shall comply with all necessary approvals or permits for the proposed overwater activities, including, but not limited to, those issued by the Regional Water Board, California Department of Fish and Wildlife (CDFW), the Corps, the U.S. Fish and Wildlife Service (USFWS), NMFS, and local agencies. Permittees shall submit copies of such approvals or permits

to the Executive Officer with their NOIs and not later than prior to implementation of overwater activities.

32. The final disposition of archaeological, historical, and paleontological resources recovered on State land under the jurisdiction of the California State Lands Commission must be approved by the Commission.

33. These WDRs and water quality certification do not allow for the take, or incidental take, of any special status species. Permittees shall use the appropriate protocols, as approved by CDFW, USFWS, and NMFS, to ensure that overwater activities do not impact the beneficial use of the Preservation of Rare and Endangered Species.

34. Permittees shall implement overwater activities in accordance with the findings herein and shall comply with all applicable water quality standards.

35. If, at any time, an unauthorized discharge to surface water occurs, or any water quality problem arises, the associated overwater activities shall cease immediately until corrective actions have been implemented, including ensuring that adequate BMPs are implemented to eliminate the discharge, and clean up and remediate any recoverable pollutants. The Regional Water Board shall be notified promptly and in no case more than 24 hours after the unauthorized discharge or water quality problem arises.

36. Permittees shall report promptly to the Regional Water Board any proposed material change in the character, location, area, and/or volume of the discharge. Permittees shall obtain confirmation from the Regional Water Board that such proposed modifications do not disqualify the Permittee from coverage under these General WDRs.

37. This Order is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to Water Code section 13330 and 23 CCR section 3867.

38. The Regional Water Board may add to or modify the conditions of this Order, as appropriate, to implement any new or revised water quality standards and implementation plans adopted or approved pursuant to the Water Code or CWA section 303.

39. Permittees shall maintain a copy of this Order and all relevant plans at work sites, so as to be available at all times to site operating personnel.

40. Permittees shall permit Regional Water Board staff or its authorized representative, upon presentation of credentials:

    a. Entry on to the premises on which maintenance activities are planned or under way, wastes are located, or in which records are kept.

    b. Access to copy any records required to be kept under the terms and conditions of this Order.

    c. Access to sample any discharge or surface water covered by this Order.

41. In the event of any violation or threatened violation of the conditions of this Order, the violation or threatened violation shall be subject to any remedies, penalties, process or sanctions as provided for under applicable State or federal law. Permittees shall implement all mitigation measures identified in the Order relating to aquatic species, water quality, and hazardous materials.

42. Permittees shall pay the full fees required by 23 CCR section 3833 and owed by the Permittees. The State Water Board dredge and fill fee calculator for General Orders is located at

http://www.waterboards.ca.gov/water_issues/programs/cwa401/docs/dredgefillcalculator.xlsx A check payable to the Regional Water Board in the appropriate amount shall be enclosed with the copy of the NOI.

43. This Order is not intended and shall not be construed to apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license unless the pertinent certification application was filed pursuant to 23 CCR subsection 3855(b) and that application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

44. This Order is not transferable.

I, Bruce H. Wolfe, Executive Officer, do hereby certify that the foregoing is a full, complete and correct copy of an Order adopted by the California Regional Water Quality Control Board, San Francisco Bay Region on **DATE**.

____

Bruce H. Wolfe
Executive Officer

Attachment A: National Marine Fisheries Services Essential Fish Habitat Consultation for the construction and maintenance of overwater structures in San Francisco Bay
Attachment B: California Eelgrass Mitigation Policy and Implementation Guidelines
Attachment C: Notice of Intent to Comply with the Terms of the WDRs/WQC Form

Attachment A

NMFS Essential Fish Habitat Consultation

Available at:

https://www.waterboards.ca.gov/sanfrancisco bay/board_info/agendas/2018/February/6b_ssr.pdf

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

Table of Contents

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.

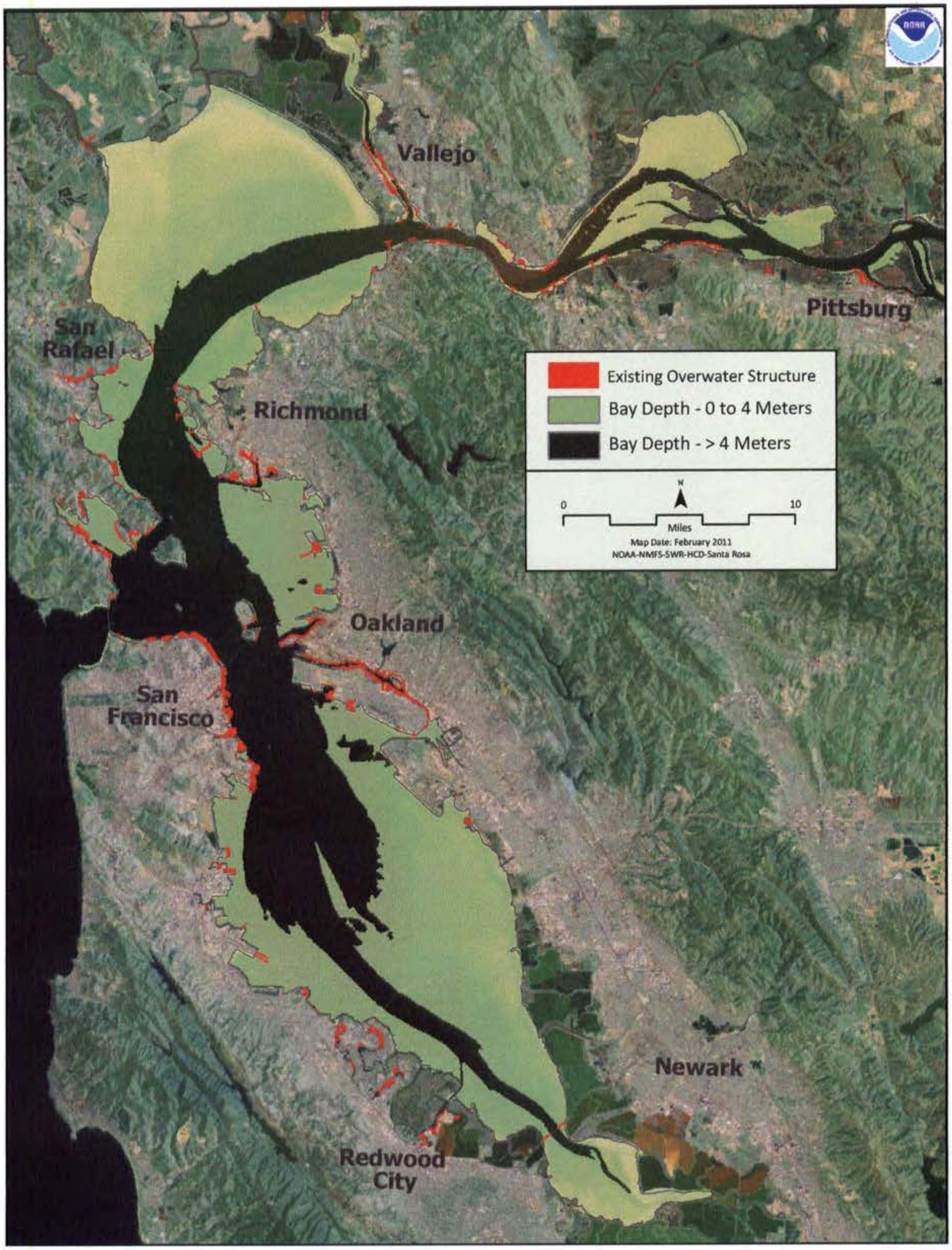

Figure 1. Action area covered by the EFH Programmatic Consultation for Overwater Structures in San Francisco Bay.

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. Shading Effects

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.

IX. LITERATURE CITED

Able, K.W., J.P. Manderson, and A.L. Studholme. 1998. The distribution of shallow water juvenile fishes in an urban estuary. The effects of manmade structures in the lower Hudson River. *Estuaries* 21(48): 731-744.

Able, K.W., J.P. Manderson, and A.L. Studholme. 1999. Habitat quality for shallow water fishes in an urban estuary: The effects of manmade structures on growth. *Marine Ecology Progress Series* 187: 227–235.

Armstrong, D.A., J.A. Armstrong, and P. Dinnel. 1987. Ecology and population dynamics of Dungeness crab, *Cancer Magister* in Ship Harbor, Anacortes, Washington. FRI-UW-8701. UW, School of Fisheries, Fisheries Research Institute, Seattle, WA

Army Corps of Engineers. 2010. Regional Supplement to the Army Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0). J. S. Wakeley, R. W. Lichvar, and C. V. Noble (eds.). ERDC/EL TR-10-3. Vicksburg, MS: U.S. Army Engineer Research and Development Center. http://www.usace.army.mil/CECW/Pages/reg_supp.aspx.

Baldwin, D.H., J.F. Sandahl, J.S. Labenia and N.L. Scholz. 2003. Sublethal Effects of Copper on Coho Salmon: Impacts on Nonoverlapping Receptor Pathways in the Peripheral Olfactory Nervous System. *Environmental Toxicology and Chemistry* 22: 2266-2274.

Beal, J.L., B.S. Schmit, and S.L. Williams. 1999. The effect of dock height and alternative construction materials on light irradiance (PAR) and seagrass *Halodule wrightii* and *Syringodium filiforme* cover. Florida Department of Environmental Protection, Office of Coastal and Aquatic Managed Areas (CAMA), CAMA notes.

Benfield, M.C. and T.J. Minello. 1996. Relative effects of turbidity and light intensity on reactive distance and feeding of an estuarine fish. *Environmental Biology of Fish* 46: 211-216.

Blanton, S., R.M. Thom, A. Borde, H. Diefenderfer, and J. Southard. 2002. Evaluation of methods to increase light under ferry terminals. Report to Washington State Department of Transportation, PNNL-13714.

Blossey, B. and Notzold, R. 1995. Evolution of increased competitive ability in invasive nonindigenous plants – a hypothesis. *Journal of Ecology* 83: 887-889.

Bodammer, J.E. 1981. The cytopathological effects of copper on the olfactory organs of larval fish (*Pseudopleuronectes americanus* and *Melanogrammus aeglefinus*). Copenhagen (Denmark): ICES CM-1981/E: 46.

Boesch D.F., & R.E. Turner. 1984. Dependence of fishery species on salt marshes: the role of food and refuge. Estuaries, 7: 460-468.

Britt, L.L. 2001. Aspects of the vision and feeding ecology of larval lingcod (*Ophiodonelongatus*) and Kelp Greenling (*Hexagrammos decagrammus*). M.Sc. Thesis, University of Washington.

Bulleri, F. and M.G. Chapman. 2010. The introduction of coastal infrastructure as a driver of change in marine environments. *Journal of Applied Ecology* 47: 26-53.

Burdick, D.M. and F.T. Short. 1995. The effects of boat docks on eelgrass beds in Massachusetts coastal waters, Waquoit Bay National Research Reserve, Boston, MA.

Burdick, D. M. and F.T. Short. 1999. The effects of boat docks on eelgrass beds in coastal waters of Massachusetts. *Environmental Management* 23(2): 231-40.

Byers, J.E. 1999. The distribution of an introduced mollusk and its role in the long-term demise of a native confamilial species. *Biological Invasions* 1: 339-353.

California Census Data 2009. Southern California Association of Governments. http://www.scag.ca.gov/census

California Coastal Commission. 2003. Staff report coastal development permit application. Staff Report E-02-024 (State Lands Commission). 25 p.

California Department of Fish and Game. 2008. Introduced aquatic species in the marine and estuarine waters of California. Submitted to the California State Legislature as required by the Coastal Ecosystems Protection Act of 2006.

California Department of Fish and Game. 2001. California Living Marine Resources: A Status Report. (eds) W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson. www.dfg.ca.gov/mrd.

Caltrans. 2001. Pile installation demonstration project, fisheries impact assessment. PIDP EA 012081. San Francisco–Oakland Bay Bridge East Span Seismic Safety Project. *Caltrans Contract* 04A0148 San Francisco, CA: Caltrans.

Caltrans. 2004. Fisheries and hydroacoustic monitoring program compliance report for the San Francisco–Oakland bay bridge east span seismic safety project. *Caltrans Contract* EA12033. San Francisco, CA: Caltrans.

Campbell, S., C. Roder, L. McKenzie, and W.L. Long. 2002. Seagrass resources in the Whitsunday region 1999 and 2000. DPI Information Series QI02043 (DPI, Cairns) 50 pp.

Cardwell, R.D. and R.R. Koons. 1981. Biological considerations for the siting and design of marinas and affiliated structures in Puget Sound. Technical Report No. 60. Washington Dept. of Fisheries, Olympia, WA.

Cloern, J.E. 1987. Turbidity as a control on phytoplankton biomass and productivity in estuaries. *Continental Shelf Research* 7:1367-1381.

Cohen, A.N. 2005. *Guide to the Exotic Species of San Francisco Bay.* San Francisco Estuary Institute, Oakland, CA. www.exoticsguide.org

Cohen, A.N., L.H. Harris, B.L. Bingham, J.T. Carlton, J.W. Chapman, C.C. Lambert, G. Lambert, J.C. Ljubenkov, S.N. Murray, L.C. Rao, K. Reardon, and E. Schwindt. 2002. Project Report for the Southern California Exotics Expedition 2000: A Rapid Assessment Survey of Exotic Species in Sheltered Coastal Waters.

Cohen, A.N. and J.T. Carlton. 1995. Biological Study. Nonindigenous Aquatic Species in a United States Estuary: A Case Study of the Biological Invasions of the San Francisco Bay and Delta. A Report for the U.S. Fish and Wildlife Service, Washington, DC and The National Sea Grant College Program, Connecticut, Sea Grant, NTIS Report Number PB96-166525.

Cohen, A.N. and J.T. Carlton. 1998. Accelerating invasion rate in a highly invaded estuary. *Science* 279:555-558.

Currant, M., M. Ruedi, R.J. Petit, and L. Excoffier. 2008. The hidden side of invasions: massive introgression by local genes. *Evolution* 62(8): 1908-1920.

Czerny, A.B. and K.H. Dunton. 1995. The effects of in-situ light reduction on the growth of 2 subtropical seagrasses, *Thalassia testudinum* and *Halodule wrightii. Estuaries* 18: 418–427.

Dafforn, K.A., T.M. Glasby, and E.L Johnson. 2009a. Links between estuarine condition and spatial distribution of marine invaders. *Biodiversity Research* 15: 807-821.

Dafforn, K.A., E.L. Johnston, and T.M. Glasby. 2009b. Shallow moving structures promote marine invader dominance. *Biofouling* 25(3): 277-287.

Dean, T.A., L. Haldorson, D.R. Laur, S.C. Jewett, and A. Blanchard. 2000. The distribution of nearshore fishes in kelp and eelgrass communities in Prince William Sound, Alaska: associations with vegetation and physical habitat characteristics. *Environmental Biology of Fishes* 57: 271-287.

Dennison, W.C. and R.S. Alberte. 1982. Photosynthetic responses of *Zostera marina* L. (eelgrass) to *in situ* manipulations of light intensity. *Oecologia* 55: 137-144.

Dennison, W.C. 1987. Effect of light on seagrass photosynthesis, growth and depth distribution. *Aquatic Botany* 27: 15-26.

Dennison, W.C., R.J. Orth, K.A. Moore, J.C. Stevenson, V. Carter, S. Kollar, P.W. Bergstrom, and R.A. Batiuk. 1993. Assessing water quality with submersed aquatic vegetation. *Bioscience* 43: 86-94.

Desmond J.S., G.D. Williams, & J.B. Zedler. 2000. Fish use of tidal creek habitats in tow southern Claifornia salt marshes. Ecological engineering, 14:233-252.

Duarte, C.M. 1991. Seagrass depth limits. *Aquatic Botany* 40: 363-377.

Dunton, K.H. 1994. Seasonal growth and biomass of the subtropical seagrass *Halodule wrightii* in relation to continuous measurements of underwater irradiance. *Marine Biology* 120: 479-489.

Eisler, R. 2000. Handbook of Chemical Risk Assessment: Health Hazards to Humans, Plants and Animals, Volume 1: Metals. First CRC Press LLC Printing 2000. 738 p.

Environmental Protection Agency. 2000. Environmental screening checklist and workbook for the water transportation industry. http://www.epa.gov/compliance/resources/publications/monitoring/selfevaluation/wtr_fnl.pdf

Environmental Protection Agency. 2008. Memorandum: Updated Ecological Risk Assessment for Creosote. United States Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances. March 7, 2008. 56 p. Available through: http://www.epa.gov/pesticides/reregistration/status_page_c.htm.

Fonseca, M.S., W.J. Kenworthy, and G.W. Thayer. 1998. Guidelines for the conservation and restoration of seagrasses in the United States and adjacent waters. NOAA's Coastal Ocean Program Decision Analysis Series No. 12. NOAA Coastal Ocean Office, Silver Spring, MD. 222 p.

Fonseca, M.S., P.E. Whitfield, W.J. Kenworth, D.R. Colby, and B.E. Julius. 2004. Use of two spatially explicit models to determine the effect of injury geometry on natural resource recovery. *Aquatic Conservation* 14(3): 281-298.

Francour, P., A. Ganteaume, and M. Poulain. 1999. Effects of boat anchoring in *Posidonia oceanica* seagrass beds in the Port-Cros National Park (north-western Mediterranean Sea). *Aquatic Conservation: Marine and Freshwater Ecosystems* 9: 391-400.

Fresh, K.L., B. Williams, and D. Penttila. 1995. Overwater structures and impacts on eelgrass in Puget Sound, WA. *Puget Sound Research '95 Proceedings*. Seattle, WA: Puget Sound Water Quality Authority.

Fresh, K.L., B.W. Williams, S. Wyllie-Echeverria, and T. Wyllie-Echeverria. 2001. Mitigating impacts of overwater floats on Eelgrass *Zostera marina* in Puget Sound, Washington. Puget Sound Research 2001.

Fresh, K.L., T. Wyllie-Echeverria, S. Wyllie-Echeverria , and B.W. Williams. 2006. Using light permeable grating to mitigate impacts of residential floats on eelgrass *Zostera marina* L. in Puget Sound, Washington. *Ecological Engineering* 28: 354-362.

Frost, M.T., A.A. Rowden, and M.J. Attrill. 1999. Effects of habitat fragmentation on the macroinvertebrate infaunal communities associated with the seagrass *Zostera Marina L. Aquatic Conservation: Marine and Freshwater Ecosystem* 9: 255-263.

Goals Project. 1999. Baylands ecosystem habitat goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, CA/San Francisco Bay Regional Water Quality Control Board, Oakland, CA.

Govindjee and R. Govindjee. 1975. Introduction to photosynthesis. In: Govindjee (ed.) *Bioenergetics of Photosynthesis*. 1-50. New York, NY: Academic Press.

Haas M.A., C.A. Simenstad Jr., J.R. Cordell, D.A. Beauchamp, and B.S. Miller. 2002. Effects of large overwater structures on epibenthic juvenile salmon prey assemblages in Puget Sound, WA. Washington State Transportation Center (TRAC), University of Washington, WSDOT. Final Research Report WA-RD 550.

Haertel, L. and C. Osterberg. 1967. Ecology of Zooplankton, Benthos and Fishers in the Columbia River Estuary. *Ecology* 48(3): 459-472.

Hanson J., M. Helvey, and R. Strach (eds). 2003. Non-fishing impacts to essential fish habitat and recommended conservation measures. Long Beach, CA: National Marine Fisheries Service (NOAA Fisheries) Southwest Region. Version 1. 75 p.

Hastings, K., P. Hesp, and G.A. Kendrick. 1995. Seagrass loss associated with boat moorings at Rottnest Island, Western Australia. *Ocean & Coastal Management* 26(3): 225-246.

Hecht, S.A., D.H. Baldwin, C.A. Mebane, T. Hawkes, S.J. Gross and N.L. Scholz. 2007. An overview of sensory effects on juvenile salmonids exposed to dissolved copper: applying a benchmark concentration approach to evaluate sublethal neurobehavioral toxicity. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-83, 39 p. Available at: www.nwfsc.noaa.gov/assets/25/6696_11162007_114444_SensoryEffectsTM83Final.pdf

Heiman, K.W., N. Vidargas, and F. Micheli. 2008. Non-native habitat as home for non-native species: comparison of communities associated with invasive tubeworm and native oyster reefs. *Aquatic Biology* 2: 47-56.

Helfman, G.S. 1981. The advantage to fish of hovering in shade. *Copeia* (2): 392-400.

Herbert, R.J.H., T.P. Crowe, S. Bray, and M. Sheader. 2009. Disturbance of intertidal soft sediment assemblages caused by swinging boat moorings. *Hydrobiologia* 625: 105-116.

Herke, W.H. and B.D. Rogers. 1993. Maintenance of the estuarine environment. In *Inland Fisheries Management in North America.*, edited by Kohler, C. C. and W. A. Hubert. Pages 263-286. Bethesda, Maryland: American Fisheries Society.

Hiscock, K., J. Sewell, and J. Oakley. 2005. Marine health check 2005. A report to gauge the health of the UK's sea-life. Godalming, WWF-UK. 79 p.

Hoffman, R.S. 1986. Fishery utilization of eelgrass (*Zostera marina*) beds and non-vegetated shallow water areas in San Diego Bay. SWR-86-4, NMFS/SWR.

Hoss, D.E. and G.W. Thayer. 1993. The importance of habitat to the early life history of estuarine dependent fishes. *American Fisheries Society Symposium* 14: 147-158.

Irlandi, E.A. and M.K. Crawford. 1997. Habitat linkages: the effect of intertidal saltmarshes and adjacent subtidal habitats on abundance, movement, and growth of an estuarine fish. Oecologia 110: 222-230.

Jackson, E.L., A.A. Rowden, M.J. Attrill, S.F. Bossy, and M.B. Jones. 2002. Comparison of fish and mobile macroinvertebrates associated with seagrass and adjacent sand at St. Catherine Bay, Jersey (English Channel): Emphasis on commercial species. *Bulletin of Marine Science* 71(3): 1333-1341.

Jefferson County Marine Resources Committee. 2010. Voluntary no-anchor eelgrass protection zone: A non-regulatory marine protected area, Port Townsend Bay, Washington. Northwest straits project – Marine resources committee action and administration. Grant No: G1000023. 17 p.

Johnson, L.L., E. Casillas, M. Myers, L. Rhodes, and O.P. Olson. 1991. Patterns of oocyte development and related changes in plasma estradiol 17B, vitellogenin, and plasma chemistry in English sole (*Parophrys vetulus*). *Journal of Experimental Marine Biology and* Ecology 152: 161-85.

Johnson, L., S.Y. Sol, G.M. Ylitalo, T. Hom, B. French, O.P. Olson, and T.K. Collier. 1999. Reproductive Injury in English Sole (*Pleuronectes vetulus*) from the Hylebos Waterway, Commencement Bay, Washington. *Journal of Aquatic Ecosystems Stress and Recovery* 6: 289-310

Karrow, N.A., H.J. Boermans, D.G. Dixon, A. Hontella, K.R. Solomon, J.J. Whyte, and N.C. Bols. 1999. Characterizing the immunotoxicity of creosote to rainbow trout (*Oncorhynchus mykiss*): a microcosm study. *Aquatic Toxicology* 45: 223-239.

Kearny, V., Y. Segal, and M.W. Lefor. 1983. The effects of docks on saltmarsh vegetation. The Connecticut State Department of Environmental Protection, Water Resources Unit, Hartford, CT. 06106. 22p.

Kelty, R.A. and S. Bliven. 2003. Environmental and Aesthetic Impacts of Small Docks and Piers, Workshop Report: Developing a Science-Based Decision Support Tool for Small Dock Management, Phase 1: Status of the Science. NOAA Coastal Ocean Program Decision Analysis Series No. 22. National Centers for Coastal Ocean Science, Silver Spring, MD. 69 pp.

Kennish M.J. 2002. Impacts of motorized watercraft on shallow estuarine and coastal marine environments. *Journal of Coastal Research Special Issue* 37: 1-202.

Kenworthy, W.J. and D.E. Haunert (eds.). 1991. The light requirements of seagrasses: proceedings of a workshop to examine the capability of water quality criteria, standards and monitoring programs to protect seagrasses. NOPA Technical Memorandum NMFS-SEFC 287.

Kenworthy W.J. and M. Fonesca. 1996. Light requirements of seagrasses *Halodule wrightii and Syringodium filiforme* derived from the relationship between diffuse light attenuation and maximum depth distribution. *Estuaries* 19: 740-750.
Klein-MacPhee G., J.A. Cardin , and W.J. Berry. 1984. Effects of silver on eggs and larvae of the winter founder. *Transactions of the American Fisheries Society* 113(2): 247-251.

Knutson, P.L. 1988. Role of coastal marshes in energy dissipation and shore protection. Pages 161–175 *in* D. D. Hook (ed.), The ecology and management of wetlands. Croom Helm, London, UK.

Landry, J.B., W.J. Kenworthy, and G. Di Carlo. 2008. The effects of docks on seagrasses with particular emphasis on the threatened seagrass, *Halophila johnsonii*. Report to NMFS.

Larkum W.D. 2006. Photosynthesis and metabolism in seagrasses at the cellular level. In *Seagrass: Biology, ecology, and conservation*. eds. W.D. Larkum, R.J. Orth, and C.M. Duarte, 325-345.

Lee, K-S., S.R. Park, and Y.K. Kim. 2007. Effects of irradiance, temperature, and nutrients on growth dynamics of seagrass: a review. *Journal of Experimental Marine Biology and Ecology* 350: 144-175.

Liu, K.K., K. Iseki, and S.Y. Chao. 2000. Continental margin carbon fluxes. In: Hanson, R.B., Ducklow, H.W., Field, J.G. (Eds.), *The Changing Ocean Carbon Cycle*. Cambridge, pp. 187-239.

Loflin, R.K. 1995. The effects of docks on seagrass beds in the Charlotte Harbor Estuary. *Florida Scientist* 58: 198–205.

MacIntyre, H.L., R.J. Geider, and D.C. Miller. 1996. Microphytobenthos: The ecological role of the "secret garden" of unvegetated, shallow-water marine habitats. I. Distribution, abundance and primary production. *Estuaries* 19: 186–201.

Merkel and Associates, Inc. 2000. Environmental controls on the distribution of eelgrass (*Zostera marina* L.) in south San Diego Bay: An assessment of relative roles of light, temperature, and turbidity in dictating the development and persistence of seagrass in a shallow back-bay environment. Technical Report to Duke Energy South Bay LLC.

Merkel and Associates, Inc. 2004. Baywide eelgrass (*Zostera marina* L.) inventory of San Francisco Bay. Prepared for Parsons Brinkerhoff Quade & Douglas, California Department of Transportation, and National Marine Fisheries Service.

Merkel and Associates, Inc. 2008a. Commercial fisheries revitalization and coastal public access plan. Existing Marine Biological Resources at Driscoll's wharf and Tuna harbor. Technical Report prepared for Lisa Wise Consulting LLC.

Merkel and Associates, Inc. 2008b. Baseline eelgrass survey in Richardson Bay, San Francisco Bay. Prepared for Marin Bayland Advocates and Audobon Society.

Merkel and Associates, Inc. 2009. Visual photo observations of leopard sharks in Seaplane Lagoon, Port of Los Angeles.

Merkel and Associates, Inc. 2010a. San Francisco Bay eelgrass inventory. California Department of Transporation, Oakland, California/National Marine Fisheries Service, Santa Rosa, California. November 2010.

Merkel and Associates, Inc. 2010b. Eelgrass distribution and status within San Francisco Bay; October 2010 Regional Eelgrass Monitoring Results. National Marine Fisheries Service. December 2010.

Milazzo, M., F. Badalamenti, G. Ceccherelli, and R. Chemello. 2004. Boat anchoring on *Posidonia oceanica* beds in a marine protected area (Italy, western Mediterranean): effect of anchor types in different anchoring stages. *Journal of Experimental Marine Biology and Ecology* 299: 51-62.

Mooney, H.A. and R.J. Hobbs (eds.). 2000. *Invasive Species in a Changing World.* Island Press, Washington, D.C. 457 pp.

National Marine Fisheries Service (NMFS). 2007. Report on the subtidal habitats and associated biological taxa in San Francisco Bay. Schaeffer K, McGourty K, and Cosentino-Manning N, editors. Santa Rosa, CA. p 86.

NMFS and U.S. Army Corps of Engineers (USACE). 2001. Dock construction guidelines in Florida for docks and other minor structures constructed in or over submerged aquatic vegetation (SAV), marsh, or mangrove habitat.

Northeast Fishery Management Council (NEFMC). 1998. Final amendment #11 to the northeast multispecies fishery management plan, Amendment #9 to the Atlantic sea scallop fishery management plan, and components of the proposed Atlantic herring fishery management plan for EFH, incorporating the environmental assessment. Newburyport (MA): NEFMC Vol. 1

Neira C., F. Delgadillo-Hinojosa, A. Zirino, G. Mendoza, L.A. Levin, M. Porrachia, and D. D. Deheyn. 2009. Spatial distribution of copper in relation to recreational boating in a California shallow-water basin. *Chemistry and Ecology* 25(6): 417-433.

Nelson, T.A. 1997. Epiphyte-grazer interactions on *Zostera marina* (Anthophyta: Monocotyledones): effects of density on community function. *Journal of Phycology* 33: 743-752.

Nightingale, B. and C.A. Simenstad. 2001a. Overwater Structures: Marine Issues. White Paper Research Project T1803, Task 35. WSDOT.

Nightingale, B. and C.A. Simenstad. 2001b. Dredging activities: Marine issues. White Paper Research Project T1803, Task 35. WSDOT.

Olson, A.M., S.D. Visconty, and C.M. Sweeney. 1996. Modeling the shade cast by overwater structures. Pacific Estuarine Research Society, 19th Annual Meeting. Washington Department of Ecology, Olympia, Washington. SMA 97-1 School Mar. Affairs, Univ. Wash., Seattle, WA.

O'Neill, S.M., J.E. West, and S. Quinnell. 1995. Contaminant monitoring in fish: overview of the Puget Sound Monitoring Program Fish Task. Puget Sound Research '95 Proceedings. In: E. Robichaud (ed.) Puget Sound Water Quality Authority.

Ostendorp, W., T. Gretler, M. Mainberger, M. Peintinger, and K. Schmieder. 2008. Effects of mooring management on submerged vegetation, sediments and macro-invertebrates in Lake Constance, Germany. *Wetlands Ecology and Management* 17(5): 525-541.

Otero, E. 2008. Characterization of mechanical damage to seagrass beds in La Cordillera Reefs Natural Reserve. Conservation and Management of Puerto Rico's Coral Reefs, Task CRI-10. 57 p.

Pacific Fishery Management Council (PFMC). 1999. Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon; Amendment 14 to the Pacific Coast Salmon Plan. (http://pcouncil.org/wp-content/uploads/fmpthrua14.pdf)

PFMC. 2008. Pacific coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery as Amended through Amendment 19. (http://www.pcouncil.org/wp-content/uploads/fmpthru19.pdf)

Parametrix and Battelle Marine Sciences Laboratory. 1996. Anacortes Ferry Terminal eelgrass, macroalgae, and macrofauna habitat survey report. Report for Sverdrup Civil, Inc. and WSDOT

Peeling, T.J. 1974. A proximate biological survey of San Diego Bay, California. Naval Undersea Center, San Diego, CA.

Penttila, D. and D. Doty. 1990. Results of 1989 eelgrass shading studies in Puget Sound, Progress Report Draft. WDFW Marine Fish Habitat Investigations Division.

Pimentel, D., L. Lach, R. Zuniga, and D. Morrison. 2000. Environmental and economic costs of nonindigenous species in the United States. *BioScience* 50: 53-65.

Pimentel, D., R. Zuniga, and D. Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* 52: 273-288.

Rasheed, M.A. 1999. Recovery of experimentally created gaps with a tropical *Zostera capricorni* (Aschers.) seagrass meadow, Queensland Australia. *Journal of Experimental Marine Biology and Ecology* 235(2): 183-200.

Rasheed, M.A. 2004. Recovery and succession in a multi-species tropical seagrass meadow following experimental disturbance: the role of sexual and asexual reproduction. *Journal of Experimental Marine Biology and Ecology* 31(1): 13-45.

Sanger, D.M., A.F. Holland, and C. Gainey. 2004. Cumulative impacts of dock shading on *Spartina alterniflora* in South Carolina estuaries. *Environmental Management* 33: 741-748.

Sargent, F.J., T.J. Leary, D.W. Crewz, and C.R. Kruer. 1995. Scarring of Florida's seagrasses: assessment and management options. FMRI Technical Report. TR-1. Florida Marine Research Institute, St. Petersburg, Florida. 37 p.

San Francisco Estuary Institute. 2008. Effects of short-term water quality impacts due to dredging and disposal on sensitive fish species in San Francisco Bay. Prepared for the U.S. Army Corps of Engineers, San Francisco District. Contribution No. 560. http://www.spn.usace.army.mil/ltms/Water%20Quality.pdf

San Francisco Estuary Institute. 2009. California wetland and riparian area protection policy, Technical memorandum No. 2: wetland definition. Oakland, CA.

Schoellhammer, D.H. 1996. Factors affecting suspended-solid concentrations in South San Francisco Bay, California. Journal of Geophysical Research, 101: 12087-12095.

Science Applications International Corporation (SAIC). 2010. Final 2008 Biological Surveys of Los Angeles and Long Beach Harbors. Report submitted to the Ports of Los Angeles and

Long Beach.

Setchell, W.A. 1929. Morphological and phenological notes on *Zostera marina* L. University of California Publications in Botany, 14: 389-452.

Shafer, D.J. 1999. The effects of dock shading on the seagrass *Halodule wrightii* in Perdido Bay, Alabama . *Estuaries* 22(4): 936-943.

Shafer, D. and J. Robinson. 2001. An evaluation of the use of grid platforms to minimize shading impacts to seagrasses. WRAP Technical Notes Collection (ERDC TN-WRAP-01-02. US Army Engineer Research and Development Center, Vicksburg, MS. Available at: www.wes.army.mil/el/wrap.

Shafer, D.J. 2002. Potential impacts to seagrasses from single-family residential dock structures in the Pacific Northwest. U.S. Army Corps of Engineers Report, Seattle, WA, 28 p.

Shafer, D. J., J. Karazsia, L. Carrubba, and C. Martin. 2008. Evaluation of regulatory guidelines to minimize impacts seagrasses from single-family residential dock structures in Florida and Puerto Rico. ERDC/EL TR-08-X. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Short, F.T. and H.A. Neckles. 1999. The effects of global climate change on seagrasses. *Aquatic Botany* 63: 169-196.

Short, F. 2009. Eelgrass distribution in the Great Bay Estuary for 2008. The Piscataqua Region Estuaries Partnership. 7 p.

Silva, P.C., R.A. Woodfield, A.N. Cohen, L.H. Harris, and J.H.R. Goddard. 2002. First report of the Asian kelp *Undaria pinnatifida* in the northeastern Pacific Ocean. *Biological Invasions* 4: 333-338.

Simberloff, D. and B. Von Holle. 1999. Positive Interactions of non-indigenous species: invasional meltdown? *Biological Invasions* 1: 21-32.

Simberloff, D., I. Parker, and P. Windle. 2005. Introduced species policy, management, and future research needs. *Frontiers in Ecology and the Environment* 3: 12-20.

Simenstad, C.A., A.M. Olson, and R.M. Thom. 1998. Mitigation between regional transportation needs and preservation of eelgrass beds, Research Report. WSDOT/USDOT.

Simenstad, C.A., B.S. Miller, C.F. Nyblade, K. Thornburgh, and L.J. Bledsoe. 1979. Food web relationship of northern Puget Sound and the Strait of Juan de Fuca, EPA Interagency Agreemnt No. D6-E693-EN. Office of Environmental Engineering and Technology, US EPA.

Simenstad, C.A. and E.O. Salo. 1980. Foraging success as a determinant of estuarine and nearshore carrying capacity of juvenile chum salmon (*Oncorhynchus keta*) in Hood Canal, *Washington. Proc. of North Pac. Aquaculture Symp. Report* 82-2, Fairbanks, AK: Alaska Sea Grant.

Smith, K. and R. Mezich. 1999. Comprehensive assessment of the effects of single family docks on seagrass in Palm Beach County, Florida, Draft Report for the Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Sogard S.M., & Able K.W. 1991. A comparison of eelgrass, sea lettuce macroalgae and marsh creeks as habitats for epibenthic fishes and decapods. Estuarine, Coastal and Shelf Science, 33: 501-519.

South Florida Natural Resources Center, 2008. Patterns of propeller scarring of seagrass in Florida Bay, SFNRC Technical Series, 2008:1, 27 p.

Steinmetz, A.M., M.M. Jeansonne, E.S. Gordon, and J.W. Burns. 2004. An evaluation of glass prisms in boat docks to reduce shading of submerged aquatic vegetation in the lower St. Johns River, Florida.

Struck S.D., C.B. Craft, S.W. Broome, and M.D. Sanclements. 2004. Effects of bridge shading on estuarine marsh benthic invertebrate community structure and function. *Environmental Management* 34(1): 99-111.

Stutes, A.L., J. Cebrian, and A.A. Corcoran. 2006. Effects of nutrient enrichment and shading on sediment primary production and metabolism in eutrophic estuaries. *Marine Ecology Progress Series* 312: 29-43.

Thom R.M., D.K. Shreffler, and K. Macdonald. 1994. Shoreline Armoring Effects on Coastal Ecology and Biological Resources in Puget Sound, Washington. Report 94-80. Shorelands and Environmental Assistance Program, Washington Department of Ecology.

Thom, R., A. Borde, P. Farley, M. Horn, and A. Ogston. 1996. Passenger-only ferry propeller wash study: threshold velocity determinations and field study, Vashon Terminal. Report to WSDOT PNWD-2376/UC-000.

Thom, R.M., L.D. Antrim, A.B. Borde, W.W. Gardiner, D.K. Shreffler, P.G. Farley, J.G. Norris, S. Wyllie-Echeverria, and T.P. McKenzie. 1997. Puget Sound's eelgrass meadows: factors contributing to depth distribution and spatial patchiness.

Thom, R.M., S.L. Southard, A.B. Borde, and P. Stoltz. 2008. Light requirements for growth and survival of eelgrass (*Zostera marina* L.) in Pacific Northwest estuaries. *Estuaries and Coasts* 31: 969-980.

Tyrell, M.C. and J.E. Byers. 2007. Do artificial substrates favor nonindigenous fouling species over native species? *Journal of Experimental Marine Biology and Ecology* 342: 54-60.

Underwood, G.J.C. and J. Kromkamp. 1999. Primary production by phytoplankton and microphytobenthos in estuaries. *Advances in Ecological Research* 29: 93–153.

U.S. Environmental Protection Agency. 2001. National management measures guidance to control nonpoint source pollution from marinas and recreational boating. Washington (DC): EPA Office of Water. EPA-841-B-01-005.

U.S. Geological Survey. 1998. Classification of wetlands and deepwater habitats of the Unites States unconsolidated bottom.

Valle, C.F., J.W. Obrien, and K.B. Weise. 1999. Differential habitat use by California halibut, *Paralichthys californicus,* barred sand bass, *Paralabrax nebulifer*, and other juvenile fishes in Alamitos Bay, California. *Fisheries Bulletin* 97: 646–660.

Vitousek, P.M., C.M. D'Antonio, L.L. Loope, and R. Westbrooks. 1996. Biological invasion as global environmental change. *American Scientist* 84: 468-478.
Walker, D.I., R.J. Lukatelich, G. Bastyan, and A.J. Mccomb. 1989. Effect of boat moorings on seagrass beds near Perth, Western Australia. *Aquatic Botany* 36: 69–77.

Washington State Department of Natural Resources. 2005. Aquatic Resources Program Endangered Species Act Compliance Project Habitat Classification Verification and Activities Effects Report.

Wasson, K., K. Fenn, and J.S. Pearse. 2005. Habitat differences in marine invasions of central California. *Biological Invasions* 7: 935-948.

Weis, J.S., P. Weis and T. Proctor. 1998. The Extent of Benthic Impacts of CCA-treated Wood Structures in Atlantic Coast Estuaries. *Archives Environmental Contamination and Toxicology* 34: 313-322

Weis, J. and P. Weis. 2004. Effects of CCA Wood on Non-Target Aquatic Biota. Pages 32-44 in Pre-Conference Proceedings, Environmental Impacts of Preservative-Treated Wood. Florida Center for Solid and Hazardous Waste Management, Gainesville, FL. Available at: http://www.ccaresearch.org/Pre-Conference/#release

Weitkamp, D.E. 1991. Epibenthic zooplankton production and fish distribution at selected pier apron and adjacent non-apron sites in Commencement Bay, WA, Report to Port of Tacoma. Parametrix, Seattle, WA.

West, J. 1997. Protection and restoration of marine life in the inland waters of Washington State, Puget Sound/Georgia Basin Environmental Report Series: Number 6. Puget Sound Water Quality Action Team.

Whitcraft, C.R. and L.A. Levin. 2007. Regulation of benthic algal and animal communities by salt marsh plants: Impact of shading. *Ecology* 88: 904-917.

Wyllie-Escheverria, S. 1990. Geographic range and distribution of *Zostera marina*, eelgrass in San Francisco Bay. In: K. Merkel and R. Hoffman (eds.), Proceedings of the California Eelgrass Symposium, 99. p. 65-69. Sweetwater River Press, National City, CA.

Wyllie-Echeverria, S. & P.J. Rutten. 1989. Inventory of eelgrass (Zostera marina L.) in San Francisco/San Pablo Bay. NMFS/SWR. SWR-89-05, 18 pp.

Whitney, D. and W. Darley. 1983. Effects of light intensity upon salt marsh benthic microalgal photosynthesis. *Marine Biology* 75: 249–252.

Wilber, D.H. & D.G. Clarke. 2001. Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. North American Journal of Fisheries Management, 21: 855-875.

Wilcox, B. and D. Murphy. 1985. 'Conservation strategy': the effects of fragmentation on extinction. *American Naturalist* 125: 879-887.

Williams, S.L. 1988a. *Thalassia testudium* productivity and grazing by green turtles in a highly disturbed seagrass bed. *Marine Biology* 98: 447-55.

Williams, S.L. 1988b. Assessment of anchor damage and carrying capacity of seagrass beds in Francis and Maho Bays for green sea turtles. Biosphere Reserve Report No. 25. U.S. Department of the Interior, National Park Service. 32 p.

Williams, B. and C. Bechter. 1996. Impact of mooring buoy installations on eelgrass and macroalgae, Washington Department of Fish and Wildlife.

Zimmerman, R.C., J.L. Reguzzoni, S. Wyllie-Echeverria, M. Josselyn, and R.S. Alberte. 1991. Assessment of environmental suitability for growth of *Zostera marina* L. (eelgrass) in San Francisco Bay. *Aquatic Botany* 39: 353-366.

Zimmerman R.C. 2006. Light and photosynthesis in seagrass meadows. In *Seagrass: Biology, ecology, and conservation.* eds. W.D. Larkum, R.J. Orth, and C.M. Duarte, 302-321.

Zimmerman, R.C., J.L. Reguzzoni, S. Wyllie-Echeverria, M. Josselyn, & R.S. Alberte. 1991. Assessment of environmental suitability for growth of Zostera marina L. (eelgrass) in San Francisco Bay. Aquatic Botany, 39: 353-366.

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 <u>no expansion</u> in surface area. The construction site is within designated EFH but sensitive species (SAV or saltmarsh) or their suitable habitat <u>are not</u> in the vicinity. *No construction conditions required by NMFS.*

1c. The construction proposed is a replacement of existing structures with <u>no expansion</u> in surface area. The construction site is within designated EFH and sensitive species (SAV or saltmarsh) or their suitable habitat <u>are</u> 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 <u>are not</u> 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 <u>are</u> in the vicinity. *Go to 4.*

2a. The new or replacement structures meets <u>all</u> 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 <u>does not</u> meet <u>all</u> 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.

Attachment B

NOAA Eelgrass Guidelines

Available at:

https://www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2018/February/6b_ssr.pdf

NOAA FISHERIES
West Coast Region

California Eelgrass Mitigation Policy and Implementing Guidelines

October 2014

Photo credit: www.Lorenz-Avelar.com

Table of Contents

I. National Marine Fisheries Service's (NMFS) California Eelgrass Mitigation Policy

A. Policy Statement

It is NMFS' policy to recommend **no net loss of eelgrass habitat function** in California.

For all of California, compensatory mitigation should be recommended for the loss of existing eelgrass habitat function, but only after avoidance and minimization of effects to eelgrass have been pursued to the maximum extent practicable. Our approach is congruous with the approach taken in the federal Clean Water Act guidelines under section 404(b)(1) (40 CFR 230). In absence of a complete functional assessment, eelgrass distribution and density should serve as a proxy for eelgrass habitat function. Compensatory mitigation options include comprehensive management plans, in-kind mitigation, mitigation banks and in-lieu-fee programs, and out-of-kind mitigation. While in-kind mitigation is preferred, the most appropriate form of compensatory mitigation should be determined on a case-by-case basis.

Further, it is the intent of this policy to ensure that there is no loss associated with delays in establishing compensatory mitigation. This should be accomplished by creating a greater amount of eelgrass than is lost, if the mitigation is performed contemporaneously or after the impacts occur. To achieve this, NMFS, in most instances, should recommend compensatory mitigation for vegetated and unvegetated eelgrass habitat be successfully completed at a ratio of at least 1.2:1 mitigation area to impact area. This ratio is based on present value calculation[1] using a discount rate of 0.03 (NOAA-DARP 1999). This ratio assumes that restored eelgrass habitat achieves habitat function comparable to existing eelgrass habitat within a period of three years or less (Hoffman 1986, Evans & Short 2005, Fonseca *et al.* 1990).

For ongoing projects, once mitigation has been successfully implemented to compensate for the loss of eelgrass habitat function within a specified footprint, NMFS should not recommend additional mitigation for subsequent loss of eelgrass habitat if 1) ongoing project activities result in subsequent loss of eelgrass habitat function within the same footprint for which mitigation was completed and 2) the project applicant can document that no new area of eelgrass habitat is impacted by project activities.

This policy does not address mitigation for potential eelgrass habitat. NMFS recognizes impacts to potential eelgrass habitat may preclude eelgrass movement or expansion to suitable unvegetated areas in the future, potentially resulting in declines in eelgrass abundance over time. In addition, it does not address other shallow water habitats. Regulatory protections in the estuarine/marine realm typically focus on wetlands and submerged aquatic vegetation. Mudflats, sandflats, and other superficially bare habitats do not garner the same degree of recognition and

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[1] Present Value (PV) is a calculation used in finance to determine the present day value of an amount that is received at a future date. The premise of the equation is that receiving something today is worth more than receiving the same item at a future date; $PV = C_1/(1+r)^n$ where C_1= resource at period 1, r= interest or discount rate, n=number of periods.

concern, even though these are some of the most productive and fragile ecosystems (Reilly *et al*. 1999). NMFS will continue to collaborate with federal and state partners on these issues.

B. Eelgrass Background and Information

Eelgrass species (*Zostera marina* L. and *Z. pacifica*) are seagrasses that occur in the temperate unconsolidated substrate of shallow coastal environments, enclosed bays, and estuaries. Eelgrass is a highly productive species and is considered to be a "foundation" or habitat forming species. Eelgrass contributes to ecosystem functions at multiple levels as a primary and secondary producer, as a habitat structuring element, as a substrate for epiphytes and epifauna, and as sediment stabilizer and nutrient cycling facilitator. Eelgrass provides important foraging areas and shelter to young fish and invertebrates, food for migratory waterfowl and sea turtles, and spawning surfaces for invertebrates and fish such as the Pacific herring. Eelgrass also provides a significant source of carbon to the detrital pool which provides important organic matter in sometimes food-limited environments (*e.g.*, submarine canyons). In addition, eelgrass has the capacity to sequester carbon in the underlying sediments and may help offset carbon emissions. Given the significance and diversity of the functions and services provided by seagrass, Costanza *et al.* (2007) determined seagrass ecosystems to be one of Earth's most valuable.

California supports dynamic eelgrass habitats that range in extent from less than 11,000 acres to possibly as much as 15,000 acres statewide. This is inclusive of estimates for poorly documented beds in smaller coastal systems as well as open coastal and insular areas. While among the most productive of habitats, the overall low statewide abundance makes eelgrass one of the rarest habitats in California. Collectively just five systems, Humboldt Bay, San Francisco Bay, San Diego Bay, Mission Bay and Tomales Bay support over 80 percent of the known eelgrass in the state. The uneven distribution of eelgrass resources increases the risk to this habitat and also contributes to its dynamic nature. Further, the narrow depth range within which eelgrass can occur further places this habitat at risk in the face of global climate change and sea level rise predictions.

Seagrass habitat has been lost from temperate estuaries worldwide (Duarte 2002, Lotze *et al.* 2006, Orth *et al.* 2006). While both natural and human-induced mechanisms have contributed to these losses, impacts from human population expansion and associated pollution and upland development is the primary cause (Short and Wyllie-Echeverria 1996). Human activities that affect eelgrass habitat distribution and abundance, including, but not limited to, urban development, harbor development, aquaculture, agricultural runoff, effluent discharges, and upland land use associated sediment discharge (Duarte 2008) occur throughout California. For example, dredging and filling; shading and alteration of circulation patterns; and watershed inputs of sediment, nutrients, and unnaturally concentrated or directed freshwater flows can directly and indirectly destroy eelgrass habitats. Conversely, in many areas great strides have been made at restoring water quality and expanding eelgrass resources through directed efforts at environmental improvements and resource enhancement. While improvements in eelgrass management have occurred overall, the importance of eelgrass both ecologically and economically, coupled with ongoing human pressure and potentially increasing degradation and losses associated with climate change, highlight the need to protect, maintain, and where feasible, enhance eelgrass habitat.

C. Purpose and Need for Eelgrass Mitigation Policy

Eelgrass warrants a strong protection strategy because of the important biological, physical, and economic values it provides, as well as its importance to managed species under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Vegetated shallows that support eelgrass are also considered special aquatic sites under the 404(b)(1) guidelines of the Clean Water Act (40 C.F.R. § 230.43). The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) developed this policy to establish and support a goal of protecting this resource and its habitat functions, including spatial coverage and density of eelgrass habitats. This NMFS policy and implementing guidelines are being shared with agencies and the public to ensure there is a clear and transparent process for developing eelgrass mitigation recommendations.

Pursuant to the MSA, eelgrass is designated as an essential fish habitat (EFH) habitat area of particular concern (HAPC) for various federally-managed fish species within the Pacific Coast Groundfish Fishery Management Plan (FMP) (PFMC 2008). An HAPC is a subset of EFH that is rare, particularly susceptible to human-induced degradation, especially ecologically important, and/or located in an environmentally stressed area. HAPC designations are used to provide additional focus for conservation efforts.

This policy and guidelines support but do not expand upon existing NMFS authorities under the MSA, the Fish and Wildlife Coordination Act (FWCA), and the National Environmental Policy Act (NEPA). Pursuant to the EFH provisions of the MSA, FWCA, and obligations under the NEPA as a responsible agency, NMFS annually reviews and provides recommendations on numerous actions that may affect eelgrass resources throughout California. Section 305(b)(1)(D) of the MSA requires NMFS to coordinate with, and provide information to, other federal agencies regarding the conservation and enhancement of EFH. Section 305(b)(2) requires all federal agencies to consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Under section 305(b)(4) of the MSA, NMFS is required to provide EFH Conservation Recommendations to federal and state agencies for actions that would adversely affect EFH (50 C.F.R. § 600.925). NMFS makes its recommendations with the goal of avoiding, minimizing, or otherwise compensating for adverse effects to EFH. When impacts to NMFS trust resources are unavoidable, NMFS may recommend compensatory mitigation to offset those impacts. In order to fulfill its consultative role, NMFS may also recommend, among other things, the development of mitigation plans, habitat distribution maps, surveys and survey reports, progress milestones, monitoring programs, and reports verifying the completion of mitigation activities.

Eelgrass impact management and mitigation throughout California has historically been undertaken without a statewide strategy. Federal actions with impacts to eelgrass require considerable NMFS staff time for project review, coordination and development of conservation recommendations. As federal staff resources vary with budgets, and threats to aquatic resources remain steady or increase, regulatory streamlining and increased efficiency are crucial for continued protection of important coastal habitats, including eelgrass. The California Eelgrass Mitigation Policy (CEMP) is meant to increase efficiency of existing regulatory authorities in a programmatic manner, provide transparency to federal agencies and action proponents, and ensure that unavoidable impacts to eelgrass habitat are fully and appropriately mitigated. It is the intent of NMFS to collaborate with other federal, state, and local agencies charged with the protection of marine resources to seek a unified approach to actions affecting eelgrass such that consistency across agencies with respect to this resource may be enhanced.

D. Relevance to Other Federal and State Policies

Based on our understanding of existing federal and state policies regarding aquatic resource conservation, the CEMP does not conflict with existing policies and complements the federal and state wetland policies as described below. NMFS does not intend to make any recommendations, which, if adopted by the action agency and carried out, would violate other federal, state, or local laws. The CEMP also complements the NOAA Aquaculture Policy and National Shellfish Initiative and builds upon the NOAA Seagrass Conservation Guidelines and the Southern California Eelgrass Mitigation Policy.

1. Corps/EPA Mitigation Rule and supporting guidance

In 2008, the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps) issued revised regulations governing compensatory mitigation for authorized impacts to wetlands, streams, and other waters of the U.S. under Section 404 of the Clean Water Act. The regulations emphasize avoiding impacts to wetlands and other water resources. For unavoidable impacts, the rule incorporates Natural Resource Council recommendations to improve planning, implementing and managing wetland replacement projects, including: science-based assessment of impacts and compensation measures, watershed assessments to drive mitigation sites and plans, measurable and enforceable ecological performance standards for evaluating mitigation projects, mitigation monitoring to document whether the mitigation employed meets ecological performance standards, and complete compensation plans. The regulations also encourage the expansion of mitigation banking and in lieu fee agreements to improve the quality and success of compensatory mitigation projects.

The NMFS policy to recommend no net loss of eelgrass function and the eelgrass mitigation guidelines offered herein align with the provisions of the EPA and Corps mitigation rule, but provide more specific recommendations on how to avoid and minimize impacts to eelgrass and how to implement eelgrass surveys, assessments, mitigation, and monitoring.

2. State of California Wetland Conservation Policies

The 1993 State of California Wetlands Conservation Policy established a framework and strategy to ensure no overall net loss and long-term gain in the quantity, quality, and permanence of wetlands acreage and values in California in a manner that fosters creativity, stewardship, and respect for private property, reduce procedural complexity in administration of state and federal wetlands conservation programs, and encourage partnerships to make landowner incentive programs and cooperative planning efforts the primary focus of wetlands conservation and restoration.

The State of California is also developing a Wetland and Riparian Area Protection Policy. The first phase of this effort was published as the "Preliminary Draft Wetland Area Protection Policy" with the purpose of protecting all waters of the State, including wetlands, from dredge and fill discharges. It includes a wetland definition and associated delineation methods, an assessment framework for collecting and reporting aquatic resource information, and requirements applicable to discharges of dredged or fill material. The draft specifies that dredge or fill projects will provide for replacement of existing beneficial uses through compensatory mitigation. The preliminary policy includes a determination that compensatory mitigation will sustain and improve the overall abundance, diversity and condition of aquatic resources in a project watershed area.

Based on the definition of wetlands included in these state wetland policies, the policies do not directly apply to subtidal eelgrass habitat, but may apply to intertidal eelgrass habitat. The NMFS policy of recommending no net loss to eelgrass habitat function and recommendations for compensatory mitigation for eelgrass impacts complement the state protection policies for wetlands.

3. NOAA Aquaculture Policy and National Shellfish Initiative

In 2011, NOAA released the National Marine Aquaculture Policy and the National Shellfish Initiative. The Policy encourages and fosters sustainable aquaculture development that provides domestic jobs, products, and services and that is in harmony with healthy, productive, and resilient marine ecosystems, compatible with other uses of the marine environment, and consistent with the National Policy for the Stewardship of the Ocean, our Coasts, and the Great Lakes (National Ocean Policy). The goal of the Initiative is to increase populations of bivalve shellfish in our nation's coastal waters—including oysters, clams, abalone, and mussels—through both sustainable commercial production and restoration activities. The Initiative supports shellfish industry jobs and business opportunities to meet the growing demand for seafood, while protecting and enhancing habitat for important commercial, recreational, and endangered and threatened species and species recovery. The Initiative also highlights improved water quality, nutrient removal, and shoreline protection as benefits from shellfish production and restoration. Both the Policy and the Initiative seek to improve interagency coordination for permitting commercial and restoration shellfish projects, as well as support research and other data collection to assess and refine conservation strategies and priorities.

The regulatory efficiencies, transparency, and compensation for impacts to eelgrass promoted by the CEMP directly support the National Aquaculture Policy statements and National Shellfish Initiative through: (1) protection of eelgrass, an important component of productive and resilient coastal ecosystems in California and habitat for wild species, and (2) improved coordination with federal partners regarding planning and permitting for commercial shellfish projects. Furthermore, research conducted under the direction of the National Shellfish Initiative could be informed by and also inform NMFS consultations regarding eelgrass impacts and mitigation in California.

4. NOAA Seagrass Conservation Guidelines

The NOAA publication, "Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters" (1998) was developed by Mark Fonseca of NOAA's Beaufort Laboratory along with Jud Kenworthy and Gordon Thayer and was funded by NOAA's Coastal Ocean Program. The document presents an overview of seagrass conservation and restoration in the United States, discusses important issues that should be addressed in planning seagrass restoration projects, describes different planting methodologies, proposes monitoring criteria and means for evaluation success, and discusses issues faced by resource managers. The CEMP considers information presented in the Fonseca *et al*. document, but deviates in some cases in order to provide reasonable and practicable guidelines for eelgrass conservation in California.

5. Southern California Eelgrass Mitigation Policy

In southern and central California, eelgrass mitigation has been addressed in accordance with the Southern California Eelgrass Mitigation Policy applied by NMFS, US Fish & Wildlife Service, California Department of Fish and Wildlife, California Coastal Commission, US Army Corps of Engineers, and other resource and regulatory agencies since 1991, and which has generally been effective at ensuring eelgrass impacts are mitigated in most circumstances. Given the success of the Southern California Eelgrass Mitigation Policy over its 20-year history, this policy reflects an expansion of the application of the Southern California policy with minor modifications to ensure a high standard of statewide eelgrass management and protection. This policy will supersede the Southern California Eelgrass Mitigation Policy for all areas of California upon its adoption.

II. Implementing Guidelines for California

This policy and guidelines will serve as the guidance for staff and managers within NMFS for developing recommendations concerning eelgrass issues through EFH and FWCA consultations and NEPA reviews throughout California. This policy will inform NMFS's position on eelgrass issues for California in other roles as a responsible, advisory, or funding agency or trustee. In addition, this document provides guidance to assist NMFS in performing its consultative role under the statutes described above. Finally, pursuant to NMFS obligation to provide information to federal agencies under Section 305(b)(1)(D) of the MSA, this policy serves that role by providing information intended to further the conservation and enhancement of EFH. Should this policy or guidelines be inconsistent with any formally-promulgated NMFS regulations, those formally-promulgated regulations will take precedence over any inconsistent provisions of this policy.

While many of the activities impacting eelgrass are similar across California, eelgrass stressors and growth characteristics differ between southern California (U.S./Mexico border to Pt. Conception), central California (Point Conception to San Francisco Bay entrance), San Francisco Bay, and northern California (San Francisco Bay to the California/Oregon border). The amount of scientific information available to base management decisions on also differs among areas within California, with considerably more information and history with eelgrass habitat management in southern California than the other regions. Gaps in region-specific scientific information do not override the need to be protective of eelgrass habitat while relying on the best information currently available from areas within and outside of California. Although the primary orientation of this policy is toward statewide use, where indicated below, specific elements of this policy may differ between southern California, central California, northern California and San Francisco Bay.

NMFS will continue to explore the science of eelgrass habitat and improve our understanding of eelgrass habitat function, impacts, assessment techniques, and mitigation efficacy. Approximately every 5 years, NMFS intends to evaluate monitoring and survey data collected by federal agencies and action proponents per the recommendations of these guidelines. NMFS managers will determine if updates to these guidelines are appropriate based on information evaluated during the 5-year review. Updates to these guidelines and supporting technical information will be available on the NMFS website.

The information below serves as a common starting place for NMFS recommendations to achieve no net loss of eelgrass habitat function. NMFS employees should not depart from the guidelines provided herein without appropriate justification and supervisory concurrence. However, the recommendations that NMFS ultimately makes should be provided on a case-by-case basis to provide flexibility when site specific conditions dictate. In the EFH context, NMFS recommendations are provided to the action agency, which has final approval of the action; in accordance with the MSA, the action agency may take up NMFS recommendations or articulate its reasons for not following the recommendations. In the FWCA context, NMFS makes recommendations which must be considered, but the action agency is ultimately responsible for the wildlife protective measures it adopts (if any). For these reasons, neither this policy nor its implementing guidelines are to be interpreted as binding on the public.

A. Eelgrass Habitat Definition

Eelgrass distribution fluctuates and can expand, contract, disappear, and recolonize areas within suitable environments. Vegetated eelgrass areas can expand by as much as 5 meters (m) and contract by as much as 4 m annually (Donoghue 2011). Within eelgrass habitat, eelgrass is expected to fluctuate in density and patch extent based on prevailing environmental factors (*e.g.*, turbidity, freshwater flows, wave and current energy, bioturbation, temperature, etc.). To account for seagrass fluctuation, Fonseca *et al.* (1998) recommends that seagrass habitat include the vegetated areas as well as presently unvegetated spaces between seagrass patches.

In addition, there is an area of functional influence, where the habitat function provided by the vegetated cover extends out into adjacent unvegetated areas. Those functions include detrital enrichment, energy dampening and sediment trapping, primary productivity, alteration of current or wave patterns, and fish and invertebrate use, among other functions. The influence of eelgrass on the local environment can extend up to 10 m from individual eelgrass patches, with the distance being a function of the extent and density of eelgrass comprising the bed as well as local biologic, hydrographic, and bathymetric conditions (Bostrom and Bonsdorff 2000, Bostrom *et al*. 2001, Ferrell and Bell 1991, Peterson *et al*. 2004, Smith *et al.* 2008, van Houte-Howes *et al.* 2004, Webster *et al*. 1998). Detrital enrichment will generally extend laterally as well as down slope from the beds, while fish and invertebrates that utilize eelgrass beds may move away from the eelgrass core to areas around the bed margins for foraging and in response to tides or diurnal cycles (Smith *et al*. 2008).

To encompass fluctuating eelgrass distribution and functional influence around eelgrass cover, for the purposes of this policy and guidelines, eelgrass habitat is defined as areas of vegetated eelgrass cover (any eelgrass within 1 m^2 quadrat and within 1 m of another shoot) bounded by a 5 m wide perimeter of unvegetated area (See Attachment 1 for a graphical depiction of this definition). Unvegetated areas may have eelgrass shoots a distance greater than 1 m from another shoot, and may be internal as well as external to areas of vegetated cover. For isolated patches and on a case-by-case basis, it may be acceptable to include an unvegetated area boundary less than or greater than 5 m wide. The definition excludes areas of unsuitable environmental conditions such as hard bottom substrates, shaded locations, or areas that extend to depths below those supporting eelgrass. Suitable depths can vary substantially depending upon site-specific conditions. In general, eelgrass does not extend deeper than 12 feet mean lower low water (MLLW) in most protected bays and harbors in Southern California, and is more limited in Central and Northern California embayments. However, eelgrass can grow much deeper in entrance channels and offshore areas

B. Surveying Eelgrass

NMFS may recommend action agencies conduct surveys of eelgrass habitat to evaluate effects of a proposed action. Eelgrass habitat should be surveyed using visual or acoustic methods and mapping technologies and scales appropriate to the action, scale, and area of work. Surveys should document both vegetated eelgrass cover as well as unvegetated areas within eelgrass habitat (See section II.A. for definition). Assessing impacts to eelgrass habitat relies on the completion of quality surveys and mapping. As such, inferior quality of surveys and mapping (*e.g.*, completed at an inappropriate scale or using inappropriate methods) may make proper evaluation of impacts impossible, and may result in a recommendation from NMFS to re-survey and re-map project areas. Also, to account for fluctuations in eelgrass habitat due to environmental variations, a reference site(s) should be incorporated into the survey (See section V.B.4 below for more details).

1. Survey Parameters

Because eelgrass growth conditions in California vary, eelgrass mapping techniques will also vary. Diver transects or boundary mapping may be suited to very small scale mapping efforts, while aerial and/or acoustic survey with ground-truthing may be more suited to larger survey areas. Aerial and above-water visual survey methods should be employed only where the lower limit of eelgrass is clearly visible or in combination with methods that adequately inventory eelgrass in deeper waters.

The survey area should be scaled as appropriate to the size of the potential action and the potential extent and distribution of eelgrass impacts, including both direct and indirect effects. The resolution of mapping should be adequate to address the scale of effects reasonably expected to occur. For small projects, such as individual boat docks, higher mapping resolution is appropriate in order to detect actual effects to eelgrass at a scale meaningful to the project size. At larger scales, the mapping resolution may be less refined over a larger area, assuming that minor errors in mapping will balance out over the larger scale. Survey reports should provide a detailed description of the survey coverage (*e.g.*, number, location, and type of samples) and any interpolation methods used in the mapping.

While many parameters may be useful to describe eelgrass habitat condition (*e.g.*, plant biomass, leaf length, shoot:root ratios, epiphytic loading), many are labor intensive and may be impractical for resource management applications on a day-to-day basis. For this reason, four parameters have been identified for use in eelgrass habitat surveys and assessment of effects of an action on eelgrass. These parameters that should be articulated in eelgrass surveys are: 1) spatial distribution, 2) areal extent, 3) percentage of vegetated cover, and 4) the turion (shoot) density.

a) Spatial Distribution

The spatial distribution of eelgrass habitat should be delineated by a contiguous boundary around all areas of vegetated eelgrass cover extending outward a distance of 5 m, excluding gaps within the vegetated cover that have individual plants greater than 10 m from neighboring plants. Where such separations occur, either a separate area should be defined, or a gap in the area should be defined by extending a line around the void along a boundary defined by adjacent plants and including the 5 meter perimeter. The boundary of the eelgrass habitat should not extend into areas where depth, substrate, or existing structures are unsuited to supporting eelgrass habitat.

b) Aerial Extent

The eelgrass habitat aerial extent is the quantitative area (*e.g.*, square meters) of the spatial distribution boundary polygon of the eelgrass habitat. The total aerial extent should be broken down into extent of vegetated cover and extent of unvegetated habitat. Areal extent should be determined using commercially available geo-spatial analysis software. For small projects, coordinate data for polygon vertices could be entered into a spreadsheet format, and area could be calculated using simple geometry.

c) Percent Vegetated Cover

Eelgrass vegetated cover exists when one or more leaf shoots (turions) per square meter is present. The percent bottom cover within eelgrass habitat should be determined by totaling the area of vegetated eelgrass cover and dividing this by the total eelgrass habitat area. Where substantial differences in bottom cover occur across portions of the eelgrass habitat, the habitat could be subdivided into cover classes (*e.g.*, 20% cover, 50% cover, 75% cover).

d) Turion (Shoot) Density

Turion density is the mean number of eelgrass leaf shoots per square meter within mapped eelgrass vegetated cover. Turion density should be reported as a mean ± the standard deviation of replicate measurements. The number of replicate measurements (n) should be reported along with the mean and deviation. Turion densities are determined only within vegetated areas of eelgrass habitat and therefore, it is not possible to measure a turion density equal to zero. If different cover classes are used, a turion density should be determined for each cover class.

2. Eelgrass Mapping

For all actions that may directly or indirectly affect eelgrass habitat, an eelgrass habitat distribution map should be prepared on an accurate bathymetric chart with contour intervals of not greater than 1 foot (local vertical datum of MLLW). Exceptions to the detailed bathymetry could be made for small projects or for projects where detailed bathymetry may be infeasible. Unless region-specific mapping format and protocols are developed by NMFS (in which case such region-specific mapping guidance should be used), the mapping should utilize the following format and protocols:

a) Bounding Coordinates

Horizontal datum - Universal Transverse Mercator (UTM), NAD 83 meters, Zone 11 (for southern California) or Zone 10 (for central, San Francisco Bay, and northern California) is the preferred projection and datum. Another projection or datum may be used; however, the map and spatial data should include metadata that accurately defines the projection and datum.

Vertical datum - Mean Lower Low Water (MLLW), depth in feet.

b) Units

Transects, grids, or scale bars should be expressed in meters. Area measurements should be in square meters.

c) File Format

A spatial data layer compatible with readily available commercial geographic information system software producing file formats compatible with ESRI® ArcGIS software should be sent to NMFS when the area mapped supports at least 10 square meters of eelgrass. For those areas supporting less than 10 square meters of eelgrass, a table may alternatively be provided giving the vertices bounding x, y coordinates of the eelgrass areas in a spreadsheet or an ASCII file format. In addition to a spatial layer and/or table, a hard-copy map should be included with the survey report. The projection and datum should be clearly defined in the metadata and/or an associated text file.

Eelgrass maps should, at a minimum, include the following:

- A graphic scale bar, north arrow, legend, horizontal datum and vertical datum;
- A boundary illustrating the limits of the area surveyed;
- Bathymetric contours for the survey area, including both the action area(s) and reference site(s) in increments of not more than 1 foot;
- An overlay of proposed action improvements and construction limits;
- The boundary of the defined eelgrass habitat including an identification of area exclusions based on physical unsuitability to support eelgrass habitat; and

- The existing eelgrass cover within the defined eelgrass habitat at the time of the survey.

3. Survey Period

All mapping efforts should be completed during the active growth period for eelgrass (typically March through October for southern California, April through October for central California, April through October for San Francisco Bay, and May through September for northern California) and should be considered valid for a period of 60 days to ensure significant changes in eelgrass distribution and density do not occur between survey date and the project start date. The 60 day period is particularly important for eelgrass habitat survey conducted at the very beginning of the growing season, if eelgrass habitat expansion occurs as the growing season progresses. A period other than 60 days could be warranted and should be evaluated on a case-by-case basis, particularly for surveys completed in the middle of the growing season. However, when the end of the 60-day validity period falls outside of the region-specific active growth period, the survey could be considered valid until the beginning of the next active growth period. For example, a survey completed in southern California in the August-October time frame would be valid until the resumption of the active growth phase (i.e., in most instances, March 1). In some cases, NMFS and the action agency may agree to surveys being completed outside of the active growth period. For surveys completed during or after unusual climatic events (*e.g.*, high fluvial discharge periods, El Niño conditions), NMFS staff should be contacted to determine if any modifications to the common survey period are warranted.

4. Reference Site Selection

Eelgrass habitat spatial extent, aerial extent, percent cover and turion density are expected to naturally fluctuate through time in response to natural environmental variables. As a result, it is necessary to correct for natural variability when conducting surveys for the purpose of evaluating action effects on eelgrass or performance of mitigation areas. This is generally accomplished through the use of a reference site(s), which is expected to respond similarly to the action area in response to natural environmental variability. It is beneficial to select and monitor multiple reference sites rather than a single site and to utilize the average reference site condition as a metric for environmental fluctuations. This is especially true when a mitigation site is located within an area of known environmental gradients, and reference sites may be selected on both sides of the mitigation site along the gradient. Environmental conditions (*e.g.*, sediment, currents, proximity to action area, shoot density, light availability, depth, onshore and watershed influences) at the reference site(s) should be representative of the environmental conditions at the impact area (Fonseca *et al*. 1998). Where practical, the reference site(s) should be at least the size of the anticipated impact and/or mitigation area to limit the potential for minor changes in a reference site (*e.g.*, propeller scarring or ray foraging damage) overly affecting mitigation needs. The logic for site(s) selection should be documented in the eelgrass mitigation planning documents.

C. Avoiding and Minimizing Impacts to Eelgrass

This section describes measures to avoid and minimize impacts to eelgrass caused by turbidity, shading, nutrient loading, sedimentation and alteration of circulation patterns. Not all measures are equally suited to a particular project or condition. Measures to avoid or minimize impacts should be focused on stressors where the source and control are within the purview of the permittee and action agency. Action agencies in coordination with NMFS should evaluate and establish impact avoidance and minimization measures on a case-by-case basis depending on the action and site-specific information, including prevailing current patterns, sediment source, characteristics, and quantity, as well as the nature and duration of work.

1. Turbidity

To avoid and minimize potential turbidity-related impacts to eelgrass:

- Where practical, actions should be located as far as possible from existing eelgrass; and
- In-water work should occur as quickly as possible such that the duration of impacts is minimized.

Where proposed turbidity generating activities must occur in proximity to eelgrass and increased turbidity will occur at a magnitude and duration that may affect eelgrass habitat, measures to control turbidity levels should be employed when practical considering physical and biological constraints and impacts. Measures may include:

- Use of turbidity curtains where appropriate and feasible;
- Use of low impact equipment and methods (*e.g.*, environmental buckets, or a hydraulic suction dredge instead of clamshell or hopper dredge, provided the discharge may be located away from the eelgrass habitat and appropriate turbidity controls can be provided at the discharge point);
- Limiting activities by tide or day-night windows to limit light degradation within eelgrass habitat;
- Utilizing 24-hour dredging to reduce the overall duration of work and to take advantage of dredging during dark periods when photosynthesis is not occurring; or
- Other measures that an action party may propose and be able to employ to minimize potential for adverse turbidity effects to eelgrass.

NMFS developed a flowchart for a stepwise decision making process as guidance for action agencies to determine when to implement best management practices (BMPs) for minimizing turbidity from dredging actions as part of a programmatic EFH consultation in San Francisco Bay. The parameters considered in the flow chart are relevant to all marine areas of California. This document is posted on the NMFS West Coast Region web page (http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html) and may be used to evaluate avoidance and minimization measures for any project that generates increased turbidity.

2. Shading

A number of potential design modifications may be used to minimize effects of shading on eelgrass. Boat docks, ramps, gangways, and similar structures should avoid eelgrass habitat to the maximum extent feasible. If avoidance of eelgrass or habitat is infeasible, impacts should be minimized by utilizing, to the maximum extent feasible, design modifications and construction materials that allow for greater light penetration. Action modifications should include, but are not limited to:

- Avoid siting over-water or landside structures in areas where shading of eelgrass habitat would occur;
- Maximizing the north-south orientation of the structure;
- Maximizing the height of the structure above the water;
- Minimizing the width and supporting structure mass to decrease shade effects;
- Relocating the structure in deeper water and limiting the placement of structures in shallow areas where eelgrass occurs to the extent feasible; and
- Utilizing light transmitting materials in structure design.

Construction materials used to increase light passage beneath the structures may include, but are not limited to, open grating or adequate spacing between deck boards to allow for effective illumination to support eelgrass habitat. The use of these shade reducing options may be appropriate where they do not conflict with safety, ADA compliance, or structure utility objectives.

NMFS developed a stepwise key as guidance for action agencies to determine which combination of modifications are best suited for minimizing shading effects from overwater structures on eelgrass as part of a programmatic EFH consultation in San Francisco Bay. The parameters considered in the flow chart are relevant to all marine areas of California. This document is posted on the West Coast Region web page (http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html) and may be used to evaluate avoidance and minimization measures for any project that results in shading.

3. Circulation patterns

Where appropriate to the scale and nature of potential eelgrass impacts, action parties should evaluate if and how the action may alter the hydrodynamics of the action area such that eelgrass habitat within or in proximity to the action area may be adversely affected. To maintain good water flow and low residence time of water within eelgrass habitat, action agencies should ensure actions:

- Minimize scouring velocities near or within eelgrass beds;
- Maintain wind and tidal circulation to the extent practical by considering orientation of piers and docks to maintain predominant wind effects;
- Incorporate setbacks on the order of 15 to 50 meters from eelgrass habitat where practical to allow for greater circulation and reduced impact from boat maneuvering, grounding, and propeller damage, and to address shading impacts; and
- Minimize the number of piles and maximize pile spacing to the extent practical, where piles are needed to support structures.

For large-scale actions in the proximity of eelgrass habitats, NMFS may request specific modeling and/or field hydrodynamic assessments of the potential effects of work on characteristics of circulation within eelgrass habitat.

4. Nutrient loading

Where appropriate to the scale and nature of potential eelgrass impacts, the following measures should be considered for implementation to reduce the potential for excessive nutrient loading to eelgrass habitat:

- diverting site runoff from landscaped areas away from discharges around eelgrass habitat;
- implementation of fertilizer reduction program;
- reduction of watershed nutrient loading;
- controlling local sources of nutrients such as animal wastes and leach fields; and
- maintaining good circulation and flushing conditions within the water body.

Reducing nutrient loading may also provide opportunities for establishing eelgrass as mitigation for project impacts.

5. Sediment loading

Watershed development and changes in land use may increase soil erosion and increase sedimentation to downstream embayments and lagoons.

- To the extent practicable, maintain riparian vegetation buffers along all streams in the watershed.
- Incorporate watershed analysis into agricultural, ranching, and residential/commercial development projects.
- Increase resistance to soil erosion and runoff. Sediment basins, contour farming, and grazing management are examples of key practices.
- Implement best management practices for sediment control during construction and maintenance operations (*e.g.,* Caltrans 2003).

Reducing sediment loading may also provide opportunities for establishing eelgrass as mitigation for project impacts in systems for which sedimentation is a demonstrable limiting factor to eelgrass.

D. Assessing Impacts to Eelgrass Habitat

If appropriate to the statute under which the consultation occurs, NMFS should consider both direct and indirect effects of the project in order to assess whether a project may impact eelgrass. NMFS is aware that many of the statutes and regulations it administers may have more specific meanings for certain terms, including "direct effect" and "indirect effect", and will use the statutory or regulatory meaning of those terms when conducting consultations under those statutes.[2] Nevertheless, it is useful for NMFS to consider effects experienced

[2] In the EFH context, adverse effects include any impact that reduces quality and/or quantity of EFH, including direct or indirect physical, chemical, or biological alterations of the waters or substrate (50 CFR 600.910). The Council of Environmental Quality (CEQ) regulations regarding NEPA implementation (40 CFR 1508.8(a)) define direct and indirect impacts of an action for the purposes of NEPA. Other NMFS statutes provide their own definitions regarding effects.

contemporaneously with project actions (both at the project site and away from the project site) and which might occur later in time.

Generally, effects to eelgrass habitat should be assessed using pre- and post-project surveys of the impact area and appropriate reference site(s) conducted during the time period of maximum eelgrass growth (typically March through October for southern California, April through October for central California, April through October for San Francisco Bay, and May through September for northern California). NMFS should consider the likelihood that the effects would occur before recommending pre- and post-project eelgrass surveys. The pre-construction survey of the eelgrass habitat in the action area and an appropriate reference site(s) should be completed within 60 days before start of construction. After construction, a post-action survey of the eelgrass habitat in the action area and at an appropriate reference site(s) should be completed within 30 days of completion of construction, or within the first 30 days of the next active growth period following completion of construction that occurs outside of the active growth period. Copies of all surveys should be provided to the lead federal agency, NMFS, and other interested regulatory and/or resource agencies within 30 days of completing the survey. The recommended timing of surveys is intended to minimize changes in eelgrass habitat distribution and abundance during the period between survey completion and construction initiation and completion. For example, a post-action survey completed beyond 30 days following construction or outside of the active growing season may show declines in eelgrass habitat as a result of natural senescence rather than the action.

The lead federal agency and NMFS should consider reference area eelgrass performance, physical evidence of impact, turbidity and construction activities monitoring data, as well as other documentation in the determination of the impacts of the action undertaken. Impact analyses should document whether the impacts are anticipated to be complete at the time of the assessment, or whether there is an anticipation of continuing eelgrass impacts due to chronic or intermittent effects. Where eelgrass at the impact site declines coincident with and similarly to decline at the reference site(s), the percentage of decline at the reference site should be deducted from the decline at the impact site. However, if eelgrass expands within the reference site(s), the impact site should only be evaluated against the pre-construction condition of the reference site and not the expanded condition. If an action results in increased eelgrass habitat relative to the reference sites, this increase could potentially be considered (subject to the caveats identified herein) by NMFS and the action agency as potential compensation for impacts to eelgrass habitat that occur in the future (see Section II. E. 3). An assessment should also be made as to whether impacts or portions of the impact are anticipated to be temporary. Information supporting this determination may be derived from the permittee, NMFS, and other resource and regulatory agencies, as well as other eelgrass experts.

For some projects, environmental planning and permitting may take longer than 60 days. To accommodate longer planning schedules, it may also be necessary to do a preliminary eelgrass survey prior to the pre-construction survey. This preliminary survey can be used to anticipate potential impacts to eelgrass for the purposes of mitigation planning during the permitting process. In some cases, preliminary surveys may focus on spatial distribution of eelgrass habitat only or may be a qualitative reconnaissance to allow permittees to incorporate avoidance and minimization measures into their proposed action or to plan for future mitigation needs. The pre-and post- project surveys should then verify whether impacts occur as anticipated, and if planned mitigation is adequate. In some cases, a preliminary survey could be completed a year or more in advance of the project action.

1. Direct Effects

Biologists should consider the potential for localized losses of eelgrass from dredging or filling, construction-associated damage, and similar spatially and temporally proximate impacts (these effects could be termed "direct"). The actual area of the impact should be determined from an analysis that compares the pre-action condition of eelgrass habitat with the post-action conditions from this survey, relative to eelgrass habitat change at the reference site(s).

2. Indirect Effects

Biologists should also consider effects caused by the action which occur away from the project site; furthermore, effects occurring later in time (whether at or away from the project site) should also be considered. Biologists should consider the potential for project actions to alter conditions of the physical environment in a manner that, in turn, reduce eelgrass habitat distribution or density (*e.g.*, elevated turbidity from the initial implementation or later operations of an action, increased shading, changes to circulation patterns, changes to vessel traffic that lead to greater groundings or wake damage, increased rates of erosion or deposition).

For actions where the impact cannot be fully determined until a substantial period after an action is taken, an estimate of likely impacts should be made prior to implementation of the proposed action based on the best available information (*e.g.*, shading analyses, wave and current modeling). A monitoring program consisting of a pre-construction eelgrass survey and three post-construction eelgrass surveys at the impact site and appropriate reference site(s) should be performed. The action party should complete the first post-construction eelgrass survey within 30 days following completion of construction to evaluate any immediate effects to eelgrass habitat. The second post-construction survey should be performed approximately one year after the first post-construction survey during the appropriate growing season. The third post-construction survey should be performed approximately two years after the first post-construction survey during the appropriate growing season. The second and third post-construction surveys will be used to evaluate if indirect effects resulted later in time due to altered physical conditions; the time frames identified above are aligned with growing season (attempting a survey outside of the growing season would show inaccurate results).

A final determination regarding the actual impact and amount of mitigation needed, if any, to offset impacts should be made based upon the results of two annual post-construction surveys, which document the changes in the eelgrass habitat (areal extent, bottom coverage, and shoot density within eelgrass) in the vicinity of the action, compared to eelgrass habitat change at the reference site(s). Any impacts determined by these monitoring surveys should be mitigated. In the event that monitoring demonstrates the action to have resulted in greater eelgrass habitat impacts than initially estimated, additional mitigation should be implemented in a manner consistent with these guidelines. In some cases, adaptive management may allow for increased success in eelgrass mitigation without the need for additional mitigation.

E. Mitigation Options

The term mitigation is defined differently by various federal and State laws, regulations and policies. In a broad sense, mitigation may include a range of measures from complete avoidance of adverse effects to compensation for adverse effects by preserving, restoring or creating similar resources at onsite or offsite locations. The Corps and EPA issued regulations governing compensatory mitigation to offset unavoidable adverse effects to waters of the United States authorized by Clean Water Act section 404 permits and other permits issued by the Corps (73 FR 19594; April 10, 2008). For those regulations (33 CFR 332.2 and 40 CFR 230.92, respectively), the Corps and EPA, define "compensatory mitigation" as "the restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse effects which remain after all appropriate and practicable avoidance and minimization has been achieved."

When impacts to eelgrass would occur, the action agency should develop a mitigation plan to achieve no net loss in eelgrass function following the recommended steps in this policy. If NMFS determines a mitigation plan is needed, and it was not included with the EFH Assessment for the proposed action, NMFS may recommend, either as comments on the EFH Assessment or as an EFH Conservation Recommendation, that one be provided. Potential mitigation options are described below. The action agency should consider site specific conditions when determining the most appropriate mitigation option for an action.

1. Comprehensive management plans

NMFS supports the development of comprehensive management plans (CMPs) that protect eelgrass resources within the context of broader ecosystem needs and management objectives. Recommendations different from specific elements described below for in-kind mitigation may be appropriate where a CMP (*e.g.,* an enforceable programmatic permit, Special Area Management Plan, harbor plan, or ecosystem-based management plan) exists that is considered to provide adequate population-level and local resource distribution protections to eelgrass. One such CMP under development at the time these guidelines were developed is *City of Newport Beach Eelgrass Protection Mitigation Plan for Shallow Water in Lower Newport Bay: An Ecosystem Based Management Plan.* If satisfactorily completed and adopted, it is anticipated the protection measures for eelgrass within this area would be adequate to meet the objectives of this policy.

In general, it is anticipated that CMPs may be most appropriate in situations where a project or collection of similar projects will result in incremental but recurrent impacts to a small portion of local eelgrass populations through time (*e.g.*, lagoon mouth maintenance dredging, maintenance dredging of channels and slips within established marinas, navigational hazard removal of recurrent shoals, shellfish farming, and restoration or enhancement actions). In order to ensure that these alternatives provide adequate population-level and local resource distribution protections to eelgrass and that the plan is consistent with the overall conservation objectives of this policy, NMFS should be involved early in the plan's development.

2. In-kind mitigation

In-kind compensatory mitigation is the creation, restoration, or enhancement of habitat to mitigate for adverse impacts to the same type of habitat. In most cases in-kind mitigation is the preferred option to compensate for impacts to eelgrass. Generally, in-kind mitigation should achieve a final mitigation ratio of 1.2:1 across all areas of the state, independent of starting mitigation ratios. A starting mitigation ratio is the ratio of mitigation area to impact area when mitigation is initiated. The final mitigation ratio is the ratio of mitigation area to impact area once mitigation is complete. The 1.2:1 ratio assumes: (1) there is no eelgrass function at the mitigation site prior to mitigation efforts, (2) eelgrass function at the mitigation site is achieved within three years, (3) mitigation efforts are successful, and (4) there are no landscape differences (*e.g.*, degree of urban influence, proximity to freshwater source), between the impact site and the mitigation site. Variations from these assumptions may warrant higher or lower mitigation ratios. For example, a higher ratio would be appropriate for an enhancement project where the mitigation site has some level of eelgrass function prior to the mitigation action.

Typically, in-kind eelgrass mitigation involves transplanting or seeding of eelgrass into unvegetated habitat. Successful in-kind mitigation may also warrant modification of physical conditions at the mitigation site to prepare for transplants (*e.g.*, alter sediment composition, depth, etc.). In some areas, other in-kind mitigation options such as removing artificial structures that preclude eelgrass growth may be feasible. If in-kind mitigation that does not include transplants or seeding is proposed, post-mitigation monitoring as described below should be implemented to verify that mitigation is successful.

Information provided below in Section II.F includes specific recommendations for in-kind mitigation, including site selection, reference sites, starting mitigation ratios, mitigation methods, mitigation monitoring and performance criteria. Many of the recommendations provided in these guidelines for eelgrass assessments, surveys, and mitigation may apply throughout the state even if a non-transplant mitigation option is proposed.

3. Mitigation banks and in-lieu-fee programs

In 2006 and 2011, the NMFS Southwest Region (merged with the Northwest Region in 2013 to form the West Coast Region) signed interagency Memorandum of Understandings that established and refined a framework for developing and using combined or coordinated approaches to mitigation and conservation banking and in-lieu-fee programs in California. Other signatory agencies include: the California Resources Agency, California Department of Fish and Wildlife, the Corps, the US Fish &Wildlife Service, the EPA, the Natural Resource Conservation Service, and the State Water Resources Control Board.

Under this eelgrass policy, NMFS supports the use of mitigation bank and in-lieu fee programs to compensate for impacts to eelgrass habitat, where such instruments are available and where such programs are appropriate to the statutory structure under which mitigation is recommended. Mitigation banks and in-lieu fee conservation programs are highly encouraged by NMFS in heavily urbanized waters. Credits should be used at a ratio of 1:1 if those credits have been established for a full three-year period prior to use. If the bank credits have been in place for a period less than three years, credits should be used at a ratio determined through application of the wetland mitigation calculator (King and Price 2004).

At the request of the action party, and only with approval of NMFS and other appropriate resource agencies and subject to the caveats below, surplus eelgrass area that, after 60-months, exceeds the mitigation needs, as defined in section II.F.6 Mitigation Monitoring and Performance Milestones, has the potential to be considered for future mitigation needs. Additionally, only with the approval of NMFS and other appropriate resource agencies and subject to the caveats below, eelgrass habitat expansion resulting from project activities, and that otherwise would not have occurred, has the potential to be considered for future mitigation needs. Exceeding mitigation needs does not guarantee or entitle the action party or action agency to credit such mitigation to future projects, since every future project must be considered on a case-by-case basis (including the location and type of impact) and viewed in light of the relevant statutory authorities.

4. Out-of-kind mitigation

Out-of-kind compensatory mitigation means the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type. In most cases, out-of-kind mitigation is discouraged, because eelgrass is a rare, special-status habitat in California. There may be some scenarios, however, where out-of-kind mitigation for eelgrass impacts is ecologically desirable or when in-kind mitigation is not feasible. This determination should be made based on an established ecosystem plan that considers ecosystem function and services relevant to the geographic area and specific habitat being impacted. Any proposal for out-of-kind mitigation should demonstrate that the proposed mitigation will compensate for the loss of eelgrass habitat function within the ecosystem. Out-of-kind mitigation that generates services similar to eelgrass habitat or improves conditions for establishment of eelgrass should be considered first. NMFS and the federal action agency should be consulted early when out-of-kind mitigation is being proposed in order to determine if out-of-kind mitigation is appropriate, in coordination with other relevant resource agencies (e.g., California Department of Fish and Wildlife, California Coastal Commission, U.S. Fish and Wildlife Service)

F. In-kind Mitigation for Impacts to Eelgrass

As all mitigation project specifics will be determined on a case-by-case basis, circumstances may exist where NMFS staff will need to modify or deviate from the recommended measures described below before providing their recommendation to action agencies.

1. Mitigation Site Selection

Eelgrass habitat mitigation sites should be similar to the impact site. Site selection should consider distance from action, depth, sediment type, distance from ocean connection, water quality, and currents. Where eelgrass that is impacted occurs in marginally suitable environments, it may be necessary to conduct mitigation in a preferable location and/or modify the site to be better suited to support eelgrass habitat creation. Mitigation site modification should be fully coordinated with NMFS staff and other appropriate resource and regulatory agencies. To the extent feasible, mitigation should occur within the same hydrologic system (*e.g.*, bay, estuary, lagoon) as the impacts and should be appropriately distributed within the same ecological subdivision of larger systems (*e.g.*, San Pablo Bay or Richardson Bay in San Francisco Bay), unless NMFS and the action agency concur that good justification exists for altering the distribution based on valued ecosystem functions and services.

In identifying potentially suitable mitigation sites, it is advisable to consider the current habitat functions of the mitigation site prior to mitigation use. In general, conversion of unvegetated subtidal areas or disturbed uplands to eelgrass habitats may be considered appropriate means to mitigate eelgrass losses, while conversion of other special aquatic sites (*e.g.*, salt marsh, intertidal mudflats, and reefs) is unlikely to be considered suitable. It may be necessary to develop suitable environmental conditions at a site prior to being able to effectively transplant eelgrass into a mitigation area. Mitigation sites may need physical modification, including increasing or lowering elevation, changing substrate, removing shading or debris, adding wave protection or removing impediments to circulation.

2. Mitigation Area Needs

In-kind mitigation plans should address the components described below to ensure mitigation actions achieve no net loss of eelgrass habitat function. Alternative contingent mitigation should be specified and included in the mitigation plan to address situations where performance milestones are not met.

a) Impacts to Areal Extent of Eelgrass Habitat

Generally, mitigation of eelgrass habitat should be based on replacing eelgrass habitat extent at a 1.2 (mitigation) to 1 (impact) mitigation ratio for eelgrass throughout all regions of California. However, given variable degrees of success across regions and potential for delays and mitigation failure, NMFS calculated *starting* mitigation ratios using “The Five-Step Wetland Mitigation Ratio Calculator” (King and Price 2004) developed for NMFS Office of Habitat Conservation. The calculator utilizes methodology similar to Habitat Equivalency Analysis (HEA), which is an accepted method to determine the amount of compensatory restoration needed to provide natural resource services that are equivalent to loss of natural resource services following an injury (http://www.darrp.noaa.gov/economics/pdf/heaoverv.pdf). HEA is commonly used by NOAA during damage assessment cases, including those involving seagrass. Similar to HEA, the mitigation calculator is based on the “net present value” approach to asset valuation, an economics concept used to compare values of all types of investments, and then modified to incorporate natural resource services. Using the calculator allows for consistency in methodology for all areas within California, avoids arbitrary identification of size of the mitigation area, and avoids cumulative loss to eelgrass habitat that would likely occur with a standard 1:1 ratio (because of the complexity of eelgrass mitigation and the time for created eelgrass to achieve full habitat function).

The calculator includes a number of metrics to determine appropriate ratios that focus on comparisons of quality and quantity of function of the mitigation relative to the site of impact to ensure full compensation of lost function. (see Attachment 4). Among other metrics, the calculator employs a metric of likelihood of failure within the mitigation site based on regional mitigation failure history. As such, the mitigation calculator identifies a recommended starting mitigation ratio (the mitigation area to eelgrass impact area) based on regional history of success in eelgrass mitigation. Increased initial mitigation site size should be considered to provide greater assurance that the performance milestones, as specified in Section II.F.6, will be met. This is a common practice in the eelgrass mitigation field to reduce risk of falling short of mitigation needs (Thom 1990). Independent of starting mitigation ratio utilized for a given mitigation action, mitigation success should generally be evaluated against a ratio of 1.2:1.

The elevated starting mitigation ratio should be applied to the area of impact to vegetated eelgrass cover only. For unvegetated eelgrass habitat, a starting mitigation ratio of 1.2:1 is appropriate.

To determine the recommended starting mitigation ratio for each region, the percentage of transplant successes and failures was examined over the history of transplanting in the region. NMFS staff examined transplants projects over the past 25 years in all mitigation regions (see Attachment 6). Eelgrass mitigation in Southern California has a 35-year history with 66 transplants performed over that period. In the past 25 years, a total of 47 eelgrass transplants for mitigation purposes have been conducted in Southern California. Forty-three of these were established long enough to evaluate success for these transplants. The overall failure rate, with failure defined as not meeting success criteria established for the project, was 13 percent. Eelgrass mitigation within central California has a better history of successful completion than within southern California, San Francisco Bay, and northern California. However, the number of eelgrass mitigation actions conducted in this region is low and limited to areas within Morro Bay. While the success of eelgrass mitigation in central California has been high, the low number of attempts makes mitigation in this region uncertain. Eelgrass habitat creation/restoration in San Francisco Bay and in northern California has had varied success.

In all cases, best information available at the time of this policy's development was used to determine the parameter values entered into the calculator formula. As regional eelgrass mitigation success changes and the results of ongoing projects become available, the starting mitigation ratio may be updated. Updates in mitigation calculator inputs should not be made on an individual action basis, because the success or lack of success of an individual mitigation project may not reflect overall mitigation success for the region. Rather NMFS should re-evaluate the regional transplant history approximately every 5 years, increasing the record of transplant success in 5 year increments for new projects implemented after NMFS' adoption of these guidelines. If the 5-year review shows that new efforts are more successful than those from the beginning of the 25-year period, NMFS staff should consider removing early projects (*e.g.*, those completed 20 years prior) from the analysis.

On a case-by-case basis and in consultation with action agencies, NMFS may consider proposals with different starting mitigation ratios where sufficient justification is provided that indicates the mitigation site would achieve the no net loss goal. In addition, CMPs could consider different starting mitigation ratios, or other mitigation elements and techniques, as appropriate to the geographic area addressed by the CMP.

Regardless of starting mitigation ratio, eelgrass mitigation should be considered successful, if it meets eelgrass habitat coverage over an area that is 1.2 times the impact area with comparable eelgrass density as impacted habitat. Please note, delayed implementation, supplemental transplant needs, or NMFS and action agency agreement may result in an altered mitigation area. In the EFH consultation context, NMFS may recommend an altered mitigation area during implementation of the federal agency's mitigation plan following EFH consultation or NEPA review, or as an EFH Conservation Recommendation if the federal agency re-initiates EFH consultation.

(1) Southern California (Mexico border to Pt. Conception)

For mitigation activities that occur concurrent to the action resulting in damage to existing eelgrass habitat, a starting ratio of 1.38 to 1 (transplant area to vegetated cover impact area) should be recommended to counter the regional failure risk. That is, for each square meter of vegetated eelgrass cover adversely impacted, 1.38 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

(2) Central California (Point Conception to mouth of San Francisco Bay).

For mitigation activities that occur concurrent to the action resulting in damage to existing eelgrass habitat, a starting ratio of 1.20 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 0 percent failure rate over the past 25 years (4 transplant actions). It should however be noted that all of these successful transplants included a greater area of planting than was necessary to achieve success such that the full mitigation area would be achieved, even with areas of minor transplant failure.

(3) San Francisco Bay (including south, central, San Pablo and Suisun Bays).

For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass bed resource, a ratio of 3.01 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 60 percent failure rate over the past 25 years (10 transplant actions). That is, for each square meter adversely impacted, 3.01 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

(4) Northern California (mouth of San Francisco Bay to Oregon border).

For mitigation activities that occur concurrent to the action resulting in damage to the existing eelgrass habitat, a starting ratio of 4.82 to 1 (transplant area to vegetated cover impact area) should be recommended based on a 75 percent failure rate over the past 25 years (4 transplant actions). That is, for each square meter of eelgrass habitat adversely impacted, 4.82 square meters of new habitat with suitable conditions to support eelgrass should be planted with a comparable bottom coverage and eelgrass density as impacted habitat.

b) Impacts to Density of Eelgrass Beds

Degradation of existing eelgrass habitat that results in a permanent reduction of eelgrass turion density greater than 25 percent, and that is a statistically significant difference from pre-impact density, should be mitigated based on an equivalent area basis. The 25 percent and statistically significant threshold is believed reasonable based on supporting information (Fonseca *et al.* 1998, WDFW 2008), and professional practice under SCEMP. In these cases, eelgrass remains present at the action site, but density may be potentially affected by long-term chronic or intermittent effects of the action. Reduction of density should be determined to have occurred when the mean turion density of the impact site is found to be statistically different (α=0.10 and β=0.10) from the density of a reference and at least 25 percent below the reference mean during two annual sampling events following implementation of an action. The number of samples taken to describe density at each site (*e.g.,* impact and reference) should be sufficient to provide for appropriate statistical power. For small impact areas that do not allow for a sample size that provides statistical power, alternative methods for pre- and post- density comparisons could be considered. Mitigation for reduction of turion density without change in eelgrass habitat area should be on a one-for-one basis either by augmenting eelgrass density at the impact site or by establishing new eelgrass habitat comparable to the change in density at the impact site. For example, a 25 percent reduction in density of 100-square meters (100 turions/square meter) of eelgrass habitat to 75 turions/square meter should be mitigated by the establishing 25 square meters of new eelgrass habitat with a density at or above the 100 turions/square meter pre-impact density.

3. Mitigation Technique

In-kind mitigation technique should be determined on a case-by-case basis. Techniques for eelgrass mitigation should be consistent with the best available technology at the time of mitigation implementation and should be tailored to the specific needs of the mitigation site. Eelgrass transplants have been highly successful in southern and central California, but have had mixed results in San Francisco Bay and northern California. Bare-root bundles and seed buoys have been utilized with some mixed success in northern portions of the state. Transplants using frames have also been used with some limited success. For transplants in southern California, plantings consisting of bare-root bundles consisting of 8-12 individual turions each have proven to be most successful (Merkel 1988).

Donor material should be taken from the area of direct impact whenever practical, unless the action resulted in reduced density of eelgrass at the area of impact. Site selections should consider the similarity of physical environments between the donor site and the transplant receiver site and should also consider the size, stability, and history of the donor site (*e.g.*, how long has it persisted and is it a transplant site). Plants harvested should be taken in a manner to thin an existing bed without leaving any noticeable bare areas. For all geographic areas, no more than 10 percent of an existing donor bed should be harvested for transplanting purposes. Ten percent is reasonable based on recommendations in Thom *et al.* (2008) and professional practice under SCEMP. Harvesting of flowering shoots for seed buoy techniques should occur only from widely separated plants.

It is important for action agencies to note that state laws and regulations affect the harvesting and transplantation of donor plants and permission from the state, where required, should be obtained; for example, California Department of Fish and Wildlife may need to provide written authorization for harvesting and transplanting donor plants and/or flowering shoots.

4. Mitigation Plan

NMFS should recommend that a mitigation plan be developed for in-kind mitigation efforts. During consultation, NMFS biologists should request that mitigation plans be provided at least 60 days prior to initiation of project activities to allow for NMFS review. When feasible, mitigation plans should be developed based on preliminary or pre-project eelgrass surveys. When there is uncertainty regarding whether impacts to eelgrass will occur, and the need for mitigation is based on comparison of pre- and post-project eelgrass surveys, NMFS biologists should request that the mitigation plan be provided no more than 60 days following the post-project survey to allow for NMFS review and minimize any delay in mitigation implementation.

At a minimum, the mitigation plan should include:

- Description of the project area
- Results of preliminary eelgrass survey and pre/post-project eelgrass surveys if available (see Section II.B.1 and II.B.2)
- Description of projected and/or documented eelgrass impacts
- Description of proposed mitigation site and reference site(s) (see Section II.B.4)
- Description of proposed mitigation methods (see Section II.F.3)
- Construction schedule, including specific starting and ending dates for all work including mitigation activities. (see Section II.F.5)
- Schedule and description of proposed post-project monitoring and when results will be provided to NMFS
- Schedule and description of process for continued coordination with NMFS through mitigation implementation
- Description of alternative contingent mitigation or adaptive management should proposed mitigation fail to achieve performance measures (see Section II.F.6)

5. Mitigation Timing

Mitigation should commence within 135 days following the initiation of the in-water construction resulting in impact to the eelgrass habitat, such that mitigation commences within the same eelgrass growing season as impacts occur. If possible, mitigation should be initiated prior to or concurrent with impacts. For impacts initiated within 90 days prior to, or during, the low-growth period for the region, mitigation may be delayed to within 30 days after the start of the following growing season, or 90 days following impacts, whichever is longer, without the need for additional mitigation as described below. This timing avoids survey completion during the low growth season, when results may misrepresent progress towards performance milestones.

Delays in eelgrass mitigation result in delays in ultimate reestablishment of eelgrass habitat functions, increasing the duration and magnitude of project impacts to eelgrass. To offset loss of eelgrass habitat function that accumulates through delay, an increase in successful eelgrass mitigation is needed to achieve the same compensatory habitat function. Because habitat function is accumulated over time once the mitigation habitat is in place, the longer the delay in initiation of mitigation, the greater the additional habitat area needed (i.e., mitigation ratio increasingly greater than 1.2:1) to offset losses. Unless a specific delay is authorized or dictated by the initial schedule of work, federal action agencies should determine whether delays in mitigation initiation in excess of 135 days warrant an increased final mitigation ratio. If increased mitigation ratios are warranted, NMFS should recommend higher mitigation ratios (see Attachment 7). Where delayed implementation is authorized by the action agency, the increased mitigation ratio may be determined by utilizing the Wetlands Mitigation Calculator (King and Price 2004) with an appropriate value for parameter D (See Attachment 4). Examples of delay multipliers generated using the Wetlands Mitigation Calculator are provided in Attachment 5.

Conversely, implementing mitigation ahead of impacts can be used to reduce the mitigation needs by achieving replacement of eelgrass function and services ahead of eelgrass losses. If eelgrass is successfully transplanted three years ahead of impacts, the mitigation ratio would drop from 1.2:1 to 1:1. If mitigation is completed less than three years ahead of impacts, the mitigation calculator can be used to determine the appropriate intermediate mitigation ratio.

6. Mitigation Monitoring and Performance Milestones

In order to document progress and persistence of eelgrass habitat at the mitigation site through and beyond the initial establishment period, which generally is three years, monitoring should be completed for a period of five years at both the mitigation site and at an appropriate reference site(s) (Section II.B.4. Reference Site Selection). Monitoring at a reference site(s) may account for any natural changes or fluctuations in habitat area or density. Monitoring should determine the area of eelgrass and density of plants at 0, 12, 24, 36, 48, and 60 months after completing the mitigation. These intervals will provide yearly updates on the establishment and persistence of eelgrass during the growing season. These monitoring recommendations are consistent with findings of the National Research Council (NRC 2001), the Corps requirements for compensatory mitigation (33 CFR 332.6(b)), and other regional resource policies (Corps 2010, Evans and Leschen 2010, SFWMD 2007).

All monitoring work should be conducted during the active eelgrass growth period and should avoid the recognized low growth season for the region to the maximum extent practicable (typically November through February for southern California, November through March for central California, November through March for San Francisco Bay, and October through April for northern California). Sufficient flexibility in the scheduling of the 6 month surveys should be allowed in order to ensure the work is completed during this active growth period. Additional monitoring beyond the 60-month period may be warranted in those instances where the stability of the proposed mitigation site is questionable, where the performance of the habitat relative to reference sites is erratic, or where other factors may influence the long-term success of mitigation. Mitigation plans should include a monitoring schedule that indicates when each of the monitoring events will be completed.

The monitoring and performance milestones described below are included as eelgrass transplant success criteria in the SCEMP. These numbers represent milestones and associated timelines typical of successful eelgrass habitat development based on NMFS' experience with: (1) conducting eelgrass surveys and monitoring and (2) reviewing mitigation monitoring results for projects implemented under SCEMP. Restored eelgrass habitat is expected to develop through an initial 3 year monitoring period such that, within 36 months following planting, it meets or exceeds the full coverage and not less than 85 percent of the density relative to the initial condition of affected eelgrass habitat. Restored eelgrass habitat is expected to sustain this condition for at least 2 additional years.

Monitoring events should evaluate the following performance milestones:

Month 0 – Monitoring should confirm the full coverage distribution of planting units over the initial mitigation site as appropriate to the geographic region.

Month 6 – Persistence and growth of eelgrass within the initial mitigation area should be confirmed, and there should be a survival of at least 50 percent of the initial planting units with well-distributed coverage over the initial mitigation site. For seed buoys, there should be demonstrated recruitment of seedlings at a density of not less than one seedling per four (4) square meters with a distribution over the extent of the initial planting area. The timing of this monitoring event should be flexible to ensure work is completed during the active growth period.

Month 12– The mitigation site should achieve a minimum of 40 percent coverage of eelgrass and 20 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 24– The mitigation site should achieve a minimum of 85 percent coverage of eelgrass and 70 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 36– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 48– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Month 60– The mitigation site should achieve a minimum of 100 percent coverage of eelgrass and 85 percent density of reference site(s) over not less than 1.2 times the area of the impact site.

Performance milestones may be re-evaluated or modified if declines at a mitigation site are also demonstrated at the reference site, and therefore, may be a result of natural environmental stressors that are unrelated to the intrinsic suitability of the mitigation site. In the EFH consultation context, NMFS should provide recommendations regarding modification of performance milestones as technical assistance during interagency coordination as described in the mitigation plan or as EFH Conservation Recommendations if the federal action agency re-initiates EFH consultation.

7. Mitigation Reporting

NMFS biologists should request monitoring reports and spatial data for each monitoring event in both hard copy and electronic version, to be provided within 30 days after the completion of each monitoring period to allow timely review and feedback from NMFS. These reports should clearly identify the action, the action party, mitigation consultants, relevant points of contact, and any relevant permits. The size of permitted eelgrass impact estimates, actual eelgrass impacts, and eelgrass mitigation needs should be identified, as should appropriate information describing the location of activities. The report should include a detailed description of eelgrass habitat survey methods, donor harvest methods and transplant methods used. The reports should also document mitigation performance milestone progress (see II.F.6. Mitigation Monitoring and Performance Milestones). The first report (for the 0-month post-planting monitoring) should document any variances from the mitigation plan, document the sources of donor materials, and document the full area of planting. The final mitigation monitoring report should provide the action agency and NMFS with an overall assessment of the performance of the eelgrass mitigation site relative to natural variability of the reference site to evaluate if mitigation responsibilities were met. An example summary is provided in Attachment 3.

8. Supplemental Mitigation

Where development of the eelgrass habitat at the mitigation site falls short of achieving performance milestones during any interim survey, the monitoring period should be extended and supplemental mitigation may be recommended to ensure that adequate mitigation is achieved. In the EFH consultation context, NMFS should provide recommendations regarding extended monitoring as technical assistance during interagency coordination as described in the mitigation plan or as EFH Conservation Recommendations if the federal action agency re-initiates EFH consultation. In some instances, an adaptive management corrective action to the existing mitigation area may be appropriate. In the event of a mitigation failure, the action agency should convene a meeting with the action party, NMFS, and applicable regulatory and/or resource agencies to review the specific circumstances and develop a solution to achieve no net loss in eelgrass habitat function.

As indicated previously, while in-kind mitigation is preferred, the most appropriate form of compensatory mitigation should be determined on a case-by-case basis. In cases where it is demonstrated that in-kind replacement is infeasible, out-of-kind mitigation may be appropriate over completion of additional in-kind mitigation. The determination that an out-of-kind mitigation is appropriate will be made by NMFS, the action agency, and the applicable regulatory agencies, where a regulatory action is involved.

G. Special Circumstances

Depending on the circumstances of each individual project, NMFS may make recommendations different from those described above on a case by case basis. For the scenarios described below, for example, NMFS could recommend a mitigation ratio or 1:1 or for use of out-of-kind mitigation. Because NMFS needs a proper understanding of eelgrass habitat in the project area and potential impacts of the proposed project to evaluate the full effects of authorized activities, NMFS should not make recommendations that diverge from these guidelines if they would result in surveys, assessments or reports inferior to those which might be obtained through the guidance in Section II. The area thresholds described below are taken from the SCEMP and/or reflect recommendations NMFS staff have repeatedly made during individual EFH consultations. These thresholds minimize impacts to eelgrass habitat quality and quantity, based on NMFS' experience with: (1) conducting eelgrass surveys and monitoring and (2) reviewing project monitoring results for projects implemented under SCEMP. The special circumstance included for shellfish aquaculture longlines is supported by Rumrill and Poulton (2004) and the NMFS Office of Aquaculture.

1. Localized Temporary Impacts

NMFS may consider modified target mitigation ratios for localized temporary impacts wherein the damage results in impacts of less than 100 square meters and eelgrass habitat is fully restored within the damage footprint within one year of the initial impact (e.g., placement of temporary recreational facilities, shading by construction equipment, or damage sustained through vessel groundings or environmental clean-up operations). In such cases, the 1.2:1 mitigation ratio should not apply, and a 1:1 ratio of impact to recovery would apply. A monitoring program consisting of a pre-construction eelgrass survey and three post-construction eelgrass surveys at the impact site and appropriate reference site(s) should be completed in order to demonstrate the temporary nature of the impacts. NMFS should recommend that surveys be completed as follows: 1) the first post-construction eelgrass survey should be completed within 30 days following completion of construction to evaluate direct effects of construction, 2) the second and third post-construction surveys should be performed approximately one year after the first post-construction survey, and approximately two years after the first post-construction survey, respectively, during the appropriate growing season to confirm no indirect, or longer term effects resulted from construction. A compelling reason should be demonstrated before any reduced monitoring and reporting recommendations are made.

2. Localized Permanent Impacts

a) If both NMFS and the authorizing action agencies concur, the compensatory mitigation elements of this policy may not be necessary for the placement of a single pipeline, cable, or other similar utility line across existing eelgrass habitat with an impact corridor of no more than 1 meter wide. NMFS should recommend the completion of pre- and post-action surveys as described in section II.B. and II.D. The actual area of impact should be determined from the post-action survey. NMFS should recommend the completion of an additional survey (after 1 year) to ensure that the action or impacts attributable to the action have not exceeded the 1-meter corridor width. NMFS should recommend that, if the post-action or 1 year survey demonstrates a loss of eelgrass habitat greater than the 1-meter wide corridor, mitigation should be undertaken.

b)) If both NMFS and the authorizing action agencies concur that the spacing of shellfish aquaculture longlines does not result in a measurable net loss of eelgrass habitat in the project area, then mitigation associated with local losses under longlines may not be necessary. NMFS should recommend the completion of pre- and post-action surveys as described in section II.B. and II.D. NMFS should recommend the completion of additional post-action monitoring surveys (to be completed approximately 1 year and 2 years following implementation of the action) to ensure that the action or impacts attributable to the action have not resulted in net adverse impacts to eelgrass habitat. NMFS should recommend that, if the 1-year or 2-year survey demonstrates measurable impact to eelgrass habitat, mitigation should be undertaken. c) NMFS should consider mitigation on a 1:1 basis for impacts less than 10 square meters to eelgrass patches where impacts are limited to small portions of well-established eelgrass habitat or eelgrass habitat that, despite highly variable conditions, generally retain extensive eelgrass, even during poor years. A reduced mitigation ratio should not be considered where impacts would occur to isolated or small eelgrass habitat areas within which the impacted area constitutes more than 1% of the eelgrass habitat in the local area during poor years.

c) If NMFS concurs and suitable out-of-kind mitigation is proposed, compensatory mitigation may not be necessary for actions impacting less than 10 square meters of eelgrass.

III. Glossary of Terms

Except where otherwise specified, the explanations of the following terms are provided for informational purposes only and are described solely for the purposes of this policy; where a NMFS statute, regulation, or agreement requires a different understanding of the relevant term, that understanding of the term will supplant these explanations provided below.

Compensatory mitigation – restoration, establishment, or enhancement of aquatic resources for the purposes of offsetting unavoidable authorized adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved.

Ecosystem – a geographically specified system of organisms, the environment, and the processes that control its dynamics. Humans are an integral part of an ecosystem.

Ecosystem function – ecological role or process provided by a given ecosystem.

Ecosystem services – contributions that a biological community and its habitat provide to the physical and mental well-being of the human population (*e.g.*, recreational and commercial opportunities, aesthetic benefits, flood regulation).

Eelgrass habitat – areas of vegetated eelgrass cover (any eelgrass within 1 square meter quadrat and within 1 m of another shoot) bounded by a 5 m wide perimeter of unvegetated area

Essential fish habitat (EFH) – EFH is defined in the MSA as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

EFH Assessment – An assessment as further explained in 50 C.F.R. § 600.920(e).

EFH Consultation – The process explained in 50 C.F.R. § 600.920

EFH Conservation Recommendation – provided by the National Marine Fisheries Service (NMFS) to a federal or state agency pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Act regarding measures that can be taken by that agency to conserve EFH. As further explained in 50 C.F.R. § 600.925, EFH Conservation Recommendations may be provided as part of an EFH consultation with a federal agency, or may be provided by NMFS to any federal or state agency whose actions would adversely affect EFH .

Habitat – environment in which an organism(s) lives, including everything that surrounds and affects its life, including biological, chemical and physical processes.

Habitat function – ecological role or process provided by a given habitat (*e.g.*, primary production, cover, food, shoreline protection, oxygenates water and sediments, etc.).

In lieu fee program – a program involving the restoration, establishment, and/or enhancement of aquatic resources through funds paid to a governmental or non-profit natural resources management entity to satisfy compensatory mitigation needs; an in lieu fee program works like a mitigation bank, however, fees to compensate for impacts to habitat function are collected prior to establishing an on-the-ground conservation/restoration project.

In-kind mitigation – mitigation where the adverse impacts to a habitat are mitigated through the creation, restoration, or enhancement of the same type of habitat.

Mitigation – action or project undertaken to offset impacts to an existing natural resource.

Mitigation bank – a parcel of land containing natural resource functions/values that are conserved, restored, created and managed in perpetuity and used to offset unavoidable impacts to comparable resource functions/values occurring elsewhere. The resource functions/values contained within the bank are translated into quantified credits that may be sold by the banker to parties that need to compensate for the adverse effects of their activities.

Out-of-kind mitigation – mitigation where the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type

IV. Literature Cited

Bostrom, C. and E. Bonsdorff. 2000. Zoobenthic community establishment and habitat complexity–the importance of seagrass shoot density, orphology and physical disturbance for faunal recruitment. Marine Ecology Progress Series 205:123-138.

Bostrom, C., E. Bonsdorff, P. Kangas, and A. Norkko. 2002. Long-term changes of a Brackish-water eelgrass (Zostera marina L.) community indicate effects of coastal eutrophication. Estuarine, Coastal and Shelf Science 55: 795-804.

California Department of Transportation. 2003. Storm Water Quality Handbooks: Construction Site Best Management Practices (BMPs) Manual.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M, Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V.O., Paruelo, J., Raskin, R.G., Sutton, P., and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature 387: 253-260.

Council on Environmental Quality (CEQ). Regulations 1508 – National Environmental Policy Act (40 CFR 1508).

Donoghue, C. 2011. Technical Memorandum: Operational Definition of an Eelgrass (*Zostera marina*) Bed. A Summary of a Workgroup Discussion and Related Analysis. Washington State Department of Natural Resources. October 2011.

Duarte, C. M. 2002. The future of seagrass meadows. Environmental Conservation 29(2):192-206.

Duarte, C.M., Dennison, W.C., Orth, R.J.W. and T.J.B. Carruthers. 2008. The charisma of coastal ecosystems: addressing the imbalance. Estuaries and Coasts: J CERF 31:233–238.

Evans, N.T. and Leschen, A. 2010. Technical guidelines for the delineation, restoration, and monitoring of eelgrass (*Zostera marina*) in Massachusetts coastal waters. Massachusetts Division of Marine Fisheries Technical Report TR-43. 8 p.

Evans, N. T., and F. T. Short. 2005. Functional trajectory models for assessment of transplanted eelgrass, Zostera marina L., in the Great Bay Estuary, New Hampshire. Estuaries 28(6):936-947.

Ferrell, D. J., and J.D. Bell. 1991. Differences among assemblages of fish associated with *Zostera capricorni* and bare sand over a large spatial scale. Marine Ecology Progress Series 72:15-24.

Fonseca, M.S., Kenworthy, W.J., Thayer, G.W. 1998. Guidelines for the conservation and restoration of seagrasses in the United Stated and adjacent waters. NOAA Coastal Ocean Program Decision Analysis Series, No. 12. NOAA Coastal Ocean Office, Silver Spring, MD. 222 p.

Fonseca, M. S., W. J. Kenworthy, D. R. Colby, K. A. Rittmaster, and G. W. Thayer. 1990. Comparisons of fauna among natural and transplanted eelgrass Zostera marina meadows: criteria for mitigation. Marine Ecology Progress Series 65:251-264

Hoffman, R. S. 1986. Fishery Utilization of Eelgrass (Zostera marina) Beds and Non-vegetated Shallow Water Areas in San Diego Bay. SWR-86-4, NMFS/SWR.

King, D. M., and E. W. Price. 2004. Developing Defensible Wetland Mitigation Ratios: A Companion to "The Five-step Wetland Mitigation Ratio Calculator." Prepared by King and Associates, Inc. for NOAA, Office of Habitat Conservation, Habitat Protection Division.

Lotze, H. K., H. S. Lenihan, B. J. Bourque, R. H. Bradbury, R. G. Cooke, M. C. Kay, S. M. Kidwell, M. X. Kirby, C. H. Peterson, and J. B. C. Jackson. 2006. Depletion, degradation, and recovery potential of estuaries and coastal seas. Science 312:1806-1809.

Merkel, K. W. 1988. Growth and survival of transplanted eelgrass: The importance of planting unit size and spacing. In: Proceedings of the California Eelgrass Symposium. Chula Vista, CA.

National Oceanic and Atmospheric Administration-Damage Assessment and Restoration Program (NOAA-DARP). 1999. Discounting and the treatment of uncertainty in natural resource damage assessment. *Technical Paper 99-1.*

National Research Council. 2001. Compensating for Wetlands Losses under the Clean Water Act. National Academy Press, Washington DC, USA.

Orth, R. J., T. J. B. Carruthers, W. C. Dennison, C. M. Duarte, J. W. Fourqurean, K. L. Heck, Jr., A. R. Hughes, G. A. Kendrick, W. J. Kenworthy, S. Olyarnik, F. T. Short, M. Waycott, and S. L. Williams. 2006. A global crisis for seagrass ecosystems. BioScience 56(12):987-996.

Pacific Fishery Management Council (PFMC). 2008. Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery as Amended Through Amendment 19.

Peterson, C.H., R.A. Luttich Jr., F. Micheli, and G.A. Skilleter. 2004. Attenuation of water flow inside seagrass canopies of differing structure. Marine Ecology Progress Series 268: 81-92.

Rumrill, S.S. and V.K. Poulton. 2004. Ecological role and potential impacts of molluscan shellfish culture in the estuarine environment of Humboldt Bay, CA. http://hdl.handle.net/1794/3798

Short, F. T., and S. Wyllie-Echeverria. 1996. Natural and human-induced disturbance of seagrasses. Environmental Conservation 23(1):17-27.

Smith, Timothy M., J. S. Hindell, G. P. Jenkins, and R. M. Connolly. 2008. Edge effects on fish associated with seagrass and sand patches. Marine Ecology Progress Series 359:203-213.

South Florida Water Management District. 2007. Environmental Monitoring Report Guidelines. Environmental Resource Regulation Department. 18 p.

Thom, R.N. 1990. A review of eelgrass (*Zostera marina L.*) transplanting projects in the Pacific Northwest. The Northwest Environmental Journal 6:121-137.

Thom, R.N., J. Gaeckle, A. Borde, M. Anderson, M. Boyle, C. Durance, M. Kyte, P. Schlenger, J. Stutes, D. Weitkamp, S. Wyllie-Echeverria, and S. Rumrill. 2008. Eelgrass (*Zostera marina L.*) restoration in the Pacific Northwest: recommendations to improve project success. U.S. Department of Energy. Technical Report WA-RD 706.1.

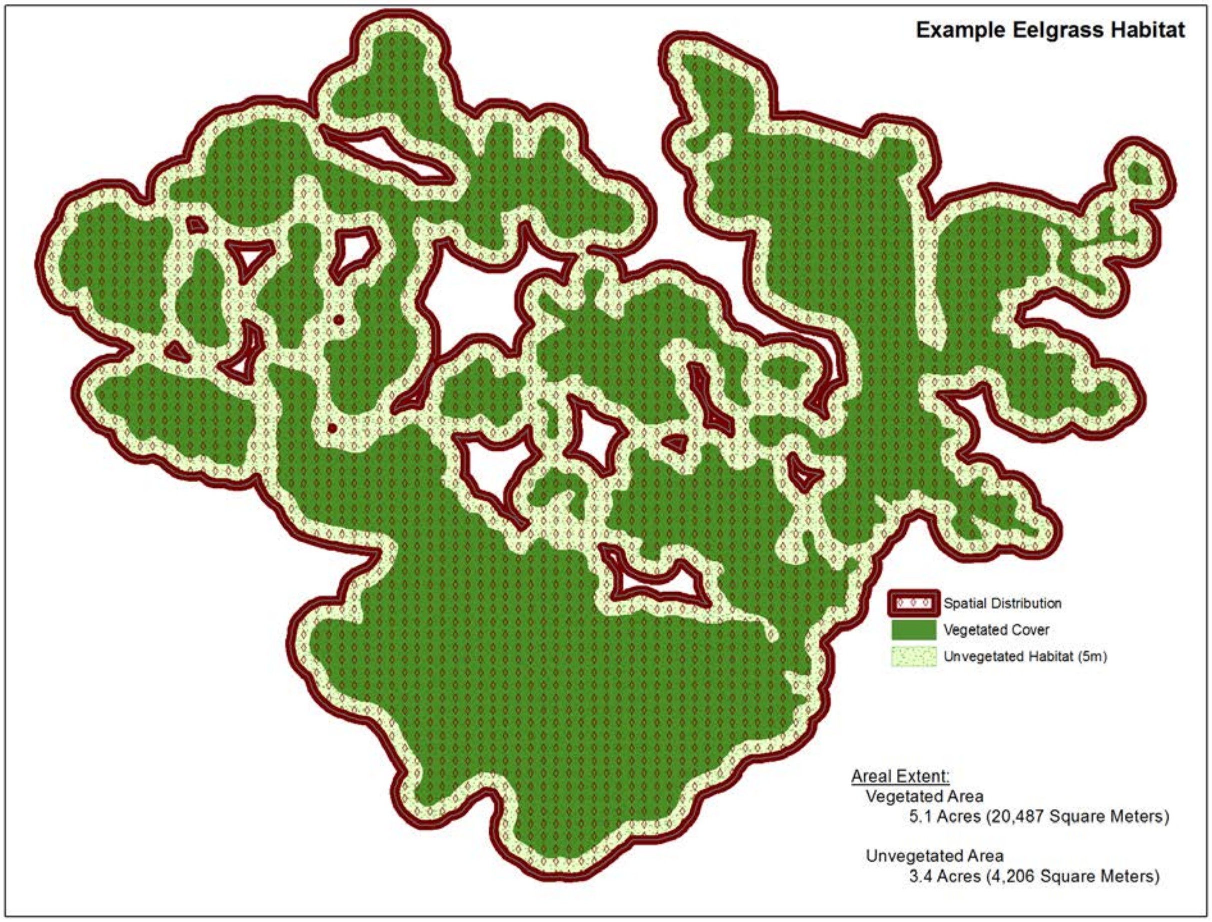
United States Army Corps of Engineers. 2010. New England District Compensatory Mitigation Guidance. 94 p.

van Houte-Howes, S.J. Turner, and C. A. Pilditch. 2004. Spatial Differences in Macroinvertebrate Communities in Intertidal Seagrass Habitats and Unvegetated Sediment in Three New Zealand Estuaries. Estuaries 27(6):945-957.

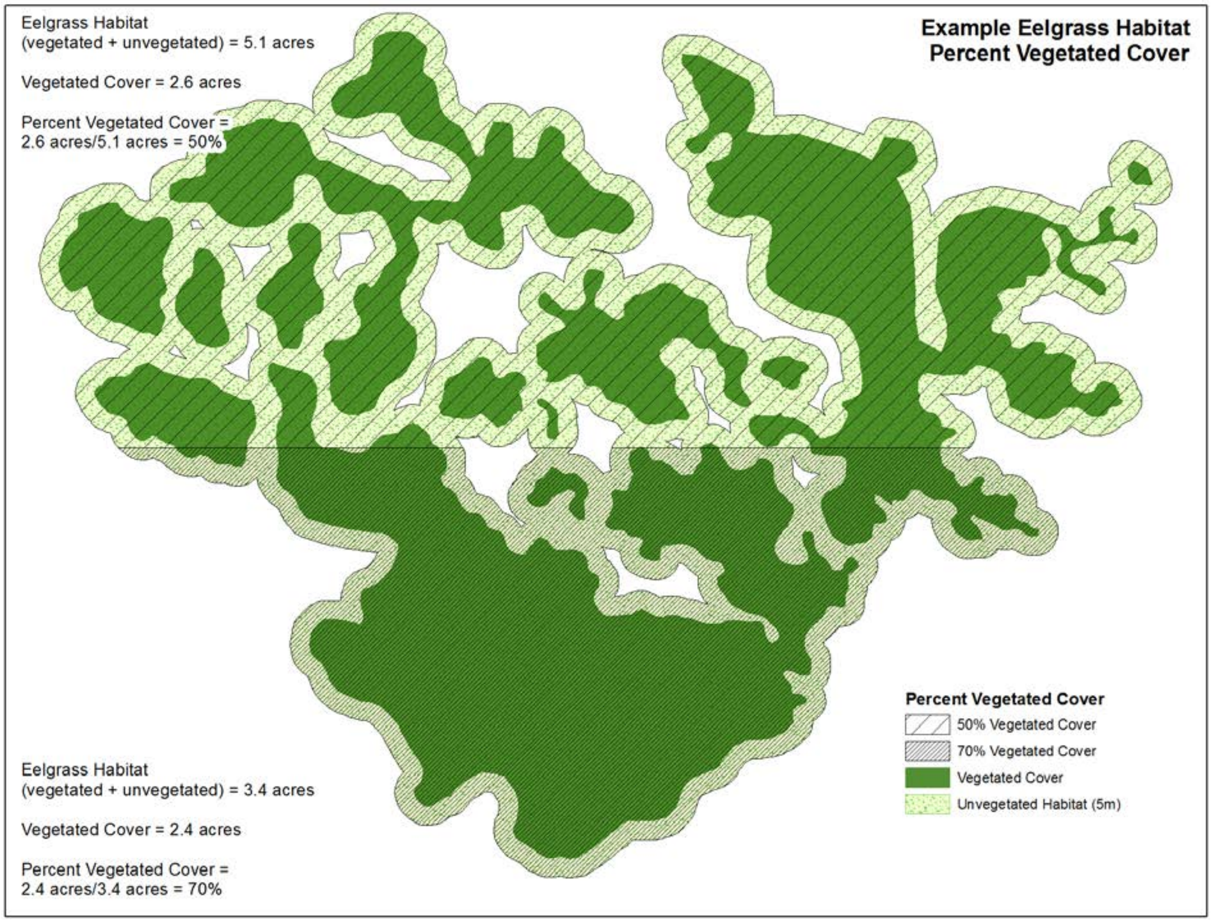
Washington Department of Fish and Wildlife. 2008. Eelgrass/macroalgae habitat interim survey guidelines (http://wdfw.wa.gov/publications/00714/).

Webster, P.J., A.A. Rowden, and M.J. Attrill. 1998. Effect of shoot density on the infaunal macro-invertebrate community within a *Zostera marina* seagrass bed. Estuarine, Coastal and Shelf Science 47: 351-357.

ATTACHMENT 1. Graphic depiction of eelgrass habitat definition including spatial distribution and aerial coverage of vegetated cover and unvegetated eelgrass habitat.

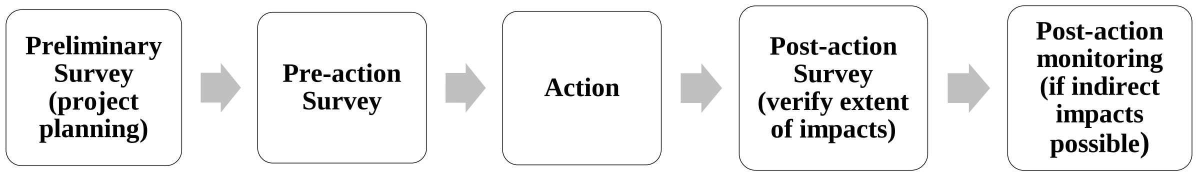


ATTACHMENT 2. Example Eelgrass Habitat Percent Vegetated Cover.



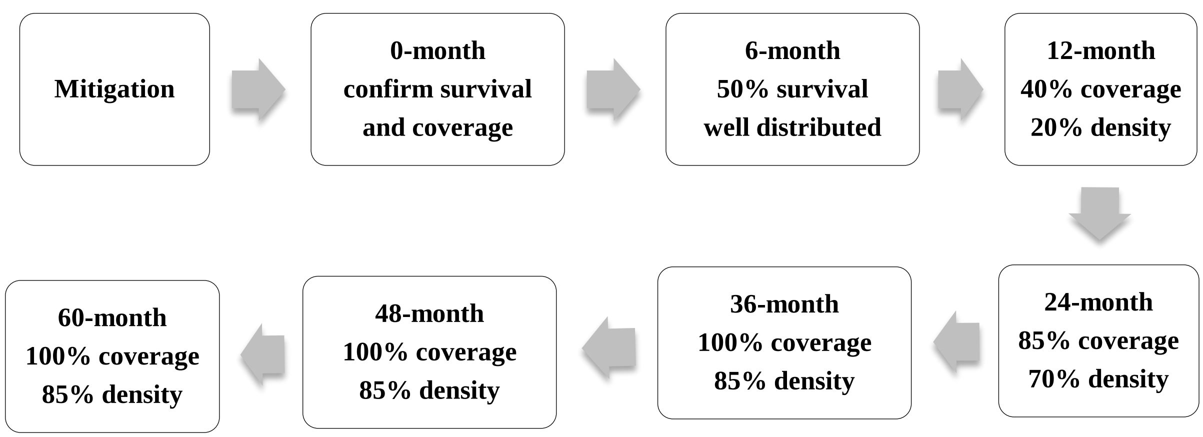
ATTACHMENT 3. Flow chart depicting timing of surveys and monitoring.

a) Eelgrass impact surveys



- All surveys should be completed during the growing season
- Surveys should be completed at the impact site and an appropriate reference site(s)
- A preliminary survey completed for planning purposes may be completed a year or more in advance of the action.
- Pre-action and post-action surveys should be completed within 60 days of the action.
- A survey is good for 60 days, or if that 60 day period extends beyond the end of growing season, until start of next growing season
- Two years of monitoring following the initial post-action monitoring event may be needed to verify lack or extent of indirect effects.
- Survey reports should be provided to NMFS and the federal action agency within 30 days of completion of each survey event

b) Eelgrass mitigation monitoring



- Mitigation should occur coincident or prior to the action
- All monitoring should be completed during the growing season
- Performance metrics for each monitoring event are compared to the 1.2:1 mitigation ratio
- Monitoring reports should be provided to NMFS and the federal action agency 30 days of completion of each monitoring event
- NMFS and action agency will evaluate if performance metrics met, and decide if supplemental mitigation or other adaptive management measures are needed

ATTACHMENT 4. Eelgrass transplant monitoring report.

In order to ensure that NMFS is aware of the status of eelgrass transplants, action agencies should provide or ensure that NMFS is provided a monitoring report summary with each monitoring report. For illustrative purposes only, an example of a monitoring report summary is provided below.

ACTION PARTY CONTACT INFORMATION:

Action Name (same as permit reference):

(a) Action party Information

Name		Address	
Contact Name		City, State, Zip	
Phone		Fax	
Email			

MITIGATION CONSULTANT

Name		Address	
Contact Name		City, State, Zip	
Phone		Fax	
Email			

PERMIT DATA:

Permit	Issuance Date	Expiration Date	Agency Contact

EELGRASS IMPACT AND MITIGATION NEEDS SUMMARY:

Permitted Eelgrass Impact Estimate (m^2):			
Actual Eelgrass Impact (m^2):		On (post-construction date):	
Eelgrass Mitigation Needs (m^2):		Mitigation Plan Reference:	
Impact Site Location:			
Impact Site Center Coordinates (actionion &			

datum):	
Mitigation Site Location:	
Mitigation Site Center Coordinates (actionion & datum):	

ACTION ACTIVITY DATA:

Activity	Start Date	End Date	Reference Information
Eelgrass Impact			
Installation of Eelgrass Mitigation			
Initiation of Mitigation Monitoring			

MITIGATION STATUS DATA:

	Mitigation Milestone	Scheduled Survey	Survey Date	Eelgrass Habitat Area (m^2)	Bottom Coverage (Percent)	Eelgrass Density (turions/m^2)	Reference Information
Month	0						
	6						
	12						
	24						
	36						
	48						
	60						

FINAL ASSESSMENT:

Was mitigation met?	
Were mitigation and monitoring performed timely?	
Were mitigation delay increases needed or were supplemental mitigation programs necessary?	

ATTACHMENT 5. Wetlands mitigation calculator formula and parameters.

Starting mitigation ratios for each region within California were calculated using “The Five-Step Wetland Mitigation Ratio Calculator” (King and Price 2004) developed for NMFS Office of Habitat Conservation. The discrete time equation this method uses to solve for the appropriate mitigation ratio is as follows:

$$R = \frac{\sum_{t=0}^{T_{max}} (1+r)^{-t}}{(B(1-E)(1+L)-A)\left[\sum_{t=-D}^{C-D-1} \frac{(t+D)}{C(1+r)^{t}} + \sum_{C-D}^{T_{max}} (1+r)^{-t}\right] + \left[\sum_{t=-D}^{T_{max}} \frac{\left(1-(1-k)^{(t+D)}\right)}{(1+r)^{(t+D)}}\right](A(1+L))}$$

The calculator parameters in the above equation and values used to calculate starting mitigation ratios for CEMP are as follows:

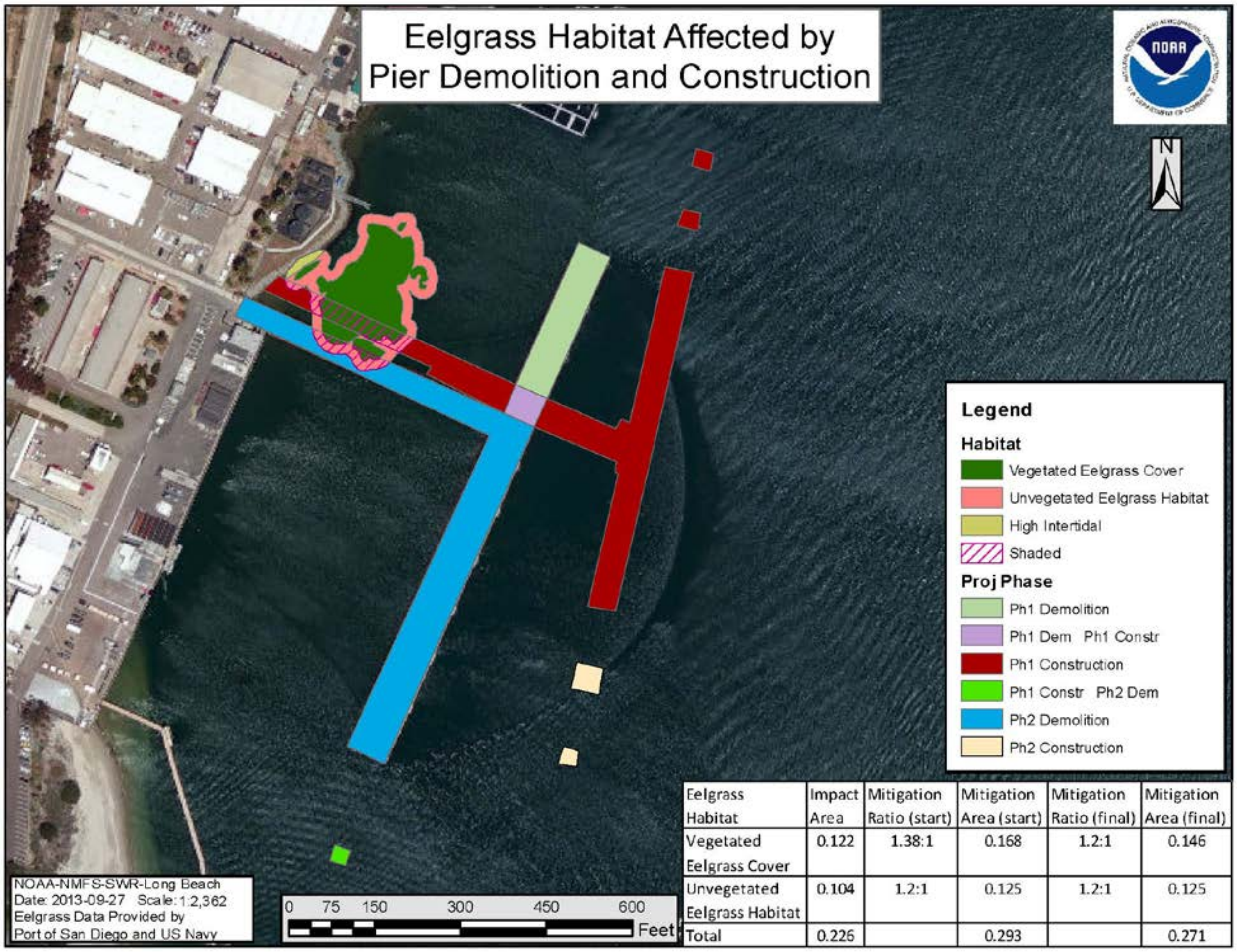
Symbol	Calculator Parameter	Value
A	The level of habitat function provided at the mitigation site prior to the mitigation project	0%
B	The maximum level of habitat function that mitigation is expected to attain, if it is successful	100%
C	The number of years after construction that the mitigation project is expected to achieve maximum function	3 yrs
D	The number of years before destruction of the impacted wetland that the mitigation project begins to generate habitat function	0 yrs
E	The percent likelihood that the mitigation project will fail and provide none of the anticipated benefits	various*
L	The percent difference in expected habitat function based on differences in landscape context of the mitigation site when compared with the impacted wetland	0%
k	The percent likelihood that the mitigation site, in the absence purchase or easement would be developed in any future year	0%
r	The discount rate used for comparing gains and losses that accrue at different times in terms of their present value	3%**
Tmax	The time horizon used in the analysis (chosen to maintain 1.2:1 ratio at E=100% and other parameter values listed above).	13 yrs

* The value for E was based on regional history of success in eelgrass mitigation and varied between regions (see Attachment X).

** NOAA suggests the use of a 3 percent real discount rate for discounting interim service losses and restoration gains, unless a different proxy for the social rate of time preference is more appropriate. (NOAA-DARP 1999) We use this value here, because it is based on best available information and is consistent with the NOAA Damage Assessment and Restoration Program.

ATTACHMENT 6. Example calculations for application of starting and final mitigation ratios for impacts to eelgrass habitat in southern California.

In this example, a pier demolition and construction would impact 0.122 acres of vegetated eelgrass habitat (dark green) and 0.104 acres of unvegetated habitat (pink). Area of impact is indicated by purple hatch mark. Application of recommended starting mitigation ratio for southern California (1.38:1) and final mitigation ratio (1.2:1) to compute starting and final mitigation area for this example are shown in the table.



Eelgrass Habitat	Impact Area	Mitigation Ratio (start)	Mitigation Area (start)	Mitigation Ratio (final)	Mitigation Area (final)
Vegetated Eelgrass Cover	0.122	1.38:1	0.168	1.2:1	0.146
Unvegetated Eelgrass Habitat	0.104	1.2:1	0.125	1.2:1	0.125
Total	0.226		0.293		0.271

ATTACHMENT 7. Example mitigation area multipliers for delay in initiation of mitigation activities.

Delays in eelgrass transplantation result in delays in ultimate reestablishment of eelgrass habitat values, increasing the duration and magnitude of project effects to eelgrass. The delay multipliers in the table below have been generated by altering the implementation start time within "The Five-Step Wetland Mitigation Ratio Calculator" (King and Price 2004).

MONTHS POST-IMPACT	DELAY MULTIPLIER (Percent of Initial Mitigation Area Needed)
0-3 mo	100%
4-6 mo	107%
7-12 mo	117%
13-18 mo	127%
19-24 mo.	138%
25-30 mo.	150%
31-36 mo	163%
37-42 mo.	176%
43-48 mo.	190%
49-54 mo.	206%
55-60 mo.	222%

ATTACHMENT 8. Summary of Eelgrass Transplant Actions in California

See table starting next page.

SUMMARY OF EELGRASS (*ZOSTERA MARINA*) TRANSPLANT PROJECTS IN CALIFORNIA

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
Southern California Eelgrass Restoration History									
	Southern	San Diego Bay	North Island	1976	<0.1	SP	yes	no	-
	Southern	San Diego Bay	"Delta" Beach	1977	1.6	SP	yes	partial	-
	Southern	San Diego Bay	North Island	1978	<0.1	SP	yes	yes	+
	Southern	Newport Bay	Carnation Cove	1978	<0.1	SP	no	no	-
	Southern	Newport Bay	West Jetty	1980	<0.1	SP	yes	partial	0
	Southern	Mission Bay	multiple beaches	1982	<0.1	SP	no	partial	0
	Southern	LA/LB Harbor	Cabrillo Beach	1985	<0.1	BR	yes	yes	+
	Southern	Alamitos Bay	Peninsula	1985	<0.1	BR	yes	yes	+
	Southern	Huntington Hbr.	Main Channel	1985	<0.1	BR	yes	no	0
	Southern	Newport Bay	Upper	1985	<0.1	BR	yes	no	0
	Southern	Mission Bay	Sail Bay	1986	2.7	BR	yes	yes	+
	Southern	San Diego Bay	NEMS I	1987	3.8	BR	no	yes	+
	Southern	San Diego Bay	Chula Vista Wildlife Reserve	1987	<0.1	BR	yes	no	+[1]
	Southern	San Diego Bay	Harbor Island	1988	0.1	BR	yes	yes	+
	Southern	Huntington Harbour	Entrance Channel	1989	0.1	BR	no	yes	+
	Southern	San Diego Bay	Le Meridien Hotel	1990	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Embarcadero	1991	<0.1	BR	yes	yes	+[2]
	Southern	Mission Bay	Sea World Lagoon	1991	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Loew's Marina	1991	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	NEMS 2	1993	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Sea Grant Study	1993	<0.1	BR	yes	yes	+
	Southern	Agua Hedionda Lagoon	Outer Lagoon	1993	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	NEMS 5	1994	0.4	BR	yes	yes	+
	Southern	Mission Bay	South Shores Basin	1994	2.9	BR	yes	yes	+
	Southern	Talbert Marsh	Talbert Channel	1995	<0.1	BR	na	yes	+[4]
	Southern	Mission Bay	various sites	1995	4.8	BR	yes	yes	+
	Southern	Mission Bay	Ventura Cove[5]	1996	0.5	BR	yes	yes	+[6]
	Southern	Mission Bay	Santa Clara Cove	1996	<0.1	BR	yes	no	0[10]
	Southern	Mission Bay	West Mission Bay Drive Bridge	1996	<0.1	BR	no	yes	0[10]
	Southern	Mission Bay	De Anza Cove	1996	<0.1	BR	yes	yes	+
	Southern	Batiquitos Lagoon	all basins	1997	21.6 [7]	BR	yes	yes	+[4]
	Southern	San Diego Bay	NEMS 5	1997	7.1	BR	yes	yes	+
	Southern	San Diego Bay	Convair Lagoon	1998	2.5	BR	yes	no	-[12]
	Southern	San Diego Bay	NEMS 6	1999	0.3	BR	yes	yes	+
	Southern	Aqua Hedionda	Bristol Cove	1999	0.3	BR	yes	yes	+
	Southern	Aqua Hedionda	Middle Lagoon and Inner Lagoon	1999	4	BR	yes	yes	+
	Southern	Newport Bay	Balboa Is.Grand Cana	1999	<0.1	BR	yes	yes	+
	Southern	Mission Bay	West Ski Island	2001	0.2	BR	yes	yes	+

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
	Southern	San Diego Bay	Expanded NEMS 6	2001	0.6	BR	yes	yes	+
	Southern	Newport Bay	USCG Corona del Mar	2002	<0.1	BR	yes	yes	+
	Southern	Huntington Harbour	Sunset Bay	2002	<0.1	BR	yes	yes	+
	Southern	San Diego Bay	Navy Enhancement Is.	2002	1	BR	yes	yes	+
	Southern	San Diego Bay	Coronado Bay Bridge	2003	0.3	BR	no	no	0
	Southern	LA Harbor	P300 Expansion Area	2003	5.9	BR	yes	partial	-[9]
	Southern	Newport Bay	Newport Bay Channel Dredging	2004	0.4	BR	yes	no	-
	Southern	San Diego Bay	South Bay Borrow Pit	2004	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	USCG ATC Pier	2004	0.1	BR	yes	yes	+
	Southern	San Diego Bay	South Bay Borrow Pit Sup.	2006	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	D Street Marsh	2006	0.3	BR	yes	pending	pending
	Southern	LA Harbor	P300 Supplement	2007	0.8	BR	yes	yes	pending
	Southern	San Diego Bay	Glorietta Bay Shoreline Park	2007	0.2	BR	yes	yes	pending
	Southern	Bolsa Chica	Pilot Eelgrass Restoration	2007	0.5	BR	yes	yes	+[4]
	Southern	San Diego Bay	Borrow Pit Supplement	2007	4.2	BR	yes	yes	pending[8]
	Southern	San Diego Bay	Sweetwater Silvergate Frac-out	2008	<0.1	BR	yes	yes	0[11]
	Southern	San Diego Bay	Harbor Drive Bridge/NTC Channel	2009	<0.1	BR	yes	pending	pending
Southern California Eelgrass Success Rate (1989-2009, Last 20 Years)								**87%**	**n=43**
Central California Eelgrass Restoration History									
	Central	Morro Bay	Anchorage Area	1985	<0.1	BR	no	yes	+
	Central	Morro Bay	Target Rock	1997	<0.1	BR	no	yes	+
	Central	Morro Bay	Morro Bay Launch Ramp	2000	<0.1	BR	yes	yes	+
	Central	Morro Bay	Mooring Area A1	2002	0.3	BR	yes	yes	+
	Central	Morro Bay	Western Shoal	2010	0.8	BR	yes	pending	pending
Central California Eelgrass Success Rate (1985-2009, Inadequate History to Exclude Older Projects)								**100%**	**n=4**
San Francisco Bay Eelgrass Restoration History									
	San Francisco Bay	San Francisco Bay	Richmond Training Wall	1985	<0.1	BR	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Keil Cove and Paradise Cove	1989	0.1	Plugs	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Bayfarm Island/Middle Harbor Shoal	1998	0.1	BR and Plugs	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Bayfarm Island	1999	0.1	BR	NA	partial	NA[4]
	San Francisco Bay	San Francisco Bay	Brickyard Cove, Berkeley	2002	0.2	BR	yes	yes	+[13]
	San Francisco Bay	San Francisco Bay	Emeryville Shoals	2002	0.1	Mixed Test	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	0.6	Seed Bouy	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	<0.1	mod. TERFS	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Marin CDay, R&GC, Audubon	2006	<0.1	Seeding	NA	no	NA[4]
	San Francisco Bay	San Francisco Bay	Clipper Yacht Harbor, Sausalito	2007	<0.1	Frames	yes	pending	pending
	San Francisco Bay	San Francisco Bay	Albany, Emeryville, San Rafael	2007	<0.1	BR	NA	partial	pending[4]
	San Francisco Bay	San Francisco Bay	Belvedere	2008	<0.1	Frames	yes	pending	pending
San Francisco Bay Eelgrass Success Rate (1985-2009, Inadequate History to Exclude Older Projects)								**40%**	**n=10**

No.	Region	System	Location	Year	Size*	Type**	Consistent with Permit Conditions	Success Status***	Net Result****
Northern California Eelgrass Restoration History									
	Northern	Humboldt Bay	Indian Island	1982	unknown	BR	unknown	no	-
	Northern	Bodega Harbor	Spud Point Marina	1984	1.3	BR	yes	no	-
	Northern	Humboldt Bay	Indian Island	1986	<0.1	BR	yes	no	-
	Northern	Humboldt Bay		1986	0.2	unknown	unknown	no	-
	Northern	Humboldt Bay	SR255 Bridge	2004	<0.1	BR	yes	no	-
	Northern	Humboldt Bay	Maintenance Dredging Project	2005	<0.1	BR	yes	yes	+
Northern California Eelgrass Success Rate (1982-2009, Inadequate History to Exclude Older Projects)								**25%**	**n=4**

* size in hectares

SP = sediment laden plug

** BR = bare root

*** success status is measured as yes, no, partial, pending, or unknown. Success rate is reported as percentage of sucessful over total completed within the past 25 years.
yes = 1, partial = 0.5, no = 0, and pending or unknown are not counted in either the numerator or denominator in determining success percentage.

**** + = net increase in eelgrass coverage, 0 = no change in eelgrass coverage, - = net decrease in eelgrass coverage

1 Transplant was initially adversely impacted by an unknown source of sediment and was deemed unsuitable.

2 The transplant declined initially and later recovered from what was determined to be a one time sedimentation event.

3 Transplant was experimental due to dense beds of the exotic muscle*Musculista senhousia*
which inhibited the growth of the transplant. Replacement transplant done elsewhere.
Transplant was completed in an area deemed unsuitable. Insufficient coverage required the construction of a remedial site.
Monitoring continues at both the initial and remedial sites.

4 Transplant was experimental.

5 Multiple sites.

6 Mitigation for marina at Princess Resort, project not built

7 Amount of eelgrass present within all basins as of 2000 mapping.

8 Regional eelgrass decline has resulted in die-offs both within restoration and reference areas equally full recovery had not occurred at the time of evaluation, yet project exceeds control-corrected requ

9 Original site was constructed as a plateau that was underfilled and anticipated to fall short of objectives. A supplemental
transplant was therefore completed when development began to exhibit shortfalls in area.

10 Shortfall mitigated by withdraw from established eelgrass mitigation bank.

11 Exception conditions from SCEMP requiring only replacement in place for unanticipated damage

12 Mitigated out-of-kind with non-eelgrass to satisfy permit requirements after shortfall in eelgrass mitigation.

Attachment C

Notice of Intent

California Regional Water Quality Control Board
San Francisco Bay Region

Watershed Division
1515 Clay Street, Suite 1400, Oakland, CA 94612

NOTICE OF INTENT

TO COMPLY WITH THE TERMS OF
GENERAL WASTE DISCHARGE REQUIREMENTS FOR PROJECTS UNDER THE CONSTRUCTION AND MAINTENANCE OF OVERWATER STRUCTURES
IN
SAN FRANCISCO BAY
ORDER NUMBER R2-2018-XXXX

FOR AGENCY TRACKING USE ONLY			
Place ID:	*Reg Measure ID:*	*Date NOI Received:*	*Check# and Amount*

I. PROJECT and APPLICANT INFORMATION

Project Title:	Click here to enter text.		
Applicant Name:	Click here to enter text.		
Business/Agency:	Click here to enter text.		
Street Address:	Click here to enter text.		
City, County, State, Zip:	Click here to enter text.		
Telephone:	Click here to enter text.	Fax	Click here to enter text.
E-mail:	Click here to enter text.		

II. PROPERTY OWNER ☐ Check Box if Same As Above

Name:			
Street Address:	Click here to enter text.		
City, County, State, Zip:	Click here to enter text.		
Telephone:	Click here to enter text.	Fax	Click here to enter text.
E-mail:	Click here to enter text.		

III. PROJECT LOCATION

A. Address or description of project location.				
Click here to enter text.				
B. Check box to verify that a map of the project location is enclosed:	☐			
C. County:	Click here to enter text.			
D. Assessor's Parcel No.:	Click here to enter text.			
E. Coordinates (*If available, provide at least latitude/longitude or UTM coordinates. Check appropriate boxes)*				
Latitude/Longitude:	*Latitude:*	Click here to enter text.	*Longitude:*	Click here to enter text.
	☐ Degrees/Minutes/Seconds	☐ Decimal Degrees	☐ Decimal	

IV. PROJECT CATEGORY

Explain the covered activity or activities being implemented for this project:
Click here to enter text.

V. PROJECT INFORMATION

A. Estimated Project Term:	Beginning (Month / Year)	Click here to enter text.	Ending (Month / Year)	Click here to enter text.
B. Seasonal Work Period:	Click here to enter text.			
C. Estimated Total Number of Work Days:	Click here to enter text.			

D. Describe the project in detail and enclose diagrams, drawings, plans, and/or maps that provide all of the following: site-specific construction details; dimensions of each structure; extent of activity in San Francisco Bay, where equipment will enter or exit the area, if applicable; and project overview showing the location of each structure and calculations at each site of area of disturbance. (*Attach additional sheets as needed*).
Click here to enter text.
E. Specify the equipment and machinery (if any) that will be used to complete the project. Describe in detail the measures that will be taken to prevent unauthorized discharges of construction materials and waste.
Click here to enter text.

H. Projects associated with construction or maintenance, including upgrades, retrofit, expansion, demolition, and reconfiguration of piers and docks (including associated ramps and floating docks) up to 10,000 square feet of overwater coverage are permitted under this Order. This includes pile removal, replacement, and installation. Will the proposed project fit under this category?	☐ yes ☐ no
I. Projects associated with upgrade, retrofit, expansion, demolition, and reconfiguration and new construction of wharves and marinas with less than 50,000 square feet of overwater coverage are permitted under this Order. This includes pile removal, replacement, and installation. Will the proposed project fit under this category?	☐ yes ☐ no
J. Is this project within 150 feet of mapped eelgrass beds? Maps of eelgrass beds in the San Francisco Bay are available on the Department of Fish and Wildlife's MarineBIOS website at http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/seagrass_info/california_eelgrass.html To access the eelgrass layers, click on the habitat drop down menu at the layers tab.	☐ yes ☐ no
K. If the proposed project is within 150 feet of mapped eelgrass beds, by checking the "yes" box, the Applicant confirms they will perform pre-construction eelgrass surveys during the active growth period, from May – September.	☐ yes ☐ no
L. Project activities within 700 feet of tidal marsh of suitable Ridgway's Rail (formerly California Clapper Rail) or California Black Rail habitat are prohibited during rail breeding season (January 15 - August 31 for Ridgway's Rail, February 1 - August 31 for California Black Rail). By checking "yes", the Applicant confirms they will work outside these dates.	☐ yes ☐ no
M. No project activities shall occur within 50 feet of suitable Ridgway's Rail or California Black Rail habitat during extreme high tide events or when adjacent tidal marsh is flooded. Extreme high tides events are defined as a tide forecast of 6.5 feet or higher measured at the Golden Gate Bridge and adjusted to the timing of local high tides. By checking "yes", the Applicant confimrs they will comply with these conditions.	☐ yes ☐ no

VI. DISCHARGE INFORMATION

B. Identify the volume or quantity of material for each project activity that will result in impacts to Waters. Declare the amount of each type of materials placed in Waters and whether the placement is temporary or permanent.

Material Type	Volume or Number	Maximum Allowed	Permanent Effect
1. Piles	Click here to enter text.	20 per day	☐ yes ☐ no
2. Piers and Docks	Click here to enter text.	10,000 square feet	☐ yes ☐ no
3. Wharves and Marinas	Click here to enter text.	50,000 square feet	☐ yes ☐ no

4. Floats and Buoys	Click here to enter text.		☐ yes ☐ no
5. Bank Stabilization	Click here to enter text.	500 linear feet	☐ yes ☐ no

VII. PROJECT SIZE

A. For the receiving water body, indicate the area(s) in ACRES and/or LINEAR FEET that will be affected by the project and identify the impact(s) as permanent or temporary.

San Francisco Bay	Temporary Impact		Permanent Impact	
	Acres	Linear Feet	Acres	Linear feet
AREA AFFECTED	Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.

IX. NOTICE OF TERMINATION AND CERTIFICATION

Applicants must notify the Regional Water Board once the project is complete, including as-built plans and date of completion.

X. APPLICATION REQUIREMENTS AND FEES

Permit:	Submit Application to:	Time Restrictions:
General WDR Order No. R2-2018-XXXX	Regional Water Board – SF Bay Region Watershed Management Division 1515 Clay Street, Suite 1400, Oakland, CA 94612	Must be submitted at least 30 days prior to start of proposed project.
Fees:	Submit with this NOI the required fee for the project. Fees are determined based on the current statewide Dredge & Fee calculator. The calculator is available on the "resources for applicants" section of the Water Boards' Dredge/Fill (401) and Wetlands program website: http://www.waterboards.ca.gov/water_issues/programs/cwa401/#resources	

XI. SIGNATURE / CERTIFICATION

San Francisco Bay Regional Water Quality Control Board: Notice of Intent to Comply with the Terms of General Waste Discharge Requirements and Clean Water Act § 401 Water Quality Certification for the construction and maintenance of Overwater Structures - Order No. R2-2018-XXXX

I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel property gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and/or imprisonment. Furthermore, I understand and will comply with the Requirements of Order R2-2018-XXXX.
______________________________ Applicant Signature   ______________ Date ______________________________ Printed Name