Program Year 2023 - 2024

Marine Monitoring

ANNUAL REPORT

OCSAN
ORANGE COUNTY SANITATION DISTRICT

OC SAN
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www.ocsan.gov

March 14, 2025

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SUBJECT: 2021 NPDES Permit Requirement (Order No. R8-2021-0010, NPDES Permit No. CA0110604) Marine Monitoring Annual Report

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In accordance with the requirements of the 2021 NPDES Permit (Order No. R8 2021-0010, NPDES permit No. CA0110604), Attachment E. Monitoring and Reporting Program, Section XII. Reporting Requirements, Subsection D(3) Receiving Water Monitoring Report (pg. E-72), enclosed is the Orange County Sanitation District (OC San) 2023-24 Marine Monitoring Annual Report.

This report focuses on the final effluent and receiving water findings and conclusions for the monitoring period of July 1, 2023, to June 30, 2024. During this reporting period, OC San's final effluent met all permit requirements and exhibited no discernable impact on the receiving environment.

If you have any questions or comments, please contact Dr. Danny Tang, Ocean Monitoring Supervisor, at (714) 593-7427 or myself at (714) 593-7450.

Lan C. Wiborg
Director of Environmental Services

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SUBJECT: 2021 NPDES Permit Requirement (Order No. R8-2021-0010, NPDES Permit No. CA0110604) Marine Monitoring Annual Report

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In accordance with the requirements of the 2021 NPDES Permit (Order No. R8 2021-0010, NPDES permit No. CA0110604), Attachment E. Monitoring and Reporting Program, Section XII. Reporting Requirements, Subsection D(3) Receiving Water Monitoring Report (pg. E-72), enclosed is the Orange County Sanitation District (OC San) 2023-24 Marine Monitoring Annual Report.

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March 14, 2025

SUBJECT: **OC San 2023-24 Marine Monitoring Annual Report Certification Statement**

The following certification satisfies Attachment E of the Orange County Sanitation District (OC San) Monitoring and Reporting Program, Order No. R8-2021-0010, NPDES No. CA0110604, for the submittal of the attached OC San 2023-24 Marine Monitoring Annual Report.

I certify under penalty of law that this document was prepared under my supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted.

Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the data, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fines and imprisonment for known violations.

Lan Wiborg
Director of Environmental Services

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The Orange County Sanitation District dedicates this report in memory of Absalon Diaz and commemorates his years of service to the public.

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Acknowledgements

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List of Abbreviations

AhR	aryl hydrocarbon receptor
ASTM	American Society for Testing Materials
ATL	Advisory Tissue Level
BOD	biochemical oxygen demand
BRI	Benthic Response Index
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CBOD	carbonaceous biochemical oxygen demand
CECs	contaminants of emerging concern
CDOM	colored dissolved organic matter
COP	California Ocean Plan
CRKSC	Central Region Kelp Survey Consortium
CRM	certified reference material
CTD	conductivity, temperature and depth
DDT	dichlorodipheynyltrichloroethane; also defined as the sum of 4,4′-DDT, 2,4′-DDT, 4,4′-DDE, 2,4′-DDE, 4,4′-DDD, 2,4′-DDD, and 4,4′-DDMU
DO	dissolved oxygen
DS	dissolved sulfides
ELAP	California Environmental Laboratory Accreditation Program
ELOM	Environmental Laboratory and Ocean Monitoring
EMI	epibenthic macroinvertebrate
ENSO	El Niño Southern Oscillation
EPA	US Environmental Protection Agency
ERα	estrogen receptor-alpha
ERM	effects range median
FIB	fecal indicator bacteria
FRI	Fish Response Index
FSU	Florida State University
GC-MS	gas chromatography/mass spectrometry
GC-MS/MS	tandem gas chromatography-mass spectrometry
GR	glucocorticoid receptor
GWRS	Groundwater Replenishment System
H′	Shannon-Wiener Diversity
HRGC/HRMS	high resolution gas chromatography with high resolution mass spectrometry
ICPMS	inductively coupled plasma mass spectroscopy
IEDC	industrial endocrine disrupting compounds
IFCB	Imaging FlowCytobot
ITI	Infaunal Trophic Index
LAB	linear alkylbenzenes
LC-MS/MS	liquid chromatography coupled with tandem mass spectrometry
LIMS	Laboratory Information Management System
MBARI	Monterey Bay Aquarium Research Institute
MBI	Michael Baker International
MDL	method detection limit
MGD	million gallons per day
MLD	mixed layer depth
MOCI	California Multivariate Ocean Climate Index
MS	matrix spike

MSD	matrix spike duplicate
N/A	not applicable
ND	not detected
nMDS	non-metric multidimensional scaling
NPDES	National Pollutant Discharge Elimination System
NPGO	North Pacific Gyre Oscillation
NTU	nephelometric turbidity units
OAH	ocean acidification and hypoxia
OC San	Orange County Sanitation District, may also appear as OCSD or CSDOC in historical documents
OCHCA	Orange County Health Care Agency
OCWD	Orange County Water District
OOC	out of compliance
OMP	Ocean Monitoring Program
ORO	out of range occurrence
PAH	polycyclic aromatic hydrocarbon
PAR	photosynthetically active radiation
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PDO	Pacific Decadal Oscillation
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFCAs	perfluoroalkyl carboxylic acids
PFDA	perfluorodecanoic acid
PFDoA	perfluorododecanoic acid
PFHpA	perfluoroheptanoic acid
PFHxA	perfluorohexanoic acid
PFHxS	perfluororhexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	pefluorosulfonic acid
PFSAs	perfluoroalkyl sulfonic acid
PFTeDA	perfluorotetradecanoic acid
PFTrDA	perfluorotridecanoic acid
PFUnDA	perfluoroundecanoic acid
PPCP	pharmaceuticals and personal care products
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RL	reporting limit
RO	reverse osmosis
ROMS-BEC	Regional Ocean Model System-Biogeochemical Elemental Cycling Model
RPD	relative percent difference
RWQCB	Regional Water Quality Control Board
SCB	Southern California Bight
SCBRWQP	Southern California Bight Regional Water Quality Program
SCCOOS	Southern California Coastal Ocean Observing System
SCCWRP	Southern California Coastal Water Research Project
SDI	Swartz's 75% Dominance Index
SDR	Synoptic Data Review
SIMPROF	similarity profile

SOP	standard operating procedure
SPS	strategic process studies
SRM	standard reference material
STV	Statistical threshold value
SWRCB	State Water Resources Control Board
TCEP	tris(2-chloroethyl) phosphate
TCPP	tris(2-chloro-1-methylethyl) phosphate
TDCPP	tris(1,3-dichloro-2-propyl) phosphate
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TOC	total organic carbon
TP	total phosphorus
TSS	total suspended solids
WET	whole effluent toxicity
ZID	zone of initial dilution

Executive Summary

The Orange County Sanitation District (OC San) operates Reclamation Plant No. 1 in Fountain Valley and Reclamation Plant No. 2 in Huntington Beach, California, with the mission to protect public health and the environment by providing effective wastewater collection, treatment, and recycling. To evaluate potential environmental and human health impacts from its discharge of final effluent into the Pacific Ocean, OC San conducts extensive monitoring of final effluent samples and long-term monitoring of coastal water quality, sediment quality, invertebrate and fish communities, fish bioaccumulation, and fish health within 185 square miles (479 square km) of ocean. The final effluent, consisting of secondary-treated wastewater mixed with reverse osmosis concentrate from the Groundwater Replenishment System, is released through a 120-in (305-cm) outfall extending 5 miles (8.0 km) offshore at a depth of 197 ft (60 m) of water. The data collected are used to determine compliance with final effluent and receiving water conditions as specified in OC San's National Pollution Discharge Elimination System permit (Order No. R8-2021-0010, NPDES Permit No. CA0110604). The permit was jointly issued on June 23, 2021, by the U.S. Environmental Protection Agency, Region IX and the Regional Water Quality Control Board, Region 8 and came into effect on August 1, 2021. This report focuses on monitoring results and conclusions from the 2023-24 program year (July 1, 2023, through June 30, 2024).

EFFLUENT QUALITY

No permit exceedances were recorded among the final effluent parameters measured for compliance, and all mass emission benchmarks were met. In terms of performance goals, only one of the 80 final effluent constituents monitored, total chromium was detected above its respective performance goal value for two or more consecutive months. Consistent with prior chromium levels greater than the performance goal, the samples were speciated, and it was determined that the signal is Cr(III) and not Cr(VI). OC San will continue to speciate between Cr(III) and Cr(VI) whenever the total chromium performance goal is exceeded.

WATER QUALITY

Compliance for all three fecal indicator bacteria was achieved in the majority of the samples collected in coastal areas used for water contact sports. Analysis of ammonia nitrogen samples and water column profiles of chlorophyll-*a* concentrations indicated no correlation between nutrients discharged from the outfall and primary production. Compliance criteria for dissolved oxygen and pH were met in 100% of the measurements. By contrast, minimal plume-related changes in water clarity were occasionally detected; however, none of the changes were determined to be environmentally significant, since they fell within natural ranges to which marine organisms are exposed.

SEDIMENT QUALITY

Measured sediment parameters were comparable among benthic stations located within and beyond the zone of initial dilution[1] (ZID). Furthermore, measured values were comparable to OC San historical values and Southern California Bight Regional Monitoring results, and they were below applicable Effects-Range-Median guidelines of biological concern. In addition, whole sediment toxicity tests showed no measurable toxicity.

[1] The zone of initial dilution represents a 60-m boundary around the OC San outfall diffuser.

BIOLOGICAL COMMUNITIES

Infaunal Communities

Infaunal communities were generally similar among within-ZID and non-ZID benthic stations based on comparable community measure values (species richness, abundance, Shannon-Wiener Diversity Index, and Swartz's 75% Dominance Index) and community structure. In addition, the infaunal communities within the monitoring area can be classified as reference condition based on their low Benthic Response Index scores (<25) and high Infaunal Trophic Index scores (>60).

Demersal Fish and Epibenthic Macroinvertebrate Communities

The community measure values and community structure of the epibenthic macroinvertebrates and demersal fishes at outfall and non-outfall trawl stations were comparable throughout the entire program year. In addition, the community measure values were within regional and OC San historical ranges. Fish communities at all stations were classified as reference condition based on their low Fish Response Index scores (<45).

FISH BIOACCUMULATION AND HEALTH

Contaminants in Fish Tissue

The concentration of chlorinated pesticides and trace metals in composite liver tissues of flatfish samples and in composite muscle tissues of rockfish samples were similar between outfall and non-outfall locations. Furthermore, the concentration of all contaminants measured in sport fish samples were below California's "Do not consume" Advisory Tissue Levels.

Fish Health

No anomalies were detected in the odor and color of demersal fish samples. Additionally, disease symptoms such as skeletal deformities, tumors, fin erosion, and skin lesions were recorded in less than 1% of the fish samples captured in the monitoring area, and large external parasites were observed in less than 1% of the fish samples examined. Liver tissue damage was minimal in the flatfish samples collected at outfall and non-outfall locations.

CONCLUSION

The 2023-24 final effluent monitoring results indicated that OC San's pretreatment and treatment systems are robust, and OC San employs sound operation practices at Reclamation Plant No. 1 and Reclamation Plant No. 2. The results of the bacterial, physical, and chemical parameters measured in the water column during the 2023-24 program year indicate good water quality in OC San's monitoring area. Additionally, the sediment quality appeared to be minimally impacted based on the relatively low concentrations of chemical contaminants measured in samples collected in the monitoring area, as well as from the absence of sediment toxicity in controlled laboratory tests of sediment collected at outfall-depth stations. The assemblages of sediment-dwelling animals and contaminant concentrations in fish tissue samples were comparable between outfall and non-outfall areas. Negligible disease symptoms were recorded in fish samples and minimal liver pathologies were observed in flatfish samples. Overall, these results suggest that the receiving environment was not degraded by OC San's discharge of treated wastewater, and as such, beneficial uses were protected and maintained.

Chapter 1. The Ocean Monitoring Program

INTRODUCTION

The Orange County Sanitation District (OC San) operates two facilities, Reclamation Plants No. 1 and No. 2, located in Fountain Valley and Huntington Beach, respectively. OC San discharges secondary-treated wastewater to the Pacific Ocean through a 120-in (305-cm) diameter, submarine outfall located offshore of the Santa Ana River (Figure 1-1). This discharge is regulated by the U.S. Environmental Protection Agency (EPA), Region IX and the California Regional Water Quality Control Board (RWQCB), Region 8 under the Federal Clean Water Act, the California Ocean Plan (COP), and the RWQCB Basin Plan. OC San's specific discharge and monitoring requirements for the 2023-24 program year are contained in its National Pollutant Discharge Elimination System (NPDES) permit (Order No. R8-2021-0010, NPDES Permit No. CA0110604) that was issued jointly by the EPA and the RWQCB on June 23, 2021 and came into effect on August 1, 2021.

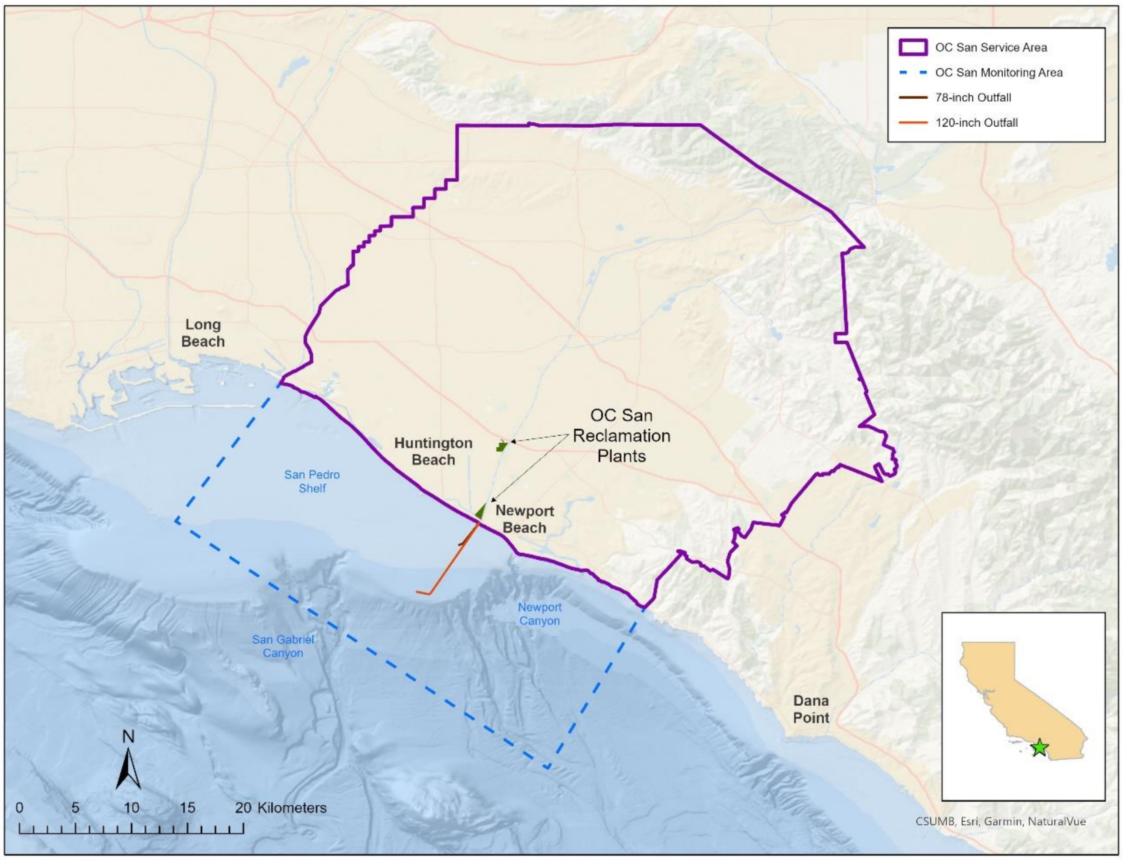

Figure 1-1 Regional setting and sampling area for OC San's Ocean Monitoring Program. Inset shows the general location of OC San's sampling area in the State.

REGULATORY SETTING FOR THE OCEAN MONITORING PROGRAM

OC San's NPDES permit includes requirements to monitor influent, final effluent, and the receiving water. Effluent flows, constituent concentrations, and toxicity are monitored to determine compliance with permit limits and to provide data for interpreting changes to receiving water conditions. Additionally, constituent concentrations and average mass emissions of the effluent are evaluated as indicators of treatment efficiency of the plants. Impacts of wastewater discharge to coastal receiving waters are evaluated by OC San's Ocean Monitoring Program (OMP) based on three inter-related components: (1) Core monitoring; (2) Strategic Process Studies (SPS); and (3) regional monitoring. Information obtained from each of these program components is used to further understand the coastal ocean environment and improve interpretations of the monitoring data. These program components are summarized below and further described throughout this report.

The Core monitoring component is designed to measure compliance with permit conditions and for temporal trend analysis. Four major elements comprise this component: (1) coastal oceanography and water quality, (2) sediment quality, (3) benthic infaunal community health, and (4) demersal fish and epibenthic macroinvertebrate community health, which includes fish tissue contaminant and liver histopathology analyses.

OC San conducts SPS, as well as other special studies, to provide information about relevant coastal and ecotoxicological processes, emerging contaminants, and modern monitoring tools to provide further insight into the Core monitoring component. Recent studies have included contributions to the development of ocean circulation and biogeochemical models and demersal fish tracking to inform species selection for continued monitoring. Ongoing and recently completed SPS are further described in Chapter 4 of this report.

Since 1994, OC San has participated in seven regional monitoring studies of environmental conditions within the Southern California Bight (SCB): 1994 SCB Pilot Project, Bight '98, Bight '03, Bight '08, Bight '13, Bight '18, and Bight '23. OC San plays an integral role in these regional projects by contributing to many of the program design decisions and by participating in field sampling, sample and data analyses, and reporting. Results from these efforts provide information that is used by individual dischargers, local, state, and federal resource managers, researchers, and the public to improve the understanding of regional environmental conditions. This provides a larger-scale perspective for comparisons with data collected from local, individual point sources. Program documents and reports can be found at the Southern California Coastal Water Research Project's website.

Other collaborative regional monitoring efforts include:

- Participation in the Southern California Bight Regional Water Quality Program (previously known as the Central Bight Water Quality Program), a water quality sampling effort with the City of Los Angeles, the Los Angeles County Sanitation Districts, and the City of San Diego.
- Supporting and working with the Southern California Coastal Ocean Observing System (SCCOOS) to upgrade and maintain water quality sensors on the Newport Pier Automated Shore Station.
- Supporting the SCCOOS Newport Pier Imaging FlowCytobot (IFCB), an in-situ autonomous imaging flow cytometer which captures high resolution images of phytoplankton.
- Partnering with the Orange County Health Care Agency and other local Publicly Owned Treatment Works to conduct regional shoreline (aka surfzone) bacterial monitoring used to determine the need for beach postings and/or closure.
- Participating in the Central Region Kelp Survey Consortium Monitoring Program for tracking the extent and magnitude of surface canopy kelp measured by aerial survey within the central Bight region.
- Ocean Acidification and Hypoxia (OAH) Mooring to monitor OAH at a single location.

ENVIRONMENTAL SETTING

OC San's ocean monitoring area is adjacent to California's most highly urbanized area (OCSD 2021, 2022). Beaches are a primary reason for people to visit coastal Southern California (Kildow and Colgan 2005, NOAA 2015). Although highest visitations occur during the warmer summer months, Southern California's Mediterranean climate and convenient beach access results in significant year-round use by the public. A large percentage of the local economies rely on beach use and its associated recreational activities, which are highly dependent upon local water quality conditions (Turbow and Jiang 2004, Leeworthy and Wiley 2007, Leggett et al. 2014). In 2016, Orange County's coastal economy, comprising tourism, recreation, construction, and fishing industries, was valued at $4.3 billion (E2 2019).

The Core monitoring area covers most of the San Pedro Shelf and extends southeast off the shelf (Figure 1-1). These nearshore coastal waters receive inputs from a variety of anthropogenic sources, such as wastewater discharges, dredged material disposals, oil and gas activities, boat/vessel discharges, urban and agricultural runoff, and atmospheric fallout. The majority of municipal and industrial sources are located between Point Dume and San Mateo Point. Untreated discharges from the Los Angeles, San Gabriel, and Santa Ana Rivers—representing nearly 30% of the surface flow to the SCB (SCCWRP, personal communication, November 30, 2020)—are responsible for a substantial amount of contaminant inputs (Schafer and Gossett 1988, SCCWRP 1992, Schiff et al. 2000, Schiff and Tiefenthaler 2001, Tiefenthaler et al. 2005).

The San Pedro Shelf is primarily composed of soft sediments (sands with silts and clays) with scattered hard substrate reefs and manmade structures and is inhabited by biological communities typical of these environments (OCSD 2004). Seafloor depth on the shelf increases gradually from the shoreline to approximately 262 ft (80 m), after which it increases rapidly down to the open basin. The 120-in outfall diffuser lies at a nominal depth of 197 ft (60 m) on the southern portion of the shelf between the Newport and San Gabriel submarine canyons. The monitoring area southeast of the outfall is characterized by a much narrower shelf and deeper water offshore (Figure 1-1).

The 120-in outfall, and its associated ballast rock, rests on soft-bottom habitat and is one of the largest artificial reefs in the SCB. As a reef, it supports biological communities typical of hard substrates that would not otherwise be found in the monitoring area (Lewis and McKee 1989, OCSD 2000). Together with OC San's 78-in (198-cm) emergency outfall, nearly 25 acres (approximately 102,193 m^2 or 1.1×10^6 ft^2) of seafloor was converted from a flat, sandy habitat into a raised, hard-bottom substrate.

As part of the California Current Ecosystem, conditions within OC San's Core monitoring area are affected by global, regional, and local oceanographic influences. Global climatic (e.g., El Niño) and large-scale regional current conditions (e.g., the California Current) influence the water characteristics and the direction of water flow along the Orange County coastline (Hood 1993). The California Multivariate Ocean Climate Index (MOCI, Farallon Institute 2024) is a unitless measure that synthesizes multiple local and regional ocean and atmospheric conditions to represent the environmental state of California's coastal ocean (Figure 1-2). It displays both temporal and spatial ocean state variability and intensity along the coast and has been shown to have good predictive skill relative to biology across multiple trophic levels (García-Reyes and Sydeman 2017). Consistent with MOCI, temperature anomalies recorded at stations along the California Cooperative Oceanic Fisheries Investigations (CalCOFI) Transect Line 90 (SIO 2025) illustrate that the basin-wide, cross-shelf temperature signal reaches out to 311 miles (500 km) from shore and spans the water column from near the surface to the OC San outfall depth of 60 m (Rudnick et al. 2017; Figure 1-3).

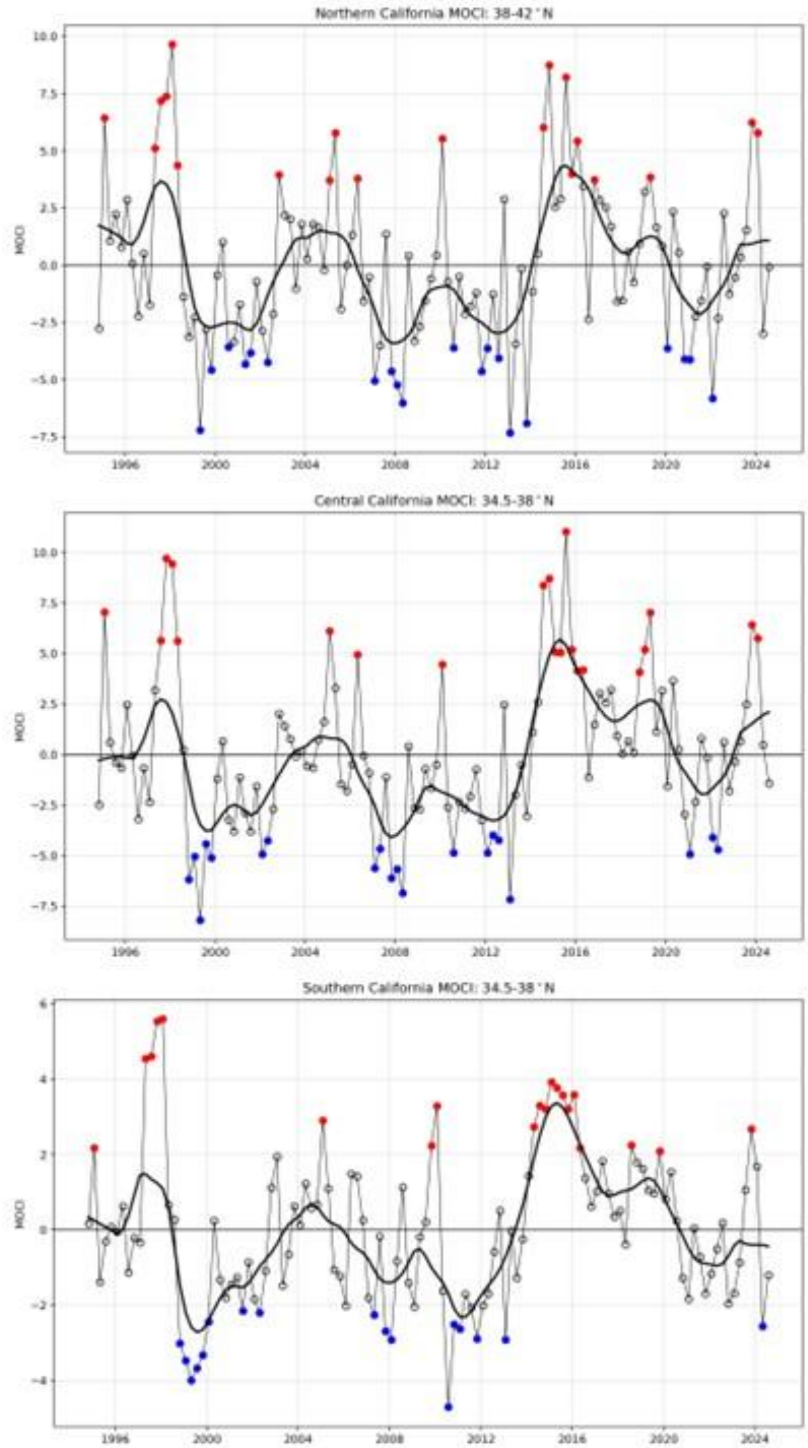

Figure 1-2 California Multivariate Ocean Climate Index for Northern (top figure), Central (middle figure) and Southern (bottom figure) California. Red circles represent values one standard deviation above the mean (i.e., they indicate warm conditions and weak upwelling); blue circles represent values one standard deviation below the mean (i.e., they indicate cold conditions and strong upwelling).

Other oceanographic processes (e.g., upwelling, coastal eddies) and algal blooms also influence the characteristics of receiving waters on the San Pedro Shelf. Tidal flows, currents, and internal waves mix and transport OC San's wastewater discharge with coastal waters and resuspended sediments. Locally, the predominant low-frequency current flows in the monitoring area are alongshore (upcoast or downcoast) with minor across-shelf (toward the beach) transport (CSDOC 1997, 1998; SAIC 2001, 2009, 2011; OCSD, 2004, 2011). The specific direction of the flow varies with depth and season and is subject to reversals over time periods of days to weeks (SAIC 2011). Tidal currents in the monitoring area are relatively weak compared to lower frequency currents, which are responsible for transporting material over long distances (OCSD 2001, 2004). Combined, these processes contribute to the variability of seawater movement observed within the monitoring area. Algal blooms, while variable, have both regional and local distributions that can impact human and marine organism health (Nezlin et al. 2018, Smith et al. 2018, UCSC 2018, CeNCOOS 2019).

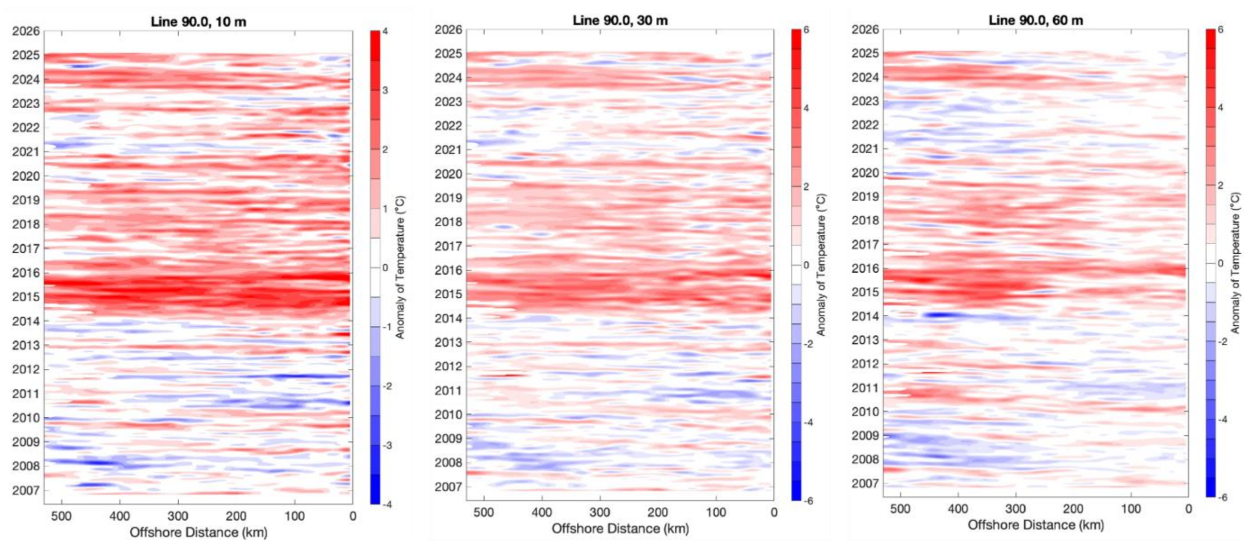

Figure 1-3 Temperature anomalies measured from the shoreline to 311 miles (500 km) offshore along CalCOFI Line 90 at 32 ft (10 m) below the surface (left figure), at OC San's typical plume trapping depth of 98 ft (30 m) (middle figure), and at OC San's nominal outfall depth of 197 ft (60 m) (right figure). Source: Climatology of the California Underwater Glider Network, Scripps Institution of Oceanography (Feb. 28, 2025).

Atmospheric weather events (e.g., episodic storms, drought, and climatic cycles) influence surface flows and hence, environmental conditions and biological communities. River flows, together with urban stormwater runoff, represent significant, if episodic, point sources of fresh water, sediments, suspended particles, nutrients, bacteria, and other contaminants to the coastal area (Hood 1993, Grant et al. 2001, Warrick et al. 2007), although some studies indicate that the spatial impact of these effects may be limited (Ahn et al. 2005, Reifel et al. 2009). While materials supplied to coastal waters by rivers and stormwater flows are essential to natural biogeochemical cycles, an excess or a deficit may have important environmental and human health consequences.

Stormwater runoff has a large influence on sediment movement in the region (Brownlie and Taylor 1981, Warrick and Millikan 2003). Major storm events can generate waves capable of extensive coastal erosion and inundation and can resuspend and move sediments along the coast. Understanding the dynamics of weather cycles and watershed inputs is an important factor in evaluating spatial and temporal trends in local coastal environmental quality, especially as it relates to beach bacterial contamination. For example, in the 2023-24 program year, during non-rainfall periods, up to 95% of monitored Orange County Beaches received grades of either "A" or "B", while during rainfall periods, the proportion of beaches with "A" or "B" grades was reported to be 89% (Heal the Bay 2024).

Other anthropogenic influences that are present in the region likely also contribute to the complexity of contaminant signatures in the monitoring region. For example, in October 2021, a damaged and leaking pipeline approximately 3 miles (4.8 km) offshore of Huntington Beach released approximately 25,000 gallons (nearly 95,000 L) of crude oil into the monitoring region (Pipeline P00547 Incident). The spill created a 13-square mile (34-square km) oil slick that extended over most of OC San's offshore monitoring stations. The Orange County oil spill and its impacts to the OMP are detailed in OCSD, 2023.

PROGRAM RATIONALE

The complexities of the environmental setting and related difficulties in assigning a cause or source to a pollution event are the rationale for OC San's extensive OMP. The program has contributed substantially to the understanding of water quality and environmental conditions along Orange County beaches and coastal ocean reach. The large amount of information collected provides a broad understanding of both natural and anthropogenic processes that affect coastal oceanography and marine biology, the near-coastal ocean ecosystem, and its related designated beneficial uses.

This report presents OMP compliance determinations for data collected from July 1, 2023, through June 30, 2024. Results of effluent monitoring for permit-specified limits, performance goals, and mass emission benchmarks are reported in Chapter 2. Compliance determinations for receiving water monitoring results were made by comparing OMP findings to the criteria specified in OC San's NPDES permit and are addressed in Chapter 3. Progress and outcomes for SPS, special studies, and regional monitoring efforts can be found in Chapter 4. Supporting information including methods, detailed results, and QA/QC findings are provided in appendices.

REFERENCES

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Chapter 2. Final Effluent Characteristics and Mass Emissions

INTRODUCTION

OC San's mission is to protect public health and the environment by providing effective wastewater collection, treatment, and recycling. This is achieved through extensive industrial pretreatment (source control), primary, secondary and solids treatment processes, biosolids management, and water reuse programs. This chapter presents OC San's compliance determinations, performance goals, and mass emission benchmarks for its final effluent to demonstrate the effectiveness of the suite of treatment processes during the 2023-24 program year. The performance goals and mass emission benchmarks are not considered enforceable effluent limitations or standards for the regulation of discharge from OC San.

OC San's Reclamation Plants No. 1 and No. 2 receive domestic sewage from approximately 80% of the County's 2.6 million residents, industrial wastewater from 542 permitted businesses within its service area and, for the past 24 years, dry weather urban runoff from over 21 diversions. Once the influent undergoes secondary treatment processes at Plant No. 1, including nitrification and partial denitrification at two activated sludge facilities, this flow is provided to the Orange County Water District (OCWD) for the Groundwater Replenishment System (GWRS). OCWD further treats this water to recharge local groundwater supplies (primarily for indirect potable use and secondarily as a saltwater intrusion barrier). The influent at Plant No. 2 is split into a reclaimable stream and a non-reclaimable stream. The reclaimable stream undergoes secondary treatment through a trickling filter solids-contact process whereas the non-reclaimable stream undergoes secondary treatment by a high purity oxygen activated sludge. The treated reclaimable stream is pumped from Plant No. 2 to OCWD for the GWRS, while the treated non-reclaimable stream discharges to the outfall. The final effluent consists of non-reclaimable secondary effluent mixed with reverse osmosis (RO) concentrate from OCWD, and it is discharged under normal operations through the 120-in ocean outfall (Discharge Point 001). The 120-in outfall extends 5 miles (8.0 km) from the Huntington Beach shoreline and has a discharge capacity of 480 million gallons per day (MGD) (1.8×10^9 L/day) (Figure 3-1). The last 1.1 miles (1.8 km) of the 120-in outfall consists of a diffuser with 503 ports that discharge the treated effluent at a nominal depth of 197 ft (60 m). OC San also has a 78-in emergency outfall (Discharge Point 002) that is 1.3 miles (0.8 km) long (Figure 3-1). The 0.2-mile (0.3-km) long diffuser section of the 78-in outfall resides at a nominal depth of 66 ft (20 m) and has 130 effluent ports, with a discharge capacity of 230 MGD (8.7×10^8 L/day).

During the 2023-24 program year, OC San received and processed influent volumes averaging 193 MGD (7.3×10^8 L/day). After diversions to OCWD and the return of their reject flows (e.g., RO concentrate), OC San discharged an average of 101 MGD (3.8×10^8 L/day) of treated wastewater through the 120-in outfall. The 78-in outfall was not used during the 2023-24 program year.

RESULTS

No permit exceedances were recorded among the 42 final effluent parameters measured for compliance during the 2023-24 program year (Table 2-1). The 12-month averages of most parameters were considerably lower than their respective permit limits. For example, the 12-month average for the monthly total suspended solids (TSS) was 5,526 lbs/day compared to the 51,541 lbs/day permit limit. Likewise, the 12-month average for the instantaneous maximum of total chlorine residual was 192 lbs/day compared to the 18,658 lbs/day permit limit. Among the three radioactive parameters measured in the final effluent, only two results were recorded above the stipulated criterion of 50 pCi/L for monthly gross beta radioactivity

(Table 2-1). Nonetheless, the monthly combined radium-226 & 228 values[2] were all below the stipulated criterion of 5 pCi/L. No anomalies were detected among the 51 miscellaneous parameters measured in the final effluent (Table 2-1). Furthermore, the results of the nitrogen-based nutrient parameters were within expected ranges.

Among the 80 constituents analyzed for mass emission benchmarks, all had a 12-month average value below their respective benchmarks (see Table 2.7 in OCSD (2023)). Results for 69% (55 out of 81) of the measured constituents were below their respective detection limits.

Among the 80 constituents monitored for performance goals, total chromium was detected above its respective performance goal of 1.55 µg/L for two consecutive months in the 2023-24 program year (see Table 2.12 in OCSD (2023)). Samples from the final effluent on November and December 2023 were sent out to an outside lab for further speciation analysis, with the results indicating that the signal is coming from Cr(III) and not Cr(VI). This distinction is important because of the differences in toxicity, where Cr(III) may pose health effects under circumstances of chronic exposure, as compared to Cr(VI) which is much more toxic for both acute and chronic exposures, Cr(VI) is identified as a carcinogen (EPA, 2000). OC San will continue to speciate between Chromium (III) and Chromium (IV) whenever the total chromium performance goal is exceeded. Please refer to Section 2.8.4 in the 2023-2024 Pretreatment Program Annual Report OCSD (2023) for a full discussion of total chromium.

Conclusion

Overall, these results indicate OC San's pretreatment and treatment systems are robust, and OC San employs sound operation practices at its two reclamation plants.

Summary of Non-Compliance

There were no exceedances of effluent limitations in the 2023-24 program year.

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[2] Analysis for combined radium-226 & 228 is triggered when the gross alpha or gross beta result for the same sample is above the stipulated criterion of 15 pCi/L and 50 pCi/L, respectively.

Table 2-1 Monthly and 12-month averages of parameters measured in the final effluent during the 2023-24 program year. ND = Not Detected; NA = Not Applicable.

Parameter	Units	7/23	8/23	9/23	10/23	11/23	12/23	1/24	2/24	3/24	4/24	5/24	6/24	12-month Average	Permit Limit or Criterion
		Month/Year													
Parameters with Effluent Limitations															
Turbidity Monthly Avg	NTU	2.7	2	2.6	2.5	2	1.6	4	3.2	2.7	7.8	5.2	1.8	3.2	75
Turbidity Weekly Avg [a]	NTU	2.7	2	2.6	2.5	2	1.6	4	3.2	2.7	7.8	5.2	1.8	3.2	100
Turbidity Instantaneous Max [a]	NTU	2.7	2	2.6	2.5	2	1.6	4	3.2	2.7	7.8	5.2	1.8	3.2	225
pH Instantaneous Min	Standard Units	7.31	7.26	7.41	7.3	6.98	7.21	7.36	7.24	7.22	7.31	7.33	7.39	7.3	6
pH Instantaneous Max	Standard Units	7.92	7.71	7.64	7.61	7.49	7.96	7.53	7.82	7.52	7.62	7.59	7.55	7.7	9
TSS Monthly Avg	mg/L	5.8	5.5	5.9	5.4	6	5.3	6.6	6.4	6.2	8.6	9.8	4.8	6.4	30
TSS Weekly Avg	mg/L	6.3	6.5	6.8	5.8	7.3	6.5	6.8	6.7	6.6	10	17.9	5.6	7.7	45
TSS Monthly Avg	lbs/day	3,569	4,330	4,413	3,431	3,393	3,144	4,161	7,390	8,858	8,334	11,100	4,185	5,526	51,541
TSS Weekly Avg	lbs/day	4,282	4,437	5,606	3,775	3,849	3,947	4,801	9,099	9,635	9,545	19,374	5,892	7,020	77,312
TSS Monthly Avg Removal	%	99.2	98.9	98.7	99.2	99.2	99.3	99	98.2	97.7	98.1	96.5	98.8	98.6	≥85
Settleable Solids Monthly Avg	ml/L	0	0	0	0	0	0	0	0	0	0	0	0	0.0	1
Settleable Solids Weekly Avg	ml/L	0	0	0	0	0	0	0	0	0	0	0	0	0.0	1.5
Settleable Instantaneous Max	ml/L	0	0	0	0	0	0	0	0	0	0	0.5	0	0.0	3
Oil & Grease Monthly Avg	mg/L	0.215	0.208	0.206	0.659	0.426	0.515	0.426	1.28	0.316	0.6	1.1	0.2	1	25
Oil & Grease Weekly Avg [b]	mg/L	0.215	0.208	0.206	0.659	0.426	0.515	0.426	1.28	0.316	0.6	1.1	0.2	1	40
Oil & Grease Instantaneous Max [b]	mg/L	0.215	0.208	0.206	0.659	0.426	0.515	0.426	1.28	0.316	0.619	1.05	0.211	0.5	75
Oil & Grease Monthly Avg	lbs/day	129	119	155	382	218	268	184	1,851	541	531	1,329	207	493	42,951
Oil & Grease Weekly Avg [c]	lbs/day	129	119	155	382	218	268	184	1,851	541	531	1,329	207	493	68,722
Oil & Grease Instantaneous Max [c]	lbs/day	129	119	155	382	218	268	184	1,851	541	531	1,329	207	493	128,853
Total Chlorine Residual Daily Max	mg/L	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.08	0.2	0.1	1.45
Total Chlorine Residual Instantaneous Max	mg/L	0.17	0.16	0.25	0.16	0.18	0.18	0.2	0.24	0.27	0.41	0.1	0.21	0.2	10.86
Total Chlorine Residual 6-Month Median	mg/L	0.08	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.08	0.08	0.07	0.1	0.36
Total Chlorine Residual Daily Max	lbs/day	79.75	171.56	99.51	136.12	128.97	110.89	107.76	266.95	210.61	142.11	183.71	117.31	146.3	2,491
Total Chlorine Residual Instantaneous Max	lbs/day	114	157	224	124	116	113	128	274	312	442	113	184	192	18,658
Total Chlorine Residual 6-Month Median	lbs/day	59	57	57	57	55	52	50	51	51	50	50	63	54.3	618
$CBOD_5$ Monthly Avg	mg/L	9.8	7.8	8.1	9.5	9.1	7.5	12	6.5	5.7	7.5	6.5	4.4	7.9	25

Table 2-1 Monthly and 12-month averages of parameters measured in the final effluent during the 2023-24 program year. ND = Not Detected; NA = Not Applicable.

		Month/Year													
Parameter	**Units**	**7/23**	**8/23**	**9/23**	**10/23**	**11/23**	**12/23**	**1/24**	**2/24**	**3/24**	**4/24**	**5/24**	**6/24**	**12-month Average**	**Permit Limit or Criterion**
$CBOD_5$ Weekly Avg	mg/L	10.7	9	9	10.3	11	9.4	13.2	11.2	6.5	9.5	10.7	4.8	9.6	40
$CBOD_5$ Monthly Avg	lbs/day	5,998	5,978	6,079	5,817	5,251	4,346	7,603	7,276	7,933	7,270	7,252	3,853	6,221	42,951
$CBOD_5$ Weekly Avg	lbs/day	6,413	6,144	6,755	5,963	6,331	5,043	8,986	9,326	8,633	9,010	11,304	4,407	7,360	68,722
$CBOD_5$ Monthly Avg Removal	%	98.2	98	97.9	98.3	98.5	98.8	97.8	97.7	97.4	97.8	96.9	98.6	98.0	≥85
Benzidine Monthly Avg	µg/L	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0125
Benzidine Monthly Avg	lbs/day	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0215
Hexachlorobenzene Monthly Avg	µg/L	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0380
Hexachlorobenzene Monthly Avg	lbs/day	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0653
Toxaphene Monthly Avg	µg/L	0						0						0.0	0.0380
Toxaphene Monthly Avg	lbs/day	0						0						0.0	0.0653
PCBs Monthly Avg	µg/L	0										0		0.0	0.0034
PCBs Monthly Avg	lbs/day	0										0		0.0	0.0058
TCDD Equivalents Monthly Avg	pg/L	0			0			0			0			0.0	0.7059
TCDD Equivalents Monthly Avg	lbs/day	0			0			0			0			0.0	0.0000012
Acute Toxicity Quarterly	Pass or Fail			Pass	Pass				Pass		Pass			N/A	Pass
Chronic Toxicity Monthly	Pass or Fail	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass [d]	Pass	Pass	Pass	N/A	Pass
Parameters with Stipulated Criteria															
Gross Alpha Radioactivity Monthly	pCi/L	6.13	8.34	7.03	8.73	8.19	2.51	9.99	16.4	18	3.4	12.9	12.1	9.5	15
Gross Beta Radioactivity Monthly [e]	pCi/L	15	42	-25	6.1	190	154	44	7.4	1.2	-5.1	-13	-16	33.4	50
Radium-226 & 228 Monthly	pCi/L	3	0.4	2	3	0.1	2	1	0.9	0.2	2	3	2	1.6	5
Strontium-90	pCi/L	0.124	1.12	0.153	0.0818	-0.901	1.25	0.87	0.563	-2.67	-0.00248	0.899	4.15	0.5	—
Tritium	pCi/L	38	366	126	—	1100	181	674	103	-41.4	304	192	-53.3	271.8	—
Uranium	pCi/L	15	15	12	15	12	15	16	33	11	18	12	13	15.6	—
Miscellaneous Parameters															
Fecal Coliform Density Monthly Avg	MPN/100 mL	130,000	240,000	320,000	180,000	190,000	75,000	99,000	79,000	260,000	740,000	830,000	340,000	290,000	N/A
Fecal Coliform Density Daily Max	MPN/100 mL	330,000	1,100,000	1,300,000	490,000	920,000	350,000	540,000	210,000	1,600,000	35,000,000	3,500,000	1,100,000	3,870,000	N/A
Enterococcus Density Monthly Avg	MPN/100 mL	4,150	4,039	3,663	5,475	7,320	2,793	4,848	3,968	6,902	12,116	12,726	5,463	6,122	N/A
Enterococcus Density Daily Max	MPN/100 mL	14,136	19,863	7,270	24,196	24,196	11,199	12,997	12,997	24,196	24,196	24,196	12,997	17,703	N/A
Nitrite Nitrogen Monthly	mg/L	5.8	5.6	3.8	4.2	5.1	3.5	8.2	1.6	1.8	1.9	0.41	1.8	3.6	N/A
Nitrate Nitrogen Monthly	mg/L	21	25	14	17	21	29	19	7.8	12	13	6.5	9.2	16.2	N/A
Organic Nitrogen Monthly	mg/L	5.6	1.7	6	1.9	2.3	5.8	6.1	2.5	1.8	1.8	1.7	2	3.3	N/A

Table 2-1 Monthly and 12-month averages of parameters measured in the final effluent during the 2023-24 program year. ND = Not Detected; NA = Not Applicable.

		Month/Year													
Parameter	**Units**	**7/23**	**8/23**	**9/23**	**10/23**	**11/23**	**12/23**	**1/24**	**2/24**	**3/24**	**4/24**	**5/24**	**6/24**	**12-month Average**	**Permit Limit or Criterion**
Total Nitrogen Annually	lbs/year													14,486,198 [f]	N/A
Total Phosphorus (as P) Monthly	mg/L	2.22	2.77	2.33	2.61	2.49	3.23	1.99	0.897	1.71	0.977	1.32	2.02	2.05	N/A
BOD_5 Monthly Avg	mg/L	19.9	15.4	19.4	18.3	20	13.6	18.7	16.7	13.2	15.5	13.2	11.9	16.3	N/A
Ammonia (as N) Monthly Avg	mg/L	31.3	23.1	27.7	27.3	23.6	27.1	35.6	17.1	15.4	27.7	32.2	32.6	26.7	N/A
PCB-18 Annually [g]	pg/L	24												24.0	N/A
PCB-28 Annually [g]	pg/L	12												12.0	N/A
PCB-37 Annually [g]	pg/L	2.6												2.6	N/A
PCB-44 Annually [g]	pg/L	41												41.0	N/A
PCB-49 Annually [g]	pg/L	4.5												4.5	N/A
PCB-52 Annually [g]	pg/L	15												15.0	N/A
PCB-66 Annually [g]	pg/L	3.1												3.1	N/A
PCB-70 Annually [g]	pg/L	8.3												8.3	N/A
PCB-74 Annually [g]	pg/L	8.3												8.3	N/A
PCB-77 Annually [h]	pg/L	ND												ND	N/A
PCB-81 Annually [h]	pg/L	ND												ND	N/A
PCB-87 Annually [h]	pg/L	ND												ND	N/A
PCB-99 Annually [g]	pg/L	4.3												4.3	N/A
PCB-101 Annually [g]	pg/L	7.2												7.2	N/A
PCB-105 Annually [g]	pg/L	2.3												2.3	N/A
PCB-110 Annually [g]	pg/L	7.9												7.9	N/A
PCB-114 Annually [h]	pg/L	ND												ND	N/A
PCB-118 Annually [g]	pg/L	5.6												5.6	N/A
PCB-119 Annually [h]	pg/L	ND												ND	N/A
PCB-123 Annually [h]	pg/L	ND												ND	N/A
PCB-126 Annually [h]	pg/L	ND												ND	N/A
PCB-128 Annually [h]	pg/L	ND												ND	N/A
PCB-138 Annually [g]	pg/L	8.8												8.8	N/A
PCB-149 Annually [h]	pg/L	ND												ND	N/A
PCB-151 Annually [h]	pg/L	ND												ND	N/A
PCB-153/168 Annually [g]	pg/L	7.3												7.3	N/A
PCB-156 Annually [h]	pg/L	ND												ND	N/A

Table 2-1 Monthly and 12-month averages of parameters measured in the final effluent during the 2023-24 program year. ND = Not Detected; NA = Not Applicable.

		Month/Year													
Parameter	**Units**	**7/23**	**8/23**	**9/23**	**10/23**	**11/23**	**12/23**	**1/24**	**2/24**	**3/24**	**4/24**	**5/24**	**6/24**	**12-month Average**	**Permit Limit or Criterion**
PCB-157 Annually [h]	pg/L	ND												ND	N/A
PCB-158 Annually [g]	pg/L	1.0												1.0	N/A
PCB-167 Annually [h]	pg/L	ND												ND	N/A
PCB-169 Annually [h]	pg/L	ND												ND	N/A
PCB-170 Annually [h]	pg/L	ND												ND	N/A
PCB-177 Annually [h]	pg/L	ND												ND	N/A
PCB-180 Annually [h]	pg/L	ND												ND	N/A
PCB-183 Annually [h]	pg/L	ND												ND	N/A
PCB-187 Annually [g]	pg/L	2.0												1.0	N/A
PCB-189 Annually [h]	pg/L	ND												ND	N/A
PCB-194 Annually [h]	pg/L	ND												ND	N/A
PCB-201 Annually [h]	pg/L	ND												ND	N/A
PCB-206 Annually [h]	pg/L	ND												ND	N/A

[a] The values reported for this parameter are the same as those for the Turbidity Monthly Avg, because turbidity is measured only once in each calendar month.
[b] The values reported for this parameter are the same as those for the Oil & Grease Monthly Avg (mg/L), because oil & grease are measured only once in each calendar month.
[c] The values reported for this parameter are the same as those for the Oil & Grease Monthly Avg (lbs/day), because oil & grease are measured only once in each calendar month.
[d] At least one test acceptability criteria was not met in two in-house and one external reference toxicant tests (see Appendix C).
[e] The gross beta value is calculated by subtracting naturally occurring potassium-40 from the gross beta particle, which may result in a negative value.
[f] This value represents the annual total, not the annual average.
[g] Since the contract laboratory reported “Detected, but no Quantified (DNQ)” for the PCB constituent, i.e., the sample result was less than the reported Minimum Level, but greater than or equal to the laboratory’s Method Detection Limit, the result provided represents an estimated concentration.
[h] The result is reported as ND (Not Detected) because the sample result was less than the contract laboratory’s Method Detection Limit.

Chapter 3. Receiving Water Compliance Monitoring

INTRODUCTION

This chapter provides OC San's OMP receiving water compliance results for the 2023-24 program year. The program includes sample collection, analysis, and data interpretation to evaluate potential impacts of treated wastewater discharge on the following receiving water characteristics:

- Bacterial
- Physical
- Chemical
- Biological
- Radioactivity

Specific criteria for each of those characteristics are listed in OC San's NPDES permit (Table 3-1). Permit compliance must be determined each monitoring year based on the Federal Clean Water Act, the COP, and the RWQCB Basin Plan.

The Core OMP sampling locations include 28 offshore water quality stations to evaluate physical, chemical, and bacterial characteristics in the water column, 22 benthic stations to assess sediment quality (geochemistry and toxicity) and infaunal communities, 14 trawl stations to evaluate demersal fish and macroinvertebrate communities, and two rig fishing zones for assessing human health risk from the consumption of sport fishes (Figure 3-1, Figure 3-2, and Figure 3-3). Sampling frequencies varied by component and ranged from monthly offshore water quality sampling to annual fish tissue assessments (see Appendix A).

Table 3-1 List of compliance criteria from OC San's ocean discharge permit (Order No. R8-2021-0010, NPDES No. CA0110604) including compliance status of each criterion for the 2023-24 program year.

	Criteria	Criteria Met
	Bacterial Characteristics	
VI.A.1.a.	For the State Water Board Water-Contact Objectives, a 30-day geometric mean of fecal coliform density shall not exceed 200/100 mL and a single sample maximum shall not exceed 400/100 mL.	Yes [a]
VI.A.1.a.	For the State Water Board Water-Contact Objectives, a 6-week rolling geometric mean of enterococci, calculated weekly, shall not exceed 30 CFU or MPN per 100 mL and a statistical threshold value of 110 CFU or MPN per 100 mL shall not be exceeded by more than 10 percent of all enterococci samples collected in a calendar month.	Yes [a]
VI.A.1.c.	For the State Water Board Shellfish Harvesting Standards, the median total coliform density shall not exceed 70 per 100 mL and not more than 10 percent of the samples shall exceed 230 per 100 mL.	Yes [a]
VI.A.1.d.	For the USEPA Recreational Water Quality Criteria, a 30-day geometric mean of enterococci shall not exceed 30 CFU or MPN per 100 mL and a statistical threshold value corresponding to the 90th percentile of the same water quality distribution shall not exceed 110 CFU or MPN per 100 mL in the same 30-day interval.	Yes [a]

Table 3-1 List of compliance criteria from OC San's ocean discharge permit (Order No. R8-2021-0010, NPDES No. CA0110604) including compliance status of each criterion for the 2023-24 program year.

	Criteria	Criteria Met
	Physical Characteristics	
VI.A.2.a.	Floating particulates and grease and oil shall not be visible.	Yes
VI.A.2.b.	The discharge of waste shall not cause aesthetically undesirable discoloration of the ocean surface.	Yes
VI.A.2.c.	Natural light shall not be significantly reduced at any point outside the initial dilution zone as the result of the discharge of waste.	Yes
VI.A.2.d.	The rate of deposition of inert solids and the characteristics of inert solids in ocean sediments shall not be changed such that benthic communities are degraded.	Yes
VI.A.2.e.	Trash from the discharge shall not be present in ocean waters, along shorelines or adjacent areas in amounts that adversely affect beneficial uses or cause nuisance.	Yes
	Chemical Characteristics	
VI.A.3.a.	The dissolved oxygen concentration shall not at any time be depressed more than 10 percent from that which occurs naturally, as the result of the discharge of oxygen demanding waste materials.	Yes
VI.A.3.b.	The pH shall not be changed at any time more than 0.2 units from that which occurs naturally.	Yes
VI.A.3.c.	The dissolved sulfide concentration of waters in and near sediments shall not be significantly increased above that present under natural conditions.	Yes
VI.A.3.d.	The concentration of substances, set forth in Chapter II, Table 3 of the California Ocean Plan, in marine sediments shall not be increased to levels which would degrade indigenous biota.	Yes
VI.A.3.e.	The concentration of organic materials in marine sediments shall not be increased to levels which would degrade marine life.	Yes
VI.A.3.f.	Nutrient materials shall not cause objectionable aquatic growths or degrade indigenous biota.	Yes
VI.A.3.g.	Numerical water quality objectives established in Table 3 of the California Ocean Plan shall not be exceeded as a result of discharges from the facility through Discharge Points 001 and 002 (as computed using an applicable dilution factor).	Yes
	Biological Characteristics	
VI.A.4.a.	Marine communities, including vertebrate, invertebrate, and plant species, shall not be degraded.	Yes
VI.A.4.b.	The natural taste, odor, and color of fish, shellfish, or other marine resources used for human consumption shall not be altered.	Yes
VI.A.4.c.	The concentration of organic materials in fish, shellfish, or other marine resources used for human consumption shall not bioaccumulate to levels that are harmful to human health.	Yes
VI.A.5.	Discharge of radioactive waste, which meets the definition of "pollutant" at 40 CFR § 122.2, shall not degrade marine life.	Yes

[a] Overall, compliance with FIB objectives was met during the 23/24 program year. Please refer to Appendix Table B-2, Table B-3, Table B-4 for full evaluations and to review singular, spontaneous exceedances of FIB water quality objectives.

WATER QUALITY

Offshore Bacteria

The majority (73–87%) of samples for three fecal indicator bacteria (FIB) were below the method detection limit (MDL) of 10 MPN/100mL (Table B-1). Fecal coliform measurements met the 30-day geometric mean of ≤200 MPN or CFU/100 mL consistently throughout the 2023-24 program year. One fecal coliform sample measured greater than the single sample maximum of 400 MPN or CFU/100 mL (0.001%); all other samples achieved compliance with this objective (Table B-2). Total coliform measurements met the State Water Resources Control Board's (SWRCB's) median density of ≤70 MPN or CFU/100 mL consistently throughout the 2023-24 program year. There were three stations sampled during spring 2024 that did not meet the criterion of ≤10% samples ≥230 MPN or CFU /100 mL; all other stations achieved this objective consistently throughout the 2023-24 program year (Table B-3). Enterococci measurements met the SWRCB 6-week rolling geometric mean and the EPA's 30-day geometric mean of ≤30 CFU or MPN/100 mL consistently throughout the 2023-24 program year. The statistical threshold value for enterococci of ≤10% of samples ≥110 CFU or MPN/100 mL was achieved in the majority of samples. There were two stations in different months that did not meet this objective due to the number of samples being low with one elevated result; all other measurements achieved compliance with this objective (Table B-4).

Floating Particulates and Oil and Grease

There were no observations of oils and grease or floating particles of sewage origin at any water quality station in the 2023-24 program year (Table B-5 and Table B-6). Therefore, compliance was achieved.

Ocean Discoloration and Transparency

Overall, transmissivity (water clarity) standards were met 95% of the time (Table 3-2). All transmissivity values were within natural ranges of variability to which marine organisms are exposed (Table B-7; CSDOC 1996a, b; OCSD 2004). There were no adverse effects from the treated wastewater discharge relative to ocean discoloration at any offshore station.

Dissolved Oxygen

Oxygen compliance was 100% (Table 3-2), with measured values well within the range of long-term monitoring results (Table B-7; CSDOC 1996a, b; OCSD 2004).

Acidity (pH)

Compliance with COP pH standards was 100% (Table 3-2), with measured values within the range to which marine organisms are naturally exposed (Table B-7; CSDOC 1996a, b; OCSD 2004).

Table 3-2 Summary of OC San's monthly offshore water quality compliance testing results for dissolved oxygen, pH, and transmissivity for the 2023-24 program year.

Survey Date	Number of Stations [a]	Dissolved Oxygen		pH		Transmissivity	
		ORO [b]	OOC [c]	ORO	OOC	ORO	OOC
7/18/2023	27	0%	0%	0%	0%	7%	4%
8/8/2023	27	0%	0%	0%	0%	11%	4%
9/12/2023	27	0%	0%	0%	0%	15%	11%
10/25/2023	27	0%	0%	0%	0%	11%	4%
11/6/2023	27	0%	0%	0%	0%	15%	15%
12/6/2023	27	0%	0%	0%	0%	7%	0%
1/25/2024	27	0%	0%	0%	0%	7%	0%
2/12/2024	27	0%	0%	0%	0%	11%	0%
3/5/2024	27	0%	0%	0%	0%	15%	15%
4/29/2024	27	0%	0%	0%	0%	7%	4%
5/9/2024	27	0%	0%	0%	0%	11%	4%
6/5/2024	27	0%	0%	0%	0%	7%	4%
Annual	**324**	**0%**	**0%**	**0%**	**0%**	**10%**	**5%**

[a] Does not include within-ZID Station 2205.
[b] Out-of-Range-Occurrence (ORO) - see Appendix A for calculation method.
[c] Out-of-Compliance (OOC) - see Appendix A for calculation method.

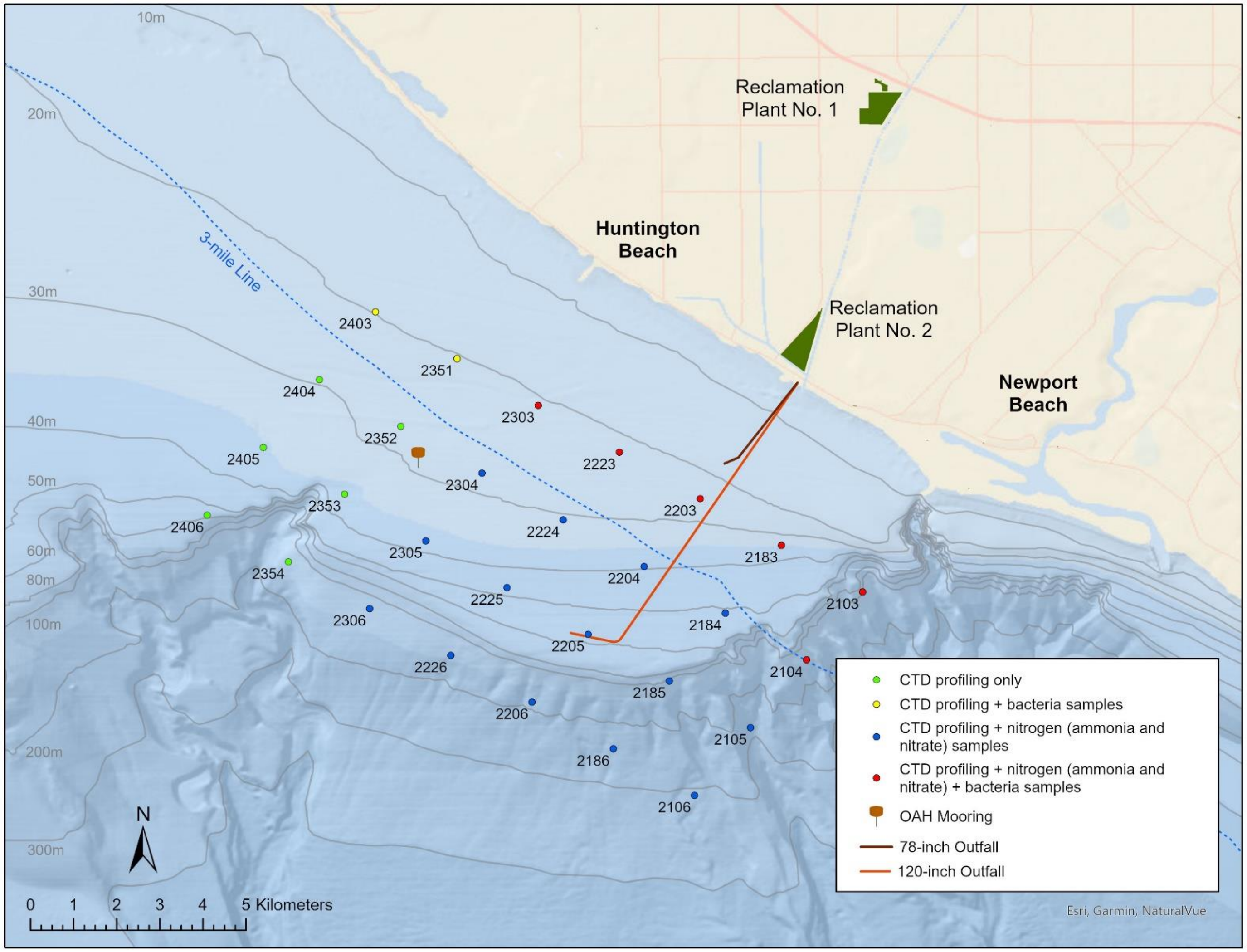


Figure 3-1 Offshore water quality monitoring stations for the 2023-24 program year.

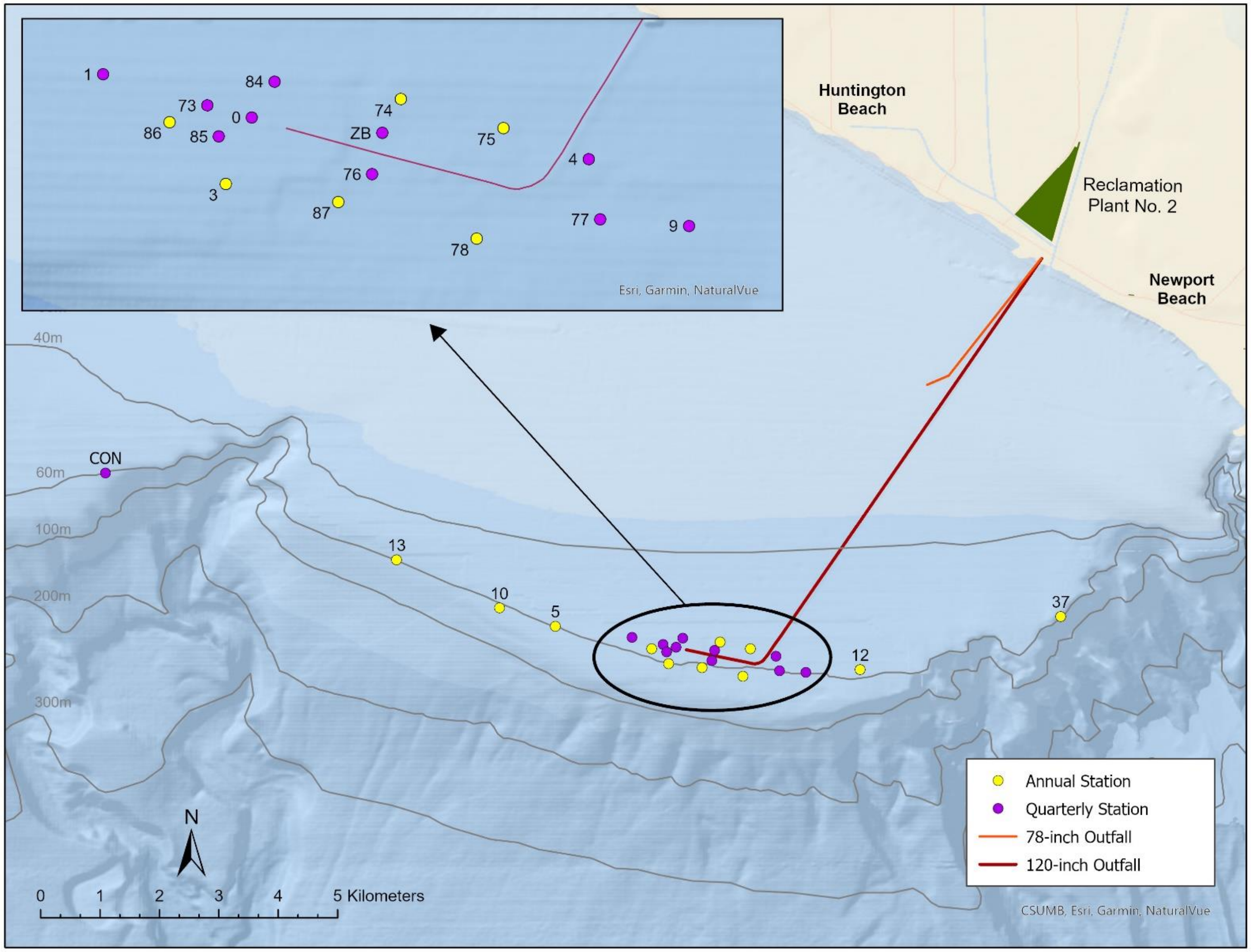


Figure 3-2 Benthic monitoring stations for the 2023-24 program year.

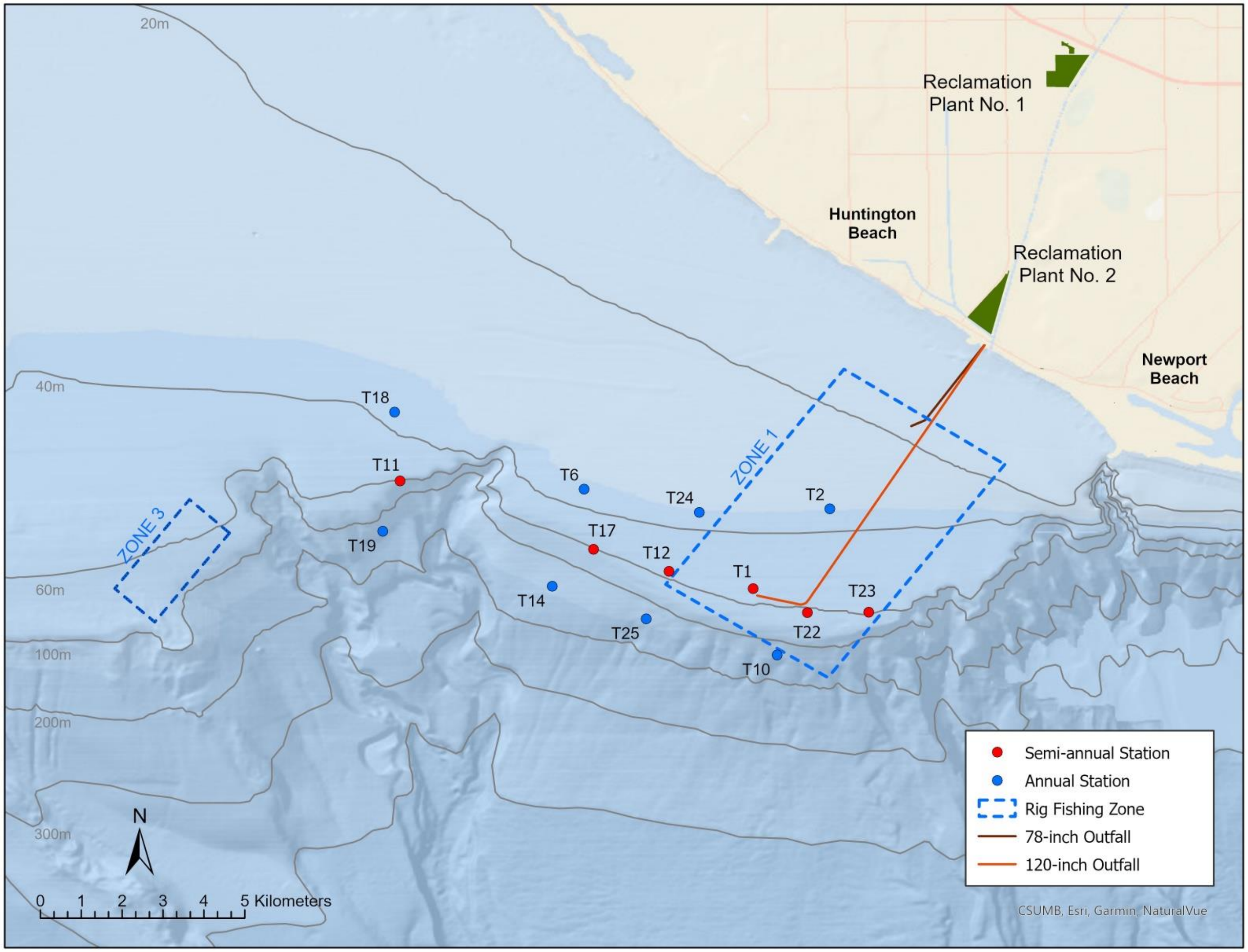


Figure 3-3 Trawl monitoring stations, as well as rig fishing locations, for the 2023-24 program year.

Nutrients

<u>Ammonia Nitrogen</u>

Over 96% of the monthly Core water samples for ammonia nitrogen (NH_3-N) analysis—which included within-ZID Station 2205—were below the method detection limit and reporting limit of 0.04 mg/L (Table B-8). The small fraction of detectable NH_3-N concentrations ranged from 0.04 to 0.16 mg/L. Plume-related changes in NH_3-N were not considered environmentally significant as maximum values were 25 times less than the chronic (4 mg/L) and 37 times less than the acute (6 mg/L) toxicity standards of the COP (SWRCB 2012). In addition, and in contrast to colored dissolved organic matter, there were no positive relationships between NH_3-N values and chlorophyll-*a* concentrations (a proxy for the amount of phytoplankton present in the ocean) (Figure 3-4), indicating no direct impact to aquatic life (e.g., phytoplankton blooms caused by the discharge).

<u>Nitrate Nitrogen</u>

Over 70% of the monthly Core water quality samples for nitrate nitrogen (NO_3-N) analysis were below their respective reporting limits (Table B-9).

Radioactivity

Pursuant to OC San's NPDES Permit, OC San measures the influent and the effluent for radioactivity but not the receiving waters. The results of radioactive measurements of influent (published in OC San's monthly Discharge Monitoring Reports) and effluent (see Chapter 2) samples during the 2023-24 program year indicated that federal standards were consistently met.

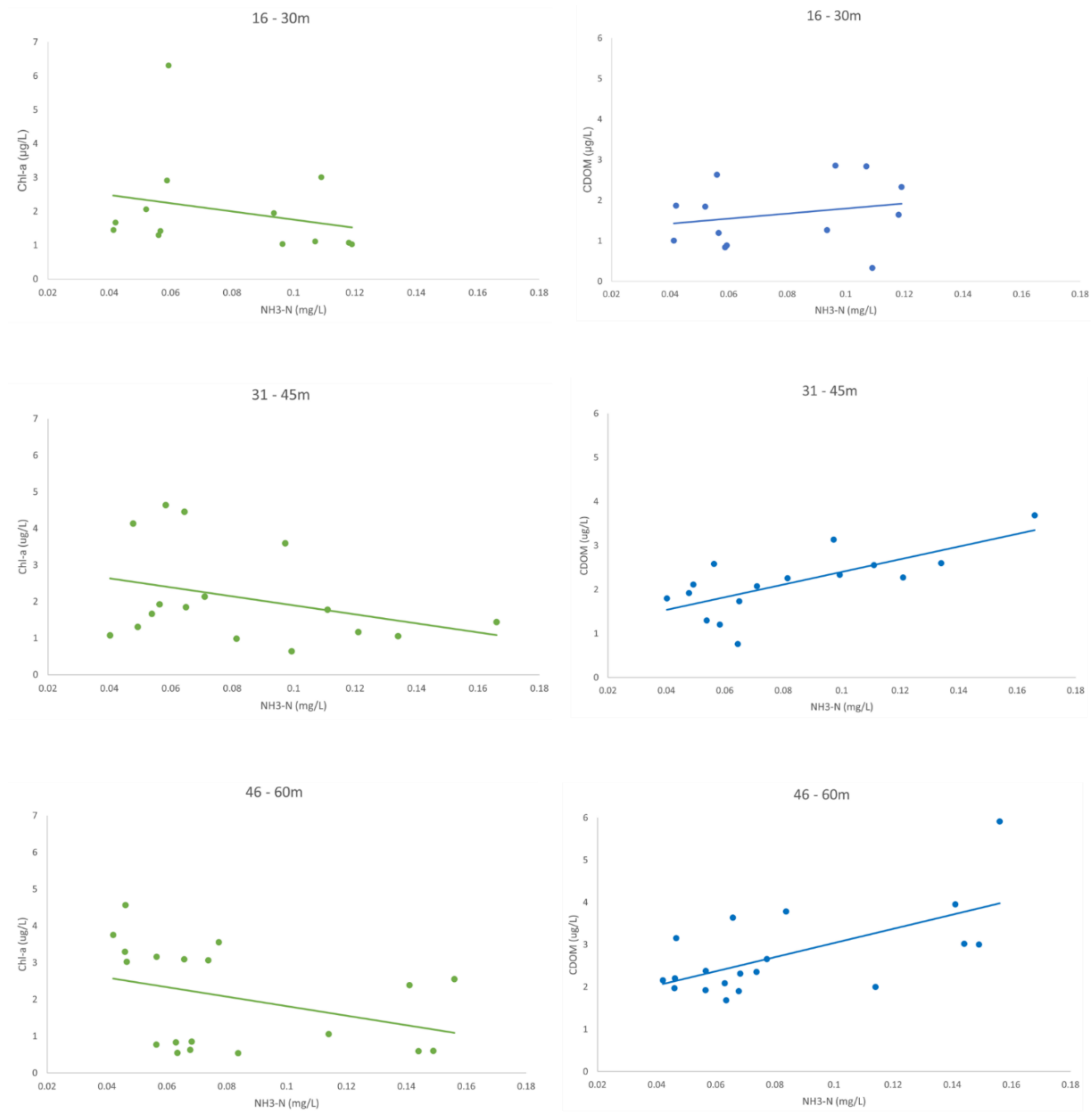


Figure 3-4 Linear regression plots of detectable ammonia nitrogen (NH_3-N) versus chlorophyll-*a* (left column) and colored dissolved organic matter (CDOM) (right column) by 15-m depth bins for the 2023-24 Core monthly water quality cruises. Note: plots from 0–15 m were not included because NH_3-N measurements at that depth bin were all below the method detection limit of 0.04 mg/L.

SEDIMENT GEOCHEMISTRY

Sediment parameters measured in the quarterly and annual surveys, the results were comparable to historical values (Table 3-3 and Table 3-4). Additionally, most station values for 2023-24 were lower than those of the 2018 Southern California Bight Regional Monitoring Program (Bight ‘18; Du et al. 2020), and all station values were below applicable sediment quality guidelines. From a temporal standpoint, the quarterly data remained consistent throughout the year and were comparable between the within-ZID and non-ZID stations. There was no measurable sediment toxicity at any of the 11 quarterly stations monitored in the summer benthic survey (Table 3-5). Overall, measured sediment geochemistry data remained consistent between quarterly and annual surveys, as well as with historical trends.

Table 3-3 Physical properties, as well as biogeochemical and contaminant concentrations, of sediment samples collected at each quarterly and annual station sampled during the 2023-24 program year compared to Effects Range-Median (ERM), regional, and historical values. ND = Not Detected; ZID = zone of initial dilution.

Station	Depth (m)	Median Phi	Fines (%)	TOC (%)	Sulfides (mg/kg)	Total P (mg/kg)	Total N (mg/kg)	ΣPAH (µg/kg)	ΣDDT (µg/kg)	ΣPest (µg/kg)	ΣPCB (µg/kg)
Quarter 1 (July–September)											
Middle Shelf Zone 2, Non-ZID (51–90 m)											
1	56	3.29	12.42	0.60	2.95	1,100	450	24.7	2.93	ND	6.63
9	59	2.83	6.27	0.46	ND	780	430	3.45	1.94	0.10	5.00
73	55	3.11	9.07	0.43	2.50	1,200	470	22.3	2.40	ND	9.31
77	60	3.03	9.12	0.27	1.39	850	390	14.5	1.72	ND	1.22
84	54	3.16	10.48	0.36	1.86	960	430	48.5	2.75	ND	5.41
85	57	3.09	9.46	0.42	2.14	1,100	420	72.9	2.92	0.20	10.03
CON	59	3.20	11.68	0.33	3.31	860	340	15.6	3.61	ND	1.49
	Mean	**3.10**	**9.80**	**0.41**	**2.02**	**979**	**419**	**28.8**	**2.61**	**0.04**	**5.58**
Middle Shelf Zone 2, Within-ZID (51–90 m)											
0	56	3.07	9.00	0.46	1.52	1,300	510	139.0	4.53	0.40	9.94
4	56	3.02	8.34	0.49	1.35	950	530	11.3	2.46	ND	2.90
76	58	3.08	9.42	0.31	1.85	860	250	68.2	1.49	0.10	2.58
ZB	56	3.16	10.57	0.38	2.03	790	360	18.1	2.10	ND	2.89
	Mean	**3.08**	**9.30**	**0.41**	**1.69**	**975**	**412**	**59.2**	**2.64**	**0.12**	**4.58**
Quarter 2 (October–December)											
Middle Shelf Zone 2, Non-ZID (51–90 m)											
1	56	3.28	13.0	0.30	1.70	890	360	80.2	ND	ND	3.14
9	59	2.90	8.38	0.22	2.31	770	280	16.0	ND	ND	1.57
73	55	3.15	9.21	0.29	2.67	870	360	7.33	ND	ND	9.30
77	60	3.04	7.75	0.28	2.69	740	190	14.9	ND	ND	1.45
84	54	3.18	12.02	0.30	2.14	860	300	32.5	ND	ND	6.59
85	57	3.12	11.2	0.32	2.09	950	360	255	ND	ND	9.50
CON	59	3.25	13.34	0.30	ND	760	350	33.9	ND	ND	1.60
	Mean	**3.13**	**10.7**	**0.29**	**1.94**	**834**	**314**	**62.8**	**0**	**0**	**4.74**

Table 3-3 Physical properties, as well as biogeochemical and contaminant concentrations, of sediment samples collected at each quarterly and annual station sampled during the 2023-24 program year compared to Effects Range-Median (ERM), regional, and historical values. ND = Not Detected; ZID = zone of initial dilution.

Station	Depth (m)	Median Phi	Fines (%)	TOC (%)	Sulfides (mg/kg)	Total P (mg/kg)	Total N (mg/kg)	ΣPAH (μg/kg)	ΣDDT (μg/kg)	ΣPest (μg/kg)	ΣPCB (μg/kg)
Middle Shelf Zone 2, Within-ZID (51–90 m)											
0	56	3.12	13.0	0.31	2.85	1,200	380	74.3	ND	ND	10.86
4	56	3.13	11.89	0.25	3.12	720	320	43.6	ND	ND	2.22
76	58	3.17	9.66	0.32	3.28	830	380	15.9	ND	ND	2.70
ZB	56	3.11	10.40	0.26	3.10	780	270	12.8	ND	ND	2.56
	Mean	**3.13**	**11.20**	**0.28**	**3.09**	**882**	**338**	**36.6**	**0**	**0**	**4.58**
Quarter 3 (January–March)											
Middle Shelf Zone 2, Non-ZID (51–90 m)											
1	56	3.29	12.02	0.41	5.66	860	300	44.4	ND	ND	2.91
9	59	2.84	7.83	0.32	2.09	690	290	7.23	ND	ND	ND
73	55	3.15	10.77	0.42	3.81	1,000	300	84.5	ND	ND	12.70
77	60	3.08	7.07	0.35	3.63	770	170	7.3	ND	ND	ND
84	54	3.29	13.64	0.43	2.96	900	360	64.4	ND	ND	11.60
85	57	3.14	8.43	0.49	5.63	1,000	290	498.0	ND	ND	9.61
CON	59	3.23	12.94	0.35	1.12	850	300	17.4	ND	ND	0.21
	Mean	**3.15**	**10.40**	**0.40**	**3.56**	**867**	**287**	**103.3**	**0**	**0**	**5.29**
Middle Shelf Zone 2, Within-ZID (51–90 m)											
0	56	3.08	10.44	0.39	3.43	1,000	290	65.7	ND	ND	13.90
4	56	3.11	10.06	0.39	2.12	730	210	38.3	ND	ND	0.47
76	58	3.08	7.85	0.33	4.47	810	280	23.8	ND	ND	2.73
ZB	56	3.14	11.72	0.39	1.29	780	310	57.3	ND	ND	0.67
	Mean	**3.10**	**10.00**	**0.38**	**2.83**	**830**	**272**	**46.3**	**0**	**0**	**4.44**

Table 3-3 Physical properties, as well as biogeochemical and contaminant concentrations, of sediment samples collected at each quarterly and annual station sampled during the 2023-24 program year compared to Effects Range-Median (ERM), regional, and historical values. ND = Not Detected; ZID = zone of initial dilution.

Station	Depth (m)	Median Phi	Fines (%)	TOC (%)	Sulfides (mg/kg)	Total P (mg/kg)	Total N (mg/kg)	ΣPAH (µg/kg)	ΣDDT (µg/kg)	ΣPest (µg/kg)	ΣPCB (µg/kg)
Quarter 4 (April–June)											
Middle Shelf Zone 2, Non-ZID (51–90 m)											
1	56	3.22	9.15	0.28	3.15	970	340	17.6	ND	ND	4.01
9	59	2.81	4.59	0.47	1.42	800	390	7.30	ND	ND	ND
73	55	3.09	8.69	0.38	1.62	870	420	17.0	ND	ND	8.87
77	60	3.03	7.53	0.31	1.40	840	360	6.50	ND	ND	ND
84	54	3.17	10.20	0.42	2.22	860	490	90.7	ND	ND	4.73
85	57	3.00	6.34	0.41	4.03	1,000	360	64.0	ND	ND	8.30
CON	59	3.22	11.10	0.33	1.18	870	360	21.5	ND	ND	ND
	Mean	**3.08**	**8.20**	**0.37**	**2.15**	**887**	**389**	**32.1**	**0**	**0**	**3.70**
Middle Shelf Zone 2, Within-ZID (51–90 m)											
0	56	2.97	4.76	0.47	1.07	1,200	550	63.6	ND	ND	13.00
4	56	3.11	9.68	0.32	2.89	770	320	20.9	ND	ND	0.47
76	58	3.11	9.78	0.36	1.97	810	340	13.7	ND	ND	0.70
ZB	56	3.08	8.69	0.35	1.56	850	480	21.7	ND	ND	8.18
	Mean	**3.07**	**8.20**	**0.38**	**1.87**	**908**	**422**	**30.0**	**0**	**0**	**5.59**

Table 3-3 Physical properties, as well as biogeochemical and contaminant concentrations, of sediment samples collected at each quarterly and annual station sampled during the 2023-24 program year compared to Effects Range-Median (ERM), regional, and historical values. ND = Not Detected; ZID = zone of initial dilution.

Station	Depth (m)	Median Phi	Fines (%)	TOC (%)	Sulfides (mg/kg)	Total P (mg/kg)	Total N (mg/kg)	ΣPAH (µg/kg)	ΣDDT (µg/kg)	ΣPest (µg/kg)	ΣPCB (µg/kg)
Annual (July–September) Middle Shelf Zone 2, Non-ZID (51–90 m)											
3	60	3.13	6.42	0.48	ND	1,000	380	64.07	2.79	ND	4.56
5	59	3.38	11.15	0.45	2.61	960	470	21.0	2.79	ND	2.54
10	62	3.69	17.81	0.40	3.10	890	500	42.11	3.15	ND	2.90
12	58	2.99	9.98	0.30	1.88	850	400	24.18	1.85	ND	1.06
13	59	3.55	16.40	0.40	2.71	930	340	23.4	2.66	0.20	2.05
37	56	1.89	3.47	0.25	19.30	520	120	15.2	1.58	0.50	0.59
74	57	3.17	12.27	0.57	1.54	950	720	31.09	1.87	0.10	2.08
75	60	3.15	8.77	0.56	2.24	920	480	20.63	1.63	0.20	2.52
78	63	3.09	10.94	0.41	1.46	880	360	30.16	1.95	0.20	1.36
86	57	3.11	9.60	0.55	3.56	1,100	530	181.89	2.85	0.20	11.98
87	60	3.16	11.63	0.43	1.57	1,000	530	35.6	2.29	0.30	2.75
	Mean	**3.12**	**10.80**	**0.44**	**3.63**	**909**	**439**	**44.5**	**2.31**	**0.15**	**3.13**
Sediment Quality Guidelines											
ERM		—	—	—	—	—	—	44,792	46.10	—	180.0
Regional Bight ′18 Summer Values (area weighted mean)											
Middle Shelf		—	35.0	0.74	—	—	600	67.0	13.0	—	4.30
OC San Historical Values (July 2013–June 2023) [mean (range)]											
Middle Shelf Zone 2, Non-ZID		3.32 (2.11-5.41)	16.40 (4.00-87.00)	0.39 (0.21-2.70)	4.17 (0-198.00)	910 (360-2,000)	396 (0-2,100)	76.25 (2.74-1,714)	1.67 (0-52.90)	0.15 (0-36.30)	3.28 (0-149)
Middle Shelf Zone 2, Within-ZID		3.19 (2.78-3.47)	11.88 (4.34-33.1)	0.40 (0.26-0.97)	3.07 (0-19.0)	1,004 (490-2,900)	400 (90.0-610)	163.6 (6.53-3,190)	1.77 (0-58.25)	0.11 (0-2.73)	7.19 (0-373)

Table 3-4 Metal concentrations (mg/kg) in sediment samples collected at each quarterly and annual station sampled during the 2023-24 program year compared to Effects Range-Median (ERM), regional, and historical values. ZID = zone of initial dilution.

Station	Depth (m)	Al	Sb	As	Ba	Be	Cd	Cr	Cu	Fe	Pb	Hg	Ni	Se	Ag	Zn
Quarter 1 (July–September) Middle Shelf Zone 2, Non-ZID (51–90 m)																
1	56	7,849	0.09	3.09	38.0	0.26	0.19	19.3	8.79	14,650	6.41	0.03	8.21	2.07	0.21	40.7
9	59	7,834	0.06	2.99	31.7	0.25	0.10	16.7	6.15	14,630	5.04	0.02	7.86	1.82	0.06	36.6
73	55	7,890	0.07	3.95	37.0	0.26	0.32	20.5	10.80	15,290	6.98	0.05	8.90	1.91	0.18	45.8
77	60	8,036	0.06	3.02	34.0	0.26	0.10	17.4	6.56	16,060	5.13	0.02	8.01	2.05	0.09	38.8
84	54	7,760	0.07	4.19	34.3	0.26	0.25	18.7	9.83	15,040	6.21	0.03	8.21	1.82	0.14	42.2
85	57	7,795	0.08	3.30	32.2	0.26	0.43	21.1	10.70	15,020	6.50	0.04	8.35	1.82	0.20	45.1
CON	59	8,372	0.08	2.75	44.2	0.24	0.08	16.9	7.32	14,380	5.65	0.02	8.12	1.85	0.06	37.0
	Mean	**7,934**	**0.07**	**3.33**	**35.9**	**0.26**	**0.21**	**18.66**	**8.59**	**15,010**	**5.99**	**0.03**	**8.24**	**1.91**	**0.13**	**40.9**
Middle Shelf Zone 2, Within-ZID (51–90 m)																
0	56	7,727	0.08	4.03	36.3	0.26	0.34	20.7	10.7	15,250	6.75	0.03	8.51	1.86	0.17	44.7
4	56	7,620	0.06	3.14	32.0	0.26	0.14	17.5	6.68	14,700	5.27	0.02	7.78	1.75	0.09	38.8
76	58	8,239	0.06	2.63	37.7	0.27	0.13	17.8	7.35	16,110	5.09	0.02	8.43	1.74	0.09	41.2
ZB	56	8,117	0.07	3.74	35.3	0.26	0.20	17.7	7.26	16,260	5.19	0.03	8.48	1.85	0.09	43.1
	Mean	**7,926**	**0.07**	**3.38**	**35.3**	**0.26**	**0.20**	**18.4**	**8.00**	**15,580**	**5.58**	**0.02**	**8.30**	**1.80**	**0.11**	**42.0**
Quarter 2 (October–December) Middle Shelf Zone 2, Non-ZID (51–90 m)																
1	56	8,144	0.07	3.47	46.0	0.28	0.18	18.5	8.46	14,930	6.46	0.03	8.33	1.82	0.13	45.1
9	59	7,362	0.05	2.66	33.3	0.26	0.10	16.2	6.11	13,600	4.52	0.02	7.41	1.61	0.07	37.2
73	55	7,577	0.07	3.18	41.6	0.28	0.33	20.4	12.10	14,070	8.29	0.05	8.56	1.71	0.18	45.4
77	60	7,849	0.06	2.88	38.8	0.28	0.10	17.1	6.35	14,980	4.75	0.02	7.80	1.68	0.07	40.4
84	54	7,670	0.07	3.61	42.4	0.27	0.31	19.4	9.46	14,590	5.81	0.03	8.36	1.68	0.15	45.0
85	57	7,623	0.08	3.06	37.4	0.27	0.31	19.9	9.64	14,650	6.01	0.03	8.12	1.66	0.14	45.5
CON	59	8,121	0.08	3.26	51.3	0.26	0.10	18.1	6.88	15,210	5.39	0.02	8.60	1.66	0.11	41.8
	Mean	**7,764**	**0.07**	**3.16**	**41.5**	**0.27**	**0.20**	**18.5**	**8.43**	**14,576**	**5.89**	**0.03**	**8.17**	**1.69**	**0.12**	**42.9**

Table 3-4 Metal concentrations (mg/kg) in sediment samples collected at each quarterly and annual station sampled during the 2023-24 program year compared to Effects Range-Median (ERM), regional, and historical values. ZID = zone of initial dilution.

Station	Depth (m)	Al	Sb	As	Ba	Be	Cd	Cr	Cu	Fe	Pb	Hg	Ni	Se	Ag	Zn
Middle Shelf Zone 2, Within-ZID (51–90 m)																
0	56	7,591	0.13	4.38	41.2	0.27	0.23	20.3	13.2	14,820	6.32	0.05	8.18	1.47	0.16	48.1
4	56	7,564	0.06	3.16	37.9	0.27	0.12	17.4	6.46	14,340	4.95	0.02	7.71	1.49	0.08	41.1
76	58	7,610	0.05	3.04	35.2	0.28	0.13	17.0	7.2	14,870	4.78	0.02	7.88	1.63	0.09	41.0
ZB	56	7,700	0.06	3.86	38.2	0.27	0.19	17.1	7.16	15,090	5.15	0.06	8.14	1.42	0.08	43.0
	Mean	**7,616**	**0.08**	**3.61**	**38.1**	**0.27**	**0.17**	**17.95**	**8.5**	**14,780**	**5.30**	**0.04**	**7.98**	**1.50**	**0.10**	**43.3**
Quarter 3 (January–March)																
Middle Shelf Zone 2, Non-ZID (51–90 m)																
1	56	7,511	0.12	3.35	42.7	0.26	0.17	18.7	8.99	15,330	6.75	0.02	8.74	1.54	0.19	43.5
9	59	6,930	0.07	2.88	35.1	0.25	0.10	16.6	5.83	13,970	5.22	0.01	7.55	1.28	0.06	38.5
73	55	7,045	0.08	3.52	38.8	0.26	0.32	20.5	12.10	14,550	7.92	0.03	8.42	1.24	0.20	46.1
77	60	6,891	0.08	3.23	36.0	0.25	0.10	16.7	6.18	14,590	5.28	0.01	7.58	1.34	0.07	39.7
84	54	7,462	0.09	3.62	43.2	0.26	0.20	18.2	8.38	14,800	6.53	0.02	8.43	1.52	0.14	44.4
85	57	6,969	0.16	3.81	36.3	0.27	0.31	20.0	10.00	15,090	9.20	0.04	8.13	1.27	0.16	46.1
CON	59	7,265	0.12	3.31	52.7	0.26	0.09	17.7	6.65	14,880	6.28	0.01	8.41	1.47	0.07	40.5
	Mean	**7,153**	**0.10**	**3.39**	**40.7**	**0.26**	**0.18**	**18.3**	**8.30**	**14,744**	**6.74**	**0.02**	**8.18**	**1.38**	**0.13**	**42.7**
Middle Shelf Zone 2, Within-ZID (51–90 m)																
0	56	7,027	0.08	4.24	37.0	0.26	0.32	21.0	11.20	15,140	7.20	0.04	8.29	1.33	0.29	45.1
4	56	6,861	0.08	3.50	37.4	0.27	0.13	17.8	6.83	14,520	5.77	0.01	7.81	1.13	0.09	41.4
76	58	7,071	0.09	4.16	35.6	0.29	0.14	16.9	7.12	15,630	5.83	0.01	7.88	1.31	0.09	41.8
ZB	56	7,429	0.13	3.74	39.2	0.27	0.21	17.2	7.03	15,600	5.46	0.03	8.22	1.29	0.11	45.7
	Mean	**7,097**	**0.10**	**3.91**	**37.3**	**0.27**	**0.20**	**18.2**	**8.04**	**15,223**	**6.06**	**0.02**	**8.05**	**1.26**	**0.14**	**43.5**

Table 3-4 Metal concentrations (mg/kg) in sediment samples collected at each quarterly and annual station sampled during the 2023-24 program year compared to Effects Range-Median (ERM), regional, and historical values. ZID = zone of initial dilution.

Station	Depth (m)	Al	Sb	As	Ba	Be	Cd	Cr	Cu	Fe	Pb	Hg	Ni	Se	Ag	Zn
Quarter 4 (April–June)																
Middle Shelf Zone 2, Non-ZID (51–90 m)																
1	56	7,812	0.06	3.06	42.2	0.27	0.17	17.8	7.94	14,900	6.47	0.02	8.03	1.48	0.14	37.6
9	59	7,170	0.06	3.07	30.4	0.25	0.10	16.9	5.47	14,050	5.54	0.01	7.41	1.44	0.06	34.0
73	55	7,290	0.07	3.70	35.3	0.26	0.30	20.2	12.2	14,660	8.34	0.04	8.02	1.42	0.22	43.5
77	60	7,707	0.06	2.68	35.7	0.26	0.09	17.1	6.19	14,990	5.57	0.01	7.67	1.46	0.07	37.2
84	54	7,931	0.07	3.46	41.0	0.26	0.21	18.3	7.94	14,940	6.76	0.02	8.18	1.55	0.13	40.8
85	57	7,532	0.07	2.95	38.6	0.27	0.30	20.1	9.56	15,040	6.82	0.04	7.94	1.50	0.24	47.8
CON	59	8,067	0.08	3.04	51.4	0.26	0.10	18.0	6.93	15,480	6.38	0.02	8.67	1.33	0.08	38.7
	Mean	**7,644**	**0.07**	**3.14**	**39.2**	**0.26**	**0.18**	**18.34**	**8.03**	**14,866**	**6.55**	**0.02**	**7.99**	**1.45**	**0.13**	**39.9**
Middle Shelf Zone 2, Within-ZID (51–90 m)																
0	56	7,106	0.06	4.43	39.4	0.26	0.24	21.2	13.2	14,500	7.59	0.03	8.49	1.47	0.18	41.8
4	56	7,583	0.09	3.24	35.2	0.27	0.14	17.5	6.84	14,990	5.66	0.02	7.92	1.35	0.09	37.6
76	58	7,891	0.06	2.96	36.6	0.28	0.12	17.0	6.81	15,700	5.56	0.01	7.85	1.39	0.09	38.8
ZB	56	7,769	0.07	3.24	39.9	0.27	0.18	17.5	7.28	15,420	5.54	0.03	8.11	1.28	0.09	41.1
	Mean	**7,587**	**0.07**	**3.47**	**37.8**	**0.27**	**0.17**	**18.3**	**8.53**	**15,153**	**6.09**	**0.02**	**8.09**	**1.37**	**0.11**	**39.8**

Table 3-4 Metal concentrations (mg/kg) in sediment samples collected at each quarterly and annual station sampled during the 2023-24 program year compared to Effects Range-Median (ERM), regional, and historical values. ZID = zone of initial dilution.

Station	Depth (m)	Al	Sb	As	Ba	Be	Cd	Cr	Cu	Fe	Pb	Hg	Ni	Se	Ag	Zn
Annual (July–September)																
Middle Shelf Zone 2, Non-ZID (51–90 m)																
3	60	8,350	0.07	3.20	36.8	0.27	0.14	17.9	9.59	16,190	5.85	0.02	8.51	2.21	0.11	42.3
5	59	8,796	0.07	3.44	44.5	0.27	0.16	19.4	8.66	16,450	6.53	0.02	9.43	2.09	0.13	43.0
10	62	8,799	0.07	3.15	48.5	0.28	0.18	19.6	8.86	16,070	6.51	0.03	9.25	1.93	0.17	43.0
12	58	6,794	0.05	3.04	32.6	0.24	0.12	15.8	6.00	12,990	5.46	0.02	7.43	1.78	0.09	35.9
13	59	8,213	0.07	3.26	46.5	0.25	0.14	18.4	7.73	15,110	6.55	0.02	8.79	1.83	0.11	39.8
37	56	5,943	0.05	3.27	25.4	0.20	0.13	10.9	4.35	10,410	4.15	0.02	6.12	1.05	0.04	28.8
74	57	7,773	0.07	3.20	34.9	0.25	0.18	18.1	7.30	14,770	5.69	0.02	8.16	1.75	0.13	40.6
75	60	7,998	0.07	3.29	36.5	0.26	0.19	17.3	6.88	15,130	5.42	0.02	8.22	1.85	0.09	40.1
78	63	7,550	0.06	2.75	32.2	0.25	0.10	15.9	6.21	14,620	5.07	0.01	7.54	1.97	0.10	36.7
86	57	7,559	0.08	3.49	33.8	0.26	0.24	18.4	9.12	14,670	6.40	0.03	8.04	1.77	0.40	42.5
87	60	8,207	0.06	3.04	36.5	0.28	0.10	17.7	7.16	16,310	5.42	0.02	8.25	1.86	0.08	40.9
	Mean	**7,816**	**0.07**	**3.19**	**37.1**	**0.26**	**0.15**	**17.2**	**7.44**	**14,793**	**5.73**	**0.02**	**8.16**	**1.83**	**0.13**	**39.4**
Sediment Quality Guidelines																
ERM		—	—	70.00	—	—	9.60	370.00	270.00	—	218.00	0.70	51.6	—	3.70	410.0
Regional Bight ′18 Summer Values (area weighted mean)																
Middle Shelf		9,600	1.20	4.40	170.0	0.38	0.56	28.0	6.80	19,000	6.40	0.05	12.0	0.75	0.08	45.0
OC San Historical Values (July 2021–June 2023) [mean (range)])																
Middle Shelf Zone 2, Within-ZID		7,553 (6,632-8,606)	0.08 (0.06-0.12)	3.63 (2.80-5.23)	36.65 (32.5-46.1)	0.27 (0.24-0.29)	0.20 (0.08-0.47)	18.56 (15.9-26.9)	9.10 (6.02-21.3)	15,176 (13,836-17,073)	6.22 (5.11-10.5)	0.04 (0.01-0.36)	8.05 (7.28-8.62)	1.71 (1.21-2.47)	0.13 (0.07-0.47)	41.4 (37.0-49.1)
Middle Shelf Zone 2, Non-ZID		7,501 (6,656-8,448)	0.08 (0.05-0.11)	3.28 (2.67-4.16)	38.5 (30.6-56.6)	0.26 (0.23-0.29)	0.18 (0.09-0.39)	18.34 (15.5-22.0)	8.62 (5.21-27.1)	14,774 (13,577-16,080)	6.50 (4.71-10.4)	0.03 (0.01-0.16)	8.32 (6.80-22.5)	1.78 (1.26-2.69)	0.14 (0.06-0.70)	39.8 (32.8-45.6)

Table 3-5 Whole-sediment *Eohaustorius estuarius* (amphipod) toxicity test results at select outfall-depth stations for the 2023-24 program year. The home sediment represents the control; within-ZID stations are indicated by an asterisk. N/A = Not Applicable.

Station	Percent Survival	Percent of Home	p-value	Assessment
home	100	N/A	N/A	N/A
0 *	94	94	0.13	Nontoxic
1	98	98	0.55	Nontoxic
4 *	95	95	0.30	Nontoxic
9	97	97	0.55	Nontoxic
73	98	98	0.78	Nontoxic
76 *	90	90	0.04	Nontoxic
77	98	98	0.55	Nontoxic
84	95	95	0.30	Nontoxic
85	96	96	0.13	Nontoxic
CON	94	94	0.30	Nontoxic
ZB *	92	92	0.04	Nontoxic
ZB Dup *	95	95	0.30	Nontoxic

BIOLOGICAL COMMUNITIES

Infaunal Communities

A total of 501 invertebrate taxa comprising 22,915 individuals were collected in the 2023-24 program year. Annelida (segmented worms) was the dominant taxonomic group in all quarters (Table B-10). The pollution indicating species, *Capitella capitata Cmplx* (Polychaete), was found in low abundance (n=35 across all surveys and stations). Mean community measure values were comparable between within- and non-ZID stations, and all station values were within regional (Gillett et al. 2022) and OC San historical ranges in all surveys (Table 3-6). The infaunal community at all within-ZID and non-ZID stations in both surveys can be classified as reference condition based on their low (<25) Benthic Response Index (BRI) values and high (>60) Infaunal Trophic Index (ITI) values. The community composition at within-ZID stations was similar to that of most non-ZID stations based on multivariate analyses of the infaunal species and abundances and with no stations showing repeated separation from other stations throughout the sampling period (Figure 3-5). These multiple lines of evidence suggest that the outfall discharge had no adverse effect on the benthic community structure within the monitoring area. Infaunal communities were not degraded by the outfall discharge, and as such, compliance was met.

Epibenthic Macroinvertebrate Communities

A total of 42 epibenthic macroinvertebrate (EMI) species, comprising 15,494 individuals and a total weight of 172.8 kg, was collected from 20 trawls conducted in the 2023-24 program year (Table B-11 and Table B-12). As with the previous monitoring period, *Lytechinus pictus* (sea urchin) was the most dominant species in terms of abundance (n=7,883; 50.9% of total and having been collected at 19 of 20 stations). *Strongylocentrotus fragilis* (sea urchin) was the leading species in respect to biomass (119.4 kg; 69.1% of total and collected at 6 of 20 stations). Within the Middle Shelf Zone 2 stratum, the overall EMI community composition at the outfall stations were similar to those at other non-outfall stations in both summer and winter surveys based on the results of the multivariate analyses (cluster and non-metric multidimensional scaling (nMDS) analyses) (Figure 3-6). Furthermore, the community measure values at the outfall stations were similar to regional (Wisenbaker et al. 2021) and OC San historical ranges (Table 3-7). These results suggest that the outfall discharge had no adverse effect on the EMI community structure within the monitoring area. EMI communities within the monitoring area were not degraded by the outfall discharge, and compliance was met.

Fish Communities

A total of 43 fish taxa, comprising 16,714 individuals and a total weight of 337.9 kg, was collected from the monitoring area during the 2023-24 program year (Table B-13 and Table B-14). The mean species richness, abundance, biomass, Shannon-Wiener Diversity (H′), and Swartz's 75% Dominance Index (SDI) values of demersal fishes were comparable between outfall and non-outfall stations in both surveys, with values similar to regional (Wisenbaker et al. 2021) and/or OC San historical ranges (Table 3-6). More importantly, the fish communities at outfall and non-outfall stations were classified as reference condition based on their low (<45) mean Fish Response Index (FRI) scores in both surveys. Multivariate analyses (cluster and nMDS) of the demersal fish species and abundance data further demonstrated that the fish communities were similar between the outfall and non-outfall stations (Middle Shelf Zone 2 stratum) (Figure 3-7). These results suggest compliance was met, because the outfall discharge had no adverse effect on the fish community structure within the monitoring area.

Table 3-6 Community measure values for each quarterly and annual station sampled during the 2023-24 infauna surveys, including regional and historical values.

Station	Depth (m)	Species Richness	Abundance	H′	SDI	ITI	BRI
Quarter 1 (July–September)							
Middle Shelf Zone 2, Non-ZID (51–90 m)							
1	56	105	488	3.82	28	76	17
9	59	101	512	3.89	27	72	18
73	55	105	523	3.94	31	79	16
77	60	67	308	3.64	21	77	19
84	54	101	544	3.88	27	76	21
85	57	97	549	3.86	26	76	19
CON	59	103	502	3.90	28	73	17
	Mean	**97**	**489**	**3.85**	**27**	**76**	**18**
Middle Shelf Zone 2, Within-ZID (51–90 m)							
0	56	104	529	3.94	28	81	16
4	56	90	515	3.76	25	77	15
76	58	83	445	3.72	24	76	19
ZB	56	99	512	3.74	23	74	17
	Mean	**94**	**500**	**3.79**	**25**	**77**	**17**
Quarter 2 (October–December)							
Middle Shelf Zone 2, Non-ZID (51–90 m)							
1	56	101	454	3.87	30	74	15
9	59	70	220	3.66	24	72	16
73	55	103	359	4.07	39	79	18
77	60	88	284	3.83	30	73	21
84	54	95	414	3.82	28	78	17
85	57	58	174	3.52	22	83	15
CON	59	75	265	3.70	26	78	18
	Mean	**84**	**310**	**3.78**	**28**	**77**	**17**
Middle Shelf Zone 2, Within-ZID (51–90 m)							
0	56	100	390	3.93	36	75	19
4	56	117	520	3.89	29	73	17
76	58	82	379	3.6	22	77	19
ZB	56	92	443	3.83	27	79	14
	Mean	**98**	**433**	**3.81**	**29**	**76**	**17**
Quarter 3 (January–March)							
Middle Shelf Zone 2, Non-ZID (51–90 m)							
1	56	76	269	3.78	29	80	17
9	59	68	212	3.75	26	75	18
73	55	78	279	3.86	29	76	16
77	60	71	241	3.55	25	73	18
84	54	72	236	3.35	22	78	18
85	57	91	405	3.64	24	72	21
CON	59	72	277	3.42	21	78	17
	Mean	**75**	**274**	**3.62**	**25**	**76**	**18**

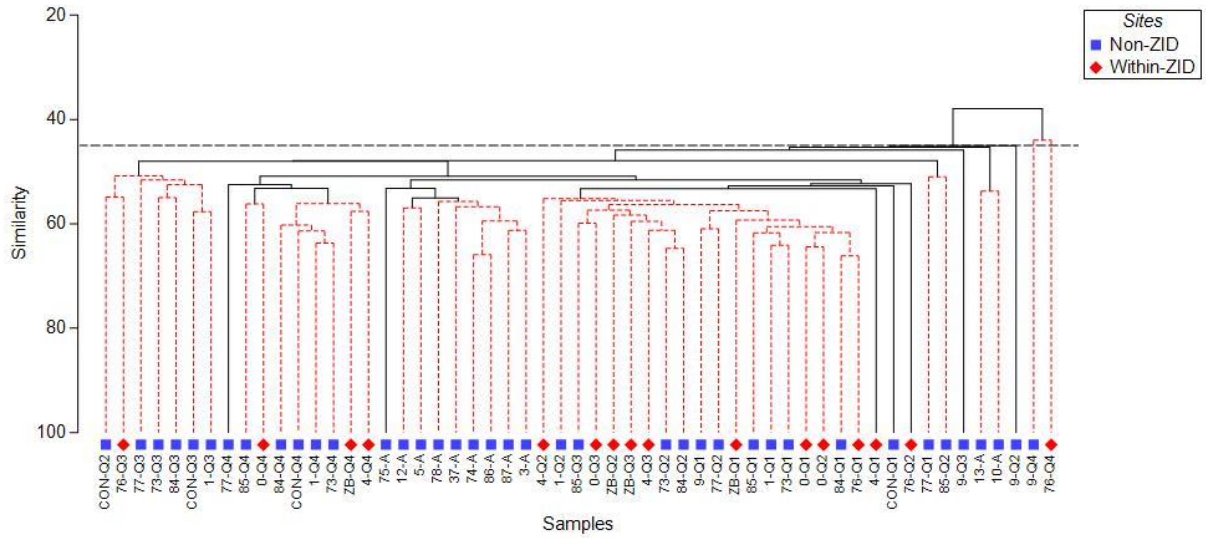
Table 3-6 Community measure values for each quarterly and annual station sampled during the 2023-24 infauna surveys, including regional and historical values.

Station	Depth (m)	Species Richness	Abundance	H′	SDI	ITI	BRI
Middle Shelf Zone 2, Within-ZID (51–90 m)							
0	56	82	440	3.64	20	76	20
4	56	90	273	4.04	35	80	14
76	58	65	201	3.69	26	82	16
ZB	56	82	371	3.80	24	79	14
	Mean	**80**	**321**	**3.79**	**26**	**79**	**16**
Quarter 4 (April–June) Middle Shelf Zone 2, Non-ZID (51–90 m)							
1	56	111	555	3.95	32	78	14
9	59	63	208	3.52	22	86	14
73	55	117	661	3.91	29	73	20
77	60	76	369	3.55	21	78	17
84	54	95	412	3.88	30	77	15
85	57	74	358	3.53	19	77	18
CON	59	102	493	3.84	28	78	17
	Mean	**91**	**437**	**3.74**	**26**	**78**	**16**
Middle Shelf Zone 2, Within-ZID (51–90 m)							
0	56	85	376	3.77	25	79	16
4	56	122	560	4.08	36	80	16
76	58	47	105	3.54	23	88	14
ZB	56	110	470	3.93	30	80	15
	Mean	**91**	**378**	**3.83**	**29**	**82**	**15**
Annual (July–September) Middle Shelf Zone 2, Non-ZID (51–90 m)							
3	60	134	677	4.04	33	72	14
5	59	122	551	4.10	38	75	15
10	62	65	213	3.53	24	85	12
12	58	99	382	3.98	33	70	16
13	59	95	294	4.06	39	76	11
37	56	143	628	4.24	41	63	19
74	57	130	786	3.93	26	72	13
75	60	123	567	4.04	34	76	14
78	63	120	502	4.09	35	76	14
86	57	139	728	4.05	32	74	15
87	60	117	485	4.02	34	78	14
	Mean	**117**	**528**	**4.01**	**34**	**74**	**14**

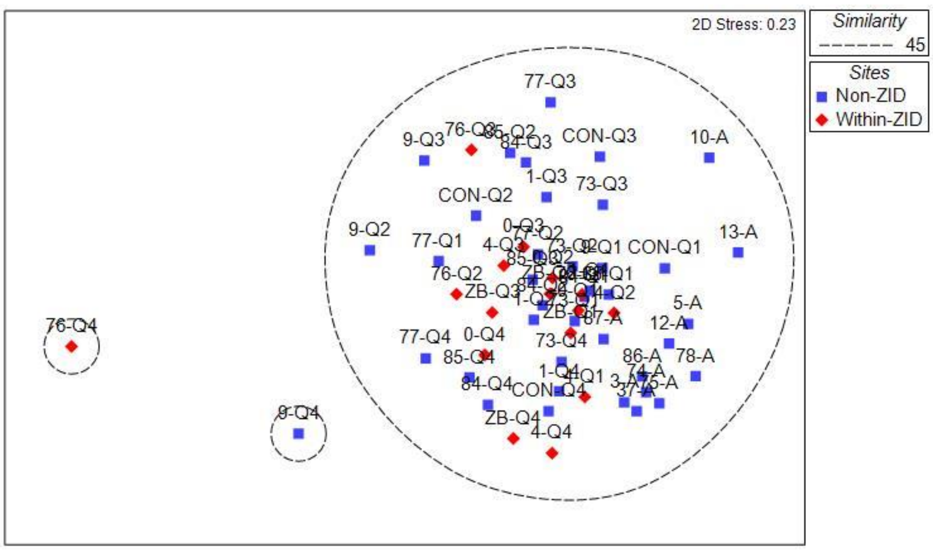
Table 3-6 Community measure values for each quarterly and annual station sampled during the 2023-24 infauna surveys, including regional and historical values.

Station	Depth (m)	Species Richness	Abundance	H′	SDI	ITI	BRI
Regional Bight ’18 Summer Values [mean (range)]							
Middle Shelf		90 (45–6,427)	417 (68-1,150)	3.72 (2.90–4.20)	—	—	16 (5-28)
OC San Historical Values (July 2013–June 2023) [mean (range)]							
Middle Shelf Zone 2 Within-ZID		87 (50-138)	374 (88-782)	3.76 (3.15-4.68)	27 (14-76)	77 (64-91)	17 (8-27)
Middle Shelf Zone 2 Non-ZID		85 (20-142)	365 (90-1,080)	3.68 (2.24-4.31)	26 (6-46)	78 (40-95)	15 (8-43)

ZID = zone of initial dilution, H′ = Shannon-Wiener Diversity, SDI = Swartz’s Dominance Index, ITI = Infaunal Trophic Index, BRI = Benthic Response Index

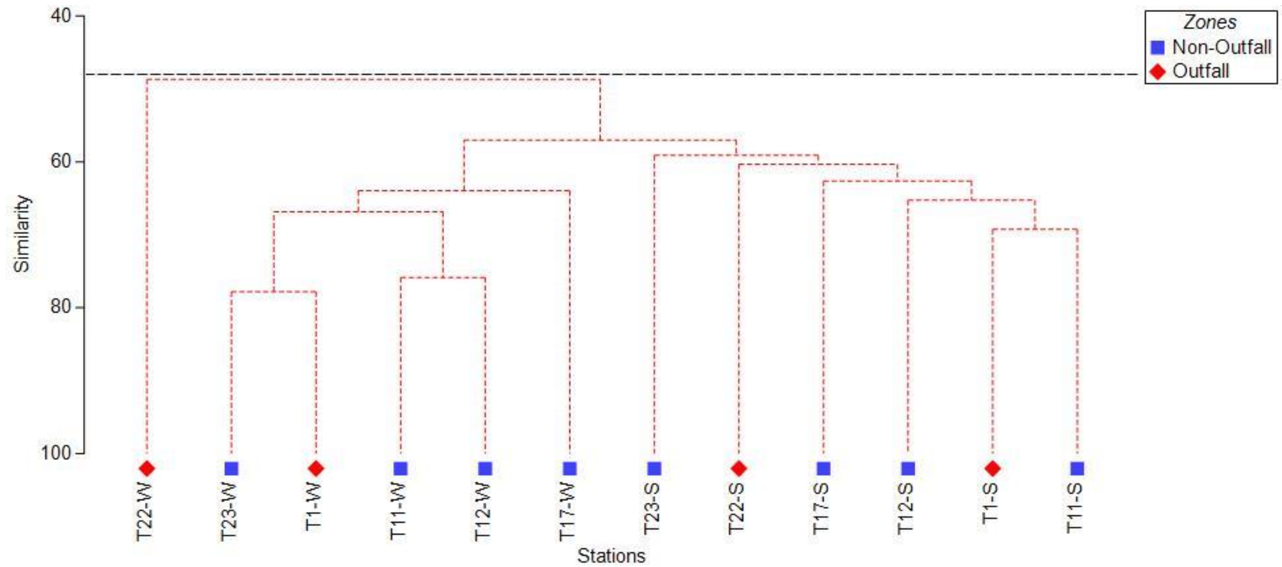


Stations connected by red dashed lines are not significantly different based on the SIMPROF test. Station labels also have a suffix for the quarter they were collected (e.g., CON-Q4); an A suffix denotes an annual station (collected during the summertime).

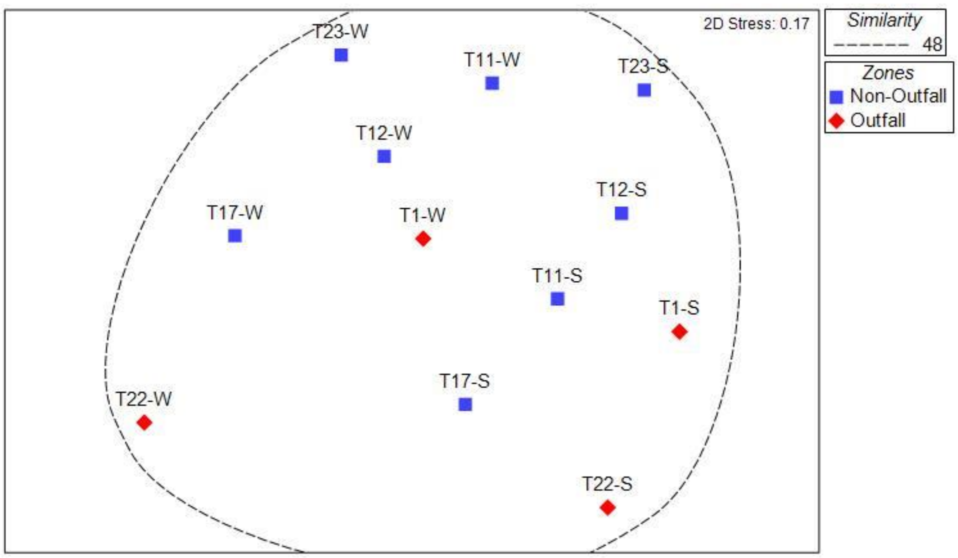


The two main clusters formed at a 46% similarity on the dendrogram are superimposed on the nMDS plot. Station labels also have a suffix for the quarter they were collected (e.g., CON-Q4); an A suffix denotes an annual station (collected during the summertime).

Figure 3-5 Dendrogram (top panel) and nMDS plot (bottom panel) of the infauna collected at within- and non-ZID stations along the Middle Shelf Zone 2 stratum for the 2023-24 program year.



Stations connected by red dashed lines are not significantly different based on the SIMPROF test.



The single cluster formed at a 55% similarity on the dendrogram is superimposed on the nMDS plot.

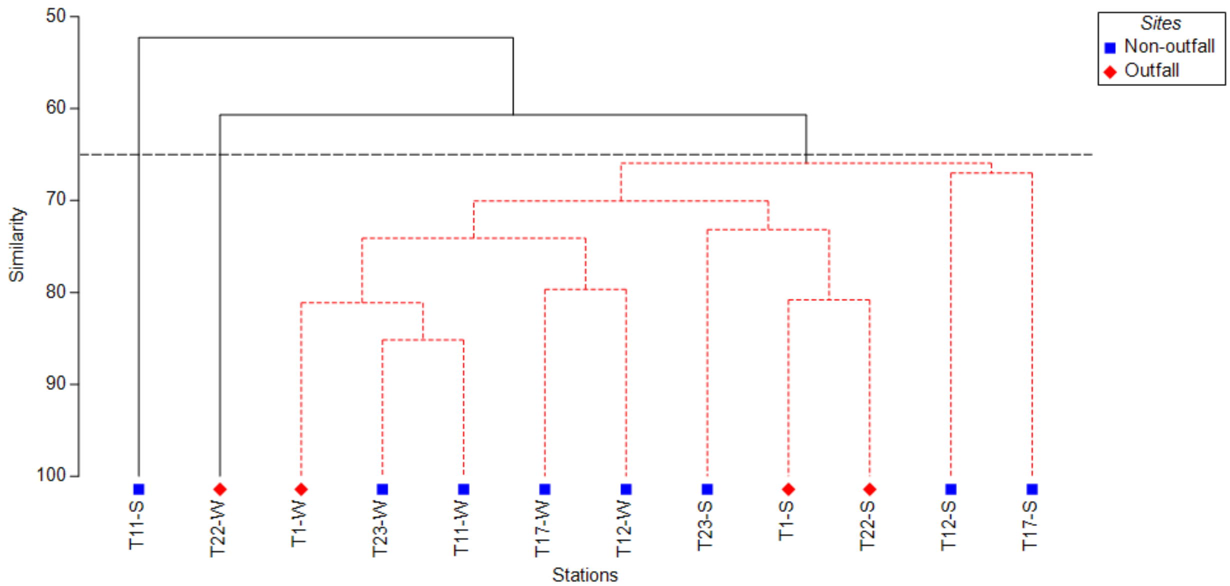
Figure 3-6 Dendrogram (top panel) and non-metric multidimensional scaling (nMDS) plot (bottom panel) of the epibenthic macroinvertebrates collected at outfall and non-outfall stations along the Middle Shelf Zone 2 stratum for the Summer 2023 (S) and Winter 2024 (W) trawl surveys.

Table 3-7 Summary of epibenthic macroinvertebrate community measures for each semi-annual and annual (*) station sampled during the Summer 2023 and Winter 2024 trawl surveys, including regional and historical values.

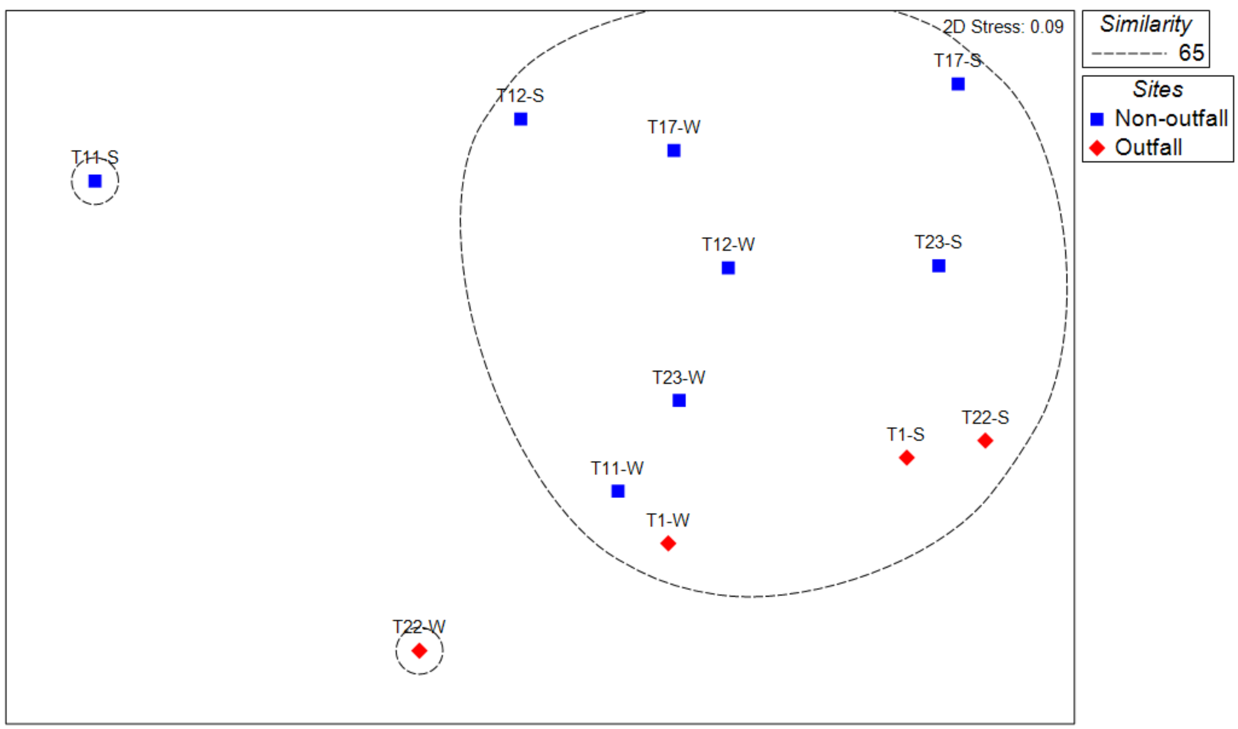
Season	Station	Depth (m)	Species Richness	Total Abundance	Biomass (kg)	H′	SDI
	Middle Shelf Zone 1 (31–50 m)						
Summer	T2*	35	16	2,472	3.64	0.27	1
	T24*	36	15	129	0.65	1.67	3
	T6*	36	14	1,118	2.83	0.81	2
	T18*	36	8	57	0.12	1.63	3
		Mean	**13**	**944**	**1.81**	**1.10**	**2**
	Middle Shelf Zone 2, Non-outfall (51–90 m)						
	T23	58	10	3,792	12.28	0.20	1
	T12	57	9	383	11.88	0.80	1
	T17	60	16	302	1.88	1.61	3
	T11	60	14	347	1.07	1.45	3
		Mean	**12**	**1206**	**6.78**	**1.02**	**2**
	Middle Shelf Zone 2, Outfall (51–90 m)						
	T22	60	19	174	4.97	1.89	4
	T1	55	16	703	1.68	1.12	2
		Mean	**18**	**439**	**3.32**	**1.51**	**3**
	Outer Shelf (121–200 m)						
	T10*	137	5	1,175	61.51	0.09	1
	T25*	137	11	978	39.18	0.53	1
	T14*	137	8	512	20.60	0.38	1
	T19*	137	11	198	3.16	1.04	2
		Mean	**9**	**716**	**31.11**	**0.51**	**1**
	Middle Shelf Zone 2, Non-outfall (51–90 m)						
Winter	T23	58	10	379	0.90	0.73	1
	T12	57	12	1,172	3.00	0.26	1
	T17	60	11	197	1.66	1.61	3
	T11	60	13	1,007	1.05	0.48	1
		Mean	**12**	**689**	**1.65**	**0.77**	**2**
	Middle Shelf Zone 2, Outfall (51–90 m)						
	T22	60	8	25	0.02	1.82	4
	T1	55	14	374	0.73	1.39	3
		Mean	**11**	**200**	**0.38**	**1.61**	**4**
Regional Bight ’18 Summer Values [area-weighted mean (range)]							
Middle Shelf			10 (3–21)	208 (4–1,026)	2.40 (0.09–24.80)	1.16 (0.35–2.57)	—
Outer Shelf			13 (1–25)	2,299 (15–27,474)	27.00 (0.06–268.60)	1.17 (0–2.30)	—
OC San Historical Values (July 2012–June 2023) [mean (range)]							
Middle Shelf Zone 1			12 (2–26)	822 (2–3,926)	1.09 (0.02–3.78)	0.98 (0.01–2.22)	2 (1–5)
Middle Shelf Zone 2, Non-outfall			11 (5–21)	675 (18–4,264)	1.88 (0.04–13.8)	1.18 (0.06–2.14)	2 (1–5)
Middle Shelf Zone 2, Outfall			13 (9–24)	414 (55–1,420)	1.20 (0.08–4.92)	1.41 (0.41–2.22)	3 (1–5)
Outer Shelf			9 (3–15)	326 (33–1,149)	10.21 (0.09–65.05)	0.86 (0.12–1.97)	2 (1–5)

Table 3-8 Summary of demersal fish community measures for each semi-annual and annual (*) station sample during the Summer 2023 and Winter 2024 trawl surveys, including regional and historical values.

Season	Station	Depth (m)	Species Richness	Total Abundance	Biomass (kg)	H′	SDI	FRI
	Middle Shelf Zone 1 (31–50 m)							
Summer	T2*	35	14	473	7.34	1.77	3	22
	T24*	36	10	990	6.81	1.61	3	20
	T6*	36	11	338	4.87	1.57	3	22
	T18*	36	10	304	3.53	1.45	3	26
		Mean	**11**	**526**	**5.64**	**1.60**	**3**	**22**
	Middle Shelf Zone 2, Non-outfall (51–90 m)							
	T23	58	18	1,766	47.71	0.84	1	20
	T12	57	16	449	9.02	1.81	4	27
	T17	60	21	1,677	16.24	1.74	3	24
	T11	60	10	50	1.03	1.65	3	34
		Mean	**16**	**986**	**18.50**	**1.51**	**3**	**26**
	Middle Shelf Zone 2, Outfall (51–90 m)							
	T22	60	15	1,039	15.88	1.43	2	27
	T1	55	12	675	9.50	1.54	3	14
		Mean	**14**	**857**	**12.69**	**1.49**	**3**	**21**
	Outer Shelf (121–200 m)							
	T10*	137	20	1,045	22.84	1.54	3	16
	T25*	137	23	1,399	23.04	1.14	2	13
	T14*	137	18	1,239	48.46	0.93	1	12
	T19*	137	25	2,289	33.09	1.39	3	10
		Mean	**22**	**1,493**	**31.86**	**1.25**	**2**	**13**
	Middle Shelf Zone 2, Non-outfall (51–90 m)							
Winter	T23	58	13	645	13.78	1.29	2	21
	T12	57	13	632	12.50	1.88	3	18
	T17	60	16	458	10.46	2.01	4	26
	T11	60	15	588	23.07	1.42	2	20
		Mean	**14**	**581**	**14.95**	**1.65**	**3**	**21**
	Middle Shelf Zone 2, Outfall (51–90 m)							
	T22	60	11	162	3.73	1.35	2	23
	T1	55	11	496	16.87	1.19	2	15
		Mean	**11**	**329**	**10.30**	**1.27**	**2**	**19**
Regional Bight ’18 Summer Values [area-weighted mean (range)]								
Middle Shelf			13 (6–27)	392 (37–3,197)	6.10 (1.30–33.00)	1.49 (0.54–2.22)	—	22 (12–34)
Outer Shelf			12 (1–22)	328 (2–1,146)	10.2 (0.10–40.10)	1.44 (0–2.17)	—	25 (6–49)
OC San Historical Values (July 2012–June 2023) [mean (range)]								
Middle Shelf Zone 1			10 (6–13)	243 (54–1,004)	4.00 (0.66–14.63)	1.42 (0.37–2.10)	3 (1–5)	22] (16–27)
Middle Shelf Zone 2, Non-outfall			14 (7–25)	584 (45–2,736)	11.73 (1.25–55.85)	1.64 (0.89–2.20)	3 (1–6)	22 (11–34)
Middle Shelf Zone 2, Outfall			14 (9–18)	428 (110–1,473)	11.96 (2.47–46.27)	1.68 (0.86–2.18)	3 (1–6)	22 (11–32)
Outer Shelf			18 (4–25)	818 (27–1,655)	16.32 (0.96–39.19)	1.58 (0.80–2.07)	3 (1–4)	21 (3–45)



Stations connected by red dashed lines are not significantly different based on the SIMPROF test.



The two main clusters formed at a 65% similarity on the dendrogram are superimposed on the NMDS plot.

Figure 3-7 Dendrogram (top panel) and non-metric multidimensional scaling plot (bottom panel) of the demersal fishes collected at outfall and non-outfall stations along the Middle Shelf Zone 2 stratum for the Summer 2023 (S) and Winter 2024 (W) trawl surveys.

FISH BIOACCUMULATION AND HEALTH

Demersal and Sport Fish Tissue Chemistry

Contaminant concentrations in composited liver tissue of Hornyhead Turbot and English Sole were similar between outfall and non-outfall locations (Table 3-9). Additionally, the contaminant concentrations in the composite samples were similar to the values from the 2022-23 program year.

Contaminant concentrations in composited muscle tissue of rockfishes were similar between outfall and non-outfall zones (Table 3-10). Moreover, the contaminant concentrations in the composite samples were similar to the values from the 2022-23 program year.

Among the composited muscle tissue of sport fish samples, the DDT, PCB, chlordane, and selenium contaminant concentrations were all below the least restrictive seven 8-ounce servings per week advisory tissue level (ATL).The two trace mercury values for Squarespot Rockfish (*Sebastes hopkinsi*) fell within a more restrictive range of two 8-ounce servings per week ATL for women aged 18-45 and children ages 1-17 (Table 3-10 and Table A-9).

Of the contaminants measured in the Bight '18 survey, mercury concentrations in one or more target species exceeded the "consume not more than two servings per week" threshold in most fishing zones (McLaughlin et al. 2020). The 2023-24 monitoring results demonstrate that demersal fishes residing near the outfall are not more prone to bioaccumulation of contaminants than those fished regionally, and that human health risk from consuming demersal fishes captured in the monitored area is not elevated.

Fish Health

The color and odor of demersal fishes captured in the monitoring area appeared normal. Disease symptoms, such as tumors, fin erosion, and skin lesions, were recorded in less than 1% of trawl-caught fishes. In addition, external parasites were recorded in less than 1% of the fishes collected, which is comparable to Southern California Bight background levels (Walther et al. 2017; Wisenbaker et al. 2021). These results indicate that the outfall discharge does not increase the prevalence of fish disease.

Liver Histopathology

Liver pathologies were observed in most of the Hornyhead Turbot and English Sole samples collected at Stations T1 (outfall) and T11 (non-outfall). Among the eight types of tissue damage that were screened for in the serial tissue sections (see Appendix A), steatosis (fatty liver) was the most prevalent, ranging from 50–60% in the Hornyhead Turbot samples and 80–92% in the English Sole samples. The mean histopathology (health) score for Hornyhead Turbot was 0.22 at T1 and 0.25 at T11, indicating comparable yet minimal tissue damage in the fish samples at both sites (Figure 3-8). The mean histopathology scores for English Sole (0.71 at T1 and 0.54 at T11) were slightly higher than those of Hornyhead Turbot but also indicated comparable yet minimal tissue damage at both sites (Figure 3-8). There was no significant difference in the histopathology scores for both species between the two sites. The results of this analysis indicate negligible outfall-related effects on the health of demersal fishes in OC San's monitoring area.

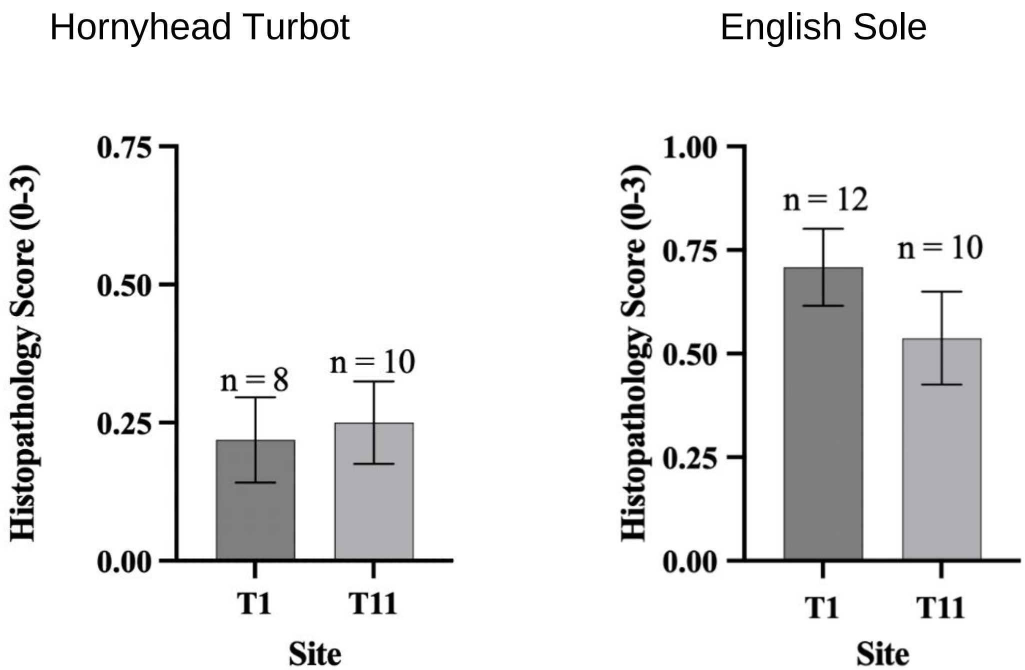


Figure 3-8 Histopathology score (mean and standard error) of liver tissue samples excised from Hornyhead Turbot and English Sole collected at outfall Station T1 and non-outfall Station T11 during the 2023-24 program year. Average scores were between zero and one, indicating minimal tissue damage.

CONCLUSION

The results of the bacterial, physical, and chemical parameters measured in the water column during the 2023-24 program year indicate good water quality in OC San's monitoring area. Additionally, the sediment quality was minimally impacted based on the relatively low concentrations of chemical contaminants measured in sediment samples and the absence of sediment toxicity in controlled laboratory tests. The benthic animal communities and contaminant concentrations in fish tissue samples were comparable between outfall and non-outfall areas, and negligible disease symptoms and minimal liver pathologies were observed in fish samples. These results indicate that the receiving environment was not impaired by OC San's discharge of treated wastewater.

SUMMARY OF NON-COMPLIANCE

Permit compliance criteria were met in the 2023-24 program year (Table 3-1).

Table 3-9 Percent lipid and contaminant concentrations (ng/g) in composite liver samples of flatfishes collected in the Winter 2024 trawl surveys at Stations T1 (Outfall) and T11 (Non-outfall), including historical values (mean and range).

Species	Station	Composite Sample Number	n [a]	Mean Standard Length (mm)	Percent Lipid	Mercury	Arsenic	Selenium	ΣDDT	ΣPCB	ΣChlordane
Pleuronichthys verticalis (Hornyhead Turbot)	Non-outfall	2542290	10	168	13.4	99.43	6,550	1,390	802.0	162.0	2.2
	Outfall	2542047	10	184	9.98	79.94	10,500	2,140	320.6	102.5	ND
Parophrys vetulus (English Sole)	Non-outfall	2542291	10	206	6.6	60.36	12,100	2,150	467.0	160.7	0.6
	Outfall	2542048	10	204	10.1	40.38	11,100	2,750	429.5	163.8	1.2
OC San Historical Values (July 2021 – June 2023)											
Pleuronichthys verticalis (Hornyhead Turbot)	Non-outfall	—	3	162 (149-177)	4.52 (3.54-5.56)	65.66 (60-71)	15,442.86 (11,800-19,300)	1,395.43 (1,240-1,560)	344.45 (326.6-361.3)	77.25 (70.5-84.4)	1.1 (1.0-1.2)
	Outfall	—	2	160 (155-165)	5.87 (5.35-5.9)	60.95 (59-96)	10,634.74 (9,460-10,700)	2470.53 (2,300-2,480)	115.39 (93.7-116.6)	76.91 (53.6-78.2)	2.95 (2.1-3.0)
Parophrys vetulus (English Sole)	Non-outfall	—	2	191 (186-196)	7.32 (5.1-8.87)	48.18 (37-56)	15,652.94 (13,800-18,300)	2,350 (2,070-2,750)	917.59 (139.7-2,195)	166.71 (ND-329.1)	0.79 (ND-1.3)
	Outfall	—	3	204 (193-220)	8.34 (6.61-10.2)	45 (33-66)	11,393.08 (8,840-15,900)	3387.31 (2,620-3,640)	413.83 (295.1-850.0)	118.8 (ND-193.1)	1.9 (ND-2.5)

[a] The value given for the 2023-24 program year represents the number of individuals used for the composite sample; the historical value represents the number of composites.

Table 3-10 Percent lipid and contaminant concentrations (ng/g) in composite muscle tissue samples of sport fishes collected in Summer 2023 rig fishing surveys at Zones 1 (Outfall) and 3 (Non-outfall), including historical values (mean and range). ND = Not detected.

Zone	Species	Composite Sample Number	n [a]	Mean Standard Length (mm)	Percent Lipid	Mercury	Arsenic	Selenium	ΣDDT	ΣPCB	ΣChlordane
Non-Outfall	*Sebastes hopkinsi*	2503746	5	210	0.9	87.29	1,020	525	15.0	2.3	ND
	(Squarespot Rockfish)	2503749	5	209	3.74	83.01	1,280	640	15.2	2.0	ND
Outfall	*Sebastes miniatus*	2504757	5	213	2.62	29.63	1,450	504	13.1	1.6	ND
	(Vermilion Rockfish)	2504762	5	211	1.06	19.93	1,400	540	7.5	0.8	ND
OC San Historical Values (September 2021 – October 2022)											
Non-outfall	*Sebastes hopkinsi* (Squarespot Rockfish)	—	1	189	2.33	38.00	2,100	670	14.6	4.9	0.6
Outfall	*Sebastes miniatus* (Vermilion Rockfish)	—	2	254 (236-271)	1.0 (0.88-1.11)	40.50 (39-42)	2,250 (1,410-3,090)	497.5 (414-581)	7.4 (5.1-9.7)	1.2 (1.1-1.3)	ND (All ND)

[a] The value given for the 2023-24 program year represents the number of individuals used for the composite samples; the historical value represents the number of composites.

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Chapter 4. Strategic Process Studies and Regional Monitoring

INTRODUCTION

OC San operates under the requirements of a NPDES permit issued jointly by the U.S. EPA and the State of California RWQCB, Region 8 (Order No. R8-2021-0010, NPDES Permit No. CA0110604) on June 23, 2021, with the effective date starting on August 1, 2021. To document the effectiveness of its source control and wastewater treatment operations in protecting the coastal ocean, OC San conducts an OMP that includes SPS, smaller special studies, and regional monitoring programs.

SPS are designed to address unanswered questions raised by the Core monitoring program and/or focus on issues of interest to OC San and/or its regulators. SPS are proposed by OC San and must be approved by RWQCB to ensure appropriate focus and level of effort.

Regional monitoring studies focus on the larger Southern California Bight (the coastline extending from Point Conception to the United States-Mexico Border). These include the “Bight” studies coordinated by the Southern California Coastal Water Research Project (SCCWRP) or studies conducted in coordination with other public agencies and/or non-governmental organizations in the region. Examples of the latter include the Central Region Kelp Survey Consortium and the Southern California Bight Regional Water Quality Program.

This chapter provides overviews of recently completed and ongoing SPS, special studies, and regional monitoring efforts. Updates on SPS and special studies may include information from prior program year(s) since some SPS and special studies may span multiple years.

STRATEGIC PROCESS STUDIES

For the 2023-24 program year, OC San had five SPS, three of which were designed to better understand potential impacts of the GWRS final expansion project on the quantity and quality of OC San’s discharged effluent.

ROMS-BEC Modeling of Outfall Plume

OC San last modeled and characterized its discharge plume in the early 2000s. Since then, significant changes have occurred in both the quantity and quality of the effluent discharged due to water conservation and wastewater reclamation (i.e., GWRS) efforts. To evaluate the spatial extent and temporal variability of the discharge plume, OC San contracted SCCWRP in 2018 for a multi-stage study comprised of:

- Validating the simulations of OC San’s discharge against observational data and conducting a model ensemble comparison with the Roberts-Snyder-Baumgartner (RSB) plume model.
- Modeling the transport and fate of OC San’s discharged effluent at progressive stages of the GWRS final expansion (Table 4-1)
- Modeling the seasonality of the plume distribution with varying ocean conditions between 1997 and 2016 (Table 4-2)
- Modeling the potential biogeochemical influence of land-based inputs on coastal processes.

Table 4-1 Pre- and post-GWRS modeling scenarios. The common ocean base year used in all model runs is 2000.

Phase	Model Year
Pre-GWRS	2000
GWRS Phase 1	2008
GWRS Initial Expansion	2016
GWRS Final Expansion	2023

Table 4-2 List of climate variability simulations.

Period	Ocean Climate Conditions
1997–98	Negative to neutral NPGO; positive PDO, positive ENSO, deep MLD
1999	Positive NPGO, negative PDO, negative ENSO, deep MLD
2004	Neutral climate signals; warm, weak ocean transport
2008	Positive NPGO, negative PDO, neutral ENSO, cold and shallow MLD
2009	Positive NPGO, neutral PDO, transition to a quick positive ENSO event, cold and shallow MLD
2014	Strong marine heatwave, neutral climate signal
2015	Strong marine heatwave, negative NPGO, positive ENSO starting in summer, positive PDO, deep MLD
2016	Marine heatwave, neutral NPGO, positive (winter) to negative (summer) ENSO and PDO

El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), mixed layer depth (MLD), and North Pacific Gyre Oscillation (NPGO).

This SPS was initially designed to use a high-resolution numerical model co-developed by scientists at SCCWRP and the University of California, Los Angeles, which couples the Regional Ocean Model System (ROMS) with the Biogeochemical Elemental Cycling (BEC) model (ROMS-BEC). During the 2021-22 program year, community stakeholders and members of the Ocean Acidification and Hypoxia Technical Advisory Committee charged with the ROMS--BEC model evaluation identified gaps in the formulation, validation, and uncertainty of the BEC model when coupled to ROMS. Strategies are currently being developed to assess these critical model features that will determine and enhance the reliability and accuracy of SCCWRP-UCLA coupled ROMS-BEC model. Based on the uncertainty of the SCCWRP-UCLA coupled ROMS-BEC model, this SPS was modified to use the well-established ROMS model to focus on the primary goal of understanding plume dispersal over time and space under a variety of scenarios related to changing flows, ocean states, and seasons as agreed upon with the RWQCB in June 2022. Future stages using the SCCWRP-UCLA coupled ROMS-BEC model, or a better prediction model, will commence upon satisfactory demonstration of the reliability and reproducibility of the coupled modeling tool.

OC San released a request for proposals on March 15, 2023, to procure a consultant to provide a technical review of SCCWRP's study design and deliverables for this SPS. Three bids were submitted on April 18, 2023. After a two-month evaluation process, Michael Baker International, Inc. (MBI) was awarded the contract on June 29, 2023. In August 2023, SCCWRP submitted their model validation report which featured two model skill assessments, one on the performance of their nonhydrostatic ROMS model against the results of the RSB model and the other on their hydrostatic ROMS model against regional scale current patterns and temperature profiles. MBI's review of the model validation report in April 2024 concluded that the conceptual layout of the RSB model does not represent OC San's outfall diffuser based on computational fluid dynamics (CFD) model simulations. With a steady current flowing unidirectionally over an outfall diffuser located in the middle of the water column and discharges occurring only on the downstream side of the diffuser as in the RSB model, the vector flow field and velocity contours are symmetric above and below the diffuser causing little additional entrainment from the mean flow (Figure 4-1). By contrast, when the outfall diffuser is located on the seabed and discharges from ports on both sides are permitted, the initial turbulent jets scrub against the seabed, forming bottom boundary layers on both sides of the diffuser that have additional turbulent eddies (Figure 4-2). SCCWRP's model parameterization of OC San's diffuser also does not align with USEPA's dilution modeling. For example, omission of the dynamics of turbulent jet entrainment and ground effects in the schematization of discharges from OC San's outfall diffuser has a significant impact on the simulated dilution, because the initial dilution occurring during the turbulent jet phase of the discharge has a multiplier effect on the subsequent dilution occurring during the plume phase of the discharge evolution. OC San and MBI are working together to draft a corrective action letter to SCCWRP.

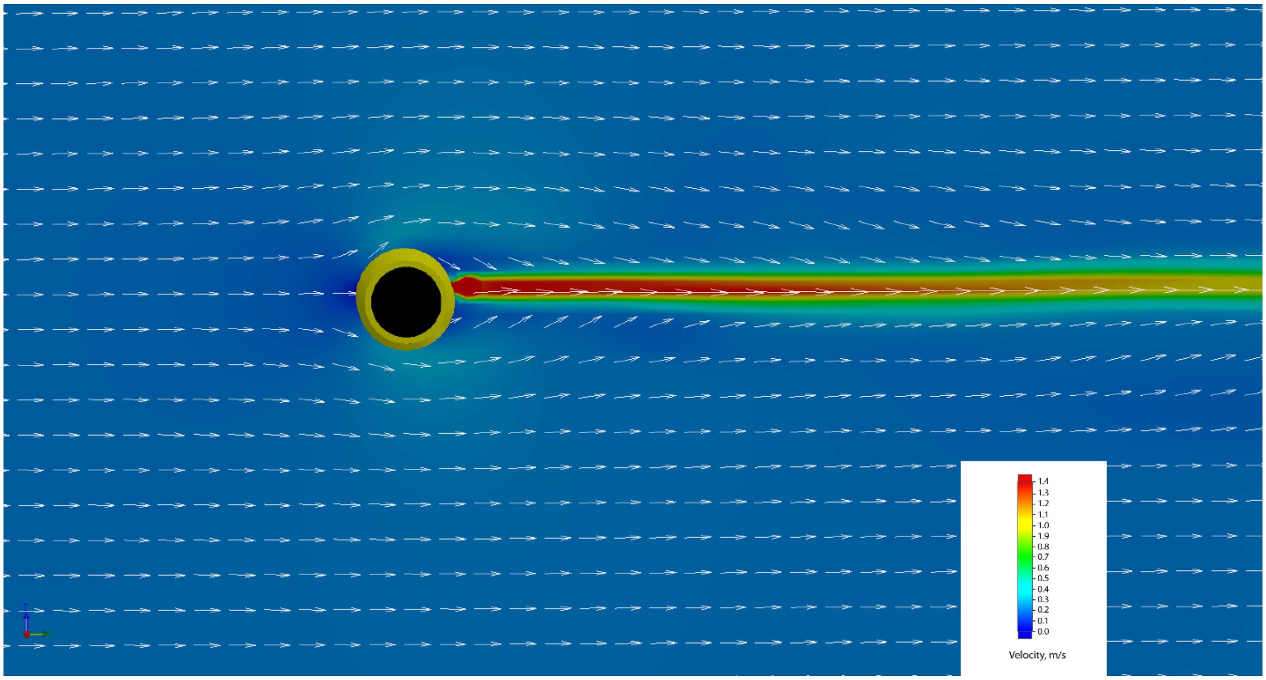

Figure 4-1 CFD model simulation of the initial turbulent jet discharge in a plane cut through OC San's 120" outfall suspended in the middle of the water column with discharge ports operating only on the downstream side of the diffuser barrel. Flow vectors shown as white arrows; velocity contouring per the velocity color bar scale in the lower left-hand corner.

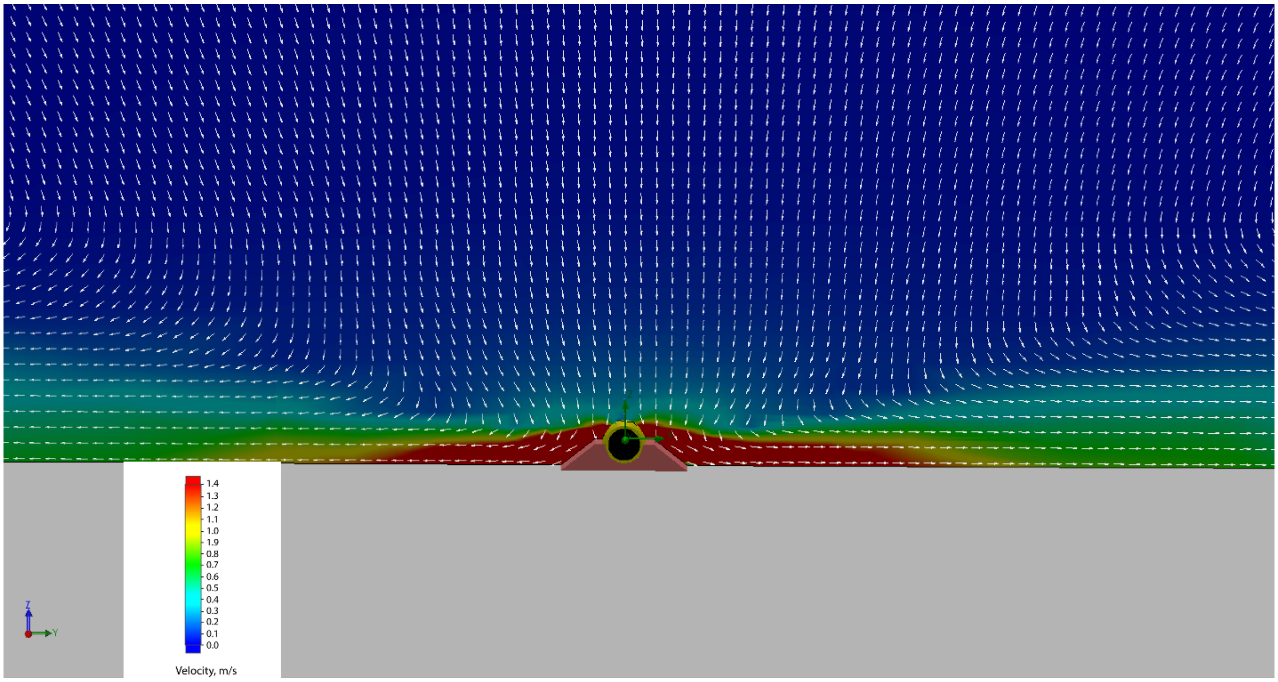

Figure 4-2 CFD model simulation of the initial turbulent jet discharges in a plane cut through OC San's 120" outfall mounted atop an anti-scour bedding with discharge ports operating on both sides of the diffuser barrel. Flow vectors shown as white arrows; velocity contouring per the velocity color bar scale in the lower left-hand corner.

Characterization of Microplastics in Wastewater

Wastewater treatment plants are a passive recipient of microplastics (<0.2 in (<5 mm) in size) from upstream residential and industrial sources to aquatic, marine, and terrestrial environments (Ziajahromi et al. 2016, Okoffo et al. 2019). In the last several years, different wastewater treatment technologies have been developed to improve the removal of microplastics from the influent (Freeman et al. 2020). Despite this, very few studies have characterized microplastics in Southern California wastewater treatment plants, including at OC San. This SPS specifically aims to address these data gaps by characterizing the relative quantity and types of microplastics found at various points throughout OC San's treatment system. A secondary goal of this study is to develop methods to extract, measure, and quantify microplastics from different types of wastewater matrices.

In-house method development was initiated in 2019 for the collection, processing, and analysis of microplastics in various wastewater matrices. Composite samples were subsequently collected throughout the treatment trains at both Plant No. 1 and Plant No. 2, and immediately processed in the lab to remove interfering organic material. All suspected microplastic particles between 1.8×10^{-3} to 0.39×10^{-2} in (45–1,000 µm) were visually identified, counted, and characterized by optical microscopy. A subset of particles across color and morphology categories were manually removed from samples, photographed and measured, and isolated for further chemical confirmation and characterization. In 2021, OC San purchased a Fourier Transform Infrared microscope which will allow further confirmation and polymeric characterization of a subset of suspected microplastic particles. OC San is currently evaluating available spectral libraries for use in identifying chemical composition of suspected microplastic particles. Remaining project tasks include the spectroscopic analysis of selected particles. Ultimately this project will inform a preliminary assessment of the transport and fate of microplastics through OC San's wastewater treatment process to the receiving environment.

Evaluation of In-Vitro Cell Bioassay for Contaminants of Emerging Concern

Contaminants of Emerging Concern (CECs) include hundreds of thousands of chemicals that may be present in the environment alone or in complex mixtures. While not all synthetic chemical mixtures pose an immediate threat to aquatic organisms, prolonged exposure to chemicals, such as endocrine disrupting compounds, can have harmful synergic effects on aquatic organisms. Similarly, many natural chemicals are essential to humans, but some, such as mercury and lead, can be harmful to aquatic life (Kortei, et al. 2020). Recent advancements in analytical tools have made it possible to detect chemicals at concentrations in the range of one part per trillion. However, these traditional instrumental approaches have their limitations (Snyder and Leusch 2018). For example, the instrumental approaches do not provide toxicology information, and chemicals can only be detected by instruments using either reference standards or more costly non-targeted analyses. To overcome these limitations, bioanalytical screening tools are used to evaluate and prioritize sites for continued monitoring. This SPS was developed to address current gaps of knowledge regarding CECs in OC San's coastal receiving environment using in-vitro cell bioassays. The study goals were to characterize the bioactivity of known and unknown CECs in wastewater and the receiving environment, to improve our understanding of the applicability of cell bioassays in coastal habitats, and to determine whether standard CECs measured across sites with elevated bioactivity could explain the observed responses.

Influent, final effluent, seawater, and sediment samples were collected from May through July of 2019 at the following locations:

1) influent and final effluent at OC San Plant No. 2,
2) seawater at surface, subsurface based on maximum colored dissolved organic matter, and bottom or maximum of 100 m depth from three stations with increasing distance from the zone of initial dilution, and
3) marine sediment from eight stations within the monitoring area, including one reference station (CON) and three known depositional sites (44, C2, and C4) (Figure 4-3).

Aqueous and sediment samples were all processed and analyzed using three in-vitro cell bioassays that screen for estrogen receptor-alpha (ERα), aryl hydrocarbon receptor (AhR), and glucocorticoid receptor (GR) activity. Cell bioassay receptors were selected to cover a range of bioactivity pathways and were based on recommendations from the State Water Resources Control Board 2012 Science Advisory Panel on the Monitoring of CECs in Ambient Waters (Maruya et al. 2014).

Statistically significant reductions in mean ERα and GR bioassay responses were observed in the effluent relative to the influent, while AhR bioactivity was comparable in both samples. Bioactivity in wastewater samples was primarily attributed to ERα chemical agonists measured in the influent (63.8%) and final effluent samples (21.9%), while less than 1% of the AhR bioassay equivalent concentrations contributed to the contaminants measured in this study. No cell bioassay activity was detected in any of the seawater samples collected from nearfield (near outfall) or farfield (non-outfall) stations across all depths. All sediment stations, except reference station CON, had measurable ERα and AhR bioactivity levels, although most values were relatively low, ranging from non-detect to 1.43 ng E2/g for ERα and non-detect to 1.7 ng TCDD/g for AhR. Stations C2, C4 and 44 had consistently higher ERα and AhR bioactivities above the pre-determined bioscreening threshold of 0.5 ng/g. Samples with bioactivity greater than the screening threshold underwent chemistry analysis. Bioactivity did not vary significantly among all sediment stations, with the exception of the historical deposition site (Station 44) for ERα and AhR. ERα signatures were highest at Station 44. For AhR bioactivity, stations in Newport Canyon and Station 44 had the highest bioactivity, while AhR bioactivity was similar at discharge Station ZB2 and reference Station CON. No GR activity was detected in any sediment samples. The mass balance analysis revealed that the presence of targeted contaminants at the sediment stations could only explain a minimal percentage of the observed bioactivity, i.e. less than 6% for ERα and less than 1% for AhR.

This study resulted in one of the first datasets of in-vitro cell bioassay responses related to wastewater discharges in marine habitats. The results indicate that complementary measurements of targeted CECs could only partially explain the observed bioactivity patterns, indicating that suites of commonly measured CECs are likely not those causing bioactivity, particularly in the receiving environment. Lessons learned and data gaps were identified where further methodological development, refinement, and investment into this screening tool are needed before application for widespread monitoring. Moving forward, this study points to the potential for cell bioassays to be used either for preliminary screening of contamination in new sites or samples, or as a complementary validation tool to understand the bioactivity potential of sites with known contamination issues. However, further development and refinement of bioanalytical screening methods will need to occur before they can be widely used as a monitoring tool by OC San to track and quantify broad changes in the receiving environment.

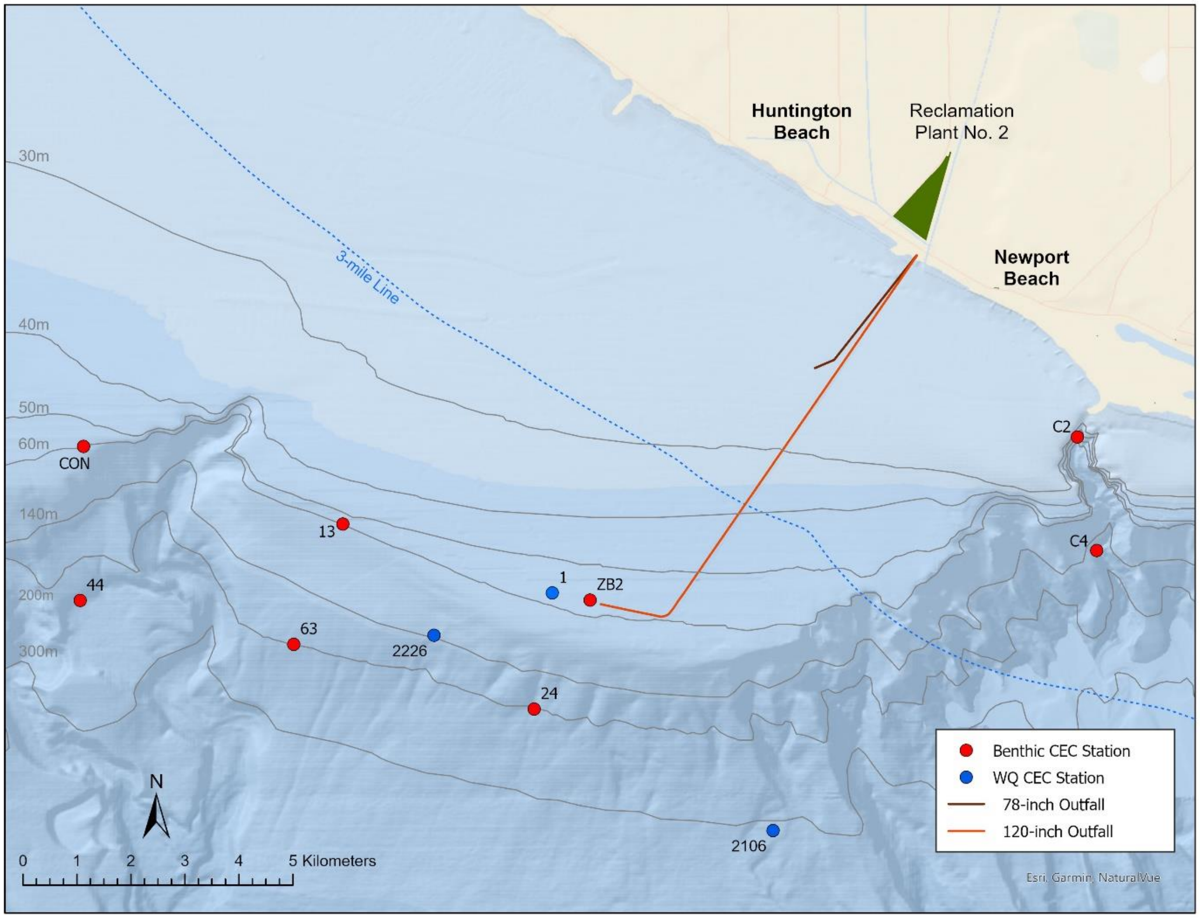

Figure 4-3 Benthic and sea water sampling stations for the cell bioassay study.

Sediment Linear Alkylbenzenes

Linear Alkylbenzenes (LABs) are a class of organic compounds that consist of linear alkyl chains attached to a benzene ring. They are used as raw materials in the production of commonly used detergents. These organic contaminants have been found to be concentrated in wastewater effluent, and as a result, have been used to track the presence and settling of wastewater particles in the offshore environment. From 1998–2014, OC San used LABs to measure its discharge footprint and investigate whether other contaminants present in the sediment were associated with the effluent discharge. This SPS will provide updated data and a recalibrated baseline for evaluating future changes in effluent quality, quantity, and dispersion due to the GWRS final expansion.

In the Summer of 2020, OC San laboratory staff initiated improvements to the GC-MS LAB analytical method by enhancing quantitation reliability through the addition of several commercially available surrogate and internal standards. In the Fall of 2020, OC San laboratory staff subsequently analyzed LAB signatures from a total of 68 sediment samples collected from 29 semi-annual and 39 annual monitoring stations. LAB measurements were added to a database of historical LAB data measured throughout OC San's monitoring region. Data analysis and comparisons are ongoing to determine spatial and temporal changes in the amount of total LABs detected among the monitored sediment stations. The remaining steps include a summarization of historical LAB discharge patterns and a brief literature review of potential alternative sewage tracers that may be used to complement or enhance the current LAB tracers for potential future applications.

Meiofauna Baseline Study

The increase of reverse osmosis concentrate return flows from the GWRS final expansion may negatively affect marine biota in the receiving water. While meiofauna, which are sediment-dwelling animals less than 0.02-in (500 µm) in size, are known to be more sensitive to anthropogenic impacts than macrofauna, baseline information on meiofauna diversity and abundance in OC San's monitoring area was previously unexamined. On April 21, 2022, OC San awarded a contract to Dr. Jeroen Ingels at Florida State University (FSU) to characterize the meiofauna communities in the receiving environment and to evaluate the suitability of using meiofauna for a Before-After Control-Impact study of the GWRS final expansion for this SPS.

In August and December 2022, a multicorer or box corer was used to collect three replicate sediment chemistry and meiofauna samples at four stations on the San Pedro Shelf (Figure 4-4). For the sediment chemistry samples, the three sediment cores were extruded, sliced in 0–1 cm (0–0.4 in), 1–3 m (0.4–1.2 in) and 3–5 cm (1.2–2.0 in) sections, and combined into a single composite sample. Sediment from each composite sample was transferred into containers using a stainless-steel scoop and kept on wet ice in the field. For the meiofauna samples, each sediment core was extruded, sliced in 0–1 cm, 1–3 m, and 3–5 cm sections, and preserved separately in DESS preservative in HDPE Nalgene bottles. Samples were transported to OC San's Laboratory where they were logged into the Laboratory Information Management System. Meiofauna samples were subsequently shipped to FSU whereas sediment chemistry samples were stored at OC San's Laboratory for further processing. Analysis of grain size and concentrations of total organic carbon, total nitrogen, total phosphorus, dissolved sulfides, metals, and persistent organic pollutants in the sediment samples were completed in 2023. Morphological and molecular identifications of meiofauna samples are ongoing.

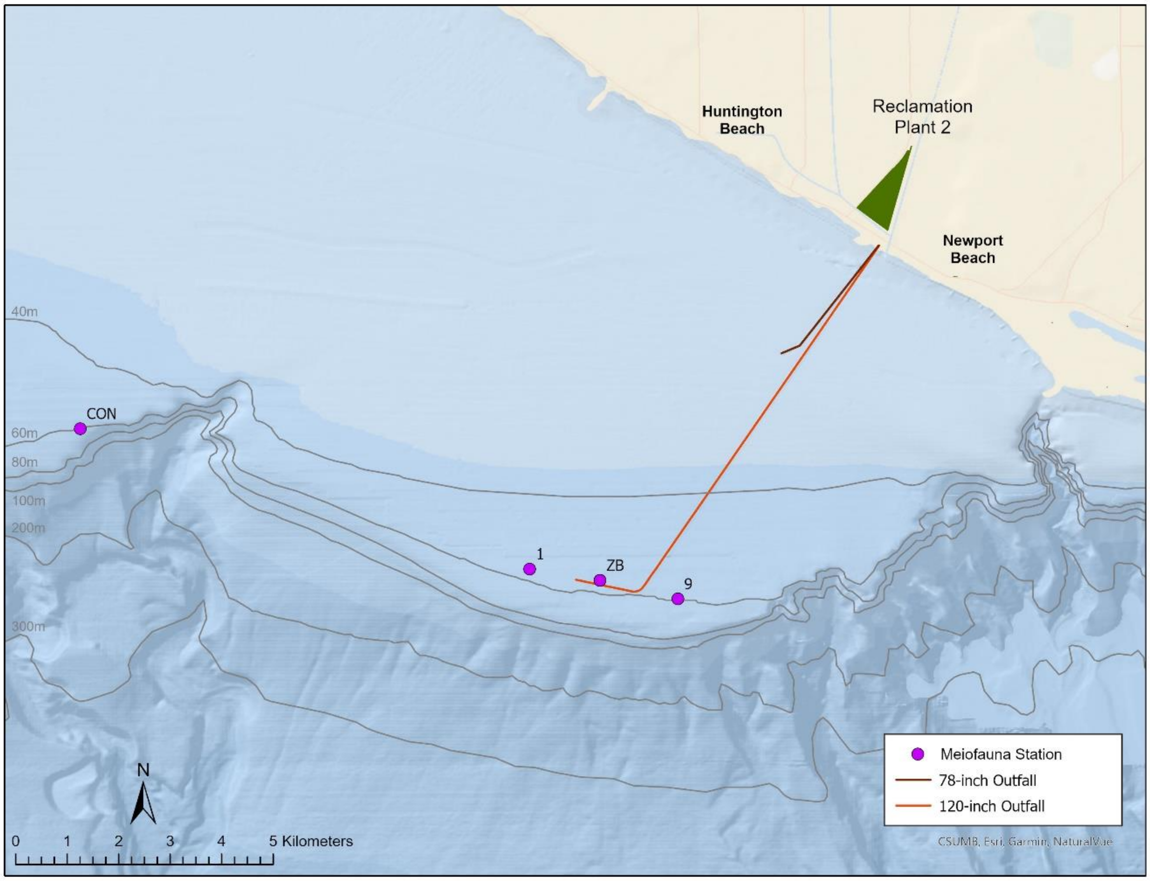

Figure 4-4 Benthic sampling stations for the meiofauna baseline study.

OTHER MONITORING REQUIREMENTS

Effluent Monitoring for Targeted Contaminants of Emerging Concern

Since 2014, OC San has conducted annual monitoring for a suite of CECs listed in the agency's NPDES permit. For the 2023-24 program year, OC San targeted 14 pharmaceuticals and personal care products (PPCPs), seven hormones, seven industrial endocrine disrupting compounds (IEDCs), six pesticides and insecticides, four polybrominated diphenyl ether (PBDE) flame retardants and three organophosphate esters flame retardants, and 12 per- and polyfluoroalkyl substances (PFAS) in the final effluent for this special study (Table 4-3).

Table 4-3 Contaminants of emerging concern monitored in OC San's final effluent.

	Hormones	
17α-Ethinyl estradiol	17β-Estradiol	Progesterone
17α-Estradiol	Estriol	Testosterone
	Estrone	
	Industrial Endocrine Disrupting Compounds	
Bisphenol A	Nonylphenol diethoxylate	4-n-Octylphenol diethoxylate
4-para-Nonylphenol	Nonylphenol monoethoxylate	Octylphenol monoethoxylate
	Octylphenol	
	Pharmaceuticals and Personal Care Products	
Acetaminophen	Erythromycin	Oxybenzone
Caffeine	Fluoxetine hydrochloride	Primidone
Carbamazepine	Galaxolide	Sulfmethoxazole
DEET	Gemfibrozil	Triclosan
Diclofenac	Ibuprofen	
	Flame Retardants	
BDE-47	BDE-183	TCEP
BDE-99	BDE-100	TCPP
		TDCPP
	Pesticides and Insecticides	
Fipronil	Bifenthrin	Chloropyrifos
Fipronil Sulfone	Total Permethrin	Diazinon
	Per- and Polyfluoroalkyl Substances	
PFDA	PFNA	PFUnDA
PFDoA	PFOA	PFBS
PFHxA	PFTeDA	PFHxS
PFHpA	PFTrDA	PFOS

In summary, PPCPs have exhibited variable patterns in concentrations since the start of this study in 2022 (Figure 4-5), with some compounds experiencing notable increases, and others discernable decreases. Targeted hormone compounds have revealed that certain compounds are generally detected with some frequency, while others have not been detected to date (Figure 4-6). Industrial endocrine disrupting compounds also show variability in patterns of detection (Figure 4-7). Flame retardants are plotted in their respective subgroups: polybromated diphenyl ethers (PBDEs) and organophosphate esters (OPEs), and the concentrations; both cases depict temporal dynamics (Figure 4-8). In comparing classes of flame retardants, OPEs have been measured in all samples collected as part of this study. Analysis of pesticides and insecticides reveal temporal variability in the presence of the targeted compounds (Figure 4-9). Finally, per- and polyfluoroalkyl substance analyses have targeted nine perfluoroalkyl carboxylic acids (PFCAs) and three perfluoroalkyl sulfonic acids (PFSAs; Figure 4-10). It appears that PFAS concentrations vary greatly based on carbon chain length.

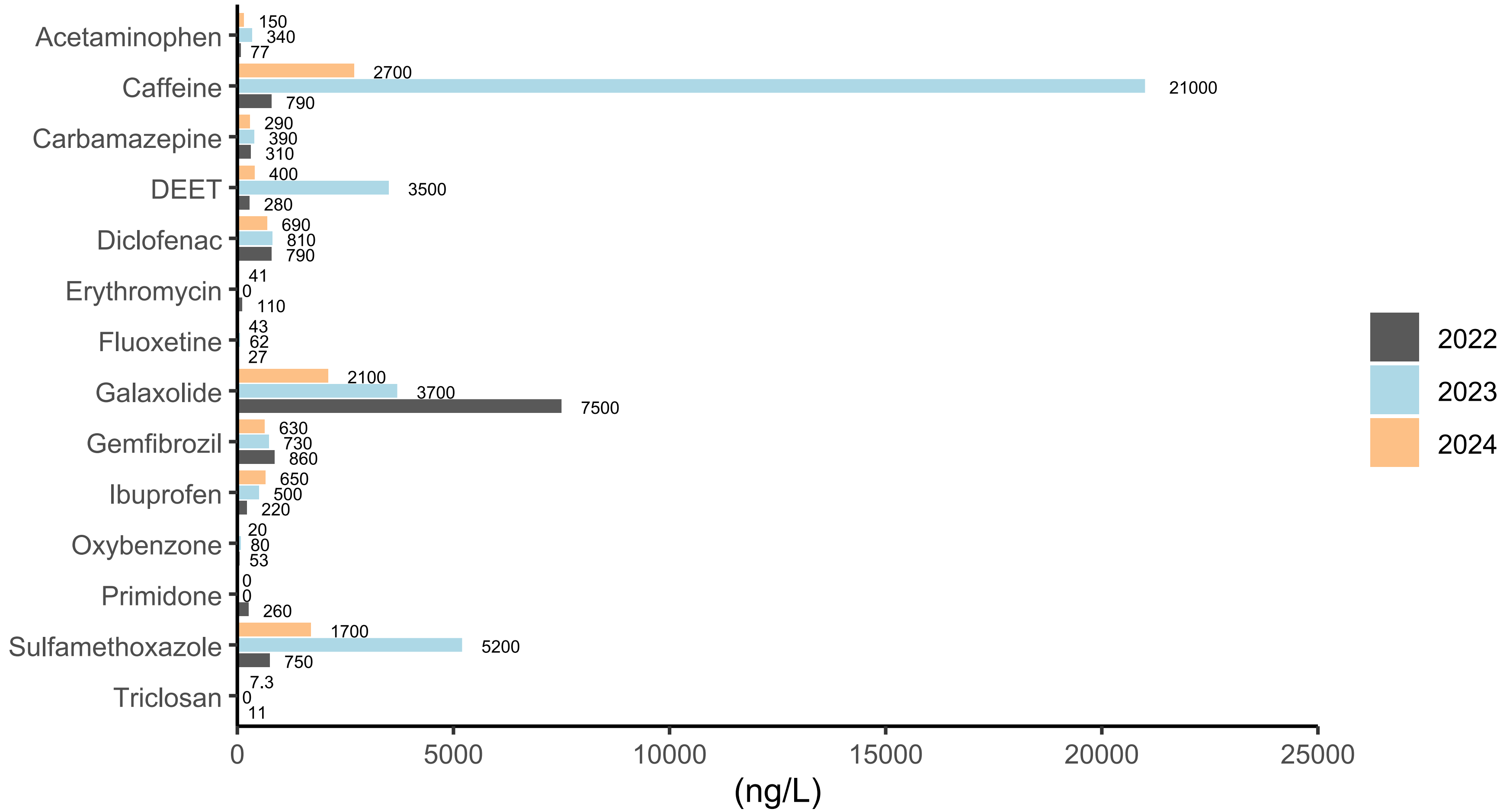

Figure 4-5 Pharmaceuticals and personal care products analyzed in final effluent, where ND=0.

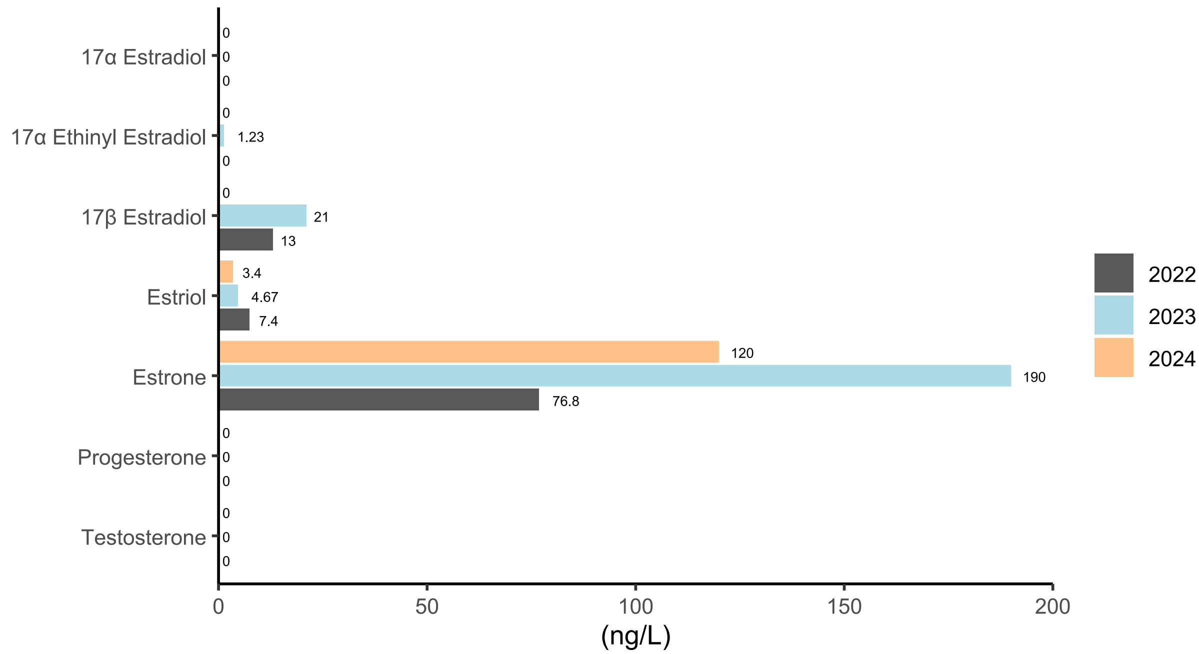

Figure 4-6 Hormones measured in final effluent, where ND=0.

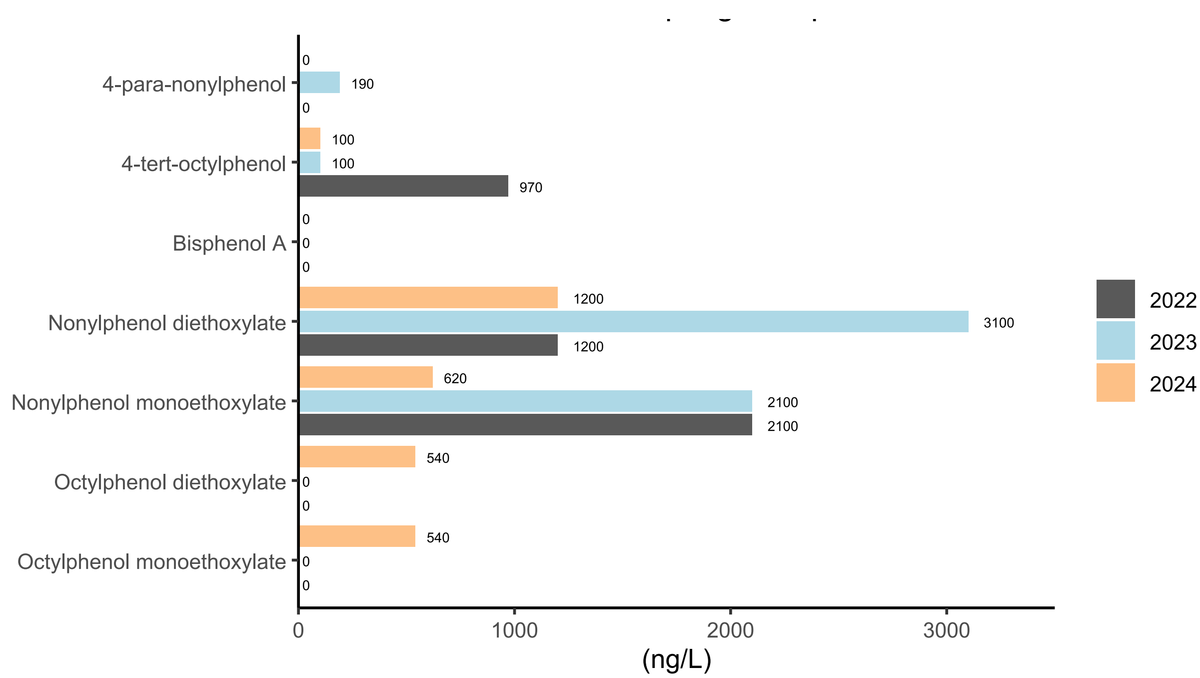

Figure 4-7 Industrial endocrine disrupting compounds measured in final effluent, where ND=0.

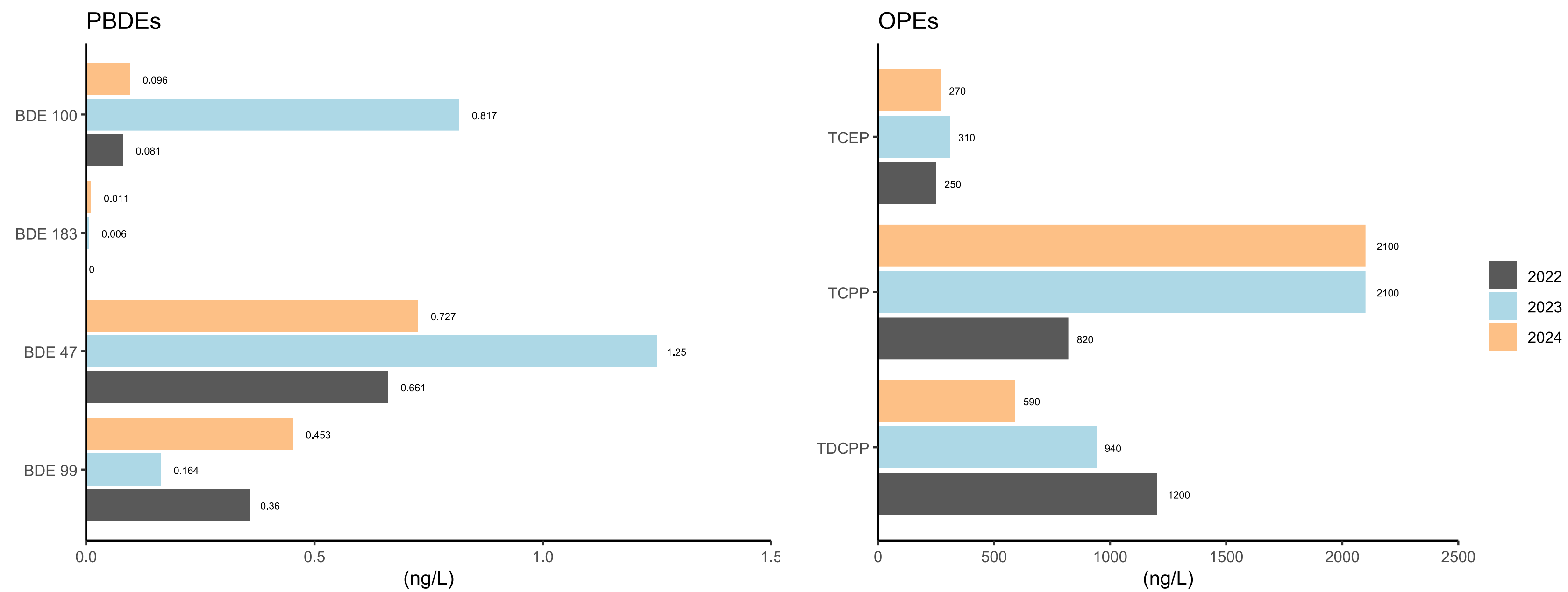

Figure 4-8 Flame retardants measured in final effluent, where ND=0.

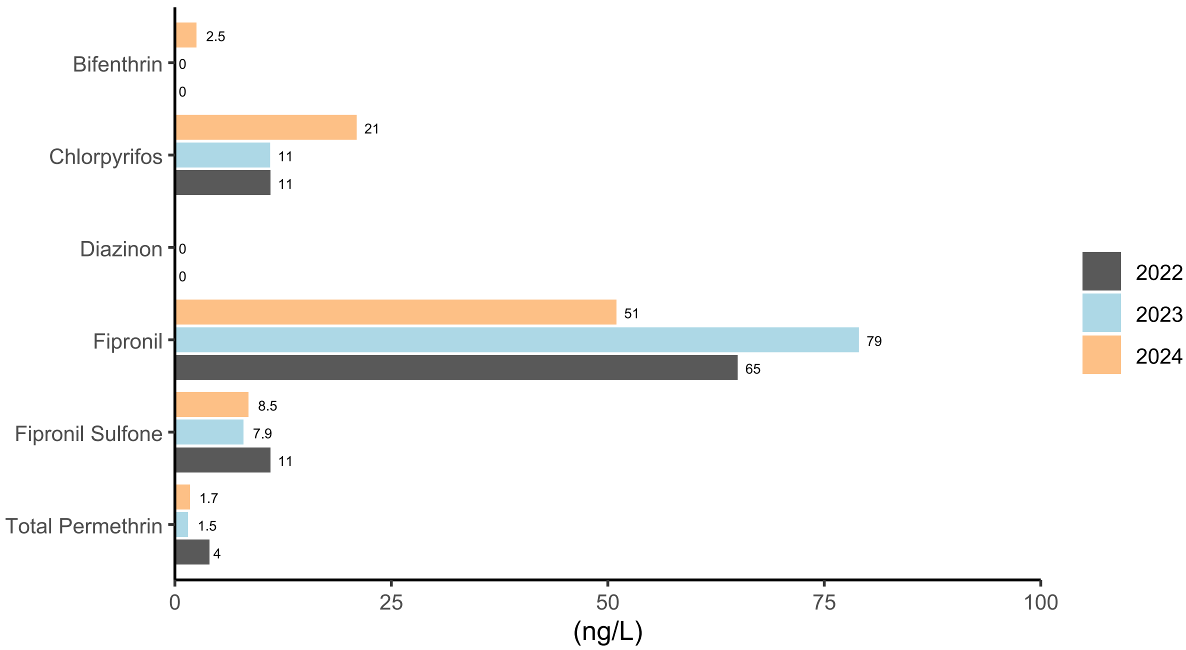

Figure 4-9 Pesticides and insecticides measured in final effluent, where ND=0.

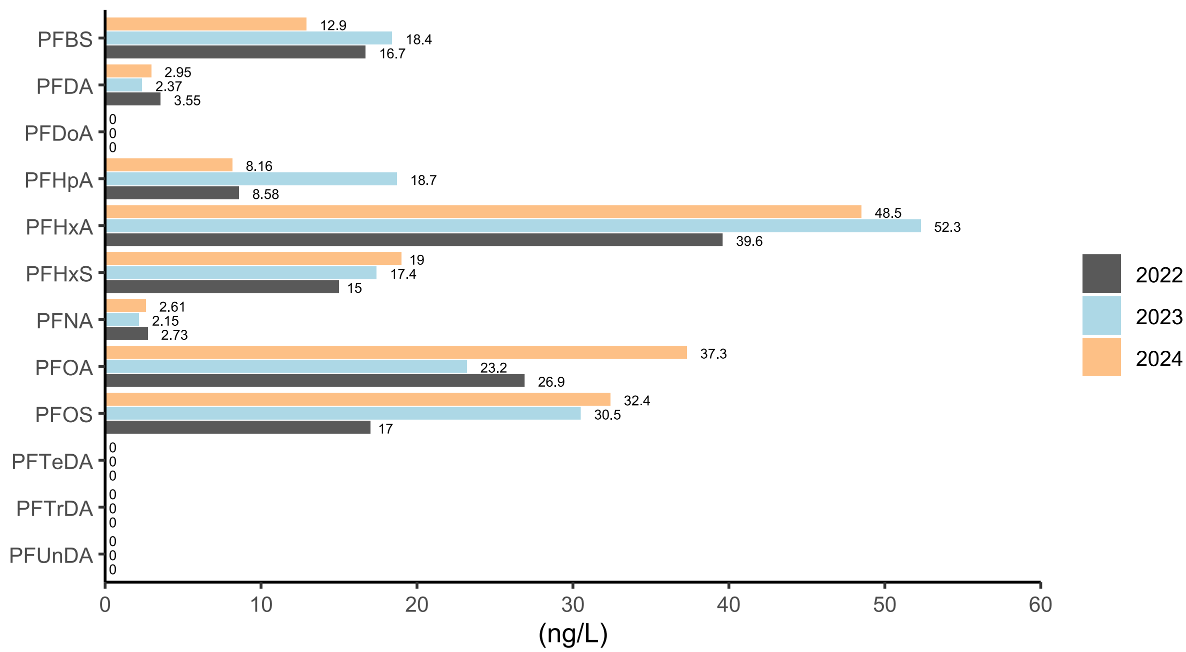

Figure 4-10 Per- and polyfluoroalkyl substances measured in final effluent, where ND=0.

REGIONAL MONITORING

Regional Shoreline (Surfzone) Bacterial Sampling

OC San partners with the Orange County Health Care Agency (OCHCA), the South Orange County Wastewater Authority, and Orange County Public Works in the Ocean Water Protection Program. Samples for this regional bacterial monitoring program are collected from 126 stations along 42 miles (68 km) of coastline (from Seal Beach to San Clemente State Beach) and 70 miles (113 km) of harbor and bay frontage. OC San samples 36 stations weekly along 19 miles (31 km) of coastline from Seal Beach to Crystal Cove State Beach (Figure 4-11).

OCHCA reviews bacteriological data to determine whether a station meets Ocean Water-Contact Sports Standards (i.e., Assembly Bill 411; AB411), and uses these results as the basis for health advisories, postings, or beach closures. Results are available on the OCHCA's website.

Of the 36 regional surfzone stations sampled by OC San, 18 are classified as Core stations because they have been sampled since the 1970s (Figure 4-11). Overall, geometric mean FIB concentrations were generally low across all Core stations, where results from the winter quarter were typically higher than the other quarters (Table B-15).

OC San's Dry Weather Urban Runoff Diversion Program continues its successful track record of helping to maintain the quality of the receiving waters along the Orange County coastline. The 2023-2024 Annual Heal the Bay Beach Report Card showed that Orange County beaches received very favorable ratings, with nine beaches making the honor roll (Heal the Bay 2024). Please refer to OC San's 2023-2024 Pretreatment Annual Report for an in-depth discussion on the Dry Weather Urban Runoff Diversion Program and the successes in maintaining the quality of receiving waters along Orange County's beaches (OCSD 2024).

Southern California Bight Regional Water Quality Program

OC San is a member of a cooperative regional sampling effort known as the Southern California Bight Regional Water Quality Program (SCBRWQP; previously known as the Central Bight Regional Water Quality Monitoring Program) with the City of Los Angeles, the Los Angeles County Sanitation Districts, and the City of San Diego. Each quarter, the participating agencies sample 251 stations that cover the coastal waters from Los Angeles County to Crystal Cove State Beach and from Point Loma to the United States–Mexico Border (Figure 4-12). The participants use comparable conductivity-temperature-depth (CTD) profiling systems and field sampling methods. OC San samples 72 stations, which includes the 28 Core water quality stations, as part of this program (Figure 4-13). The SCBRWQP monitoring provides regional data that enhances the evaluation of water quality changes due to natural (e.g., upwelling) or anthropogenic discharges (e.g., outfalls and stormwater flows) and provides a regional context for comparisons with OC San's monitoring results. The SCBRWQP serves as the basis for SCCWRP's Bight water quality sampling (see section below).

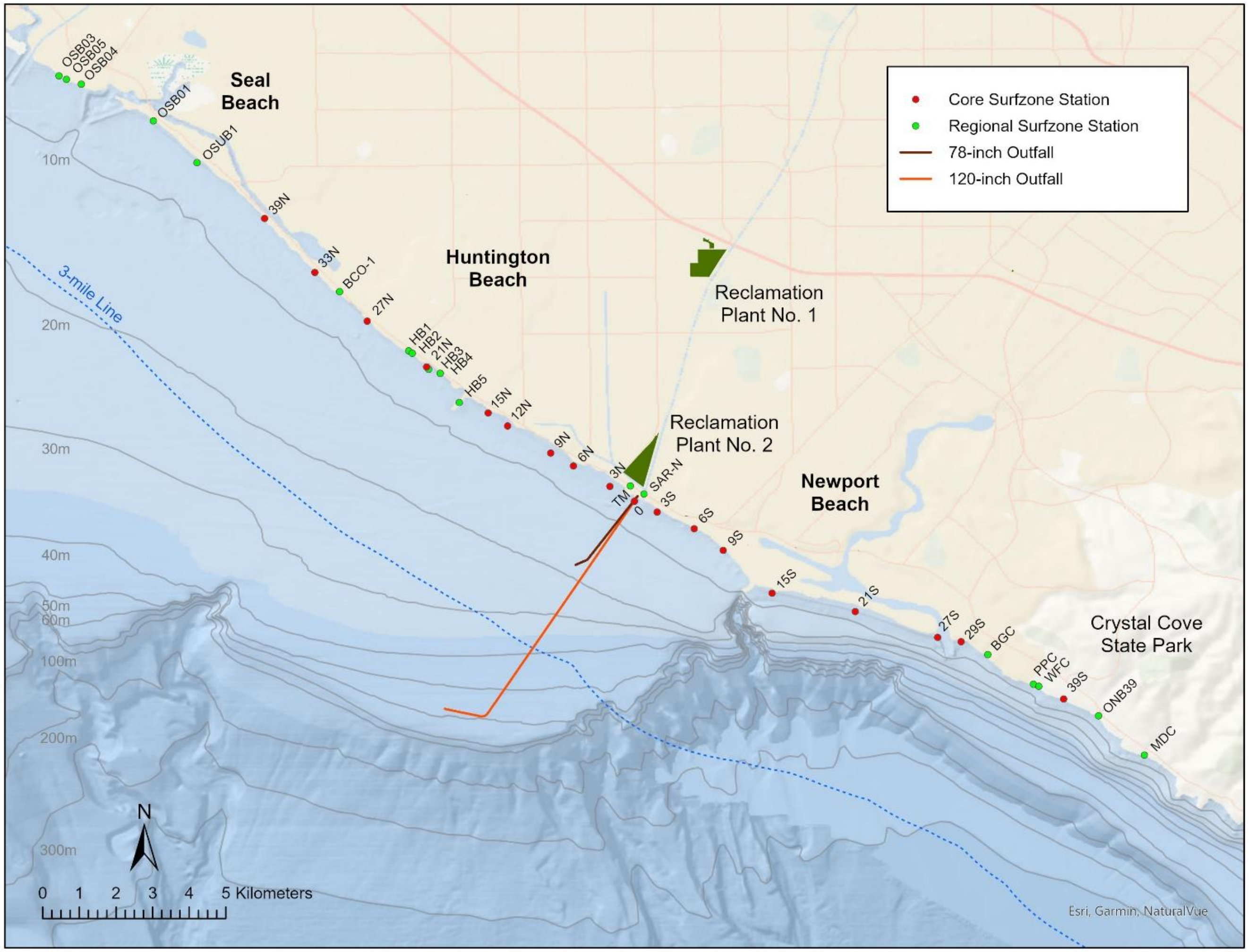

Figure 4-11 OC San's shoreline (aka surfzone) water quality monitoring stations for the 2023-24 program year.

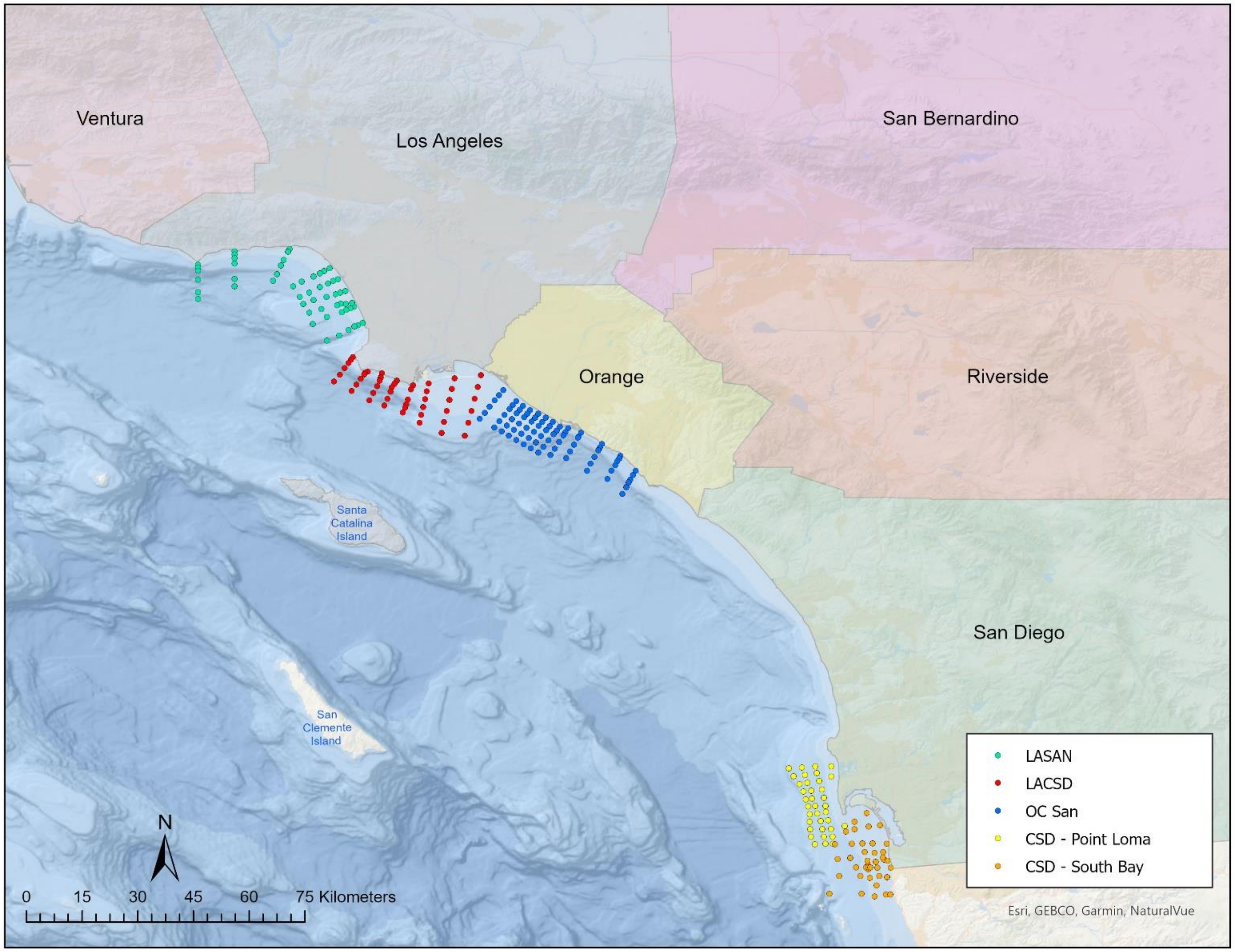

Figure 4-12 Southern California Bight Regional Water Quality Program monitoring stations for the 2023-24 program year.

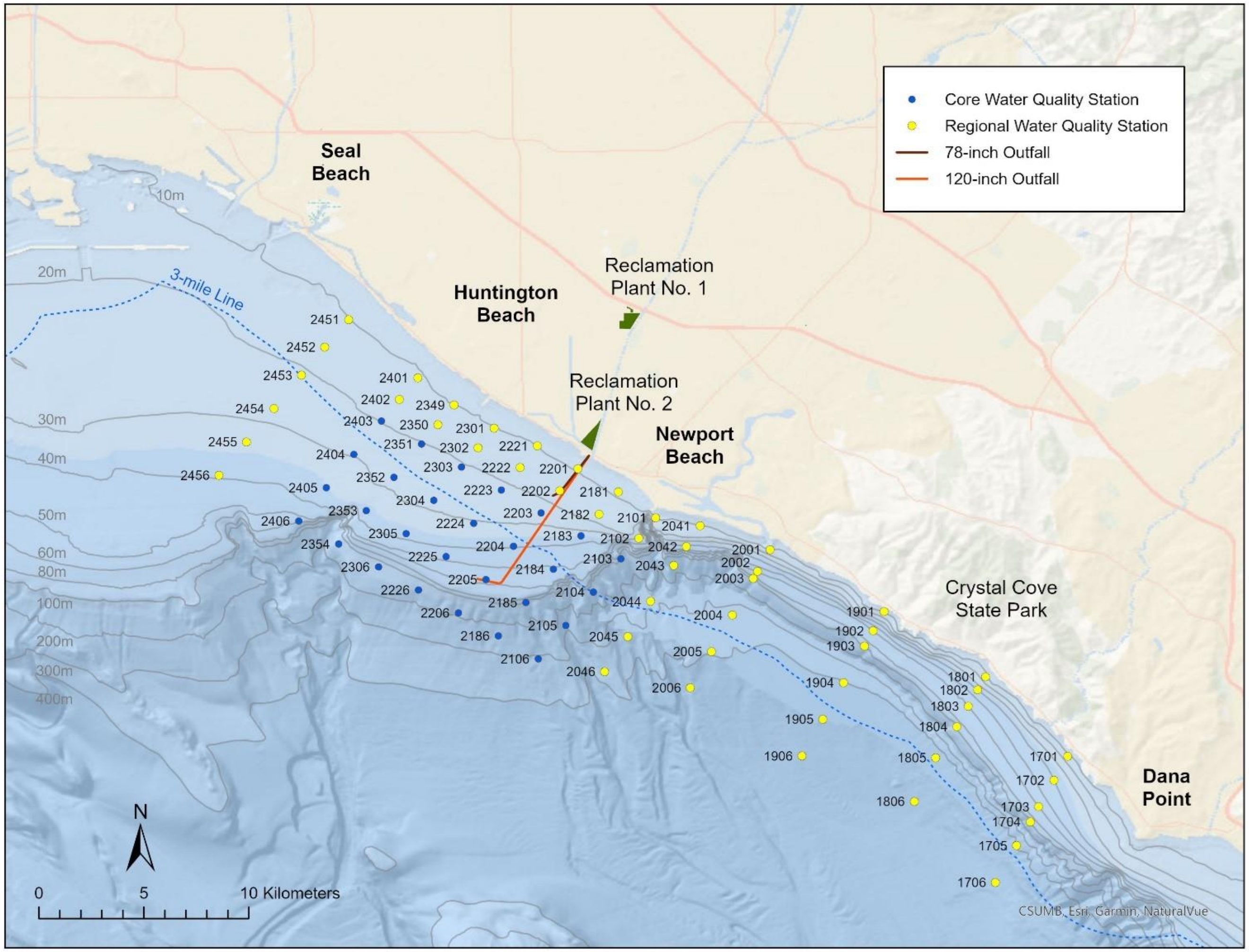

Figure 4-13 OC San's offshore water quality monitoring stations for the 2023-24 program year.

Southern California Bight Regional Monitoring Program

Since 1994, OC San has participated in all seven studies that comprise the SCB Regional Monitoring Program: 1994 SCB Pilot Project, Bight ’98, Bight ’03, Bight ’08, Bight ’13, Bight ’18, and Bight ‘23. OC San has played a considerable role in all aspects of this program, including study design, sampling, quality assurance, data analysis, and reporting. Results from these efforts provide information that is used by individual dischargers, resource managers, and the public to improve understanding of SCB environmental conditions and to provide a regional perspective for comparisons with data collected from individual point sources. Bight assessment reports are available at [Bight Program Documents – Southern California Coastal Water Research Project].

Prior to the start of Bight ’23 on July 1, 2023, OC San staff served on technical committees for the Sediment Quality, Microbiology, Water Quality, Harmful Algal Blooms, Trash and Microplastic, and Field components of the program. In addition, OC San staff participated in taxonomy, toxicity, and sediment chemistry intercalibration studies.

During the 2023-24 program year, OC San and contract staff completed the following Bight ’23 tasks:

- Sampling in lower Newport Bay and at offshore sites ranging from 5 m (16 ft) to 1,000 m (3,281 ft) in depth (Figure 4-14).
- Trial runs for eDNA sample collection and bongo net tows.
- Collection of 22 of 30 wet weather beach samples for pathogen analysis.
- Sediment toxicity testing on 10 samples.
- Sorting of 43 infauna samples.
- Analysis of grain size, total organic carbon, total nitrogen, metals, PAHs, PCBs, pesticides, and CECs in 45 sediment samples.
- Training on ddPCR on CrAssPhage, HF183 and enterococci.
- Resolution of unidentified trawl-caught fish and epibenthic microbenthic invertebrate specimens.
- Submission of trawl and benthic field data, as well as in-house sediment chemistry data.

Central Region Kelp Survey Consortium

OC San is a member of the Central Region Kelp Survey Consortium (CRKSC), which was formed in 2003 to map surface canopy of giant kelp (*Macrocystis pyrifera*) beds off Ventura, Los Angeles, and Orange counties via aerial photography. The program was modeled after the San Diego Regional Water Quality Control Board, Region 9 Kelp Survey Consortium, which began in 1983. Both consortia sample 3–4 times/year to count the number of observable kelp beds and calculate maximum kelp canopy coverage. Combined, the CRKSC and San Diego aerial surveys provide synoptic coverage of kelp beds along approximately 81% of the 270 miles (435 km) of the Southern California mainland coast from northern Ventura County to the United States–Mexico Border. Survey results are typically presented annually by MBC Aquatic Sciences to both consortia, regulators, and the public and is published as a report biennially for the CRKSC region. Findings from the most recent report (MBC 2023) covering 2021 and 2022 are summarized below.

2023 CRKSC Summary

Three aerial overflights were conducted in 2023 (April 20, June 20, and December 23) covering the three quarters prioritized for kelp canopy analysis. In the Central Region, the total amount of surface kelp canopy increased slightly overall (12%) between 2022 and 2023, from 2.015 km^2 to 2.252 km^2, respectively. However, kelp canopy has remained lower than the historical average (4.1 km^2) over the past five years. The Horseshoe Kelp and Huntington Flats kelp beds, most proximal to OC San’s monitoring area, experienced no change. These two areas within the Central Region historically lack observable surface canopy and as such there was no canopy observed in 2023. The largest increases in canopy coverage between 2022 and 2023 was observed in the Corona del Mar bed (2600% increase), followed by Latigo Canyon (+500%) and Paradise Cove (+118%). Generally, the largest decreases since 2022 were observed in the northern extent of the Central Region: Nicolas Canyon (-97%), El Pescador-La Piedra (-83%), and Deer Creek (-67%) were among the sites that experienced the highest percentage of canopy loss since 2022. The Big Rock kelp bed was not observed during the 2022 surveys, but it reappeared in 2023. The regional kelp surveys continue to demonstrate that kelp bed dynamics in the Central Region are influenced by large-scale oceanographic conditions and microvariations in local topography and currents that cause shifts in kelp bed performances.

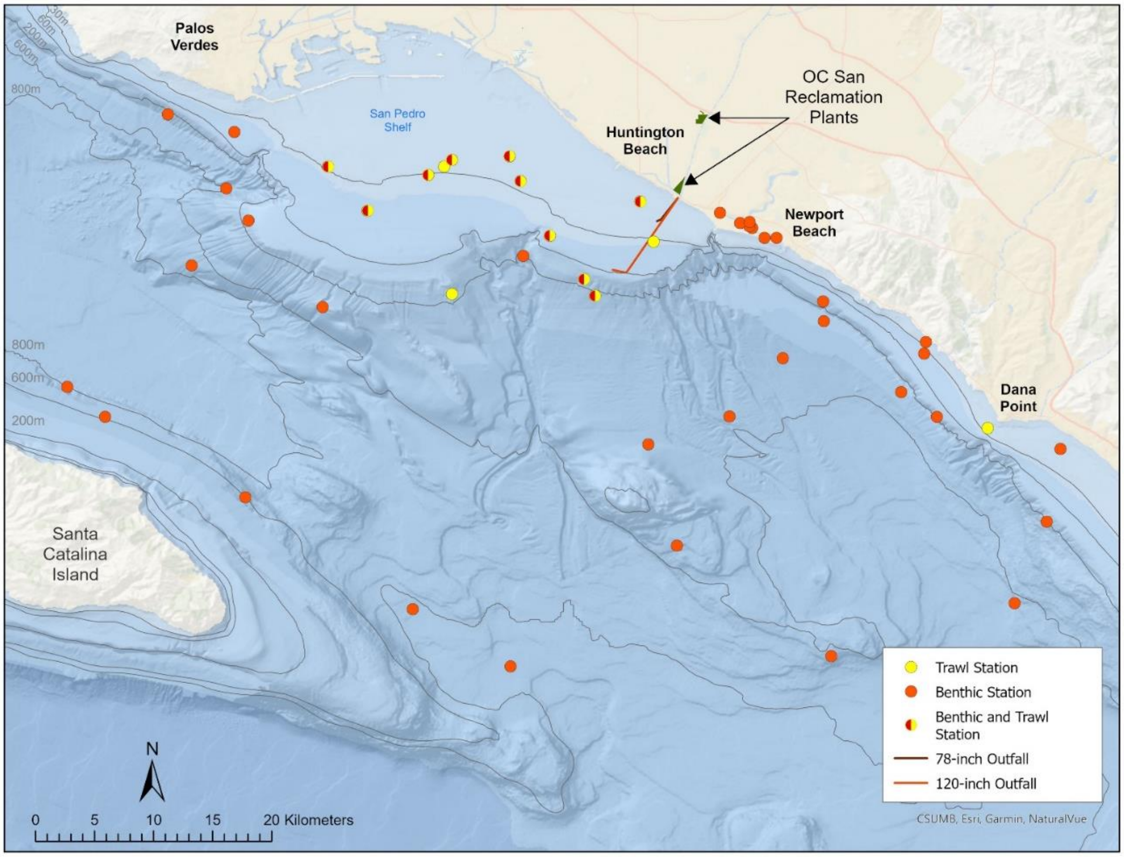

Figure 4-14 **OC San's Bight '23 trawl and sediment sampling stations.**

Ocean Acidification and Hypoxia Mooring

In 2012, OC San became the first publicly owned treatment works in Southern California to deploy an Ocean Acidification and Hypoxia (OAH) mooring to support the Bight '13 Water Quality studies (and the Bight '18 and Bight '23 Water Quality surveys later on). This mooring program was established to better understand the temporal variability (frequency and duration) in oxygen and pH trends off the San Pedro Shelf. The original telemetry mooring system was custom designed by the Monterey Bay Aquarium Research Institute (MBARI) to measure surface pH and partial pressure of carbon dioxide. It was also equipped with three subsurface instrument packages for measuring temperature, depth, salinity, oxygen, pH, and chlorophyll-*a* fluorescence (mid-water depth only). Additionally, MBARI developed and provided OC San staff with a private website for accessing and reviewing the output data.

The MBARI OAH mooring was decommissioned in January 2022 due to various challenges including inconsistent deployment and recovery, loss or damage of sensors, long lead times in sensor replacements, repairs and calibrations, and staff safety concerns during deployments. A new mooring system named the OAH mini-mooring system was developed by Dr. Uwe Send's Ocean Time-Series Group at the Scripps Institution of Oceanography. This OAH mini-mooring can be more safely and easily deployed and recovered while providing a more reliable set of OAH time-series data. In May 2023, the OAH mini-mooring was successfully deployed and has collected temperature, salinity, oxygen, pH and chlorophyll-*a* fluorescence data at a 30-meter location near the outfall (Figure 3-1). A public website has been established to review the near real-time preliminary data and monitor environmental conditions and instrumentation performance: OC San mini-mooring.

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Appendix A. Methods

INTRODUCTION

This appendix contains a summary of the field sampling, laboratory testing, and data analysis methods used for the final effluent and receiving water monitoring requirements for OC San during the July 1, 2023 through June 30, 2024 program year.

EFFLUENT MONITORING

Field Methods

Composite and grab samples of final effluent were collected by OC San staff at the final effluent sampling building located at Reclamation Plant No. 2 in Huntington Beach. Two Hach AS950 autosamplers were set up to collect 24-hour composite samples. One sampler is flow-paced and was used as the primary sampler, whereas the other sampler is time-paced and was used as a backup when needed. Grab samples were collected using the auto, pump, and grab functions on the autosampler. Sampling frequencies varied from every 12 hours to annually (see Table E-4 in OC San's NPDES permit). Samples were collected using the respective container types and respective preservation methods listed in Table A-1. All samples were refrigerated then transported to the OC San laboratory at Reclamation Plant No. 1 in Fountain Valley, where they were received into the Laboratory Information Management System (LIMS) and then distributed for contractor lab or in-house analysis.

Laboratory Methods

Final effluent samples were processed and analyzed using the methods listed in Table A-1. The measured parameters are listed in Table A-2, of which 14 have effluent limitations, seven have stipulated criteria, and 80 have performance goals and mass emission benchmarks.

Data Analyses

Compliance determinations were made by comparing measurements of constituents in the final effluent samples, including acute and chronic toxicity testing results, to the criteria specified in OC San's NPDES permit. The mass emission for each analyte was computed based on the measured concentration and the final effluent flow. Among the six radionuclides that were measured, the results of tritium, strontium-90, and uranium are not provided in Chapter 2 since the combined radium-226 & 228 results in the 2023-24 program year did not exceed the stipulated criterion of 5 pCi/L.

Table A-1 Final effluent collection and analysis summary for the 2023-24 program year.

Parameter	Sample Type	Container	Preservation	Holding Time	Method
pH	Grab	Plastic or Glass	None	15 min	ELOM SOP 4500-H+B, Rev. 11
Enterococcus	Grab	Plastic	Sodium Thiosulfate, <10 ºC	6 hr	ELOM SOP 9223B–9230D, Rev. F
Fecal Coliforms	Grab	Plastic	Sodium Thiosulfate, <10 ºC	6 hr	ELOM SOP 9221E, Rev. 5
Oil and Grease	Grab	Amber glass	≤6 ºC, H_2SO_4 to pH <2	28 days	ELOM SOP 400 1664B, Rev. 8
Nitrite Nitrogen (as N)	24-hr Composite	Plastic or Glass	≤6 ºC	2 days	EPA Method 353.2
Nitrate Nitrogen (as N)	24-hr Composite	Plastic or Glass	≤6 ºC	2 days	EPA Method 353.2
Total Kjeldahl Nitrogen (TKN)	24-hr Composite	Plastic or Glass	≤6 ºC, H_2SO_4 to pH <2	28 days	EPA Method 351.2; ELOM SOP 351.2, Rev. 2.0
Organic Nitrogen	Calculated	—	—	—	Calculated
Total Nitrogen	Calculated	—	—	—	Calculated
Total Phosphorus (as P)	24-hr Composite	Plastic	HNO_3	180 days	EPA Method 200.7
Ammonia (as N)	24-hr Composite	Plastic or Glass	≤6 ºC, H_2SO_4 to pH <2	28 days	ELOM SOP 350.1, Rev. 2
Settleable Solids	Grab	Plastic or Glass	—	48 hr	ELOM SOP 2540 F, Rev. 9
Total Chlorine Residual	Grab	Plastic or Glass	—	Immediate	ELOM SOP 4500-Cl G, Rev. 4 & 5
Purgeable Organic Compounds	Grab	Glass	Sodium Thiosulfate, ≤6 ºC	3 days	ELOM SOP 624.1, Rev. 4
Base/Neutrals and Acids Semi-volatile Organic Compounds	Grab	Glass	≤6 ºC	7 days	ELOM SOP 625.1, Rev. 5
TCDD	24-hr Composite	Amber glass	Dark at 0 to 4 ºC	30 days	EPA Method 1613b, Rev. B
Metals	24-hr Composite	Acid Washed Plastic or Glass	HNO3	6 months	EPA Method 1631; ELOM SOP 200.8, Rev. 15
Tributyltin	24-hr Composite	Glass	HCl	14 days	SM 6710 B
Cyanide	Grab	Plastic or Glass	10N NaOH to pH >10, ≤6 ºC	14 days	EPA Method 335.4; ELOM SOP 4500-CN-N-335.4, Rev. 10
Turbidity	24-hr Composite	Plastic or Glass	≤6 ºC	—	ELOM SOP 2130 B, Rev. 6
Radionuclides	24-hr Composite	Plastic or Amber Glass	≤6 ºC, HNO_3 to pH ≤2	6 months	SM 7110C; EPA Methods 200.8, 900.0, 903.1, 904.0, 905.0 & 906.0
Total Suspended Solids	24-hr Composite	Plastic or Glass	≤6 ºC	7 days	ELOM SOP 2540 D/E
Organochlorine Pesticides and Polychlorinated Biphenyls	24-hr Composite	Glass	≤6 ºC	7 days	EPA Methods 608.3 & 1668 C
Acute Whole Effluent Toxicity Testing	24-hr Composite	Plastic	≤6 ºC	36 hr	ELOM SOP 8510, Rev. 7
Chronic Whole Effluent Toxicity Testing	24-hr Composite	Plastic	≤6 ºC	36 hr	ELOM SOP 8210, Rev. 7; ELOM SOP 8230, Rev.7
Carbonaceous Biochemical Oxygen Demand	24-hr Composite	Plastic or Glass	≤6 ºC	48 hr	ELOM SOP 5210 B

Table A-2 Parameters measured in final effluent samples during the 2023-24 program year.

Parameters with Effluent Limitations		
Carbonaceous Biochemical Oxygen Demand	Turbidity	Hexachlorobenzene [b]
Total Suspended Solids	Total Chlorine Residual	Toxaphene [c]
pH	Acute toxicity	PCBs
Oil and Grease	Chronic toxicity	TCDD Equivalents
Settleable Solids	Benzidine [b]	
Parameters with Stipulated Criteria		
Gross Alpha Radioactivity	Radium-226	Tritium
Gross Beta Radioactivity	Radium-228	Strontium-90
		Uranium
Parameters with Performance Goals and Mass Emission Benchmarks		
Marine Aquatic Life Toxicants		
Arsenic, total recoverable	Nickel, total recoverable	Total Chlorine Residual
Cadmium, total recoverable	Selenium, total recoverable	Non-chlorinated Phenols [b]
Chromium (VI)	Silver, total recoverable	Chlorinated Phenols [b]
Copper, total recoverable	Zinc, total recoverable	Endosulfan [c]
Lead, total recoverable	Cyanide, total recoverable	Endrin [c]
Mercury, total recoverable	Ammonia (as N)	Hexachlorocyclohexane [c]
Human Health Toxicants – Non-Carcinogens		
Acrolein [a]	Dichlorobenzenes [a]	Hexachlorocyclopentadiene [b]
Antimony	Diethyl phthalate [b]	Nitrobenzene [b]
Bis(2-chloroethoxy) methane [b]	Dimethyl phthalate [b]	Thallium
Bis(2-chloroiso-propyl) ether [b]	4,6-dinitro-2-methylphenol [b]	Toluene [a]
Chlorobenzene [a]	2,4-dinitrophenol [b]	Tributyltin
Chromium (III)	Ethylbenzene [a]	1,1,1-trichloroethane [a]
Di-n-butyl-phthalate [b]	Fluoranthene [b]	
Human Health Toxicants – Carcinogens		
Acrylonitrile [a]	1,2-dichloroethane [a]	Isophorone [b]
Aldrin [c]	1,1-dichloroethylene [a]	N-nitrosodimethylamine [b]
Benzene [a]	Dichlorobromomethane [a]	N-nitrosodi-n-propylamine [b]
Benzidine [b]	Dichloromethane [a]	N-nitrosodiphenylamine [b]
Beryllium	1,3-dichloropropene [a]	PAHs [a]
Bis(2-chloroethyl) ether [b]	Dieldrin [c]	PCBs
Bis(2-ethylhexyl) phthalate [b]	2,4-dinitrotoluene [b]	TCDD equivalents
Carbon tetrachloride [a]	1,2-diphenylhydrazine [b]	1,1,2,2-tetrachloroethane [a]
Chlordane [c]	Halomethanes [b]	Tetrachloroethylene [a]
Chlorodibromomethane [b]	Heptachlor [c]	Toxaphene [c]
Chloroform [a]	Heptachlor epoxide [c]	Trichloroethylene [a]
DDT [c]	Hexachlorobenzene [b]	1,1,2-trichloroethane [a]
1,4-dichlorobenzene [a]	Hexachlorobutadiene [b]	2,4,6-trichlorophenol [b]
3,3′-dichlorobenzidine [b]	Hexachloroethane [b]	Vinyl chloride [a]
Miscellaneous Parameters		
Fecal Coliform Density	Nitrate Nitrogen (as N)	Total Phosphorus (as P)
Enterococcus Density	Organic Nitrogen	Biochemical Oxygen Demand
Nitrite Nitrogen (as N)	Total Nitrogen	Individual PCB Congeners

[a] Purgeable Organic Compound
[b] Base/Neutrals and Acids Semi-volatile Organic Compound
[c] Organochlorine Pesticide

RECEIVING WATER QUALITY MONITORING

Field Methods

Offshore Zone

Permit-specified water quality monitoring was conducted six times per quarter for compliance with the California Ocean Plan (COP 2019). Monthly surveys (3 per quarter) sampled the full 28-station grid for dissolved oxygen (DO), pH, water clarity, and nutrient compliance determinations (Figure 3-1). During two full-grid surveys, bacteriological samples were also collected at eight of the 28 stations (aka REC-1 stations) located within 3 miles (4.8 km) of the coast. These samples, when combined with those from the three additional REC-1 station surveys, were used for quarterly REC-1 water-contact compliance determinations.

Each survey included measurements of pressure (from which depth is calculated), water temperature, conductivity (from which salinity is calculated), DO, pH, water clarity (light transmissivity, beam attenuation coefficient [beam-c], and photosynthetically active radiation [PAR]), chlorophyll-*a* fluorescence, and colored dissolved organic matter (CDOM). Measurements were conducted using a Sea-Bird Electronics SBE911-plus conductivity-temperature-depth (CTD) profiling system deployed from M/V *Nerissa*. Profiling was conducted at each station from 3.3 ft (1 m) below the surface to 6.6 ft (2 m) above the bottom or to a maximum depth of 246 ft (75 m), when water depths exceeded 75 m. SEASOFT V2 (2018a) software was used for data acquisition, data display, and sensor calibration. PAR was measured in conjunction with chlorophyll-*a* because of the positive linkage between light intensity and photosynthesis per unit chlorophyll (Hardy 1993). Weather conditions, sea state, and visual observations of floatable materials or grease that might be of sewage origin were also noted. A Sea-Bird Electronics Carousel Water Sampler (SBE32) equipped with Niskin bottles was used to collect discrete water samples at specified stations and depths for analysis of NH_3-N, NO_3-N, and FIB. Six liters of surface seawater (control sample) were collected at Station 2106 during each survey for NH_3-N and NO_3-N quality assurance/quality control (QA/QC) analysis. All bottled samples were kept on wet ice in coolers and transported within 6 hours to OC San's laboratory where they were logged into the LIMS and then delivered to laboratory staff under chain of custody protocols. A summary of the sampling and analysis methods is presented in Table A-3.

Southern California Bight Regional Water Quality

An expanded grid of 44 water quality stations was sampled quarterly as part of the Southern California Bight Regional Water Quality Monitoring Program. These stations were sampled by OC San in addition to the 28-station grid (Figure 4-13) and provided regional continuity with the station assignments of the City of Los Angeles, Los Angeles County Sanitation Districts, and City of San Diego. The total sampling area extends from Point Conception in the north to the U.S./Mexico Border in the south, with a significant spatial gap between Crystal Cove State Beach and Mission Bay (Figure 4-12). Oceanographic data were collected using CTD instrumentation within a fixed-grid pattern comprising 299 stations during a targeted period of 3–4 days. Parameters measured included pressure, water temperature, conductivity, DO, pH, chlorophyll-*a*, PAR, and light transmissivity. Profiling was conducted from the surface to 2 m from the bottom or to a maximum depth of 328 ft (100 m). OC San's sampling and analytical methods were the same as those presented in Table A-3.

Ocean Acidification and Hypoxia Mini-Mooring

The OAH mini-mooring was deployed in May 2023 and continues to provide near real-time data. This mooring is equipped with a Seabird SBE 16plus-IM V2 SeaCAT CTD, SBE 63 optical dissolved oxygen sensor, SeaFET V2 pH, and ECO chlorophyll-*a* optical fluorometer. Data were collected and telemetered hourly, providing near real-time context to the nearshore monitoring area.

Shoreline Zone

Regional shoreline (also referred to as "surfzone") FIB samples were collected weekly at a total of 36 stations as part of the Ocean Water Protection Program. When water at the creek/storm drain stations flowed to the ocean, three bacteriological samples were collected at the source and 25 yards (nearly 23 m) up- and downcoast. When flow was absent, a single sample was collected 25 yards downcoast.

Samples were collected in ankle-deep seawater, with the mouth of a sterile bottle facing an incoming wave but away from both the sampler and ocean bottom. After the sample was taken, the bottle was tightly capped and promptly stored on ice in the dark. The occurrence and size of any grease particles at the high tide line were also recorded. All samples were transported to OC San's Laboratory where they were received into the LIMS for analysis within 6 hours of collection.

Table A-3 Receiving water quality sample collection and analysis methods by parameter for the 2022-23 program year. NA = Not Applicable.

Parameter	# Sampling Events	Sampling Method	Method Reference	Field Preservation	Container	Holding Time	Sampling Depth	Field Replicates
Shoreline (Surfzone)								
Total Coliforms	1-2/week	Grab	SM 9222 B [i]	Ice (<10 °C)	125 mL HDPE (sterile container)	8 hr (field + lab)	Ankle-deep water	At least 10% of samples
Fecal Coliforms	1-2/week	Grab	SM 9222 D [i]	Ice (<10 °C)	125 mL HDPE (sterile container)	8 hr (field + lab)	Ankle-deep water	At least 10% of samples
Enterococci	1-2/week	Grab	EPA Method 1600 [j]	Ice (<10 °C)	125 mL HDPE (sterile container)	8 hr (field + lab)	Ankle-deep water	At least 10% of samples
Offshore								
Temperature [a]	6/quarter	*in-situ* probe	ELOM SOP 1500.1 - CTD Operations	N/A	N/A	N/A	Every 1 m [k]	At least 10% of stations
Salinity (conductivity) [b]	6/quarter	*in-situ* probe	ELOM SOP 1500.1 - CTD Operations	N/A	N/A	N/A	Every 1 m [k]	At least 10% of stations
pH [c]	6/quarter	*in-situ* probe	ELOM SOP 1500.1 - CTD Operations	N/A	N/A	N/A	Every 1 m [k]	At least 10% of stations
Dissolved Oxygen [d]	6/quarter	*in-situ* probe	ELOM SOP 1500.1 - CTD Operations	N/A	N/A	N/A	Every 1 m [k]	At least 10% of stations
Transmissivity [e]	6/quarter	*in-situ* probe	ELOM SOP 1500.1 - CTD Operations	N/A	N/A	N/A	Every 1 m [k]	At least 10% of stations
Photosynthetically Active Radiation (PAR) [f]	6/quarter	*in-situ* probe	ELOM SOP 1500.1 - CTD Operations	N/A	N/A	N/A	Every 1 m [k]	At least 10% of stations
Chlorophyll-*a* fluorescence [f]	6/quarter	*in-situ* probe	ELOM SOP 1500.1 - CTD Operations	N/A	N/A	N/A	Every 1 m [k]	At least 10% of stations
Color Dissolved Organic Matter (CDOM) [f]	6/quarter	*in-situ* probe	ELOM SOP 1500.1 - CTD Operations	N/A	N/A	N/A	Every 1 m [k]	At least 10% of stations
Ammonia Nitrogen (NH_3-N)	6/quarter	Niskin	ELOM SOP 4500-NH3-G-Oceanwater, Rev. L [i]	Ice (<6 °C)	125 mL HDPE	28 days	Surface, 10 m, 20 m, 30 m, 40 m, 50 m, 60 m, Bottom	At least 10% of stations
Nitrate Nitrogen (NO_3-N)	6/quarter	Niskin	ELOM SOP 353.2-NO2NO3_WQ, Rev. EPA 353.2	Ice (<6 °C)	125 mL HDPE	28 days	Surface, 10 m, 20 m, 30 m, 40 m, 50 m, 60 m, Bottom	At least 10% of stations
Total Coliforms and *Escherichia coli* [g]	5/quarter [h]	Niskin	SM 9222 B [i, j] & 9223 C [i]	Ice (<10 °C)	125 mL HDPE (sterile container)	8 hr (field + lab)	Surface, 10 m, 20 m, 30 m, 40 m, 50 m, 60 m, Bottom	At least 10% of stations
Enterococci	5/quarter [h]	Niskin	EPA Method 1600 [j]; SM 9230 D [i]	Ice (<10 °C)	125 mL HDPE (sterile container)	8 hr (field + lab)	Surface, 10 m, 20 m, 30 m, 40 m, 50 m, 60 m, Bottom	At least 10% of stations

Table A-3 Receiving water quality sample collection and analysis methods by parameter for the 2022-23 program year. NA = Not Applicable.

Parameter	# Sampling Events	Sampling Method	Method Reference	Field Preservation	Container	Holding Time	Sampling Depth	Field Replicates
Fecal Coliforms	5/quarter [h]	Niskin	SM 9222 D [i, j] & 9223 C [i]	Ice (<10 °C)	125 mL HDPE (sterile container)	8 hr (field + lab)	Surface, 10 m, 20 m, 30 m, 40 m, 50 m, 60 m, Bottom	At least 10% of stations
Surface Observations	6/quarter	Visual observations	NPDES Permit	N/A	N/A	N/A	Surface	N/A

[a] Calibrated reference cells (0.0005 °C accuracy) annually.
[b] Calibrated to IAPSO Standard and Guildline 8400B Autosal annually.
[c] Referenced and calibrated to NIST buffers of pH 7, 8, and 9 prior to each survey.
[d] Referenced and calibrated each survey by comparison with the lab dissolved oxygen probe, which is calibrated daily.
[e] Referenced and calibrated to known transmittance in air.
[f] Factory calibrated annually.
[g] Fecal coliform count calculation: *Escherichia coli* MPN/100 mL × 1.1.
[h] REC-1 surveys completed within 30 days for geometric mean calculations.
[i] APHA (2012).
[j] During the transition period related to ELAP accreditation and 2021 NPDES permit adoption, the surfzone FIB method was used for some offshore FIB samples.
[k] Sampled continuously at 24 scans/second but data are processed at 1 m intervals.

Laboratory Methods

Analysis of NH_3-N, NO_3-N, and FIB samples followed methods listed in Table A-3. QA/QC procedures included, with each sample batch, analysis of laboratory blanks and duplicates (for FIB), other analytical quality control samples (matrix spikes, matrix spike replicates, and blank spikes), and standard reference materials (for NH_3-N and NO_3-N). All data underwent at least three separate validations prior to being included in the final database used for summary statistics and compliance determination.

Data Analyses

Raw CTD data were processed using both SEASOFT V2 (2018b) and Esri ArcGIS Pro 3.1.4 software. The steps included retaining the data collected as the unit is lowered through the water column and removing potential outliers (i.e., data that exceeded specific sensor response criteria limits). Flagged data were removed if they were attributed to instrument failures, electrical noise (e.g., large data spikes), or physical interruptions of sensors (e.g., by air bubbles) rather than by actual oceanographic events. After outlier removal, averaged 1-m depth values were prepared from the down-cast data; if there were any missing 1-m depth values, then the up-cast data were used as a replacement.

Compliance Determinations

COP compliance was assessed based on: (1) specific numeric criteria for DO, pH, and FIB (REC-1 zone only); and (2) narrative (non-numeric) criteria for transmissivity, floating particulates, oil and grease, water discoloration, beach grease, and nutrients (e.g., NH_3-N).

<u>DO, pH, and Transmissivity</u>

- DO cannot be depressed >10% below the reference profile mean;
- pH cannot exceed ±0.2 pH units of the reference profile mean; and
- Natural light (defined as transmissivity) shall not be significantly reduced, where statistically different from the reference profile mean is defined as the lower 95% confidence limit.

Compliance was calculated using a method developed by SCCWRP in conjunction with its member agencies and the State Water Resources Control Board. The methodology involves four steps:

1. identification of the stations affected by the effluent plume using CDOM,
2. selection of reference sampling sites representing non-plume impacted conditions using CDOM,
3. a per meter comparison between water quality profiles in the reference and plume-affected zones, and
4. calculation of maximum delta and comparison to COP standards to determine out-of-range-occurrences (OROs).

Reference density profiles are calculated and the profiles below the mixed layer at plume (CDOM) stations are compared and a maximum difference value is used to establish the number of OROs. Detailed methodology, as applied to DO, can be found in Nezlin et al. (2016). In accordance with the NPDES permit specifications, the outfall station (2205) was not included in the comparisons because it is within the zone of initial dilution (ZID).

To determine whether an ORO was an out-of-compliance (OOC) event, each ORO was evaluated to determine if it represented a logical OOC event. These evaluations were based on: (A) current direction, (B) confirmation of wastewater with FIB and nutrients (i.e., NH_3-N and NO_3-N), when available; and (C) water column features relative to naturally occurring events (i.e., low transmissivity due to elevated phytoplankton as measured by chlorophyll-*a*). ORO and OOC percentages were calculated according to the total number of observations (n=324).

<u>Fecal Indicator Bacteria</u>

FIB compliance used corresponding bacterial standards at each REC-1 station. Bacteria parameter evaluations are treated respectively, given different requirements and objectives and FIB compliance was determined using the following thresholds (EPA 2012, SWRCB 2019):

Fecal coliform (SWRCB REC-1 objectives)

- A 30-day geometric mean of fecal coliform[3] density shall not exceed 200 per 100 mL.
- A single sample maximum of fecal coliform density shall not exceed 400 per 100 mL.

Enterococci (SWRCB REC-1 objectives)

- A 6-week rolling geometric mean of enterococci, calculated weekly, shall not exceed 30 CFU or MPN per 100 mL.
- A statistical threshold value of 110 CFU or MPN per 100 mL shall not be exceeded by >10% of all enterococci samples collected in a calendar month.

Total coliform (SWRCB shellfish harvesting standards)

- The median total coliform density shall not exceed 70 per 100 mL.
- Not more than 10% of the samples shall exceed 230 per 100 mL.

Enterococci (U.S. EPA recreational water quality criteria)

- A 30-day geometric mean shall not exceed 30 CFU or MPN per 100 mL.
- A statistical threshold value corresponding to the 90th percentile of the same water quality distribution shall not exceed 110 CFU or MPN per 100 mL in the same 30-day interval.

Evaluation of fecal coliform is performed using a depth-average of result values for each station to determine compliance. Evaluation of enterococci is performed utilizing each sample depth result for calculation of the 6-week rolling geometric mean; statistical threshold values are calculated with individual depths for each calendar month. Evaluation of total coliform is performed utilizing each sample depth result to determine compliance.

OC San has no NPDES permit compliance criteria for FIB at the shoreline (surfzone) stations. These data were given to the Orange County Health Care Agency (which follows State Department of Health Service AB411 standards) for the Ocean Water Protection Program (http://ocbeachinfo.com/) as part of a cooperative regional monitoring program.

Nutrients and Aesthetics

Compliance determinations for aesthetics and nutrients were based on presence/absence and level of potential effect at each station. Station groupings for aesthetic evaluations are shown in Table B-5 and Table B-6 and are based on relative distance and direction from the outfall. Compliance for the floating particulates, oil and grease, and water discoloration were determined based on presence/absence at the ocean surface for each station. Compliance with the excess nutrient criterion was based on evaluation of NH_3-N compared to COP objectives for chronic (4 mg/L) and acute (6 mg/L) toxicity to marine organisms.

SEDIMENT GEOCHEMISTRY MONITORING

Field Methods

Sediment samples were collected for geochemistry analyses from 11 quarterly and 11 annual stations during the 2023-24 program year (Figure 3-2). In addition, 2-3 L of sediment was collected from the 11 quarterly stations in October 2023 for whole sediment toxicity testing. Each station was assigned to a Middle Shelf Zone 2, within-ZID (167–295 ft or 51–90 m) or a Middle Shelf Zone 2, non-ZID (51–90 m) station group. In Chapter 3, the Middle Shelf Zone 2, within- and non-ZID station groups are simply referred to as within-ZID and non-ZID stations, respectively.

A single sample was collected at each station using a paired 0.1 m^2 Van Veen grab sampler deployed from M/V *Nerissa*. All sediment samples were qualitatively and quantitatively assessed for acceptability prior to processing. Samples were deemed acceptable if they had a minimum depth of 2 in (5 cm). However, if

[3] Fecal coliform compliance was determined by multiplying detected *E. coli* counts by 1.1 to obtain calculated fecal coliform counts.

three consecutive sediment grabs each yielded a depth of less than 5 cm at a station, then the depth threshold was lowered to less than or equal to 1.6 in (≤4 cm). The top 0.8 in (2 cm) of the sample was transferred into containers using a stainless-steel scoop (Table A-4). The sampler and scoop were rinsed thoroughly with filtered seawater prior to sample collection. All sediment samples were transported on wet ice to OC San's laboratory where they were logged into the LIMS and then stored for further processing. Sample storage and holding times followed specifications in OC San's Environmental Laboratory and Ocean Monitoring Standard Operating Procedures (ELOM SOP) (OCSD 2016; Table A-4).

Table A-4 Sediment collection and analysis summary for the 2023-24 program year.

Parameter	Container	Preservation	Holding Time	Method
Dissolved Sulfides	HDPE container	Freeze	6 months	ELOM SOP 4500-S2 G, Rev. 4
Grain Size	Plastic bag	4 °C	6 months	Plumb (1981)
Mercury	Amber glass jar	Freeze	6 months	ELOM SOP 245.1B, Rev. G
Metals	Amber glass jar	Freeze	6 months	ELOM SOP 200.8B_SED, Rev. F
Sediment Toxicity	HDPE container	4 °C	2 months	ELOM SOP 8810
Total Chlorinated Pesticides	Glass jar	Freeze	12 months	EPA Method 3545 / 8270E
Total DDT	Glass jar	Freeze	12 months	EPA Method 3545 / 8270E
Total Nitrogen	Glass jar	Freeze	6 months	EPA Methods 351.2M & 353.2M
Total Organic Carbon	Glass jar	Freeze	6 months	ASTM D4129-05
Total Phosphorus	Glass jar	Freeze	6 months	EPA Method 6010B
Total Polychlorinated Biphenyls	Glass jar	Freeze	12 months	EPA Method 3545 / 8270E
Total Polycyclic Aromatic Hydrocarbons	Glass jar	Freeze	12 months	EPA Method 3545 / 8270E

Laboratory Methods

The measured sediment chemistry parameters are listed in Table A-5. Sediment grain size, total organic carbon, total nitrogen, and total phosphorus samples were subsequently transferred to local and interstate laboratories for analysis (Appendix C). Sample transfers were conducted and documented using required chain of custody protocols through the LIMS. All other analyses were conducted by OC San lab staff.

Sediment chemistry and grain size samples were processed and analyzed using the methods listed in Table A-4. Method blanks, analytical quality control samples (duplicates, matrix spikes, and blank spikes), and standard reference materials were prepared and analyzed with each sample batch as required for each method. Total polychlorinated biphenyls (ΣPCB) and total polycyclic aromatic hydrocarbons (ΣPAH) were calculated by summing the measured value of each respective constituent listed in Table A-5. Total dichlorodiphenyltrichloroethane (ΣDDT) represents the summed values of 4,4'-DDMU and the 2,4- and 4,4'-isomers of DDD, DDE, and DDT. Total chlorinated pesticides (ΣPest) represent the summed values of 13 chlordane derivative compounds plus dieldrin.

Whole sediment toxicity testing was conducted using the *Eohaustorius estuarius* amphipod survival test (EPA 1994). Amphipods were exposed to test and home (control) sediments for 10 days, and the percent survival of amphipods in each treatment was determined.

Data Analyses

All analytes that were undetected (i.e., with resultant concentration below the method detection limit) are reported as ND (not detected). Further, an ND value was treated as zero for calculating a mean analyte concentration; however, if a station group contained all ND for a particular analyte, then the mean analyte concentration is reported as ND. Sediment contaminant concentrations were evaluated against sediment quality guidelines known as Effects Range-Median (ERM) (Long et al. 1998). The ERM guidelines were developed for the National Oceanic and Atmospheric Administration National Status and Trends Program

(NOAA 1993) as non-regulatory benchmarks to aid in the interpretation of sediment chemistry data and to complement toxicity, bioaccumulation, and benthic community assessments (Long and MacDonald 1998). The ERM is the 50th percentile sediment concentration above which a toxic effect frequently occurs (Long et al. 1995), and as such, an ERM exceedance is considered a significant potential for adverse biological effects. OC San's historical sediment geochemistry data from the past 10 monitoring periods, as well as Bight '18 sediment geochemistry data (Du et al. 2020), were also used as benchmarks. Data analysis consisted of summary statistics and qualitative comparisons only.

For whole sediment toxicity testing, a station sample is categorized as non-toxic if the result is not statistically significant using a standard t-test and the magnitude of difference compared to the control is less than 20%.

Table A-5 Parameters measured in sediment samples during the 2023-24 program year.

Metals			
Aluminum	Beryllium	Iron	Selenium
Antimony	Cadmium	Lead	Silver
Arsenic	Chromium	Mercury	Zinc
Barium	Copper	Nickel	
Organochlorine Pesticides [a]			
Chlordane Derivates and Dieldrin			
Aldrin	Endosulfan-alpha	*gamma*-BHC	Hexachlorobenzene
cis-Chlordane	Endosulfan-beta	Heptachlor	Mirex
trans-Chlordane	Endosulfan-sulfate	Heptachlor epoxide	*trans*-Nonachlor
Dieldrin	Endrin		
DDT Derivatives			
2,4'-DDD	2,4'-DDE	2,4'-DDT	4,4'-DDMU
4,4'-DDD	4,4'-DDE	4,4'-DDT	
Polychlorinated Biphenyl (PCB) Congeners			
PCB 18	PCB 81	PCB 126	PCB 169
PCB 28	PCB 87	PCB 128	PCB 170
PCB 37	PCB 99	PCB 138	PCB 177
PCB 44	PCB 101	PCB 149	PCB 180
PCB 49	PCB 105	PCB 151	PCB 183
PCB 52	PCB 110	PCB 153/168	PCB 187
PCB 66	PCB 114	PCB 156	PCB 189
PCB 70	PCB 118	PCB 157	PCB 194
PCB 74	PCB 119	PCB 158	PCB 201
PCB 77	PCB 123	PCB 167	PCB 206
Polycyclic Aromatic Hydrocarbon (PAH) Compounds			
Acenaphthene	Benzo[g,h,i]perylene	Fluoranthene	1-Methylnaphthalene
Acenaphthylene	Benzo[k]fluoranthene	Fluorene	2-Methylnaphthalene
Anthracene	Biphenyl	Indeno[1,2,3-c,d]pyrene	2,6-Dimethylnaphthalene
Benz[a]anthracene	Chrysene	Naphthalene	1,6,7-Trimethylnaphthalene
Benzo[a]pyrene	Dibenz[a,h]anthracene	Perylene	1-Methylphenanthrene
Benzo[b+j]fluoranthene		Phenanthrene	
Benzo[e]pyrene		Pyrene	
Miscellaneous Parameters			
Dissolved Sulfides	Total Nitrogen	Total Organic Carbon	Total Phosphorus
Grain Size	Whole Sediment Toxicity		

[a] Pesticides were analyzed only in the summer quarter.

BENTHIC INFAUNA MONITORING

Field Methods

A tandem 0.1 m^2 Van Veen grab sampler deployed from the M/V *Nerissa* was used to collect a sediment sample from the same stations and frequencies as described in the sediment geochemistry field methods section (Figure 3-2). The purpose of the quarterly surveys was to determine potential impacts on the benthic infauna community from treated effluent discharged at the outfall depth of 197-ft (60-m). Results were evaluated for comparison with long-term trends along the 197-ft (60-m) depth contour and for variations potentially attributable to the final expansion of the GWRS.

All sediment samples were qualitatively and quantitatively assessed for acceptability prior to processing. Samples were deemed acceptable if they had a minimum depth of 2 in (5 cm). However, if three consecutive sediment grabs each yielded a depth of less than 2 in at a station, then the depth threshold was lowered to less than or equal to 1.6 in (≤4 cm). At each station, acceptable sediment in the sampler was emptied into a 25 in × 18 in × 8 in (63.5 cm × 45.7 cm × 20.3 cm) plastic tray and then decanted onto a sieving table. A hose with an attached fan spray nozzle was used to gently wash the sediment with filtered seawater into a 16 in × 16 in, 0.04 in (40.6 cm × 40.6 cm, 1.0 mm) sieve. Organisms retained on the sieve were rinsed with 7% magnesium sulfate anesthetic into one or more 0.3-gallon (1-L) plastic containers and then placed in a cooler containing ice packs. After approximately 30 minutes in the anesthetic, animals were fixed by adding full strength buffered formaldehyde to the container to achieve a 10%, by volume, solution. Samples were transported to OC San's Laboratory where they were logged into the LIMS and then stored for further processing.

Laboratory Methods

After 3–10 days in formalin, samples were rinsed with tap water and then transferred to 70% ethanol for long-term preservation. Samples were sent under chain of custody protocols to Aquatic Bioassay and Consulting, Inc. (Ventura, CA), where they were sorted to five major taxonomic groups (aliquots): Annelida (bristle worms), Mollusca (snails, clams, etc.), Arthropoda (shrimps, crabs, etc.), Echinodermata (sea stars, sea urchins, etc.), and miscellaneous phyla (Cnidaria, Nemertea, etc.). Removal of organisms was monitored to ensure that at least 95% of all organisms were successfully separated from the sediment matrix (Appendix C). Upon completion of sample sorting, the major taxonomic groups were distributed for identification and enumeration (Table A-6). A subset of the samples from each of the five major taxonomic groups was identified by two taxonomists as part of the QC analysis (see Appendix C). Taxonomic differences arising from the QC analysis were resolved, and the database was edited accordingly. Species names used in this report follow those given in SCAMIT, 2023.

Data Analyses

Infaunal community data were analyzed to determine if populations outside the ZID were affected by the outfall discharge. Six community measures were used to assess infaunal community health and function: (1) total number of species (richness), (2) total number of individuals (abundance), (3) H′, (4) SDI, (5) ITI, and (6) BRI. H′ was calculated using $\log_e$ (Zar 1999). SDI was calculated as the minimum number of species with combined abundance equal to 75% of the individuals in the sample (Swartz 1978). SDI is inversely proportional to numerical dominance; thus, a low SDI value indicates high dominance (i.e., a community dominated by a few species). The ITI was developed by Word (1978, 1990) to provide a measure of infaunal community "health" based on a species' mode of feeding (e.g., primarily suspension vs. deposit feeder). ITI values greater than 60 are considered indicative of a "normal" community, while 30–60 represent a "changed" community, and values less than 30 indicate a "degraded" community. The BRI measures the pollution tolerance of species on an abundance-weighted average basis (Smith et al. 2001). This measure is scaled inversely to ITI with low values (<25) representing reference conditions and high values (>72) representing defaunation or the exclusion of most species. The intermediate value range of 25–34 indicates a marginal deviation from reference conditions, 35–44 indicates a loss of biodiversity, and 45–72 indicates a loss of community function. The BRI was used to determine compliance with NPDES permit conditions, as it is a commonly used southern California benchmark for infaunal community structure and was developed with the input of regulators (Ranasinghe et al. 2007, 2012). OC San's historical infauna data from the past 10 monitoring periods, as well as Bight ’18 infauna data (Gillett et al. 2022), were also used as benchmarks.

The presence or absence of certain indicator species (pollution sensitive and pollution tolerant) was also determined for each station. The presence of pollution sensitive species, i.e., *Amphiodia urtica* (brittle star) and amphipod crustaceans in the genera *Ampelisca* and *Rhepoxynius*, typically indicates the existence of a healthy environment, while the occurrence of large numbers of pollution tolerant species, i.e., *Capitella capitata* Cmplx (polychaete), may indicate stressed or organically enriched environments. Patterns of these species were used to assess the spatial and temporal influence of the wastewater discharge in the receiving environment.

Table A-6 Benthic infauna taxonomic aliquot distribution for the 2023-24 program year.

Quarter	Survey (No. of Samples)	Taxonomic Aliquots	Contractor	OC San
Summer 2023	Quarterly (11)	Annelida	0	11
		Arthropoda	0	11
		Echinodermata	0	11
		Mollusca	11	0
		Miscellaneous Phyla	0	11
	Annual (11)	Annelida	11	0
		Arthropoda	11	0
		Echinodermata	11	0
		Mollusca	11	0
		Miscellaneous Phyla	11	0
Fall 2023	Quarterly (11)	Annelida	0	11
		Arthropoda	0	11
		Echinodermata	0	11
		Mollusca	11	0
		Miscellaneous Phyla	0	11
Winter 2024	Quarterly (11)	Annelida	0	11
		Arthropoda	0	11
		Echinodermata	0	11
		Mollusca	11	0
		Miscellaneous Phyla	0	11
Spring 2024	Quarterly (11)	Annelida	11	0
		Arthropoda	0	11
		Echinodermata	0	11
		Mollusca	11	0
		Miscellaneous Phyla	0	11
		Total	**110**	**165**

PRIMER v7 (2015) multivariate statistical software was also used to examine the spatial patterns of infaunal invertebrate communities at the 11 quarterly and 11 annual stations. Analyses included (1) hierarchical clustering with group-average linking based on Bray-Curtis similarity indices and similarity profile (SIMPROF) permutation tests of the clusters and (2) ordination of the same data using nMDS to confirm hierarchical clustering. Prior to the calculation of the Bray-Curtis indices, the data were fourth root transformed to down-weight the highly abundant species and to incorporate the less common species (Clarke and Warwick 2014).

TRAWL COMMUNITIES MONITORING

Field Methods

Demersal fishes and epibenthic macroinvertebrates (EMIs) were collected by trawling in July 2023 (summer) for the annual and semi-annual stations and in February and March 2024 (winter) at the semi-annual stations. Sampling was conducted at 14 stations: Middle Shelf Zone 1 (118 ft or 36 m) Stations T2, T24, T6, and T18; Middle Shelf Zone 2 (60 m) Stations T23, T22, T1, T12, T17, and T11; and Outer Shelf (449 ft or 137 m) Stations T10, T25, T14, and T19 (Figure 3-3). Middle Shelf Zone 2 stations were sampled in both summer and winter; the remaining stations were sampled in summer only.

OC San's trawl sampling protocols are based upon regionally developed sampling methods (Bight '23 Field Sampling & Logistics Committee 2023). These methods require that a portion of the trawl track must pass within a 100 m radius of the nominal station position and be within 10% of the station's nominal depth. In addition, the speed and bottom-time duration of the trawl should range from 2.5–3.3 ft/s (0.77–1.0 m/s) and 8–15 minutes, respectively. A minimum of one trawl was conducted from M/V *Nerissa* at each station using a 25 ft (7.6 m) wide and 1 in (2.54 cm) mesh, Marinovich, semi-balloon otter trawl with a 0.3 in (0.64 cm) mesh cod-end liner, a 29 ft (8.9 m) chain-rigged foot rope, and 75 ft (23 m) long trawl bridles following regionally adopted methodology (Mearns and Allen 1978). The trawl wire scope varied from a ratio of approximately 5:1 at the shallowest stations to approximately 3:1 at the deepest station. To minimize catch variability due to weather and current conditions, which may affect the bottom-time duration of the trawl, trawls generally were taken along a constant depth and usually in the same direction at each station. Station locations and trawling speeds and paths were determined using Global Positioning System navigation. Trawl depths were determined using a Sea-Bird Electronics SBE 39 pressure sensor attached to one of the trawl boards.

Upon retrieval of the trawl net, the contents (fishes and EMIs) were emptied into a large flow-through water tank. Fishes were sorted by species into separate containers; EMIs were placed together in one or more containers. The identity of individual fish in each container was checked for sorting accuracy. Fish samples collected at Stations T1 and T11 were processed as follows: (1) up to 15 arbitrarily selected specimens of each species were weighed to the nearest gram and measured individually to the nearest millimeter (standard length for most species; total length for some species); and (2) if a trawl catch contained more than 15 individuals of a species, then the excess specimens were enumerated in 1 cm size classes and a bulk weight was recorded for each species. Individual lengths and weights of fish samples from T1 and T11 were recorded to maintain a historical record of these data sets. Fish samples collected at the other stations were enumerated in 1 cm size classes and a bulk weight was recorded for each species. EMIs were sorted to species, counted, and batch weighed. For each invertebrate species with large abundances (n>100), 100 individuals were counted and then batch weighed; the remaining individuals were batch weighed and abundance was calculated later using the weight of the first 100 individuals proportionally. EMI specimens that could not be identified in the field were preserved in 10% buffered formalin for subsequent taxonomic analysis in OC San's taxonomy laboratory.

Laboratory Methods

After 3–10 days in formalin, the EMI specimens retained for further taxonomic scrutiny were rinsed with tap water and then transferred to 70% ethanol for long-term preservation. These EMIs were identified using relevant taxonomic keys and, in some cases, were compared to voucher specimens housed in OC San's taxonomy laboratory. Species names used in this report follow those given in SCAMIT (2023) and Love and Passarelli (2020).

Data Analyses

Total number of species, total abundance, biomass, H′, and SDI were calculated for both fishes and EMIs at each station. Fish biointegrity in OC San's monitoring area was assessed using the FRI. The FRI is a multivariate weighted-average index produced from an ordination analysis of calibrated species abundance data (Allen et al. 2001, 2006). FRI scores less than 45 are classified as reference (normal) and those greater than 45 are non-reference (abnormal or disturbed). OC San's historical trawl EMI and fish data from the past 11 monitoring periods, as well as Bight ’18 trawl data (Wisenbaker et al. 2021), were also used as benchmarks.

PRIMER v.7 (2015) multivariate statistical software was used to examine the spatial patterns of the fish and EMI assemblages at the Middle Shelf Zone 2 stations. Analyses included (1) hierarchical clustering with group-average linking based on Bray-Curtis similarity indices and SIMPROF permutation tests of the clusters and (2) ordination of the same data using nMDS to confirm hierarchical clustering. Prior to the calculation of the Bray-Curtis indices, the data were fourth root transformed to down-weight the highly abundant species and incorporate the importance of the less abundant species (Clarke and Warwick 2014). Stations at the other strata were excluded from the analyses, as Clarke and Warwick (2014) advised that clustering is less useful and may be misleading where there is a strong environmental forcing, such as depth.

Middle Shelf Zone 2 stations were grouped into the following categories to assess spatial, outfall-related patterns: “outfall” (Stations T22 and T1) and “non-outfall” (Stations T23, T12, T17, and T11).

FISH TISSUE CONTAMINANTS MONITORING

To assess contaminant concentrations in demersal fishes, three flatfish species, English Sole (*Parophrys vetulus*), Hornyhead Turbot (*Pleuronichthys verticalis*) and Pacific Sanddab (*Citharichthys sordidus*), in the size range of 6 to 8 in (15 to 20 cm) standard length were targeted during trawls for analysis of liver tissue chemistry. Liver tissue was analyzed because it typically has higher lipid content than muscle tissue and thus bioaccumulates relatively higher concentrations of lipid-soluble contaminants that have been linked to pathological conditions as well as immunological or reproductive impairment (Arkoosh et al. 1998).

To assess contaminant concentrations in local sport fishes, demersal fishes in the family Scorpaenidae (e.g., Vermilion Rockfish) were targeted using hook-and-line fishing, as they are frequently caught and consumed by recreational anglers. As such, contaminants in the muscle tissue of these fishes were analyzed to gauge human health risk and provide information for the management of local seafood consumption advisories.

Field Methods

For the trawl surveys described above, fish tissue chemistry samples were collected at the outfall (T1) and non-outfall (T11) stations. The sampling objective was to collect a maximum of 20 individual flatfish at Stations T1 and T11. In February of 2024, 10 Hornyhead Turbot and 10 English Sole were collected at each station.

For sport fish muscle tissue chemistry, hook-and-line fishing gear (aka “rig fishing”) was used to target a maximum of 10 individuals of scorpaenid fishes at each outfall (Zone 1) and non-outfall (Zone 3) areas in September 2023 (Figure 3-3). Ten Vermillion Rockfish (*Sebastes miniatus*) were collected at Zone 1 and 10 Squarespot Rockfish (*Sebastes hopkinsi*) were collected at Zone 3.

Each fish collected for bioaccumulation analysis was weighed to the nearest gram and its standard length measured to the nearest millimeter, placed in a pre-labelled, re-sealable plastic bag, and temporarily stored on wet ice in an insulated cooler. Bioaccumulation samples were subsequently transported whole to OC San’s laboratory where they were logged into the LIMS and then delivered to laboratory staff under chain of custody protocols. Sample storage and holding times for bioaccumulation analyses followed specifications in OC San’s ELOM SOP (OCSD 2016; Table A-7).

Laboratory Methods

Individual fish were dissected in the laboratory under clean conditions. Liver and muscle tissue samples were sorted into two composite samples per station. All composites were comprised of more than one individual fish. Muscle and liver tissues were analyzed using methods shown in Table A-7 for various parameters listed in Table A-8. Method blanks, analytical quality control samples (duplicates, matrix spikes, and blank spikes), and standard reference materials were prepared and analyzed with each sample batch. All reported concentrations are on a wet weight basis.

Table A-7 Fish tissue handling and analysis summary for the 2023-24 program year. N/A = Not Applicable.

Parameter	Container	Preservation	Holding Time	Method
Arsenic and Selenium	Ziplock bag & glass jar	Freeze	6 months	ELOM SOP 200.8B SED, Rev. F
Organochlorine Pesticides	Ziplock bag & glass jar	Freeze	12 months	EPA Method 3545 / 8270 E
DDTs	Ziplock bag & glass jar	Freeze	12 months	EPA Method 3545 / 8270 E
Lipids	Ziplock bag & glass jar	Freeze	N/A	EPA Method 3545
Mercury	Ziplock bag & glass jar	Freeze	6 months	ELOM SOP 245.1B, Rev. G
Polychlorinated Biphenyls	Ziplock bag & glass jar	Freeze	12 months	EPA Method 3545 / 8270 E

Table A-8 Parameters measured in fish tissue samples during the 2023-24 program year.

	Metals	
Arsenic	Mercury	Selenium
	Organochlorine Pesticides	
	Chlordane Derivatives	
cis-Chlordane	*trans*-Chlordene	*cis*-Nonachlor
trans-Chlordane	Heptachlor	*trans*-Nonachlor
cis-Chlordene	Heptachlor epoxide	Oxychlordane
	DDT Derivatives	
2,4′-DDD	2,4′-DDE	2,4′-DDT
4,4′-DDD	4,4′-DDE	4,4′-DDT
		4,4′-DDMU
	Polychlorinated Biphenyl (PCB) Congeners	
PCB 18	PCB 105	PCB 158
PCB 28	PCB 110	PCB 167
PCB 37	PCB 114	PCB 169
PCB 44	PCB 118	PCB 170
PCB 49	PCB 119	PCB 177
PCB 52	PCB 123	PCB 180
PCB 66	PCB 126	PCB 183
PCB 70	PCB 128	PCB 187
PCB 74	PCB 138	PCB 189
PCB 77	PCB 149	PCB 194
PCB 81	PCB 151	PCB 201
PCB 87	PCB 153/168	PCB 206
PCB 99	PCB 156	
PCB 101	PCB 157	
	Miscellaneous Parameter	
	Percent Lipids	

ΣDDT and ΣPCB were calculated as described in the sediment geochemistry section. Total chlordane (ΣChlordane) represents the sum of nine derivative compounds (*cis*- and *trans*-chlordane, *cis*- and *trans*-chlordene, heptachlor, heptachlor epoxide, *cis*- and *trans*-nonachlor and oxychlordane). Organic contaminant data were not lipid normalized.

Data Analyses

All analytes that were undetected (i.e., with result concentration below the method detection limit) are reported as ND. Further, an ND value was treated as zero for calculating a mean analyte concentration; however, if fish tissue samples had all ND for a particular analyte, then the mean analyte concentration is reported as ND. Data analysis consisted of summary statistics (i.e., means and ranges) and qualitative comparisons only.

The State of California Office of Environmental Health Hazard Assessment advisory tissue levels for ΣDDT, ΣPCB, methylmercury, selenium, and ΣChlordane were used to assess human health risk in rig fishing samples (Klasing and Brodberg 2008; Table A-9).

Table A-9 Advisory tissue levels (ATLs) for selected contaminants in 8-ounce servings of uncooked fish.

Contaminant	ATLs for the number of 8-ounce servings per week (in ng/g) [a]							
	7	6	5	4	3	2	1	Do not consume
Mercury (Women 18–45; Children 1–17)	≤31	>31–36	>36–44	>44–55	>55–70	>70–150	>150–440	>440
Mercury (Women >45; men)	≤94	>94–109	>109–130	>130–160	>160–220	>220–440	>440–1,370	>1,370
Selenium	≤1,000	>1,000–1,200	>1,200–1,400	>1,400–1,800	>1,800–2,500	>2,500–4,900	>4,900–15,000	>15,000
ΣDDT	≤220	>220–260	>260–310	>310–390	>390–520	>520–1,000	>1,000–2,100	>2,100
ΣPCB	≤9	>9–10	>10–13	>13–16	>16–21	>21–42	>42–120	>120
ΣChlordane	≤80	>80–90	>90–110	>110–140	>140–190	>190–280	>280–560	>560

[a] Serving sizes are based on an average 160-pound person. Individuals weighing less than 160 pounds should eat proportionately smaller amounts (for example, individuals weighing 80 pounds should eat one 4-ounce serving in a week when the table recommends eating one 8-ounce serving a week).

FISH HEALTH MONITORING

Assessment of the overall health of fish populations is also required by OC San's NPDES permit. This entails documenting physical symptoms of disease and abnormalities in fish samples collected during each trawl survey, as well as conducting annual liver histopathology analysis.

Field Methods

All trawl fish samples collected during the 2023-24 program year were visually inspected for lesions, tumors, large, non-mobile external parasites, and other signs of disease (e.g., skeletal deformities). Any atypical odor and coloration of fish samples were also noted. A maximum of 20 individual flatfish (English Sole, Hornyhead Turbot, and Pacific Sanddab) were targeted for liver histopathology analysis at each outfall (T1) and non-outfall (T11) station during the February 2024 trawl survey. Twelve English Sole and eight Hornyhead Turbot were collected at Station T1, and 10 English Sole and 10 Hornyhead Turbot were collected at Station T11. Each fish collected for liver histopathology analysis was weighed to the nearest gram and its standard length measured to the nearest millimeter, placed in a pre-labelled, plastic, re-sealable bag, and temporarily stored on wet ice in an insulated cooler. Flatfish samples were hand delivered under chain of custody protocols to Dr. Kristy Forsgren (California State University, Fullerton).

Laboratory Methods

At the CSU Fullerton laboratory, a 0.08–0.16 in (2–4 mm) section of liver tissue was removed from each fish sample and placed in 10% neutral-buffered formalin for 48 hours. Liver tissues were stored in 70% ethanol post-fixation; the 70% ethanol was changed every 3–4 days until histological processing. Liver tissues were dehydrated in a graded ethanol series (i.e., 70%, 95%, 100%), cleared with xylene, embedded in paraffin wax, and cut into 2×10^{-4} in (5 µm) thick serial sections using a Leica Biosystems Microm HM 325 rotary microtome. Tissues were then stained with hematoxylin and eosin and examined using an Olympus BX41 compound microscope. Photomicrographs were taken with a Q Imaging Digital Camera attached to the microscope. Five sections from each paraffin-embedded liver tissue sample were examined under the compound microscope by two independent assessors to determine the frequency and severity of liver tissue damage in each fish sample collected at both stations. The tissue damage screened for included fibrosis, steatosis, cytoplasmic vacuolization, lipofuscin, necrosis, granulocytoma, and parasites. The overall health of the liver tissue from each fish was evaluated by the presence of tissue damage and scored on a scale of 0–3 based on Van Dyk et al. (2012). The four scores of liver tissue damage were classified as follows: 0) no tissue damage present; 1) minimal tissue damage (<30% of tissue) which is likely to have little to no impact on liver function; 2) moderate tissue damage (30−70% of tissue) which may cause impairment of liver function; and 3) acute tissue damage (>70% of tissue) which may lead to irreparable damage to liver function.

Data Analyses

Analysis of fish disease data consisted of qualitative comparisons only. For the liver histopathology samples, the scores of the five sections per sample were averaged for statistical analysis. A two-tailed t-test was performed to determine significant differences between the species (Hornyhead Turbot and English Sole) and stations (T1 and T11). The level of statistical significance was determined at $p<0.05$.

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Appendix B. Supporting Data

Table B-1 Percentages of fecal indicator bacteria densities (MPN/100 mL) by quarter and select depth strata for the REC-1 water quality surveys (five surveys/quarter; eight stations/survey) conducted during the 2023-24 program year.

			Total Coliform				Fecal Coliform				Enterococci			
Quarter	**Depth Strata (m)**	**n**	<10 [a]	10–70	71–230 [b]	>230 [c]	<10 [a]	10–200	201–400 [d]	>400 [e]	<10 [a]	10–30	31–110 [f]	>110 [c]
Summer	1–15	80	98%	1%	0%	1%	97.5%	2.5%	0%	0%	89%	10%	1%	0%
	16–30	60	90%	10%	0%	0%	97%	3%	0%	0%	88%	10%	0%	2%
	31–45	15	67%	33%	0%	0%	87%	13%	0%	0%	100%	0%	0%	0%
	46–60	20	80%	20%	0%	0%	85%	15%	0%	0%	90%	10%	0%	0%
	Water Column	**175**	**90%**	**9%**	**0%**	**1%**	**95%**	**5%**	**0%**	**0%**	**89.7%**	**9.1%**	**0.6%**	**1%**
Fall	1–15	80	100%	0%	0%	0%	100%	0.0%	0%	0%	91%	8%	1%	0%
	16–30	60	77%	22%	2%	0%	92%	8%	0%	0%	85%	15%	0%	0%
	31–45	15	27%	40%	33%	0%	53%	47%	0%	0%	93%	7%	0%	0%
	46–60	20	40%	45%	10%	5%	65%	35%	0%	0%	75%	25%	0%	0%
	Water Column	**175**	**79%**	**16%**	**5%**	**1%**	**89%**	**11%**	**0%**	**0%**	**87%**	**12%**	**1%**	**0%**
Winter	1–15	80	56%	35%	4%	5%	95%	5%	0%	0%	80%	15%	4%	1%
	16–30	60	70%	25%	5%	0%	87%	13%	0%	0%	75%	17%	8%	0%
	31–45	15	60%	20%	20%	0%	67%	33%	0%	0%	73%	20%	7%	0%
	46–60	20	55%	45%	0%	0%	75%	25%	0%	0%	75%	25%	0%	0%
	Water Column	**175**	**61%**	**31%**	**5%**	**2%**	**87%**	**13%**	**0%**	**0%**	**77%**	**17%**	**5%**	**1%**
Spring	1–15	80	81%	18%	1%	0%	91%	9%	0%	0%	76%	20%	3%	1%
	16–30	60	37%	33%	7%	23%	57%	32%	12%	0%	73%	18%	7%	2%
	31–45	15	40%	40%	0%	20%	60%	27%	7%	7%	87%	0%	13%	0%
	46–60	20	80%	20%	0%	0%	95%	5%	0%	0%	85%	5%	5%	5%
	Water Column	**175**	**62%**	**25%**	**3%**	**10%**	**77%**	**18%**	**5%**	**1%**	**77%**	**16%**	**5%**	**2%**
Annual	1–15	320	84%	13%	1%	2%	96%	4%	0%	0%	84%	13%	2%	1%
	16–30	240	68%	23%	3%	6%	83%	14%	3%	0%	80%	15%	4%	1%
	31–45	60	48%	33%	13%	5%	67%	30%	2%	2%	88%	7%	5%	0%
	46–60	80	64%	33%	3%	1%	80%	20%	0%	0%	81%	16%	1%	1%
	Water Column	**700**	**73%**	**20%**	**3%**	**3%**	**87%**	**12%**	**1%**	**0%**	**83%**	**14%**	**3%**	**1%**

Calculations may include slight deviations due to rounding.
[a] Method detection limit.
[b] Range for exceedance of the median density criterion.
[c] Value for exceedance of the <10% of the samples criterion.
[d] Range for exceedance of the 30-day geometric mean criterion.
[e] Value for exceedance of the single sample maximum criterion.
[f] Range for exceedance of the 6-week rolling geometric mean criterion.

Table B-2 Depth-averaged fecal coliform densities (MPN/100 mL) in discrete samples collected in offshore waters during the 2023-24 program year. Results were compared to the State Water Resources Control Board (SWRCB) Water-Contact Objectives.

Quarter	Station	Date					Met SWRCB 30-day geometric mean of ≤200/100mL	Met SWRCB single sample standard of ≤400/100 mL
		7/17/2023	**7/18/2023**	**7/19/2023**	**8/3/2023**	**8/8/2023**		
Summer	2103	<10	<10	<10	<10	<10	YES	YES
	2104	<10	<10	<10	<10	<10	YES	YES
	2183	<10	<10	<10	<10	<10	YES	YES
	2203	<10	<10	<10	<10	<10	YES	YES
	2223	<10	<10	<10	10.7	<10	YES	YES
	2303	<10	<10	<10	<10	<10	YES	YES
	2351	<10	<10	<10	<10	<10	YES	YES
	2403	<10	<10	<10	<10	<10	YES	YES
		10/19/2023	**10/24/2023**	**10/25/2023**	**10/26/2023**	**11/6/2023**		
Fall	2103	18	11.3	<10	12.3	<10	YES	YES
	2104	<10	16.6	<10	17.1	<10	YES	YES
	2183	<10	<10	<10	<10	<10	YES	YES
	2203	<10	<10	<10	<10	<10	YES	YES
	2223	<10	<10	<10	<10	<10	YES	YES
	2303	<10	<10	<10	<10	<10	YES	YES
	2351	<10	<10	<10	<10	<10	YES	YES
	2403	<10	<10	<10	<10	<10	YES	YES
		1/23/2024	**1/24/2024**	**1/25/2024**	**1/30/2024**	**2/12/2024**		
Winter	2103	<10	<10	<10	<10	12	YES	YES
	2104	<10	<10	<10	10.6	<10	YES	YES
	2183	<10	<10	<10	19.4	11.5	YES	YES
	2203	<10	<10	<10	<10	<10	YES	YES
	2223	<10	<10	<10	<10	<10	YES	YES
	2303	<10	<10	<10	<10	<10	YES	YES
	2351	<10	<10	<10	<10	<10	YES	YES
	2403	10.7	<10	<10	<10	<10	YES	YES

Table B-2 Depth-averaged fecal coliform densities (MPN/100 mL) in discrete samples collected in offshore waters during the 2023-24 program year. Results were compared to the State Water Resources Control Board (SWRCB) Water-Contact Objectives.

Quarter	Station	Date					Met SWRCB 30-day geometric mean of ≤200/100mL	Met SWRCB single sample standard of ≤400/100 mL
		4/24/2024	**4/25/2024**	**4/29/2024**	**4/30/2024**	**5/9/2024**		
Spring	2103	30.2	17.7	<10	<10	<10	YES	YES
	2104	29.9	15.4	<10	<10	<10	YES	YES [a]
	2183	69.3	23	11.5	<10	<10	YES	YES
	2203	47.7	37.9	<10	<10	<10	YES	YES
	2223	20.7	12.4	10.7	<10	<10	YES	YES
	2303	<10	17.9	<10	<10	<10	YES	YES
	2351	<10	<10	<10	<10	<10	YES	YES
	2403	<10	<10	<10	<10	<10	YES	YES

Station depth averages calculated for each sample date

[a] One sample at Station 2104 exceeded ≤400/100 mL objective, at depth = 40 m (n=1/28)

Table B-3 Median total coliform densities (MPN/100 mL) in discrete depth samples collected in offshore waters during the 2023-24 program year. Results were compared to the State Water Resources Control Board (SWRCB) Shellfish Harvesting Standards.

Quarter	Station	Date					Met SWRCB Standard of median ≤70/100 mL	Met SWRCB Standard of ≤10% of samples ≥230/100 mL
		7/17/2023	**7/18/2023**	**7/19/2023**	**8/3/2023**	**8/8/2023**		
Summer	2103	<10	<10	<10	<10	<10	YES	YES
	2104	<10	<10	<10	<10	<10	YES	YES
	2183	<10	<10	<10	<10	<10	YES	YES
	2203	<10	<10	<10	<10	<10	YES	YES
	2223	<10	<10	<10	<10	<10	YES	YES
	2303	<10	<10	<10	<10	<10	YES	YES
	2351	<10	<10	<10	<10	<10	YES	YES
	2403	<10	<10	<10	<10	<10	YES	YES
		10/19/2023	**10/24/2023**	**10/25/2023**	**10/26/2023**	**11/6/2023**		
Fall	2103	<10	<10	<10	<10	<10	YES	YES
	2104	<10	25.5	<10	25.5	<10	YES	YES
	2183	<10	<10	<10	<10	<10	YES	YES
	2203	<10	<10	<10	<10	<10	YES	YES
	2223	<10	<10	<10	<10	<10	YES	YES
	2303	<10	<10	<10	<10	<10	YES	YES
	2351	<10	<10	<10	<10	<10	YES	YES
	2403	<10	<10	<10	<10	<10	YES	YES
		1/23/2024	**1/24/2024**	**1/25/2024**	**1/30/2024**	**2/12/2024**		
Winter	2103	<10	<10	<10	<10	25.5	YES	YES
	2104	<10	<10	<10	<10	20	YES	YES
	2183	<10	<10	<10	25.5	63	YES	YES
	2203	<10	10	<10	<10	41	YES	YES
	2223	<10	41	<10	<10	<10	YES	YES
	2303	<10	20	<10	<10	<10	YES	YES
	2351	<10	20	<10	<10	<10	YES	YES
	2403	10	<10	<10	<10	<10	YES	YES

Table B-3 Median total coliform densities (MPN/100 mL) in discrete depth samples collected in offshore waters during the 2023-24 program year. Results were compared to the State Water Resources Control Board (SWRCB) Shellfish Harvesting Standards.

Quarter	Station	Date					Met SWRCB Standard of median ≤70/100 mL	Met SWRCB Standard of ≤10% of samples ≥230/100 mL
		4/24/2024	4/25/2024	4/29/2024	4/30/2024	5/9/2024		
Spring	2103	20	<10	<10	<10	<10	YES	NO [b]
	2104	10	10	<10	<10	<10	YES	YES
	2183	592.5	36	19.25	10	<10	YES [a]	NO [c]
	2203	487	364	<10	<10	<10	YES [a]	NO [d]
	2223	20	<10	<10	<10	<10	YES	YES
	2303	<10	10	<10	<10	<10	YES	YES
	2351	<10	<10	<10	<10	<10	YES	YES
	2403	<10	<10	<10	<10	<10	YES	YES

[a] Quarterly compliance was still achieved.
[b] For the spring quarter, Station 2103 experienced 14% (n=5/35) of samples >230 MPN/100 mL
[c] For the spring quarter, Station 2183 experienced 16% (n=4/25) of samples >230 MPN/100 mL
[d] For the spring quarter, Station 2204 experienced 20% (n=4/20) of samples >230 MPN/100 mL

Table B-4 Enterococci densities (MPN/100 mL) based on discrete depth samples collected in offshore waters during the 2023-24 program year. Results were compared to the State Water Resources Control Board (SWRCB) Water-Contact Objectives and U.S. EPA Water Quality Criteria.

Quarter	Station	Rolling 6-Week Geometric Mean									Met SWRCB 6-week rolling geometric mean and EPA 30-day geometric mean of ≤30/100 mL
		6/10-7/22	**6/17-7/29**	**6/24-8/5**	**7/1-8/12**	**7/8-8/19**	**7/15-8/26**	**7/22-9/2**	**7/29-9/9**	**8/5-9/16**	
Summer	2103	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2104	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2183	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2203	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2223	<10	<10	<10	<10	<10	<10	10	10	<10	YES
	2303	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2351	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2403	11	11	10	<10	<10	<10	<10	<10	<10	YES
		9/9-10/21	**9/16-10/28**	**9/23-11/4**	**9/30-11/11**	**10/7-11/18**	**10/14-12/2**	**10/21-12/2**	**10/28-12/9**	**11/4-12/16**	
Fall	2103	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2104	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2183	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2203	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2223	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2303	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2351	13	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2403	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
		12/16-1/27	**12/23-2/3**	**12/30-2/10**	**1/6-2/17**	**1/13-2/24**	**1/20-3/2**	**1/27-3/9**	**2/3-3/16**	**2/10-3/23**	
Winter	2103	<10	<10	<10	<10	<10	<10	11	13	13	YES
	2104	<10	<10	<10	<10	<10	<10	<10	11	11	YES
	2183	<10	<10	<10	<10	<10	<10	<10	12	12	YES
	2203	<10	<10	<10	10	10	10	14	14	14	YES
	2223	<10	<10	<10	<10	<10	<10	<10	11	11	YES
	2303	<10	<10	<10	<10	<10	<10	14	25	25	YES
	2351	<10	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2403	10	<10	<10	<10	<10	<10	<10	<10	<10	YES

Table B-4 Enterococci densities (MPN/100 mL) based on discrete depth samples collected in offshore waters during the 2023-24 program year. Results were compared to the State Water Resources Control Board (SWRCB) Water-Contact Objectives and U.S. EPA Water Quality Criteria.

Quarter	Station	Rolling 6-Week Geometric Mean								Met SWRCB 6-week rolling geometric mean and EPA 30-day geometric mean of ≤30/100 mL
		3/16-4/27	3/23-5/4	3/30-5/11	4/6-5/18	4/13-5/25	4/20-6/1	4/27-6/8	5/4-6/15	
Spring	2103	10	<10	<10	<10	<10	<10	<10	<10	YES
	2104	11	11	10	10	10	10	<10	<10	YES
	2183	13	12	11	11	11	11	10	<10	YES
	2203	11	12	11	11	11	11	11	<10	YES
	2223	<10	<10	<10	<10	<10	<10	<10	<10	YES
	2303	<10	<10	<10	<10	<10	<10	<10	16	YES
	2351	<10	<10	<10	<10	<10	<10	<10	14	YES
	2403	<10	<10	<10	<10	<10	<10	<10	<10	YES

Percentage of enterococci samples ≥110/100 mL in a calendar month (where <10% meets SWRCB and EPA criteria)

	2023						2024					
	July	August	September	October	November	December	January	February	March	April	May	June
2103	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2104	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2183	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2203	<10	<10	<10	<10	<10	<10	<10	33[a]	<10	<10	<10	<10
2223	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2303	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2351	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2403	11[b]	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

[a] from 1 of 3 samples
[b] from 1 of 9 samples

Table B-5 Summary of floatable material by station group observed during the 28-station grid water quality surveys for the 2023-24 program year. Total number of station visits = 336.

Parameter	Station Group							
	Upcoast Offshore	Upcoast Inshore	Infield Onshore	Within-ZID	Infield Inshore	Downcoast Offshore	Downcoast Inshore	
	2225, 2226, 2305, 2306, 2353, 2354, 2405, 2406	2223, 2224, 2303, 2304, 2351, 2352, 2403, 2404	2206	2205	2203, 2204	2105, 2106, 2185, 2186	2103, 2104, 2183, 2184	Totals
Oil and Grease	0	0	0	0	0	0	0	0
Trash/Debris	3	7	1	1	2	5	4	23
Biological Material (kelp)	3	2	2	1	1	1	6	16
Material of Sewage Origin	0	0	0	0	0	0	0	0
Totals	6	9	3	2	3	6	10	39

Table B-6 Summary of floatable material by station group observed during the REC-1 water quality surveys for the 2023-24 program year. Total number of station visits = 96.

Parameter	Station Groups			
	Upcoast Inshore	Infield Inshore	Downcoast Inshore	
	2223, 2303, 2351, 2403	2203	2103, 2104, 2183	Totals
Oil and Grease	0	0	0	0
Trash/Debris	1	0	0	1
Biological Material (kelp)	4	0	0	4
Material of Sewage Origin	0	0	0	0
Totals	5	0	0	5

Table B-7 Summary statistics of water quality compliance parameters by quarter and depth strata for the Core monthly water quality surveys (three surveys/quarter, 28 stations/survey) conducted during the 2023-24 program year.

		Oxygen (mg/L)				pH				Transmissivity (%)			
Quarter	**Depth Strata (m)**	Minimum	Mean	Maximum	Std. Dev.	Minimum	Mean	Maximum	Std. Dev.	Minimum	Mean	Maximum	Std. Dev
Summer	1–15	7.06	8.21	12.00	0.62	7.89	8.04	8.40	0.08	61.48	82.38	87.82	4.39
	16–30	5.88	8.01	9.21	0.66	7.89	8.01	8.16	0.06	77.67	84.47	87.82	2.21
	31–45	4.88	6.93	8.86	0.85	7.81	7.96	8.08	0.04	80.29	85.34	88.96	1.67
	46–60	4.41	6.14	7.71	0.82	7.82	7.93	8.05	0.03	80.66	85.96	89.10	1.94
	61–75	4.19	5.50	6.93	0.82	7.82	7.90	7.98	0.03	82.05	86.98	89.46	1.51
	Water Column	**4.19**	**7.36**	**12.00**	**1.22**	**7.81**	**7.99**	**8.40**	**0.08**	**61.48**	**84.45**	**89.46**	**3.32**
Fall	1–15	6.77	7.34	8.16	0.20	7.88	7.97	8.07	0.05	72.88	86.21	88.09	2.40
	16–30	6.35	7.54	8.13	0.26	7.85	7.96	8.06	0.05	71.95	86.31	88.10	1.99
	31–45	6.42	7.51	8.10	0.37	7.85	7.96	8.04	0.05	78.09	86.80	88.38	1.18
	46–60	5.89	6.78	7.87	0.44	7.82	7.93	8.03	0.05	84.65	87.49	88.92	0.90
	61–75	5.32	6.10	7.26	0.38	7.80	7.90	7.99	0.04	85.63	88.01	89.14	0.88
	Water Column	**5.32**	**7.21**	**8.16**	**0.56**	**7.80**	**7.95**	**8.07**	**0.05**	**71.95**	**86.71**	**89.14**	**1.92**
Winter	1–15	6.71	7.89	8.35	0.20	8.08	8.68	9.75	0.72	65.11	83.74	88.84	3.95
	16–30	6.33	7.49	8.07	0.37	7.99	8.65	9.75	0.75	59.68	85.72	89.66	3.68
	31–45	5.59	7.12	8.23	0.61	7.91	8.60	9.73	0.77	74.10	87.36	90.79	2.21
	46–60	5.17	6.38	8.02	0.66	7.88	8.53	9.70	0.79	82.98	88.02	90.89	1.64
	61–75	4.59	5.40	6.76	0.46	7.83	8.45	9.62	0.78	82.83	88.05	90.68	1.87
	Water Column	**4.59**	**7.17**	**8.35**	**0.90**	**7.83**	**8.61**	**9.75**	**0.76**	**59.68**	**85.96**	**90.89**	**3.61**
Spring	1–15	3.82	7.32	11.11	1.48	7.64	8.01	8.36	0.14	70.30	80.70	88.34	3.27
	16–30	3.14	4.23	6.80	0.68	7.57	7.68	8.01	0.08	70.37	85.68	89.94	3.20
	31–45	3.15	3.69	6.07	0.53	7.56	7.61	7.68	0.03	81.52	87.23	90.03	1.56
	46–60	2.81	3.59	5.81	0.56	7.55	7.59	7.66	0.02	84.22	87.41	90.19	1.55
	61–75	2.93	3.48	5.58	0.58	7.55	7.58	7.63	0.02	82.42	87.53	90.37	1.76
	Water Column	**2.81**	**4.93**	**11.11**	**1.89**	**7.55**	**7.75**	**8.36**	**0.20**	**70.30**	**84.84**	**90.37**	**3.92**
Annual	1–15	3.82	7.69	12.00	0.90	7.64	8.17	9.75	0.47	61.48	83.26	88.84	4.11
	16–30	3.14	6.82	9.21	1.60	7.57	8.07	9.75	0.51	59.68	85.54	89.94	2.93
	31–45	3.15	6.31	8.86	1.65	7.56	8.03	9.73	0.53	74.10	86.68	90.79	1.88
	46–60	2.81	5.72	8.02	1.41	7.55	7.99	9.70	0.52	80.66	87.22	90.89	1.73
	61–75	2.93	5.12	7.26	1.15	7.55	7.96	9.62	0.50	82.05	87.64	90.68	1.61
	Water Column	**2.81**	**6.67**	**12.00**	**1.60**	**7.55**	**8.07**	**9.75**	**0.51**	**59.68**	**85.49**	**90.89**	**3.41**

Table B-8 Percentages of ammonia nitrogen (mg/L) concentrations by quarter and select depth strata for the Core monthly water quality surveys (three surveys/quarter; 20 stations/survey) conducted during the 2023-24 program year.

Quarter	Depth Strata (m)	n	<MDL [a]	MDL–3.9	4–5.9 [b]	≥6 [c]
Summer	1–15	120	100.0%	0%	0%	0%
	16–30	114	99.1%	0.9%	0%	0%
	31–45	48	97.9%	2.1%	0%	0%
	46–60	63	95.2%	4.8%	0%	0%
	Water Column	**345**	**98.6%**	**1.4%**	**0%**	**0%**
Fall	1–15	120	100.0%	0%	0%	0%
	16–30	114	100.0%	0.0%	0%	0%
	31–45	48	93.8%	6.3%	0%	0%
	46–60	63	95.2%	4.8%	0%	0%
	Water Column	**345**	**98.3%**	**1.7%**	**0%**	**0%**
Winter	1–15	120	98.3%	2%	0%	0%
	16–30	114	97.4%	2.6%	0%	0%
	31–45	48	89.6%	10.4%	0%	0%
	46–60	63	92.1%	7.9%	0%	0%
	Water Column	**345**	**95.7%**	**4.3%**	**0%**	**0%**
Spring	1–15	120	100.0%	0%	0%	0%
	16–30	114	92.1%	7.9%	0%	0%
	31–45	48	85.4%	14.6%	0%	0%
	46–60	63	87.3%	12.7%	0%	0%
	Water Column	**345**	**93.0%**	**7.0%**	**0%**	**0%**
Annual	1–15	480	99.6%	0.42%	0%	0%
	16–30	456	97.1%	2.9%	0%	0%
	31–45	192	91.7%	8.3%	0%	0%
	46–60	252	92.5%	7.5%	0%	0%
	Water Column	**1,380**	**96.4%**	**3.6%**	**0%**	**0%**

[a] Method detection limit (MDL) = 0.04 mg/L.
[b] California Ocean Plan (COP) chronic toxicity criteria.
[c] COP acute toxicity criteria

Table B-9 Percentages of nitrate nitrogen (mg/L) concentrations by quarter and select depth strata for the Core monthly water quality surveys (three surveys/quarter; 20 stations/survey) conducted during the 2023-24 program year.

Quarter	Depth Strata (m)	n	<MDL	MDL–RL	>RL
Summer [a]	1–15	120	100.0%	0.0%	0.0%
	16–30	114	67.5%	8.8%	23.7%
	31–45	48	33.3%	4%	62.5%
	46–60	63	24%	3%	73%
	Water Column	**345**	**66.1%**	**4.1%**	**29.8%**
Fall [a,c,d]	1–15	120	84.2%	15.0%	0.8%
	16–30	114	83.3%	16.7%	0.0%
	31–45	48	46%	31%	23%
	46–60	63	3%	41%	56%
	Water Column	**345**	**64%**	**22.6%**	**13.6%**
Winter [d]	1–15	119	99.2%	0.0%	1%
	16–30	114	71.9%	27.2%	0.9%
	31–45	48	29%	67%	4%
	46–60	63	6%	92%	2%
	Water Column	**344**	**63.4%**	**1.5%**	**35.1%**
Spring [b,d]	1–15	119	48%	21.0%	31.1%
	16–30	113	6.2%	3.5%	90.3%
	31–45	48	10%	0%	90%
	46–60	63	17%	0%	83%
	Water Column	**343**	**23.3%**	**8.5%**	**68.2%**
Annual [a]	1–15	478	82.8%	9%	8.2%
	16–30	455	57.4%	14.1%	28.6%
	31–45	192	29.7%	26%	44.8%
	46–60	252	13%	34%	53%
	Water Column	**1377**	**54.2%**	**17.6%**	**28.2%**

[a] OC San's laboratory used a method detection limit (MDL) of 0.005 mg/L and a RL of 0.015 mg/L.
[b] OC San's laboratory used a method detection limit (MDL) of 0.005 mg/L and a reporting limit (RL) of 0.05 mg/L.
[c] Contract laboratory used a method detection limit (MDL) of 0.012 mg/L and a reporting limit (RL) or 0.1 mg/L.
[d] Contract laboratory used a method detection limit (MDL) of 0.036 mg/L and a reporting limit (RL) of 0.2 mg/L.

Table B-10 Species richness and abundance values of the major infauna groups collected at the Middle Shelf stratum and each season during the 2023-24 program year. Values represent the mean and range (in parentheses).

Season	Parameter	Stratum	Annelida	Arthropoda	Echinodermata	Misc. Phyla	Mollusca
Summer	Species Richness	Middle Shelf Zone 2 Within-ZID (51–90 m)	51 (48-57)	22 (19-24)	3 (2-5)	7 (4-10)	10 (7-14)
		Middle Shelf Zone 2, Non-ZID (51–90 m)	60 (38-84)	25 (12-36)	3 (1-7)	8 (2-14)	11 (4-17)
	Abundance	Middle Shelf Zone 2 Within-ZID (51–90 m)	372 (342-392)	81 (67-89)	6 (3-12)	18 (12-30)	21 (12-32)
		Middle Shelf Zone 2, Non-ZID (51–90 m)	366 (152-623)	85 (23-155)	11 (1-22)	24 (2-45)	24 (12-58)
Fall	Species Richness	Middle Shelf Zone 2 Within-ZID (51–90 m)	57 (48-63)	22 (18-30)	3 (2-6)	5 (2-7)	9 (6-13)
		Middle Shelf Zone 2 Non-ZID (51–90 m)	46 (33-58)	19 (10-22)	3 (2-5)	5 (2-8)	9 (3-15)
	Abundance	Middle Shelf Zone 2 Within-ZID (51–90 m)	311 (272-357)	77 (62-103)	15 (12-24)	9 (6-17)	20 (12-30)
		Middle Shelf Zone 2 Non-ZID (51–90 m)	217 (118-315)	54 (29-84)	7 (3-14)	11 (3-22)	18 (8-34)
Winter	Species Richness	Middle Shelf Zone 2 Within-ZID (51–90 m)	43 (35-48)	20 (16-23)	2 (2-4)	3 (2-5)	9 (8-11)
		Middle Shelf Zone 2 Non-ZID (51–90 m)	42 (36-56)	16 (12-19)	3 (3-4)	3 (2-6)	8 (6-11)
	Abundance	Middle Shelf Zone 2 Within-ZID (51–90 m)	223 (120-344)	62 (50-83)	9 (6-15)	7 (2-13)	18 (13-23)
		Middle Shelf Zone 2 Non-ZID (51–90 m)	197 (134-332)	46 (26-65)	7 (5-12)	6 (2-15)	16 (8-22)
Spring	Species Richness	Middle Shelf Zone 2 Within-ZID (51–90 m)	52 (31-70)	24 (12-33)	4 (3-5)	4 (1-7)	6 (0-10)
		Middle Shelf Zone 2 Non-ZID (51–90 m)	53 (40-67)	20 (13-28)	3 (2-5)	5 (1-10)	8 (0-14)
	Abundance	Middle Shelf Zone 2 Within-ZID (51–90 m)	272 (78-406)	74 (18-115)	9 (7-11)	10 (1-24)	12 (0-20)
		Middle Shelf Zone 2 Non-ZID (51–90 m)	335 (169-520)	63 (29-105)	8 (5-14)	13 (1-37)	16 (0-32)

Table B-11 Abundance and species richness of epibenthic macroinvertebrates collected in the Summer 2023 and Winter 2024 trawl surveys.

Stratum	Middle Shelf Zone 1				Middle Shelf Zone 2												Outer Shelf					
Station	**T2**	**T24**	**T6**	**T18**	**T23**		**T22**		**T1**		**T12**		**T17**		**T11**		**T10**	**T25**	**T14**	**T19**		
Nominal Depth (m)	**35**	**36**	**36**	**36**	**58**		**60**		**55**		**57**		**60**		**60**		**137**	**137**	**137**	**137**		
Season	**S**	**S**	**S**	**S**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**S**	**S**	**S**	**Total**	**%**
Lytechinus pictus		17	319	22	3,664	304	35	5	504	219	300	1,121	133	21	194	914	14	39	29	29	7,883	50.9
Ophiura luetkenii	2,344		762	6	5	4	3	5		1		2	2	88	5	17		7	3		3,254	21.0
Strongylocentrotus fragilis							1						4		1		1,157	865	470		2,498	16.1
Hamatoscalpellum californicum	88	68	7	16	13	11	66	6	78	60	40	8	91	27	66	20		6			671	4.3
Thesea sp B	2	13	2	4	48	50	27	5	38	45	30	9	26	13	28	33					373	2.4
Sicyonia ingentis	1							1	8	2		4	10	1			2		4	143	176	1.1
Ophiothrix spiculata	1	6	4	1	48	1	5	1	8	13					3	1		49			141	0.9
Astropecten californicus	6	10	6		6		20		38	7	2	6	3	4	2	7	1	1	3	7	129	0.8
Sicyonia penicillata	3	1				3				2		16		37		6					68	0.4
Luidia foliolata	2						4	1	3	6	3	2	15	3	7	3		4	1	6	60	0.4
Luidia armata	9	4	2	1		1				2		1	1	1	29					1	52	0.3
Acanthoptilum sp	8					3	1			14	2			1							29	0.2
Pleurobranchaea californica			1	3	4		1		1		3		2		3			2		4	24	0.2
Luidia asthenosoma		3			1	1	2		3	1			5		4					2	22	0.1
Orthopagurus minimus		1	5		1				4						1	1					13	0.1
Octopus rubescens									2			1	6							3	12	0.1
Acanthodoris brunnea							1	1	8						1						11	0.1
Ericerodes hemphillii	1		1						2		1	1			3	1					10	0.1
Heterogorgia tortuosa		1	1			1				1		1	1			2					8	0.1
Philine auriformis	1	1	5				1														8	0.1
Flabellinopsis iodinea	3	1	2																		6	<0.1
Apostichopus californicus					2		1						1	1							5	<0.1
Platymera gaudichaudii																	1	3		1	5	<0.1
Astropecten sp				4																	4	<0.1
Tritonia festiva							2		2												4	<0.1
Loxorhynchus crispatus										1	2										3	<0.1
Rossia pacifica													1					1		1	3	<0.1
Stylasterias forreri									2							1					3	<0.1

Table B-11 Abundance and species richness of epibenthic macroinvertebrates collected in the Summer 2023 and Winter 2024 trawl surveys.

Stratum	Middle Shelf Zone 1				Middle Shelf Zone 2												Outer Shelf					
Station	**T2**	**T24**	**T6**	**T18**	**T23**		**T22**		**T1**		**T12**		**T17**		**T11**		**T10**	**T25**	**T14**	**T19**		
Nominal Depth (m)	**35**	**36**	**36**	**36**	**58**		**60**		**55**		**57**		**60**		**60**		**137**	**137**	**137**	**137**		
Season	**S**	**S**	**S**	**S**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**S**	**S**	**S**	**Total**	**%**
Tritia insculpta																1		1		1	3	<0.1
Lamellaria diegoensis	1						1														2	<0.1
Octopus californicus													1						1		2	<0.1
Platydoris macfarlandi									2												2	<0.1
Acanthodoris rhodoceras		1																			1	<0.1
Amphiuridae							1														1	<0.1
Baptodoris mimetica	1																				1	<0.1
Brisaster latifrons																			1		1	<0.1
Loxorhynchus grandis							1														1	<0.1
Metacarcinus anthonyi			1																		1	<0.1
Paguristes parvus		1																			1	<0.1
Randallia ornata		1																			1	<0.1
Romaleon antennarium							1														1	<0.1
Stylatula elongata	1																				1	<0.1
Total Abundance	**2,472**	**129**	**1,118**	**57**	**3,792**	**379**	**174**	**25**	**703**	**374**	**383**	**1,172**	**302**	**197**	**347**	**1,007**	**1,175**	**978**	**512**	**198**	**15,494**	**100**
Total No. of Species	**16**	**15**	**14**	**8**	**10**	**10**	**19**	**8**	**16**	**14**	**9**	**12**	**16**	**11**	**14**	**13**	**5**	**11**	**8**	**11**	**42**	

Table B-12 Biomass (kg) of epibenthic macroinvertebrates collected in the Summer 2023 and Winter 2024 trawl surveys.

Stratum	Middle Shelf Zone 1				Middle Shelf Zone 2												Outer Shelf					
Station	T2	T24	T6	T18	T23		T22		T1		T12		T17		T11		T10	T25	T14	T19		
Nominal Depth (m)	35	36	36	36	58		60		55		57		60		60		137	137	137	137		
Season	S	S	S	S	S	W	S	W	S	W	S	W	S	W	S	W	S	S	S	S	Total	%
Strongylocentrotus fragilis							0.014						0.019		0.010		61.154	37.926	20.270		119.393	69.1
Lytechinus pictus		0.099	0.766	0.090	10.954	0.760	0.057	0.005	1.310	0.469	0.870	2.566	0.405	0.032	0.283	0.916	0.099	0.220	0.190	0.025	20.116	11.6
Loxorhynchus crispatus										0.001	10.300										10.301	6.0
Ophiura luetkenii	3.516		1.066	0.003	0.004	0.001	0.001	0.003		0.001		0.001	0.001	0.083	0.004	0.010		0.008	0.002		4.704	2.7
Loxorhynchus grandis							4.605														4.605	2.7
Apostichopus californicus					1.109		0.197						0.720	0.916							2.942	1.7
Pleurobranchaea californica			0.001	0.001	0.044		0.010		0.001		0.595		0.147		0.051			0.195		1.766	2.811	1.6
Platymera gaudichaudii																	0.234	0.566		0.260	1.060	0.6
Sicyonia penicillata	0.055	0.015				0.050				0.017		0.259		0.589		0.039					1.024	0.6
Metacarcinus anthonyi			0.966																		0.966	0.6
Luidia armata	0.013	0.023	0.005	0.017		0.030				0.045		0.006	0.016	0.010	0.660					0.027	0.852	0.5
Luidia foliolata	0.012						0.011	0.003	0.130	0.099	0.046	0.019	0.008	0.011	0.005	0.020		0.160	0.001	0.295	0.820	0.5
Sicyonia ingentis	0.003							0.002	0.022	0.008		0.003	0.038	0.001			0.008		0.036	0.666	0.787	0.5
Thesea sp B	0.003	0.018	0.004	0.004	0.118	0.050	0.025	0.007	0.065	0.062	0.038	0.017	0.029	0.013	0.029	0.033					0.515	0.3
Octopus californicus													0.385						0.060		0.445	0.3
Paguristes parvus		0.419																			0.419	0.2
Astropecten californicus	0.016	0.037	0.008		0.002		0.020		0.024	0.008	0.018	0.049	0.004	0.001	0.004	0.021	0.014	0.023	0.026	0.037	0.312	0.2
Octopus rubescens									0.090			0.075	0.070							0.069	0.304	0.2
Ophiothrix spiculata	0.001	0.008	0.003	0.001	0.041	0.001	0.001	0.001	0.007	0.001					0.002	0.001		0.056			0.124	0.1
Hamatoscalpellum californicum	0.011	0.012	0.004	0.001	0.005	0.003	0.013	0.001	0.010	0.007	0.007	0.001	0.009	0.002	0.010	0.003		0.004			0.103	0.1
Rossia pacifica													0.017					0.023		0.016	0.056	<0.1
Luidia asthenosoma		0.009			0.001	0.001	0.001		0.007	0.002			0.015		0.006					0.001	0.043	<0.1
Brisaster latifrons																			0.018		0.018	<0.1
Acanthoptilum sp	0.002					0.001	0.001			0.006	0.001			0.001							0.012	<0.1
Tritonia festiva							0.004		0.004												0.008	<0.1
Ericerodes hemphillii	0.001		0.001						0.001		0.001	0.001			0.001	0.001					0.007	<0.1
Heterogorgia tortuosa		0.001	0.001			0.001				0.001		0.001	0.001			0.001					0.007	<0.1
Orthopagurus minimus		0.001	0.001		0.001				0.001						0.001	0.001					0.006	<0.1

Table B-12 Biomass (kg) of epibenthic macroinvertebrates collected in the Summer 2023 and Winter 2024 trawl surveys.

Stratum	Middle Shelf Zone 1				Middle Shelf Zone 2												Outer Shelf					
Station	**T2**	**T24**	**T6**	**T18**	**T23**		**T22**		**T1**		**T12**		**T17**		**T11**		**T10**	**T25**	**T14**	**T19**		
Nominal Depth (m)	**35**	**36**	**36**	**36**	**58**		**60**		**55**		**57**		**60**		**60**		**137**	**137**	**137**	**137**		
Season	**S**	**S**	**S**	**S**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**S**	**S**	**S**	**Total**	**%**
Acanthodoris brunnea							0.001	0.001	0.002						0.001						0.005	<0.1
Philine auriformis	0.001	0.001	0.001				0.001														0.004	<0.1
Flabellinopsis iodinea	0.001	0.001	0.001																		0.003	<0.1
Lamellaria diegoensis	0.001						0.002														0.003	<0.1
Stylasterias forreri									0.002							0.001					0.003	<0.1
Tritia insculpta																0.001		0.001		0.001	0.003	<0.1
Acanthodoris rhodoceras		0.001																			0.001	<0.1
Amphiuridae							0.001														0.001	<0.1
Astropecten sp				0.001																	0.001	<0.1
Baptodoris mimetica	0.001																				0.001	<0.1
Platydoris macfarlandi									0.001												0.001	<0.1
Randallia ornata		0.001																			0.001	<0.1
Romaleon antennarium							0.001														0.001	<0.1
Stylatula elongata	0.001																				0.001	<0.1
Total	**3.638**	**0.646**	**2.828**	**0.118**	**12.279**	**0.898**	**4.966**	**0.023**	**1.677**	**0.727**	**11.876**	**2.998**	**1.884**	**1.659**	**1.067**	**1.048**	**61.509**	**39.182**	**20.603**	**3.163**	**172.789**	**100**

Table B-13 Abundance and species richness of demersal fishes collected in the Summer 2023 and Winter 2024 trawl surveys.

Stratum	Middle Shelf Zone 1				Middle Shelf Zone 2												Outer Shelf					
Station	**T2**	**T24**	**T6**	**T18**	**T23**		**T22**		**T1**		**T12**		**T17**		**T11**		**T10**	**T25**	**T14**	**T19**		
Nominal Depth (m)	**35**	**36**	**36**	**36**	**58**		**60**		**55**		**57**		**60**		**60**		**137**	**137**	**137**	**137**		
Season	**S**	**S**	**S**	**S**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**S**	**S**	**S**	**Total**	**%**
Citharichthys sordidus	41	265	145	138	1,453	443	596	93	296	83	200	189	474	23	24	223	586	1,008	960	1,549	8,789	52.6
Icelinus quadriseriatus	173	295	73	9	18	23	189	15	191	7	23	22	381	17	6	10				1	1,453	8.7
Citharichthys xanthostigma	105	21	5	1	24	56	52	34	60	329	22	138	19	57	3	259				1	1,186	7.1
Chitonotus pugetensis	21	70	40	59	69	15	29		67	9	89	37	452	48		3				46	1,054	6.3
Zaniolepis latipinnis					24	25	6				38	152	197	123	2	4	11	2	2	136	722	4.3
Synodus lucioceps	1	244	4	24	97	18	96	2	6	4	12	13	13	21	9	29	3	30	15	47	688	4.1
Zaniolepis frenata					2								4				146	125	136	96	509	3.0
Microstomus pacificus											34	11	63	11			88	68	51	105	431	2.6
Symphurus atricaudus	16	3	7		20	9	22	3	16	27	6	18	32	4		15	16	27	7	88	336	2.0
Sebastes saxicola							1										118	80	28	95	322	1.9
Citharichthys stigmaeus	85	82	54	66																	287	1.7
Zalembius rosaceus					3	25		8		1	4	7	3	124	1	4	1				181	1.1
Parophrys vetulus	3				27	7	1		5	11	6	25	2	18	1	11	1	1	3	50	172	1.0
Hippoglossina stomata	12	3	6	2	11	15	10	1	12	16		13	2	1		10	10	2	3	4	133	0.8
Pleuronichthys verticalis		1	2	3	1	7	3	1	3	7	2	6	10	3		15	10	2		1	77	0.5
Lyopsetta exilis																	15	31	12	9	67	0.4
Scorpaena guttata	1		1		8	1	21	1	3	2	4		6	2	1	1	1	1		1	55	0.3
Odontopyxis trispinosa	7	6			5		6		15		1	1	11		1						53	0.3
Porichthys notatus					1						2		1					1		26	31	0.2
Sebastes miniatus							6							4			6	1	9		26	0.2
Lycodes pacificus																		2	2	18	22	0.1
Sebastes semicinctus											3			1			13	1	1	2	21	0.1
Sebastes elongatus																	5	3	3	4	15	0.1
Sebastes chlorostictus					1												5	4	3		13	0.1
Xystreurys liolepis	6			1		1		2								2				1	13	0.1
Merluccius productus																	8	1			9	0.1
Sebastes goodei											3				2					3	8	<0.1
Sebastes levis																	1	3		3	7	<0.1
Argentina sialis																		3	2		5	<0.1

Table B-13 Abundance and species richness of demersal fishes collected in the Summer 2023 and Winter 2024 trawl surveys.

Stratum	Middle Shelf Zone 1				Middle Shelf Zone 2												Outer Shelf					
Station	**T2**	**T24**	**T6**	**T18**	**T23**		**T22**		**T1**		**T12**		**T17**		**T11**		**T10**	**T25**	**T14**	**T19**		
Nominal Depth (m)	**35**	**36**	**36**	**36**	**58**		**60**		**55**		**57**		**60**		**60**		**137**	**137**	**137**	**137**		
Season	**S**	**S**	**S**	**S**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**W**	**S**	**S**	**S**	**S**	**Total**	**%**
Chilara taylori									1				1					2		1	5	<0.1
Pleuronichthys decurrens				1				2					1			1					5	<0.1
Raja inornata			1										3							1	5	<0.1
Agonopsis sterletus	1				1																2	<0.1
Paralichthys californicus	1															1					2	<0.1
Sebastes paucispinis																		1	1		2	<0.1
Astroscopus zephyreus																				1	1	<0.1
Cymatogaster aggregata													1								1	<0.1
Glyptocephalus zachirus																			1		1	<0.1
Peprilus simillimus																	1				1	<0.1
Rhinogobiops nicholsii													1								1	<0.1
Sebastes dallii					1																1	<0.1
Sebastes hopkinsi							1														1	<0.1
Sebastes rosaceus														1							1	<0.1
Total Abundance	**473**	**990**	**338**	**304**	**1,766**	**645**	**1,039**	**162**	**675**	**496**	**449**	**632**	**1,677**	**458**	**50**	**588**	**1,045**	**1,399**	**1,239**	**2,289**	**16,714**	**100**
Total No. of Species	**14**	**10**	**11**	**10**	**18**	**13**	**15**	**11**	**12**	**11**	**16**	**13**	**21**	**16**	**10**	**15**	**20**	**23**	**18**	**25**	**43**	

Table B-14 Biomass (kg) of demersal fishes collected in the Summer 2023 and Winter 2024 trawl surveys.

Stratum	Middle Shelf Zone 1				Middle Shelf Zone 2												Outer Shelf					
Station	T2	T24	T6	T18	T23		T22		T1		T12		T17		T11		T10	T25	T14	T19		
Nominal Depth (m)	35	36	36	36	58		60		55		57		60		60		137	137	137	137		
Season	S	S	S	S	S	W	S	W	S	W	S	W	S	W	S	W	S	S	S	S	Total	%
Citharichthys sordidus	0.120	1.566	0.850	0.620	39.666	7.636	6.218	1.183	2.605	0.959	2.616	2.516	3.471	0.641	0.334	3.714	10.020	14.718	10.731	14.993	125.177	37.0
Citharichthys xanthostigma	3.316	0.465	0.060	0.014	1.265	2.316	2.175	1.716	2.841	12.824	2.416	5.000	0.766	3.316	0.215	13.308				0.037	52.050	15.4
Sebastes miniatus							0.566							0.095			0.073	0.010	29.786		30.530	9.0
Parophrys vetulus	0.916				1.690	0.526	0.010		0.930	1.365	0.400	1.236	0.110	1.066	0.164	1.373	0.095	0.105	0.390	4.505	14.881	4.4
Synodus lucioceps	0.012	7.545	0.030	0.225	1.116	0.392	2.232	0.015	0.214	0.197	0.148	0.340	0.150	0.485	0.095	0.337	0.045	0.407	0.180	0.660	14.825	4.4
Microstomus pacificus											0.750	0.288	0.766	0.256			3.666	2.719	2.095	2.305	12.845	3.8
Scorpaena guttata	0.220		0.150		1.786	0.340	3.836	0.160	0.640	0.070	0.876		1.315	0.496	0.145	0.075	0.310	0.270		0.430	11.119	3.3
Chitonotus pugetensis	0.142	0.465	0.221	0.358	0.555	0.119	0.180		0.526	0.061	1.608	0.360	4.615	0.385		0.031				0.428	10.054	3.0
Zaniolepis latipinnis					0.270	0.366	0.074				0.369	1.336	1.698	1.336	0.023	0.058	0.260	0.025	0.050	2.305	8.170	2.4
Hippoglossina stomata	0.320	0.190	0.127	0.391	0.705	1.066	0.306	0.075	0.453	0.344		0.386	0.695	0.000		0.560	0.505	0.150	0.205	0.308	6.786	2.0
Symphurus atricaudus	0.280	0.045	0.130		0.360	0.160	0.440	0.065	0.358	0.555	0.110	0.290	0.450	0.050		0.252	0.334	0.510	0.220	1.716	6.325	1.9
Pleuronichthys verticalis		0.080	0.325	0.723	0.044	0.646	0.260	0.129	0.194	0.470	0.130	0.485	0.280	0.271		1.175	0.930	0.120		0.056	6.318	1.9
Sebastes saxicola							0.003										2.316	1.516	0.710	1.766	6.311	1.9
Zaniolepis frenata					0.022								0.045				2.315	1.366	1.566	0.926	6.240	1.8
Icelinus quadriseriatus	0.530	2.020	0.260	0.048	0.080	0.079	0.660	0.094	0.683	0.024	0.094	0.070	1.266	0.130	0.020	0.030				0.003	6.091	1.8
Raja inornata			2.386										0.415							0.000	2.801	0.8
Zalembius rosaceus					0.092	0.259		0.017		0.001	0.108	0.190	0.090	1.916	0.011	0.037	0.027				2.748	0.8
Paralichthys californicus	0.696															1.900					2.596	0.8
Xystreurys liolepis	0.250			0.336		0.075		0.153								0.153				1.200	2.167	0.6
Sebastes paucispinis																		0.018	1.886		1.904	0.6
Citharichthys stigmaeus	0.520	0.465	0.330	0.528																	1.843	0.5
Lyopsetta exilis																	0.320	0.526	0.295	0.148	1.289	0.4
Merluccius productus																	0.776	0.210			0.986	0.3
Porichthys notatus					0.027						0.107		0.022					0.060		0.616	0.832	0.2
Sebastes chlorostictus					0.005												0.295	0.125	0.130		0.555	0.2
Sebastes semicinctus											0.028			0.009			0.405	0.027	0.017	0.063	0.549	0.2
Pleuronichthys decurrens				0.292				0.119					0.019			0.064					0.494	0.1
Lycodes pacificus																		0.040	0.030	0.213	0.283	0.1
Astroscopus zephyreus																				0.220	0.220	0.1

Table B-14 Biomass (kg) of demersal fishes collected in the Summer 2023 and Winter 2024 trawl surveys.

Stratum	Middle Shelf Zone 1				Middle Shelf Zone 2												Outer Shelf					
Station	T2	T24	T6	T18	T23		T22		T1		T12		T17		T11		T10	T25	T14	T19		
Nominal Depth (m)	35	36	36	36	58		60		55		57		60		60		137	137	137	137		
Season	S	S	S	S	S	W	S	W	S	W	S	W	S	W	S	W	S	S	S	S	Total	%
Sebastes elongatus																	0.110	0.030	0.025	0.048	0.213	0.1
Odontopyxis trispinosa	0.020	0.010			0.012		0.020		0.042		0.004	0.003	0.032		0.003						0.146	<0.1
Sebastes levis																	0.023	0.050		0.068	0.141	<0.1
Sebastes goodei											0.060				0.023					0.058	0.141	<0.1
Glyptocephalus zachirus																			0.140		0.140	<0.1
Chilara taylori									0.015				0.009					0.040		0.013	0.077	<0.1
Cymatogaster aggregata													0.022								0.022	<0.1
Sebastes hopkinsi							0.019														0.019	<0.1
Peprilus simillimus																	0.012				0.012	<0.1
Agonopsis sterletus	0.002				0.009																0.011	<0.1
Rhinogobiops nicholsii													0.007								0.007	<0.1
Sebastes rosaceus														0.006							0.006	<0.1
Sebastes dallii					0.005																0.005	<0.1
Argentina sialis																		0.002	0.002		0.004	<0.1
Total	**7.344**	**12.851**	**4.869**	**3.535**	**47.709**	**13.980**	**16.999**	**3.726**	**9.501**	**16.870**	**9.824**	**12.500**	**16.243**	**10.458**	**1.033**	**23.067**	**22.837**	**23.044**	**48.458**	**33.085**	**337.933**	**100**

Table B-15 Summary statistics of OC San's Core shoreline (surfzone) stations for total coliform, fecal coliform, and enterococci by station during the 2023-24 program year. Station 0 = mouth of the Santa Ana River.

	Summer				Fall				Winter				Spring				Annual			
Station	Min	Geometric Mean	Max	Std. Dev	Min	Geometric Mean	Max	Std Dev	Min	Geometric Mean	Max	Std. Dev.	Min	Geometric Mean	Max	Std. Dev.	Min	Geometric Mean	Max	Std. Dev.
Total Coliforms (CFU/100 mL)																				
39N	<17	23	3100	4	<17	13	17	1	<17	32	>3000	5	<17	14	33	1	<17	19	>3100	3
33N	<17	16	200	2	<17	15	50	1	<17	30	>4300	6	<17	13	17	1	<17	18	>4300	2
27N	<17	17	280	2	<17	12	<17	1	<17	27	>5300	5	<17	14	33	1	<17	17	>5300	2
21N	<17	19	330	2	<17	13	17	1	<17	42	>5100	8	<17	18	67	1	<17	21	>5100	3
15N	<17	25	>1800	4	<17	17	220	2	<17	41	>7100	8	<17	20	50	1	<17	24	>7100	3
12N	<17	24	>3200	4	<17	22	130	2	<17	59	>20000	11	<17	17	100	1	<17	27	>20000	4
9N	<17	29	>4100	4	<17	19	67	1	<17	48	>14000	6	<17	18	180	1	<17	26	>14000	3
6N	<17	36	>3200	4	<17	25	400	2	<17	48	>20000	6	<17	20	150	1	<17	30	>20000	3
3N	<17	24	>1600	3	<17	21	170	2	<17	67	>20000	7	<17	17	170	1	<17	28	>20000	3
0	<17	23	>1500	3	<17	21	130	2	<17	146	>20000	11	<17	28	>1900	3	<17	38	>20000	5
3S	<17	14	33	1	<17	19	100	1	17	189	>20000	10	<17	21	100	2	<17	32	>20000	5
6S	<17	14	33	1	<17	16	50	1	<17	61	>2900	5	<17	19	>100	2	<17	23	>2900	3
9S	<17	13	17	1	<17	18	300	2	<17	46	>1100	4	<17	15	>33	1	<17	20	>1100	2
15S	<17	15	50	1	<17	17	150	2	<17	43	400	4	<17	15	33	1	<17	20	400	2
21S	<17	14	33	1	<17	17	67	1	<17	39	>800	4	<17	18	50	1	<17	20	>800	2
27S	<17	17	120	1	<17	15	50	1	<17	24	900	3	<17	13	17	1	<17	17	900	2
29S	<17	19	500	2	<17	15	50	1	<17	36	2300	5	<17	21	100	2	<17	22	2300	2
39S	<17	15	67	1	<17	17	320	2	<17	28	800	3	<17	15	>50	1	<17	18	800	2

Table B-15 Summary statistics of OC San's Core shoreline (surfzone) stations for total coliform, fecal coliform, and enterococci by station during the 2023-24 program year. Station 0 = mouth of the Santa Ana River.

	Summer				Fall				Winter				Spring				Annual			
Station	Min	Geometric Mean	Max	Std. Dev	Min	Geometric Mean	Max	Std Dev	Min	Geometric Mean	Max	Std. Dev.	Min	Geometric Mean	Max	Std. Dev.	Min	Geometric Mean	Max	Std. Dev.
Fecal Coliforms (CFU/100 mL)																				
39N	<17	18	860	3	<17	13	17	1	<17	18	700	3	<17	14	50	1	<17	16	860	2
33N	<17	14	50	1	<17	15	100	1	<17	20	1000	3	<17	13	17	1	<17	15	1000	1
27N	<17	15	83	1	<17	13	17	1	<17	20	920	3	<17	13	17	1	<17	15	920	1
21N	<17	13	17	1	<17	12	<17	1	<17	22	1700	4	<17	13	17	1	<17	15	1700	2
15N	<17	18	250	2	<17	15	67	1	<17	24	2900	4	<17	15	50	1	<17	18	2900	2
12N	<17	20	720	3	<17	17	120	1	<17	30	3400	7	<17	14	17	1	<17	20	3400	3
9N	<17	19	1000	2	<17	16	50	1	<17	25	2300	3	<17	16	50	1	<17	19	2300	2
6N	<17	26	840	2	<17	21	83	1	<17	24	4600	3	<17	15	83	1	<17	21	4600	2
3N	<17	17	460	2	<17	20	120	2	<17	26	6200	4	<17	13	33	1	<17	18	6200	2
0	<17	16	620	2	<17	19	120	1	<17	51	6400	5	<17	17	330	2	<17	23	6400	3
3S	<17	14	33	1	<17	14	33	1	<17	50	>3100	7	<17	13	17	1	<17	19	>3100	3
6S	<17	13	17	1	<17	13	17	1	<17	23	400	3	<17	13	33	1	<17	15	400	1
9S	<17	13	17	1	<17	15	50	1	<17	23	220	2	<17	13	17	1	<17	15	220	1
15S	<17	15	50	1	<17	17	100	1	<17	25	200	2	<17	12	<17	1	<17	17	200	1
21S	<17	15	67	1	<17	16	50	1	<17	29	150	2	<17	20	83	1	<17	19	150	1
27S	<17	14	50	1	<17	17	180	2	<17	15	50	1	<17	13	17	1	<17	14	180	1
29S	<17	14	33	1	<17	15	67	1	<17	23	200	2	<17	14	33	1	<17	16	200	1
39S	<17	13	17	1	<17	15	130	1	<17	15	33	1	<17	13	17	1	<17	14	130	1

Table B-15 Summary statistics of OC San's Core shoreline (surfzone) stations for total coliform, fecal coliform, and enterococci by station during the 2023-24 program year. Station 0 = mouth of the Santa Ana River.

	Summer				Fall				Winter				Spring				Annual			
Station	Min	Geometric Mean	Max	Std. Dev	Min	Geometric Mean	Max	Std Dev	Min	Geometric Mean	Max	Std. Dev.	Min	Geometric Mean	Max	Std. Dev.	Min	Geometric Mean	Max	Std. Dev.
Enterococci (CFU/100 mL)																				
39N	<2	3	16	2	<2	2	8	1	<2	5	>400	5	<2	1	6	1	<2	2	>400	3
33N	<2	3	14	2	<2	7	58	3	<2	8	>400	5	<2	2	6	1	<2	4	>400	3
27N	<2	4	104	4	<2	2	8	1	<2	8	>400	6	<2	2	8	1	<2	4	>400	3
21N	<2	3	14	2	<2	4	160	4	<2	11	>400	6	<2	2	8	1	<2	4	>400	3
15N	<2	3	14	2	<2	4	180	4	<2	5	>400	6	<2	1	2	1	<2	3	>400	3
12N	<2	3	16	2	<2	4	70	3	<2	10	452	7	<2	2	16	2	<2	4	452	4
9N	<2	4	46	3	<2	3	46	2	<2	9	>400	6	<2	2	6	1	<2	4	>400	3
6N	<2	5	>400	4	<2	7	114	3	<2	9	>400	6	<2	2	20	2	<2	5	>400	4
3N	<2	4	48	3	<2	6	96	3	<2	8	>400	6	<2	2	12	1	<2	4	>400	4
0	<2	3	28	2	<2	4	36	2	<2	19	>400	7	<2	4	114	3	<2	5	>400	4
3S	<2	3	26	2	<2	6	36	2	6	30	>400	4	<2	2	18	2	<2	6	>400	4
6S	<2	2	10	2	<2	3	14	2	2	15	>400	4	<2	2	20	2	<2	4	>400	3
9S	<2	2	8	1	<2	9	220	6	<2	11	296	5	<2	2	14	2	<2	4	296	4
15S	<2	3	18	2	<2	4	156	3	<2	9	170	5	<2	1	4	1	<2	4	170	3
21S	<2	2	10	1	<2	2	30	2	<2	7	272	5	<2	3	14	2	<2	3	272	3
27S	<2	1	4	1	<2	2	40	3	<2	4	98	3	<2	1	2	1	<2	2	98	2
29S	<2	5	20	2	<2	3	10	1	<2	8	300	6	<2	3	24	2	<2	4	300	3
39S	<2	2	12	2	<2	2	62	2	<2	3	160	4	<2	2	22	2	<2	2	160	2

Appendix C. Quality Assurance/Quality Control (QA/QC)

INTRODUCTION – FINAL EFFLUENT MONITORING QA/QC

OC San's Final Effluent Monitoring Program is designed to measure compliance with permit conditions. The program includes measurements which can be assigned to the following general categories:

- Physical and Aggregate Properties,
- Microbiology,
- Inorganic Nonmetals,
- Metals,
- Individual Organics,
- Radionuclides,
- Whole Effluent Toxicity, and
- Aggregate Organics.

The Final Effluent Monitoring Program complies with OC San's NPDES Permit requirements and applicable federal, state, local, and contract requirements. The quality assurance practices employed are set forth in the OC San laboratory Quality Manual (OCSD 2023 and 2024). The objectives of the quality assurance program are as follows:

- Data generated will be of sufficient quality to stand up to scientific and legal scrutiny.
- Data will be generated in accordance with procedures appropriate for the intended use of the data.
- Whenever possible, data will be generated by laboratories certified by the State Water Resources Control Board Environmental Laboratory Accreditation Program (ELAP).
- For each target analyte, the appropriate required quality control samples are analyzed as required by the method and/or the accreditation standards.

The various aspects of the program are conducted on a daily, weekly, monthly, quarterly, semi-annual, or annual schedule.

This appendix details quality assurance/quality control (QA/QC) information for the various samples collected and analyzed for OC San's 2023-24 Final Effluent Monitoring Program. Detection limits and reporting limits for the various methods are shown in Table C-1, Table C-2, and Table C-3.

Table C-1 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at OC San's laboratory during the 2023-24 program year.

Parameter	**MDL (MPN/100 mL)**	**RL (MPN/100 mL)**	**Parameter**	**MDL (MPN/100 mL)**	**RL (MPN/100 mL)**
Fecal Indicator Bacteria					
Fecal coliform	18	18	Enterococci	10	10
Parameter	**Range (Unit)**	**Resolution (Unit)**			
Wet Chemistry					
pH [a]	4 to 10	0.01			
Parameter	**MDL (mg/L)**	**RL (mg/L)**	**Parameter**	**MDL (NTU)**	**RL (NTU)**
Chlorine, total	0.01	0.05	Turbidity	0.04	0.2
Parameter	**MDL (mg/L)**	**RL (mg/L)**	**Parameter**	**MDL (µg/L)**	**RL (µg/L)**
Nutrients					
Ammonia Nitrogen [b]	0.376	1	Cyanide	2.22	5
Ammonia Nitrogen [c]	0.631	1			
TKN [d]	0.351	1			
TKN [e]	0.699	1			
Parameter	**MDL (mg/L)**	**RL (mg/L)**	**Parameter**	**MDL (mg/L)**	**RL (mg/L)**
Aggregate Organics					
BOD (Total)	—	0.2	Oil and Grease	1.36	2.5
BOD (Carbonaceous)	—	0.2			
Parameter	**MDL (mg/L)**	**RL (mg/L)**	**Parameter**	**MDL (mL/L)**	**RL (mL/L)**
Solids					
Total Suspended Solids (TSS)	0.350	1	Settleable solids	—	0.1

Table C-1 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at OC San's laboratory during the 2023-24 program year.

Parameter	MDL (µg/L)	RL (µg/L)	Parameter	MDL (µg/L)	RL (µg/L)
Metals July 2023–August 2023					
Antimony	0.188	0.20	Manganese	0.924	1.00
Arsenic	0.242	0.40	Molybdenum	0.158	0.20
Barium	0.276	0.40	Nickel	0.392	0.40
Beryllium	0.074	0.20	Phosphorus	0.070	0.20
Cadmium	0.108	0.20	Selenium	0.710	0.80
Chromium	0.338	0.40	Silver	0.230	0.25
Copper	0.858	0.90	Thallium	0.116	0.20
Lead	0.180	0.20	Zinc	3.618	3.80
Metals August 2023–April 2024					
Antimony	0.188	0.40	Manganese	1.10	2.00
Arsenic	0.260	0.40	Molybdenum	0.158	0.40
Barium	0.982	1.60	Nickel	0.480	1.00
Beryllium	0.074	0.20	Phosphorus	0.070	0.20
Cadmium	0.108	0.20	Selenium	0.710	1.60
Chromium	0.338	0.50	Silver	0.250	0.30
Copper	1.000	1.10	Thallium	0.116	0.40
Lead	0.18	0.40	Zinc	3.96	5.00
Metals April 2024–June 2024					
Antimony	0.138	0.50	Manganese	0.258	0.50
Arsenic	0.248	0.50	Molybdenum	0.314	0.50
Barium	0.284	0.50	Nickel	1.344	2.00
Beryllium	0.062	0.20	Phosphorus	0.070	0.20
Cadmium	0.066	0.20	Selenium	0.986	2.00
Chromium	0.434	0.50	Silver	0.270	0.50
Copper	0.736	1.00	Thallium	0.298	0.50
Lead	0.200	0.50	Zinc	8.35	10.0

Table C-1 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at OC San's laboratory during the 2023-24 program year.

Parameter	MDL (µg/L)	RL (µg/L)	Parameter	MDL (µg/L)	RL (µg/L)
Purgeable Organic Compounds					
Acrolein	1.19	5	1,1-Dichloroethane	0.59	1
Acrylonitrile	0.68	2	1,2-Dichloroethane	0.65	2
Benzene	0.64	2	1,1-Dichloroethene	0.68	2
Bromodichloromethane	0.60	2	trans-1,2-Dichloroethene	0.70	1
Bromoform	0.64	2	1,2-Dichloropropane	0.56	1
Bromomethane	1.14	2	cis-1,3-Dichloropropene	0.51	[f]
Carbon Tetrachloride	0.80	2	trans-1,3-Dichloropropene	0.58	[f]
Chlorobenzene	0.46	2	Ethylbenzene	0.54	2
Chloroethane	0.63	1	Methylene chloride	0.83	2
2-Chloroethylvinyl ether	0.72	1	1,1,2,2-Tetrachloroethane	0.41	2
Chloroform	1.56	2	Tetrachloroethene	0.76	2
Chloromethane	0.81	2	Toluene	0.68	2
Dibromochloromethane	0.53	2	1,1,1-Trichloroethane	0.73	2
1,2-Dichlorobenzene	0.44	2	1,1,2-Trichloroethane	0.60	2
1,3-Dichlorobenzene	0.45	2	Trichloroethene	0.62	2
1,4-Dichlorobenzene	0.45	2	Vinyl chloride	0.83	2
Parameter	**MDL (ng/L)**	**RL (ng/L)**	**Parameter**	**MDL (ng/L)**	**RL (ng/L)**
Hormone Compounds					
17a-Estradiol	1.83	4	Estrone	0.64	4
17a-Ethynylestradiol	1.41	4	Progesterone	0.29	4
17b-Estradiol	0.40	4	Testosterone	1.05	4
Estriol	0.41	4			

[a] Traditional MDLs and RLs do not apply to pH measurements.
[b] July 2023–June 2024
[c] June 18, 2024–June 30, 2024
[d] June 2023–April 2024
[e] May 2024–June 2024
[f] The sum of cis- and trans-1,3-Dichloropropene = 2 µg/L

Table C-2 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at OC San's laboratory during the 2023-24 program year.

Parameter	MDL [a] (µg/L)	RL [a] (µg/L)	MDL [b] (µg/L)	RL [b] (µg/L)
Base/Neutral Extractables				
Azobenzene	0.42	1	0.42	1
1,2,4-Trichlorobenzene	0.55	1	0.55	1
1,2-Dichlorobenzene	0.72	1	0.72	1
1,3-Dichlorobenzene	0.67	1	0.67	1
1,4-Dichlorobenzene	0.78	1	0.78	1
Acenaphthene	0.43	1	0.43	1
Acenaphthylene	0.34	1	0.34	1
Anthracene	0.40	1	0.40	1
Benzidine	3.19	5	3.19	5
Benz(a)anthracene	0.47	1	0.47	1
Benzo(a)pyrene	0.47	1	0.47	1
Benzo(b)fluoranthene	0.43	1	0.43	1
Benzo(k)fluoranthene	0.40	1	0.40	1
Benzo(g,h,i)perylene	0.36	1	0.36	1
Butyl benzyl phthalate	0.48	1	0.48	1
bis(2-Chloroethoxy)methane	0.49	1	0.49	1
bis(2-Chloroethyl)ether	0.60	1	0.60	1
bis(2-Ethylhexyl)phthalate	0.54	1	0.85	1
4-Bromophenyl phenyl ether	0.39	1	0.39	1
2-Chloronaphthalene	0.39	1	0.39	1
4-Chlorophenyl phenyl ether	0.34	1	0.34	1
Chrysene	0.44	1	0.44	1
Dibenz(a,h)anthracene	0.38	1	0.38	1
Di-n-butylphthalate	0.50	1	0.50	1
3,3'-Dichlorobenzidine	0.40	1	0.40	1
Diethyl phthalate	0.50	1	0.50	1
Dimethyl phthalate	0.77	1	0.77	1
2,4-Dinitrotoluene	0.43	1	0.43	1
2,6-Dinitrotoluene	0.29	1	0.64	1
Di-n-octylphthalate	0.61	5	2.16	5
Fluoranthene	0.45	1	0.45	1
Fluorene	0.36	1	0.36	1
Hexachlorobenzene	0.45	1	0.45	1
Hexachlorobutadiene	0.56	1	0.56	1
Hexachlorocyclopentadiene	1.34	5	1.34	5
Hexachloroethane	0.69	1	0.69	1
Indeno(1,2,3-c,d)pyrene	0.37	1	0.37	1
Isophorone	0.45	1	0.45	1
Naphthalene	0.54	1	0.54	1
Nitrobenzene	0.60	1	0.60	1
n-Nitrosodimethylamine	0.82	2	0.82	2
n-Nitrosodi-n-propylamine	0.46	1	0.46	1

Table C-2 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at OC San's laboratory during the 2023-24 program year.

Parameter	MDL [a] (µg/L)	RL [a] (µg/L)	MDL [b] (µg/L)	RL [b] (µg/L)
n-Nitrosodiphenylamine	0.45	1	0.45	1
2,2′-Oxybis(1-chloropropane)	0.58	1	0.58	1
Phenanthrene	0.40	1	0.40	1
Pyrene	0.46	1	0.46	1
Acid Extractables				
4-Chloro-3-methylphenol	0.42	1	0.42	1
2-Chlorophenol	0.56	1	0.56	1
2,4-Dichlorophenol	0.57	1	0.57	1
2,4-Dimethylphenol	0.71	2	1.57	2
2,4-Dinitrophenol	2.15	5	2.15	5
4,6-Dinitro-2-methylphenol	0.87	2	0.87	2
2-Nitrophenol	0.54	1	0.54	1
4-Nitrophenol	0.26	1	0.84	1
Pentachlorophenol	0.51	2	1.32	2
Phenol	0.33	1	0.33	1
2,4,6-Trichlorophenol	0.37	1	0.37	1

[a] July 2023–May 2024.
[b] June 2024.

Table C-3 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at contract laboratories during the 2023-24 program year.

Parameter	MDL (mg/L)	RL (mg/L)	Parameter	MDL (µg/L)	RL (µg/L)
Nutrients					
Nitrate as N	0.040	0.2	Cyanide [a]	3.8	5
Nitrite as N	0.042	0.1	Cyanide [b]	1.5	5
Ammonia Nitrogen	0.34	2.0			
TKN	1.3	2.0			
Parameter	**MDL (µg/L)**	**RL (µg/L)**		**MDL (ng/L)**	**RL (ng/L)**
Metals					
Chromium	0.089	0.2	Mercury	0.1	0.5
Chromium, Hexavalent	0.0079	0.02			
Parameter	**MDL (µg/L)**	**RL (µg/L)**	**Parameter**	**MDL (µg/L)**	**RL (µg/L)**
Organochlorine Pesticides (July 2023 – April 2024)					
2,4'-DDD	0.0022	0.01	Dieldrin	0.0034	0.01
2,4'-DDE	0.0019	0.01	Endosulfan I	0.0038	0.01
2,4'-DDT	0.0038	0.01	Endosulfan II	0.0038	0.01
4,4´-DDD	0.0054	0.01	Endosulfan sulfate	0.0059	0.01
4,4´-DDE	0.0036	0.01	Endrin	0.0034	0.01
4,4´-DDT	0.0056	0.01	Endrin aldehyde	0.0038	0.01
Aldrin	0.0020	0.01	Heptachlor	0.0046	0.01
alpha-BHC	0.0049	0.01	Heptachlor epoxide	0.0036	0.01
beta-BHC	0.0030	0.01	Methoxychlor	0.0076	0.01
delta-BHC	0.0038	0.01	Mirex	0.0065	0.01
gamma-BHC (Lindane)	0.0030	0.01	*cis*-Nonachlor	0.0050	0.01
alpha-Chlordane	0.0058	0.01	*trans*-Nonachlor	0.0034	0.01
gamma-Chlordane	0.0046	0.01	Oxychlordane	0.0023	0.01
Chlordane (tech)	0.20	0.20	Toxaphene	1.0	1.0

Table C-3 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at contract laboratories during the 2023-24 program year.

Parameter	MDL (µg/L)	RL (µg/L)	Parameter	MDL (µg/L)	RL (µg/L)
Organochlorine Pesticides (May 2024 – June 2024)					
2,4'-DDD	0.0062	0.01	Dieldrin	0.0034	0.01
2,4'-DDE	0.0056	0.01	Endosulfan I	0.0038	0.01
2,4'-DDT	0.0038	0.01	Endosulfan II	0.0038	0.01
4,4´-DDD	0.0054	0.01	Endosulfan sulfate	0.0058	0.01
4,4´-DDE	0.0036	0.01	Endrin	0.0080	0.01
4,4´-DDT	0.0056	0.01	Endrin aldehyde	0.0079	0.01
Aldrin	0.0062	0.01	Heptachlor	0.0046	0.01
alpha-BHC	0.0048	0.01	Heptachlor epoxide	0.0036	0.01
beta-BHC	0.0030	0.01	Methoxychlor	0.0076	0.01
delta-BHC	0.0038	0.01	Mirex	0.0064	0.01
gamma-BHC (Lindane)	0.003	0.01	*cis*-Nonachlor	0.0050	0.01
alpha-Chlordane	0.0058	0.01	*trans*-Nonachlor	0.0034	0.01
gamma-Chlordane	0.0046	0.01	Oxychlordane	2.0	2.0
Chlordane (tech)	1.0	1.0	Toxaphene	0.0024	0.01

Table C-3 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at contract laboratories during the 2023-24 program year.

Parameter	MDL (µg/L)	RL (µg/L)	Parameter	MDL (µg/L)	RL (µg/L)
PCBs as Aroclors					
PCB 1016	1.0	1.0	PCB 1248	1.0	1.0
PCB 1221	1.0	1.0	PCB 1254	1.0	1.0
PCB 1232	1.0	1.0	PCB 1260	1.0	1.0
PCB 1242	1.0	1.0			
Parameter	**MDL (pg/L)**	**RL (pg/L)**	**Parameter**	**MDL (pg/L)**	**RL (pg/L)**
PCBs as Congeners					
PCB 18	0.72	39	PCB 128	0.56	77
PCB 28	1.0	77	PCB 138	0.57	77
PCB 37	1.1	19	PCB 149	0.62	39
PCB 44	0.91	120	PCB 151	0.65	39
PCB 49	0.83	39	PCB 153	0.50	39
PCB 52	0.94	96	PCB 156	0.72	39
PCB 66	0.83	39	PCB 157	0.72	39
PCB 70	0.89	150	PCB 158	0.45	19
PCB 74	0.89	150	PCB 167	0.47	39
PCB 77	1.0	19	PCB 168	0.50	39
PCB 81	1.0	19	PCB 169	0.87	19
PCB 87	0.28	120	PCB 170	0.64	39
PCB 99	0.63	39	PCB 177	0.63	19
PCB 101	0.56	120	PCB 180	0.49	39
PCB 105	0.45	39	PCB 183	0.54	19
PCB 110	0.46	39	PCB 187	0.27	19
PCB 114	0.48	39	PCB 189	0.96	19
PCB 118	0.43	39	PCB 194	0.49	39
PCB 119	0.28	120	PCB 201	0.30	19
PCB 123	0.54	39	PCB 206	2.10	39
PCB 126	0.46	19			

Table C-3 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at contract laboratories during the 2023-24 program year.

Parameter	MDA Range (pCi/L)	RL (pCi/L)	Parameter	MDA Range (pCi/L)	RL (pCi/L)
Radiation [g]					
Gross Alpha	0.04-0.747	—	Strontium-90	0.641-1.99	2.0
Gross Beta	3.424-15.494	—	Tritium	191-726	700-1000
Radium-226	0.20-0.69	1.0	Uranium	0.015	0.13
Radium-228	0.600-2.52	3.0			
Parameter	**MDL (mg/L)**	**RL (mg/L)**	**Parameter**	**MDL (mg/L)**	**RL (mg/L)**
Potassium [c]	0.2	0.5	Total Dissolved Solids	4	10
Potassium [d]	0.086	0.5			
Parameter	**MDL (µg/L)**	**RL (µg/L)**			
Miscellaneous					
Tributyltin	0.0023	0.005			
Parameter	**MDL (ng/L)**	**RL (ng/L)**	**Parameter**	**MDL (ng/L)**	**RL (ng/L)**
Pharmaceuticals and Primary Care Products					
Acetaminophen	5	5	Ibuprofen	4	4
Caffeine	400	400	Oxybenzone	4	4
Carbamazepine	4	4	Primidone	1000	1000
DEET	400	400	Sulfamethoxazole	400	400
Diclofenac	20	20	TCEP	10	10
Erythromycin	5	5	TCPP	50	50
Fluoxetine	4	4	TDCPP	50	50
Galaxolide	6	48	Triclosan	8	8
Gemfibrozil	20	20			
Pesticides and Insecticides					
Bifenthrin	1.1	2	Fipronil sulfone	1.2	2
Fipronil	1.7	2	Permethrin	1.4	5
Chlorpyrifos & Diazinon					
Chlorpyrifos (2023)	4.0	10	Diazinon	3.4	10
Chlorpyrifos (2024)	—	19			

Table C-3 Method detection limit (MDL) and reporting limit (RL) for final effluent constituents analyzed at contract laboratories during the 2023-24 program year.

Parameter	MDL (ng/L)	RL (ng/L)	Parameter	MDL (ng/L)	RL (ng/L)
Ethoxylates					
4-n-Octylphenol diethoxylate	220	500	4-tert-Octylphenolmonoethoxylate	200	500
4-n-Octylphenol m o n o e t h	140	500	Bisphenol A	480	1000
4-Nonylphenol	160	500	Nonylphenol	200	500
4-Octylphenol	100	500	Nonylphenol diethoxylate	220	500
4-tert-Octylphenol	150	500	Nonylphenol monoethoxylate	160	500
4-tert-Octylphenol diethoxylate	210	500			
Parameter	**MDL (pg/L)**	**RL (pg/L)**	**Parameter**	**MDL (pg/L)**	**RL (pg/L)**
Flame Retardants (PBDEs)					
BDE-47	0.27	22	BDE-99	0.42	33
BDE-100	0.40	33	BDE-183/176	0.45	55
Parameter	**MDL Range (pg/L)**	**RL Range (pg/L)**	**Parameter**	**MDL Range (pg/L)**	**RL Range (pg/L)**
TCDD-Equivalents [h]					
1,2,3,4,6,7,8-Hepta CDD	5.11-5.69	23.1-25.7	1,2,3,7,8-Penta CDD	7.68-8.56	23.1-25.7
1,2,3,4,6,7,8-Hepta CDF	5.80-6.46	23.1-25.7	1,2,3,7,8-Penta CDF	6.20-6.91	23.1-25.7
1,2,3,4,7,8,9-Hepta CDF	6.77-7.54	23.1-25.7	2,3,4,6,7,8-Hexa CDF	5.48-6.10	23.1-25.7
1,2,3,4,7,8-Hexa CDD	6.08-6.77	23.1-25.7	2,3,4,7,8-Penta CDF	6.97-7.77	23.1-25.7
1,2,3,4,7,8-Hexa CDF	6.29-7.01	23.1-25.7	2,3,7,8-Tetra CDD	3.62-4.03	4.62-5.15
1,2,3,6,7,8-Hexa CDD	5.37-5.98	23.1-25.7	2,3,7,8-Tetra CDF	1.61-1.79	4.62-5.15
1,2,3,6,7,8-Hexa CDF	5.64-6.29	23.1-25.7	Octa CDD	15.1-16.8	46.2-51.5
1,2,3,7,8,9-Hexa CDD	5.53-6.17	23.1-25.7	Octa CDF	12.6-14.0	46.2-51.5
1,2,3,7,8,9-Hexa CDF	5.86-6.53	23.1-25.7			

[a] July 2023 – October 2023
[b] November 2023 – June 2024
[c] July 2023 – September 2023
[d] October 2023 – June 2024
[e] MDA values varied per testing period depending on verification studies performed, amount of sample used, and dilution factor.
[f] MDL or RL values varied per testing period depending on verification studies performed, amount of sample used, and dilution factor.

EFFLUENT QUALITY NARRATIVE

Physical and Aggregate Properties

A summary of the QC associated with these effluent quality analyses is given in Table C-4, unless noted otherwise.

Physical Characteristics

Total Suspended Solids (TSS) were analyzed at the OC San laboratory using ELOM SOP 2540 D/E. One duplicate sample failed to meet the method precision criteria, most likely due to a lack of homogeneity between the sample aliquots that were poured for analysis. This is a known potential issue with this analysis, and while the laboratory takes steps to ensure homogeneity, occasionally the issue cannot be avoided.

Settleable solids were analyzed at the OC San laboratory using ELOM SOP 2540 F. All QC samples associated with this analysis met the method acceptance criteria.

pH was analyzed at the OC San laboratory using ELOM SOP 4500-H+B. Duplicate determinations were carried out on a process control sample using the field pH meter. Three duplicate samples failed to meet the method precision criteria, potentially due to a lack of homogeneity between the parent sample and the duplicate sample.

Turbidity was analyzed at the OC San laboratory using ELOM SOP 2130 B. All QC samples associated with this analysis met the method acceptance criteria.

Microbiology

Fecal coliforms were analyzed at the OC San laboratory using ELOM SOP 9221E. Two sample duplicates exceeded the precision criterion, possibly due to a non-homogenous sample.

Enterococci were analyzed at the OC San laboratory using ELOM SOP 9223B-9230D. All sample duplicates met the precision criterion.

Inorganic Nonmetals

Phosphorus analysis was performed at the OC San laboratory using ELOM SOP 200.7. Most QC samples met the method acceptance criteria except for one matrix spike with low percent recovery, and one matrix spike/matrix spike duplicate set which exhibited moderately high percent recovery above acceptance criterion, possibly due to matrix interference. The data in the affected batches were deemed acceptable after careful consideration of all the other passing QC samples.

Ammonia (as nitrogen) was analyzed at the OC San laboratory using ELOM SOP 4500-NH_3-350.1 through October 2023. Starting in November 2023 through the remainder of the monitoring period, ammonia (as nitrogen) was analyzed using ELOM SOP 350.1. Most QC samples associated with the ammonia analysis met the method acceptance criteria. Eight blank samples exhibited detections for ammonia above the MDL, however, these detections were below the RL and were judged to not have an adverse impact on the quality of the data within the associated batch of samples. A few issues were observed with the matrix spike and matrix spike duplicate accuracy criteria. These issues were attributed to matrix interference. For all impacted batches, an assessment of the other batch QC samples was conducted, and batches were accepted only when the totality of the passing QC indicated that the batch results were of sufficient quality. At the OC San laboratory, one sample was not analyzed during the monitoring period due to instrumentation error. One sample during the monitoring period was analyzed at Weck Laboratories in the City of Industry, CA, using EPA Method 350.1. A summary of the QC associated with this analysis is presented in Table C-5, and all QC samples associated with that analysis met the acceptance criteria of the method.

Total Kjeldahl Nitrogen (TKN) was analyzed at the OC San laboratory using ELOM SOP 4500-Norg D351.2. Most QC samples associated with the TKN analysis met the method acceptance criteria. Four blank samples exhibited detections for TKN above the MDL, however, these detections were below the RL and were judged to not have an adverse impact on the quality of the data within the associated batch of samples. One blank spike did not meet the method acceptance criteria, as it was determined that spiking solution was not added to the sample. A low-level blank spike sample included in that batch for ongoing MDL verification did meet method acceptance criteria for percent recovery, however, and following an assessment of the other passing QC samples within that batch, the batch was deemed acceptable despite the blank spike failure. One matrix spike/matrix spike duplicate set exhibited percent recovery just below method acceptance criteria, attributable to matrix interference. For all impacted batches, an assessment of the other batch QC samples was conducted, and batches were accepted only when the totality of the passing QC indicated- that the batch results were of sufficient quality. One sample during the monitoring period was analyzed at Weck Laboratories in the City of Industry, CA, using EPA Method 351.2. A summary of the QC associated with this analysis is presented in Table C-5, and all QC samples associated with that analysis met the acceptance criteria of the method.

Nitrate and nitrite (as nitrogen) were analyzed at Weck Laboratories in the City of Industry, CA, using EPA Method 353.2. A summary of the QC associated with this analysis is presented in Table C-5. All QC samples associated with the nitrate and nitrite analyses met the method acceptance criteria, except for one matrix spike and matrix spike duplicate pair in which percent recovery failed high for nitrate. This failure was likely due to matrix interferences in the sample, as supported by passing matrix spike precision and the remaining QC samples in that batch.

Cyanide was primarily analyzed at Weck Laboratories in the City of Industry, CA, using EPA Method 335.4. Only the September 2023 sample was analyzed by the OC San laboratory using ELOM SOP 4500-CN. The majority of QC samples associated with the cyanide analysis met the method acceptance criteria (Table C-4 and Table C-5). For all samples analyzed, the blank QC samples associated with this analysis met the method acceptance criteria. One blank spike QC sample in April 2024 was outside of percent recovery acceptance criterion but deemed acceptable since CN was not detected or below the reporting limit. A few issues were observed with the matrix spike and matrix spike duplicate accuracy and precision criteria. These issues were usually attributed to matrix interference. Data in the affected batches were accepted after reviewing the other batch QC results.

Total residual chlorine was analyzed at the OC San laboratory using ELOM SOP 4500-Cl G. Nearly all QC samples associated with this analysis met the method acceptance criteria. Two duplicate samples had precision results which exceeded the method-specified acceptance criteria. This was due to measuring duplicates at relatively low sample concentrations, where a small difference in concentration can result in a large relative percent difference between the results.

Metals

On a monthly basis, final effluent samples were analyzed for a variety of heavy metals. A full list of metals analyzed, along with their associated method detection limits (MDLs), is presented in Table C-2. Metals analysis was performed at the OC San laboratory using ELOM SOP 200.8. Nearly all QC samples associated with the metals analysis met the method acceptance criteria. One blank sample exhibited a detection for nickel that exceeded the method acceptance criteria. One matrix spike duplicate sample yielded a result for barium just above method percent recovery criteria. In both instances, the data associated with the affected batches was deemed acceptable after careful review of all other passing QC parameters.

On a monthly basis, final effluent samples were analyzed for mercury by Weck Laboratories using the low-level EPA Method 1631. A summary of the QC associated with these analyses is provided in Table C-5. Four trip blanks had detections for mercury above the MDL, but below the RL. Despite the trip blank detections, all blank QC samples met the method acceptance criteria for mercury analysis, as did all remaining QC samples for this program year.

On three separate occasions during the program year, samples were sent to Weck Laboratories for chromium speciation in response to performance goal exceedances for chromium at the OC San laboratory. Samples were analyzed for total chromium and hexavalent chromium. A summary of the QC associated with these samples is presented in Table C-5. For the hexavalent chromium analysis, one matrix spike failed to meet the percent recovery acceptance criterion, which also resulted in a failure of the precision criteria for that matrix spike/matrix spike duplicate (MS/MSD) pair. The failures were likely due to matrix interference, and the associated sample results were accepted based on the other successful QC samples in the batch. For all three samples, it was determined that all the chromium detected in the final effluent is in the form of trivalent chromium, with all ND results for hexavalent chromium.

Individual Organics

Individual organic compounds encompass a wide range of contaminants. A full list of organic compounds analyzed, along with their associated method detection limits (MDLs), is provided in Table C-2 and Table C-3.

Semi-volatile organic compounds were analyzed at the OC San laboratory using ELOM SOP 625.1. For method 625.1, 2 compounds were detected above the MDL in blank samples, but met the blank acceptance criteria outlined in the EPA method. In August 2023, the laboratory experienced some stability issues with the instrument used for method 625.1 analysis. The first set of samples from that month were rejected due to QC issues, and a second set of samples were collected before the end of the month. The second set of samples was sent to Weck Laboratories for analyses, and were also extracted for in-house analysis in case the instrument issues could be resolved in time. The batch analyzed by the contract laboratory had multiple QC issues, as well as not meeting desired sensitivity levels due to excessive dilution of the samples. The extracts from the second set of samples were also analyzed in-house, and the results were deemed to be acceptable. The only QC issue was in the acid fraction, where two compounds in the blank spike failed slightly low, but within the allowable marginal exceedance criteria. Technically, only one compound is allowed to fail within the blank spike. Both failing compounds met the blank spike acceptance criteria within the matrix spike/matrix spike duplicate samples associated with the batch. Based on our evaluation of the totality of the QC data, and the fact that sample data were consistent with historical trends, the data associated with the second August 2023 batch were accepted. Most of the matrix spike and matrix spike duplicate samples met QC acceptance criteria for accuracy and precision during the program year, however, some failures were observed as outlined in Table C-4, most likely resulting from matrix interferences.

Volatile (purgeable) organic compounds were analyzed at the OC San laboratory using ELOM SOP 624.1. For method 624.1, one compound was outside of percent recovery acceptance criterion in the blank spike. Four compounds exhibited percent recovery below acceptance criteria in matrix spike/matrix spike duplicate samples resulting in one instance of precision criterion failure. These matrix spike and matrix spike duplicate failures were attributable to matrix interference. The data in all affected batches were deemed acceptable after careful consideration of all the other passing QC samples.

Per- and Polyfluoroalkyl Substances (PFAS) are analyzed once per calendar year at the OC San laboratory, not the fiscal year, and this analysis was performed outside of the date range covered during this program year.

Hormones were analyzed at the OC San laboratory using ELOM SOP 539. In the blank spike and blank spike duplicate, one compound exceeded acceptance criteria for percent recovery, however, this compound was not detected in the sample analyzed. The only other QC failure observed occurred in the matrix spike and matrix spike duplicate set, where one compound exceeded the precision criteria. This failure was likely due to matrix effects. The data in the affected batch were deemed acceptable after careful consideration of all the other passing QC samples.

TCDD equivalents were analyzed by Enthalpy Analytical in El Dorado Hills, CA, using EPA Method 1613B. One blank sample exhibited a detection above the MDL for a single compound, however, this detection was judged to not have an adverse impact on the quality of the data as detection of this compound in the final effluent sample within that batch was below the minimum level and did not contribute to the sum TEQ calculation. A summary of the QC associated with this analysis is presented in Table C-5. All remaining QC samples associated with this analysis passed.

Tributyltin was analyzed by Weck Laboratories using Standard Method 6710B. All QC samples associated with this analysis passed (Table C-5).

Organochlorine pesticides and polychlorinated biphenyls (PCBs) were analyzed by Weck Laboratories using EPA Method 608.3. A summary of the QC associated with this analysis is provided in Table C-5. In one batch, the blank spike duplicate recovery failed for all but three compounds. However, the blank spike displayed passing recoveries for all compounds. Due to the differences in percent recovery between the blank spike/blank spike duplicate in that batch, all compounds were outside of precision criteria. All data within that batch were qualified with appropriate qualifier codes. In the second batch displayed in Table C-5, all QC samples met method acceptance criteria.

Individual PCB congeners were analyzed by Eurofins Sacramento in Sacramento, CA, using EPA Method 1668C. All QC samples associated with this analysis passed (Table C-5).

Pharmaceuticals and Personal Care Products (PPCPs) and phosphate flame retardants were analyzed together by Weck Laboratories using EPA Method 1694 (modified), excluding the analyte galaxolide, which was analyzed by Eurofins Eaton in Pomona, CA, using Eurofins Eaton Lab SOP “PBDE, Pyrethroids, and Pesticides”. Two samples were analyzed for galaxolide during this program year, and blank spike duplicate samples were only performed for this analyte. A summary of the QC associated with this analysis is presented in Table C-5. All QC samples associated with this analysis passed, except for precision criteria for one of the blank spike/blank spike duplicate sets associated with the analysis for galaxolide. Results associated with this batch were deemed acceptable after careful consideration of all other passing QC samples, and the data were qualified with appropriate qualifier codes.

Pyrethroids were analyzed by Weck Laboratories using EPA Method 8270 (modified). All QC samples associated with this analysis passed (Table C-5).

Polybrominated Diphenyl Ethers (PBDEs) were analyzed by ALS Environmental in Burlington, ON, Canada, using EPA Method 1614. All QC samples associated with this analysis passed (Table C-5).

Chlorpyrifos and Diazinon were analyzed by Weck Laboratories using EPA Method 625.1. Chlorpyrifos was also analyzed and reported from one of the samples sent to Eurofins Eaton for galaxolide analysis. A summary of the QC associated with this analysis is presented in Table C-5. Chlorpyrifos failed slightly low in the blank spike sample analyzed by Weck. Diazinon failed slightly low in the blank spike/blank spike duplicate set, also analyzed by Weck. In this instance, the sample data was deemed acceptable as chlorpyrifos met acceptance criteria in the blank spike duplicate, and both chlorpyrifos and diazinon produced acceptable recovery in a low-level standard also analyzed with the batch. Detections for both analytes in the effluent sample were at or below the RL.

Industrial Endocrine Disrupting Compounds (IEDCs), in the form of alkylphenols and alkylphenol ethoxylates, were analyzed by Weck Laboratories using ASTM Method D7065. A summary of the QC associated with this analysis is provided in Table C-5. All QC samples associated with this analysis passed.

Radionuclides

Radionuclides analyzed include gross alpha, gross beta, radium-226, radium-228, strontium-90, tritium, and uranium.

Gross alpha and gross beta were analyzed by Weck Labs using Standard Method 7110 C and EPA Method 900.0, respectively. A summary of the QC associated with these analyses is provided in Table C-5. All QC samples associated with gross alpha and gross beta analyses passed method acceptance criteria.

Radium-226 and radium-228 were analyzed by GEL Laboratories in Charleston, SC, using EPA Methods 903.1 and 904.0, respectively. A summary of the QC associated with these analyses is presented in Table C-5. For radium-226, one blank sample did not meet method acceptance criteria, however, detection of radium-226 in the associated effluent sample was below the MDA. For radium-228, three blank samples did not meet method acceptance criteria, however, in all cases the detection of radium-228 in associated effluent samples was below the MDA. All other QC samples met acceptance criteria for radium-226 and radium-228 analyses.

Strontium-90 and tritium were analyzed by GEL Laboratories using EPA Methods 905.0 and 906.0, respectively. A summary of the QC associated with these analyses is presented in Table C-5. For strontium-90, one blank spike sample exceeded acceptance criteria, however in that instance, the associated effluent sample result was below the MDA. All remaining QC samples for Strontium-90 met the method acceptance criteria during the program year. For tritium, all QC samples during the program year met the method acceptance criteria.

Uranium was analyzed by Weck Laboratories using EPA Method 200.8. A summary of the QC associated with this analysis is presented in Table C-5. All QC samples analyzed during the monitoring period met the method acceptance criteria.

Potassium and Total Dissolved Solids (TDS) were analyzed by Weck Laboratories along with the gross alpha and gross beta samples to provide supporting data. A summary of the QC associated with this analysis is provided in Table C-5. TDS data are used to determine which analytical method is best suited to the particular sample being analyzed. All QC criteria relating to the TDS analysis were met. Potassium data are used to evaluate the contribution of naturally occurring beta radiation to the gross beta result. For potassium, all QC samples met the method acceptance criteria.

Whole Effluent Toxicity

Whole effluent toxicity (WET) testing was performed at the OC San laboratory or at Enthalpy Analytical for the months of December 2023 and March 2024. On a monthly basis, chronic WET testing was performed using ELOM SOP 8230 and 8240. On a quarterly basis, acute WET testing was performed using ELOM SOP 8510. All QC samples for quarterly acute met the required acceptance criteria during the program year. Eleven out of 12 QC samples for monthly chronic WET testing met the required acceptance criteria during the program year (Table C-4). A valid chronic WET test for March 2024 was not available, because at least one test acceptability criteria (TAC) was not met in two in-house and one external reference toxicant tests. From March 7-14, 2024, OC San conducted an in-house test, and the reference toxicant test failed to meet the following TAC: >0.85mg average weight of control larvae, LC_{50} with copper <205 µg/L, and <25% minimum significant difference for survival. OC San conducted another in-house test from March 21-28, 2024, and the reference toxicant test failed to meet the LC_{50} with copper <205 µg/L TAC. Lastly, OC San sent out testing to Enthalpy Analytical from March 27-April 3, 2024, and the reference toxicant test failed to meet the LC_{50} with copper <205 µg/L TAC. After conducting a root-cause analysis, the TAC failures were likely due to the poor quality of topsmelt provided by the sole nationwide supplier. This conclusion was based on: 1) OC San follows standard laboratory protocols for organism handling as outlined in EPA/600/R-95/136; 2) a different dilution water source was used for each round of testing in March; 3) no out-of-range water quality measurements were recorded during the three rounds of testing in March; and 4) other contract laboratories also observed reference toxicant tests that failed to meet the LC_{50} with copper <205 µg/L.

Aggregate Organics

Aggregate organics analyses include measurements of Biochemical Oxygen Demand (BOD), Carbonaceous BOD (CBOD), and oil and grease. All analyses were performed at the OC San laboratory. QC summary data can be found in Table C-4.

BOD and CBOD were determined by ELOM SOP 5210 B. For BOD and CBOD, most QC samples met the method acceptance criteria. The BOD method is sensitive to temperature and atmospheric pressure, which can result in occasional QC failures. Data associated with failing QC samples were reported with appropriate qualifiers after reviewing the other successful QC associated with the batch. Corrective action investigations were carried out to identify the root causes of the failures, and to identify ways to prevent those failures from recurring in the future.

Oil and grease were measured using ELOM SOP 400_1664 B. For oil and grease, all QC samples met the method acceptance criteria during this program year, with the exception of one matrix spike sample which exhibited low recovery. The data in the affected batch were deemed acceptable after careful consideration and evaluation of all the other passing QC samples within that batch.

Table C-4 Final effluent QA/QC summary for samples analyzed at OC San's Laboratory during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Quarterly	Purgeable Organic Compounds	5 (5)	Blank	5	32	131	100
			Lab Blank	4	32	128	100
			Trip Blank	4	32	128	100
			Blank Spike	5	32	130	99
			Matrix Spike	5	32	127	97
			Matrix Spike Duplicate	5	32	127	97
			Matrix Spike Precision	5	32	130	99
Discrepancies in % of compounds passed attributable to the condition that not all analytes were run for all QC samples. [a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike - Target accuracy % recovery varies by analyte. For matrix spike and matrix spike duplicate - Target accuracy % recovery varies by analyte. For matrix spike precision - Target precision % RPD varies by analyte.							
Monthly	Semi-volatile Organic Compounds	13 (13)	Blank	13	57	682	100
			Blank Spike	13	57	668	98
			Matrix Spike	13	57	643	94
			Matrix Spike Duplicate	13	57	648	95
			Matrix Spike Precision	13	57	672	98
[a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike - Target accuracy % recovery varies by analyte. For matrix spike and matrix spike duplicate - Target accuracy % recovery varies by analyte. For matrix spike precision - Target precision % RPD varies by analyte.							
Monthly	Metals	15 (12)	Blank	36	15	539	100
			Blank Spike	12	15	180	100
			Matrix Spike	16	15	240	100
			Matrix Spike Duplicate	16	15	239	100
			Matrix Spike Precision	16	15	240	100
[a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank ≤10% <2.2 × MDL (10% of analyte level determined for sample). For blank spike - Target accuracy % recovery 85–115. For matrix spike - Target accuracy % recovery 70–130. For matrix spike duplicate - Target accuracy % recovery 70–130. For matrix spike precision - Target precision % RPD <20.							

Table C-4 Final effluent QA/QC summary for samples analyzed at OC San's Laboratory during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Monthly	Total Phosphorus	12 (12)	Blank	12	1	12	100
			Blank Spike	12	1	12	100
			Matrix Spike	12	1	10	83
			Matrix Spike Duplicate	12	1	11	92
			Matrix Spike Precision	12	1	12	100

[a] An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank ≤10% <2.2 × MDL (10% of analyte level determined for sample).
For blank spike - Target accuracy % recovery 85–115.
For matrix spike - Target accuracy % recovery 70–130.
For matrix spike duplicate - Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <20.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Daily	Ammonia Nitrogen	365 (111)	Blank	214	1	206	96
			Blank Spike	214	1	214	100
			Matrix Spike	393	1	379	96
			Matrix Spike Duplicate	392	1	378	96
			Matrix Spike Precision	392	1	391	100

[a] An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <MDL.
For blank spike - Target accuracy % recovery 90–110.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 90–110.
For matrix spike precision - Target precision % RPD ≤10.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Monthly	TKN	11 (11)	Blank	11	1	7	64
			Blank Spike	11	1	10	91
			Matrix Spike	11	1	10	91
			Matrix Spike Duplicate	11	1	10	91
			Matrix Spike Precision	11	1	11	100

[a] An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <MDL.
For blank spike - Target accuracy % recovery 90–110.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 90–110.
For matrix spike precision - Target precision % RPD ≤10.

Table C-4 Final effluent QA/QC summary for samples analyzed at OC San's Laboratory during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Monthly	Cyanide	1 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	1	1	0	0
			Matrix Spike Duplicate	1	1	1	100
			Matrix Spike Precision	1	1	1	100
[a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike - Target accuracy % recovery 90–110. For matrix spike and matrix spike duplicate - Target accuracy % recovery 90–110. For matrix spike precision - Target precision % RPD ≤10.							
Daily	pH	366 (366)	Duplicate	366	1	363	99
			Check Standard	366	1	366	100
[a] An analysis passed if the following criteria were met: For duplicate - Target precision % RPD ≤5. For check standard - Target accuracy ±0.1 pH units							
Monthly	Turbidity	12 (12)	Blank	12	1	12	100
			Duplicate	12	1	12	100
[a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <0.10 NTU. For duplicate - Target precision % RPD ≤25.							
Daily	Total Residual Chlorine	1,098 (732)	Blank	367	1	367	100
			Duplicate	1,327	1	1,325	100
[a] An analysis passed if the following criteria were met: For duplicate: Target precision % RPD ≤50.							
Monthly	Oil & Grease	12 (12)	Blank	12	1	12	100
			Blank Spike	12	1	12	100
			Matrix Spike	12	1	11	92
			Duplicate	12	1	12	100
[a] An analysis passed if the following criteria were met: For blank – Analyte concentration in the Blank < MDL For blank spike – Target accuracy % recovery 78–114 For matrix spike – Target accuracy % recovery 78–114 For duplicate - Target precision % RPD ≤ 18.							

Table C-4 Final effluent QA/QC summary for samples analyzed at OC San's Laboratory during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Daily	Biochemical Oxygen Demand (BOD)	366 (364)	Blank BOD	364	1	359	99
			Blank Spike BOD	364	1	349	96
			Duplicate BOD	573	1	560	98
	Carbonaceous BOD (CBOD)		Blank Spike CBOD	364	1	356	98
			Duplicate CBOD	364	1	364	100

[a] An analysis passed if the following criteria were met:
For blank BOD T - Analyte concentration in the Blank ≤0.20 mg/L average depletion.
For blank spike BOD T - Target accuracy 198±30.5 mg/L.
For blank spike BOD C - Target accuracy 180±28 mg/L.
For duplicate BOD T and BOD C - Target precision % RPD ≤30.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Daily	Total Suspended Solids	366 (365)	Blank	365	1	365	100
			Blank Spike	365	1	365	100
			Duplicate	730	1	729	100

[a] An analysis passed if the following criteria were met:
For blank – Analyte concentration in the Blank < 0.5 mg/L
For blank spike – Target accuracy % recovery 82–116.
For duplicate – Target precision % RPD ≤ 20.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Daily	Settleable Solids (Composite)	366 (366)	Duplicate	366	1	366	100
Daily	Settleable Solids (Grab)	732 (366)					

[a] An analysis passed if the following criteria were met:
For duplicate: Target precision % RPD ≤ 25%.

Table C-4 Final effluent QA/QC summary for samples analyzed at OC San's Laboratory during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Annually	Hormones	1 (1)	Blank	1	7	7	100
			Blank Spike	1	7	6	86
			Blank Spike Duplicate	1	7	6	86
			Blank Spike Precision	1	7	7	100
			Matrix Spike	1	7	7	100
			Matrix Spike Duplicate	1	7	7	100
			Matrix Spike Precision	1	7	6	86

[a] An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <3 × MDL.
For blank spike and blank spike duplicate - Target accuracy % recovery 70–150.
For blank spike precision - Target precision % RPD ≤30.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–150.
For matrix spike precision - Target precision % RPD ≤30.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Monthly	Chronic Whole Effluent Toxicity	12 (12)	Reference Toxicant Test Negative Control Germination and Mean Length [b]; Control Survival and Biomass [c]	12	1	11	92
Quarterly	Acute Whole Effluent Toxicity	4 (4)	Reference Toxicant Test Negative Control Survival	4	1	4	100

[a] An analysis passed if the following criteria were met:
For chronic kelp reference toxicant test ≥ 70% germination in control; > 10 µm germ-tube length in control; NOEC < 35 µg/L, %MSD of <20 for both germination and germ-tube length.
For chronic topsmelt reference toxicant test ≥ 80% survival in controls; >0.85 mg average weight of control larvae (9 day old); LC50 with copper must be <205 µg/L; <25% MSD for survival and <50% MSD for biomass.
For acute topsmelt reference toxicant test: control survival ≥ 90%.
[b] Kelp test used July 2023–October 2023.
[c] Topsmelt test used November 2023–June 2024.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Annual	Fecal Coliforms	366 (366)	Duplicate	52	1	50	96
	Enterococci	366 (366)	Duplicate	54	1	54	100

[a] Analysis passed if the average range of logarithms is less than the precision criterion.

Table C-5 Final effluent QA/QC summary for samples analyzed at contract laboratories during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed *	% Compounds Passed
Monthly	Nitrate as N and Nitrite as N	12 (12)	Blank	13	2	26	100
			Blank Spike	13	2	26	100
			Matrix Spike	21	2	40	100
			Matrix Spike Duplicate	21	2	40	100
			Matrix Spike Precision	21	2	42	100
			Duplicate Precision	1	2	2	100
Discrepancies in % of compounds passed attributable to the condition that not all analytes were run for all QC samples. * An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike - Target accuracy % recovery 90–110. For matrix spike and matrix spike duplicate - Target accuracy % recovery 90–110. For matrix spike precision - Target precision % RPD <20. For duplicate precision – Target precision % RPD <20.							
Daily	Ammonia Nitrogen	1(1)	Blank	2	1	2	100
			Blank Spike	2	1	2	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
* An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike - Target accuracy % recovery 90–110. For matrix spike and matrix spike duplicate – Target accuracy % recovery 90–110. For matrix spike precision – Target precision % RPD ≤ 15.							
Monthly	TKN	1(1)	Blank	2	1	2	100
			Blank Spike	2	1	2	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
* An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike - Target accuracy % recovery 90–110. For matrix spike and matrix spike duplicate – Target accuracy % recovery 90–110. For matrix spike precision – Target precision % RPD ≤10.							

Table C-5 Final effluent QA/QC summary for samples analyzed at contract laboratories during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed*	% Compounds Passed
Monthly	Cyanide	12 (12)	Blank	12	1	12	100
			Blank Spike	12	1	11	92
			Matrix Spike	12	1	8	67
			Matrix Spike Duplicate	12	1	9	75
			Matrix Spike Precision	12	1	10	83

* An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <MDL.
For blank spike - Target accuracy % recovery 90–110.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 90–110.
For matrix spike precision - Target precision % RPD <20.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed*	% Compounds Passed
Monthly	Chromium, Total	3 (3)	Blank	3	1	3	100
			Blank Spike	3	1	3	100
			Matrix Spike	5	1	5	100
			Matrix Spike Duplicate	5	1	5	100
			Matrix Spike Precision	5	1	5	100

[a] An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <MDL.
For blank spike - Target accuracy % recovery 85–115.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <30.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed*	% Compounds Passed
Monthly	Chromium, Hexavalent	3 (3)	Blank	3	1	3	100
			Blank Spike	3	1	3	100
			Matrix Spike	6	1	5	83
			Matrix Spike Duplicate	6	1	5	83
			Matrix Spike Precision	6	1	5	83

[a] An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <MDL.
For blank spike - Target accuracy % recovery 90–110.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 88–112.
For matrix spike precision - Target precision % RPD <10.

Table C-5 Final effluent QA/QC summary for samples analyzed at contract laboratories during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed *	% Compounds Passed
Monthly	Mercury	12 (12)	Blank	15	1	15	100
			Trip Blank	12	1	8	67
			Blank Spike	12	1	12	100
			Matrix Spike	16	1	16	100
			Matrix Spike Duplicate	16	1	16	100
			Matrix Spike Precision	16	1	16	100

* An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <MDL.
For trip blank – Analyte concentration in the Trip Blank <MDL
For blank spike - Target accuracy % recovery 85–115.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 75–125.
For matrix spike precision - Target precision % RPD <20.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed *	% Compounds Passed
Monthly	Gross Alpha	12 (12)	Blank	12	1	12	100
			Blank Spike	12	1	12	100
			Matrix Spike	12	1	12	100
			Matrix Spike Duplicate	12	1	12	100
			Matrix Spike Precision	12	1	12	100

* An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <20% sample results.
For blank spike - Target accuracy % recovery 75–183 (July 2023–August 2023), 60–122 (September 2023–April 2024), 72–130 (May 2024–June 2024).
For matrix spike and matrix spike duplicate - Target accuracy % recovery 17–172 (July 2023–August 2023), 28–149 (September 2023–April 2024), 67–141 (May 2024–June 2024).
For matrix spike precision - Target precision % RPD <30.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed *	% Compounds Passed
Monthly	Gross Beta	12 (12)	Blank	13	1	13	100
			Blank Spike	12	1	12	100
			Matrix Spike	12	1	12	100
			Matrix Spike Duplicate	12	1	12	100
			Matrix Spike Precision	12	1	12	100

* An analysis passed if the following criteria were met:
For blank - Analyte concentration in the Blank <20% sample results.
For blank spike - Target accuracy % recovery 77–123.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 61–125.
For matrix spike precision - Target precision % RPD <30.

Table C-5 Final effluent QA/QC summary for samples analyzed at contract laboratories during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed *	% Compounds Passed
Monthly	Radium-226	12 (12)	Blank	12	1	11	92
			Blank Spike	12	1	12	100
			Matrix Spike	12	1	12	100
			Duplicate	12	1	12	100
* An analysis passed if the following criteria were met: For blank – Analyte concentration in the Blank <20% sample results. For blank spike - Target accuracy % recovery 75–125 (July–October 2023, December 2023, May–June 2024), 90–110 (November 2023, January–April 2024). For matrix spike - Target accuracy % recovery 75–125 (July–October 2023, December 2023, May–June 2024), 80–120 (November 2023, January–April 2024). For duplicate - Target precision % RPD <20 at 5xMDA.							
Monthly	Radium-228	12 (12)	Blank	12	1	9	75
			Blank Spike	12	1	12	100
			Matrix Spike	4	1	4	100
			Duplicate	12	1	12	100
* An analysis passed if the following criteria were met: For blank – Analyte concentration in the Blank <20% sample results. For blank spike - Target accuracy % recovery 75–125 (July–October 2023, December 2023, May–June 2024), 80–120 (November 2023, January –April 2024). For matrix spike - Target accuracy % recovery 70–130 (November 2023, January –April 2024). For duplicate - Target precision % RPD <20 at 5 × MDA.							
Monthly	Strontium-90	12 (12)	Blank	12	1	12	100
			Blank Spike	12	1	11	92
			Matrix Spike	4	1	4	100
			Duplicate	12	1	12	100
* An analysis passed if the following criteria were met: For blank – Analyte concentration in the Blank <20% sample results. For blank spike - Target accuracy % recovery 75–125 (July–December 2023, April–June 2024), 90–110 (January–March 2024). For matrix spike - Target accuracy % recovery 75–125 (July–December 2023, April–June 2024), 80–120 (January–March 2024) For duplicate – Target precision % RPD <20 at 5 × MDA.							
Monthly	Tritium	11 (11)	Blank	11	1	11	100
			Blank Spike	11	1	11	100
			Matrix Spike	11	1	11	100
			Duplicate	11	1	11	100
* An analysis passed if the following criteria were met: For blank – Analyte concentration in the Blank <20% sample results. For blank spike - Target accuracy % recovery 75–125 (July–December 2023, April–June 2024), 90–110 (January–March 2024). For matrix spike - Target accuracy % recovery 75–125 (July–December 2023, April–June 2024), 80–120 (January–March 2024). For duplicate – Target precision % RPD <20 at 5 × MDA.							

Table C-5 Final effluent QA/QC summary for samples analyzed at contract laboratories during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed *	% Compounds Passed
Monthly	Uranium	12(12)	Blank	12	1	12	100
			Blank Spike	12	1	12	100
			Matrix Spike	17	1	17	100
			Matrix Spike Duplicate	17	1	17	100
			Matrix Spike Precision	17	1	17	100
* An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <20% sample results. For blank spike - Target accuracy % recovery 85–115. For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130. For matrix spike precision - Target precision % RPD <30.							
Monthly	Potassium	12(12)	Blank	12	1	12	100
			Blank Spike	12	1	12	100
			Matrix Spike	21	1	21	100
			Matrix Spike Duplicate	21	1	21	100
			Matrix Spike Precision	21	1	21	100
			Duplicate Precision	1	1	1	100
* An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike - Target accuracy % recovery 85–115. For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130. For matrix spike precision - Target precision % RPD <30. For duplicate precision – Target precision % RPD <30.							
Monthly	Total Dissolved Solids	12(12)	Blank	12	1	12	100
			Blank Spike	12	1	12	100
			Duplicate	23	1	23	100
[a] An analysis passed if the following criteria were met: For blank - Target amount <RL. For blank spike - Target accuracy % recovery 97–103. For matrix spike precision - Target precision % RPD <10.							

Table C-5 Final effluent QA/QC summary for samples analyzed at contract laboratories during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed *	% Compounds Passed
Semi-annually (2023)	Organochlorine Pesticides and PCBs	1(1)	Blank	1	35	35	100
			Trip Blank	1	35	35	100
			Blank Spike	1	19	19	100
			Blank Spike Duplicate	1	19	3	16
			Blank Spike Precision	1	19	0	0
Semi-annually (2024)	Organochlorine Pesticides and PCBs	1(1)	Blank	1	35	35	100
			Trip Blank	1	35	35	100
			Blank Spike	1	19	19	100
			Blank Spike Duplicate	1	19	19	100
			Blank Spike Precision	1	19	19	100
* An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For trip blank – Analyte concentration in the Trip Blank <MDL For blank spike and blank spike duplicate - Target accuracy % recovery varies by analyte. For blank spike precision - Target precision % RPD <30.							
Annual	PCB Congeners	1(1)	Blank	1	37	37	100
			Blank Spike	1	20	20	100
			Blank Spike Duplicate	1	20	20	100
			Blank Spike Precision	1	20	20	100
* An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank < 2 × ML in Table 2 of EPA Method 1668C. For blank spike and blank spike duplicate - Target accuracy % recovery 60–135. For blank spike precision - Target precision % RPD <50.							
Quarterly	TCDD Equivalents	4(4)	Blank	4	17	67	99
			Blank Spike	4	17	68	100
* An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike - Target accuracy % recovery varies by analyte.							

Table C-5 Final effluent QA/QC summary for samples analyzed at contract laboratories during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [*]	% Compounds Passed
Annually	Pharmaceuticals and Personal Care Products	3(6)	Blank	6	17	18	100
			Blank Spike	6	17	18	100
			Blank Spike Duplicate	2	1	2	100
			Blank Spike Precision	2	1	1	50
			Matrix Spike	4	16	16	100
			Matrix Spike Duplicate	4	16	16	100
			Matrix Spike Precision	4	16	16	100
Discrepancies in % of compounds passed attributable to the condition that not all analytes were run for all QC samples. [a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank < 2 × MDL. For blank spike and blank spike duplicate - Target accuracy % recovery 23–118 (Galaxolide only), 50-150 (others). For blank spike precision- Target precision % RPD <30 (galaxolide only). For matrix spike and matrix spike duplicate - Target accuracy % recovery 50–150 (except for Galaxolide). For matrix spike precision - Target precision % RPD <30 (except for Galaxolide).							
Annually	Pyrethroids	1(1)	Blank	1	4	4	100
			Blank Spike	1	4	4	100
			Blank Spike Duplicate	1	4	4	100
			Blank Spike Precision	1	4	4	100
[a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike and blank spike duplicate - Target accuracy % recovery 50–150. For blank spike precision – Target precision % RPD <50.							
Annually	PBDEs	1(1)	Blank	1	4	4	100
			Blank Spike	1	4	4	100
[a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank ≤10% MDL (10% of analyte level determined for sample). For blank spike - Target accuracy % recovery 50–150.							
Annually	Chlorpyrifos & Diazinon	2(2)	Blank	2	2	3	100
			Blank Spike	2	2	1	33
			Blank Spike Duplicate	2	2	2	67
			Blank Spike Precision	2	2	3	100
			Matrix Spike	1	1	0	0
Discrepancies in % of compounds passed attributable to the condition that not all analytes were run for all QC samples. [a] An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank < MDL. For blank spike and blank spike duplicate- Target accuracy % recovery 72–144 (Chlorpyrifos 2023), 22–121 (Chlorpyrifos 2024), 75–151 (Diazinon). For blank spike precision - Target precision % RPD <30. For matrix spike – Target accuracy % recovery 33–121% (Chlorpyrifos only).							

Table C-5 Final effluent QA/QC summary for samples analyzed at contract laboratories during the 2023-24 program year.

Frequency	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed *	% Compounds Passed
Annually	Ethoxylates	1(1)	Blank	1	11	11	100
			Blank Spike	1	11	11	100
			Blank Spike Duplicate	1	11	11	100
			Blank Spike Precision	1	11	11	100
a An analysis passed if the following criteria were met: For blank - Analyte concentration in the Blank <MDL. For blank spike and blank spike duplicate - Target accuracy % recovery 50–150. For blank spike precision - Target precision % RPD <30.							
Quarterly	Tributyltin	4(4)	Blank	4	1	4	100
			Blank Spike	4	1	4	100
			Blank Spike Duplicate	4	1	4	100
			Blank Spike Precision	4	1	4	100

* An analysis passed if the following criteria were met:
For blank – Analyte concentration in the Blank <MDL.
For blank spike – Target accuracy % recovery 50–150.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 50–150.
For matrix spike precision - Target precision % RPD <40.

INTRODUCTION – CORE OCEAN MONITORING PROGRAM QA/QC

OC San's Core Ocean Monitoring Program (OMP) is designed to measure compliance with permit conditions and for temporal and spatial trend analysis. The program includes measurements of:

- Water quality,
- Sediment quality,
- Benthic infaunal community health,
- Fish and epibenthic macroinvertebrate community health,
- Fish tissue contaminant concentrations (chemical body burden), and
- Fish health (including external parasites and diseases).

The Core OMP complies with OC San's Quality Assurance Project Plan (QAPP; OCSD 2016) requirements and applicable federal, state, local, and contract requirements. The objectives of the quality assurance program are as follows:

- Scientific data generated will be of sufficient quality to stand up to scientific and legal scrutiny.
- Data will be gathered or developed in accordance with procedures appropriate for the intended use of the data.
- Data will be of known and acceptable precision, accuracy, representativeness, completeness, and comparability as required by the program.

The various aspects of the program are conducted on a weekly, monthly, quarterly, semi-annual, annual, or quinquennial schedule. Sampling and data analyses are designated by quarters, which are referred to as winter (January–March), spring (April–June), summer (July–September), and fall (October–December).

This appendix details quality assurance/quality control (QA/QC) information for the collection and analysis of water quality, sediment geochemistry, fish tissue chemistry, and benthic infauna samples for OC San's 2023-24 Core OMP.

RECEIVING WATER QUALITY NARRATIVE

OC San's Environmental Laboratory and Ocean Monitoring (ELOM) staff collected 2,172 combined samples for NH_3-N and nitrate-nitrite nitrogen (NO_3+NO_2-N) (543 in each quarter during the 2023-24 program year). Twelve surface seawater samples were also collected at a control site (Station 2106) in each quarter. All samples were stored on wet ice upon collection. Samples were preserved with 1:1 sulfuric acid upon receipt by the ELOM laboratory staff, and then stored at <6.0 °C until analysis according to the ELOM's Standard Operating Procedures (SOPs) (OCSD 2023).

ELOM staff also collected 175 bacteria samples in each quarter of the 2023-24 program year. One bottle was damaged during transport in the winter quarter resulting in an unusable sample. All samples were iced upon collection and stored at <10 °C until analysis in accordance with ELOM SOPs.

Ammonia as Nitrogen (NH_3-N)

The samples were analyzed for NH_3-N on a segmented flow analyzer using Standard Methods 4500-NH_3-G-Ocean Water. Sodium salicylate and dichloroisocyanuric acid were added to the samples to react with NH_3-N to form indophenol blue in a concentration proportional to the NH_3-N concentration in the sample. The blue color was intensified with sodium nitroprusside and was measured at 660 nm. During the spring quarter, two samples were inadvertently analyzed for NH_3-N instead of NO_3+NO_2-N, resulting in 545 samples analyzed for NH_3-N in contrast with the 543 samples collected in that quarter.

For each batch, a blank and a spike in a seawater control were analyzed every 20 or fewer samples. In addition, a matrix spike and matrix spike duplicate were analyzed every 10 or fewer samples. An external reference sample was analyzed once each month. The method detection limit (MDL) for low-level NH_3-N samples using the segmented flow instrument is shown in Table C-6. All samples were analyzed within the required holding time. Table C-7 contains all QA/QC samples analyzed within the 2023-24 program year. All analyses conducted met the established QA/QC acceptance criteria.

Nitrate Nitrite as Nitrogen (NO_3+NO_2-N)

The samples were analyzed for NO_3+NO_2-N on a segmented flow analyzer using EPA Method 353.2. Nitrate in the samples was reduced to nitrite upon passing through a reducing column. The nitrite was diazotized with sulfanilamide and then coupled with N-(1-napthyl) ethylene diamine dihydrochloride to form an azo dye in a concentration proportional to the NO_3+NO_2-N concentration in the sample. The color was measured at 520 nm. Due to ongoing issues with in-house instrumentation, some samples for NO_3+NO_2-N were sent to contract labs for analysis during the program year. During the fall quarter, 138 samples were sent to Enthalpy Analytical in Orange, CA, and 132 samples were sent to Weck Laboratories. During the winter quarter, 542 samples were sent to Weck Laboratories for analysis. One winter quarter sample was lost due to a broken sample bottle. During the spring quarter, 540 samples were sent to Weck Laboratories for analysis. One sample was lost due to a broken sample bottle, and two samples were accidentally analyzed for NH_3-N instead of NO_3+NO_2-N during the spring quarter. All samples sent to a contract lab for NO_3+NO_2-N analysis during the program year were analyzed using EPA method 353.2.

For each batch, a blank and a spike in a seawater control were analyzed every 20 or fewer samples. In addition, a matrix spike and matrix spike duplicate were analyzed every 10 or fewer samples. An external reference sample was analyzed once each month. The MDL for low-level NO_3+NO_2-N samples using the segmented flow instrument is shown in Table C-6. All samples were analyzed within the required holding time.

Table C-7 contains all QA/QC samples analyzed within the 2023-24 program year. Analyses conducted at OC San’s laboratory, Enthalpy Analytical, and Weck Laboratories met all established QA/QC criteria.

Bacteria

Samples collected offshore (i.e., Recreational (aka REC-1)) were analyzed for FIB using Enterolert™ for enterococci and Colilert-18™ for total coliforms and *Escherichia coli*. Fecal coliforms were estimated by multiplying detected *E. coli* results by a factor of 1.1. These methods utilize enzyme substrates that produce, upon hydrolyzation, a fluorescent signal when viewed under long-wavelength (365 nm) ultraviolet light. For samples collected along the shoreline (aka surfzone), samples were analyzed by membrane filtration methods. EPA Method 1600 was applied to enumerate enterococci bacteria. For enumeration of total and fecal coliforms, Standard Methods 9222B and 9222D were used, respectively. MDLs for bacteria are presented in Table C-6.

All samples were analyzed within the required holding time. REC-1 samples were processed and incubated within 8 hours of sample collection. At least one duplicate sample was analyzed in each sample batch; additional duplicates were analyzed based on the number of samples in the batch. At a minimum, duplicate analyses were performed on 10% of samples per sample batch. All equipment, reagents, and dilution waters were sterilized before use. Sterility of sample bottles was tested for each new lot/batch before use. Each lot of medium, whether prepared or purchased, was tested for sterility and performance with known positive and negative controls prior to use. For surfzone samples, a positive and a negative control were run simultaneously with each batch of sample for each type of media used to ensure performance. New lots of Quanti-Tray and petri dish were checked for sterility before use. Each Quanti-Tray sealer was checked monthly by addition of Gram stain dye to 100 mL of water, and the tray was sealed and subsequently checked for leakage. Each lot of commercially purchased dilution blanks was checked for appropriate volume and sterility. New lots of ≤10 mL volume pipettes were checked for accuracy by weighing volume delivery on a calibrated top loading scale. Although the precision criterion is used to measure the precision of duplicate analyses for plate-based methods (APHA 2017), this criterion was used for most probable number methods due to a lack of criterion. Acceptable duplicates ranged from 75% to 95% for the three FIB during the program year (Table C-7).

Table C-6 Method detection limit (MDL) and reporting limit (RL) for constituents analyzed in receiving water, sediment, and fish tissue samples during the 2023-24 program year.

Receiving Water Fecal Indicator Bacteria and Nutrients					
Parameter	**MDL (MPN/100 mL)**	**RL (MPN/100 mL)**	**Parameter**	**MDL (mg/L)**	**RL (mg/L)**
Total coliform	10	10	Ammonia Nitrogen	0.040	0.040
E. coli	10	10	Nitrate-Nitrite as N [a]	0.005	0.05
Enterococci	10	10	Nitrate-Nitrite as N [b]	0.033	0.05
			Nitrate-Nitrite as N [c,e]	0.12	0.10
			Nitrate-Nitrite as N [d,f]	0.036	0.20
Surfzone Fecal Indicator Bacteria					
Parameter	**MDL (CFU/100 mL)**	**RL (CFU/100 mL)**			
Total Coliform	17	17			
E. coli	17	17			
Enterococci	2	2			

[a] July 2023–October 2023
[b] April 2024
[c] November 2023
[d] December 2023–June 2024

Table C-6 Method detection limit (MDL) and reporting limit (RL) for constituents analyzed in receiving water, sediment, and fish tissue samples during the 2023-24 program year.

Sediment					
Parameter	**MDL (ng/g dry)**	**RL (ng/g dry)**	**Parameter**	**MDL (ng/g dry)**	**RL (ng/g dry)**
Organochlorine Pesticides (July 2023–January 2024)					
2,4'-DDD	0.10	0.50	Endosulfan-alpha	0.60	1.0
2,4'-DDE	0.10	0.50	Endosulfan-beta	0.30	1.0
2,4'-DDT	0.10	0.50	Endosulfan-sulfate	0.10	0.50
4,4'-DDD	0.11	0.50	Endrin	0.40	1.00
4,4'-DDE	0.10	0.50	Heptachlor	0.10	0.50
4,4'-DDT	0.10	0.50	Heptachlor epoxide	0.11	0.50
4,4'-DDMU	0.11	0.50	Hexachlorobenzene	0.10	0.50
Aldrin	0.11	0.50	Mirex	0.10	0.50
gamma-BHC	0.10	0.50	*cis*-Nonachlor	0.10	0.50
cis-Chlordane	0.10	0.50	*trans*-Nonachlor	0.10	0.50
trans-Chlordane	0.10	0.50	Oxychlordane	0.10	0.50
Dieldrin	0.20	1.0			
Parameter	**MDL (ng/g dry)**	**RL (ng/g dry)**	**Parameter**	**MDL (ng/g dry)**	**RL (ng/g dry)**
Organochlorine Pesticides (February 2024–June 2024)					
2,4'-DDD	0.07	0.50	Endosulfan-alpha	0.14	0.50
2,4'-DDE	0.70	1.0	Endosulfan-beta	0.24	0.50
2,4'-DDT	0.07	0.5	Endosulfan-sulfate	0.10	0.50
4,4'-DDD	0.10	0.50	Endrin	0.11	0.50
4,4'-DDE	0.13	0.50	Heptachlor	0.13	0.50
4,4'-DDT	0.08	0.50	Heptachlor epoxide	0.12	0.50
4,4'-DDMU	0.13	0.50	Hexachlorobenzene	0.07	0.50
Aldrin	0.08	0.50	Mirex	0.07	0.50
gamma-BHC	0.12	0.50	*cis*-Nonachlor	0.12	0.50
cis-Chlordane	0.11	0.50	*trans*-Nonachlor	0.14	0.50
trans-Chlordane	0.12	0.50	Oxychlordane	0.14	0.50
Dieldrin	0.16	0.50			

Table C-6 Method detection limit (MDL) and reporting limit (RL) for constituents analyzed in receiving water, sediment, and fish tissue samples during the 2023-24 program year.

Sediment PCB Congeners (July 2023–January 2024)					
Parameter	**MDL (ng/g dry)**	**RL (ng/g dry)**	**Parameter**	**MDL (ng/g dry)**	**RL (ng/g dry)**
PCB 8	0.05	0.10	PCB 128	0.05	0.10
PCB 18	0.05	0.10	PCB 138	0.05	0.10
PCB 28	0.05	0.10	PCB 149	0.05	0.10
PCB 37	0.05	0.10	PCB 151	0.05	0.10
PCB 44	0.05	0.10	PCB 153/168	0.08	0.10
PCB 49	0.05	0.10	PCB 156	0.05	0.10
PCB 52	0.05	0.10	PCB 157	0.05	0.10
PCB 66	0.05	0.10	PCB 158	0.05	0.10
PCB 70	0.05	0.10	PCB 167	0.05	0.10
PCB 74	0.05	0.10	PCB 169	0.05	0.10
PCB 77	0.05	0.10	PCB 170	0.05	0.10
PCB 81	0.05	0.10	PCB 177	0.05	0.10
PCB 87	0.05	0.10	PCB 180	0.05	0.10
PCB 99	0.05	0.10	PCB 183	0.05	0.10
PCB 101	0.05	0.10	PCB 187	0.05	0.10
PCB 105	0.05	0.10	PCB 189	0.05	0.10
PCB 110	0.05	0.10	PCB 194	0.05	0.10
PCB 114	0.05	0.10	PCB 195	0.05	0.10
PCB 118	0.05	0.10	PCB 201	0.05	0.10
PCB 119	0.05	0.10	PCB 206	0.05	0.10
PCB 123	0.05	0.10			
PCB 126	0.05	0.10			

Table C-6 Method detection limit (MDL) and reporting limit (RL) for constituents analyzed in receiving water, sediment, and fish tissue samples during the 2023-24 program year.

Sediment					
PCB Congeners (February 2024–June 2024)					
Parameter	**MDL (ng/g dry)**	**RL (ng/g dry)**	**Parameter**	**MDL (ng/g dry)**	**RL (ng/g dry)**
PCB 8	0.04	0.20	PCB 128	0.04	0.20
PCB 18	0.07	0.20	PCB 138	0.04	0.20
PCB 28	0.04	0.20	PCB 149	0.05	0.20
PCB 37	0.05	0.20	PCB 151	0.06	0.20
PCB 44	0.05	0.20	PCB 153/168	0.04	0.20
PCB 49	0.07	0.20	PCB 156	0.05	0.20
PCB 52	0.07	0.20	PCB 157	0.06	0.20
PCB 66	0.07	0.20	PCB 158	0.04	0.20
PCB 70	0.06	0.20	PCB 167	0.05	0.20
PCB 74	0.04	0.20	PCB 169	0.05	0.20
PCB 77	0.05	0.20	PCB 170	0.04	0.20
PCB 81	0.04	0.20	PCB 177	0.04	0.20
PCB 87	0.12	0.20	PCB 180	0.04	0.20
PCB 99	0.07	0.20	PCB 183	0.04	0.20
PCB 101	0.07	0.20	PCB 187	0.04	0.20
PCB 105	0.09	0.20	PCB 189	0.05	0.20
PCB 110	0.12	0.20	PCB 194	0.03	0.20
PCB 114	0.05	0.20	PCB 195	0.05	0.20
PCB 118	0.05	0.20	PCB 201	0.07	0.20
PCB 119	0.06	0.20	PCB 206	0.06	0.20
PCB 123	0.04	0.20			
PCB 126	0.04	0.20			

Table C-6 Method detection limit (MDL) and reporting limit (RL) for constituents analyzed in receiving water, sediment, and fish tissue samples during the 2023-24 program year.

Parameter	MDL (ng/g dry)	RL (ng/g dry)	Parameter	MDL (ng/g dry)	RL (ng/g dry)
Sediment PAH Compounds (July 2023–April 2024)					
1,6,7-Trimethylnaphthalene	1.41	2.0	Benzo(g,h,i)perylene	2.06	5.0
1-Methylnaphthalene	1.19	2.0	Benzo(k)fluoranthene	5.97	6.0
1-Methylphenanthrene	2.67	5.0	Biphenyl	1.33	2.0
2,6-Dimethylnaphthalene	1.12	2.0	Chrysene	3.37	5.0
2-Methylnaphthalene	1.25	2.0	Dibenz(a,h)anthracene	1.72	2.0
Acenaphthene	1.31	2.0	Fluoranthene	4.84	5.0
Acenaphthylene	1.41	2.0	Fluorene	1.40	2.0
Anthracene	1.53	2.0	Indeno(1,2,3-c,d)pyrene	5.19	6.0
Benz(a)anthracene	3.16	5.0	Naphthalene	3.24	5.0
Benzo(a)pyrene	2.25	5.0	Perylene	1.64	2.0
Benzo(b+j)fluoranthene	3.96	5.0	Phenanthrene	3.18	5.0
Benzo(e)pyrene	1.12	2.0	Pyrene	5.03	6.0
Sediment PAH Compounds (May 2024–June 2024)					
1,6,7-Trimethylnaphthalene	0.41	2.0	Benzo(g,h,i)perylene	0.54	2.0
1-Methylnaphthalene	0.53	2.0	Benzo(k)fluoranthene	0.65	2.0
1-Methylphenanthrene	0.41	2.0	Biphenyl	10	10
2,6-Dimethylnaphthalene	0.30	2.0	Chrysene	0.44	2.0
2-Methylnaphthalene	0.41	2.0	Dibenz(a,h)anthracene	0.49	2.0
Acenaphthene	0.36	2.0	Fluoranthene	0.51	2.0
Acenaphthylene	1.1	2.0	Fluorene	0.25	2.0
Anthracene	0.43	2.0	Indeno(1,2,3-c,d)pyrene	0.49	2.0
Benz(a)anthracene	0.68	2.0	Naphthalene	0.72	2.0
Benzo(a)pyrene	0.38	2.0	Perylene	0.55	2.0
Benzo(b+j)fluoranthene	0.78	4.0	Phenanthrene	0.64	2.0
Benzo(e)pyrene	0.64	2.0	Pyrene	0.57	2.0

Table C-6 Method detection limit (MDL) and reporting limit (RL) for constituents analyzed in receiving water, sediment, and fish tissue samples during the 2023-24 program year.

Metals					
Parameter	**MDL (µg/kg dry)**	**RL (µg/kg dry)**	**Parameter**	**MDL (µg/kg dry)**	**RL (µg/kg dry)**
Antimony	57.8	100	Lead	20.2	50
Arsenic	26.9	50	Mercury	0.75	0.8
Barium	75.6	100	Nickel	57.1	100
Beryllium	15.0	50	Selenium	241	250
Cadmium	44.7	50	Silver	69.5	100
Chromium	29.2	50	Zinc	431	750
Copper	69.1	100			
Sediment Miscellaneous Parameters					
Parameter	**MDL (mg/kg dry)**	**RL (mg/kg dry)**	**Parameter**	**MDL (mg/kg dry)**	**RL (mg/kg dry)**
Nitrite Nitrate as N [f]	0.33-0.54	1.4-3.2	Total Phosphorus [f]	3.6-8.3	12-16
Total TKN [f]	—	27-65	Dissolved Sulfides	1.03	1.03
Parameter	**MDL (%)**	**RL (%)**	**Parameter**	**MDL (%)**	**RL (%)**
Total Organic Carbon [f]	0.0042	0.2	Total Organic Carbon [h]	—	0.1
Total Organic Carbon [g]	—	0.02	Particle Grain Size	0.01	0.01
Fish Tissue					
Parameter	**MDL (ng/kg wet)**	**RL (ng/kg wet)**	**Parameter**	**MDL (ng/kg wet)**	**RL (ng/kg wet)**
Organochlorine Pesticides					
2,4'-DDD	0.2	1	*cis*-Chlordane	0.9	1
2,4'-DDE	0.3	1	*trans*-Chlordane	0.3	1
2,4'-DDT	0.3	1	Heptachlor	0.3	1
4,4'-DDD	0.4	1	Heptachlor epoxide	0.4	1
4,4'-DDE	0.3	1	*cis*-Nonachlor	0.4	1
4,4'-DDT	0.3	1	*trans*-Nonachlor	0.4	1
4,4'-DDMU	0.4	1	Oxychlordane	0.5	1

Table C-6 Method detection limit (MDL) and reporting limit (RL) for constituents analyzed in receiving water, sediment, and fish tissue samples during the 2023-24 program year.

Parameter	MDL (ng/kg wet)	RL (ng/kg wet)	Parameter	MDL (ng/kg wet)	RL (ng/kg wet)
Fish Tissue PCB Congeners					
PCB 18	0.4	1	PCB 126	0.4	1
PCB 28	0.2	1	PCB 128	0.3	1
PCB 37	0.4	1	PCB 138	0.2	1
PCB 44	0.3	1	PCB 149	0.3	1
PCB 49	0.1	1	PCB 151	0.3	1
PCB 52	0.2	1	PCB 153/168	0.4	2
PCB 66	0.2	1	PCB 156	0.5	1
PCB 70	0.3	1	PCB 157	0.3	1
PCB 74	0.3	1	PCB 158	0.3	1
PCB 77	0.5	1	PCB 167	0.2	1
PCB 81	0.5	1	PCB 169	0.4	1
PCB 87	0.4	1	PCB 170	0.2	1
PCB 99	0.4	1	PCB 177	0.2	1
PCB 101	0.2	1	PCB 180	0.2	1
PCB 105	0.4	1	PCB 183	0.3	1
PCB 110	0.6	1	PCB 187	0.3	1
PCB 114	0.4	1	PCB 189	0.6	1
PCB 118	0.6	1	PCB 194	0.6	1
PCB 119	0.4	1	PCB 201	0.3	1
PCB 123	0.6	1	PCB 206	0.2	1
Fish Tissue Metals					
Arsenic	10.8	20	Mercury	3.80	4.00
Selenium	96.2	100			

[e] Enthalpy Analytical, Orange, CA
[f] Weck Laboratories, Inc. City of Industry, CA
[g] McCampbell Analytical, Inc., Pittsburg, CA
[h] ALS Environmental, Kelso, WA
[i] Integral Consulting, Santa Cruz, CA

Table C-7 Receiving water quality QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested [a]	Number of Compounds Passed [a]	% Compounds Passed
Summer	Ammonia Nitrogen	543 (33)	Blank	33	1	33	100
			Blank Spike	33	1	33	100
			Matrix Spike	57	1	57	100
			Matrix Spike Duplicate	57	1	57	100
			Matrix Spike Precision	57	1	57	100
Fall	Ammonia Nitrogen	543 (32)	Blank	32	1	32	100
			Blank Spike	32	1	32	100
			Matrix Spike	58	1	58	100
			Matrix Spike Duplicate	58	1	58	100
			Matrix Spike Precision	58	1	58	100
Winter	Ammonia Nitrogen	543 (33)	Blank	33	1	33	100
			Blank Spike	33	1	33	100
			Matrix Spike	58	1	58	100
			Matrix Spike Duplicate	58	1	58	100
			Matrix Spike Precision	58	1	58	100
Spring	Ammonia Nitrogen	545 (32)	Blank	32	1	32	100
			Blank Spike	32	1	32	100
			Matrix Spike	58	1	58	100
			Matrix Spike Duplicate	58	1	58	100
			Matrix Spike Precision	58	1	58	100

[a] An analysis passed if the following criteria were met:
For blank - Target amount <2 × MDL.
For blank spike - Target accuracy % recovery 90–110.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 80–120.
For matrix spike precision - Target precision % RPD <11.

Table C-7 Receiving water quality QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested [a]	Number of Compounds Passed [a]	% Compounds Passed
Summer	Nitrite and Nitrate as N	543 (33)	Blank	33	1	33	100
			Blank Spike	33	1	33	100
			Matrix Spike	57	1	57	100
			Matrix Spike Duplicate	57	1	57	100
			Matrix Spike Precision	57	1	57	100
Fall	Nitrite and Nitrate as N	543 (33)	Blank	32	1	32	100
			Blank Spike	40	1	40	100
			Matrix Spike	58	1	58	100
			Matrix Spike Duplicate	58	1	58	100
			Matrix Spike Precision	58	1	58	100
			Duplicate	1	1	1	100
Winter	Nitrite and Nitrate as N	542 (32)	Blank	33	1	33	100
			Blank Spike	33	1	33	100
			Matrix Spike	63	1	63	100
			Matrix Spike Duplicate	63	1	63	100
			Matrix Spike Precision	63	1	63	100
			Duplicate	1	1	1	100
Spring	Nitrite and Nitrate as N	540 (29)	Blank	29	1	29	100
			Blank Spike	30	1	30	100
			Matrix Spike	55	1	55	100
			Matrix Spike Duplicate	55	1	55	100
			Matrix Spike Precision	55	1	55	100

[a] An analysis passed if the following criteria were met:
For blank - Target amount <2 × MDL.
For blank spike - Target accuracy % recovery 90–110.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 80–120.
For matrix spike precision - Target precision % RPD <11.
For duplicate precision – Target precision % RPD<11.

Table C-7 Receiving water quality QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested [a]	Number of Compounds Passed [a]	% Compounds Passed
Summer	Total Coliforms	175 (5)	Duplicate	20	1	18	90
	Fecal Coliforms [c]	175 (5)	Duplicate	20	1	17	85
	Enterococci	175 (5)	Duplicate	20	1	19	95
Fall	Total Coliforms	175 (5)	Duplicate	20	1	17	85
	Fecal Coliforms [b]	175 (5)	Duplicate	20	1	17	85
	Enterococci	175 (5)	Duplicate	20	1	17	85
Winter	Total Coliforms	174 (5)	Duplicate	20	1	19	95
	Fecal Coliforms [b]	174 (5)	Duplicate	20	1	17	85
	Enterococci	174 (5)	Duplicate	20	1	15	75
Spring	Total Coliforms	175 (5)	Duplicate	20	1	18	90
	Fecal Coliforms [b]	175 (5)	Duplicate	20	1	17	85
	Enterococci	175 (5)	Duplicate	20	1	19	95
Annual	Total Coliforms	700 (20)	Duplicate	80	1	72	90
	Fecal Coliforms [b]	700 (20)	Duplicate	80	1	68	85
	Enterococci	700 (20)	Duplicate	80	1	70	88

[a] Analysis passed if the average range of logarithms is less than the precision criterion.
[b] Fecal coliforms were estimated by multiplying *E. coli* by a factor of 1.1.

SEDIMENT CHEMISTRY NARRATIVE

OC San's ELOM laboratory received 22 sediment samples from ELOM's OMP staff in Summer 2023 and 11 samples each in Fall 2023, Winter 2024, and Spring 2024. An additional 45 samples were received for the Bight '23 regional monitoring program from SCCWRP throughout August to November 2023. Bight '23 data are not included in this report. All samples were stored according to ELOM SOPs. All samples were analyzed for polychlorinated biphenyl congeners (PCBs), polycyclic aromatic hydrocarbons (PAHs), trace metals, mercury, dissolved sulfides, total organic carbon (TOC), total nitrogen, total phosphorus, and grain size. Summer quarter samples were also analyzed for organochlorine pesticides (dieldrin and derivatives of dichlorodiphenyltrichloroethane and chlordane). All samples were analyzed within the required holding times.

PAHs, PCBs, and Organochlorine Pesticides

The analytical methods used to detect PAHs, organochlorine pesticides, and PCBs in the samples are described in the ELOM SOPs. All sediment samples were extracted using an accelerated solvent extractor. Approximately 1 g (dry weight) of sample was used for PAH analysis and 5 g (dry weight) was used for the analysis of organochlorine pesticides and PCBs. A separatory funnel extraction was performed using 100 mL of sample when field and rinse blanks were included in the batch. PAH sediment extracts were analyzed by GC-MS while PCB and organochlorine pesticides were detected by GC-MS/MS.

A typical sample batch included 20 field samples with required QC samples. Sample batches that were analyzed for PAHs, organochlorine pesticides, and PCBs included the following QC samples: one method blank, one blank spike, one standard reference material (SRM), and one matrix spike/matrix spike duplicate set. In addition, a sample batch may also include the trip blank, instrument (rinse) blank, and one blank spike duplicate. MDLs and SRM acceptance criteria for each PAH, PCB, and pesticide constituent are presented in Table C-6 and Table C-8, respectively.

All analyses were performed with appropriate QC measures, as defined in OC San's QAPP, with most compounds tested during the monitoring period meeting QA/QC criteria (Table C-9). As is usual for an analysis in which many analytes are measured in a complex matrix, there were a few instances of QC failures in the blank spike, blank spike duplicate, matrix spike, matrix spike duplicate, and SRM. Each failure was carefully evaluated, and the data associated with any failing QC parameters was only deemed acceptable after a thorough review of all the batch QC. Gross QC failures resulted in re-processing of samples followed by re-analysis. When constituent concentrations in a sample exceeded the calibration range of the instrument, the sample was diluted and reanalyzed. Any deviations from standard protocol that occurred during sample preparation or analysis are noted in the raw data packages.

Trace Metals

Dried sediment samples were analyzed for trace metals in accordance with methods in the ELOM SOPs. A typical sample batch for antimony, arsenic, barium, beryllium, cadmium, chromium, copper, nickel, lead, silver, selenium, and zinc analyses included three blanks, a blank spike, and one SRM. Additionally, sample duplicates, matrix spikes, and matrix spike duplicates were analyzed at least once for every 10 sediment samples. The analysis of the blank spike and SRM provided a measure of the accuracy of the analysis. The analysis of the sample, its duplicate, and the two sample spikes were evaluated for precision.

All samples were analyzed using inductively coupled plasma mass spectroscopy (ICPMS). If any analyte in a sample exceeded both the appropriate calibration curve and linear dynamic range, the sample was diluted and reanalyzed. MDLs for metals are presented in Table C-6. Acceptance criteria for trace metal SRMs are presented in Table C-8. Some matrix spike and matrix spike duplicates in each quarter were outside of the method-specified acceptance criteria possibly due to matrix interference (Table C-9). Two equipment blank compounds in the summer quarter and two in the fall quarter were over the minimum acceptance levels. The affected batches were deemed acceptable on account of the associated sample results having significantly higher levels of each of the four compounds than the equipment blank results. MS/MSD precision criteria passed for all samples, showing that there is no issue with precision. In the CRM samples, antimony failed slightly low in the two fall batches. Cadmium failed slightly high in the winter/spring batch. Results for antimony and cadmium within the affected batches were deemed to be acceptable based on the other passing QC samples within each batch. All other samples met the QA/QC criteria for all compounds tested (Table C-9).

Mercury

Dried sediment samples were analyzed for mercury in accordance with methods described in the ELOM SOPs. QC for a typical batch included a blank, blank spike, and SRM. A set of sediment sample duplicates, matrix spike, and matrix spike duplicates were run once for every 10 sediment samples. When sample mercury concentration exceeded the appropriate calibration curve, the sample was diluted with the reagent blank and reanalyzed. The samples were analyzed for mercury on a Perkin Elmer FIMS 400 system.

The MDL for sediment mercury is presented in Table C-6. Acceptance criteria for the mercury SRM are presented in Table C-8. Table C-9 contains all mercury QA/QC samples analyzed within the 2023-24 program year. One duplicate sample precision in the summer quarter and two in the winter quarter were outside of the method-specified acceptance criteria. This was most likely due to a lack of homogeneity in the aliquots taken from the parent sample. One matrix spike in the fall quarter was outside of the method-specified acceptance criteria most likely due to matrix interference. Affected batches were deemed to be acceptable based on the other passing QC samples within each batch. All other samples met the QA/QC criteria for all compounds tested (Table C-9).

Dissolved Sulfides (DS)

DS samples were analyzed in accordance with methods described in the ELOM SOPs. The MDL for DS is presented in Table C-6. All QC samples within the 2023-24 program year met the QC acceptance criteria (Table C-9).

Total Organic Carbon (TOC)

TOC samples were analyzed by Weck Laboratories in the Summer and Fall of 2023 and by ALS Environmental Services in in the Winter and Spring of 2024. The RL for TOC is presented in Table C-6. All analyzed TOC QC samples passed the QC acceptance criteria (Table C-9).

Grain Size

Grain size samples were analyzed by Integral Consulting Inc. in Santa Cruz, CA, using a laser diffraction method. The smallest detectable grain size with this method is 0.375 µm. The method can distinguish differences between Phi size ranges to a level of 0.01%. All analyzed grain size QC samples passed the QA/QC criteria of RPD ≤10% (Table C-9).

Total Nitrogen (TN)

TN is calculated by analyzing each sample for combined nitrate + nitrite (as N) and for Total Kjeldahl Nitrogen (TKN) and summing the results. Samples were analyzed by Weck Laboratories. The MDL values for nitrate + nitrite (as N) and RL values for TKN are presented in Table C-6. All samples analyzed for nitrate + nitrite (as N) met the designated QC acceptance criteria (Table C-9) except for one MSD sample failure stemming from matrix effects. For TKN, some issues were observed with the MS/MSD sets due to the inherent high TKN concentration in the sample. All other samples analyzed for TKN met the designated QC acceptance criteria (Table C-9).

Total Phosphorus (TP)

TP samples were analyzed by Weck Laboratories. The MDL for TP is presented in Table C-6. Table C-9 contains all TP QA/QC samples analyzed within the 2023-24 program year. One matrix spike and one matrix spike duplicate sample recovery failures in the summer quarter resulted from the parent samples having inherently high concentrations of phosphorus. All other QC sample results met the QC acceptance criteria (Table C-9).

Table C-8 Acceptance criteria for standard reference materials for sediment and fish tissue analyses during the 2023-24 program year.

Sediment			
Parameter	**True Value (ng/g)**	**Acceptance Range (ng/g)**	
		Minimum	**Maximum**
Organochlorine Pesticides, PCB Congeners, and Percent Dry Weight SRM 1944; New York/New Jersey Waterway Sediment, National Institute of Standards and Technology			
PCB 8	22.3	13.4	31.2
PCB 18	51.0	30.6	71.4
PCB 28	80.8	48.5	113
PCB 44	60.2	36.1	84.3
PCB 49	53.0	31.8	74.2
PCB 52	79.4	47.6	111
PCB 66	71.9	43.1	101
PCB 87	29.9	17.9	41.9
PCB 99	37.5	22.5	52.5
PCB 101	73.4	44.0	103
PCB 105	24.5	14.7	34.3
PCB 110	63.5	38.1	88.9
PCB 118	58.0	34.8	81.2
PCB 128	8.47	5.08	11.9
PCB 138	62.1	37.3	86.9
PCB 149	49.7	29.8	69.6
PCB 151	16.9	10.2	23.7
PCB 153/168	74.0	44.4	104
PCB 156	6.52	3.91	9.13
PCB 170	22.6	13.6	31.6
PCB 180	44.3	26.6	62.0
PCB 183	12.2	7.31	17.1
PCB 187	25.1	15.1	35.1
PCB 194	11.2	6.72	15.7
PCB 195	3.75	2.25	5.25
PCB 206	9.21	5.53	12.9
PCB 209	6.81	4.09	9.53
2,4'-DDD [a]	38.0	22.8	53.2
2,4'-DDE [a]	19.0	11.4	26.6
4,4'-DDD [a]	108	64.8	151
4,4'-DDE [a]	86.0	51.6	120
4,4'-DDT [a]	170	102	238
gamma-BHC [a]	2.00	1.20	2.80
cis-Chlordane	16.5	9.91	23.1
trans-Chlordane [a]	19.00	11.4	26.6
Hexachlorobenzene	6.03	3.62	8.44
cis-Nonachlor [a]	3.70	2.22	5.18
trans-Nonachlor	8.20	4.92	11.5
Percent Dry Weight	98.8%	—	—

Table C-8 Acceptance criteria for standard reference materials for sediment and fish tissue analyses during the 2023-24 program year.

Sediment			
Parameter	**True Value (ng/g)**	**Acceptance Range (ng/g)**	
		Minimum	**Maximum**
PAH Compounds and Percent Dry Weight			
SRM 1941b; New York/New Jersey Waterway Sediment, National Institute of Standards and Technology			
Acenaphthene [a]	38.4	23.0	53.8
Acenaphthylene [a]	53.3	32.0	74.6
Anthracene	184	110	258
Benz[a]anthracene	335	201	469
Benzo[a]pyrene	358	215	501
Benzo[b]fluoranthene	453	272	634
Benzo[b+j]fluoranthene [a]	670	402	938
Benzo[e]pyrene	325	195	455
Benzo[g,h,i]perylene	307	184	430
Benzo[k]fluoranthene	225	135	315
Biphenyl [a]	74	44.4	104
Chrysene	291	175	407
Dibenz[a,h]anthracene	53	31.8	74.2
2,6-Dimethylnaphthalene [a]	75.9	45.5	106
Fluoranthene	651	391	911
Fluorene	85	51.0	119
Indeno[1,2,3-c,d]pyrene	341	205	477
1-Methylnaphthalene [a]	127	76.2	178
2-Methylnaphthalene [a]	276	166	386
1-Methylphenanthrene	73.2	43.9	102
Naphthalene	848	509	1187
Perylene	397	238	556
Phenanthrene	406	244	568
Pyrene	581	349	813
1,6,7-Trimethylnaphthalene [a]	25.5	15.3	35.7
Percent Dry Weight	97.6%	—	—

Table C-8 Acceptance criteria for standard reference materials for sediment and fish tissue analyses during the 2023-24 program year.

Sediment			
Parameter	**True Value (mg/kg)**	**Acceptance Range (mg/kg)**	
		Minimum	**Maximum**
Metals (CRM-540 ERA Metals in Soil, Lot No. D119-540)			
Aluminum	8040	3830	12200
Antimony	129	12.7	245
Arsenic	183	152	214
Barium	297	244	351
Beryllium	78.8	65.4	92.2
Cadmium	221	182	259
Chromium	200	163	237
Copper	136	114	158
Iron	14000	8420	19600
Lead	257	211	303
Mercury	18.2	13.3	23.1
Nickel	169	139	198
Selenium	217	172	263
Silver	67.8	54.1	81.4
Zinc	224	180	268

Table C-8 Acceptance criteria for standard reference materials for sediment and fish tissue analyses during the 2023-24 program year.

Fish Tissue			
Parameter	True Value (ng/g)	Acceptance Range (ng/g)	
		Minimum	Maximum
Organochlorine Pesticides and PCB Congeners (SRM 1946, Lake Superior Fish Tissue; National Institute of Standards and Technology)			
2,4'-DDD	2.20	1.76	2.64
4,4'-DDD	17.7	14.2	21.2
2,4'-DDE [a]	1.04	0.83	1.25
4,4'-DDE	373	298	448
2,4'-DDT [a]	22.3	17.8	26.8
4,4'-DDT	37.2	29.8	44.6
cis-Chlordane	32.5	26.0	39.0
trans-Chlordane	8.36	6.69	10.0
Heptachlor epoxide	5.50	4.40	6.60
cis-Nonachlor	59.1	47.3	70.9
trans-Nonachlor	99.6	79.7	120
Oxychlordane	18.9	15.1	22.7
PCB 18 [a]	0.840	0.67	1.01
PCB 28 [a]	2.00	1.60	2.40
PCB 44	4.66	3.73	5.59
PCB 49	3.80	3.04	4.56
PCB 52	8.10	6.48	9.7
PCB 66	10.8	8.64	13.0
PCB 70	14.9	11.9	17.9
PCB 74	4.83	3.86	5.80
PCB 77	0.327	0.26	0.39
PCB 87	9.40	7.52	11.3
PCB 99	25.6	20.5	30.7
PCB 101	34.6	27.7	41.5
PCB 105	19.9	15.9	23.9
PCB 110	22.8	18.2	27.4
PCB 118	52.1	41.7	62.5
PCB 126	0.380	0.30	0.46
PCB 128	22.8	18.2	27.4
PCB 138	115	92.0	138
PCB 149	26.3	21.0	31.6
PCB 153/168	170	136	204
PCB 156	9.52	7.62	11.4
PCB 158 [a]	7.70	6.16	9.24
PCB 170	25.2	20.2	30.2
PCB 180	74.4	59.5	89.3
PCB 183	21.9	17.5	26.3
PCB 187	55.2	44.2	66.2
PCB 194	13.0	10.4	15.6
PCB 201 [a]	2.83	2.26	3.40
PCB 206	5.40	4.32	6.48

Table C-8 Acceptance criteria for standard reference materials for sediment and fish tissue analyses during the 2023-24 program year.

Fish Tissue			
Parameter	**True Value (%)**	**Acceptance Range (%)**	
		Minimum	**Maximum**
Lipids (SRM 1946, Lake Superior Fish Tissue; National Institute of Standards and Technology)			
Lipid [a]	10.2	6.10	14.2
Parameter	**True Value (mg/kg)**	**Acceptance Range (mg/kg)**	
		Minimum	**Maximum**
Metals (SRM DORM-4; National Research Council Canada)			
Arsenic	6.87	5.50	8.24
Selenium [a]	3.45	2.76	4.14
Mercury	0.412	0.330	0.494

[a] Parameter with non-certified value(s).

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer	PAHs	55 (2)	Blank	2	24	47	98
			Trip Blank	1	24	24	100
			Equipment Blank	1	24	24	100
			Blank Spike	4	24	93	97
			Matrix Spike	2	24	48	100
			Matrix Spike Duplicate	2	24	48	100
			Matrix Spike Precision	2	24	44	92
			SRM Analysis	2	24	43	90
Fall	PAHs	32 (1)	Blank	1	24	24	100
			Blank Spike	2	24	41	85
			Matrix Spike	1	24	24	100
			Matrix Spike Duplicate	1	24	23	96
			Matrix Spike Precision	1	24	24	100
			SRM Analysis	1	24	20	83
Winter	PAHs	15 (1)	Blank	1	24	24	100
			Trip Blank	2	24	48	100
			Equipment Blank	3	24	72	100
			Blank Spike	2	24	41	85
			Matrix Spike	1	24	21	88
			Matrix Spike Duplicate	1	24	21	88
			Matrix Spike Precision	1	24	24	100
			SRM Analysis	1	24	21	88

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Spring	PAHs	12 (1)	Blank	1	24	24	100
			Trip Blank	1	24	24	100
			Equipment Blank	1	24	24	100
			Blank Spike	2	24	41	85
			Matrix Spike	1	24	8	33
			Matrix Spike Duplicate	1	24	11	46
			Matrix Spike Precision	1	24	21	88
			SRM Analysis	1	24	19	79
Summer	PCBs and Pesticides	22 (2)	Blank	2	61	121	99
			Trip Blank	2	61	122	100
			Equipment Blank	2	61	122	100
			Blank Spike	2	61	121	99
			Matrix Spike	2	61	120	98
			Matrix Spike Duplicate	2	61	113	93
			Matrix Spike Precision	2	61	122	100
			SRM Analysis	2	33	62	94
Fall	PCBs	11 (1)	Blank	1	40	40	100
			Trip Blank	1	40	40	100
			Equipment Blank	1	40	40	100
			Blank Spike	1	40	40	100
			Matrix Spike	1	40	40	100
			Matrix Spike Duplicate	1	40	40	100
			Matrix Spike Precision	1	40	40	100
			SRM Analysis	1	24	24	100

[a] An analysis passed if the following criteria were met:
For blank, trip blank, and equipment blank - Target amount <3 × MDL.
For blank spike - Target accuracy % recovery 60–120.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 40–120.
For matrix spike precision - Target precision % RPD <30%.
For SRM analysis - Target accuracy % recovery 60–140 or certified value, whichever is greater.

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Winter	PCBs	11 (1)	Blank	1	40	40	100
			Trip Blank	1	40	40	100
			Equipment Blank	1	40	40	100
			Blank Spike	1	40	40	100
			Matrix Spike	1	40	38	95
			Matrix Spike Duplicate	1	40	39	98
			Matrix Spike Precision	1	40	40	100
			SRM Analysis	1	24	24	100
Spring	PCBs	11 (1)	Blank	1	40	38	95
			Trip Blank	1	40	40	100
			Equipment Blank	1	40	40	100
			Blank Spike	1	40	33	83
			Matrix Spike	1	40	32	80
			Matrix Spike Duplicate	1	40	34	85
			Matrix Spike Precision	1	40	37	93
			SRM Analysis	1	24	23	96

[a] An analysis passed if the following criteria were met:
For blank, trip blank, and equipment blank - Target amount <3 × MDL.
For blank spike - Target accuracy % recovery 60–120.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 40–120.
For matrix spike precision - Target precision % RPD <30.
For SRM analysis - Target accuracy % recovery 60–140 or certified value, whichever is greater.

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer	Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Zinc	22 (1)	Blank	4	12	48	100
			Trip Blank	2	12	24	100
			Equipment Blank	2	12	22	92
			Blank Spike	2	12	24	100
			Matrix Spike	3	12	33	92
			Matrix Spike Duplicate	3	12	33	92
			Matrix Spike Precision	3	12	36	100
			Duplicate	3	12	35	97
			SRM Analysis	1	12	12	100
	Mercury	11 (1)	Blank	2	1	2	100
			Trip Blank	1	1	1	100
			Equipment Blank	2	1	2	100
			Blank Spike	2	1	2	100
			Matrix Spike	3	1	3	100
			Matrix Spike Duplicate	3	1	3	100
			Matrix Spike Precision	3	1	3	100
			Duplicate	3	1	2	67
			SRM Analysis	1	1	1	100

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Fall	Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Zinc	11 (1)	Blank	3	12	36	100
			Trip Blank	1	12	12	100
			Equipment Blank	1	12	10	83
			Blank Spike	1	12	12	100
			Matrix Spike	2	12	22	92
			Matrix Spike Duplicate	2	12	22	92
			Matrix Spike Precision	2	12	24	100
			Duplicate	2	12	24	100
			SRM Analysis	1	12	11	92
	Mercury	11 (1)	Blank	1	1	1	100
			Trip Blank	1	1	1	100
			Equipment Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	1	50
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100
			SRM Analysis	1	1	1	100

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Winter	Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Zinc	11 (1)	Blank	3	12	36	100
			Trip Blank	1	12	12	100
			Equipment Blank	1	12	12	100
			Blank Spike	1	12	12	100
			Matrix Spike	2	12	22	92
			Matrix Spike Duplicate	2	12	22	92
			Matrix Spike Precision	2	12	24	100
			Duplicate	2	12	24	100
			SRM Analysis	1	12	12	100
	Mercury	11 (1)	Blank	3	1	3	100
			Trip Blank	1	1	1	100
			Equipment Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	0	0
			SRM Analysis	1	1	1	100

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Spring	Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Copper, Lead, Nickel, Selenium, Silver, Zinc	11 (1)	Blank	3	12	36	100
			Trip Blank	1	12	12	100
			Equipment Blank	1	12	12	100
			Blank Spike	1	12	12	100
			Matrix Spike	2	12	22	92
			Matrix Spike Duplicate	2	12	22	92
			Matrix Spike Precision	2	12	24	100
			Duplicate	2	12	24	100
			SRM Analysis	1	12	12	100
	Mercury	11 (1)	Blank	1	1	1	100
			Trip Blank	1	1	1	100
			Equipment Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100
			SRM Analysis	1	1	1	100

[a] An analysis passed if the following criteria were met.
For blank, trip blank, and equipment blank - Target amount <3 × MDL or <10% of sample result, whichever is greater.
For blank spike - Target accuracy % recovery 90–110.
For matrix spike and matrix spike duplicate – Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <25 for mercury and <20 for other metals.
For duplicate - Target precision % RPD <20% at 10 × MDL of sample mean.
For SRM analysis - Target accuracy % recovery 80–120 or certified value, whichever is greater.

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer	Dissolved Sulfides	22 (2)	Blank	2	1	2	100
			Blank Spike	2	1	2	100
			Matrix Spike	3	1	3	100
			Matrix Spike Duplicate	3	1	3	100
			Matrix Spike Precision	3	1	3	100
			Duplicate	3	1	3	100
Fall	Dissolved Sulfides	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100
Winter	Dissolved Sulfides	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	2	2	100
Spring	Dissolved Sulfides	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100

[a] An analysis passed if the following criteria were met:
For blank - Target amount <2 × MDL.
For blank spike - Target accuracy % recovery 80–120.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <30.
For duplicate - Target precision % RPD <30.

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer	TOC	22 (3)	Blank	3	1	3	100
			Blank Spike	3	1	3	100
			Matrix Spike	3	1	3	100
			Matrix Spike Duplicate	3	1	3	100
			Matrix Spike Precision	3	1	3	100
Fall	TOC	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Blank Spike Duplicate	1	1	1	100
			Blank Spike Precision	1	1	1	100
Winter	TOC	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	1	1	1	100
Spring	TOC	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100
			SRM Analysis	1	1	1	100

[a] An analysis passed if the following criteria were met:
For blank - Target amount < 10 × MDL.
For blank spike, matrix spike, and matrix spike duplicate - Target accuracy % recovery 80–120.
For blank spike duplicate, matrix spike precision, and duplicate - Target precision % RPD <30.
For SRM analysis – Target accuracy % recovery 77–122 or certified value, whichever is greater.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer	Grain Size	22 (2)	Duplicate	2	1	2	100
Fall	Grain Size	11 (1)	Duplicate	2	1	2	100
Winter	Grain Size	11 (1)	Duplicate	1	1	1	100
Spring	Grain Size	11 (1)	Duplicate	1	1	1	100

[a] An analysis passed if the following criteria were met:
For duplicate - Target precision mean % RPD <10% of mean phi.

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer	Nitrite Nitrate as N	22 (2)	Blank	2	1	2	100
			Blank Spike	2	1	2	100
			Matrix Spike	3	1	3	100
			Matrix Spike Duplicate	3	1	2	67
			Matrix Spike Precision	3	1	3	100
			Duplicate	2	1	2	100
Fall	Nitrite Nitrate as N	11 (2)	Blank	2	1	2	100
			Blank Spike	2	1	2	100
			Matrix Spike	3	1	3	100
			Matrix Spike Duplicate	3	1	3	100
			Matrix Spike Precision	3	1	3	100
			Duplicate	3	1	3	100
Winter	Nitrite Nitrate as N	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100
Spring	Nitrite Nitrate as N	11 (1)	Blank	2	1	2	100
			Blank Spike	2	1	2	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100

[a] An analysis passed if the following criteria were met:
For blank - Target amount <3 × MDL.
For blank spike - Target accuracy % recovery 80–120.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <30.
For duplicate - Target precision % RPD <20 at 10 × MDL of sample mean.

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer	Total Kjeldahl Nitrogen	22 (4)	Blank	4	1	4	100
			Blank Spike	4	1	4	100
			Matrix Spike	5	1	2	40
			Matrix Spike Duplicate	5	1	3	60
			Matrix Spike Precision	5	1	5	100
			Duplicate	4	1	4	100
Fall	Total Kjeldahl Nitrogen	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100
Summer	Total Kjeldahl Nitrogen	11 (2)	Blank	3	1	3	100
			Blank Spike	3	1	3	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	1	1	1	100
			Duplicate	3	1	3	100
Spring	Total Kjeldahl Nitrogen	11 (2)	Blank	4	1	4	100
			Blank Spike	6	1	6	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100

[a] An analysis passed if the following criteria were met:
For blank - Target amount <10% of sample result.
For blank spike - Target accuracy % recovery 80–120.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <30%.

Table C-9 Sediment QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer	Total Phosphorus	22 (2)	Blank	2	1	2	100
			Blank Spike	2	1	2	100
			Matrix Spike	2	1	1	50
			Matrix Spike Duplicate	2	1	1	50
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100
Fall	Total Phosphorus	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	2	1	2	100
			Matrix Spike Duplicate	2	1	2	100
			Matrix Spike Precision	2	1	2	100
			Duplicate	2	1	2	100
Winter	Total Phosphorus	11 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	1	1	1	100
			Matrix Spike Duplicate	1	1	1	100
			Matrix Spike Precision	1	1	1	100
			Duplicate	2	1	2	100
Spring	Total Phosphorus	11 (1)	Blank	2	1	2	100
			Blank Spike	5	1	5	100
			Matrix Spike	1	1	1	100
			Matrix Spike Duplicate	1	1	1	100
			Matrix Spike Precision	1	1	1	100
			Duplicate	2	1	2	100

[a] An analysis passed if the following criteria were met:
For blank - Target amount <3 × MDL.
For blank spike - Target accuracy % recovery 80–120.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <30.
For duplicate - Target precision % RPD <20 at 10 × MDL of sample mean.

FISH TISSUE CHEMISTRY NARRATIVE

For the 2023-24 program year, the ELOM laboratory received 20 rig fish samples in September 2023 and a total of 40 trawl fish samples in February 2024. The individual samples were stored, dissected, composited, and homogenized according to methods described in the ELOM SOPs. The rig fish muscle tissue samples and trawl liver tissue samples were composited according to species and zones or stations. There were a total of four muscle and four liver tissue composite samples. According to the NPDES permit, the maximum number of the same species to be composited is five for rig fish per zone and 10 for trawl fish per station. After the composited samples were homogenized, equal aliquots of the composited tissue and liver samples were kept frozen and distributed to the metals and organic chemistry sections of the analytical chemistry laboratory for analyses.

Organochlorine Pesticides and PCBs

The analytical methods used for organochlorine pesticides and PCB congeners are described in the ELOM SOPs. The composite tissue and liver samples were extracted using an ASE 350 and analyzed by GC-MS/MS.

All analyses were performed within the required holding time and with appropriate QC measures. A typical organic sample batch included up to 20 field samples with required QC samples. The QC samples included a laboratory blank, sample duplicate, matrix spike, matrix spike duplicate, SRM, and reporting level spike (using hydromatrix as the spike media). The MDLs for pesticides and PCBs in fish tissue are presented in Table C-6. Acceptance criteria for PCBs and pesticides SRM in fish tissue are presented in Table C-8.

Most compounds tested in each parameter group met the QC criteria (Table C-10). As is usual for an analysis in which many analytes are measured in a complex matrix, there were a few instances of QC failures. Results associated with the failing components were deemed acceptable based on all the other QC samples in the batch meeting their acceptance criteria. In cases where constituent concentrations in a sample exceeded the calibration range of the instrument, the sample was diluted and reanalyzed. Any variances that occurred during sample preparation or analyses were noted in the Comments/Notes section of each batch summary.

Lipid Content

Percent lipid content was determined for each composited fish muscle and liver tissue samples using methods described in the ELOM SOPs. Lipids were extracted with dichloromethane from approximately 1 g of sample and concentrated to 2 mL. A 100 µL aliquot of the extract was placed in a tared aluminum weighing boat and allowed to evaporate to dryness. The remaining residue was weighed, and the percent lipid content calculated. Acceptance criteria for lipid SRMs are presented in Table C-8. All analyses were performed within the required holding time and with appropriate QC measures. All analyzed samples passed the QC acceptance criteria (Table C-10).

Mercury

Fish tissue samples were analyzed for mercury in accordance with ELOM SOPs. Typical QC analyses for a tissue sample batch included a blank, a blank spike, and SRMs (liver and muscle). In the same batch, additional QC samples included sample duplicates, matrix spikes, and matrix spike duplicates, which were run approximately once every ten samples.

The MDL for fish mercury is presented in Table C-6. Acceptance criteria for the mercury SRMs are presented in Table C-8. All samples were analyzed within their 6-month holding time. Both the matrix spike and matrix spike duplicate results were below the established acceptance limit due to possible matrix interference. All other QC samples met the QC criteria (Table C-10).

Arsenic and Selenium

Fish tissue samples were analyzed for arsenic and selenium in accordance with ELOM SOPs. Typical QC analyses for a tissue sample batch included three blanks, a blank spike, and an SRM (muscle). Additional

QC samples included a sample duplicate, a matrix spike, and a matrix spike duplicate, which were run at least once every 10 samples.

The MDLs for arsenic and selenium in fish tissue are presented in Table C-6. Acceptance criteria for the arsenic and selenium SRMs are presented in Table C-8. All samples were analyzed within a 6-month holding time. Antimony recovery used in the blank spike was below the established limit. Results for antimony within the affected batch were deemed to be acceptable based on the other passing QC samples (Table C-10).

Table C-10 Fish tissue QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer (Rig) and Winter (Trawl)	PCBs and Pesticides	8 (1)	Blank	1	54	54	100
			Blank Spike	1	54	44	81
			Matrix Spike	1	54	54	100
			Matrix Spike Duplicate	1	54	53	98
			Matrix Spike Precision	1	54	54	100
			Duplicate	1	54	54	100
			SRM Analysis	1	41	25	61

[a] An analysis passed if the following criteria were met:
For blank - Target amount <2 × MDL.
For blank spike - Target accuracy % recovery 75–125.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <25.
For duplicate - Target precision % RPD <25 at 3 × MDL of sample mean.
For SRM analysis - Target accuracy % recovery 80–120 or certified value, whichever is greater.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer (Rig) and Winter (Trawl)	Percent Lipid	8 (1)	Blank [b]	1	1	—	—
			Duplicate	1	1	1	100
			SRM Analysis	1	1	1	100

[a] An analysis passed if the following criteria were met:
For duplicate - Target precision % RPD <25.
For SRM analysis - Target % recovery 60–140.
[b] Data are provided for information only since there is no criterion for lipid blanks.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer (Rig) and Winter (Trawl)	Mercury	8 (1)	Blank	1	1	1	100
			Blank Spike	1	1	1	100
			Matrix Spike	1	1	0	0
			Matrix Spike Duplicate	1	1	0	0
			Matrix Spike Precision	1	1	1	100
			Duplicate	1	1	1	100
			SRM Analysis	1	1	1	100

Table C-10 Fish tissue QA/QC summary for the 2023-24 program year.

Period	Parameter	Total Samples (Total Batches)	QA/QC Sample Type	Number of QA/QC Samples Tested	Number of Compounds Tested	Number of Compounds Passed [a]	% Compounds Passed
Summer (Rig fish samples) and Winter (trawl samples)	Arsenic & Selenium	8 (1)	Blank	3	2	6	100
			Blank Spike	1	2	1	50
			Matrix Spike	1	2	2	100
			Matrix Spike Dup	1	2	2	100
			Matrix Spike Precision	1	2	2	100
			Duplicate	1	2	2	100
			SRM Analysis	1	2	2	100

[a] An analysis passed if the following criteria were met:
For blank - Target amount <2 × MDL for mercury and <3 × MDL for arsenic and selenium.
For blank spike - Target accuracy % recovery 90–110.
For matrix spike and matrix spike duplicate - Target accuracy % recovery 70–130.
For matrix spike precision - Target precision % RPD <25.
For duplicate - Target precision % RPD <30 at 10 × MDL of sample mean.
For SRM analysis - Target accuracy % recovery 80–120 or certified value, whichever is greater.

BENTHIC INFAUNA NARRATIVE

The 2023-24 taxonomy QA/QC follow OC San's QAPP. Benthic infauna samples from one annual and two quarterly stations underwent comparative taxonomic analysis by two independent taxonomists. Samples were randomly chosen for re-identification from each taxonomist's allotment of assigned samples. These were swapped between taxonomists with the same expertise in the major taxa. The resulting datasets were compared, and a discrepancy report generated. The participating taxonomists reconciled the discrepancies. Necessary corrections to taxon names or abundances were made to the database. The results were scored, and errors tallied by station. Percent errors were calculated using the equations below:

Equation 1: $$\%\ Error_{\#\ Individuals} = \left(\frac{\left|\#\ Individuals_{Resolved} - \#\ Individuals_{Original}\right|}{\#\ Individuals_{Resolved}}\right) \times 100$$

Equation 2: $$\%\ Error_{ID\ Taxa} = \left(\frac{\#\ Taxa_{Misidentification}}{\#\ Taxa_{Resolved}}\right) \times 100$$

Equation 3: $$\%\ Error_{ID\ Individuals} = \left(\frac{\#\ Individuals_{Misidentification}}{\#\ Individuals_{Resolved}}\right) \times 100$$

Please refer to OC San's QAPP for detailed explanation of the variables. The first two equations are considered gauges of errors in accounting (e.g., recording on a wrong line, miscounting, etc.), which, by their random nature, are difficult to predict. Equation 3 is the preferred measure of identification accuracy. It is weighted by abundance and has a more rigorous set of corrective actions (e.g., additional taxonomic training) when errors exceed 10%.

In addition to the re-identifications, a Synoptic Data Review (SDR) was conducted upon completion of all data entry and QA. This consisted of a review of the infauna data for the survey year, aggregated by taxonomist (including both in-house and contractor). From this, any possible anomalous species reports, such as species reported outside its known depth range and possible data entry errors, were flagged for further investigation.

QC objectives of ≤10% error for identification accuracy (Equation 3) were met in the 2023-24 program year (Table C-11). No significant changes were made to the 2023-24 infauna dataset based on the SDR.

Table C-11 Percent error rates calculated for the 2023-24 infauna QA samples.

Error Type	Station			Mean
	77	**4**	**13**	
1. % Error # Individuals	0.3	0.8	-3.7	**-0.9**
2. % Error # ID Taxa	8.3	6.3	2.8	**5.8**
3. % Error # ID Individuals	2.9	2.5	1.0	**2.1**

[a] The negative value indicates an undercount by the original taxonomist.

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