APPENDIX G

NMFS ESSENTIAL FISH HABITAT ASSESSMENT

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

August 9, 2022

Dan Lawson
Long Beach Office Branch Chief (Acting)
Protected Resources Division
National Marine Fisheries Service, West Coast Region
National Oceanic and Atmospheric Administration

Re: Submittal of the Essential Fish Habitat Assessment for the United States-Mexico-Canada Agreement Mitigation of Contaminated Transboundary Flows Project (Alternative 1) and request for review and concurrence pursuant to the Magnuson-Stevens Fishery Conservation and Management Act

Dear Dan Lawson:

The United States Environmental Protection Agency, Region 9 (EPA) would like to request the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) review of the enclosed Essential Fish Habitat (EFH) Assessment. EPA is submitting this request pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the implementing regulations found at 50 CFR Part 600. The proposed Federal Action is the implementation of Alternative 1 of the United States-Mexico-Canada Agreement (USMCA) Mitigation of Contaminated Transboundary Flows Project, as described below and in the EFH Assessment. EPA has determined that implementation of the proposed Federal Action will adversely affect EFH that occurs within the proposed Federal Action's Action Area.

In January 2020, Congress passed the USMCA Implementation Act, which appropriated funds to EPA for implementation of wastewater infrastructure projects at the U.S.-Mexico border and authorized EPA to plan, design, and construct wastewater treatment projects in the Tijuana River area. These projects aim to reduce transboundary flows that cause adverse public health and environmental impacts in the Tijuana River watershed and adjacent coastal areas. In accordance with the requirements of the National Environmental Policy Act, EPA has developed a Draft Programmatic Environmental Impact Statement (PEIS) to support an informed decision-making process that considers and reviews the environmental impacts of reasonable alternatives to meet the purpose and need of the USMCA goals.

EPA has identified two alternatives that it has evaluated in its Draft PEIS: a limited funding approach for implementation (Alternative 1) and a more comprehensive solution (Alternative 2) that would warrant additional funding. EPA has not yet identified a preferred alternative; however, EPA has completed an EFH Assessment evaluating potential effects to EFH for the activities associated with Alternative 1, which includes four Core Projects. If implemented, and as described in the Draft PEIS, most activities under the Core Projects would be located within the U.S. in the Tijuana River Valley in San Diego, California. Though Alternative 1 also includes actions in Mexico, the EFH Assessment does not include analysis for international activities occurring in Mexico except when transboundary flows could be affected. Further details regarding the USMCA Mitigation of Contaminated Transboundary Flows Project are provided in the Draft PEIS, which was made available for public review on June 17, 2022.[1]

On May 5, 2022, EPA submitted to NMFS a preliminary draft combined BA and EFH Assessment report and solicited feedback regarding whether EPA should move forward with requesting official review pursuant to ESA Section 7 and the MSA. On May 25, 2022, EPA submitted to NMFS a draft BA and EFH report for review with a request to initiate informal consultation (see Appendix E of the Draft PEIS). On May 27, 2022, NMFS provided comments on the May 5, 2022 preliminary draft BA and EFH report and requested that EPA make appropriate revisions before resubmitting the BA and EFH Assessment to initiate consultation pursuant to ESA Section 7 and the MSA. Since receiving the comments from NMFS on the preliminary draft, EPA decided to separate the BA and EFH Assessments into their own distinct reports, rather than a combined report. The enclosed EFH Assessment incorporates revisions intended to address NMFS's comments related to EFH on the May 5, 2022 preliminary draft BA and EFH Assessment report.

EPA's evaluation of the EFH in the Action Area and potential effects associated with the construction and operations of Alternative 1 are detailed in the enclosed EFH Assessment. The proposed Federal Action will result in a net reduction in effects and a benefit to EFH in the Action Area. In order to achieve these benefits to marine water quality, the proposed Federal Action will increase discharges of treated effluent via the SBOO due to the expansion of treatment facilities in the U.S. This increase in discharges via the SBOO that will occur due to the proposed Federal Action ***would adversely affect*** EFH within the area of the ZID due to an increase in the total amount of chemicals toxic to marine life. There remains uncertainty as to whether, and to what degree, EFH located outside of the ZID would be affected by the discharge. Additionally, as described in the EFH Assessment, anchor deployment during recommissioning of diffuser ports on the SBOO may disturb small areas of seabed communities, which ***would adversely affect*** Groundfish EFH within the affected footprint; the recommissioning contractor will adhere to the mitigation measures described in that section. Within the ZID, adverse effects that have the potential to occur are limited to these two effects. With regard to the portion of the Action Area outside of the ZID, the EFH Assessment concludes that the proposed Federal Action ***would not adversely affect*** EFH outside of the ZID. The proposed Federal Action would improve the quality of EFH throughout the Action Area beyond the ZID. Table 1 below summarizes effects determinations for EFH in the Action Area.

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[1] The Draft PEIS and appendices are available on EPA's website at https://www.epa.gov/sustainable-water-infrastructure/usmca-draft-programmatic-environmental-impact-statement.

Table 1. Summary of EPA's Effects Determination by Essential Fish Habitat for Construction and Operation.

Essential Fish Habitat	Effects from Construction	Effects from Operation
Pacific Coast Groundfish EFH	Would Adversely Affect [a]	Would Adversely Affect [b]
Coastal Pelagic Species and Krill EFH	No Adverse Effect	Would Adversely Affect [b]
Dorado EFH (HMS FMP)	No Adverse Effect	Would Adversely Affect [b]
Common Thresher Shark EFH (HMS FMP)	No Adverse Effect	Would Adversely Affect [b]
Rocky Reef HAPC (Imperial Beach Kelp Forest) (PCG FMP)	No Adverse Effect	No Adverse Effect
Canopy Kelp HAPC (Imperial Beach Kelp Forest) (PCG FMP)	No Adverse Effect	No Adverse Effect
Estuarine HAPC (TJRE) (PCG FMP)	No Adverse Effect	No Adverse Effect
Zuniga Jetty and adjacent seagrass beds (PCG FMP)	No Adverse Effect	No Adverse Effect

a – Adverse effects would be limited to within the seabed area disturbed by anchor deployment.
b – Adverse effects would be limited to within the ZID.

We are hereby requesting review of the enclosed EFH Assessment for the proposed Federal Action by NMFS pursuant to 50 CFR § 600.920 and request concurrence with the effects determinations specified in the EFH Assessment. If you have questions or need additional information, please contact me (415-947-4187, lee.lily@epa.gov) or Mimi Soo-Hoo of my staff (415-972-3500, soo-hoo.mimi@epa.gov).

Sincerely,

LILY LEE Digitally signed by LILY LEE Date: 2022.08.09 17:48:18 -07'00'

Lily Lee
Manager, Infrastructure Section

Enclosures (1):

1. *Essential Fish Habitat Assessment, USMCA Mitigation of Contaminated Transboundary Flows Project,* prepared by Tenera Environmental, Inc. under subcontract to Eastern Research Group, Inc. (August 9, 2022)

cc: (with enclosures)

Chi Mori
Joe Dillon
Bryant Chesney
Susan Wang

Essential Fish Habitat Assessment

USMCA Mitigation of Contaminated Transboundary Flows Project

Prepared for:

United States Environmental Protection Agency
Office of Wastewater Management
1200 Pennsylvania Avenue, NW
Washington DC 20460

Prepared by:

Eastern Research Group, Inc.

Tenera Environmental, Inc.

9 August 2022

Work Performed Under EPA Contract No. 68HERH19D0033
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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

ADCP	acoustic doppler current meter
APTP	advanced primary treatment plant
BA	Biological Assessment
BOD	biochemical oxygen demand
CDFW	California Department of Fish and Wildlife
CEC	Contaminant of Emerging Concern
CFR	Code of Federal Regulations
CILA	Comisión International de Limites y Aguas
CoSD	City of San Diego
CPS	Coastal Pelagic Species
DDT	dichloro-diphenyl-trichloroethane
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EID	Environmental Information Document
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FMC	Fishery Management Councils
FMP	Fishery Management Plans
ft	feet
GIS	Geographical Information System
HAB	harmful algal blooms
HAPC	Habitat Areas of Particular Concern
HdC	Hotel del Coronado
HMS	Highly Migratory Species
IBWC	International Boundary and Water Commission
ITP	South Bay International Wastewater Treatment Plant
km	kilometer(s)
m	meter(s)
MGD	million gallons per day
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
PB-CILA	Planta de Bombeo-CILA
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyls
PCG	Pacific Coast Groundfish
PCS	Pacific Coast Salmon
PEIS	Programmatic Environmental Impact Statement
PFMC	Pacific Fishery Management Council
PLOO	Point Loma Ocean Outfall
POP	persistent organic pollutant
PSP	paralytic shellfish poisoning
RNKSC	Region Nine Kelp Survey Consortium
SAB	San Antonio de los Buenos
SBOO	South Bay Ocean Outfall
SBWRP	South Bay Water Reclamation Plant
SD RSMP	San Diego Regional Sediment Management Plan

(Continued)

SF	square feet
SFA	Sustainable Fisheries Act
TBT	tributyltin
TCEP	tris(chloroethyl) phosphate
TCPP	tris(chloropropyl) phosphate
TDCPP	tris(1,3-dichloro-2-propyl) phosphate
TDS	total dissolved solids
TJRE	Tijuana River Estuary
TSS	total suspended solids
U.S.	United States
USIBWC	United States Section of the International Boundary and Water Commission
USMCA	United States–Mexico–Canada Agreement
WWTP	wastewater treatment plant

1. BACKGROUND

1.1 Project Background and Overview

Transboundary flows of untreated wastewater (sewage), trash, and sediment routinely enter the United States (U.S.) from Mexico via the Tijuana River, its tributaries, and across the maritime boundary along the San Diego County coast. Transboundary flows crossing into the U.S. from Mexico have raised water quality and human health concerns since at least the 1930s. These transboundary flows impact public health and the environment and have been linked to beach closures along the San Diego County coast.

In January 2020, Congress passed the U.S.–Mexico–Canada Agreement (USMCA) Implementation Act, which appropriated $300 million to the U.S. Environmental Protection Agency (EPA) under Title IX of the Act for architectural, engineering, planning, design, construction, and related activities in connection with the construction of high-priority wastewater facilities in the U.S.-Mexico border area. Subtitle B, Section 821 of the Act authorized EPA to plan, design, and construct wastewater (including stormwater) treatment projects in the Tijuana River area.

EPA established the Eligible Public Entities Coordinating Group, consisting of federal, state, and local stakeholders, and solicited their input on the set of project options to be considered for evaluation in a Programmatic Environmental Impact Statement (PEIS) consistent with requirements of the National Environmental Policy Act (NEPA). EPA and the U.S. Section of the International Boundary and Water Commission (USIBWC) are joint lead agencies, in accordance with 40 Code of Federal Regulations (CFR) 1501.7, for preparation of the PEIS. EPA and USIBWC have identified three alternatives for evaluation in the PEIS: no disbursement of funding and continuation of current wastewater management practices (No-Action Alternative), a limited funding approach for implementing the Proposed Action (Alternative 1), and a more comprehensive solution for implementing the Proposed Action (Alternative 2). Full implementation of Alternative 1 identified in the PEIS is the proposed Federal Action and the subject of this Essential Fish Habitat (EFH) Assessment prepared pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA). A separate Biological Assessment (BA) report was submitted to the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) on July 22, 2022 that considers the effects of this proposed Federal Action on resources protected under the Endangered Species Act (ESA).

Further details are provided in Section 1.6 (Proposed Federal Action) below and in the Draft PEIS, which was made available for public review on June 17, 2022.[1]

1.2 Consultation History

On February 26, 2021, members of the EPA-led NEPA planning team provided a joint presentation to NMFS that included information on the planning effort underway as part of the USMCA Mitigation of Contaminated Transboundary Flows Project. At this point in the project cycle, the

[1] The Draft PEIS and appendices are available on EPA's website at https://www.epa.gov/sustainable-water-infrastructure/usmca-draft-programmatic-environmental-impact-statement.

EPA-led team had developed 10 project alternatives that were under consideration in an Environmental Information Document (EID).

On July 7, 2021, once the draft EID was near completion, the NEPA planning team gave a second presentation to NMFS that provided an update on three tentative project alternatives that would be brought forward to the PEIS.

On August 4, 2021, the NEPA planning team provided a technical memorandum to NMFS. The technical memorandum intended to further facilitate early discussions between the EPA and NMFS in relation to marine wildlife listed under the ESA and EFH that may be affected by the project. The technical memorandum described the Action Area that could be affected based on the proposed suite of project options under consideration for evaluation in the NEPA process and a discussion of potential EFH in the Action Area identified during the development of the EID. The memorandum also contained a list of species that the EPA had determined could occur within this Action Area and a table of key ESA-related references, primarily related to management milestones for ESA-listed species. EPA requested feedback from NMFS on the EFH resources considered in the technical memorandum, as well as the ESA species list and references table. On August 25, 2021, NMFS provided an email response with comments relating to ESA-related material in the technical memorandum. No comments were provided on the EFH resources.

Since these discussions, EPA completed the Alternative Analysis which identified the Alternatives 1 and 2 considered in the Draft PEIS. The consultation with NMFS includes only Alternative 1 (i.e., the Core Projects). EFH consultation for Supplemental Projects would be conducted, if necessary, at the time of the subsequent tiered NEPA analyses for those projects.

On May 5, 2022, EPA submitted to NMFS a preliminary draft combined BA and EFH Assessment report and solicited feedback regarding whether EPA should move forward with requesting official review pursuant to ESA Section 7 and the MSA. On May 25, 2022, EPA submitted to NMFS a draft BA and EFH Assessment report for review with a request to initiate informal consultation (see Appendix E of the Draft PEIS). On May 27, 2022, NMFS provided comments on the May 5, 2022 preliminary draft BA and EFH Assessment report and requested that EPA make appropriate revisions before submitting the BA and EFH Assessment to initiate consultation pursuant to ESA Section 7 and the MSA. Since receiving the comments from NMFS on the preliminary draft, EPA decided to separate the BA and EFH Assessments into their own distinct reports, rather than a combined report. This EFH Assessment incorporates revisions intended to address NMFS's comments related to EFH on the May 5, 2022 preliminary draft EFH Assessment.

1.3 Transboundary Flows

See Section 1.3 (Transboundary Flows) of the BA report submitted to NMFS on July 22, 2022 for background regarding transboundary flows of untreated wastewater, trash, and sediment that enter the U.S. via the Tijuana River, via tributaries that flow north through canyons to the Tijuana River Valley and Estuary, and via coastal waters of the Pacific Ocean.

1.4 Existing Facilities and Operation

See Section 1.4 (Existing Facilities and Operation) of the BA report submitted to NMFS on July 22, 2022, and Section 1.2 of the Draft PEIS for background regarding existing wastewater collection, conveyance, and treatment infrastructure relevant to the proposed Federal Action.

1.5 South Bay Ocean Outfall

See Section 1.5 (South Bay Ocean Outfall) of the BA report submitted to NMFS on July 22, 2022 for a description of the South Bay Land Outfall and South Bay Ocean Outfall (SBOO), which discharges treated effluent from the South Bay International Wastewater Treatment Plant (ITP) and the South Bay Water Reclamation Plant (SBWRP) to the Pacific Ocean.

1.6 Proposed Federal Action

The proposed Federal Action evaluated in this EFH Assessment is the issuance of U.S. appropriations (including but not limited to USMCA Implementation Act appropriations) for, and implementation (i.e., design and construction) of, water infrastructure projects to address impacts from transboundary flows in the Tijuana River watershed and adjacent coastal areas.

Because of the programmatic nature of the decisions to be made, only certain projects (those identified as Core Projects in the PEIS) will be able to be implemented by USIBWC at the completion of the initial NEPA process. The Core Projects are sufficiently evolved to be ready for decision making but are expected to fully expend the $300 million of USMCA Implementation Act appropriations. Other projects (those identified as Supplemental Projects in the PEIS) are expected to require substantial additional U.S. appropriations beyond the USMCA Implementation Act appropriations and funds from existing programs such as EPA's Border Water Infrastructure Program, and would require additional tiered NEPA review before USIBWC would be able to implement them. Therefore, for purposes of this EFH Assessment, the Federal Action is the funding and implementation of the four projects identified as Core Projects in the PEIS. This corresponds with the scope of PEIS Alternative 1.

The following are the four Core Projects that comprise the proposed Federal Action:

A. Expand the ITP from its current capacity of 25 million gallons per day (MGD) to 60 MGD.[2]

B. Install a wastewater conveyance system from Matadero Canyon and Los Laureles Canyon in Mexico that conveys dry-weather flows to the expanded ITP for treatment.

C. Rehabilitate or replace targeted sewer collectors in Tijuana that currently leak into the Tijuana River.

D. Construct and operate a 35-MGD Advanced Primary Treatment Plant (APTP) for advanced primary treatment of diverted water from the existing Planta de Bombeo-Comisión International de Limites y Aguas (PB-CILA) diversion in Mexico.

See Section 1.6 (Proposed Federal Action) of the BA report submitted to NMFS on July 22, 2022 for a summary of these four projects. See Section 2.4 of the Draft PEIS, which was made available for public review on June 17, 2022, for additional details.[3]

[2] average daily flow

[3] The Draft PEIS and appendices are available on EPA's website at https://www.epa.gov/sustainable-water-infrastructure/usmca-draft-programmatic-environmental-impact-statement.

1.7 Action Area

The Action Area for this EFH Assessment is identical to the Action Area depicted in Section 1.7 (Action Area) of the BA report submitted to NMFS on July 22, 2022.

2. ENVIRONMENTAL BASELINE

See Section 2 (Environmental Baseline) of the BA report submitted to NMFS on July 22, 2022 for content regarding the following:

- Existing oceanographic characteristics, water quality conditions, ocean habitat, and geographic locations of infrastructure in the Action Area.
- Existing SBOO effluent characteristics and pollutant monitoring efforts.
- Estimated zone of initial dilution (ZID) surrounding the SBOO under existing operational conditions, based on nearfield and far-field modeling.
- Previous and ongoing monitoring surveys and detection analyses of the SBOO effluent plume.
- Nearshore pollution—including occurrences of phytoplankton blooms and the transport of norovirus pathogens—that may be affected by the existing conditions of the Tijuana River Estuary (TJRE) and San Antonio de los Buenos (SAB) Creek.
- Other sources that may affect water quality in the Action Area, such as terrestrial runoff from metropolitan areas and discharges from the Point Loma Ocean Outfall (PLOO).
- Existing conditions of seabed habitat and seabed communities in the Action Area.

3. ESSENTIAL FISH HABITAT

3.1 Determination of EFH

The location of areas of EFH in the Action Area and their character is described below. EFH is designated under the MSA of 1976 (Public Law 104-267). The MSA established jurisdiction over marine fishery resources in the U.S. The MSA was reauthorized and amended by the Sustainable Fisheries Act (SFA) of 1996 (Public Law 104-297) to include the EFH mandate. The SFA set forth a number of new directives for NMFS, regional Fishery Management Councils (FMCs), and other federal agencies to identify and protect important marine, estuarine, and anadromous fish habitat. The MSA requires that all federal agencies consult with NMFS on all proposed actions permitted, funded, or undertaken by the agency that may adversely affect EFH.

Congress defined EFH to mean “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (50 CFR § 600.10). In 2002, NMFS further clarified EFH with the following definitions (50 CFR § 600.10):

- “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.
- “Spawning, breeding, feeding, or growth to maturity” covers a species' full life cycle.

The SFA requires that regional FMCs prepare Fishery Management Plans (FMPs) for the identification, protection, and enhancement of EFH for federally “managed species.” There are four FMPs on the Pacific coast of North America that include managed species with designated EFH that may occur in the Action Area. These FMPs are the Coastal Pelagic Species (CPS) FMP, the Pacific Coast Groundfish (PCG) FMP, the Pacific Coast Salmon (PCS) FMP, and the Highly Migratory Species (HMS) FMP.

Two FMPs—the PCG and CPS FMPs—provide very broad definitions of EFH area. Subsequently, most of the Pacific coastline of North America is encompassed by PCG, CPS, and krill EFH (i.e., EFH designated under the CPS FMP for the protection and management of krill [Euphasiids]). The entire submerged portion of the Action Area occurs within the groundfish EFH under the PCG FMP; however, it is noted within the PCG FMP (Pacific Fishery Management Council [PFMC], 2020) that this very broad definition of EFH is “precautionary.” All marine and estuarine waters from the shoreline along the California coast to the limits of the U.S. Exclusive Economic Zone (EEZ) (200 nautical miles [nm]) and above the thermocline where sea surface temperatures range between 50 and 79 degrees Fahrenheit are designated as coastal pelagic EFH under the CPS FMP. The EFH designated for krill extends to the 1,000 fathoms depth contour and from the surface to a depth of 1,300 feet (ft) (PFMC, 2019). Therefore, the entire submerged portion of the Action Area also occurs within CPS EFH. Two species of fishes protected under the HMS FMP, dorado and common thresher shark, have EFH that extends inshore to the 6 fathoms depth contour, overlapping the Action Area, SBOO, effluent discharge, and areas likely affected by the ongoing nearshore pollution via SAB Creek. No PCS FMP EFH is designated in the Action Area.

3.2 Pacific Coast Groundfish EFH

More than 90 species of fishes are managed under the PCG FMP. These include all 70 species of rockfishes, predominantly from the genus *Sebastes*. In addition to the rockfishes, there are 12 species of flatfishes, six species of roundfishes, and four species of elasmobranchs. All of these species are widely distributed in the nearshore environment of the eastern north Pacific Ocean, with many of these species ranging from Alaska to Baja, Mexico and from shallow depths in the nearshore ocean (less than 10 meters [m]) to 1,000s of meters deep along the continental edge. However, within this range of species there are distinct associations with latitude; depth; and, to some degree, biogenic and physical habitat character, such as hard substrate (e.g., rocky reefs and boulder fields) or submerged aquatic vegetation (e.g., kelp forests and seagrass beds). The majority of rockfishes associate most closely with hard substrate habitat, either directly above and among rocky reef structure, or adjacent to rocky reef and within midwater and canopy portions of kelp forests.

Conversely, flatfishes managed under the PCG FMP most closely associate with sandy seafloor habitat, although several species are likely to be more abundant adjacent to reefs and among boulder fields and other low-relief mixed hard substrates. Sandy seafloor habitat is abundant throughout the continental shelf adjacent to the California coastline and encompasses the majority of seafloor habitat within the Action Area. Although the wye diffuser and main barrel of the SBOO are covered in ballast rock, sandy seafloor lies adjacent, surrounds the artificial reef, and is overlapped by the current and expected future ZID. Sandy seafloor habitat can maintain abundant infaunal and epibenthic macrofaunal communities that, in turn, are food for fishes such as flatfish managed under the PCG FMP. This forage character is a key constituent of sandy seafloor EFH for these PCG species.

Many PCG FMP species (excluding the elasmobranchs) have pelagic egg and larval stages that inhabit the water column, typically above the thermocline; are widely dispersed on ocean currents; and potentially show limited association with features of water column habitat, such as convergent fronts and eddies. Because EFH is defined as including "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (50 CFR § 600.10), the EFH encompassing PCG FMP fishes therefore includes a large proportion of the U.S. EEZ.

3.3 Coastal Pelagic Species and Krill EFH

The CPS FMP includes four finfish, market squid (*Doryteuthis opalescens*), and krill (euphasiids). The four finfish species are Pacific sardine (*Sardinops sagax*), Pacific chub mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), and jack mackerel (*Trachurus symmetricus*). Krill consists of several species in the northeastern Pacific. Off the coast of San Diego, *Euphausia pacifica* is likely the most abundant species. *Thysanoessa spinifera*, the co-dominant species in the California Current region, has a more northerly distribution than *E. pacifica* (Cimino et al., 2020). Other species that may occur in the region include *Nematoscelis difficilis* and *Nictiphanes simplex* (Fiedler et al., 1998).

CPS finfishes are pelagic schooling fishes that inhabit the upper water column, generally above the thermocline. Northern anchovy are the smallest of these four finfishes and form some of the largest schools. However, in some years sardines can form larger schools than anchovies, particularly in warm water periods (Chavez et al., 2003). Pacific chub mackerel, jack mackerel, and Pacific sardines are often found schooling together. Jack mackerel are typically more common on offshore banks in late spring, summer, and early fall than the remainder of the year, with schools often more common over rocky structures than the other CPS species. Pacific chub mackerel tend to remain closer inshore from July to November and generally increase in offshore abundance from March to May. Market squid are generally found above the thermocline in pelagic schools. Market squid form large spawning aggregations that are targeted by fishermen. Typically, these aggregations form near shallow semi-protected areas with sandy or muddy bottoms adjacent to submarine canyons. During spawning, eggs are deposited on the seafloor in large masses at depths of between 5 and 55 m. The market squid fishery is one of the largest coastal fisheries in California, with peak catches typically during winter spawning aggregations, although the fishery operates throughout the year.

All CPS species produce pelagic larval and/or juvenile forms that inhabit the water column, typically from the surface to a relatively limited depth (e.g., above the thermocline). These pelagic larval forms are passively dispersed on ocean currents.

3.4 Highly Migratory Species EFH

The HMS FMP includes five species of tuna, three species of shark, two species of billfishes, and dorado (*Coryphaena hippurus*). The tuna species are North Pacific albacore (*Thunnus alalunga*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), skipjack tuna (*Katsuwonus pelamis*), and Pacific bluefin tuna (*Thunnus orientalis*). The sharks are common thresher shark (*Alopias vulpinus*), shortfin mako or bonito shark (*Isurus oxyrinchus*), and blue shark (*Prionace glauca*). The billfishes are striped marlin (*Tetrapturus audax*) and swordfish (*Xiphias gladius*). Because these are broad-ranging fishes that may occasionally occur outside of their typical range (e.g., tuna that may follow warm, clear water inshore of their typically offshore distribution), all of these species have potential to occur in the Action Area.

However, only two species of fishes protected under the HMS FMP—dorado and common thresher shark—have EFH that extends inshore to the 6 fathoms (approximately 11 m [36 ft]) depth contour. This EFH includes most of the Action Area, including the wye diffuser and portions of the main barrel of the SBOO that are above the seafloor. Although dorado produce pelagic eggs and larvae, they spawn off of southern Baja California, and their larvae and eggs are unlikely to occur within the Action Area. However, juvenile thresher sharks and dorado do occur in nearshore waters such as those of the Action Area.

Young thresher sharks are likely to feed on small schooling fishes such as northern anchovy and Pacific sardine, as well as larger fishes such as Pacific hake (*Merluccius productus*) and Pacific chub mackerel. They are also likely to regularly consume invertebrates such as market squid and pelagic red crab (*Pleuroncodes planipes*). The latter can be highly abundant in warm water years. Adult thresher sharks have a similar diet, although they are typically more common in deeper waters and therefore may be less common in the Action Area and over the SBOO. Dorado diets are less well documented, but they are likely to feed on smaller fishes than juvenile threshers, which may include northern anchovy and sardine, as well as crustaceans and squids. Adult dorado are also generally farther offshore but may feed on schooling fishes that occur in the Action Area, including the area overlying the SBOO wye diffuser and main barrel.

3.5 Habitat Areas of Particular Concern

Within the category of EFH, regional FMCs are entitled to identify Habitat Areas of Particular Concern (HAPCs). These subsets of EFH are either spatially explicit areas or habitat types that have been identified by regional FMCs as having high priority for conservation, management, or research. The PCG FMP designates several habitat-types as HAPCs. These are estuaries, canopy kelp, seagrass, rocky reefs, and areas of interest such as seamounts, banks, and canyons.

Three categories of HAPC are known to occur in the Action Area: canopy kelp, rocky reefs, and estuary. An area of submerged rocky reef occurs to the northeast of the SBOO. The rocky reef provides benthic habitat for the establishment of giant kelp plants (*Macrocystis pyrifera*) that intermittently result in the second HAPC that occurs in the area, canopy kelp. This rocky reef and intermittent canopy-forming kelp forest area is referred to in this report as the Imperial Beach Kelp Forest. The third and final area of identified HAPC in the Action Area is the TJRE, which is an estuarine HAPC.

Seagrass habitat is an HAPC and there is potential for eelgrass (*Zostera marina*), a species of seagrass, to occur within the TJRE. Geographic Information System (GIS) data layers held by California Department of Fish and Wildlife (CDFW) that delimit known eelgrass areas throughout California do not indicate eelgrass in the TJRE, despite extensive areas in the wider San Diego region. However, it is unclear from these data whether the area was surveyed as part of the data compiled for this GIS layer so these data cannot rule-out the occurrence of eelgrass in the estuary. Zedler et al. (1992), which reviewed the natural history of the marine portions of the TJRE, indicated that this habitat-forming species is absent from the estuary. On the basis that Zedler et al. (1992) states that eelgrass is not present in the estuary and supported by the absence of eelgrass in the CDFW eelgrass data layer, it is considered unlikely that eelgrass occurs in the estuary and therefore this habitat is not considered further in this analysis.

Surfgrasses (*Phyllospadix* spp.) are also considered a member of the seagrasses. Surfgrasses in California grow on shallow subtidal and intertidal hard substrate habitat. The seashore and shallow subtidal seabed in the Action Area are predominantly sandy and therefore are not likely to support surfgrass habitat. Furthermore, CDFW surfgrass data available through the CDFW MarineBIOS website do not indicate seagrass in the Action Area. It is unlikely that surfgrass occurs in the Action Area and highly unlikely that sufficient acreage of surfgrass occurs to constitute 'habitat' and therefore form EFH. Therefore, this habitat is not considered further in this analysis.

Although remotely operated vehicle footage shows that this rocky reef supports a diverse rocky reef community that includes reef-associated fishes, invertebrates, understory algae, and temperate corals, artificial rocky reef substrate is not considered to be EFH (B. Chesney [NMFS], personal communication, 2021). Therefore, potential effects of the proposed Federal Action on this habitat are not considered in this EFH Assessment. Potential impacts to the SBOO rock-armoring reef are considered in the NEPA PEIS.

3.5.1 Tijuana River Estuary

The Tijuana River empties into the Pacific Ocean via the mouth of the TJRE. The TJRE mouth is a tidal inlet that forms through the unconsolidated sand beach barrier that intermittently isolates the TJRE from the open ocean. The precise location and configuration of the inlet vary over time. The western side of the TJRE is bounded by a barrier beach and dune complex that varies in width from 100 to 500 ft. A system of four main tidal sloughs extends from the tidal inlet into the north and central part of the estuary. Oneonta Slough extends northward from the tidal inlet, parallel to the barrier beach, and connects with the tidal marsh in the northern arm of the estuary. The Tijuana River main channel enters the estuarine environment in the northern portion of the valley along what is called the Tijuana Slough. In addition to the Tijuana Slough, two more slough channels (the

Mid-Valley Slough and Old River Slough) extend through the lower Tijuana River floodplain. South Slough extends south from the tidal inlet and is parallel to the barrier beach south of the mouth.

The TJRE is a highly variable system. During the winter wet season, waters in the estuary are diluted by rainfall and streamflow. During the remainder of the year, the estuary is essentially a partially or fully enclosed extension of the ocean. Classical characterizations of estuarine systems, such as salt wedge, partially mixed, or vertically homogenous brackish water estuaries, do not apply well to the TJRE. As a result, Zedler et al. (1992) argue the TJRE may best be termed an "intermittent estuary." Tidal influence historically extended inland as far as 1.5 miles. However, the area of tidal influence has decreased in the late 20th century due to a number of factors including sediment deposition from the Tijuana River and tributaries. The estuary transitions to upland and riparian habitat along ecological transition zones, which predominantly consist of Alkali Meadow complex and High Marsh vegetation zones. These transition zones generally occur in areas to the south of the Naval Outlying Landing Field Imperial Beach and not any farther east (San Francisco Estuary Institute, 2017).

Despite the non-canonical, intermittent estuarine status of the TJRE, the estuary does provide biological ecosystem services relevant to EFH HAPC under the PCG FMP. Predominant fish species present in the estuary include topsmelt (*Atherinops affinis*), longjaw mudsucker (*Gillichthys mirabilis*), arrow goby (*Clevelandia ios*), California killifish (*Fundulus parvipinnis*), and striped mullet (*Mugil cepalus*) (Zedler et al., 1992; USIBWC, 2016). The estuary also provides nursery habitat for species caught for recreational fishing, such as the diamond turbot (*Hypsopetta guttulate*), California halibut (*Paralichthys californicus*), surfperches, anchovies, plueronectids, croakers, and sea bass (Zedler et al., 1992; USIBWC, 2008). Based on analysis of a long-term monitoring dataset from the estuary, Desmond et al. (2002) found that seasonal changes in water temperature most strongly correlated with changes in fish assemblage observed in the estuary, but discharge was also important. Peak abundance was in summer/fall when discharge was low. Interannual trends showed that periods of increased sewage input affected fish assemblage with more rapidly maturing fish (e.g., arrow goby) being more dominant under increased sewage inputs (Desmond et al., 2002).

3.5.2 Imperial Beach Kelp Forest and Zuniga Jetty Seagrass

As part of the San Diego Regional Sediment Management Plan (SD RSMP) developed in 2009, data were compiled on geological seabed habitat from hydroacoustic surveys (SD RSMP, 2022). This dataset clearly identifies an area of cobble seabed to the northeast of the SBOO. This cobble habitat provides hard substrate on which algal and invertebrate communities can attach and numerous other reef species can associate. This rocky reef also provides substrate for the attachment and growth of giant kelp (*Macrocystis pyrifera*). Given the correct ocean conditions, giant kelp plants can reach the sea surface and form a canopy structure. Canopy kelp and rocky reef habitat are two related but separate forms of HAPC recognized under the PCG FMP. This area is referred to in this report as the Imperial Beach Kelp Forest HAPC. An area of seagrass is located approximately 1 kilometer (km) offshore and to the east of the entrance to the San Diego Bay. This consists of a persistent bed of the eelgrass *Z. pacifica*, which has formed west of the Zuniga Jetty, a 1.5 km breakwater jetty that shelters the downcoast beaches from wave action and provides a barrier to the upcoast transport of sediments that would otherwise more rapidly infill the entrance to the San Diego Harbor. In addition to the Zuniga Jetty seagrass bed, smaller seagrass beds within the entrance channel to San Diego Bay also occur. These consist of a mixture of *Z. pacifica* and *Z. marina*. Both the Zuniga Jetty seagrass bed and the smaller beds within the entrance channel to San Diego Bay are on the perimeter of the Action Area beyond the farthest stations at which SBOO plume detections have occurred. The locations of the Imperial Beach rocky reef and kelp forest and the seagrass beds at the entrance to San Diego Bay in relation to the Point Loma kelp forest and other features in the region are shown in Figure 3-1.

The cobble reef area identified in the SD RSMP seabed habitat data encompasses approximately 1,400 hectares from approximately 5 m to 25 m below mean sea level. The southern limit of this bed is approximately 1,200 m directly north from the main barrel of the SBOO and approximately 1,100 m northeast of the closest diffuser port, which is the northern tip of the wye diffuser. All diffuser ports on the northern arm of the wye diffuser are currently closed.

The PCG FMP describes canopy kelp HAPC as including those waters, substrate, and other biogenic habitat associated with canopy-forming kelp species. Giant kelp, the species of algae that forms the majority of kelp canopy HAPC in southern California, is a fast-growing, perennial brown alga that attaches to and grows on hard seafloor substrate. While giant kelp plants can grow in waters as deep as 50 m in ideal conditions, giant kelp plants typically establish canopy-forming kelp forests over areas of hard substrate at depths of between 5 and 30 m along the mainland coast of southern California.

As described in Schiel & Foster (2015), giant kelp communities are highly productive relative to other habitats typical of the southern California region, including wetlands, shallow and deep sand bottoms, and rock-bottom artificial reefs. Canopy-forming kelp plants provide vertically structured habitat throughout the water column consisting of a canopy of tangled blades from the surface to a depth of 10 ft, a mid-water stipe region, and the holdfast region at the seafloor. This structure provides nurseries, feeding grounds, and shelter to a variety of groundfish species and their prey. Furthermore, the kelp itself is a source of food as living tissue on attached plants, as drift in the form of whole plants or detached pieces, and as dissolved organic matter exuded by attached and drifting plants.

Mapping of persistent kelp canopy typically involves the use of aerial imagery (photographs from an airplane). Some kelp beds, such as the Point Loma kelp bed approximately 15 km to the north of the SBOO, maintain kelp canopy at some point in the year every year. However, many kelp beds are intermittent year-to-year, therefore multiple years of observations are necessary to determine areas where kelp canopy is likely to form over the lifecycle of a project.

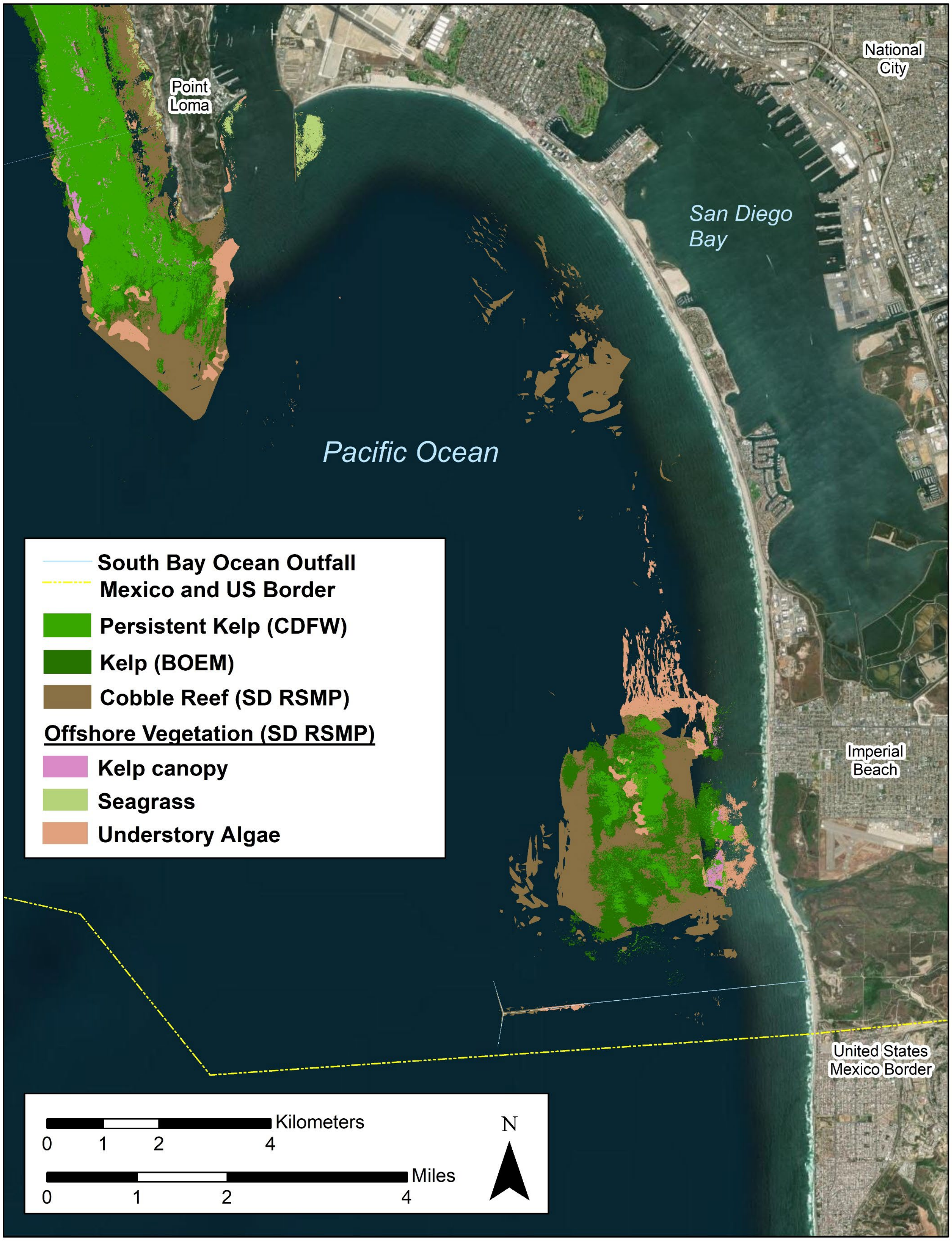

Figure 3-1. Location of rocky reef and kelp habitat in the Action Area.

Six sources of information on the formation of kelp canopy at the Imperial Beach Kelp Forest have been identified that use aerial imagery to determine canopy kelp HAPC from multiple years of observation data:

1. Persistent Kelp Canopy data from the CDFW MarineBIOS GIS tool[4] provides frequency of occurrence over eight years in aerial photographs from 1989, 1999, 2002 through 2006, and 2008. These data indicate that kelp canopy was detected in one to two years throughout much of the persistent kelp canopy area, but no more than three years during this period.

2. A series of maps (GIS shapefiles) showing kelp canopy for 15 discrete years is available on the publicly accessible CDFW GIS server.[5] A GIS shapefile representing kelp canopy from 1989 is the earliest year of data in this series. This shapefile is described as hand-drawn maps from aerial imagery. The next earliest year is described in associated metadata as produced in 1999. However, the metadata describe this layer as a digitally remeasured version of the 1989 maps. Based on this description, it is assumed that the 1999 dataset is from the same survey years as the 1989 maps. Subsequent maps include the years 2002 through 2016, not including 2007. Kelp canopy is detected in 10 of the 16 shapefiles included in this data series. Kelp canopy was detected at the Imperial Beach Kelp Forest in the years 1989 (including in the 1999 shapefile), 2002, 2003, 2004, 2005, 2006, 2008, 2009, 2014, and 2015. Kelp canopy was not detected at the Imperial Beach Kelp Forest in 2010, 2011, 2012, 2013, or 2016.

3. Data from the Bureau of Ocean Energy Management Marine Cadastre National Viewer GIS tool[6] provide the maximal extent of kelp canopy surveyed over a period of 26 years from 1989 through 2014. These data do not indicate how many years, or which years, kelp canopy formed at the Imperial Beach Kelp Forest, but they do indicate the number of years surveys were completed and the maximal extent of kelp canopy when it occurred. The area encompassing the Imperial Beach Kelp Forest includes surveys for at least 18 years during this period and the maximal extent is very similar to the maximal extent identified in the CDFW MarineBIOS data described above.

4. Data collated as part of the SD RSMP[7] include both the CDFW Persistent Kelp layer as described above and an Offshore Vegetation layer. The offshore vegetation layer includes kelp canopy, understory algae, and surfgrass derived from acoustic data (high-resolution multibeam acoustic backscatter) collected in 2002 as part of the development of the SD RSMP.

5. Giant kelp (*Macrocystis pyrifera*) beds along most of the southern California mainland coast have been mapped quarterly by the Region Nine Kelp Survey Consortium (RNKSC) since

[4] "Kelp Canopy (Persistence)" Available at https://apps.wildlife.ca.gov/marine/. Accessed in February 2022.

[5] Available at https://filelib.wildlife.ca.gov/Public/R7_MR/BIOLOGICAL/Kelp/. Accessed in February 2022.

[6] "West Coast Canopy-Forming Kelp, 1989-2014" Available at www.marinecadastre.gov/nationalviewer. Accessed in February 2022.

[7] Available at https://cespl.maps.arcgis.com/apps/webappviewer/index.html?id=32c6af0af6644d0891c566a9ecaf1c74 Accessed in February 2022.

1983.[8] The most recently reported surveys were completed in 2020. These surveys include aerial and vessel surveys of kelp beds from the U.S.-Mexico border to northern Laguna Beach in Orange County, CA. The Imperial Beach Kelp Forest is included in these surveys.

6. Ocean Imaging Corp. compiled multi-spectral aerial imagery of kelp bed areas throughout southern California as part of a Sea Grant funded project (Ocean Imaging, 2015). GIS shapefiles for this project were not available, but a report describing the results of this study was accessible. The data products include kelp canopy extents derived using digital image classification algorithms that incorporate ground-truth sampling to verify and improve the classification process. The Imperial Beach Kelp Forest included aerial imagery data from 1999, 2003 through 2006, 2008, and 2009.

During the RNKSC surveys, no kelp canopy was observed at Imperial Beach Kelp Forest beginning in 2017 and continuing through the most recently reported surveys in 2020. Prior to 2017, kelp canopy had been observed at this site each year since 1998. Dive surveys in 2020 to survey subsurface conditions at the reef found no kelp individuals on the bottom. The cobble and boulder reef covered 5 percent of the seafloor observed during diver surveys and divers noted observing purple and white urchins and bat stars. The median acreage for kelp canopy based on 42 years of aerial surveys between 1967 and 2020 is 0.11 acres (approximately 445 square meters). This is relatively small compared to Point Loma (median = 3.16 acres) and La Jolla (1.24 acres) kelp forests, which are the next-closest kelp forests in California waters. These two adjacent kelp forests are the largest kelp forests in southern California. All kelp forests monitored in the RNKSC combined have a median kelp canopy of 6.273 acres. The occurrence of kelp canopy at the Imperial Beach Kelp Forest is variable between years compared with the La Jolla and Point Loma beds, reflecting the bed's somewhat intermittent nature. The largest extent recorded for Imperial Beach Kelp Forest during the RNKSC surveys was during 2008 when the bed was 1.895 acres.

Ocean Imaging (2015) note that the Imperial Beach Kelp Forest is unusually intermittent. During the 1999–2009 timeframe of their analysis, kelp bed extents mapped in the aerial imagery shifted locations and changed in acreage between years considerably more than any other kelp beds examined in their study. Their study encompassed the majority of kelp beds in the southern California region.

According to life history information compiled in Schiel & Foster (2015), an adult plant may grow between 10 and 50 centimeters per day, which allows a kelp plant (the sporophyte phase) to readily establish kelp canopy within a calendar year. While individual fronds on an adult kelp plant usually live no more than four to nine months, individual plants can live up to nine years. To reproduce, adult giant kelp plants produce planktonic spores that become male and female gametophytes. Both these phases can be transported as far as a few kilometers from the adult plants by ocean currents before settling and growing to become adult plants.

Many factors may contribute to variation in persistence and subsequent establishment of giant kelp canopy in southern California according to Schiel & Foster (2015) and the extensive literature reviewed therein. Subtidal cobble, and to a lesser extent boulder, substrate can be moved by wave action, particularly during major storm activity. Cobble reefs such as the Imperial Beach Kelp Forest

[8] Accessed at https://www.mbcaquatic.com/reports/southern-california-bight-regional-aerial-kelp-surveys and http://kelp.sccwrp.org/reports.html. Accessed in February 2022.

can be severely reduced and sometimes lost entirely during large storms. Kelp plants established on low-relief rocky reefs are likely to be subject to sand scour and sedimentation, which can deteriorate or destroy existing plants and also inhibit recruitment.

Nitrate, an important nutrient for algae, is typically a limiting factor on the growth of giant kelp. Nitrate concentration in ocean water is negatively correlated with ocean temperature (warmer water = lower nitrate availability). During warm-water years, particularly related to climatic drivers indicated by the El Niño/Southern Oscillation (three- to seven-year cycles) and the Pacific Decadal Oscillation (20- to 30-year cycles), kelp canopy acreage along the California coast is significantly depressed. The largest changes in giant kelp forest seen over the past century are correlated with temperature, nutrient, and severe storms due to climactic periods indicated by the El Niño/Southern Oscillation. Marginal kelp beds throughout southern California may not form kelp canopy during warm temperature years.

Low-light conditions can lead to deterioration of existing kelp and limit the recruitment to hard substrate on the seafloor. Typically, low-light conditions relate to either depth or increased turbidity in the water column. Turbidity from particles suspended in the water column can be caused by many factors in the ocean, including:

- Suspension and transport of seabed material by storms, waves, and ocean currents.
- Surface runoff from the land through natural drainage such as creeks, rivers, and coastal canyons or man-made gutters, culverts, and drainpipes that end on the coast.
- Coastal landslides.
- Ocean discharge pipes from facilities like wastewater treatment or power plants.
- Plankton blooms related to localized nutrient enrichment from natural or man-made sources.

Grazing of kelp plants, particularly by sea urchins, is a major factor determining kelp canopy distribution. Urchins can reduce the size of existing kelp beds and limit the recruitment of replacement adult plants. In some cases, local urchin populations may establish dense aggregations and the subsequent intense grazing causes ‘urchin barrens’, areas devoid of non-crustose algae including canopy-forming kelps like giant kelp.

4. POTENTIAL ENVIRONMENTAL EFFECTS

4.1 Effects Summary

The purpose of the proposed Federal Action, as previously described, is to fund and implement infrastructure projects to address ongoing transboundary flows that are currently impacting the natural environment, including the marine environment and species in the Action Area. Subsequently, the net effect of this project will have a positive impact on the marine environment. However, components of the project may have short-term negative effects on EFH.

An adverse effect in this EFH Assessment means any impact that reduces the quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species, their habitat, and other ecosystem components of EFH. Adverse effects may be site specific or habitat wide, including those resulting from individual, cumulative, or synergistic consequences of actions. Appendix D of the PCG FMP identifies non-fishing activities that may adversely affect PCG EFH (PFMC, 2020). As identified in the PCG FMP Appendix D, wastewater discharge facilities may result in adverse effects to EFH through: 1) the release of contaminants, 2) maintenance and construction activities, and 3) the loss and alteration of aquatic vegetation.

4.2 Effects of Marine Construction on EFH

4.2.1 Marine Construction Activities

Most construction activities under the proposed Federal Action will occur inland at least 2 miles from the coastline and will have no direct or indirect effect on the marine environment. However, to accommodate the increase in effluent discharge volume for Projects A (Expanded ITP) and D (APTP Phase 1), up to 55 diffuser risers currently blind flanged on the southern leg of the SBOO wye diffuser are anticipated to be recommissioned. Currently, 18 of the 165 diffuser ports are open. A further 16 diffuser ports are installed but are currently capped/plugged. The remaining 131 diffuser ports are blind flanged and will require the installation of a diffuser head to be operational. The new plants under Projects A and D will be constructed and come online independently (i.e., not necessarily on the same schedule), and full treatment capacity for Project A will be reached in multiple phases up to 2050 in response to population growth in Tijuana. Therefore, it is assumed that ports on the wye diffuser will be opened in a similar phased manner over the course of several years.

It is anticipated that the recommissioning of a capped/plugged or a blind-flanged diffuser port will result in minor disturbance to marine wildlife and habitat. Specifically, divers will likely remove a relatively small area of habitat and species on and around a diffuser head that requires modification. At each modified diffuser head, it is assumed that this may result in the temporary loss of no more, and in most circumstances considerably less, than a 6-foot by 6-foot area of artificial reef habitat. This loss of habitat will be necessary to allow divers to access bolts, blind flanges, and other parts of the diffuser ports with hand tools to make the modifications likely to be required to recommission these features. As part of the recommissioning, contingency planning will be required to address potential failure of recommissioning methods that will allow for re-sealing of flanged or capped riser ports. Following completion of the diver activity, natural ecological-succession processes are highly likely to gradually replace the lost habitat over time.

During the recommissioning activities, boats will be required to transport divers and equipment to the site. At this stage it is unclear what size of vessel will be used or whether this vessel will require anchoring. If the vessel does require anchoring, it will be necessary for that vessel to safely deploy the anchor to avoid damaging the wye diffuser and associated structures on the seabed. It is assumed that anchors will be deployed onto sandy seabed and may be adjusted by divers once they are deployed. Alternatively, a permanent mooring may be positioned to allow divers to return over a series of days.

4.2.2 Potential Effects on EFH

4.2.2.1 Effects due to Diving and Vessel Activities

Diving activities will be required to remove flanged covers on risers and replace these with diffuser port units. These activities are likely to require commercial divers utilizing hand tools such as socket wrenches and pry bars to remove nuts and bolts and release the flanges that currently close inactive risers and to secure new diffuser heads on the newly recommissioned risers. During these diving activities, disturbance of sandy seafloor adjacent to the rocky reef will not occur, as the working footprint of these diving activities will occur within the boundaries of the ballast-rock reef. The ballast rock reef, risers, and other SBOO structures that will be directly contacted by these activities does not constitute EFH. While the water column above the ballast-rock reef is EFH, these activities would not result in adverse effects to this habitat.

The PEIS requires vessel operators to deploy anchors over sandy seabed at least 10 ft away from the edge of the rocky reef surrounding the SBOO in order to avoid potential white abalone habitat. Rocky reef and sandy seafloor will be identified by vessel operators with onboard sonar equipment. Anchor deployment on sandy seafloor may result in minor disturbance of seabed communities within the immediate proximity of the anchor. This disturbance may include displacement of groundfish fishes by the anchor and would include mortality of forage species (infauna) that are crushed by an anchor. This would occur within an estimated area no larger than 9 square feet (SF), based on typical small-to-medium boat anchor size. This is the estimated footprint of anchor contact with the sea floor. While this anchoring ***would adversely affect Groundfish EFH*** within this footprint, this effect is minimal relative to available adjacent habitat and will therefore have a negligible effect on species using this habitat.

Divers may be able to safely live-boat their operation, which would forego the deployment of anchors and would avoid adverse effects to Groundfish EFH due to anchoring. If anchoring is necessary, the boat operators will minimize adverse effects to Groundfish EFH by using an anchor that is as small as safely possible and minimizing the number of anchor deployments. However, these determinations will depend on the diving contractors' approach to recommissioning, including their safety assessment at the time of the dive. If the recommissioning contractor expects more than five anchor deployments, or the use of an anchor large enough to result in a seafloor footprint larger than 9 SF, the contractor will be required to develop an anchoring plan. The anchoring plan shall describe the offshore activities for which vessel anchoring is required, including anchoring arrangements, general procedures for deploying and recovering anchors, and the expected positioning of anchors relative to the SBOO and any other seafloor features identified, including biological habitat described in the EFH Assessment, BA, and PEIS. The anchoring plan shall be completed and submitted to EPA, USIBWC, and NMFS for review and approval at least 60 days prior to the start of offshore activities.

4.2.2.2 Effects due to Accidental Spills

Vessel activities bring a small risk of grounding or oil spill. However, spilled fluids from a grounded or stricken vessel can have serious environmental consequences for marine habitats and associated species. Vessels are likely to carry hydraulic fluids and fuel that would be toxic to marine life if spilled. Most marine vessel groundings or spills are the result of mechanical failures or pilot negligence. The most vulnerable EFH to oil spill effects are the TJRE and Imperial Beach Kelp Forest. Grounding is unlikely to occur at either of these locations, however a vessel that loses control at sea and cannot be rescued by U.S. Coast Guard or other resources may wash up on the beach and result in some oil spill risk that could reach these EFH HAPCs.

Therefore, vessel grounding and spill risk due to project construction activities is assessed as a potential impact. It is assumed that construction vessel operators will follow best practice by maintaining their vessels to a high standard. Furthermore, vessel operators should maintain industry standard health, safety, and environmental standards that apply specifically to the intended construction operations. This is likely to include the storage and maintenance of spill kits appropriate for dealing with small vessel-based spills such as sand buckets, absorbent pads and cloths, and other emergency containment devices to stop small spills of hydraulic fluids and other polluting fluids from entering the water if they are accidentally spilled on deck. Vessels must be maintained to a standard that eliminates the likelihood of diesel or hydraulic oil spills during normal operation. As recommended in the PEIS, in the case of a catastrophic loss of engine power that may result in a grounding, vessel captains must have procedures in place to raise Coast Guard support rapidly. As long as these measures are in place, the likelihood of adverse impacts to EFH from oil spill or grounding is negligible. Therefore, EPA concludes that the proposed Federal Action ***would not adversely affect EFH*** due to an accidental spill.

4.3 Effects of Facility Operation

4.3.1 Changes Throughout the Action Area

The only potential operational phase impact that may result in adverse effects to marine biological resources from the projects that are proposed for funding is the increase in SBOO effluent discharge volume. The projects will also result in reductions in nearshore pollution caused by the current failure of wastewater treatment infrastructure to treat wastewater from Tijuana. Projects proposed for funding are intended to reduce this pollution and therefore represent a positive effect on marine wildlife, which is discussed in this section.

Implementation of the projects funded through the proposed Federal Action will immediately lead to significant reductions in discharges of untreated wastewater to the Pacific Ocean via SAB Creek, as summarized in Table 4-1. The majority of these improvements will be accomplished through Projects A (Expanded ITP), B (Tijuana Canyon Flows to ITP), and C (Tijuana Sewer Repairs) by improving the collection and treatment of wastewater in Tijuana.

Implementation of the Core Projects will also reduce (by up to 93 percent) the portion of sediment loads via SAB Creek that come from untreated wastewater or river water. These projects will not affect sediment loads to the Pacific Ocean resulting from stormwater and erosion within the SAB Creek watershed.

Table 4-1. Impacts on Discharges to the Pacific Ocean via SAB Creek (Initial Operations) Under the Proposed Federal Action.

Projects	Untreated Wastewater Flow Volume		BOD_5 [c] Load		Nutrient Load	
	MGD	Percent Change	Tons/yr	Percent Change	Tons/yr	Percent Change
Current conditions [a]	28.2	N/A	17,200	N/A	3,916	N/A
Proposed Federal Action [b]	2.2	-92%	1,340	-92%	275	-93%

a – Current conditions were calculated using Tijuana River flow data from January 2016 through January 2022, during a period when PB-CILA capacity was 23 MGD.
b – Reflects changes in discharges and loadings that will be achieved upon startup of new treatment facilities (i.e., before the full treatment capacity comes into service in response to population growth in Tijuana).
c – BOD_5, the biochemical oxygen demand (BOD) of microorganisms over a five-day period, is an indicator of the amount of organic pollution in wastewater.

Table 4-1 identifies the improvements that will occur upon startup of the new treatment facilities. However, expansion of the ITP to 60 MGD under Project A will provide additional treatment capacity to accommodate projected population growth in Tijuana through the year 2050, assuming Tijuana canyon flows are treated at the ITP (Project B). The full water quality benefits of this project will be realized once this additional treatment capacity comes into service in response to population growth. To estimate these future improvements relative to baseline conditions, EPA and USIBWC projected 2050 baseline conditions for discharges to SAB Creek (i.e., assuming no infrastructure improvements are made) and estimated the impacts of the proposed Federal Action on this projected baseline. Table 4-2 summarizes these projected (2050) reductions in discharges of untreated wastewater to the Pacific Ocean via SAB Creek.

Table 4-2. Impacts on Discharges to the Pacific Ocean via SAB Creek (Projected 2050 Conditions) Under the Proposed Federal Action.

Projects	Untreated Wastewater Flow Volume		BOD_5 Load		Nutrient Load	
	MGD	Percent Change	Tons/yr	Percent Change	Tons/yr	Percent Change
Projected 2050 baseline conditions [a]	44.6	N/A	27,200	N/A	5,980	N/A
Proposed Federal Action [b]	5.4	-88%	3,310	-88%	674	-89%

a – Projected conditions in 2050 reflect estimates of additional wastewater generated due to projected population growth in Tijuana with no corresponding improvements to wastewater treatment infrastructure.
b – Reflects projected operations in 2050, when the 60-MGD expanded ITP will be operating at full capacity based on estimated population growth in Tijuana.

As shown above, implementation of Project A will be projected to substantially reduce future discharges of untreated wastewater to the Pacific Ocean via SAB Creek. The added capacity will help prepare for projected conditions in 2050 and provide additional coastal water quality improvements through 2050. Projects A and D will also be projected to reduce (by up to 88 percent) the portion of projected sediment loads via SAB Creek that will come from untreated wastewater or river water. These projects will not affect sediment loads to the Pacific Ocean resulting from stormwater and erosion within the SAB Creek watershed.

Quantifying the magnitude of reduction in nearshore pollution is complicated by the unpredictable nature of marine environments and the fate of pollutants. However, Feddersen et al. (2021) provide modeled predictions of reductions in nearshore pollution based on several scenarios. While their modeled scenarios differ from the projects proposed for funding under the Federal Action, the results of their model can be used to infer the likely improvements that will be achieved under the proposed Federal Action.

During most of the year from April through November (dry-season), lack of rainfall means transboundary flows into the Tijuana River Valley do not generally reach the ocean. However, large discharges of untreated wastewater are released into the ocean at the SAB Creek mouth. Dry-season model runs for the baseline model scenario in Feddersen et al. (2021) represent summer-time (tourist season) effects of the SAB Creek pollution plume. The left panel in Figure 4-1, which represents the discharge of 35 MGD of untreated wastewater via SAB Creek,[9] shows that the model predicts elevated untreated wastewater concentrations within 1 km of the coastline from SAB/Punta Bandera to the north of Hotel del Coronado (HdC). The model scenario shown in the left panel in Figure 4-1 represents conditions following a strong and long-lived period of wave action from the south-southwest (south-swell). South-swell conditions result in northward nearshore currents that advect the pollutant plume from SAB Creek along the coastline, impacting the nearshore habitat throughout the Action Area. The retention of northward-advected water is also apparent in the diffusion of the plume throughout the semi-enclosed bay in the lee of Point Loma. This advected plume results in high levels of contaminated inshore waters, and also likely contributes large amounts of nutrients to the waters in the lee of Point Loma, potentially driving blooms of phytoplankton that include harmful algal blooms (HABs) and accumulations of other pollutants in the Action Area.

Feddersen et al. (2021) also present a model run that assumes 1) diversion of the Tijuana River under river flow conditions of up to 35 MGD, similar to what will be achieved under the proposed Federal Action, and 2) 95 percent reduction in pollutant loadings to the Pacific Ocean via SAB Creek, which slightly overrepresents the estimated 92 percent reduction that will be achieved under the proposed Federal Action (see Table 4-1). Baseline conditions during dry-season and wet-season conditions are shown alongside the results of this reduction in the right panel in Figure 4-1. The sharp reduction in nearshore pollution between SAB Creek and the TJRE, and the elimination of the accumulation of plume in the retention zone in the lee of Point Loma is clear in the model runs.

[9] EPA and USIBWC now estimate that, on average, approximately 28.2 MGD of untreated wastewater is discharged to the Pacific Ocean via SAB Creek. The left panel of Figure 4-1, which represents the discharge of 35 MGD of untreated wastewater, therefore likely represents a slight overestimate of the baseline plume extent due to discharges via SAB Creek.

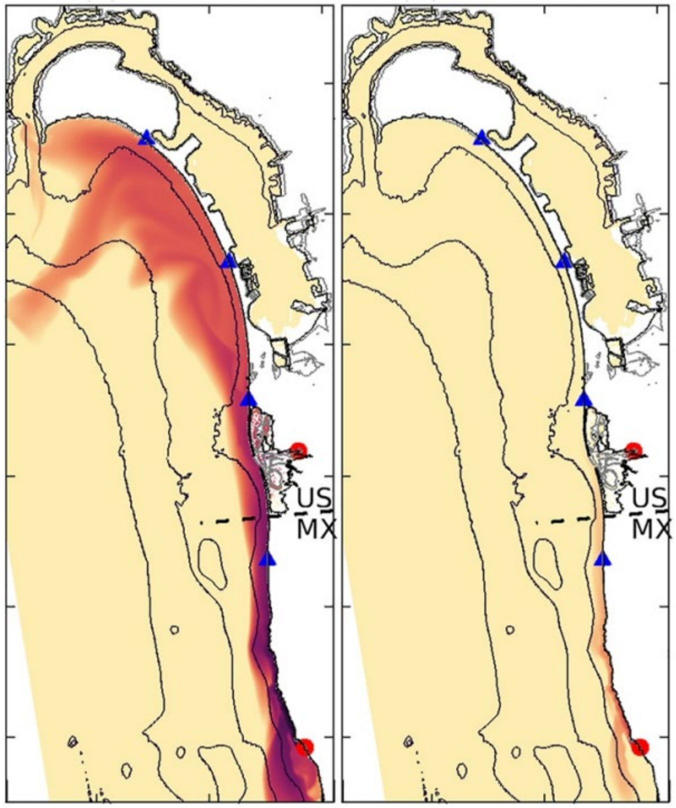

Figure 4-1. Dry-season (summer-time) modeled pollution plume during a period of south-swell. Left panel: under baseline (current conditions) and Right panel: following 95 percent reduction in pollutant loadings from SAB Creek. From Feddersen et al. (2021).

These figures illuminate the advection of the plume during south-swell conditions in the dry-season. To better understand the behavior of the plume throughout the year, Feddersen et al. (2021) provide the images in Figure 4-2. The distributions of modeled concentrations are organized around two horizontal lines, one at approximately 3 km south of Imperial Beach (representing the mouth of the TJRE) and the second at approximately 15.5 km south of Imperial Beach (representing SAB Creek). During the wet season, indicated by the horizontal yellow bar on the x-axis of the charts, the predominantly southerly distribution of the wastewater plume from both the mouth of the TJRE and SAB Creek is apparent, particularly in the baseline conditions chart (top panel). However, intermittent reversals upcoast are clearly visible during periods when there are very low (or no) concentrations of wastewater detected in the model runs downcoast and increased concentrations upcoast of these two locations. Later in the year, particularly from May through the remainder of the year (including the dry season indicated by the horizontal magenta bar on the x-axis), most polluting events appear to originate from SAB Creek as upcoast incursions of the SAB Creek plume become more frequent and prolonged as compared to those during the wet season. Model results for scenarios that reduce or eliminate either SAB Creek or TJRE plumes (bottom panel) support the discrete observations described above in relation to Figure 4-1 and demonstrate some reductions from both sources (SAB Creek and TJRE) during the wet season. However, wet-season reductions from TJRE are not as pronounced as during the dry season.

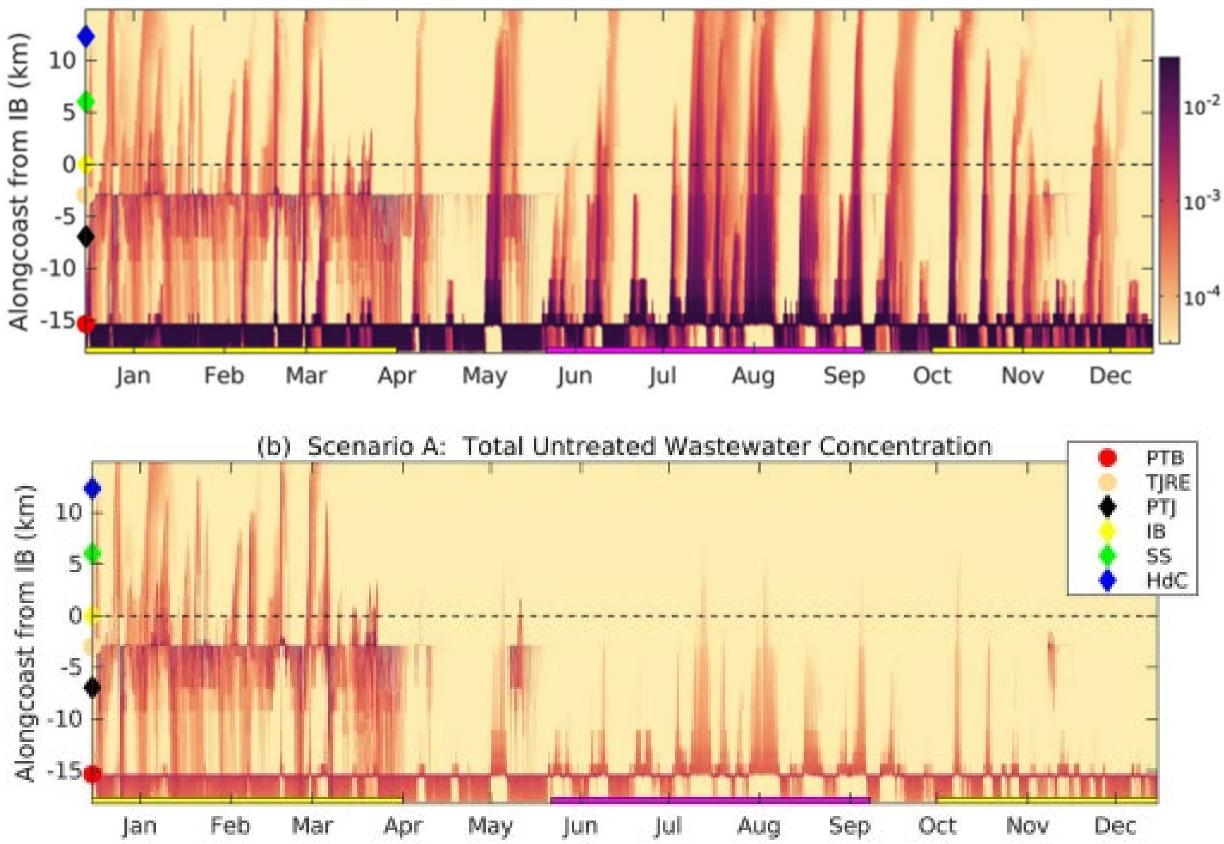

Figure 4-2. Modeled concentration of wastewater throughout the year at distances along the coast between approximately 1 km north of HdC and 2 km south of Punta Bandera (units are scaled relative to the location of Imperial Beach [IB]). Top panel under current conditions. Bottom panel most similarly matches reductions due to projects proposed under the Federal Action. From Feddersen et al. (2021).

The relative magnitude of reduction in nearshore pollution (via SAB Creek and the TJRE) due to the implementation of the proposed Federal Action is considerably greater than the magnitude of increase in the discharge of treated effluent (via the SBOO). Therefore, the net effect of the proposed Federal Action is a positive impact on the marine environment and the species and habitats that depend on a healthy marine environment to thrive. In part, this is because the pollution loading caused by untreated transboundary flows entering the marine environment will be reduced by the increase in treatment. It is also because the ejection of a plume of wastewater from a river mouth results in considerably lower rates of mixing compared to effluent ejected from diffuser nozzles on a specially designed discharge system such as the wye diffuser array on the terminus of the SBOO. Plumes released into the nearshore can become 'coastally trapped' close to shore because of the nature of alongshore currents. These coastally trapped plumes concentrate pollutants and expose marine organisms in the areas affected to higher concentrations for longer periods compared to properly ejected effluent plumes from diffuser systems.

4.3.2 Changes to the SBOO Discharge

While implementation of the Core Projects through the proposed Federal Action will reduce pollutants reaching the Pacific Ocean via SAB Creek and the TJRE, the treatment of wastewater from Mexico will result in an increase in the volume of treated effluent discharged to the Pacific Ocean via the SBOO. These increases in SBOO discharges will be in addition to the current discharges of secondary-treated effluent from the existing ITP and SBWRP. The increase in discharges via the SBOO will consist of:

1) Additional discharges of secondary-treated wastewater from the expanded ITP (Project A), with the volume of discharged effluent depending on the capacity option, and

2) New discharges of primary-treated river water from the new APTP Phase 1 (Project D).

Table 4-3 identifies the estimated changes in discharges via the SBOO that will occur upon startup of the new treatment facilities. Table 4-4 identifies the estimated changes in discharges via the SBOO as projected for the year 2050, when the 60-MGD expanded ITP (Project A) is projected to be at full capacity based on estimated population growth in Tijuana. In addition to reflecting changes in discharges expected from the proposed Federal Action, these 2050 projections also reflect an assumed increase in discharges from the SBWRP over this period. These calculations and projections are based on the analysis of a variety of data sources including influent and effluent monitoring data for the ITP, SBWRP, and San Antonio de los Buenos Wastewater Treatment Plant; Tijuana River water quality and flow data; Tijuana sanitary collection and pumping system flow data; and North American Development Bank studies and estimates projecting future wastewater flows to the International Collector and canyons along the U.S.-Mexico border.

Full implementation of the Core Projects (including the 60-MGD expanded ITP) will result in the following changes to the flow rate, nutrient loadings, and BOD_5 loadings of discharges via the SBOO (these estimates also reflect discharges from the SBWRP):

- **Flow Rate:** The average daily SBOO effluent flow rate will immediately increase from approximately 28.8 MGD under current conditions to approximately 65.2 MGD under initial operating conditions of the expanded ITP and new 35-MGD APTP. The average daily SBOO effluent rate will then gradually increase (over the course of the 20-year period from 2030 to 2050) to approximately 84.7 MGD by 2050 as the full capacity of the 60-MGD expanded ITP comes into service in response to population growth in Tijuana. This discharge will remain well below the SBOO design capacity of 174 MGD average daily flow rate.

- **BOD_5:** The annual BOD_5 loadings in SBOO discharges will immediately increase from approximately 533 tons/yr under current conditions to approximately 2,270 tons/yr under initial operating conditions of the expanded ITP and new 35-MGD APTP. Annual BOD_5 loadings will then gradually increase (over the course of the 20-year period from 2030 to 2050) to approximately 2,640 tons/yr by 2050.

- **Nutrients:** The total annual nutrient loadings (including total annual nitrogen and phosphorous loadings) in SBOO discharges will immediately increase from approximately 1,670 tons/yr under current conditions to approximately 4,240 tons/yr under initial operating conditions of the expanded ITP and new 35-MGD APTP. The total annual nutrient loadings will then gradually increase (over the course of the 20-year period from 2030 to 2050) to approximately 5,280 tons/yr by 2050.

Table 4-3. Estimated SBOO discharge characteristics (annual averages) under current conditions and following implementation of the proposed Federal Action (initial operations).

Parameter	Units	Current Conditions (Existing ITP and SBWRP) [a]	Following Implementation of Proposed Federal Action (60-MGD ITP, 35-MGD APTP, and SBWRP) – Initial Operations [b]	% Change
Effluent flow rate	MGD	28.8	65.2	126%
Temperature	deg C	23.4	22.9	-2%
Concentrations				
Total nutrients	mg/L	38.0	42.6	12%
Total dissolved solids (TDS)	mg/L	1,320	1,360	4%
Fecal coliform	MPN/100 mL	387,000	423,000	9%
Selenium (total recoverable)	µg/L	5.11	5.03	-2%
Lead (total recoverable)	µg/L	0.121	0.189	57%
Nickel (total recoverable)	µg/L	22.7	18.8	-17%
Thallium (total recoverable)	µg/L	2.07	2.10	1%
Cadmium (total recoverable)	µg/L	0.117	0.0969	-17%
BOD_5	mg/L	12.1	22.9	88%
Total suspended solids (TSS)	mg/L	11.2	10.8	-4%
Loadings				
Total nutrients	tons/yr	1,670	4,240	154%
TDS	tons/yr	57,700	135,000	135%
Selenium (total recoverable)	lb/yr	448	1,000	123%
Lead (total recoverable)	lb/yr	10.6	37.6	256%
Nickel (total recoverable)	lb/yr	1,990	3,740	88%
Thallium (total recoverable)	lb/yr	181	417	130%
Cadmium (total recoverable)	lb/yr	10.3	19.3	87%
BOD_5	tons/yr	533	2,270	326%
TSS	tons/yr	427	1,070	151%

a – Reflects continued ITP (25 MGD) and SBWRP (3.8 MGD) operations under current conditions, with no APTP. Annual average values were calculated using 2015–2020 effluent monitoring data.

b – Reflects expanded ITP treatment of wastewater, including inflows resulting from Projects B (Tijuana Canyon Flows to ITP) and C (Tijuana Sewer Repairs); APTP treatment of diverted Tijuana River water; and continued SBWRP operations. Under this scenario, projected operations reflect discharges upon startup of the APTP and expanded ITP (i.e., before the full 60-MGD ITP treatment capacity comes into service in response to population growth in Tijuana). SBWRP discharges are identical to those under current conditions.

Table 4-4. Estimated SBOO discharge characteristics (annual averages) under baseline (no action) conditions and following implementation of the proposed Federal Action (projected 2050 conditions).

Parameter	Units	No Action (Existing ITP and SBWRP) – Projected 2050 Conditions [a]	Following Implementation of Proposed Federal Action (60-MGD ITP, 35-MGD APTP, and SBWRP) – Projected 2050 Conditions [b]	% Change
Effluent flow rate	MGD	33.2	84.7	155%
Temperature	deg C	23.7	23.0	-3%
Concentrations				
Total nutrients	mg/L	34.8	40.9	18%
TDS	mg/L	1,270	1,340	6%
Fecal coliform	MPN/100 mL	375,000	412,000	10%
Selenium (total recoverable)	µg/L	4.50	4.93	10%
Lead (total recoverable)	µg/L	0.106	0.171	62%
Nickel (total recoverable)	µg/L	20.1	19.0	-5%
Thallium (total recoverable)	µg/L	2.02	2.08	3%
Cadmium (total recoverable)	µg/L	0.105	0.0992	-5%
BOD_5	mg/L	11.3	20.5	81%
TSS	mg/L	9.67	10.6	9%
Loadings				
Total nutrients	tons/yr	1,760	5,280	200%
TDS	tons/yr	64,500	173,000	169%
Selenium (total recoverable)	lb/yr	455	1,270	179%
Lead (total recoverable)	lb/yr	10.7	44.0	312%
Nickel (total recoverable)	lb/yr	2,030	4,890	141%
Thallium (total recoverable)	lb/yr	205	537	162%
Cadmium (total recoverable)	lb/yr	10.6	25.6	141%
BOD_5	tons/yr	574	2,640	360%
TSS	tons/yr	490	1,360	178%

a – Reflects continued ITP and SBWRP operations in 2050, with no APTP. Under this scenario, projected discharges from the ITP in 2050 (25 MGD) are identical to those under current conditions (see Table 4-3) and projected discharges from the SBWRP in 2050 (8.26 MGD) assume operations will increase to use the plant's full 15 MGD capacity by 2050, while continuing to reuse (and not discharge) the same percentage of treated effluent as they do under current operations (approximately 55 percent). Annual average values were calculated using 2015-2020 effluent monitoring data.

b – Reflects expanded ITP treatment of wastewater including inflows resulting from Projects B (Tijuana Canyon Flows to ITP) and C (Tijuana Sewer Repairs); APTP treatment of diverted Tijuana River water; and continued SBWRP operations. Under this scenario, projected ITP operations in 2050 reflect operation at the full 60-MGD capacity, based on estimated population growth in Tijuana; projected APTP operations in 2050 are identical to those under initial operations (see Table 4-3); and SBWRP discharges are identical to those under the projected 2050 baseline (no action) scenario.

These tables are not a comprehensive list of all potential pollutants of concern that could be discharged via the SBOO. For example, because the APTP will provide primary treatment of diverted dry-weather flows from the Tijuana River, the range and concentrations of pollutants in the treated effluent via the SBOO will be influenced by factors including industrial discharges and agricultural runoff within and upstream of Tijuana. These are pollutants that, in the absence of the proposed APTP, would have otherwise been discharged (untreated) to the Pacific Ocean via SAB Creek, or would have potentially reached the TJRE and Pacific Ocean via transboundary river flows. Examples could include surfactants, pesticides, and phthalates. Of note, IBWC conducted water quality sampling in the Tijuana River and Alamar River in 2019 and identified elevated levels of bis (2-ethylhexyl) phthalate at all monitoring sites, possibly due to chemical leaching from plastics and solid waste discarded in the river (IBWC, 2020). However, the river samples had low levels of organics and pesticides, and none of the river samples had detectable levels of toxic parameters of concern such as hexavalent chromium or the carcinogenic pesticides dichloro-diphenyl-trichloroethane (DDT) and Aldrin (IBWC, 2020). Additionally, because PB-CILA (the pump station that will convey diverted river flows to the APTP) will not be capable of operating when the instantaneous river flow rate exceeds 35 MGD, the APTP influent and subsequent discharges of primary-treated effluent via the SBOO will not be expected to include significant amounts of runoff-driven pollutants such as pesticides.

4.3.3 Changes in the Potential Extent of the ZID and Plume

To assess the potential for adverse effects, the magnitude of change in SBOO discharge extent has been estimated using a mixing model. Modeling was performed with the UM3 model from the Visual Plumes software suite (Plumes18 edition[10]). The nearfield dilution estimates for the two scenarios using the May 2019 ambient profile were linked to results from the Brooks Far Field model in Visual Plumes to estimate pollutant transport phenomena within a 20-km radius of the SBOO. These models are conservative with respect to shoreward dispersion of the plume (i.e., they likely overestimate shoreward dispersal) because they do not accommodate boundary conditions and other nearshore processes that would otherwise result in a reduction of shoreward advection. The modeling effort was structured into two scenarios:

- Baseline Scenario: Based on current permitted wastewater sources (assumed average daily flow of 35 MGD) and discharge characteristics.
- Alternative Scenario: Addition of new permitted flows from new or existing plants (assumed average daily flow of 110 MGD, a net 75-MGD increase over baseline).[11]

The SBOO wye diffuser includes 82 risers on each leg (northern and southern legs) and one additional riser at the center of the wye diffuser on the main barrel. Each open riser consists of four ports through which effluent is discharged. Under the Baseline scenario, the model assumed that 72 diffuser ports were open, equivalent to 18 risers (17 on the southern leg diffuser and one on the main barrel). Under the Alternative scenario, the model assumed that 332 ports were open,

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[10] Visual Plumes is a free outfall modeling software suite developed by EPA and currently distributed in partnership between the State Water Resources Control Board and Walter Frick, the lead software developer/maintainer. Plumes18 edition retrieved on January 5, 2021, from: https://www.waterboards.ca.gov/water_issues/programs/ocean/

[11] This modeled alternative scenario of 110 MGD represents a 214 percent increase in average daily flow above the assumed baseline of 35 MGD. After the completion of model runs under this effort, EPA refined its estimate of current SBOO discharges to 28.8 MGD (instead of 35 MGD) and refined its estimate of projected 2050 discharges under the proposed Federal Action to 84.7 MGD (instead of 110 MGD). This refined estimate represents a 194 percent increase in projected average daily flow above current conditions. The modeled scenarios therefore represent a conservative model construction that likely overestimates the expected changes in the SBOO effluent plume under the proposed Federal Action.

equivalent to 83 risers (all 82 on the southern leg diffuser and one on the main barrel). This is likely to represent a conservative model construction.[12]

Under each model scenario, a series of nearfield dilution estimates were computed based on a series of ambient depth profiles for density, current speed, and current direction over the period of record. The ambient profile corresponding to May 2019 produced the median nearfield density estimate. Long-term average effluent salinity and temperature for the ITP and SBWRP were modeled based on monitoring data collected from 2015 through 2020. The San Diego Regional Water Board provided PG Environmental with ambient monitoring data (salinity and temperature) for Station I16 that is located over the junction between the main barrel and the wye diffuser of the SBOO. Quarterly depth profiles for salinity and temperature (collected in February, May, August, and November) collected between August 2018–November 2020 were used in the model to characterize ambient density stratification conditions in the nearfield. The quarterly ambient monitoring data had relevant data for depths ranging from 0 to 27 m at 1-m intervals.

Depth profiles for ambient current speed and direction were estimated for the period of records using data collected from two acoustic doppler current profilers (ADCP) deployed in the vicinity of the SBOO diffuser. The ADCP devices collected high frequency time series current speed and direction data which was aggregated by calendar monthly average for the period of record (August 2018–November 2020). To estimate potential far-field transport processes over a longer time-period, current speed and direction from the ADCP devices for the period of record were visualized (Figure 4-3) and the predominant direction of flow was identified. North-south currents predominate, with weaker east-west currents present. Monthly visualizations were also made that show currents during the period of record switching between northerly and southerly current patterns. An average current speed was used for flows traveling in each of four directions: north, east, south, and west. These speeds were:

- North (0/360 degrees): 0.124 m/s
- East (90 degrees): 0.105 m/s
- South (180 degrees): 0.146 m/s
- West (270 degrees): 0.102 m/s

[12] After the completion of model runs under this effort, CoSD estimated that 288 open ports (rather than the assumed 332 open ports) will be optimal based on the operating conditions described in the Alternative scenario. This restricted number of port openings (44 fewer open ports) is expected to result in an increase in the rate of nearfield mixing and therefore reduce the size of the far-field dilution plume in comparison to the modeled results under this effort.

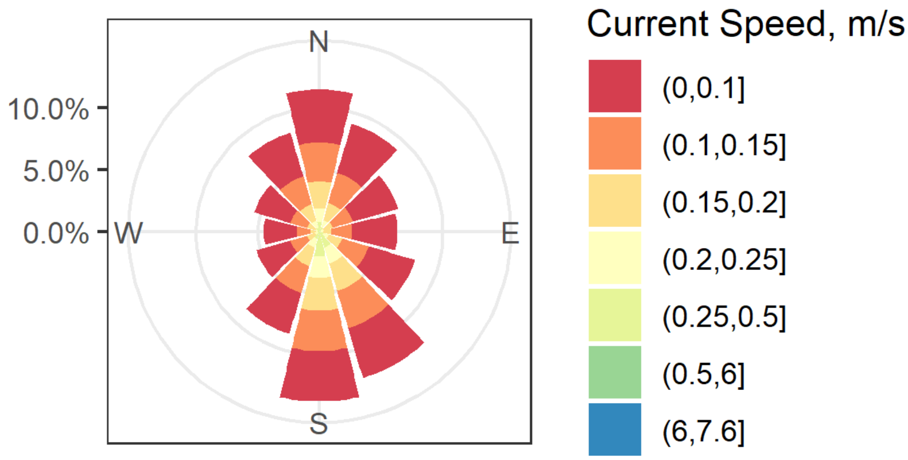

Figure 4-3. Current speed and direction measurements at the SBOO. Radius represents fraction of measurements within that speed and direction category.

The nearfield modeling results provided an estimate of the lateral extent of the ZID. As discussed in Section 2.2.2 (Zone of Initial Dilution at the SBOO) of the BA report submitted to NMFS on July 22, 2022, the boundary of the ZID under current conditions is estimated at 77 ft from each port, which equates to a circular ZID with a diameter of 154 ft around each of the 18 open risers. Under the 110-MGD alternative scenario (the proposed Federal Action) with 83 open risers, the boundary of the ZID is estimated at 61 ft from each port, equivalent to a circular ZID with a diameter of 122 ft around each of the 83 open risers (M. Reusswig [PG Environmental], personal communication, 2022). Figure 4-4 represents the modeled ZID under both current and expected future conditions following implementation of the proposed Federal Action.

Results of the far-field plume modeling are shown in Figure 4-5. The model predicts that an increase in volume of effluent from 35 MGD to 110 MGD will result in an approximate doubling in the overall modeled lateral plume extent, with less of an increase in the plume extent in areas closer to the SBOO where concentrations are higher. The change in lateral plume extent was smallest at higher concentrations closest to the SBOO (mean increase in distance at 75 percent dilution was approximately 85.5 percent), with the extent of some of the lower dilution rates (i.e., >80 percent dilution) skewing the average increase in plume size upwards. Per the nearfield modeling, the maximum vertical diameter of the plume at the boundary of the ZID will increase slightly from approximately 67 ft under current conditions to approximately 71 ft under future conditions.

It is important to consider that these results reflect a highly idealized comparison between two discharge volume scenarios. The contours in Figure 4-5 are not expected to represent actual plume positions in relation to the SBOO terminus. Instead, this is presented to demonstrate the approximate change in magnitude of the discharge in relation to dispersal potential. Differences due to rates of decay for two pollutants (Aldrin and polychlorinated biphenyls [PCBs]) showed negligible differences in modeled plume extents.

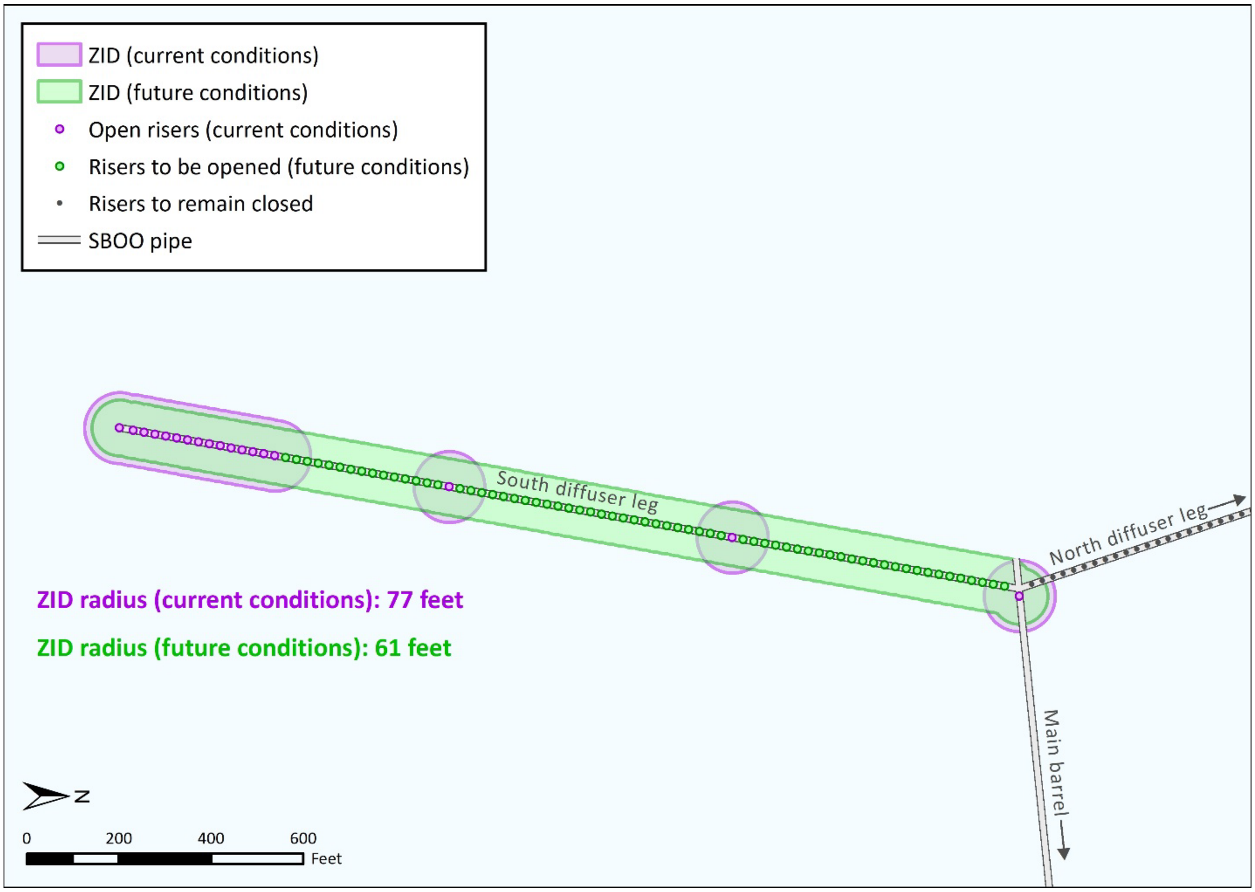

Figure 4-4. ZID around open risers on the SBOO, based on dilution modeling representing current conditions and future conditions following implementation of the proposed Federal Action.

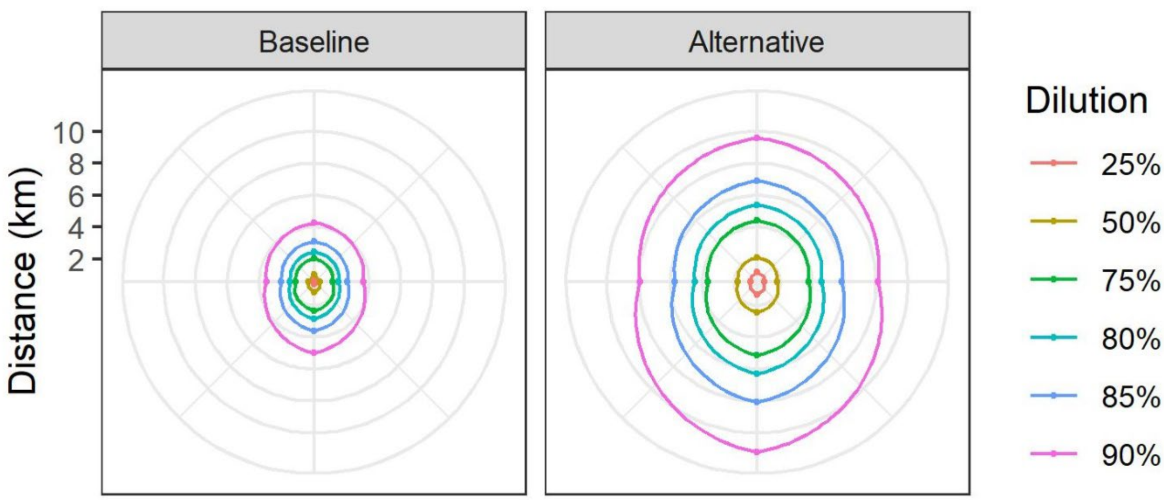

Figure 4-5. North, south, east, and west distances for percent dilution of pollutants based on coupled nearfield and far-field model. Far-field model results are highly idealized and are not expected to represent actual plume positions. Lines connecting points are provided as a visual aid and do not necessarily represent mapped contours.

4.3.4 Potential Effects on EFH

As described in the recent EFH Assessment Response completed by NMFS for the PLOO, wastewater discharge has the potential to adversely affect EFH by causing habitat modifications, reductions in habitat functioning necessary for growth through maturity, community structure modifications, and bioaccumulation of toxic pollutants (NMFS, 2022). In evaluating the proposed Federal Action, EPA considered the following potential pathways of EFH exposure to polluted waters due to discharge of wastewater (treated and untreated) to the Pacific Ocean arising from the proposed Federal Action:

1. The presence in EFH of chemicals toxic to animals at levels sufficient to cause harm when ingested either directly or indirectly via the consumption of prey.

2. An increase in the likelihood of HABs within EFH, which in turn produce toxins that directly harm animals or their prey, due to increased nutrient enrichment and other less-direct ecological consequences of reduced water quality.

The following sections discuss the potential direct and indirect effects to EFH due to the proposed Federal Action with respect to these pollutant pathways.

4.3.4.1 Effects due to Toxic Pollutants

To align with assessments completed in prior EFH consultations between NMFS and federal agencies considering actions related to wastewater treatment plant (WWTP) operation, chemicals toxic to species conserved through EFH designation are organized into three categories. These are metals and ammonia (NH_3), well-studied Persistent Organic Pollutants (POPs), and Contaminants of Emerging Concern (CECs). CECs contain many POPs that are not well-studied.

Metals become toxic at certain exposure levels and can be concentrated to these levels in wastewater. Metals also settle to the ocean floor after a period of post-discharge dispersal and can accumulate in sediments. Ammonia is a form of nitrogen that can be toxic at high concentrations. However, the primary concern regarding ammonia discharge to the ocean from wastewater is the potential for nutrient enrichment increasing the incidence of HABs. Adverse effects on EFH due to increased HAB incidences are discussed in the following section. Modern wastewater treatment processes reduce metals and ammonia in wastewater prior to their discharge as effluent. Furthermore, both of these constituents are among the pollutants regulated under the National Pollutant Discharge Elimination System program, which seeks to ensure that these pollutants will not degrade marine communities. Although discharge of effluent to the ocean via the SBOO will increase, the continued discharge of untreated wastewater from SAB Creek and through other transboundary flows into the marine environment (if not addressed through this Federal Action) would result in a higher loading of metals, nutrients, BOD, TSS, and other potential pollutants in the marine environment of the Action Area. Therefore, the implementation of projects through the funding provided by this Federal Action will result in a net decrease in the release of metals to the marine environment.

POPs are toxic chemical constituents that can accumulate in the food chain. These compounds will be found in much higher concentrations in the tissues of organisms higher in the food chain than lower in the food chain, or in the natural environment. Examples of POPs include:

- Pesticides such DDT and chlordane.
- PCBs.
- Flame retardants (polybrominated diphenyl ethers [PBDEs] and chlorinated organophosphates).
- Anti-foulant paints (e.g., tributyltins [TBTs]).

PCBs and DDT were banned in the U.S. in the 1970s and 1980s. There may be legacy PCBs still in use in Mexico. TBTs and other anti-fouling paints have been in use for a long time. However, it is unclear if this compound bioaccumulates to the extent of some other pollutants monitored for this reason.

CECs include POPs and other chemicals that are less well understood. Organophosphate esters have been identified as an increasing concern; TCEP (tris[chloroethyl] phosphate), TCPP (tris[chloropropyl] phosphate) and TDCPP (tris[1,3-dichloro-2-propyl] phosphate) are three common chemicals in this category. Organophosphate esters are frequently used as flame retardants in manufactured products such as plasticizers and electronics to meet current manufacturing regulations. Other CECs include pharmaceuticals (for humans and pets) such as prescription drugs, antibiotics, anti-fungals, and hormones. Also, personal care products can have unintended environmental consequences. These include products such as sunscreens, exfoliants containing micro-plastics, etc. Even nanomaterials such as carbon nanotubes or nano-scale particulate titanium dioxide may have harmful consequences for marine life that are yet to be well documented. Secondary treatment processes may not remove CECs from effluent discharge. For example, several TCPPs were frequently detected in the Orange County Sanitation District. These included acetaminophen, DEET, carbamazepine, ibuprofen, and other compounds.

EFH throughout the Action Area will gain a net benefit from reductions in nearshore pollution because of the proposed Federal Action to fund infrastructure to address transboundary flows. However, the proposed Federal Action will result in an increase in effluent from the SBOO, resulting in an increase in the ZID and an extension of the detectable extent of the plume (the far-field extent) as described above. When considered in isolation from the net benefits of the proposed Federal Action described above, this increase in the discharge of effluent at the SBOO would result in adverse effects to EFH in the ZID. PCG EFH, CPS and Krill EFH, Dorado EFH (HMS FMP), and Common Thresher EFH (HMS FMP) overlap the ZID. These EFH would therefore be affected by the increased discharge volume of toxic pollutants and subsequent expansion of the ZID due to the proposed Federal Action.

Prey species that feed within the ZID may bioaccumulate toxins, and some of these animals may subsequently move outside the ZID where they may be consumed by managed species grazing in waters adjacent to the ZID. However, these impacted prey species will mix with non-impacted prey species outside the ZID, so the effect is likely to reduce rapidly beyond the ZID. Because the Action Area will see a net improvement in water quality due to the proposed Federal Action, adverse effects to EFH beyond the ZID due to prey consumption would not be expected.

It is uncertain whether the discharge would result in any other effects beyond the ZID. An extensive environmental monitoring program conducted by the City of San Diego (CoSD) on the ongoing

SBOO discharge has, to date, not identified any effects to EFH, including the Imperial Beach Kelp Forest (CoSD, 2013, 2016, 2018, 2020, and 2022). However, the monitoring program may be unable to detect the effects of CECs. Efforts within the state led by the State Water Resources Control Board are ongoing to determine whether improvements to current statewide monitoring and other regulatory mechanisms can be made to address this uncertainty.[13] The expansion of discharge volume through the SBOO due to the proposed Federal Action will result in an increase in the extent of the detectable plume and pollutant loadings. With that said, the increase in the treated effluent plume extent will be a direct result of the effort to decrease nearshore pollution from transboundary flows. Currently, the effect of ongoing transboundary flows originating from SAB Creek and the TJRE on the Imperial Beach Kelp Forest HAPC are uncertain. The sizeable, persistent flows originating at SAB Creek of untreated wastewater that includes raw sewage have been shown to envelop the Imperial Beach Kelp Forest on a regular basis and discharges from the TJRE are a major source of nearshore pollution, particular during wet-season outflows from the estuary. It is highly likely that these polluting waters impact the quality of kelp canopy HAPC at the Imperial Beach Kelp Forest. The proposed Federal Action is intended to reduce these polluting events and therefore would result in a net beneficial effect to EFH in the Action Area.

4.3.4.2 Effects due to Increased HABs

Phytoplankton blooms are a common feature of all ocean systems. HABs occur when populations of usually monospecific species of toxic phytoplankton rapidly increase in numbers. These toxin-producing algal blooms cause illness and death of fish, seabirds, mammals, and other marine life. Several species contribute to the formation of HABs, however the most common phytoplankton in southern California to form HABs is *Pseudo-nitzschia*. This taxon produces domoic acid and is responsible for frequent sea lion deaths, toxic blooms and associated mammal and bird illnesses in California. Other species include *Alexandrium*, *Gymnodinium*, and *Pyrodinium*, all of which are associated with paralytic shellfish poisoning (PSP). These HABs result in concentrations of toxicants in shellfish and are a serious human health risk. The contaminated shellfish and other lower invertebrates that consume and concentrate the PSP toxins are generally unaffected. However, there is some evidence that PSPs, which transfer to higher invertebrates and vertebrates such as fishes, birds, marine mammals, and other animals, may cause harm to marine life.

In California, HABs are often related to large-scale oceanographic forcing, although studies have shown that local nutrient inputs (such as nitrification of ammonium [NH_4^+] from wastewater effluent) are important when cells reach the shore. For example, algal bloom hotspots are often associated with WWTP outfalls (Smith et al., 2018). Howard et al. (2014) evaluated the sources of nitrogen loadings to nearshore coastal ecosystems in highly urbanized areas of southern California. They reported that wastewater discharges contribute similar amounts of nitrogen as wind-driven upwelling events, with wastewater contributions in the Tijuana River coastal area being nearly an order of magnitude higher than inputs from upwelling. Howard et al. (2014) estimate that upwelling contributes approximately 2,700 tons per year of nitrogen in the San Diego area and that effluent, riverine runoff and atmospheric deposition contribute approximately 15,500 tons per year of nitrogen. It is unclear if Howard et al. (2014) included an estimate of nitrogen flux to the area from SAB Creek. SAB Creek contributes approximately 4,000 tons of nutrients to the Pacific Ocean

[13] "Surface Water Ambient Monitoring Program – Contaminants of Emerging Concern (CECs) in Aquatic Ecosystems". Available at https://www.waterboards.ca.gov/water_issues/programs/swamp/cec_aquatic/. Accessed in July 2022.

under current conditions (Table 4-1), although this annual discharge does not enter the Action Area unless south swell conditions drive the plume northward. However, the magnitude of nitrogen enrichment suggests it is a substantial source of nitrogen to the marine environment in the region and therefore may be contributing to increased HABs.

As discussed in Section 4.3.2 (Changes to the SBOO Discharge), the proposed Federal Action will reduce overall nutrient loadings to the Pacific Ocean but will increase nutrient loadings discharged specifically via the SBOO (by approximately 154 percent under initial operations and by approximately 200 percent in 2050 when compared to the no-action baseline). It is unclear whether the increase in the SBOO discharges will increase the frequency or magnitude of HABs in the Action Area. It seems highly probable that contributions of coastally trapped raw effluent presently discharged from SAB Creek and the TJRE do contribute to an increased likelihood of HAB events. The proposed Federal Action seeks to reduce or eliminate this polluting feature. If the enrichment of coastal waters due to transboundary flows does result in increased frequency of HABs, there will likely be a net reduction in this negative consequence of pollution from Mexico due to the proposed Federal Action. This will improve water quality in the marine environment and benefit EFH in the Action Area. Because it is most likely that regional-scale contributions of nutrient enrichment drive HAB occurrence in the Action Area, and the proposed Federal Action is expected to result in a net reduction in nutrient loadings to the Action Area through the implementation of the treatment facilities, this project is expected to result in a reduction in HAB events. The proposed Federal Action would not result in adverse effects to EFH due to HABs.

4.4 Summary Conclusions

Table 4-5 summarizes effects determinations for EFH in the Action Area. As described in Section 4.3 (Effects of Facility Operation), the proposed Federal Action will result in a net reduction in polluted wastewater in the Pacific Ocean that originates in Mexico and is transported into U.S. territory. These transboundary flows cause harm to EFH through contamination of the natural environment, including introduction of toxic pollutants and nutrient enrichment that are likely to be causing increased HAB events. The proposed Federal Action will result in a net reduction in these effects and a benefit to EFH in the Action Area.

In order to achieve these benefits to marine water quality, the proposed Federal Action will increase discharges of treated effluent via the SBOO due to the expansion of treatment facilities in the U.S. This increase in discharges via the SBOO that will occur due to the proposed Federal Action ***would adversely affect*** EFH within the area of the ZID due to an increase in the total amount of chemicals toxic to marine life. There remains uncertainty as to whether, and to what degree, EFH located outside of the ZID would be affected by the discharge. Additionally, as described in Section 4.2.2.1 (Effects due to Diving and Vessel Activities), anchor deployment during recommissioning of diffuser ports on the SBOO may disturb small areas of seabed communities, which ***would adversely affect*** Groundfish EFH within the affected footprint; the recommissioning contractor will adhere to the mitigation measures described in that section. Within the ZID, adverse effects that have the potential to occur are limited to these two effects. With regard to the portion of the Action Area outside of the ZID, the EFH Assessment concludes that the proposed Federal Action ***would not adversely affect*** EFH outside of the ZID. The proposed Federal Action would improve the quality of EFH throughout the Action Area beyond the ZID.

Table 4-5. Summary of EPA's Effects Determination by Essential Fish Habitat for Construction and Operation.

Essential Fish Habitat	Effects from Construction	Effects from Operation
Pacific Coast Groundfish EFH	Would Adversely Affect [a]	Would Adversely Affect [b]
Coastal Pelagic Species and Krill EFH	No Adverse Effect	Would Adversely Affect [b]
Dorado EFH (HMS FMP)	No Adverse Effect	Would Adversely Affect [b]
Common Thresher Shark EFH (HMS FMP)	No Adverse Effect	Would Adversely Affect [b]
Rocky Reef HAPC (Imperial Beach Kelp Forest) (PCG FMP)	No Adverse Effect	No Adverse Effect
Canopy Kelp HAPC (Imperial Beach Kelp Forest) (PCG FMP)	No Adverse Effect	No Adverse Effect
Estuarine HAPC (TJRE) (PCG FMP)	No Adverse Effect	No Adverse Effect
Zuniga Jetty and adjacent seagrass beds (PCG FMP)	No Adverse Effect	No Adverse Effect

a – Adverse effects would be limited to within the seabed area disturbed by anchor deployment.
b – Adverse effects would be limited to within the ZID.

5. REFERENCES CITED

Chavez, F. P., Ryan, J., Lluch-Cota, S. E., & Niquen, M. (2003). *From Anchovies to Sardines and Back: Multidecadal Change in the Pacific Ocean*. Science 299: 217-221.

Cimino, M. A., Santora, J. A., Schroeder, I., Sydeman, W., Jacox, M. G., Hazen, E. L., & Bograd, S. J. (2020). *Essential krill species habitat resolved by seasonal upwelling and ocean circulation models within the large marine ecosystem of the California Current System*. Ecography 43: 1536–1549.

City of San Diego (CoSD). (2013). *Annual Receiving Waters Monitoring Report for the South Bay Ocean Outfall (South Bay Water Reclamation Plant) 2012*. Retrieved from https://www.sandiego.gov/public-utilities/sustainability/ocean-monitoring/reports. Accessed on July 13, 2022.

CoSD. (2016). *South Bay Ocean Outfall Annual Receiving Waters Monitoring & Assessment Report 2015*. Retrieved from https://www.sandiego.gov/public-utilities/sustainability/ocean-monitoring/reports. Accessed on July 13, 2022.

CoSD. (2018). *Biennial Receiving Waters Monitoring and Assessment Report for the Point Loma and South Bay Ocean Outfalls 2016–2017*. Retrieved from https://www.sandiego.gov/public-utilities/sustainability/ocean-monitoring/reports. Accessed on July 13, 2022.

CoSD. (2020). *Biennial Receiving Waters Monitoring and Assessment Report for the Point Loma and South Bay Ocean Outfalls, 2018-2019, Addenda 1-9 Visual Observations and Raw Data*. June 2020. Environmental Monitoring and Technical Services. Retrieved from https://www.sandiego.gov/sites/default/files/2018_2019_biennial_ad_new.pdf. Accessed on April 13, 2022.

CoSD. (2021). *Interim Receiving Waters Monitoring Report for the Point Loma and South Bay Ocean Outfalls 2020*. Retrieved from https://www.sandiego.gov/public-utilities/sustainability/ocean-monitoring/reports. Accessed on April 14, 2022.

CoSD. (2022). *Biennial Receiving Waters Monitoring and Assessment Report for the Point Loma and South Bay Ocean Outfalls, 2020–2021*. Retrieved from https://www.sandiego.gov/public-utilities/sustainability/ocean-monitoring/reports. Accessed on July 13, 2022.

Desmond, J. S., Deutschman, D. H., & Zedler, J. B. (2002). *Spatial and temporal variation in estuarine fish and invertebrate assemblages: analysis of an 11-year data set*. Estuaries and Coasts 25:552-569.

Feddersen, F., Boehm, A. B., Giddings, S. N., Wu, X., & Liden, D. (2021). *Modeling untreated wastewater evolution and swimmer illness for four wastewater infrastructure scenarios in the San Diego-Tijuana (US/MX) border region*. GeoHealth, 5, e2021GH000490. Retrieved from https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2021GH000490. Accessed on April 13, 2022.

Fiedler, P. C., Reilly, S. B., Hewitt, R. P., Demer, D., Philbrick, V. A., Smith, S., Armstrong, W., Croll, D. A., Tershy, B. R., and Mate, B. R. (1998). Blue whale habitat and prey in the California Channel Islands. Deep-Sea Research II 45: 1781-1801.

Howard, M. D., Sutula, M., Caron, D. A., Chao, Y., Farrara, J. D., Frenzel, H., Jones, B., Robertson, G., McLaughlin, K., & Sengupta, A. (2014). *Anthropogenic nutrient sources rival natural sources on small scales in the coastal waters of the Southern California Bight*. Limnology and Oceanography, 59(1), pp.285-297.

IBWC. (2020). *Binational Water Quality Study of the Tijuana River and Adjacent Canyons and Drains: December 2018 to November 2019*. Final Report.

NMFS. (2022). *Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response: Reissuance of National Pollutant Discharge Elimination System (NPDES) permit (#CA0107409) for the Point Loma Wastewater Treatment Plant and Ocean Outfall*.

Ocean Imaging. (2015). *Nearshore Substrate Mapping Change Analysis Using Historical and Contemporary Multispectral Aerial Imagery*. Ocean Imaging Corp. Retrieved from https://data.cnra.ca.gov/dataset/multispectral-substrate-mapping-ca-south-coast-mpa-baseline-2011-2012/resource/49fb2781-8525-4d65-81d2-4964ade2d365. Accessed on April 14, 2022.

Pacific Fishery Management Council (PFMC). (2019). *Coastal Pelagic Species Fishery Management Plan as Amended Through Amendment 17*. June 2019. Retrieved from https://www.pcouncil.org/documents/2019/06/cps-fmp-as-amended-through-amendment-17.pdf/. Accessed on April 13, 2022.

PFMC. (2020). *Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery*. August 2020. Retrieved from https://www.pcouncil.org/documents/2016/08/pacific-coast-groundfish-fishery-management-plan.pdf/. Accessed on April 13, 2022.

San Francisco Estuary Institute. (2017). *Tijuana River Valley Historical Ecology Investigation*. Prepared for the State Coastal Conservancy. A Report of SFEI-ASC's Resilient Landscapes Program, Publication # 760, San Francisco Estuary Institute-Aquatic Science Center, Richmond, CA. Retrieved from https://www.sfei.org/projects/tijuana. Accessed on April 13, 2022.

San Diego Regional Sediment Management Plan (SD RSMP). (2022). *San Diego Nearshore Seafloor Substrate*. GIS data layer. Retrieved from https://atlas.resources.ca.gov/arcgis/rest/services/Ocean/CSMW_San_Diego_Nearshore_Seafloor_Substrate/MapServer/0. Accessed on April 15, 2022.

Schiel, D. R., & Foster, M. S. (2015). *The biology and ecology of giant kelp forests*. Berkeley, CA: University of California Press.

Smith, J., Connell, P., Evans, R. H., Gellene, A. G., Howard, M. D. A., Jones, B. H., Kaveggia, S., Palmer, L., Schnetzer, A., Seegers, B. N., Seubert, E. L., Tatters, A. O., & Caron, D. A. (2018). *A decade and a half of* Pseudo-nitzschia *spp. And domoic acid along the coast of southern California*. Harmful Algae 79: 87–104.

USIBWC. (2008). *Final Programmatic Environmental Impact Statement Improvements to the Tijuana River Flood Control Project*. Retrieved from https://www.ibwc.gov/Files/Fnl_PEIS_TJ_River_050608.pdf.

USIBWC. (2016). *Draft Environmental Assessment for Rehabilitation of the Levee System in the Tijuana River Flood Control Project*. Retrieved from https://www.ibwc.gov/Files/EA_Rehab_levee_system_Tijuana_Flood_Control_122116.pdf.

Zedler, J. B., Nordby, C. S., & Kus, B. E. (1992). *The Ecology of Tijuana Estuary, California*. A National Estuary Research Reserve. Pacific estuarine Research Laboratory, Biology Department, San Diego State University, San Diego, CA 92182.