

**City of Morro Bay and
Cayucos Sanitary District**

OFFSHORE MONITORING AND REPORTING PROGRAM

2019 ANNUAL REPORT



Marine Research Specialists

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**Report to the
City of Morro Bay and
Cayucos Sanitary District**

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Morro Bay, California 93442
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**OFFSHORE MONITORING
AND REPORTING PROGRAM**

2019 ANNUAL REPORT

**Prepared by
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**Submitted by
Marine Research Specialists**

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March 2020

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John Gunderlock
Wastewater & Collection Systems Supervisor
City of Morro Bay/Cayucos Sanitary District
955 Shasta Avenue
Morro Bay, CA 93442

30 March 2020

Reference: 2019 Annual Monitoring Report

Dear Mr. Gunderlock:

Enclosed is the referenced report. It documents the continued effectiveness of the treatment process, the absence of marine impacts, and compliance with the discharge limitations and reporting requirements specified in the NPDES discharge permits.

Please contact the undersigned if you have questions regarding this report.

Sincerely,

 **MARINE RESEARCH SPECIALISTS**
Vice President

2020.03.30 13:24:36 -07'00'

Douglas A Coats
Project Manager

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



Mr. John Gunderlock
Wastewater/Collections System Supervisor
City of Morro Bay/Cayucos CSD Wastewater Treatment Plant

Date: 3/30/2020

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LIST OF ACRONYMS AND DEFINITIONS

AHA	Activity Hazard Analyses investigate potential facility hazards
Anthropogenic	Changes to the environment induced by human activities
APCD	San Luis Obispo County Air Pollution Control District
BMPs	Best Management Practices
BOD₅	Five-day biochemical oxygen demand
Cal Poly SLO	California Polytechnic State University, San Luis Obispo
CCLEAN	Central Coast Long-term Environmental Assessment Network
CCR	California Code of Regulations (CCR 2003)
CDFG	California Department of Fish and Game
CIWQS	California Integrated Water Quality System Project
CDP	Coastal Development Permit
CMAR	Construction Manager at Risk: A project delivery method wherein the Construction Manager (CM) is required to deliver a project within a guaranteed maximum price
Coordinate Datum	All coordinates cited in this report are referenced to the WGS84 datum
COP	The California Ocean Plan (SWRCB 2005 2015) is regularly revised. The 2005 edition was in force when the prior NPDES discharge permit was issued to MBCSD and the 2015 edition was the basis for the current permit.
CSWP	Cayucos Sustainable Water Project
CV	A coefficient of variation is used to compare the relative amounts of variation in populations having different means. It is the standard deviation expressed as a percentage of the mean.
CWEA	California Water Environment Association
CWSRF	Clean Water State Revolving Fund (CWSRF) that includes a Water Recycling Funding Program administered by the SWRCB Division of Financial Assistance
dEIR	Draft Environmental Impact Report
DMR	Discharge Monitoring Report
DMR-QA	Discharge Monitoring Report Quality Assurance (DMR-QA) Study
DO	Dissolved Oxygen
EIR	Environmental Impact Report
ELAP	California Department of Health Services, Environmental Laboratory Accreditation Program
ESA	Endangered Species Act
FOG	Fats, Oils, and Greases

LIST OF ACRONYMS AND DEFINITIONS

(Continued)

HAB	Harmful Algal Bloom
I&I	Inflow and Infiltration
ITI	Infaunal Trophic Index
JPA	The Joint Powers Agreement between the City of Morro Bay and the Cayucos Sanitary District (MBCSD) outlines the contractual agreement between the two agencies for the operation of the WWTP
Leachate	A solution formed by leaching, especially a solution containing contaminants picked up through the leaching of soil
MBCSD	The City of Morro Bay and Cayucos Sanitary District
MDL	Method Detection Limit is the lowest concentration that can be reported under ideal conditions where the sample contains only the compound of interest with a concentration in an optimal calibration range and in a medium that does not interfere with the performance of the analytical instrument.
MGD	Million Gallons per Day
mg/Kg	Milligrams per Kilogram = $\mu\text{g/g}$ dry weight = parts per million
mg/L	Milligrams per Liter = aqueous parts per million
ML	The Minimum Level is the method-specific minimum concentration of a substance that can be quantitatively measured in a sample given the current analytical performance used by most certified laboratories within California, as specified in the 2005 Ocean Plan.
MLLW	Mean Lower Low Water
MPN	Most Probable Number
MRS	Marine Research Specialists
MT	Metric Ton = 1,000 kg
NEP	National Estuary Program
ND	Not Detected indicates the substance was not found in the sample at concentrations above the MDL
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOEC	No Observable Effect Concentration
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council
NTU	Nephelometric Turbidity Units
O&G	Oil and Grease
O&M	Operations and Maintenance

LIST OF ACRONYMS AND DEFINITIONS

(Continued)

OIT	Operator-in-Training
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
POTW	Publicly Owned Treatment Works
ppm	Parts per million = mg/L in solution, or mg/Kg = µg/g dry weight
PQL	Practical Quantification Limit is the lowest concentration that can be measured with statistical reliability given the sample size and analytical method.
PSDFW	Peak seasonal dry-weather flow
PWWF	Peak wet-weather flow
QA/QC	Quality Assurance and Quality Control
RFP	Request for Proposal
RFQ	Request for Qualifications
RWQCB	State of California Regional Water Quality Control Board - Central Coast Region
SLO EHS	San Luis Obispo County Environmental Health Services
SOP	Standard Operating Procedure
SSOs	Sanitary Sewer Overflows are sewage spills from wastewater collection systems
STLC	Soluble Threshold Limit Concentration applies to the measured concentration in the liquid extract from a biosolid sample, as determined by a Waste Extraction Test. The State of California classified biosolids with leachate concentrations exceeding the STLC as hazardous.
SWRCB	State Water Resources Control Board of the California Environmental Protection Agency
TKN	Total Kjeldahl Nitrogen
TRC	Total Residual Chlorine in effluent is determined from grab samples collected downstream of the chlorine contact chamber.
TSS	Total Suspended Solids
TSO	Time Schedule Order No. R3-2018-0019 dated 27 June 2018
TTLC	Total Threshold Limit Concentration applies to the total wet-weight concentration of a contaminant within a bulk biosolid sample consisting of the entire millable solid matrix rather than just the leachate. Biosolids are designated as hazardous wastes in the State of California if measured bulk concentrations exceed the TTLC.
TUc	Chronic Toxicity Units
TVS	Total Volatile Solids
USEPA	United States Environmental Protection Agency

LIST OF ACRONYMS AND DEFINITIONS

(Continued)

USFWS	United States Fish and Wildlife Service
USGPO	United States Government Printing Office
WET	Waste Extraction Tests measure the soluble leachate or the extractable amount of a substance contained within a bulk sample of biosolids. A WET is indicated if the bulk wet-weight concentration of a contaminant in a biosolids sample exceeds ten times the STLC.
WRRF	Water Resource Recovery Facility
WRF	City of Morro Bay Water Reclamation Facility
WWTP	City of Morro Bay-Cayucos Sanitary District Waste Water Treatment Plant
ZID	The Zone of Initial Dilution is a limited volume of water surrounding the outfall where wastewater rapidly mixes with receiving waters. Most receiving-water objectives of the Ocean Plan do not apply within the ZID.

EXECUTIVE SUMMARY

The City of Morro Bay and the Cayucos Sanitary District (MBCSD) jointly own the wastewater treatment plant operated by the City of Morro Bay. The treatment plant discharges effluent to the open ocean environment of northern Estero Bay under the authority of National Pollutant Discharge Elimination System (NPDES) permit No. CA0047881. During the first two months of 2018, the plant operated under a 301(h)-permit that modified NPDES limits on total suspended solids (TSS) and biochemical oxygen demand (BOD). This allowed the plant to discharge blended primary- and secondary-treated wastewater, although the vast majority of wastewater receives secondary treatment. All other NPDES limits, including restrictions on the discharge of toxic substances, applied to the MBCSD discharge without exception. Regardless, the partial-secondary level of treatment currently performed by the plant routinely achieves reductions in suspended solids and BOD that are close to, and often exceed, secondary treatment removal rates.

The current permit took effect in March 2018. It prescribed full-secondary treatment requirements on suspended solids and BOD, although their implementation was deferred to allow time for a new treatment plant to be built. Both permits require a monitoring and reporting program that evaluates short- and long-term effects of the effluent discharge on receiving waters, benthic sediments, and infaunal communities. This 2019 Annual Report partially satisfies those reporting requirements. Companion reports addressing receiving-water and benthic-sediment quality before 2019 fulfill additional reporting requirements.

This document presents a comprehensive analysis of the extensive monitoring data collected over the last three decades. Virtually every aspect of the treatment process, receiving waters, and seafloor sediments was monitored. An exhaustive quantitative analysis of all measured parameters demonstrates that the effluent discharge consistently meets the permit requirements and has no discernible effect on the ocean environment. A comparison of influent and effluent properties affirms the treatment plant's proficiency at removing contaminants and reducing organic loads within the wastewater stream. All offshore water-quality measurements indicate that the effluent plume was largely restricted to a narrow 15-m zone of initial dilution (ZID) around the outfall. Measurements within the effluent plume collected shortly after discharge quantified the plume's rapid dispersion, and demonstrated that the seafloor diffuser structure was operating better than predicted by modeling. Finally, the absence of adverse discharge-related impacts to the physics, chemistry, and biology of benthic sediments verified the effectiveness of the treatment process, the high dilution of effluent within receiving waters, and the low toxicity of the discharged effluent.

Effluent monitoring throughout 2019 documented another year of high operational performance by the treatment plant. Major effluent constituents, including TSS, BOD, and oil and grease (O&G), all had much lower concentrations and mass emissions than the permitted maximums, as has consistently been the case throughout the entire operational history of the plant. Although the treatment process efficiently removed major organic wastewater constituents, such as TSS, BOD, O&G, and coliform bacteria, the general lack of other chemical contaminants within effluent was largely due to their absence within the influent stream. Like most publicly owned treatment works, the MBCSD plant is not specifically designed to extract trace metals and synthetic organic compounds from wastewater.

Instead of removal by treatment, the effluent's low toxicity is primarily due to the absence of these contaminants within the influent, largely because of the lack of heavy industry within its service area. The few businesses that discharge to the sewer system produce wastewater that is similar to that of domestic sources, only on a larger scale. A digital database, maintained by collections system personnel, documents these sources. In addition, an ongoing public-outreach program and the convenience of an onsite

household hazardous waste recycling facility further reduced the potential introduction of pollutants into the waste stream.

Throughout more than three decades of operation, the treatment plant has consistently outperformed expectations for wastewater treatment based on regulatory standards. During that time, there has been no indication of deterioration in plant performance, and effluent quality has consistently exceeded the performance criteria anticipated in the original design. On rare occasions when brief exceptions to standards or criteria have occurred, they have been the direct result of unforeseen external events, or the temporary, unavoidable mechanical failure of a treatment-system component. In light of their diligent adherence to a program of preventative maintenance, the main challenge for plant personnel has been to respond quickly to unanticipated failures in system components or to unforeseeable external events.

Among the thousands of samples and measurements collected as part of the monitoring program during 2019, there was only one exception to the waste-discharge limits specified in the NPDES permit, as modified by the Time Schedule Order. That Order was implemented to allow construction of a new treatment plant and temporarily promulgates the previous permit's limits on suspended solids and oxygen demand. That Order's instantaneous limit on suspended solids was briefly exceeded in an effluent sample collected on April 24th. The increased solids discharge on that day was the result of an abrupt seasonal change in the weather that unexpectedly affected the Plant's secondary treatment process. Nevertheless, the near-perfect level of compliance is laudable and represents the culmination of many years of hard work by dedicated and experienced MBCSD personnel. Their knowledge and experience regularly enables them to enact appropriate proactive measures that ensure the smooth operation of this facility.

1.0 INTRODUCTION

The City of Morro Bay and the Cayucos Sanitary District (MBCSD) jointly own the wastewater treatment plant operated by the City of Morro Bay. The treatment plant's ocean discharge has been regulated by a series of National Pollutant Discharge Elimination System (NPDES) permits since March 1985.¹ The RWQCB² and USEPA³ jointly issued the original Section-301(h) permit that relaxed the full-secondary-treatment standards for suspended solids and oxygen demand that are promulgated in conventional NPDES permits. Following an extensive evaluation processes, the USEPA and the RWQCB reissued the 301(h)-modified permit three times (RWQCB-USEPA 1993ab 1998ab 2009). In March 2018, a conventional NPDES permit was issued that promulgated final effluent limits consistent with full-secondary-treatment standards (RWQCB 2018a). However, a Time Schedule Order (TSO) was also issued that set interim effluent limits to allow time for the MBCSD's partial-secondary discharge to achieve compliance with the current permit's new effluent limitations (RWQCB 2018b). The TSO also required the MBCSD to undertake a sequence of specific actions to ensure timely compliance with the final effluent limits.

1.1 REPORT SCOPE

This report examines the MBCSD treatment-plant performance during 2019 in detail. Additionally, it compares the 2019 performance with that of the prior 33 years, and assesses its compliance with the provisions with the permit and TSO that were in effect during 2019. Marine Research Specialists (MRS) began conducting the Offshore Monitoring and Reporting Program for the MBCSD in July 1993. Since then, the treatment plant staff, MRS, and various subcontracted laboratories, have collected and analyzed a multitude of samples and measurements as part of the extraordinarily intense monitoring program that was required as part of all 301(h)-modified permits.

This 2019 annual report summarizes results from the four major monitoring components that analyze the treatment plant, receiving waters, marine sediments, and benthic biota. However, the scope of this document departs from that of prior annual reports. Previous stand-alone and annual reports evaluated permit-compliance based on detailed analyses of offshore-monitoring surveys conducted prior to 2019 (MRS 2018a, 2019ab). Quarterly receiving water-quality surveys and annual benthic surveys, required under the prior 301(h)-modified permits, were discontinued by the current NPDES permit,⁴ so this annual report only summarizes findings from the 99 water-quality surveys conducted since 1993, and the 44 benthic surveys conducted since 1986.

A separate Annual Sewage Sludge Report (MBCSD 2020) is also incorporated in this report, largely by reference. That report, and its eight attachments of supporting documentation, contains detailed descriptions of the solids stabilization process, transportation offsite, pollutant concentrations, regulatory requirements, the pathogen reduction method, and the vector attraction reduction method. Some of that information is summarized in Chapter 6 of this report; namely, the results of chemical analyses conducted on composited biosolids subsamples, primarily because that data reflects on regulatory compliance, plant performance, and their potential for environmental impacts.

¹ Permit Number CA0047881

² Regional Water Quality Control Board (RWQCB) - Central Coast Region

³ United States Environmental Protection Agency (USEPA) – Region IX

⁴ The current permit requires a benthic survey to be conducted once-in-the-life of the permit. That survey was conducted in 2018 (MRS 2019b).

1.2 REPORT ORGANIZATION

In addition to this brief introductory chapter, the major chapters of this annual monitoring report are described below.

- **2.0 Overall Appraisal** Evaluation of the performance of the treatment plant and its compliance record throughout its thirty-four-year history, including the aforementioned summaries of receiving-water and seafloor-sediment conditions surrounding the offshore outfall;
- **3.0 Background** Description of current plant operations, treatment-plant history, regulatory setting of the ocean discharge, the treatment process and outfall system, and the MBCSD pollution prevention program;
- **4.0 Throughput** Examination of the volume of wastewater that passes through the treatment plant, including external factors that affect plant flow, reconciliation of flow measurements by two independent meters, and corrections to flows reported during 2019;
- **5.0 Wastewater Properties** Characterization of the major properties of the influent and effluent during 2019, the influence of the treatment process on those properties, and compliance with the relevant permit provisions;
- **6.0 Chemical Constituents** Summarization of quantifiable concentrations and mass emissions of chemical constituents within effluent, and comparison with numerical limits;
- **7.0 Biosolids** Description of the solids removal process, and the chemical compounds present within biosolids during 2019; and
- **8.0 References** Compilation of full bibliographic references for the documents cited in this report, including hyperlinks to reports available online.

In addition to these chapters, a set of appendices provides supporting documentation for the material in the body of this report. Appendix A lists the design specifications of the wastewater treatment plant. Appendix B contains a report of the annual outfall inspection that was conducted by diver. Adjustments made in this report to some of the previous daily-plant-flow reports are collated in Appendix C. A copy of the December 2019 calibration report for the influent flow meter is included as Appendix D.

2.0 OVERALL APPRAISAL

The MBCSD monitoring program was designed to appraise the performance of the wastewater treatment plant, to monitor the quality of effluent discharged to the ocean, and to assess potential impacts within receiving waters and seafloor environment. This chapter evaluates compliance with NPDES discharge regulations and gauges the potential for discharge impacts through quantitative analyses of an extensive data set of observations collected over the 34-year history of the monitoring program. It reviews all aspects of the monitoring program, including receiving-water measurements, sediment chemical concentrations, and marine biological enumerations collected prior to 2019. It also compares the latest plant-performance data from 2019 with the historical record. In contrast, the following chapters emphasize data acquired during 2019 to evaluate current plant performance and to determine compliance with the present-day discharge limits.

Throughout the monitoring program, the treatment plant consistently removed nearly all organic materials and other solids from the wastewater stream. Analyses of key diagnostic constituents, including total suspended solids (TSS), biochemical oxygen demand (BOD), and oil and grease (O&G), documented the high operational performance of the plant. Similarly, periodic analyses of effluent for trace metals, pesticides, priority pollutants, and toxicity demonstrated the benign environmental character of the effluent. A proactive operation and maintenance (O&M) program eliminated avoidable exceptions to the limits specified in the NPDES discharge permits during 2019, as in prior years.

Despite processing a large fraction of sewage within the wastestream during 2019, the plant discharged only 23% (46 MT¹) of the allowed solids (199 MT), while still attaining an annual removal rate of 89.5%, which is 19.5% higher than the permitted 75% minimum (bottom row of Table 2.1 on the following page). The resulting effluent TSS concentration (30.1 mg/L) was less than half of the permitted maximum (70 mg/L). Additionally, because the treatment plant processed most wastewater through the secondary-treatment process, it removed suspended solids at a rate exceeding the 85% standard for full secondary treatment in eleven of the twelve months (Table 5.1 on Page 5-1). Effluent TSS concentrations during seven months of the year remained at or below the 30-mg/L criterion for full secondary treatment.

During 2019, the treatment plant also removed the vast majority (84.1%) of oxygen-demanding material from the influent stream (Table 2.1 on the following page). The resulting effluent BOD concentration (49.8 mg/L) was well less than half of the permitted maximum (120 mg/L), and the total mass emission for the year (75 MT) was about one-fourth of the allowed BOD discharge (342 MT). Technology-based requirements for BOD are generally considered unimportant for open-ocean discharges because they are unlikely to result in oxygen depletion.² Nevertheless, the average BOD removal rate met or exceeded the 85% monthly standard for full secondary treatment during five months of the year, while the lowest monthly removal rate of 79% was more than 2½ times greater than the minimum 30% rate required by current discharge provisions (Table 5.1 on Page 5-1).

¹ Metric tons or 1,000 Kg (1.1 short tons)

² Page 6 in National Academy of Sciences (1993)

Table 2.1 Average Annual Wastewater Parameters

Year	Flow (MGD)	Suspended Solids				Biochemical Oxygen Demand			
		Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)
1986	1.42	332	32.8	89.8	64	235	77.0	67.2	151
1987	1.51	274	21.8	92.0	45	257	52.0	79.8	108
1988	1.51	397	29.8	90.0	62	242	43.9	81.9	92
1989	1.46	321	37.3	88.4	75	259	69.8	73.1	141
1990	1.38	345	36.0	89.6	69	261	75.7	71.0	144
1991	1.28	280	30.5	89.1	54	236	66.9	71.6	118
1992	1.41	310	43.0	86.3	84	224	59.3	73.5	116
1993	1.54	339	33.0	89.6	70	222	39.0	81.9	83
1994	1.38	310	32.0	89.4	61	249	33.0	86.4	63
1995	1.55	270	30.6	87.6	69	208	31.4	83.9	67
1996	1.55	344	33.1	89.9	70	241	35.7	85.0	73
1997	1.64	283	36.0	86.6	79	231	38.6	83.0	85
1998	1.95	236	38.8	83.9	101	216	39.1	81.5	99
1999	1.68	386	44.0	86.7	102	287	49.5	82.5	118
2000	1.77	337	37.4	87.5	91	271	50.3	81.1	125
2001	1.48	450	37.6	89.5	74	396	62.7	83.1	127
2002	1.14	374	49.2	86.0	77	386	67.5	82.4	101
2003	1.06	314	39.2	86.7	56	311	56.3	81.3	81
2004	1.09	354	28.9	91.3	44	336	53.3	83.8	81
2005	1.25	373	24.3	93.3	42	303	49.8	83.0	88
2006	1.19	335	20.5	93.2	34	291	45.3	83.8	75
2007	1.09	381	20.9	94.1	31	330	44.4	86.0	68
2008	1.10	337	20.0	94.1	30	331	38.4	88.3	58
2009	1.09	328	25.3	92.3	38	311	37.6	87.4	56
2010	1.19	383	26.6	92.1	42	350	49.4	85.2	85
2011	1.24	343	26.8	92.4	45	312	52.2	83.2	89
2012	1.10	379	27.1	92.5	41	322	49.9	83.5	77
2013	0.96	351	29.9	90.4	39	327	55.7	82.6	74
2014	0.94	377	29.2	91.3	37	352	51.4	85.3	66
2015	0.93	389	30.8	91.5	39	370	48.9	86.5	63
2016	0.84	358	37.1	90.0	42	384	63.7	82.9	74
2017	1.02	357	37.7	88.1	52	324	52.3	83.8	70
2018	0.90	306	31.7	89.4	39	279	40.6	85.5	51
2019	1.14	323	30.1	89.5	46	314	49.8	84.1	75
Average	1.29	340	32.0	89.8	57	293	50.9	81.9	90
Limit	2.06		70.0	75.0	199		120.0	30.0	342

(Continued on the next page)

Table 2.1 Average Annual Wastewater Parameters (continued)

Year	Oil and Grease				Turbidity (NTU)	pH	Chronic Toxicity (TUC)	Ammonia as NH ₃ -N (mg/L)
	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)				
1986	64	13.8	78.4	27	26	7.7		18
1987	44	6.2	85.9	13	23	7.5		
1988	38	6.3	83.4	13	40	7.5		
1989	28	6.1	78.2	12	49	7.4		26
1990	34	8.5	75.0	16	55	7.4		26
1991	73	6.9	90.5	12	50	7.3		18
1992	33	5.3	83.9	10	56	7.3		9
1993	26	6.0	76.9	13	43	7.4	19.42 ¹	20
1994	60	≈4.1 ²	93.2	≈8	36	7.5	4.37	27
1995	63	5.1	91.9	11	32	7.5	4.35	23
1996	52	7.9	84.8	17	34	7.7	4.83	23
1997	49	5.3	89.2	12	32	7.7	7.80	23
1998	51	5.4	89.4	15	34	7.6	7.80	19
1999	52	6.2	88.1	14	48	7.5	5.00	25
2000	74	5.5	92.6	13	39	7.5	5.60	24
2001	47	≈4.6	90.2	≈9	41	7.4	5.60	28
2002	39	≈4.4	88.7	≈7	41	7.5	4.98	31
2003	44	5.3	87.9	7	34	7.5	7.80	27
2004	47	≈3.7	92.0	≈6	26	7.5	5.60	29
2005	62	≈4.4	92.9	≈8	23	7.6	5.60	27
2006	44	≈4.1	90.6	≈7	26	7.6	4.36	28
2007	52	≈4.0	92.4	≈6	27	7.6	4.36	28
2008	84	≈4.4	94.8	≈7	30	7.5	5.56	27
2009	93	≈4.5	95.1	≈7	29	7.5	15.82 ³	32
2010	76	≈4.7	93.8	≈9	31	7.6	10.88 ³	34
2011	75	≈4.0	94.6	≈7	26	7.6	13.95	27
2012	91	5.0	94.5	8	26	7.6	13.95	33
2013	115	≈4.5	96.1	≈6	25	7.5	24.55	40
2014	81	≈4.0	95.1	≈5	28	7.5	17.90	50
2015	81	<1.7 ⁴	97.9	<2.7	29	7.5	17.90	45
2016	79	≈3.2	95.9	≈4	39	7.5	17.90	44

(Continued on the next page)

¹ Screening bioassay of three marine species

² Concentrations preceded by an “approximation” symbol (≈) were too low to be reliably quantified and represent estimated concentrations because they were reported below the “PQL” or Practical Quantification Limit, which is the lowest concentration that can be measured with statistical reliability given the sample size and analytical method.

³ Screening bioassay of two marine species

⁴ Concentrations preceded by a “less-than” symbol (<) indicates the substance was not detected in the sample at concentrations above the “MDL” or Method Detection Limit, which is listed after the “<” symbol. The MDL is the lowest concentration that can be reported under ideal conditions where the sample contains only the compound of interest with a concentration in an optimal calibration range and in a medium that does not interfere with the performance of the analytical instrument.

Year	Oil and Grease				Turbidity (NTU)	pH	Chronic Toxicity (TUc)	Ammonia as NH ₃ -N (mg/L)
	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (MT)				
2017	38	<1.8	95.3	<2.5	35	7.4	17.90	41
2018	50	≈1.2	97.6	≈1.4	32	7.3	12.23 ¹	39 ²
2019	— ^{3, 4}	≈1.2	—	≈1.7	32	7.5	14.77 ²	29 ²
Average	59	≈4.6	89.9	≈8	35	7.5	10.40	29
Limit		25.0			75	6-9	134.00	80.4

The general absence of industrial contaminants in the wastestream attests to the benign nature of the influent, which is almost entirely generated by nonindustrial commercial and residential sources. Prior to 2019, annual chemical analyses for 78 chemical contaminants within effluent samples typically quantified low-level concentrations of only a few common wastewater constituents and naturally occurring trace metals. Synthetic organic contaminants have been rarely detected within effluent samples collected during the long history of the monitoring program, and when they were, their concentrations were close to the detection limit. Because of this, the current permit only requires their analysis once, and that chemical scan was performed in 2018 (MRS 2018c 2019a).

During 2019, the reduced scope of effluent chemical analysis only required assessment of ten metallic/metalloid elements (Table 6.1 on Page 6-2). Low but quantifiable concentrations were found for only four of these elements. All occur naturally and are regularly found within effluent, biosolid, and marine-sediment samples. Their 2019 effluent concentrations were well below permit limits, and their associated mass emissions were well within goals established to limit contaminant loading to the marine environment. As in prior years, the 2019 chemical assay of four bio-stimulatory nutrients found that the amount emitted by the MBCSD WWTP was insignificant compared to individual contributions from other individual ocean dischargers in the region, central-coast rivers, and upwelling (Table 5.3 on Page 5-17).

Chronic bioassays conducted on effluent samples that were collected during 2019 determined that the discharge had very low toxicity to marine organisms (Table 5.2 on Page 5-15), a result consistent with the prior 26-year record of toxicity testing (Table 2.1). Likewise, the benign character of biosolids generated by the MBCSD treatment plant during 2019 and in prior years, is reflected in chemicals assays for more than 150 chemical contaminants (Table 7.1 on Page 7-2). The few compounds whose presence was detected, consisted largely of naturally occurring trace metals. Their concentrations were well below regulatory standards that would designate them as hazardous, or unsuitable for land application.

The 34-year record of effluent and biosolids monitoring data is complemented by a 33-year record of offshore monitoring. During that time, 99 quarterly receiving-seawater surveys and 44 benthic surveys have been completed. Comprehensive statistical analyses the enormous amount of data generated by these surveys unequivocally demonstrates the absence of discernible impacts from the MBCSD wastewater

¹ The July 2018 and 2019 toxicity tests included bioassays of three marine species to determine the most sensitive marine organism. The TUc listed here is the average of test results conducted in each of those years. The larval abalone was found to be the most sensitive organism, as was the case for the two screening bioassays conducted during 2009 and 2010.

² The current permit changed the required ammonia sampling frequency from monthly to annually. Consequently, the 2018 average ammonia concentration was determined from only three monthly ammonia concentrations and the 2019 average was reported as the concentration in a single effluent sample.

³ “—” indicates that the measurement was not required or its limit was not specified.

⁴ Measurement of oil & grease concentrations within influent samples is no longer required as part of the current discharge permit’s monitoring and reporting program. No influent oil & grease concentration was reported during 2019, so the associated removal rate was indeterminate for 2019.

discharge. Receiving-water surveys consistently found negligible but perceptible discharge-related excursions in seawater properties that were highly localized around the discharge point. None ever approached levels that would be considered an exception to water-quality objectives promulgated in the California Ocean Plan (COP) and the MBCSD NPDES permits. Similarly, detailed analyses of seafloor sediments, and the organisms within them, revealed a uniformly pristine environment with no evidence of spatial or temporal changes that could conceivably be ascribed to the discharge. Because of these findings, the current permit no longer required offshore monitoring after 2018.

2.1 TREATMENT PROCESS

Since 1986, the MBCSD Wastewater Treatment Plant (WWTP) has been operating under 301(h)-modified limits that relax the TSS and BOD requirements for full secondary treatment. Nevertheless, because of the Plant's partial-secondary process, the discharge continually met the 301(h)-modified discharge requirements, and occasionally achieved treatment levels comparable to full-secondary treatment. Thus, measurements of wastewater characteristics acquired throughout the 34-year monitoring program demonstrate that the treatment process surpassed expectations based on the original plant design, and easily achieved compliance with the applicable NPDES discharge permit requirements and federal regulatory standards.

The superior overall performance of the treatment process during 2019 and throughout the prior 33 years was the direct result of vigilant control by plant personnel, a proactive program of preventative maintenance, and the successful completion of numerous major maintenance and repair projects. Plant personnel actively seek-out and correct potential mechanical problems with plant components before they occur, and responded quickly to the occasional unforeseen failure of those components.

2.1.1 Historical Record

Many of the best measures of treatment performance have been achieved during the past decade of operation, and 2019 was no exception (Table 2.1). The historical record demonstrates the absence of an age-related decline in process efficiency, even after more than three decades of uninterrupted plant operation. Despite processing influent with uniformly high TSS, BOD, and O&G concentrations, the treatment process efficiently removed the vast majority of those constituents. Consistently low effluent concentrations and small emission volumes are the direct result of the treatment plant's efficiency at removing influent solids.

There is no evidence in the historical record of a decline in removal-rate efficiency, and the 2019 rates equaled or exceeded those of most prior years. For example, data in rows at the bottom of Table 2.1 show that the 89.5% TSS removal rate during 2019 was very close to the long-term average (89.8%). More revealing is the high 2019 BOD removal rate that resulted in lower-than-average effluent concentrations and emissions despite processing higher-than-average influent BOD concentrations. The 84.1% BOD removal rate during 2019 was well above the average removal rate (81.9%), and exceeded removal rates in all but nine of the prior 33 years. Seven of those nine higher BOD removal rates were achieved in the last twelve years of plant operation.

In contrast to removal rates, which reflect plant performance alone, the concentration and mass-emission of discharged wastewater constituents quantify the effluent's ability to comply with permit limits and ostensibly, its potential for environmental consequences. That compliance capability is demonstrated through comparison with permit limits listed in the last row of Table 2.1. That said, however, the uniformly low effluent concentrations and mass emissions reported in all 34 years of plant operations were the direct result of process efficiency, rather than low influent loading. The influent has always consisted largely of wastewater of domestic origin, and there has been little change in the service-area

population, or in the character and volume of influent from commercial sources. Influent concentrations of TSS and BOD have been consistently high, with only minor fluctuations from year-to-year. For example, average influent concentrations of TSS and BOD during 2019 (323 mg/L and 314 mg/L) were comparable to their long-term averages (340 mg/L and 293 mg/L).

Despite processing large volumes of wastewater of sewage origin over the last three decades, the 34-year average effluent concentrations of TSS, BOD, and O&G were all far below their respective allowable limits (compare the two bottom rows in Table 2.1). The long-term average effluent TSS and BOD concentrations were less than half of the permit limits, and the average O&G concentration was one-fifth of the allowable concentration. Even more indicative of the discharge's low historic potential for environmental consequences are the very low average annual emissions of TSS and BOD (57 MT and 90 MT), which are less than one-third of the permitted discharge (199 MT and 342 MT).

Throughout the more-than three decades of modern plant operation, other important effluent constituents were also consistently low. The highest annual average of effluent turbidity and ammonia (56 NTU¹ in 1992, and 50 mg/L in 2014) were both well below their respective permit limits (75 NTU and 80.4 mg/L). Overall long-term averages (35 NTU and 29 mg/L) were less than half the allowable levels. The highest average toxicity (24.55 TUc² in 2013) was five-times lower than the allowed maximum (134 TUc). The difference in reported chronic toxicities that lasted over extended periods, such as the low toxicities from 1994 through 2008, probably arose from a difference in the sensitivity of the test species used in the bioassays during that period.

2.1.2 Plant Throughput

Historically, the most influential factor affecting flow rate was a metering inaccuracy that resulted in flow overtotalization. A study conducted during 2002 found that rates reported by the effluent flow meter were consistently overestimated by as much as 25% (see Section 4.4 on Page 4-4). Without this overtotalization, average flow over the 34-year record would be closer to 1.14 MGD rather than the reported 1.29 MGD (bottom of the second column in Table 2.1). Because of overestimated flow prior to 2002, the annual mass emissions were also overestimated. Consequently, the average emissions over the entire plant history, shown in bold in the second to last row of Table 2.1, are slightly inflated. Specifically, over the operational history of the WWTP, the reported average TSS emission of 57 MT was actually closer to 50 MT. Similarly, the average BOD emission reported at 90 MT was, in reality, closer to 80 MT, and the reported 10 MT of discharged O&G was closer to 8 MT. Even after adjusting for past overtotalization in the historical averages, the 2019 emissions of TSS, BOD, and O&G (46 MT, 75 MT, and ≈1.4 MT) were still well below those of the corrected overall operational record (50 MT, 80 MT, and 8 MT).

During 2002, overtotalization was largely eliminated after a more accurate influent flow meter was commissioned, and flow began to be reported based on its measurements. In contrast to the existing impeller flow meter that was located within the plant's effluent-discharge stream, the new meter determined flow from influent wastewater elevations within a metering flume. However, on occasion, the new meter also overtotalizes flow, for example, when the influent flume becomes temporarily surcharged after water backs up into the influent channel behind the plant headworks. Nevertheless, judicious use of corrected effluent flow totals in place of these obviously aberrant influent flow-meter reports effectively eliminated significant flow overtotalization after 2002. Highly accurate annual flow totals are now regularly achieved by reporting a downward-adjusted effluent-meter flow on those rare occasions that the

¹ Nephelometric Turbidity Units

² Chronic Toxicity Units

influent flow data is compromised. The effluent-flow adjustment factor is updated at least annually as described in Section 4.4 on Page 4-4.

The 25% correction for effluent flow-meter inaccuracy prior to 2002 is unrelated to other long-term drops in flow rate that are evident in the historical record of annual average flow rates listed in Table 2.1. The uncorrected average flow from 1986 through 2001 (1.53 MGD) was 34% higher than the average flow reported from 2003 through 2012 (1.14 MGD). Thus, the 25% effluent flow-meter correction only accounts for part of the observed temporal difference. A detailed review of collection-system activities after 1999 (e.g., MRS¹ 2006) revealed that the additional 9% decline in flow was due to major efforts to reduce rainwater inflow and groundwater infiltration (I&I) into the collection system. These efforts included lining of the existing trunk line entering the plant along Atascadero Road during late 2000, which measurably reduced a known large infiltration source. Additionally, during 2001, a damaged major lateral serving the Morro Bay High School was replaced, and other major laterals were sealed and grouted. These efforts accounted for the additional decline in plant throughput after 2001, when average flow dropped below 1.26 MGD and remained there since. In all sixteen years prior to that time, annual reported flow was always above 1.27 MGD.

Irrespective of these past flow-measurement improvements and I&I reductions, the more-recent striking decrease in plant flow over the six years prior to 2019 was largely due to a completely unrelated factor, water conservation. At ≤ 1.02 MGD, the reported flows were the lowest on record, with the 0.84 MGD flow in 2016 being the lowest. Some of these recent flow decreases can be attributed to reduced groundwater infiltration into the collection system because of a decline in the water-table elevation during the prolonged drought. However, much of the decrease was undoubtedly related to the successful water-conservation measures implemented by the citizens of Cayucos and Morro Bay. For example, the City of Morro Bay reduced water usage during 2015 by 13.5%, significantly surpassing the 12% mandatory water-restriction goal imposed by statewide limits that went into effect in April of that year.

2.1.3 Wastewater Constituents

The treatment process was designed to remove organic particulates from the wastewater stream and disinfect effluent. As with most municipal treatment plants, the MBCSD WWTP was not designed to eliminate chemical contaminants that may be present within wastewater entering the plant. Instead, a vigorous pollution-prevention program is in place, which seeks to limit the introduction of chemical contaminants at the source, before they enter the collection system. The multifaceted pollution-prevention program includes public education efforts, an onsite hazardous waste collection facility, source identification, and inspections of commercial and industrial users. Domestic users generate more than 80% of the sewage processed at the WWTP; non-industrial users or light industry, which generate wastewater similar to that of domestic sources but on a larger scale, contribute the remaining portion of the WWTP's influent. In the absence of heavy industry within the service area, there is a concomitant lack of industrial pollutants within the MBCSD wastewater.

Because of these pollution-prevention efforts, only a few common metals and ubiquitous chemical compounds have regularly appeared in low concentrations within the effluent and biosolids samples collected over the last 34 years. Of the 78 chemical compounds tested for in the semi-annual effluent samples, only a few have been present in quantifiable amounts. Additionally, the measured concentrations of these compounds were all well below applicable NPDES discharge limits. In most cases, the concentrations were orders of magnitude lower than their respective limits. The associated mass emissions were also well below the goals identified in the discharge permits.

¹ Marine Research Specialists

As described in prior annual reports, quantifiable compounds within the effluent typically include three commonly occurring trace metals (copper, lead, and zinc), selenium, and radionuclides. The three trace metals all occur naturally within the mineralogy of sediments along the central California coast, but they also enter the collection system through internal corrosion of household plumbing systems. The metalloid selenium, also occurs naturally within the natural mineralogy of the region, but is less likely to arise within plumbing systems. Lastly, some level of radioactivity in effluent samples is expected because of naturally occurring radionuclides, and because radioactivity can be detected at extraordinarily low levels.

Consistent with the general absence of chemical contaminants, the benign nature of treated wastewater has been repeatedly demonstrated with effluent bioassays conducted over the past quarter century (Table 2.1). The expanded chronic-toxicity screening tests conducted during 2018 and 2019 continued to confirm the MBCSD effluent's low toxicity to a diverse set of sensitive marine organisms.

As with effluent samples, chemical analyses of biosolid samples have quantified only very low concentrations of some commonly occurring wastewater constituents. In addition to the bulk organic compounds, fifteen chemicals with quantifiable concentrations are typically found within biosolid samples (Table 7.1 on Page 7-2). Over the past 34 years, compounds found within the treatment-plant's sludge include ubiquitous metals, metalloids, and cyanide. All measured concentrations have been well below regulatory limits that would make the biosolids hazardous or unsuitable for composting and land application.

2.2 RECEIVING WATERS

Prior to issuance of the current permit, the receiving-water environment was monitored on a quarterly basis to evaluate the oceanographic conditions near the outfall, particularly with respect to any adverse impacts from the offshore discharge of wastewater. Comparisons of water quality at the boundary of the zone of initial dilution (ZID)¹ with gradient areas beyond the dilution zone documented compliance with the receiving-water objectives of the California Ocean Plan (COP) as promulgated in the NPDES discharge permits. Extremely sensitive electronic probes provided a detailed picture of seawater quality during each of the four offshore surveys conducted during each year. Precision navigation, in combination with high-resolution data on light transmittance, density, temperature, salinity, pH, and dissolved oxygen delineated the limited spatial extent of the dilute effluent plume within receiving waters.

During all 99 surveys conducted over the past 25 years, small anomalies in water properties associated with the submerged wastewater plume were detected. In all cases, the water-quality fluctuations were restricted to the ZID, were generated by the upward displacement of ambient seawater and not the presence of wastewater constituents, or were insignificant compared to the larger ambient variations resulting from natural oceanographic processes. Many of these plume measurements captured the signature of wastewater deep within the water column while it was undergoing rapid initial mixing during its ascent toward the sea surface. Dilution rates determined from these deep measurements were compared with expected critical initial dilution ratios based on modeling used to design the outfall. They demonstrated that the diffuser structure was dispersing the wastewater to a much greater degree than predicted by the modeling.

Because tests for compliance with the receiving-water limitations in the discharge permit only apply outside the ZID, the dilute wastewater measurements recorded shortly after discharge were not subject to COP objectives. Nevertheless, plume observations collected within the ZID were routinely below the permit limits applicable to observations collected outside this narrow 15-m mixing zone. None of the

¹ The Zone of Initial Dilution is a limited volume of water surrounding the outfall where wastewater rapidly mixes with receiving waters. Most receiving-water objectives of the COP do not apply within the ZID.

observed conditions suggested that unmixed wastewater was tangibly affecting receiving waters within or beyond the ZID. Because of this, the current permit eliminated the requirement for receiving-water surveys.

Figure 2.1 displays a horizontal map of plume dilution measured 1.5 m below the sea surface during the last survey conducted while the previous discharge permit was in effect (MRS 2018a). This snapshot of the highly localized plume footprint is typical of that observed during most offshore water-quality surveys. The lowest dilution (272-fold) is delineated in red and is offset 1.5 m south of the diffuser structure. Extremely sensitive instrumentation is incapable of discerning the effluent signature at dilutions exceeding 800-fold. Thus, detectable discharge-related changes to seawater are largely restricted to the 15-m ZID surrounding the outfall. The shoreline is located 827 m east of the discharge (Figure 3.4 on Page 3-13), so impingement of unmixed effluent onto the adjacent coastline implausible.

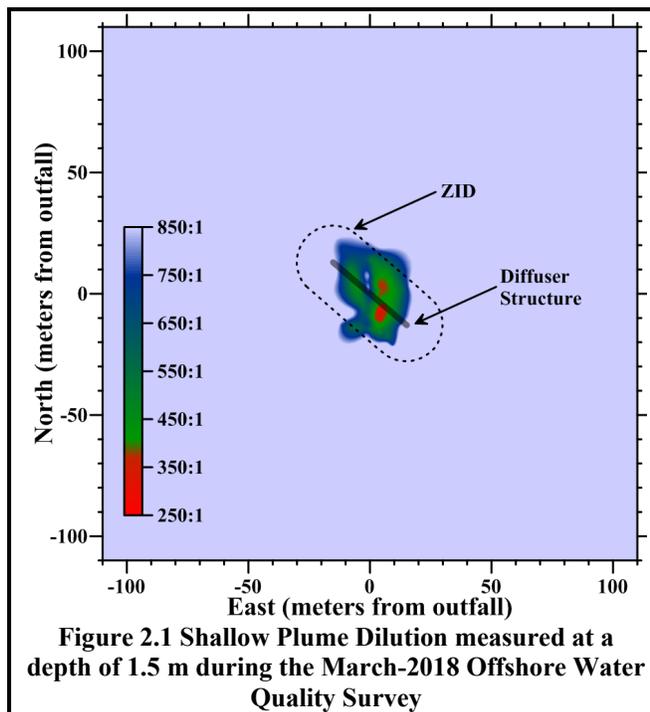


Figure 2.1 Shallow Plume Dilution measured at a depth of 1.5 m during the March-2018 Offshore Water Quality Survey

2.3 SEAFLOOR SEDIMENTS

The monitoring program has evaluated the physical, chemical, and biological conditions within benthic sediments surrounding the MBCSD outfall for more than three decades. Those evaluations provide strong empirical evidence that the quality of the sediments surrounding the outfall have not been perceptibly impacted by the discharge, and that a balanced indigenous population of marine organisms inhabits the benthos throughout the region, including locations along the ZID boundary. Because of these unequivocal findings, the requirement for annual benthic surveys was eliminated in the current permit's monitoring program.

As one component of the benthic assessment, spatiotemporal analyses were applied to the entire physicochemical dataset, which spans 33 years since benthic monitoring began in 1986. Those analyses demonstrated that there has been no buildup of sediment contaminants surrounding the outfall. In addition, trace-metal and organic concentrations collected both near and far from the outfall were tested for consistent spatial trends related to ZID proximity, and none was found. As in prior years, sediment concentrations throughout the survey area remained below thresholds considered harmful to marine biota. In fact, most sediment trace-metal concentrations within Estero Bay were well below concentrations found in the vast majority of samples collected offshore Southern California. This attests to the pristine condition of the ocean environment within northern Estero Bay. Nickel and chromium are the only trace metals that have comparatively elevated concentrations within Estero Bay sediments. However, the concentrations of these particular metals are also naturally elevated in the chromite mineral ores found throughout the region. Thus, the Estero Bay sediment metal concentrations are comparable to those found

in nearby benthic environments, such as Port San Luis (NOAA¹ 1991), and the Morro Bay Estuary (Tenera and MRS 1997).

To test for discharge-related biological effects, a large number of population indices and parameters were computed from an enumeration of the 270,000 specimens collected over past 33 years of benthic infaunal monitoring. None of these parameters exhibited statistically significant spatial distributions related to the effluent discharge or long-term spatiotemporal trends indicative of an increasingly degraded benthic habitat within or along the ZID boundary. Not only were spatial differences within individual surveys small compared to inherent sampling variability, but also the differences were generally much smaller than the long-term changes in community structure that arose from natural environmental fluctuations. Specifically, changes in the seafloor biology within the survey area correlate with widespread natural oscillations, the largest of which occur on seasonal and interannual time scales.

The most notable faunal variations within the survey area involve interannual population fluxes of the Pacific sand dollar (*Dendraster excentricus*). Specifically, striking increases in the abundance of juvenile sand dollars were documented in 1989, 1991, 1999, and 2009 in conjunction with major El Niño global climate fluctuations. During, and shortly after these episodic recruitment events, high numbers of juvenile sand dollars dominated infaunal population statistics, but because of their small size, their increased presence did not significantly alter the taxonomic composition of the infaunal community. Because these discrete population changes were related to widespread oceanographic fluctuations, they affected all of the benthic monitoring stations, including the distant reference site, and therefore, were demonstrably unrelated to the MBCSD effluent discharge.

During the first three events, residual sand-dollar populations from the initial successful sand-dollar recruitment only persisted for a year or two following the event due to predation by ochre sea stars (*Pisaster ochraceus*). These sea stars are considered a keystone species, which are organisms that are disproportionately influential in maintaining local biodiversity. Specifically, their predation has been found to be the key to controlling the populations of other species, such as sand dollars, that would otherwise dominate the resident community. However, in recent years, sea-star populations along the Pacific coast of North America suffered widespread losses from an outbreak of the sea-star wasting syndrome. The resulting absence of sea stars within the MBCSD survey area allowed the initial 2009 sand-dollar population to grow unchecked (Figure 2.2).



Figure 2.2 Photographic sequence of the growth of the 2009 Sand Dollar cohort in a) 2009, b) 2010, c) 2011, and d) 2012

¹ National Oceanic and Atmospheric Administration

As a result, during the 2018 benthic survey, and in the prior three annual surveys, numerous large sand dollars displaced nearly all of the sediment normally collected within grab samples, and the resident infauna that are normally collected with it (MRS 2019b). Thus, the overwhelming presence of mature sand dollars within the MBCSD survey area not only dominated infaunal population statistics, as they had briefly after prior El Niño events, but the taxonomic makeup of the infaunal community had now changed dramatically. During the 29 years prior to the 2015 survey, the diverse infaunal community consisted almost exclusively of assemblages of delicate suspension feeding organisms and surface detritus feeders, whose presence is considered indicative of an extremely pristine undisturbed seafloor habitat. In contrast, after 2014, few infaunal specimens were found within the small amount of available sediment surrounding the many large sand dollars collected in each grab sample. This new low-diversity infaunal community consisted almost entirely of a marine snail, which is a sand-dollar parasite, and an opportunistic lugworm that thrives in disturbed seafloor habitats. This particular lugworm, *A. bioculata*, happens to have a well-known strong affinity for sand-dollar beds.

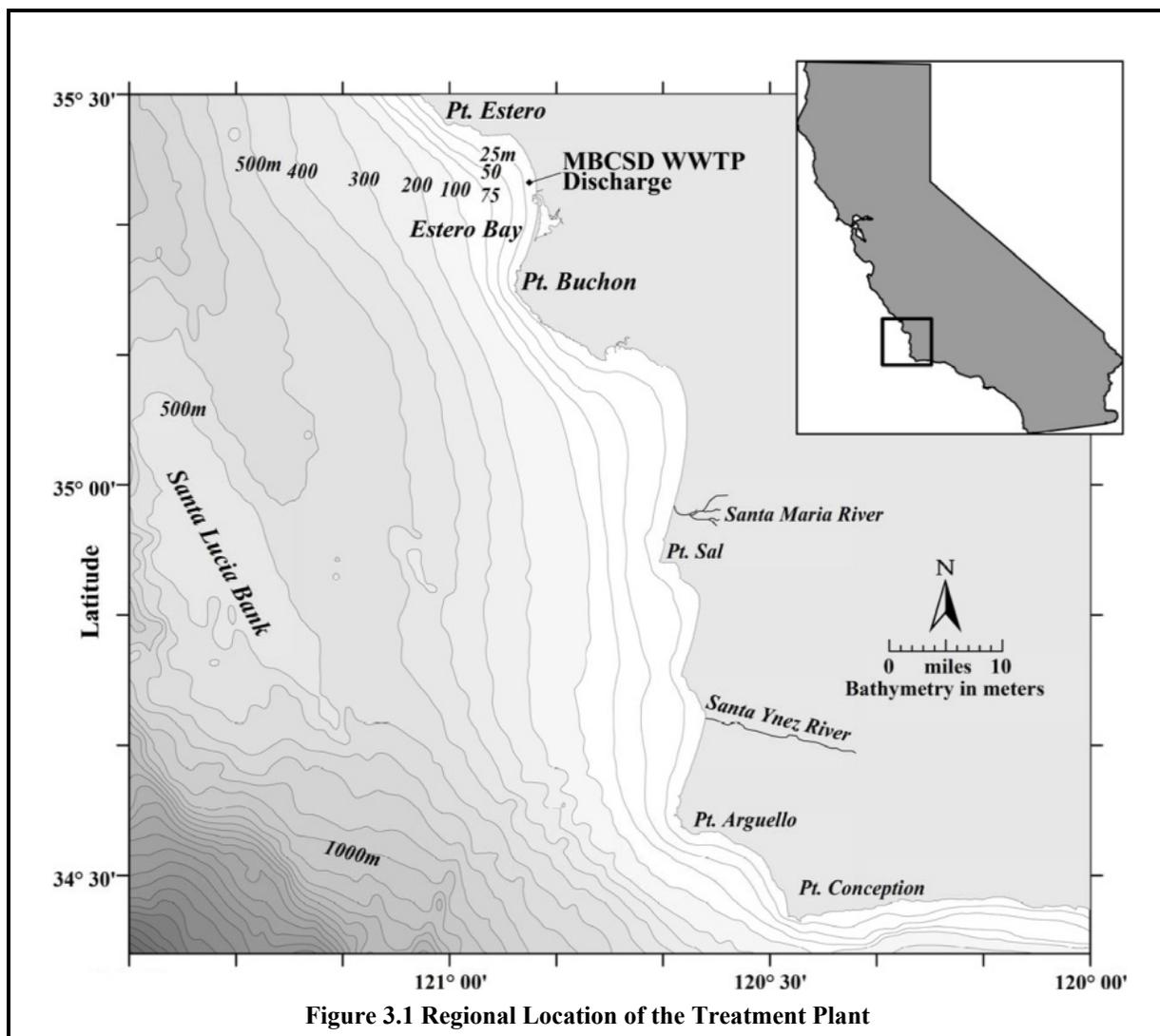
The enormous taxonomic change associated with the mature sand dollar bed resulted in an abrupt decline in every measure of infaunal community health after 2014, including infaunal density, diversity, species counts, and richness. However, a far more dramatic decline was observed in the infaunal trophic index (*ITI*), which estimates the wellbeing of the infaunal community from the abundance of suspension-feeding infauna, which typically reside in clean sediments, relative to the abundance of pollution-tolerant detritus-feeding organisms, which opportunistically occupy organically contaminated seafloor habitats. Prior to improvements in wastewater treatment during the 1980s, striking *ITI* declines were observed within seafloor sediments immediately surrounding large ocean discharges from low-performance treatment works. However, the sharp *ITI* decline measured within the MBCSD survey area was unrelated to organic loading from effluent discharge. The concentrations of organic constituents measured within both effluent and benthic sediments over the prior three years were comparable to those of the previous 29 years. Moreover, the *ITI* declines were clearly unrelated to the MBCSD discharge because they occurred uniformly throughout the survey area, with no evidence of a spatial gradient related to outfall proximity.

Instead of sediment-quality degradation resulting from organic material within MBCSD effluent, the dramatic *ITI* decline after 2014 was an artifact of the sharply increased presence of the *A. bioculata* lugworm within the sand-dollar community. Because this lugworm is a subsurface detritus feeder, it has an inordinately large negative influence on the *ITI* computation. However, regardless of its feeding style, this particular Opheliid lugworm is known to thrive within sand dollar beds irrespective of their organic content. Other field studies have consistently found significantly higher numbers of *A. bioculata* within sand dollar beds than in adjacent sediments with identical concentrations of organic material (Smith 1981).

Divers noted the continuing presence of numerous sand dollars surrounding the outfall during their December 2019 inspection (see Appendix B). Despite recent sand-dollar impacts on benthic infauna, macrofauna living on top of the sediment surface appear to be unaffected. This is evident from specimens occasionally encountered within grab samples, such as the juvenile East Pacific Red Octopus (*Octopus rubescens*) shown on the cover of this report. That specimen was found during 2018 benthic survey within the fourth sediment grab-sample collected at ZID Station B5, which is located 15 m immediately south of the diffuser structure. This benthic predator appeared to be well fed and in good health. When macrofauna like this octopus are encountered in the field, they are quickly identified, enumerated, photodocumented, and then immediately released.

3.0 BACKGROUND

The Morro Bay/Cayucos Wastewater Treatment Plant (WWTP) is publicly owned and operated by the City of Morro Bay and the Cayucos Sanitary District (MBCSD). The WWTP is located in the City of Morro Bay, within San Luis Obispo County, along the central coast of California (Figure 3.1). The plant serves the Morro Bay and Cayucos communities, which, according to the 2010 census, have a combined population of approximately 12,835 (10,243 in Morro Bay and 2,592 in Cayucos). The WWTP discharged, on average, 1.135 million gallons per day (MGD) during 2019. The plant was designed to accommodate an average dry-weather flow of 2.06 MGD, a peak seasonal dry-weather flow (PSDF) of 2.36 MGD, and a peak wet-weather flow (PWWF) of 6.64 MGD. The plant's throughput did not approach, much less surpass, any of these design limits during 2019.



3.1 OPERATIONS

Fifteen trained and certified personnel operated the WWTP during 2019 (Table 3.1). John Gunderlock served as both the WWTP and Collection System Supervisors. Joe Mueller provided additional WWTP oversight as the City’s Utilities Division Manager. WWTP personnel provided laboratory workspace to the National Estuary Program (NEP), which is dedicated to protecting and restoring the natural resources of Morro Bay and its watershed. NEP volunteers used the WWTP laboratory to analyze bacterial samples collected throughout the Morro Bay watershed.

WWTP personnel attended workshops, seminars, and continuing education classes throughout 2019. Training courses and seminars covered topics such as Environmental Safety Training, Confined Space Entry, Trench Shoring Safety, Lockout/Tagout Electrical Hazard Control, and OSHA² Construction Safety Training. Laboratory personnel training included refresher coursework in Basic Water Analysis, Laboratory Exam Review, and Distribution System Field Monitoring and Chlorine Testing for Small Systems. Plant personnel also attended the California Water Environment Association (CWEA) annual September workshop in the City of San Luis Obispo to attend wastewater education classes and earn continuing education units.

The plant Supervisor and the City’s Utilities Division Manager attended the CWEA annual conference in Palm Springs. The City’s Utilities Division Manager also attended The Water Environment Federation annual conference in Chicago and the Water Reuse Association annual conference in San Diego. Additionally, he taught a class in Oxnard California preparing students for the Advanced Water Treatment Operator exam.

Throughout 2019, WWTP personnel conducted plant tours for the public, job applicants, the fire department’s new-hire orientation program, students from local schools, members of various local agencies, and staff from other treatment plants. During plant tours, concerned citizens and Morro Bay City Councilpersons learned about treatment-plant processes and the City’s plans for the new Water Reclamation Facility (WRF). Another tour group consisted of fifty environmental-science students and two chaperones from Bakersfield High School. Plant staff gave presentations to three applied-chemistry classes about the future of wastewater treatment employment opportunities on Career Day at Morro Bay High School. Approximately 100 of these local students also participated in plant tours. A local college student from Cal Poly SLO³ and one from Humboldt State University also toured the facility on separate occasions as part of environmental-studies course reports, which compared actual WWTP specifications with calculated treatment-performance metrics. Employees from both the San Luis Obispo County engineering department and the Laguna County Sanitary District toured the facility with focus on the design of the plant’s solar sludge-drying beds and grit-disposal infrastructures. As part of the Plant’s annual permit requirements, APCD⁴ employees conducted a regulatory-based tour and inspection. The

Table 3.1 Morro Bay/Cayucos WWTP Personnel During 2019

Name	Grade and Certification No.
Joe Mueller	V-8495
John Gunderlock	V-10500
Dave Zevely	IV-34838
Richard Fernandez	III-41341
Dane Lundy	III-36547
Landon Mortimer	II-42800
Kyle Quaglino	II-43869
Steven Aschenbrener	II-7548
Alex Tapia	I-43754
Chad Rocha	I-43755
Chris Nichols	I-OIT ¹
Grant Garcia	I-OIT
Paul Valley	I-OIT
Robert Victor	I-OIT
Ryan Roberts	I-OIT

¹ Operator-in-training

² Occupational Safety and Health Administration

³ California Polytechnic State University, San Luis Obispo

⁴ San Luis Obispo County Air Pollution Control District

City of Morro Bay Fire Department held a rescue-training event at the WWTP with multiple agencies participating from around the county.

Plant operations during 2019 integrated ongoing maintenance of an overall health and safety plan. The WWTP passed an annual inspection by SLO EHS¹ in conjunction with the WWTP Hazardous Waste Business Plan on file with that county agency. The WWTP's chemical response plan was reviewed with SLO EHS representative during a tour of the WWTP.

In addition to performing the periodic effluent analyses required by the NPDES Permit during 2019, the laboratories involved in the analyses of the MBCSD WWTP samples participated in laboratory performance evaluations intended to assess the accuracy of effluent measurements and ensure the overall quality of the monitoring reports. In particular, the adequacy of each laboratory's analytical chemistry capabilities was demonstrated during 2019 when acceptable results were achieved in a Water Pollution Proficiency Testing Study, which is an annual requirement of laboratories certified by the State of California Environmental Lab Accreditation Program. It is administered by the State Water Resources Control Board and the USEPA. Successful completion of the federally mandated Discharge Monitoring Report Quality Assurance Study 39 satisfied this state regulatory requirement.

The MBCSD WWTP laboratory analyzed residual chlorine concentrations within wastewater samples collected daily basis. Wastewater flow and temperature were also reported daily, while effluent turbidity was measured five days each week. Influent and effluent pH was measured at least twice weekly. Abalone Coast Analytical performed suspended solids and BOD analyses on influent and effluent samples collected at least weekly. They also determined effluent total coliform densities within effluent grab samples collected five days each week. Aquatic Testing Laboratories evaluated the toxicity of effluent to marine organisms with bioassays collected during July. BC Laboratories and Monterey Bay Analytical Services determined trace-metal and nutrient concentrations during the annual effluent assay in July. BC Laboratories also performed weekly O&G analyses, and the annual chemical analysis of biosolid samples, as described in Chapter 7.0 of this report.

To assist WWTP personnel in the operation and maintenance (O&M) of major plant components, an O&M Manual (dated November 1987) was completed following the plant upgrade in 1986. The WWTP's O&M Manual has since been reviewed and updated on a regular basis. It is currently complete and valid for the operation and maintenance of the existing facility. The Manual was last reviewed and updated on 8 November 2019. For example, a Standard Operating Procedure (SOP) that specifies procedures for the manual operation of the main influent sluice gate was updated to assist operators in regulating plant flow during emergencies or equipment repair. It included standard operating procedures for all main gate controls and variable frequency drives to facilitate manually lowering and raising the gate to control influent flow. Additionally, laboratory personnel prepared six SOPs covering instrument calibration, inspection, and data transfer. Lastly, fourteen Activity Hazard Analyses (AHAs) and related SOPs were completed in 2019 by plant personnel. These AHAs investigated potential facility hazards and informed the development of associated SOPs.

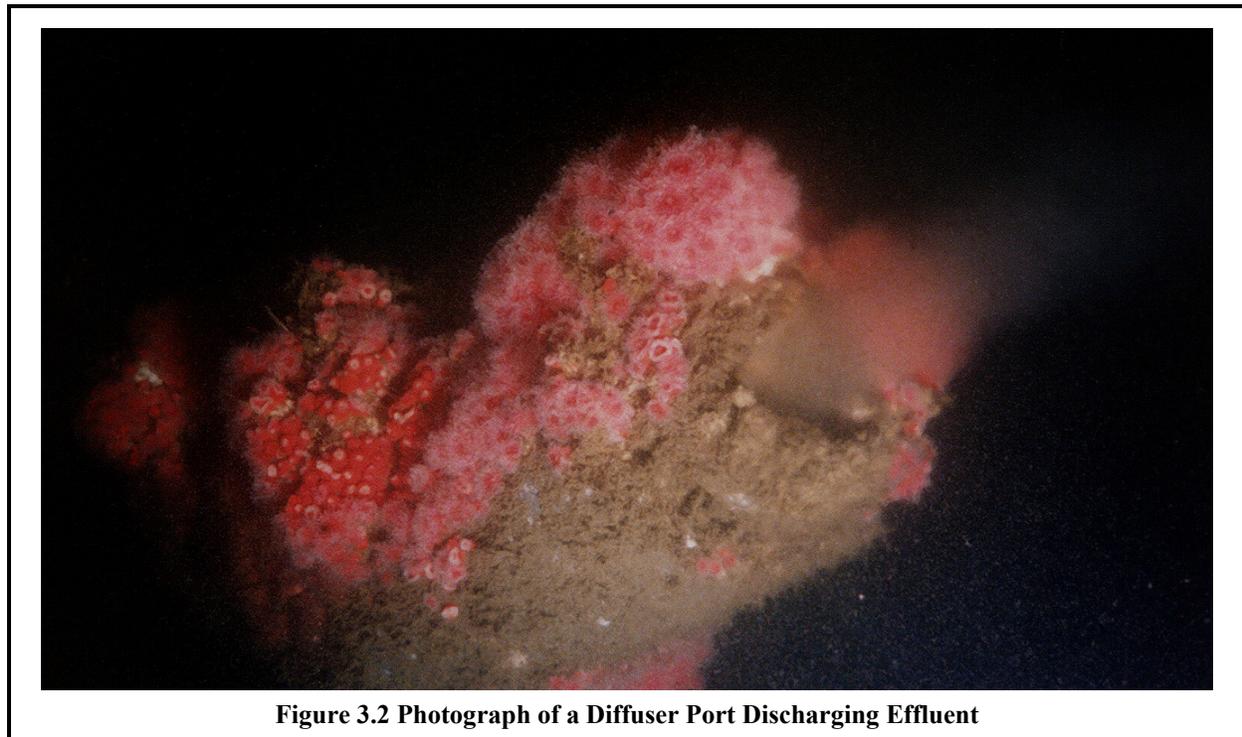
Updates also included revisions or additions to SOPs as new major equipment was placed online or when procedures for existing equipment were changed or improved. For example, the SOPs include procedures to archive project records for tasks completed on individual plant components, thereby expediting future reviews of prior actions taken. Additionally, contingency plans are embedded within the O&M Manual

¹ San Luis Obispo County Environmental Health Services

that address response to chemical spills, high flow and flood response, fire prevention and suppression, emergency evacuation, and comprehensive hazard communication procedures. Safety updates address procedures for heat illness identification and prevention, equipment lockout-tagout, confined space entry, and emergency notifications.

As part of routine maintenance procedures, divers inspect the ocean outfall's exterior and the diffuser structure for signs of damage annually. The outfall was inspected on December 16th, and the written inspection report is included herein.¹ Divers observed many mussels (*Mytilus californianus*), anemones (*Corynactis californica*), and sand dollars (*D. excentricus*), as well as small halibut (*Paralichthys californicus*), on and surrounding the outfall. The outfall and diffuser system were found to be in good condition, with no broken or plugged diffuser ports. The divers provided photodocumentation of the outfall's condition in the form of digital video recorded throughout their inspection.

Figure 3.2 shows a photograph of a diffuser port taken during a prior outfall inspection. It shows a dense cover of marine epifaunal organisms thriving on the outer surface of a diffuser port. A colony of numerous club-tipped anemones (*C. californica*), bright pinkish-red in color, covers the top surface of the port. The continued presence of these filter-feeding organisms attests to the benign nature of the effluent discharge, and to the outfall's value as an artificial reef. Quantitative biological surveys conducted within the region found that these anemones are only occasionally observed on high-relief rock surfaces within Estero Bay, and then only in deeper water (>85 m) (Morro Group 1999). Ostensibly, their susceptibility to elevated suspended-sediment loads explains their rarity on nearshore, lower-relief rocky substrates.



¹ Appendix B

3.2 PLANT HISTORY

The original WWTP, built in 1954, had a nominal capacity of 0.7 MGD and a 1-MGD maximum throughput. The original plant included a headworks structure, primary and secondary clarifiers, a biofilter, a single-stage digester, chlorination facilities, biosolids drying beds, and a short ocean outfall.

In 1964, the plant upgraded to a nominal capacity of 1 MGD and a 1.3-MGD maximum throughput to meet the demands of the growing coastal community. This upgrade added a pump station, a splitter box, a primary clarifier, a secondary clarifier, a biofilter, chlorination facilities, biosolids beds, and another primary digester, which allowed conversion of the existing digester to process secondary sludge. The existing office building and laboratory were also constructed during this upgrade.

During the 1970s, the City of Morro Bay developed a plan for additional upgrades to the WWTP facilities intended to augment the plant's capacity further. In 1980, the City began designing these planned improvements, including the construction of a new outfall to protect the marine environment, and an upgrade of processing equipment to provide full secondary treatment.

Following a yearlong study of oceanographic conditions within Estero Bay, design of the new outfall was completed in April 1981. The new outfall and diffuser system extended the discharge from the surfzone to a point much farther offshore. This deeper discharge significantly increased the effluent mixing rate within the open-ocean environment. The new outfall was completed and placed in service in June 1982.

The design of the facility improvements, completed in September 1981, called for a final effluent suspended-solids concentration of 30 mg/L and an equivalent limit on BOD. However, monetary aid from state or federal agencies to finance the construction of a full-secondary-treatment facility was not available. Because discharge through the new outfall was not causing any apparent adverse environmental impacts, and the projected future throughput was low, the State determined that additional financial aid for upgrading the MBCSD WWTP to full secondary was not warranted. Instead, the City modified the design to provide secondary treatment to a majority (1 MGD) of the projected flow to ensure full compliance with the state water-quality standards set forth in the California Ocean Plan (COP) (SWRCB¹ 1990).

State officials concurred with this partial-secondary level of treatment, provided that the USEPA approve a 301(h)-modified NPDES discharge permit that adjusted secondary-treatment requirements on suspended-solid and BOD emissions. In a March 1983 letter, RWQCB personnel formally determined that the proposed discharge would comply with state water-quality standards pursuant to Subsection 301(h) of Title 40 of the Code of Federal Regulations.²

Upgrades to the treatment plant, completed between 1983 and 1985, increased the plant's capacity to a 2.06-MGD average dry-weather flow and a peak flow of 6.6 MGD. The plant now includes primary treatment of all influent by screening, grit removal, and primary sedimentation. Additionally, depending on the hydraulic conditions within the plant, up to 1 MGD of the flow can be diverted through a secondary-treatment process consisting of trickling filters, clarifiers, and a solids-contact chamber. The secondary-treatment process utilizes two trickling filters, an aerated solids-contact channel, and a

¹ State Water Resources Control Board of the California Environmental Protection Agency

² Section 125.60(b)(2) [40 CFR 125.60(b)(2)] (USGPO 1982a) and 40 CFR 125.63(b) of the 301(h) regulations dated November 1982 (USGPO 1982b)

secondary sedimentation tank. The original sedimentation tank, built in 1954, was converted to a chlorination system where the primary- and secondary-treated effluents are mixed and disinfected prior to dechlorination and discharge through the ocean outfall.

In March 1985, an NPDES permit, based on the previously approved Section-301(h) modification, codified water-quality standards for the MBCSD WWTP. The permit required treated effluent to achieve a suspended-solids content of no more than 70 mg/L (75% removal) and a maximum BOD of 120 mg/L (30% removal). The permit also required an extensive monitoring program to assure maintenance of environmental quality. The permit was valid for five years and expired in March 1990. After an evaluation process, the permit was reissued in December 1992. During this evaluation period, improvements to the treatment facilities included the installation of a sludge-removal system within the Chlorine Contact Tank.

The MBCSD again applied for renewal of the permit in May 1997, supporting its application with an extensive technical review of more than 10 years of monitoring data (MRS 1997). An administrative extension until December 1998 allowed regulatory agencies additional time to review and issue the new permit (RWQCB 1998). In July 1998, RWQCB staff determined that the discharge described in the MBCSD application “*would comply with applicable state laws, including water quality standards, and would not result in additional treatment, pollution control, or other requirements on any other point or nonpoint source.*” This permit was finalized and issued by USEPA on 26 January 1999, with an effective date of 1 March 1999.

Based on discussions between RWQCB, USEPA, and MBCSD personnel and their consultants, the following revisions were also implemented in the 1999 permit:

- A 12.7% reduction in the allowed mass emission of suspended solids, BOD, and O&G;
- More extensive reporting requirements for biosolids;
- Elimination of shellfish monitoring;
- A revised benthic sampling program, increasing the number of stations close to the diffuser structure and eliminating seasonal sampling;
- A revised receiving-water sampling program, doubling the number of vertical profiles close to the diffuser structure and eliminating bottle casts; and
- Specification of mass emission goals for toxic chemicals.

Based on the historical absence of perceptible impacts from the discharge, and the projected continuation of consistently high effluent quality, the MBCSD again applied for a renewal of the Section-301(h)-modified discharge permit in July 2003 (MBCSD 2003). As with the previous permits, the application requested continued discharge under the 301(h) provision that allows minor modifications to the BOD and suspended-solids requirements. In February 2004, the RWQCB (2004) administratively extended the existing permit to allow time for further review. In September 2005, the USEPA Region IX (2005) issued a tentative decision concurring with issuance of a permit to the MBCSD in accordance with Section 301(h) of the Clean Water Act. In April 2006, the USEPA and RWQCB personnel issued a joint notice for a proposed action to reissue the 301(h) modified NPDES discharge permit to the MBCSD. However, in May 2006, the RWQCB and the USEPA conducted a joint public hearing addressing the reissuance of the MBCSD permit wherein the RWQCB voted to continue the hearing pursuant to the issuance of a biological evaluation by the USEPA (2007).

In 2008, the USEPA issued an Endangered Species Act (ESA) biological evaluation of continued discharge under a 301(h)-modified discharge permit wherein they determined:

...that the continued wastewater discharge from the Morro Bay/Cayucos facility is not likely to adversely affect the brown pelican or southern sea otter, both of which occur in the vicinity of the subject discharge. EPA finds that any potential direct or indirect effects of the continued wastewater discharge would be insignificant to the brown pelican and southern sea otter.

Pursuant to Section 7 of the ESA, the proposed action of the USEPA required consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), which protect federally listed endangered species and designate critical habitat that may be affected by the proposed action. In December 2007, the USFWS concurred with the USEPA's "determination that the proposed project is not likely to adversely affect the brown pelican or southern sea otter."

Nevertheless, the USEPA incorporated three conservation measures in the new NPDES discharge permit to address concerns about potential contributions to otter morbidity by cat litter and domoic acid poisoning. First, the MBCSD would implement a public outreach program to minimize the input of cat-litter-box waste into the municipal sewer system. Second, the MBCSD would be required to monitor nutrient loading from the WWTP on a regular basis. Third, the facility would upgrade to a minimum of full secondary-treatment levels by 2014.

Based on the foregoing findings and the incorporation of conservation measures, the RWQCB unanimously adopted the prior discharge permit in December 2008. Subsequently, on 9 January 2009 the California Coastal Commission unanimously determined that the new discharge permit complied with the California Coastal Zone Management Act. On 14 January 2009, the USEPA issued the new NPDES permit, effective 1 March 2009. In addition to the conservation measures noted above, the following revisions were also implemented in the 2009 permit:

- Elimination of acute toxicity testing;
- Implementation of triggered shoreline coliform monitoring;
- Revision of benthic sampling pattern, eliminating cross-shore stations and shifting from grab to composite sediment-chemistry samples; and
- Revision of receiving-water sampling program, reducing the number of vertical profiles and implementing a tow-survey component.

Although this previous NPDES permit was not finalized until January 2009, the MBCSD had actually begun to implement several of the proposed conservation measures years before. For example, in April 2006, the MBCSD, working to address the concerns of the USEPA and RWQCB, adopted an eight-year time schedule to rehabilitate and upgrade the treatment plant to tertiary treatment, including onsite composting, as the preferred alternative for upgrading the WWTP by 2014. The MBCSD subsequently adopted a draft facilities master plan that outlined the facilities necessary for a tertiary treatment capacity of 1.5 MGD in September 2007. Meanwhile, in August 2007 the City of Morro Bay and the Cayucos Sanitary District individually adopted revenue programs that identified increases in sewer-rate fees necessary for each community to finance the proposed plant upgrade and to provide revenue for needed sewer-system capital improvement projects. In July 2008, the City of Morro Bay implemented new residential and commercial water-use rates that increased the existing fees by 50%.

During 2009, based on the findings of flood hazard analysis, the City and District voted to relocate the treatment plant site to an elevated area adjacent to the existing treatment plant. In October 2009, the

MBCSD public noticed a Request for Proposal (RFP) for Engineering Design Services for the upgrade, and the City of Morro Bay released a Revised Notice of Preparation for the project, reflecting changes to the project description involving construction of treatment-plant components adjacent to the current ones. Demolition of the existing plant was to occur after the relocated treatment-plant components were constructed and brought online. The engineering design contract was awarded at the February 2010 Joint Powers (JPA) meeting with a projected completion in 15 months.

The final Environmental Impact Report for the upgrade project was released in December 2010. The Morro Bay City Council certified the EIR¹ and approved the Conditional Use Permit and Coastal Development Permit (CDP) for the upgrade project in January 2011; however, the decision to issue the CDP was subsequently appealed to the California Coastal Commission. A *de novo* hearing was held in January 2013 after which the proposed upgrade project at its current location was terminated.

Subsequently, at the February 2013 JPA meeting, the MBCSD approved development of a Major Maintenance and Repair Plan. The Plan was instituted to ensure uninterrupted operation of the existing WWTP in compliance with regulatory requirements during the extended operational period required for the development and construction of a new treatment facility at a different site. In August 2013, the MBCSD submitted an application to the RWQCB for a new discharge permit to replace the current 301(h) modified permit due to expire on 28 February 2014. Based on direction from the MBCSD and RWQCB personnel, an application was submitted for a full secondary discharge permit.

During 2013 and 2014, the MBCSD explored various sites and treatment alternatives for a new facility to process wastewater currently treated by the existing WWTP. In early 2015, the City of Morro Bay identified a Water Reclamation Facility as the preferred design, and initially selected a location east of the City and north of Highway 41. On April 30, the Cayucos Sanitary District suspended participation with the City in their WRF and began planning a separate Water Resource Recovery Facility (WRRF). The District began independently evaluating wastewater treatment alternatives, characterizing flow rates and mass loadings specific to the District's collection system, identifying beneficial uses for recycled water, evaluating potential facility locations, and developing a funding and financing strategy.

The WRRF is now encompassed in the Cayucos Sustainable Water Project (CSWP), which also incorporates the necessary conveyance infrastructure. During 2016, the Cayucos Sanitary District selected a membrane bioreactor as the WRRF treatment process, identified a CMAR² as the construction delivery method for the CSWP, selected the CMAR contractor, began preparing a dEIR,³ and purchased a property for the WRRF site along Toro Creek Road. During early 2017, the District published the dEIR and subsequently completed a final EIR, consisting of responses to comments on the dEIR. Groundbreaking for construction of the WRRF occurred in August 2018. A Project Status Update Meeting⁴ on 26 June 2019 described Project financing and a schedule with construction beginning in July 2019 and plant commissioning projected in December 2020. It also discussed upcoming Project components including a solar power project, Lift Station #5 refurbishment and expansion, land acquisition, onshore pipeline construction via horizontal directional drilling to avoid cultural resources, and acquisition of a Cayucos-owned ocean outfall within an existing oil loading line at the Chevron Estero Bay Marine Tanker Terminal.

¹ Environmental Impact Report

² A Construction Manager at Risk (CMAR) is a project delivery method wherein the Construction Manager (CM) is required to deliver a project within a guaranteed maximum price.

³ Draft Environmental Impact Report. The CSWP dEIR was completed in January 2017 and is available at: <http://www.cayucossd.org/cswp-draft-eir>. The final EIR is also available on the website link, and was certified in April 2017.

⁴ <https://www.cayucossd.org/files/73fde07cc/6.26.19+Townhall+Meeting+Presentation.pptx>

At the same time, the City of Morro Bay personnel and their consultants made significant progress on developing the new WRF to replace the existing WWTP. A Memorandum of Understanding was executed for the future purchase of a property near the South Bay Boulevard exit from Highway 1, after site-selection studies were performed to identify a preferred location for the new WRF. A draft Facility Master Plan, Master Water Reclamation Plan, and Draft Rate Study were also completed. Based on recommendations in the Master Water Reclamation Plan, full advanced treatment, a recycled water pipeline, and injection wells to facilitate indirect potable reuse are anticipated as part of the project. The City of Morro Bay received approval for a \$10.3M loan from the SWRCB CWSRF¹ for the design and planning of a recycled water project. During October and November 2017, an RFQ² was issued for the design and construction of WRF onsite improvements, and the design of WRF offsite improvements, including a lift station and pipelines.

On 7 December 2017, the RWQCB adopted a new permit for the MBCSD discharge with an effective date of 1 March 2018 (RWQCB 2018a). In contrast to prior permits, the current permit is not Section-301(h) modified, but a TSO promulgated interim TSS and BOD effluent limits identical to those of the prior 301(h)-modified permit to allow the MBCSD time to bring the CSWP and WRF online. This accompanying Time Schedule Order (RWQCB 2018b) requires full compliance with the current permit's final effluent requirements by 23 February 2023.

The current MBCSD discharge permit also implemented the following revisions to the monitoring program:

- Decreased the sampling frequency to once-in-the-life of the permit for benthic sediment chemistry and biota, and all effluent chemical constituents except for metals and nutrients, which are to be analyzed on an annual basis;
- Instituted a three-species chronic-toxicity screening study to be conducted annually for three years, followed by annual tests on the most-sensitive species; and
- Eliminated offshore receiving-water monitoring and the cat-litter public-outreach program.

In compliance with TSO provisions, the City of Morro Bay personnel and their consultants completed a number of major WRF-project milestones during 2018, including certification of the Final EIR, adoption of new rates to support the project, and a notification to proceed with the design of onsite WRF improvements. The MBCSD also submitted a request to the RWQCB for acceptance of the upcoming Enhanced Source Control Program report, which is required under Title 22 Regulations for indirect potable reuse by the WRF, in lieu of the required submission of a Pollution Prevention Plan for BOD and TSS pursuant to the Clean Water Act (MBCSD 2019).

Significant progress on the WRF Project continued throughout 2019 and into 2020. Sixty-percent design deliverables for the WRF and conveyance facilities were submitted in July and September 2019. A final CDP for the WRF was issued by California Coastal Commission in November 2019. Project funding through low-interest loans from the USEPA and the SWRCB required USFWS consultation pursuant to Section 7 of the ESA for the proposed WRF location. Initial concerns over potential impacts to the California red-legged frog (*Rana draytonii*) led to a formal consultation with the USFWS. Their biological opinion was issued in February 2020, allowing future low-interest State and Federal loans to be secured.

¹ The Clean Water State Revolving Fund (CWSRF) includes a Water Recycling Funding Program administered by the SWRCB Division of Financial Assistance.

² Request for Qualifications

3.3 REGULATORY SETTING

The 1972 Federal Clean Water Act and its 1977 amendments established national water-quality goals and created a national permit system (NPDES) of minimum standards for the quality of discharged waters (USGPO 1997a). Pursuant to the new system, states established standards specific to water bodies and designated the types of pollutants to be regulated. Since 1973 the California State Water Resources Control Board and its nine Regional Water Quality Control Boards have been delegated the responsibility of administering permitted discharges into the coastal marine waters of California. The State Board prepares and adopts the COP, which incorporates the state water-quality standards that apply to all NPDES permits. The RWQCB established a Water Quality Control Plan for the basin containing San Luis Obispo County waters (“The Basin Plan” RWQCB 2017). The Plan’s standards incorporate the applicable portions of the COP, and promulgate water-quality objectives and toxic material limitations that are designed to protect the beneficial uses of receiving waters within individual basins. The MBCSD outfall site lies within the Estero Bay Coastal Segment where the Basin Plan identifies the following the existing beneficial uses specific to those marine waters.

- **Water Contact Recreation (REC-1)** uses include recreational activities involving body contact with water, where ingestion of water is reasonably possible. Specific uses include: swimming, wading, water skiing, skin and scuba diving, white water activities, and fishing.
- **Noncontact Water Recreation (REC-2)** uses include recreational activities involving proximity to water but not normally involving body contact with water, where ingestion of water is reasonably possible. Specific uses include: picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life studies, hunting, sightseeing, and aesthetic enjoyment.
- **Industrial Service Supply (IND)** uses include industrial activities that do not depend primarily on water quality, such as, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil-well repressurization.
- **Navigation (NAV)** uses include shipping, travel, or other transportation by private, military, or commercial vessels. The RWQCB interprets NAV as being present within any natural body of water that has sufficient capacity to float watercraft for the purposes of commerce, trade, transportation, and pleasure.
- **Marine Habitat (MAR)** uses support marine ecosystems and include preservation or enhancement of marine habitats, fish, shellfish, and vegetation (kelp), or wildlife (marine mammals and shorebirds).
- **Shellfish Harvesting (SHELL)** uses support habitats suitable for the collection of filter-feeding shellfish (clams, oysters, and mussels) for human consumption, commercial, or sport purposes. Specific uses include waters that have in the past, or may in the future, contain significant shellfisheries.
- **Ocean Commercial and Sport Fishing (COMM)** uses encompass the collection of fish, shellfish, or other organisms, including uses involving organisms intended for human consumption or bait purposes.
- **Preservation of Rare, Threatened, or Endangered Species (RARE)** uses support habitats necessary for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.
- **Wildlife Habitat (WILD)** uses support terrestrial ecosystems including the preservation and enhancement of terrestrial habitats, vegetation, wildlife (mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Section 301(b) of the Clean Water Act requires publicly owned treatment works to meet effluent limitations based on secondary treatment, which is defined in terms of limits on three effluent parameters (40 CFR 133; USGPO 1997a). These limitations are:

- Total suspended solids (TSS) concentrations not exceeding 30 mg/L as a 30-day average and removal rates not less than 85%;
- BOD concentrations not exceeding 30 mg/L as a 30-day average and removal rates not less than 85%; and
- Hydrogen-ion concentration (pH) between 6.0 and 9.0.

These limits were based on the treatment capabilities of the best technology available at the time, rather than an evaluation of the treatment necessary to reduce potential environmental impacts to an acceptable level within receiving waters. Recognizing that this level of treatment may not be necessary within ocean waters, Section 301(h) was added to the Act to allow an NPDES discharge permit to modify some or all of these full secondary-treatment requirements, if certain conditions are met. The MBCSD WWTP is a combined primary and secondary-treatment facility that operated under a Section 301(h)-modified NPDES permit (number CA0047881) from March 1985 to March 2018. The modifications only applied to the TSS and BOD requirements, so all other NPDES limitations remained in force without exception, including those for wastewater pH and toxic compounds. The modification was issued only after the MBCSD satisfied the following additional requirements:

- Demonstrate the existence of a water-quality standard specific to the pollutant for which the modification is requested (40 CFR 125.61; USGPO 1997a). The COP specifies limits on TSS and dissolved-oxygen (DO) depression, thereby establishing the relevant standards (SWRCB 2005). In January 2009, the California Coastal Commission determined that the last 301(h)-modified discharge permit issued to the MBCSD complied with the State Coastal Zone Program that incorporates COP standards.
- Demonstrate that the discharge does not adversely impact public water supplies or interfere with the protection and propagation of balanced, indigenous biological populations (40 CFR 125.62). Both the USFWS and the NMFS determined that the discharge would not adversely impact threatened or endangered species, or critical habitats, pursuant to the ESA.
- Conduct a monitoring and reporting program capable of evaluating the effects of the discharge (40 CFR 125.63). The comprehensive monitoring program described in this and prior annual reports satisfies this requirement.
- Demonstrate that the discharge will not result in any additional treatment requirements on any other point or nonpoint source (40 CFR 125.64). The highly localized footprint of the MBCSD discharge does not overlap that of other discharges.
- Determine whether the WWTP is subject to pretreatment requirements. Since there are no known sources of toxic pollutants or pesticides within the collection area, the WWTP is exempt from general pretreatment requirements in lieu of a pollution prevention program. In addition, because the discharge is considered small, it is exempt from the urban pretreatment requirement (40 CFR 125.65).
- Demonstrate whether the pollution-prevention program meets the requirement for a nonindustrial source control program (40 CFR 125.66). The MBCSD pollution prevention program implements public education and source reduction programs to limit the introduction of toxic pollutants or pesticides into the treatment plant.

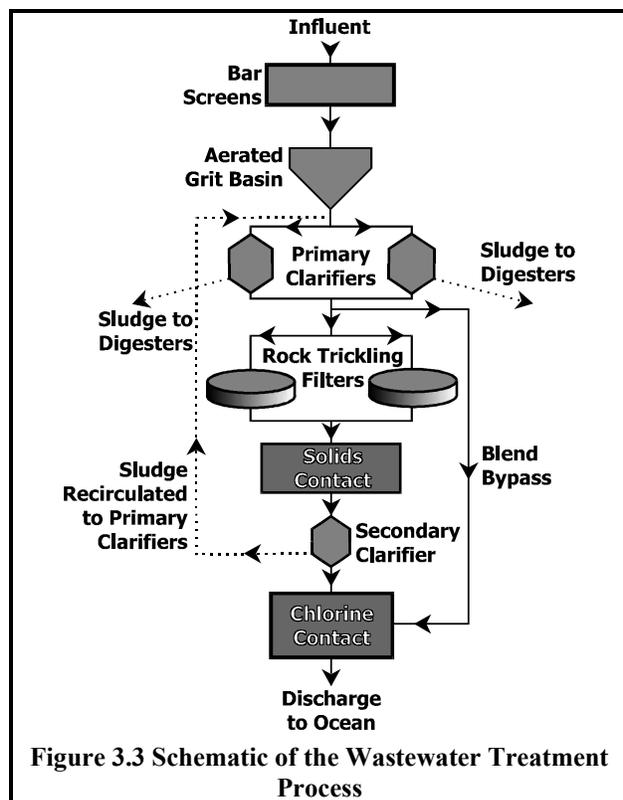
- Demonstrate that there will be no new, substantially increased discharges of BOD and TSS beyond those specified in the permit (40 CFR 125.67). The historically high performance of the plant process, the limited projected growth in population and industry within the service area, and the analyses provided in this and prior annual reports demonstrate this.
- Ensure that the WWTP exceeds the minimum requirements for primary treatment (40 CFR 125.60). The WWTP performs “*treatment by screening, sedimentation, and skimming adequate to remove at least 30 percent of the biochemical oxygen demanding material and of the suspended solids in the treatment works influent, and disinfection, where appropriate*” (40 CFR 125.58(r); USGPO 1997a).

The MBCSD WWTP is categorized as a Class III wastewater treatment facility by the Office of Operator Certification within the California State Water Resources Control Board. The Board reclassified the facility in 2001 from a Class IV facility based on the advanced treatment process and the plant’s low flow volume. A typical Class IV facility treats more than 20 MGD in the primary process, while the MBCSD plant processes a total flow of less than 2 MGD and performs partial-secondary treatment on a large portion of that flow.

During 2015, the California Department of Public Health developed a Management Plan for Commercial Shell Fishing within Morro Bay. The Plan provides reporting guidelines in the event of a sewage spill to the Bay or adjacent ocean. WWTP personnel provided comments on the Plan, and signed a Statement of Agreement concerning its implementation.

3.4 TREATMENT PROCESS AND OUTFALL SYSTEM

The WWTP operating characteristics are listed in Appendix A. All wastewater is treated through a primary treatment process, which includes screening, grit removal, and primary sedimentation, as shown in Figure 3.3. Typically, a portion of the flow is diverted for additional secondary treatment using biofilters, a solids-contact chamber, and a secondary clarifier. The secondary process consists of parallel single-stage, high-rate, trickling filters whose combined outflow goes to a solids-contact channel and then to a secondary sedimentation tank. When flows exceed 1 MGD, secondary-treated effluent can be subsequently blended with primary-treated effluent, before the entire blend is chlorinated for disinfection and then dechlorinated. The disinfected and dechlorinated effluent is discharged into Estero Bay through a 4,400-ft (1,341-m) outfall terminating in a multi-port diffuser system. Waste biosolids are anaerobically digested, dried, composted and used as soil conditioner and fertilizer. A schematic of the biosolids process is shown in Figure 7.1 on Page 7-1.



The location of the Morro Bay-Cayucos WWTP and outfall within Estero Bay is shown in Figure 3.4. The treated wastewater is released into unstressed, open-ocean waters at 35°23'11"N latitude and 120°52'29"W longitude. The effluent flows through a 27-in (0.69-m) diameter outfall that extends approximately 4,400 ft (1,341 m) in a northwesterly direction. The outfall terminates in a multi-port diffuser approximately 2,700 ft (827 m) from shore. The 170-ft (51.8 m) long diffuser lies at a water depth of 50 ft (15.2 m), measured relative to the mean lower low water (MLLW) datum. Twenty-eight of the 34 available diffuser ports are currently open. The remaining six ports can be made operational if the sustained discharge exceeds 6.60 MGD.

Because of its location, the MBCSD discharge does not interfere with the maintenance of water quality and beneficial uses designated for Estero Bay (listed in Section 3.3 on Page 3-9). The discharge occurs in well-flushed, open coastal waters where re-entrainment or accumulation of effluent will not violate applicable water-quality standards, even if combined with pollutants from other sources. Intakes and outfalls from other publicly owned treatment works are distant from the MBCSD outfall. For example, water intake for the Morro Bay desalination plant is from saltwater wells and not from the open ocean where the MBCSD discharge occurs. Similarly, surface discharge of water from the desalination plant, when it does occur, is far south of the MBCSD discharge point and does not add chemical loads to the ocean environment.



Figure 3.4 Locations of the MBCSD Outfall and Monitoring Stations within Estero Bay

3.5 POLLUTION PREVENTION PROGRAM

The MBCSD's Pollution Prevention Program seeks to minimize the introduction of incompatible contaminants, such as pollutants and pesticides, into the treatment process. The NPDES permit requires an annual status report detailing efforts to comply with the requirements for a Pollution Prevention Program. This section serves as that report.

Note, however, the City of Morro Bay and Carollo Engineers are continuing to revise the Pollution Prevention Program that will subsequently be submitted to the RWQCB for approval. The revisions will update the industrial waste survey, provide the city with a public education plan, evaluate sources of residential, industrial and commercial discharges, and develop enforcement response plans for non-compliance and other emergency procedures.

Additionally, the City's Sewer System Management Plan was updated during 2019. It established goals to manage, operate, and maintain all the components of the wastewater collection system to best prevent the occurrence of Sanitary Sewer Overflows (SSOs), and if they do occur, to mitigate potential impacts.¹ The City also began implementing its OneWater Plan² during 2019 (Morro Bay 2018a). That plan was finalized in October 2018 and integrated the Sewer System Management Plan, the Drinking-Water Master Plan, and the Stormwater Master Plan.

As in previous years, three aspects of pollution prevention were emphasized during 2019: 1) public outreach, 2) industrial-waste source control and identification, and 3) monitoring of influent and effluent for industrial contaminants.

3.5.1 Industrial Waste Survey

During 2019, as in previous years, elevated levels of industrial pollutants were not found within the MBCSD wastewater stream. Instead, more than three decades of comprehensive monitoring demonstrates that effluent discharged from the MBCSD treatment plant consists of benign constituents typical of wastewater generated from domestic sources. Based on analyses of water usage for 2013 through 2016,³ domestic and government agency sources contributed 78% of the wastewater processed by the plant. Commercial and mixed-use businesses contributed 20%, with light-industrial usage accounting for less than 2%.

However, this usage-based approach overestimates the influence of nondomestic sources on the treatment process. For example, a substantial portion of the water-use attributed to the government agencies is utilized for the irrigation of landscaping, sports fields, and agricultural uses and thus, would not be expected to flow into the collection system. These agencies include the City of Morro Bay, Morro Bay High School, the San Luis Coastal School District, Morro Elementary School, and the State Department of Parks (Morro Bay State Park). Additionally, the compounds added to the wastestream by both large commercial and government users are not particularly toxic to humans or aquatic organisms, and do not generally interfere with the treatment process.

This general lack of chemical contaminants within the wastestream arises because the local economy within the MBCSD service area relies largely on tourism and commercial fishing, with no heavy industry or manufacturing of environmental significance. Nevertheless, a digital database was developed in 1999 to catalogue business names, addresses, and contact information of potential industrial users within the service area. This database is regularly updated to track the comparatively low volume of influent derived from light industrial sources within the service area. For example, slightly more than 50 restaurants and an approximately equal number of hotels are found in the service area during any given year.

The list of businesses within the database and the nature of the wastewater they generate is updated regularly based on business license applications filed with the City of Morro Bay and input provided by the Cayucos Sanitary District. Businesses with no potential for industrial discharges, such as offices and retail stores, are classified separately from those with the potential for light-industrial discharge. Businesses that either do not generate wastewater at all, or discharge only domestic wastewater (e.g., theaters, beauty shops, and barbershops), are excluded from the industrial-discharge classification.

¹ <https://www.morro-bay.ca.us/731/Sanitary-Sewer-Overflows-SSOs>

² <https://www.morrobayca.gov/DocumentCenter/View/12500/OneWater-Plan-Final>

³ Table 4.5 on Page 4-7 (Sequential Page 105) of the [OneWater Plan](#)

The City of Morro Bay's Source Control Program divides facility inspections into two classes: Class I light-industrial facilities and Class II food-service establishments, which constitute the majority of commercial businesses discharging to the collection system. During 2019, twelve Class I and fifty-seven Class II facilities were inspected. Class I inspections emphasized compliance with the discharge requirements set out in the City's Municipal Code, such as pre-treatment to maintain an acceptable pH range. Class II inspections emphasized the Best Management Practices (BMPs) for the disposal of fats, oils, and greases (FOG). During the Class II inspections, a FOG BMP handout was distributed along with "No Grease" stickers to be displayed above kitchen sinks to raise awareness and serve as a reminder of proper FOG disposal methods. FOG BMPs are also available online as part of the Wastewater Collections Division public outreach effort.¹ The inspections themselves focused on determining the presence of grease traps or interceptors, and if present, whether they were properly cleaned and maintained. For establishments with fryers, the method and frequency of oil disposal was documented.

Class I facilities consist of light industrial businesses such as commercial laundries, car washes, dry cleaners, print shops, and the oil-water separator maintained by the City of Morro Bay. Collections personnel perform scheduled visits, surprise onsite inspections, and formal tours of these facilities. Car-wash discharges are considered industrial in nature because of the volume of solids, oils, and grease that are washed from vehicles. As with restaurants, the sewer-use ordinance within the City of Morro Bay municipal code requires self-service car washes to install and maintain grease traps within their sewer line connections. The municipal code also prohibits smaller contributors, like gas stations and repair garages, from disposing known contaminants into the collection system.

As part of the City's pretreatment program, samples from a commercial laundry's discharge are occasionally collected and analyzed. Prior inspections found that the discharge pH had extended beyond the 5.5-to-9.0 range allowed in the municipal code. Throughout 2018, City personnel discussed strategies with the launderer's staff to improve pH stability within the launderer's discharge and to achieve uninterrupted compliance municipal discharge requirements. In mid-October 2018, laundry staff installed a large mixing equalization tank and new boiler. Subsequent pH monitoring by City personnel demonstrated uninterrupted compliance with municipal code's allowable range since the pretreatment buffering system was commissioned.

In addition to chemical input from light industry, the WWTP itself intentionally introduces three chemicals (ferrous chloride, sodium hypochlorite, and sodium bisulfite) into the treatment process. Ferrous chloride is used primarily to control hydrogen sulfide emissions during flaring of digester gas and heating of the digesters at the WWTP, as required by the APCD. Wastewater facilities commonly disinfect effluent prior to discharge with some form of chlorine; the WWTP uses sodium hypochlorite. However, because even low concentrations of residual chlorine can be hazardous to aquatic life, the MBCSD treatment plant adds sodium bisulfite to the wastestream to remove excess total chlorine residual once disinfection is complete.

3.5.2 Public Outreach

The MBCSD utilizes online and written literature as well as direct communication through multiple workshops, presentations, talks, and plant tours in order to educate consumers and local businesses about the organization and operation of the treatment plant; sewer-system BMPs; and techniques for the proper disposal of a variety of household wastes.

¹ <https://www.morro-bay.ca.us/730/FOG-Fats-Oils-and-Grease>

The Cayucos Sanitary District maintains a website¹ with status updates and other information relating to the CSWP, along with Town Hall Meeting notices, responses to FAQs,² and links to other resources. The City's website³ includes a series of pages devoted to an overview of the wastewater treatment plant and collection-system operations. The web pages contain pertinent information on current topics of interest. These include the status and history of the pending transition to an offsite WRF, the availability of an onsite Household Hazardous Waste Facility, and Collection System Do's & Don'ts. Do's & Don'ts specific to SSOs,⁴ FOG,⁵ and Car Washing⁶ are available online. In addition, digital copies of the treatment plant's self-monitoring reports from 2005 onward, including, for example, this annual monitoring report are also available online.⁷ Lastly, public awareness efforts regarding the City's progress on the on WRF are regularly provided in monthly City Manager's Reports,⁸ monthly Public Works Advisory Board Minutes,⁹ and in timely News Releases.¹⁰

The Collection System Do's & Don'ts section of the City's website also provides current BMPs for cat-litter disposal and the importance of avoiding its introduction into the collection system.¹¹ This outreach program was one of the conservation measures recommended in the USEPA's (2007) biological evaluation that was conducted in preparation for issuance of the prior NPDES discharge permit. During the permit-renewal process, USEPA personnel postulated that minimizing the input of cat-litter-box wastes into the municipal sewer system could limit the number of *Toxoplasma gondii* parasites introduced into the marine environment, thereby mitigating a known disease vector affecting southern sea otters. RWQCB personnel incorporated the USEPA's concerns into a special provision within the plant's final NPDES permit requiring the creation of a cat-litter public-outreach program.

However, immediately following the finalization of that prior permit, on 21 January 2009, Johnson et al. (2009) published the results of a detailed field study of southern sea otter exposure to *T. gondii*. That study unequivocally demonstrated that the incidental disposal of cat litter into the MBCSD collection system was not the cause of the observed impacts on otter morbidity from *T. gondii* infection. The authors of the 2009 study confirmed that the epicenter of *T. gondii* exposure in otters was not located within Estero Bay, as erroneously asserted by NRDC¹² (2006) and Miller et al. (2002). More importantly, Johnson et al. (2009) also hypothesized that, based in part on the new epicenter location, "a more important source of infection might be bobcats and mountain lions" instead of housecats. In fact, the world's largest reported outbreak of human toxoplasmosis was linked to a municipal drinking-water reservoir in British Columbia that had been contaminated by cougar feces (Bowie et al. 1997; Aramini et al. 1998). Based on these recent findings, the requirement for a cat-litter outreach program was eliminated when the current MBCSD discharge permit became effective on 1 March 2018 (RWQCB 2018a).

¹ <http://www.cayucosd.org/>

² Frequently Asked Questions

³ <http://www.morro-bay.ca.us/342/Wastewater-Treatment-Plant-Operations>

⁴ <https://www.morro-bay.ca.us/731/Sanitary-Sewer-Overflows-SSOs>

⁵ <https://www.morro-bay.ca.us/730/FOG-Fats-Oils-and-Grease>

⁶ <http://www.morrobayca.gov/documentcenter/view/7814>

⁷ <http://www.morrobayca.gov/355/Monitoring-Reports>

⁸ <http://www.morrobayca.gov/Archive.aspx?AMID=81>

⁹ <http://www.morrobayca.gov/Archive.aspx?AMID=44>

¹⁰ <http://morrobaywrf.com/>

¹¹ <http://www.morrobayca.gov/documentcenter/view/1201>

¹² Natural Resources Defense Council

Other public-outreach endeavors by the MBCSD include its involvement in the collection of household hazardous wastes. Beginning in August 2000, the MBCSD collaborated with the Integrated Waste Management Authority to establish a permanent household hazardous-waste collection facility located at the WWTP. The collection facility offers free waste disposal to all residents of San Luis Obispo County every Saturday from 11:00 a.m. to 3:00 p.m., except holiday weekends. The facility remains one of the top waste-disposal sites in the county in terms of the volume of material collected. Between 20 and 50 individuals utilize the facility each weekend. During 2019, the disposal facility processed 55 MT of household hazardous waste, a large portion of which was recycled. Collected material is sorted, packaged, and labeled before transport to the appropriate offsite recycling and disposal facilities.

3.5.3 Source Identification

Past and ongoing efforts to eliminate or reduce contaminants entering the WWTP's wastestream have been successful, and as evidence of that success, elevated contaminant concentrations within effluent samples are rarely detected during the periodic chemical assays. Although nothing unusual was detected within the wastestream during 2019, anomalous concentrations of individual chemicals have been sporadically reported in the past. On those occasions, MBCSD personnel successfully traced the contaminants to the source and worked with the source owner to eliminate the contamination.

In 2006, the State Water Resources Control Board adopted new statewide waste-discharge requirements for sanitary sewer systems, which transferred responsibility for managing the introduction of FOG, and other components from the WWTP to the Collections Department under the City of Morro Bay's Sewer System Management Plan¹ and the Cayucos Sanitary District.² Ongoing source identification and resolution efforts conducted by the City and District include a grease-trap inspection program for businesses subject to the requirements. Collections personnel regularly conduct scheduled inspections as well as spot checks as described in the *Industrial Waste Survey* subsection above. During inspections, personnel discuss BMPs with restaurant staff, provided educational materials such as a BMP handbook and make recommendations for grease trap maintenance as necessary.

Known light-industrial dischargers were also inspected for compliance with source control processes and procedures. One of the most important of the Class I facilities is the commercial laundry that operates within the City of Morro Bay. Although this facility only contributes approximately 1.6% to plant flow, commercial laundries use industrial-grade detergents, bleaches, surfactants, and brighteners that can potentially harm the bacteria within the WWTP's secondary-treatment system. In addition, solvents, oils, and other substances removed from soiled laundry have the potential to release contaminants into the wastestream. To minimize this potential, the laundry installed a pretreatment system during 2002 that included pH buffering with acid to neutralize excessive increases in wastewater alkalinity that can potentially interfere with the plant's treatment process. As described above, further improvements to the buffering system were made in late 2018. Monitoring of the laundry's effluent throughout 2019 confirmed the efficacy of the improved pretreatment system.

¹ City of Morro Bay Sewer System Management Plan, originally approved June, 2009, reapproved June, 2014. City of Morro Bay Public Services Department, Wastewater Collections Division

² [CSD Ordinances.pdf](#)

4.0 THROUGHPUT

Flow through the plant during 2019 remained far below both the plant’s design capacity and the limits established in the NPDES discharge permit. The waste discharge requirements (RWQCB 2018a) state that the “*peak seasonal dry weather flow shall not exceed a monthly average of 2.36 [MGD].*” Plant throughput never approached this flow limit during 2019 (Table 5.1 on Page 5-1 later in this report), not even during winter (October through March) when the limit does not apply because increased I&I¹ from precipitation events is expected. Even so, the highest average monthly flow, 1.424 MGD in February, was only 60% of peak dry weather limit.

4.1 INFLOW AND INFILTRATION

Rainfall is an external factor that perceptibly affects plant throughput in two ways: via direct inflow of rainwater into the collection system, and via increased infiltration of groundwater resulting from a longer-term increase in the water-table elevation. Chapter 4 of the OneWater Plan² report (Morro Bay 2018a) characterized flow impacts from I&I within the City of Morro Bay’s collection system. This detailed I&I analysis was based on flow monitoring that was conducted throughout the City’s collection system during 2017 (Morro Bay 2018b).³ These studies found that rainwater inflow into the collection system was closely related to the intensity of the rainfall event. Although brief, inflow determines peak wastewater flow rates that dictate downstream pipeline and lift-station design capacities. Infiltration, on the other hand, is not easily ascribed to individual rainfall events. Instead, infiltration occurs throughout the year, although it is typically higher in late winter and early spring when the cumulative effect of rainfall elevates groundwater levels. Infiltration impacts wastewater treatment by increasing the cost of pumping and treating the additional volume of water.

I&I contributions to plant throughput during 2019 can be estimated from the rainfall and wastewater flow data shown in Figure 4.1. The clusters of solid black spikes at the bottom of the Figure delineate the duration and intensity of six major rainfall events during 2019. Together, these events deposited 18.5 inches of rainwater within the collection-system’s service area. Five of these rainfall events were intense enough to produce large brief increases in daily plant throughput that are visually apparent as sharp upward excursions in the dashed line. The throughput increase resulting from rainwater inflow during the

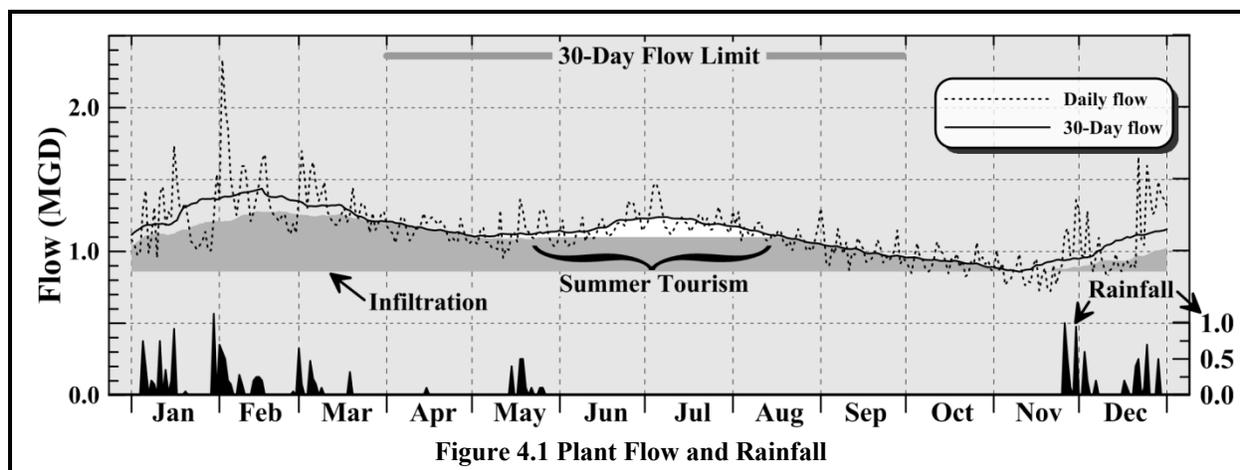


Figure 4.1 Plant Flow and Rainfall

¹ Inflow (of rainwater) and Infiltration (of groundwater)

² Section 4.2 on Page 4-9 (Sequential Page 107) <https://www.morrobayca.gov/DocumentCenter/View/12500/OneWater-Plan-Final>

³ *Ibid.* Appendix F on Sequential Page 425

least-intense 2.2-inch rainfall event in mid-May was not as readily apparent. In contrast, inflow during the intense rainfall event that started at the end of January led to the three highest daily plant flows measured during the year. Graphical estimates indicate that approximately 14 MG of rainwater was processed by the treatment plant as a result of these inflow events during 2019. However, because these events were episodic and brief, rainwater inflow only contributed 0.04 MGD (3.4%) to the 1.135 MGD average annual plant throughput.

Although rainfall events during 2019 were infrequent and brief, they also contributed to plant flow by increasing the groundwater infiltration. This longer-term effect on plant throughput is highlighted with dark shading below the solid line in Figure 4.1. The solid line shows the 30-day moving-average plant throughput. This long-term average flow was highest for the two-month period between mid-January and mid-March when it exceeded 1.25 MGD. Another rainfall-related increase in I&I began in mid-November after the long-term average throughput had declined to a low of 0.86 on November 9th. To obtain an upper-bound estimate of infiltration (shown by dark shading), the brief flow excursions during major rainfall events were excluded from the moving average. In addition, a lower-bound estimate of increased flow from tourism, shown in white and described below, was also excluded from the 30-day moving mean.

Based on the area of the shaded portion of the flow time series, at least 78 MG flowed into the collection system as a result of increased infiltration from rainstorms.¹ Although this only represents 19% of total plant throughput, the long-term influence of rainstorms contributed more to plant throughput during 2019 than the brief but intense inflows during storms.

4.2 TOURISM

Throughput resulting from seasonal and holiday increases in tourist populations was also quantified for the City's collection system as part of the OneWater plan development. Population increases during the 2019 summer tourist season resulted in a perceptible increase in the 30-day moving average flow (upward bow in the solid line from June through mid-August in Figure 4.1). The height and duration of this tourism bump indicates that the treatment plant processed an additional 7.5 MG of tourist-generated wastewater during the summer of 2019.² Although this additional wastewater volume was an order-of-magnitude smaller than I&I throughput during 2019, it produced a visually apparent increase in plant flow during the dry season. Additionally, because the tourism contribution represents wastewater of sewage origin, it is more challenging to process than groundwater. Nevertheless, at its 1.24 MGD peak in early-July, the 30-day flow was only 53% of the monthly allowance for peak dry-season flow shown by the thick shaded line that spans the 'dry' season (April through September) in Figure 4.1. Short-term increases in flow due to tourism are also apparent around the Memorial, Independence, and Labor Day holidays at the end of May, and the beginning of July and September.

4.3 FLOW CORRECTIONS

Daily plant throughput is normally determined by totaling high-sampling-frequency data from the influent flow meter. The influent flow-meter readings are used because the meter measures the volume of wastewater processed by the treatment plant based on a precision water-level transducer, and thus are

¹ The actual contribution from groundwater inflow into the collection system is undoubtedly larger, but by assuming a baseline near the minimum 30-day flow for the year (0.86 MGD), at least 78 MG of flow can be unambiguously ascribed to the influence of water-table fluctuations resulting from rainfall during the year.

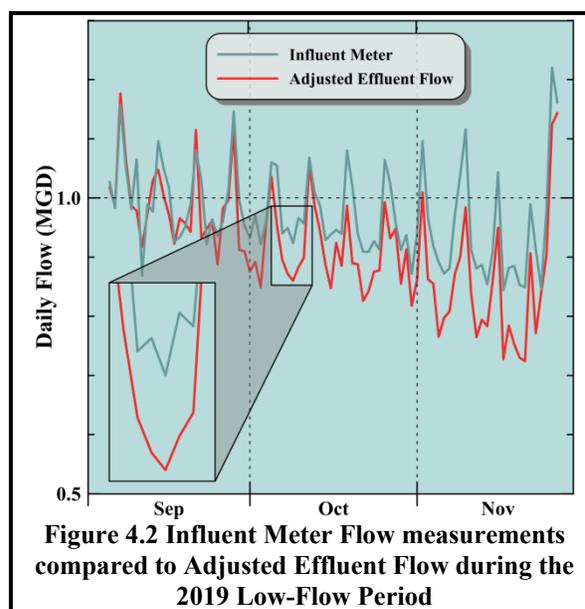
² The white area beneath the 30-day flow (solid line) accounts for 7.58 MG of wastewater throughput. At least this much of the flow is attributable to the increased population within the service area during the summer tourist season. It represents 1.8% of the 414 MG processed by the treatment plant during 2019.

more accurate than the effluent meter's mechanical impeller, which is known to overtotalize the actual flow. On rare occasions, however, the influent flow meter also reports erroneously high values. Typically, these outliers are obvious in the flow record and result from easily identifiable causes such as surcharging of the influent trunk line during major rain events, or during periods when inflow at the headworks is intentionally reduced to facilitate equipment repair. On those occasions, the original, potentially inexact daily flow from the influent meter is still reported in the CIWQS¹ database for compliance-evaluation purposes. However, when plant personnel suspect, or have direct knowledge that the influent flow reading is inaccurate or compromised, they provide a narrative about the event in the monthly monitoring form, and include an estimate of the actual flow along with the computational rationale for the estimate. Often, this corrected value is based on effluent flow readings adjusted downward to account for that meter's overtotalization.

However, the throughput analyses in this report utilizes daily flow data that occasionally depart from the flows reported in the CIWQS database. This corrected flow dataset provides a more accurate representation of actual plant throughput, and results in a more reliable assessment of plant performance. For example, the corrected dataset allows dependable determination of flow-response to rainfall events and seasonal tourism that are described in the above subsections. Additionally, it provides realistic evaluations of various parameters considered diagnostic of plant performance, and that are limited by the discharge permit. In addition to an improved determination of available plant-flow capacity, use of corrected flow values in conjunction with chemical concentrations reliably establishes their mass loading to the marine environment. These chemical mass-emissions are compared to goals that were established from historical measurements to determine whether there has been a significant increase in pollutant loading.

Appendix C lists the adjustments to reported daily flows that were applied in this report, along with the reason for each individual correction. The combined 5.57 MGD flow correction for the year only amounts to a 0.15 MGD (1.3%) reduction in the annual average flow determined from CIWQS submissions.² Of the 65 corrections that were applied, two-thirds (44) involved a bottoming-out of the influent meter readings during the low-flow period from September through October (Figure 4.2).

As described in the following sections, the adjusted effluent flow normally closely tracks the flow reported by the influent meter. However, during this three-month period, plant flows were particularly low (<1.1 MGD) and the influent meter overestimated the actual flow. The difference in waveforms is a particularly telling aspect (see the inset in the Figure), with the influent trace bottoming out well above the effluent flow's trace. The influent water-elevation sensor is located upstream of the throat section within a Palmer-Bowlus flume (OpenChannelFlow n.d.).³ At that location, changes in the flow



¹ California Integrated Water Quality System Project

² All of the flows reported herein, including the annual average flow of 1.135 MGD, are based on the corrected readings.

³ Page 3 (Sequential Page 6) in https://www.openchannelflow.com/assets/uploads/documents/Palmer-Bowlus_Flume_Users_Manual.pdf

profile at low flow rates reduces the accuracy of flow measurements, a problem that can be exacerbated by upstream sediment accumulation. A layer of sand and gravel was noted during meter calibration conducted on 10 December 2019 (see Appendix D). Although this small volume of material is unlikely to affect water-level readings at high flows, its influence will be proportionally greater at low flows, when its presence could increase perceived water levels within the flume. For this reason, the sediment within the flume should be removed per the meter-calibrator’s recommendation.

Upstream sediment removal will not resolve the decreased low-flow accuracy of the influent meter, however. The minimum recommended flow for 27-inch Palmer-Bowlus flumes is 0.945 MGD (USEPA 2017).¹ Even at higher flow rates, however, discrepancies between the MBCSD influent and effluent flow meters become apparent (Figure 4.2 on the previous page). Based on these analyses, the adjusted effluent meter readings are preferred when MBCSD flows drop below 1.1 MGD.

4.4 EFFLUENT METER OVERTOTALIZATION

The preceding discussions demonstrate the value of having contemporaneous and unrelated flow measurements, despite the tendency for the effluent meter’s tendency to overttotalize the flow. The availability of precise and closely matching measurements also provides valuable redundancy in the event that the influent meter is taken offline for repairs or calibration, or when its readings are compromised because of surcharging within the metering flume.

This meter interchangeability is only possible because of the close correspondence between the meters when they are both functioning optimally. This correspondence is visually apparent from a comparison of each meter’s flows (Figure 4.3). It justifies the use of an adjusted effluent-meter reading when the influent meter’s output is clearly compromised. This results in a continuous time series of flow data that is much more reliable than data from either meter alone. Daily flow reported by the influent meter is shown by the blue time series in Figure 4.3. A few data points were excluded from this “Target Flow” time series when influent meter’s readings were known to be compromised, and therefore unsuitable for comparison. The red time series was determined from effluent-meter readings that were adjusted to account for overttotalization. The adjustment equation changes slightly over time, for example, after the influent meter is recalibrated.

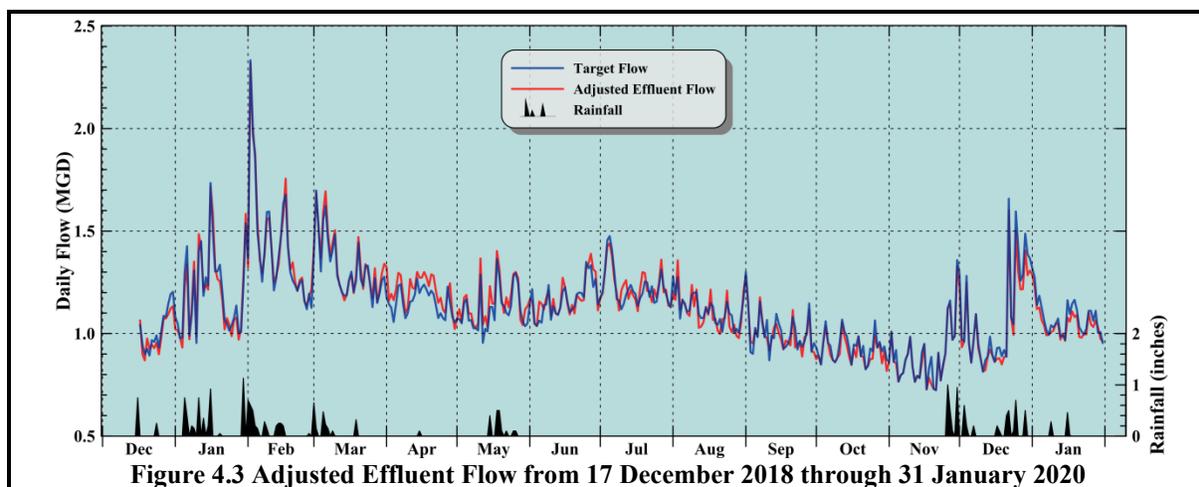


Figure 4.3 Adjusted Effluent Flow from 17 December 2018 through 31 January 2020

¹ Table O-6 on Page 596 (Sequential Page 13) in Appendix O of: <https://www.epa.gov/sites/production/files/2017-03/documents/npdesinspect-appendix-o.pdf>

To ensure that the adjustments to effluent flow readings continue to be as accurate and timely as possible, the coefficients in the adjustment equation are recomputed at least annually, or when major modifications are made to the meters or flow system. The revised effluent-meter adjustment equation is generally determined from a linear regression of flow data from both meters recorded after the last influent-meter calibration. However, re-calibration of the influent meter on 10 December 2019 did not result in substantive temporal changes in its readings, so the regression time series spans the 14-month period shown in Figure 4.3. The adjustment equation determined from these data (Equation 4.1) differed perceptibly from those determined from data collected in the three prior years (MRS 2017 2018b 2019a).

$$A = 0.844 \times E \quad \text{Equation 4.1}$$

where: A = the actual plant flow in MGD, and
 E = the flow measured by the effluent meter.

Equation 4.1 indicates that the actual plant flow is 84.4% of the effluent meter’s reading across a broad range of plant throughput. This 2019 slope regression coefficient was somewhat higher than the 0.78, 0.75, and 0.81 determined from 2016, 2017, and 2018 flow data. This partly because the new recommended equation dropped the zero-flow-intercept (small amount added at the end of the equation) because it was not found to improve the fit to 2019 data significantly. Moreover, in principle, the two flow meters would be expected to read zero flow at the same time, namely, when there is no measureable flow. The small intercept recommended in prior equations probably arose because of the low-flow bottoming-out of the influent meter readings described in the prior section.

By excluding low-flow influent data, the recommended zero-intercept equation provides excellent agreement between the adjusted-effluent and target flow data during the fourteen months prior to January 2020. This suggests that the currently-recommended adjustment equation can be used with confidence over the upcoming year, barring major physical changes to the meters. Equation 4.1 was determined from a linear regression on 355 pairs of daily flow observations that were measured by the influent and effluent meters after the prior influent-meter calibration on 15 December 2018, and when both meters were known to be functioning correctly (white dots in Figure 4.4).

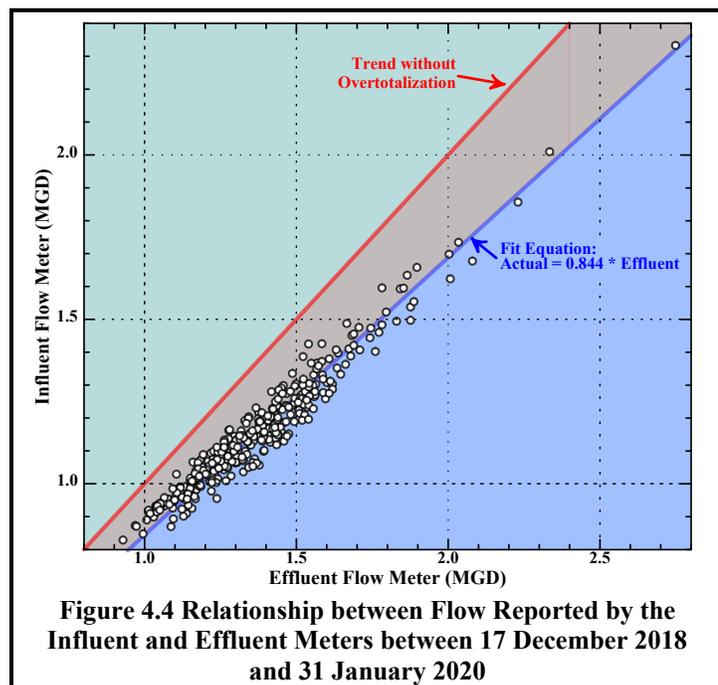


Figure 4.4 Relationship between Flow Reported by the Influent and Effluent Meters between 17 December 2018 and 31 January 2020

The Figure demonstrates that the effluent meter’s overtotalization remains significant and that an adjustment of its readings remains necessary for interchangeability. For comparison, the red line in Figure 4.4 displays the relationship between the influent and effluent meters that would be expected in the absence of overtotalization by the effluent meter, namely, exactly the same readings from each meter. That relationship departs significantly from the scatter among the cloud of white points surrounding the blue regression line in the Figure, which represent the actual post-calibration

measurements made by each meter. Although at low flows, the effluent meter overtotalizes by about 0.15 MGD, at high flows, the adjustment can be three times that much.

Equation 4.1 is now recommended for use in adjusting effluent meter data when influent-meter data are compromised or absent. Because it departs perceptibly from the equations that were recommended over the past three years, future application of the new effluent-meter adjustment equation will ensure closer correspondence with influent data, as shown in Figure 4.3 on Page 4-4. This is the case even in the presence of large flow increases that arose during the major rainfall events experienced over the last 14 months. Nevertheless, the relationship between the two meters should continue to be revisited annually, or when there are major changes to either meter.

5.0 WASTEWATER PROPERTIES

Monthly characterizations of wastewater properties documented a number of different aspects of the treatment plant's performance during 2019 (Table 5.1). Removal rates quantified the plant's ability to reduce major organic constituents within the wastestream. Effluent concentrations characterized the overall quality of effluent discharged through the ocean outfall, while mass emissions quantified the cumulative load of wastewater constituents introduced into the marine environment.

Table 5.1 Monthly Averages of Influent and Effluent Parameters

Month	Flow (MGD)	Suspended Solids				Biochemical Oxygen Demand			
		Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (kg/day)	Influent (mg/L)	Effluent (mg/L)	Removal (percent)	Emission (kg/day)
January	1.202	297	40	86.7 ¹	175	255	53	79.2	247
February	1.424	214	24	89.8	117	228	33	85.6	156
March	1.323	255	25	90.3	126	222	40	82.2	208
April	1.155	363	46	82.8	196	281	48 ²	82.8	209
May	1.117	290	34	87.6	139	274	53	80.6	217
June	1.165	345	25	91.7	108	252	50	80.0	218
July	1.223	383	34	89.5	155	313	50	84.0	223
August	1.115	288	24	91.7	100	353	38	89.2	162
September	1.008	332	23	93.1	82	343	46	86.6	159
October	0.932	260	28	88.1	96	290	43	85.3	143
November	0.892	361	25	91.3	86	408	53	87.1	168
December	1.086	521	34	91.4	140	574	94	83.6	383
Average	1.135	323	30	89.5	126	314	50	84.1	206
Monthly Limit³	≤2.36⁴		≤70	≥75.0	≤546		≤120	≥30.0	≤936
Annual Total (MT)					46				75
Nominal Annual (MT/year)					≤199				≤342

(Continued on the next page)

¹ Average monthly removal rate is correctly computed from the ratio of the sums of individual influent and effluent concentrations, which is not equivalent to an unweighted average of removal-rate percentages computed from each individual pair of measurements made during the month.

² The BOD concentration reported for the April 24th effluent sample was determined as a minimum estimated value due to a laboratory error. Thus, the April average monthly effluent concentration and mass emission are also estimated minimums, and the removal percentage is an estimated maximum.

³ Interim limits are listed for TSS and BOD as specified in the TSO

⁴ Peak Seasonal Dry-Weather Flow (PSDF)

Table 5.1 (continued) Monthly Averages of Influent and Effluent Parameters

Month	pH		Turbidity (NTU)	Settleable Solids (ml/L)	Median ¹ Total Coliform (MPN ² /100ml)	Oil and Grease	
	Influent	Effluent				Effluent (mg/L)	Emission (kg/day)
January	7.8	7.5	46	<0.1	<1	≈1.3	≈5.9
February	7.9	7.6	27	<0.1	1	<0.82	<4.4
March	7.8	7.6	27	<0.1	1	<0.82	<4.1
April	7.9	7.6	43	<0.1	1	<0.82	<3.6
May	7.9	7.6	38	<0.1	1	≈1.1	≈4.7
June	7.8	7.6	30	<0.1	2	<0.82	<3.6
July	7.8	7.6	36	<0.1	2	≈1.7	≈7.9
August	7.7	7.5	27	<0.1	10	≈1.6	≈6.8
September	7.6	7.4	24	<0.1	16	≈0.75	≈2.9
October	7.6	7.3	27	<0.1	13	≈1.1	≈3.9
November	7.7	7.4	24	<0.1	2	<0.66	<2.2
December	7.6	7.4	29	<0.1	<2	<0.66	<2.7
Average	7.8	7.5	32	<0.1	2	≈1.1	≈4.7
Monthly Limit		6-9	≤75	≤1.0	≤23	≤25.0	≤195

Treatment-plant personnel periodically collected wastewater samples throughout 2019. Results from the analyses of those samples were used to compute the monthly averages of the principal influent and effluent characteristics listed in Table 5.1. Laboratory analyses of influent and effluent samples quantified the principal physicochemical properties of the wastewater stream by determining concentrations of TSS, BOD, settleable solids, O&G, total residual chlorine (TRC), ammonia, and nutrients. Other analyses measured wastewater temperature, scattered light (turbidity), coliform density, basicity (pH), and toxicity.

The frequency and the duration of individual sampling and testing events varied among the parameters. For example, average reductions in suspended solids and BOD were determined from 24-hour composite samples of both influent and effluent that were collected and analyzed at least weekly. For the remaining properties, the permit requires analyses of effluent samples alone, although the treatment plant personnel continued pH determinations of influent on multiple occasions within each week of 2019. Effluent temperature, TRC, plant flow, and rainfall were recorded on a daily basis. Total coliform density and turbidity were measured within discrete effluent grab samples collected on five days each week. Lastly, O&G and settleable solid concentrations were determined within effluent grab samples collected once per week.

Detailed analyses of these measurements confirm that, during 2019, the plant regularly exceeded wastewater treatment expectations established in regulatory standards and the original WWTP design criteria. Moreover, the plant has consistently discharged exceptionally high quality effluent over its long history, and there has never been an indication of deteriorating plant performance. Rare exceptions to standards or criteria have been brief, and have often resulted from unavoidable repairs to, or mechanical failures of a treatment-system component. However, as a byproduct of a diligent preventative maintenance program, the plant has consistently operated at a high level of efficiency with little equipment down time.

¹ The current NPDES discharge permit requires reporting of the 30-Day Geometric Mean except when one or more values are censored, namely, below the quantification limit. In that case, the median is reported. Non-quantifiable coliform densities were present in every month of 2019.

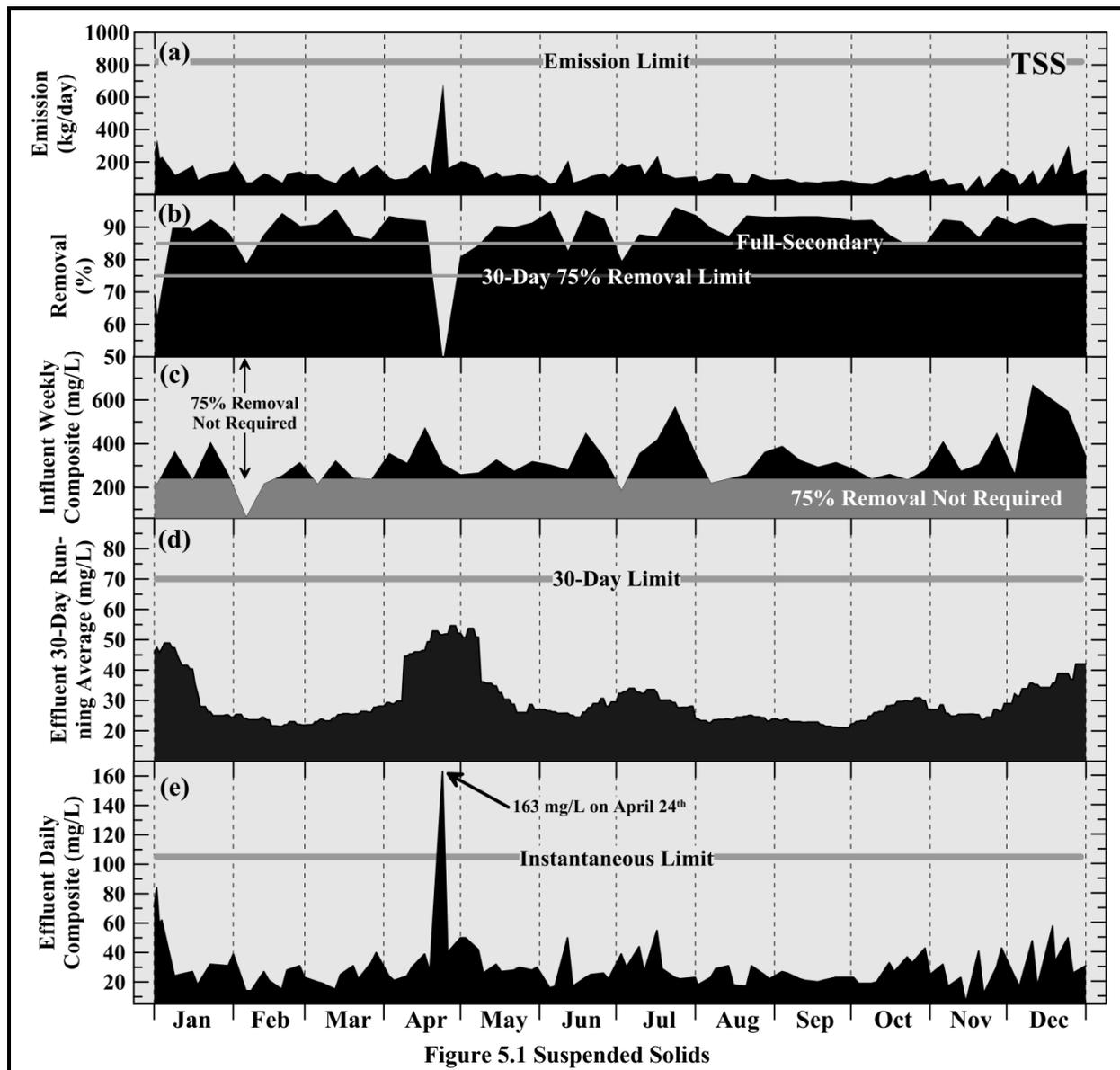
² Most Probable Number

5.1 PARTICULATE LOAD

Suspended solids, turbidity, and settleable solids measure the particulate load within wastewater. One of the principal functions of the treatment process is to remove organic material from the wastestream. As in the past, all measures of this particulate-removal capability unequivocally demonstrate that the treatment process was operating at peak performance throughout most of 2019. Except on one occasion (April 24th), all complied with the interim limits specified in the TSO.

5.1.1 Suspended Solids

The treatment plant's removal of nearly all (89.5%) of the solids from influent (Figure 5.1b; Table 5.1) documents the plant's high overall performance during 2019. In particular, the plant's annual solids removal rate exceeded the minimum required by the interim effluent limits in the TSO, which specifies



removal of 75% of the suspended solids on a monthly basis. This minimum removal rate is also promulgated in COP Table 2 (SWRCB 2015).¹

In fact, the plant's 89% annual removal rate exceeded the 85% monthly removal rate established for full-secondary treatment. This level of treatment is specified the TSO's final effluent limits that will apply in 2023, when the WRF is scheduled to be completed. Moreover, the WWTP achieved removal rates equivalent to full secondary treatment consistently throughout most of the year, with monthly averages exceeding the secondary standard in every month except April. The April average removal rate of 82.8% was only slightly below the secondary treatment benchmark. However, this slight reduction in TSS monthly removal rate was not indicative of a prolonged decline in plant performance. Instead, it resulted from an abnormally high TSS concentration (163 mg/L) that was measured within a single isolated composite effluent sample collected on April 24th (Figure 5.1e).

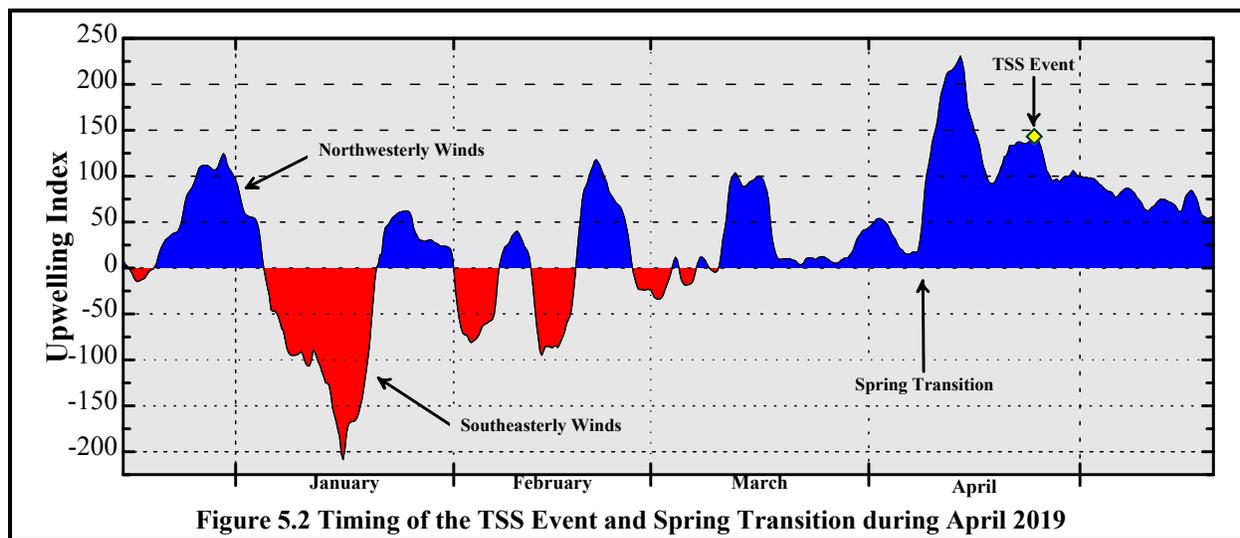
Because the TSS concentration within the concurrent influent sample was not particularly elevated (Figure 5.1c), this high effluent TSS was solely responsible for the sharply defined removal-rate decline to 48% on that particular day (Figure 5.1b). Nevertheless, other weekly samples collected during April demonstrated high removal rates so that month's average removal rate of 82.8% easily complied with the interim 75% minimum removal required by the TSO. The elevated effluent TSS also sharply increased the TSS emission reported for April 24th to 678 kg/day (Figure 5.1a), although this emission remained below the TSO's 818 kg/day instantaneous limit. At 196 kg/day, the April average TSS emission was higher than other months, but was only a third of the 546-kg/day TSO monthly limit (Table 5.1 on Page 5-1).

The 163 mg/L TSS concentration, found in the effluent sample collected on April 24th, exceeded the 105 mg/L instantaneous TSS concentration limit specified in the TSO. RWQCB staff were notified of the exceedance in a timely fashion and were informed of possible causes and corrective actions taken as required by the NPDES discharge permit. The unexpected and sudden upward excursion in effluent TSS followed a nominal TSS concentration of 27 mg/L that was measured five days earlier. Only two days after, effluent TSS had again returned to normal at 40 mg/L. The brief upward excursion in effluent TSS arose after rapid uncontrolled sloughing of biofilm in the trickling filters overloaded the solids-contact and secondary clarifier processes. This resulted in an increased presence of microorganisms within the composite effluent sample collected on April 24th.

The sloughing event coincided with an abrupt seasonal change in the weather that brought a markedly increased amount of sunshine to the population of microorganisms residing within the trickling filters. This sudden change in insolation may have triggered the sloughing event. Skies were continuously overcast in the months prior to the event as a regular series of winter rainstorms passed through the region (Figure 4.1 on Page 4-1). As described in prior annual reports (e.g., MRS 2018b),² weather along the central California Coast rapidly changes during a spring transition when northwesterly upwelling winds strengthen in response to the formation of a persistent high-pressure system over the northeastern Pacific Ocean. The spring transition during April 2019 was particularly abrupt and preceded the TSS event (Figure 5.2 on the next page).

¹ COP Table 2 Effluent Limitations only apply to dischargers for which Effluent Limitations Guidelines have not been established under the Federal Clean Water Act.

² Regional Processes Section 3.2.3 on Page 3-17 (Sequential Page 77) <https://www.morro-bay.ca.us/Archive.aspx?ADID=457>



Regardless of the potential regulatory consequence of this isolated excursion in effluent TSS, its environmental significance is unclear. The “technology-based” limits on TSS were established based on the capability of various levels of treatment to remove suspended solids from the wastestream. Thus, in contrast to concentration limits on toxic chemicals, which are determined by their potential for actual environmental impacts, technology-based limits do not reflect the degree of measurable harm within receiving waters. This is particularly true for open-ocean discharges where energetic turbulent processes quickly dissipate solids loads within a large capacity receiving-water volume. As a result, improvements in treatment level, from primary to secondary for example, has not been found to perceptibly change the seawater or sediment quality within marine environment surrounding marine discharges (Diener and Fuller 1995). In fact, Section 301(h) was added to the Clean Water Act because scientific evidence challenged the efficacy of imposing purely technology-based limits on open-ocean dischargers (Isaacs 1978). In their compliance enforcement policy, the SWRCB (2017) recognizes the distinction between potential impacts from excursions in technology-based (Group 1) concentrations and exceedances associated with toxic chemicals (Group 2).

Because the excursion in effluent TSS was short-lived, monthly average TSS parameters were all well within the permitted limits, including for the month of April (Table 5.1 on Page 5-1). Although unrelated to the compliance evaluation, another isolated excursion stands out in the influent TSS record (60 mg/L on February 6th in Figure 5.1c on Page 5-3). There was no obvious reason for this sharply reduced TSS load within the influent stream other than it followed a particularly heavy storm that deposited 3.3 inches of rainfall within the collection area. The abnormally low influent TSS concentration resulted in a slightly reduced removal rate (78.5% compared to the 89.5% annual average Figure 5.1b). Regardless of the cause, the slightly reduced TSS removal rate reported for February 6th was exclusively the result of the low influent TSS concentration, rather than a lapse in plant performance.

Reductions in influent TSS concentration, such as the one on February 6th arise from external events unrelated to the treatment process. In the absence of issues related to sample collection, they occasionally occur when rainwater inflow from intense winter storms dilute the suspended solids load within the collection system. Although these low-influent-TSS events are clearly unrelated to the efficacy of the treatment process, they weigh heavily in computation of removal rate. Because of this, removal rates are a

somewhat irrelevant measure of plant performance when influent TSS concentrations are low. From a process standpoint, the same fraction of suspended solids cannot be removed from the influent stream when there is less material available to remove. From an environmental standpoint, only the solids loading within the discharged wastestream is of concern, not the influent loading or the fraction of material removed.

Moreover, the removal-rate limits specified in the COP, NPDES discharge permit, and TSO are technology-based requirements rather than ones that reflect the actual potential for environmental impacts within receiving waters. Regulators recognize that requiring a high removal rate is unnecessary when effluent TSS concentrations are low to begin with. Consequently, the applicability of the 75% monthly removal-rate limit specified in COP Table 2 is abrogated when the requirement would result in an effluent TSS concentration of less than 60 mg/L (COP Table 2 Notes in SWRCB 2015). Thus, application of the 75% removal-rate is questionable when influent TSS concentrations fall below 240 mg/L,¹ which occurred on February 6th when the 65 mg/L concentration was reported. Because of this low influent TSS report, the average February influent concentration (214 mg/L) dropped below this removal-rate applicability threshold, yet the treatment process still achieved an 89.8% removal rate, far exceeding the required minimum 75% removal (Table 5.1 on Page 5-1).

In contrast to removal rate, the overall solids load released to the ocean explicitly reflects the discharge's potential for environmental effects. In that regard, daily mass emissions of solids were uniformly low throughout 2019, and never reached even half of the TSO's allowed amount (thick shaded gray line labeled "*Emission Limit*" in Figure 5.1a on Page 5-3), except on April 24th when it reached 83% of the TSO instantaneous maximum. Low overall effluent TSS concentrations, combined with low flow rate during 2019, resulted in an annual total solids emission that was well below the allowable solids emission (Table 5.1). Over the entire year, the WWTP only discharged 46 MT of suspended solids into the ocean. That solids emission was only 23% of the projected 199 MT that would have been discharged if effluent had contained the permitted TSS concentration of 70 mg/L and throughput reached the average dry-weather design flow of 2.06 MGD.

Aside from regulatory compliance, the record of consistently low effluent TSS concentrations also provided a good indication of the high overall plant performance for any given period during 2019 (Figure 5.1d). Month-end averages for each calendar month were well below the monthly limit of 70 mg/L (Table 5.1), as was the 30-day moving average (Figure 5.1d). This was the case even though TSS concentrations measured in samples collected on any given day, fluctuated widely (Figure 5.1e). Nevertheless, the TSS concentration within all but two of the 104² daily effluent samples were less than 60% of the 105 mg/L instantaneous maximum specified in the TSO.

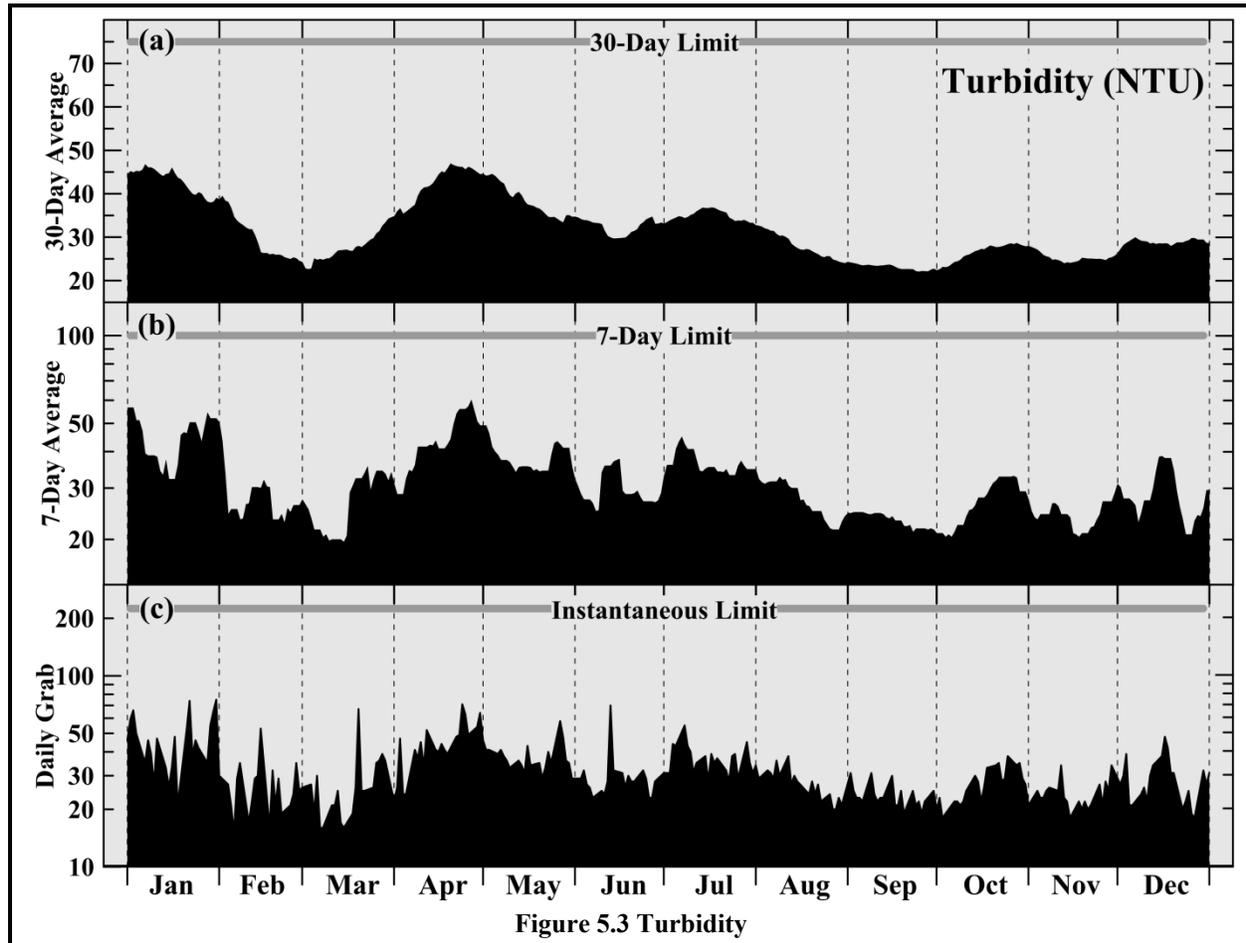
5.1.2 Turbidity

Turbidity measures the optical clarity of an effluent sample and as such, is a somewhat independent measure of solids content. Nevertheless, turbidity levels measured within individual daily grab samples were uniformly low, and they all comfortably complied with the effluent limits specified in the NPDES

¹ 240 mg/L is four-times the 60-mg/L threshold on effluent concentration that determines the applicability of removal rate for compliance evaluations. This applicability threshold derives from the first note to Table 2 of the COP (SWRCB 2015), which states: "... the discharger shall remove 75% of suspended solids from the influent stream at any time the influent concentration exceeds four times [the effluent concentration limit]."

² Effluent TSS concentrations were determined within effluent composite samples twice per week even though the current permit only requires an analysis frequency of once per week.

permit. Month-end (Table 5.1 on Page 5-2) and moving 30-day averages (Figure 5.3a) never exceeded 63% of the 75-NTU monthly limit. Over shorter periods, all of the weekly averages were less than 61% of the 100-NTU weekly limit (Figure 5.3b). Similarly, the 261¹ daily turbidity measurements (Figure 5.3c) were uniformly low and only reached approximately one-third of the allowed instantaneous limit (225 NTU).²



Effluent turbidity explicitly reflects the discharge’s potential to impact receiving seawater clarity offshore. Accordingly, offshore water-quality monitoring that was required in prior permits included measurements of seawater clarity within the water column surrounding the outfall. Over the past 25 years, 99 receiving-water surveys have been conducted using a precision instrument package that included high-resolution measurements of seawater transmissivity. Analyses of transmissivity measurements collected during these surveys repeatedly demonstrated that turbidity associated with effluent discharge dissipates rapidly upon discharge. Perceptible changes in water clarity associated with effluent particulate loading were rarely found, and then, only when the transmissometer passed extremely close to a discharge port near the seafloor. Very little sunlight reaches that depth, demonstrating that the discharge has no impact on the penetration of ambient light. The highly localized and diffuse character of wastewater turbidity upon discharge is visually apparent in the wispy cloud emanating from the diffuser port shown in Figure

¹ The current permit’s requirement for turbidity determinations is five times per week.

² Note the logarithmic scale along the Y-Axis in Figure 5.3

3.2 on Page 3-4. In fact, some of the distortion apparent in the photograph is an artifact of differences in the refractive index at the seawater-wastewater interface rather than particulate loading.

5.1.3 Settleable Solids

Settleable solid concentrations, which are the only remaining particulate-related measure of effluent quality, echo the above findings that particulate loads of all types were low during 2019. Specifically, all monthly medians were below the 0.1-ml/L detection limit (Table 5.1 on Page 5-2), which is an order-magnitude less than the permit limit of 1.0 ml/L. In fact, only six of the 53¹ weekly effluent samples collected during 2019 contained a detectable amount of settleable solids. The highest of those measurable concentrations was measured on November 20th and equaled the monthly average limit of 1 ml/L, but was well below the weekly and instantaneous limits of 1.5 ml/L and 3.0 ml/L.

Thus, during 2019, as in prior years, all measures of effluent solids demonstrated that the treatment process exceeded performance expectations by regularly removing a greater amount of solids from the influent stream, and by discharging a small fraction of the maximum anticipated load to the marine environment. The consistently low monthly averages for effluent TSS, turbidity, and settleable solids attest to the overall effectiveness of the treatment plant's screening, grit removal, sedimentation, filtration, and clarifying processes.

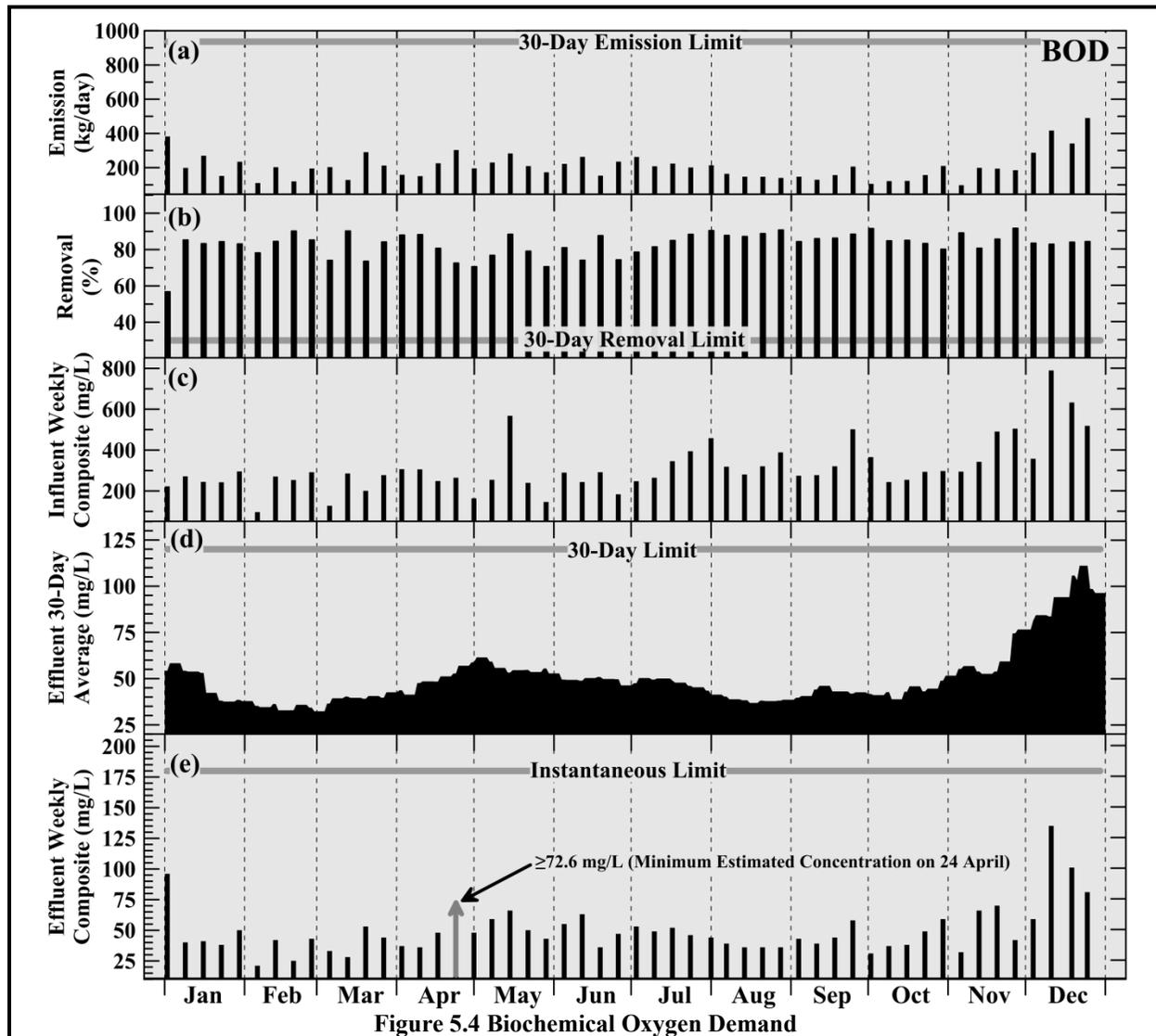
5.2 BIOCHEMICAL OXYGEN DEMAND

In combination with solids removal, a primary function of the treatment process is to reduce organic material within the wastewater stream. The effectiveness of the organic removal process is closely linked to solids removal because the majority of organic constituents are associated with wastewater particulates. However, the measure of organic loading, namely BOD, differs from the direct physicochemical measurements of turbidity and solids concentrations. Instead, BOD indirectly measures organic loading within the wastewater stream by determining the amount of oxygen required for aerobic bacteria to decompose organic matter in a sample of wastewater. Organic material, which supports bacterial degradation and demands oxygen, can harm the environment if its decomposition severely depletes DO within receiving waters. Specifically, prolonged oxygen depletion can disrupt benthic and demersal communities, and cause mass mortalities of aquatic life (Diaz and Rosenberg, 1995).

However, DO depletion is only of concern in semi-enclosed water bodies, such as bays and estuaries, which are environments that fundamentally differ from the highly oxygenated open-coastal marine environment of Estero Bay. In fact, because of the ocean's higher oxygen-replenishment capabilities, an evaluation by the National Academy of Sciences (1993) questioned the environmental benefits of imposing a technology-based BOD limit on open-ocean dischargers, namely, requiring secondary-treatment standards for BOD.

Nevertheless, the NPDES discharge permit and TSO set limits on the discharge of BOD, and independent of potential environmental influence, BOD constitutes an important measure of the overall performance of the treatment process. However, because of the complexity and duration of BOD determinations, its evaluation is only required on a weekly basis (Figure 5.4 on the next page).

¹ An additional daily effluent grab sample was analyzed for settleable solids during the first week of 2019.



In conjunction with the high overall performance of the solids removal process during 2019, BOD removal was also exceptionally high. Annually, the WWTP reduced influent organics by more than 84%, as determined by the average of weekly composite samples analyzed for BOD (Table 5.1 on Page 5-1). Thus, the WWTP removed organic material at a rate two-and-a-half-times greater than the 30% removal rate required as part of the interim limits specified in the TSO (Figure 5.4b). The monthly removal rate even met or exceeded the 85% threshold established for secondary treatment in five months of the year, and was just shy of the secondary standard in six of the other seven months, when it equaled or exceeded 80% removal.

BOD concentrations within the weekly effluent samples were below the TSO’s interim limit of 180 mg/L (Figure 5.4e). However, compliance with this instantaneous BOD limit was indeterminate for the sample collected on April 24th, when biofilm sloughed from the trickling filters resulted in a high effluent TSS. The contracting laboratory, Abalone Coast Analytical, reported 72.6 mg/L as a minimum estimated value for the BOD concentration in the sample collected on that day. Elevated BOD concentrations were not

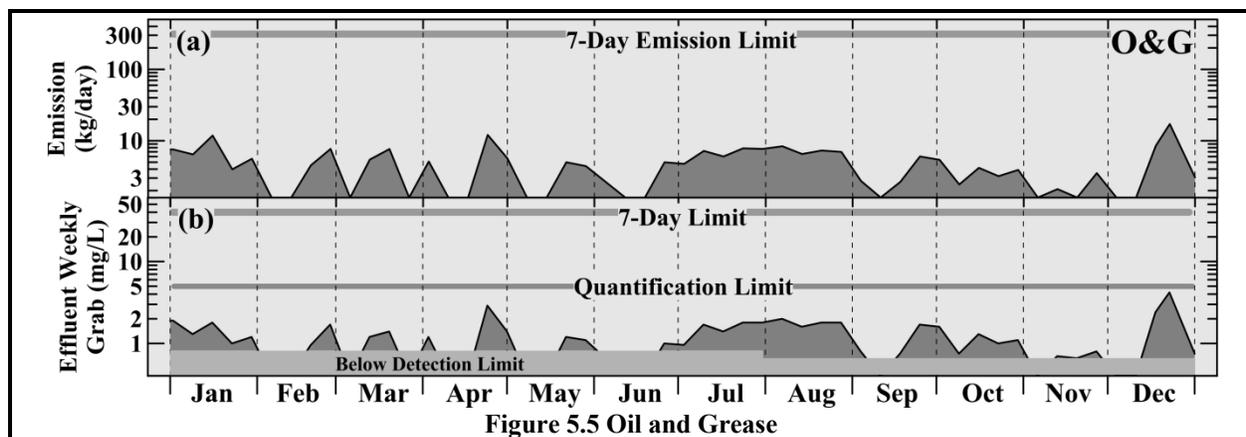
expected and they processed that sample without increasing the dilution for the test series. As such, they only could determine that the actual BOD concentration was at least 72.6 mg/L.

Irrespective of the uncertainty in this one BOD reported concentration, all but four weekly samples in April had consistently low BOD concentrations that were well below 72.6 mg/L. The three 2019 effluent samples with the highest BOD concentrations were collected in December (Last three samples in Figure 5.4e). Their presence caused a visually apparent increase in the running 30-day average at the end of the year (Figure 5.4d). The running mean remained below the 120-mg/L interim limit that applies to averages over calendar months, but the 94 mg/L December average BOD concentration (Table 5.1) was nearly double the 50-mg/L annual average.

However, this cluster of higher-than-average effluent concentrations was not the result of a decline in plant performance. Instead, they arose because influent samples collected on those same days were correspondingly high (compare Figure 5.4c with 5.4e). As a result, BOD removal rates in December were comparable to those of the rest of the 2019 BOD record (Figure 5.4b, Table 5.1). Because of the overall high plant performance and relative low wastewater throughput during 2019, BOD emissions were also consistently low (Figure 5.4a). The resulting annual BOD emission of 75 MT was only 22% of the projected 342 MT tons that would have been discharged if effluent had contained the permitted BOD concentration of 120 mg/L and throughput reached the average dry-weather design flow of 2.06 MGD allowed by the discharge permit (Table 5.1).

5.3 OIL AND GREASE

During 2019, none of the 51¹ weekly effluent grab samples contained a quantifiable amount of O&G (Figure 5.5b). Thus, by default, all reported O&G results complied with the limits specified in the NPDES discharge permit. The 5.0-mg/L quantification limit specified for the O&G analysis method was eight-times lower than the 40-mg/L weekly-average limit (compare the “Quantification Limit” and the “7-Day Limit” lines in Figure 5.5b) and fifteen-times lower than the 75-mg/L maximum-allowed daily concentration (not shown).



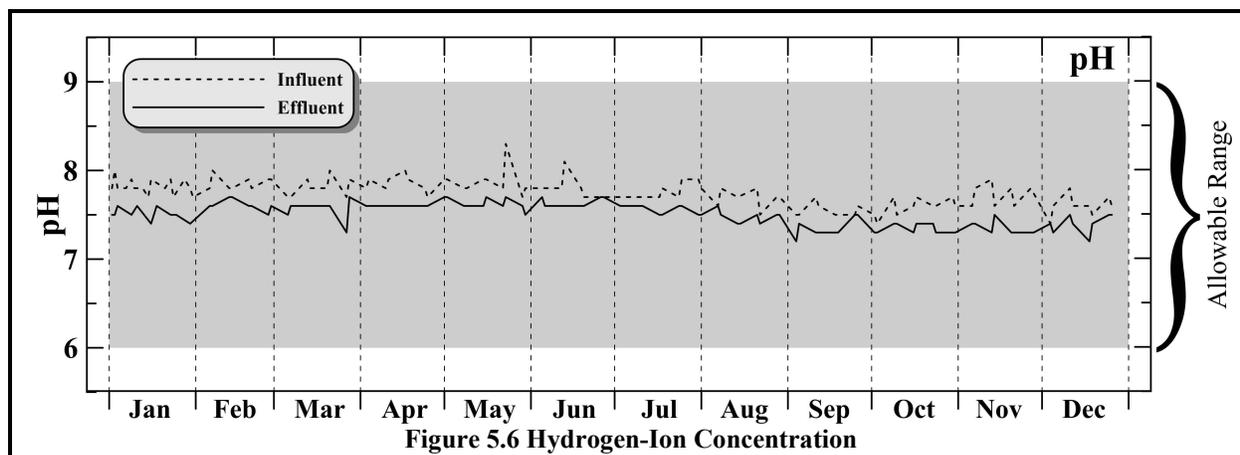
¹ The glass sample container containing the weekly grab effluent sample collected on June 5th arrived broken at BC Laboratories. The resulting unavoidable exception to the required weekly sampling frequency was reported to RWQCB staff. Enhanced sample-container protection procedures were subsequently instituted, including packaging with extra foam prior to transport.

O&G was not detected in fifteen (29%) of the 51 samples collected and analyzed during 2019 (hidden values within the light gray shading at the bottom of Figure 5.5b). On August 1st, the MDL¹ for O&G analyses at BC Laboratories dropped from 0.86 mg/L to 0.66 mg/L. As described in monthly O&G summary reports (MRS 2019e), the COP requires application of special statistical techniques for reporting central tendency (e.g. monthly averages) when some or all of the data are censored (below the MDL or PQL).² Because all of the individual 51 O&G measurements reported during 2019 were “censored,” the monthly O&G concentrations listed in Table 5.1 on Page 5-2 were computed using the COP-required statistical construct. Month-end O&G concentrations were below the method detection limit for half of the year (6 months), and all easily demonstrated compliance with the 25-mg/L monthly O&G concentration limit.

O&G mass-emission reporting is subject to the same censored-data qualifiers that apply to the reported concentrations used in the emission computation (dark gray shading in Figure 5.5a). All of the reported O&G emissions were at least an order-of-magnitude below the 312-kg/day weekly emission limit (note the logarithmic scale in Figure 5.5a). Similarly, all the monthly emissions were far below the monthly emission limit (Table 5.1).

5.4 pH

The MBCSD discharge permit requires that hydrogen-ion concentrations (pH) within effluent samples remain between 6 and 9 at all times. Although Section 301(h) of the Clean Water Act allows an NPDES permit to be issued that exceeds these pH limits, none of the past or present MBCSD discharge permits, or the TSO, allowed this exception. The general absence of heavy-industrial input into the collection system creates an influent stream with a nominal pH that routinely meets the discharge requirement even without treatment. Thus, because influent pH (dashed line in Figure 5.6) remained within the discharge limits (shaded area) throughout 2019, effluent pH measurements also remained within the allowable range by default (solid line).



¹ The method detection limit is the lowest concentration that can be reported under ideal conditions, when the sample contains only the compound of interest in a concentration within an optimal calibration range and within a medium that does not interfere with the performance of the analytical instrument.

² The special statistical analysis is described in Section III.C.8.C. *Multiple Sample Data Reduction* on Page 18 (Sequential Page 25) of https://www.waterboards.ca.gov/water_issues/programs/ocean/docs/cop2015.pdf

Comparison of the two time histories shows that the treatment process slightly moderated short-term pH fluctuations that were present within influent samples,¹ and marginally reduced its pH. Average annual effluent pH (7.50) was slightly less basic than influent (7.75) and substantially less basic than the receiving seawater (8.0).

5.5 TEMPERATURE

Although the NPDES permit does not limit effluent temperature, it is an important physical property to document because the difference between effluent and receiving-water temperature dictates the amount of mixing that occurs shortly after the wastewater is discharged into the ocean. The warmer the effluent is compared to seawater, the greater the buoyancy of the plume and the more turbulence generated by its rise within the water column (Section 3.2 on Plume Dispersion in MRS 2018b). Effluent temperature, shown by the upper time series in Figure 5.7a, exhibits a distinct semiannual cycle that tracks seasonal insolation, in a manner similar to air-temperature fluctuations. Typically, effluent temperatures begin gradually increasing in late-winter (March), peak in late summer (September), and then decline relatively quickly during late fall (November through mid-December).

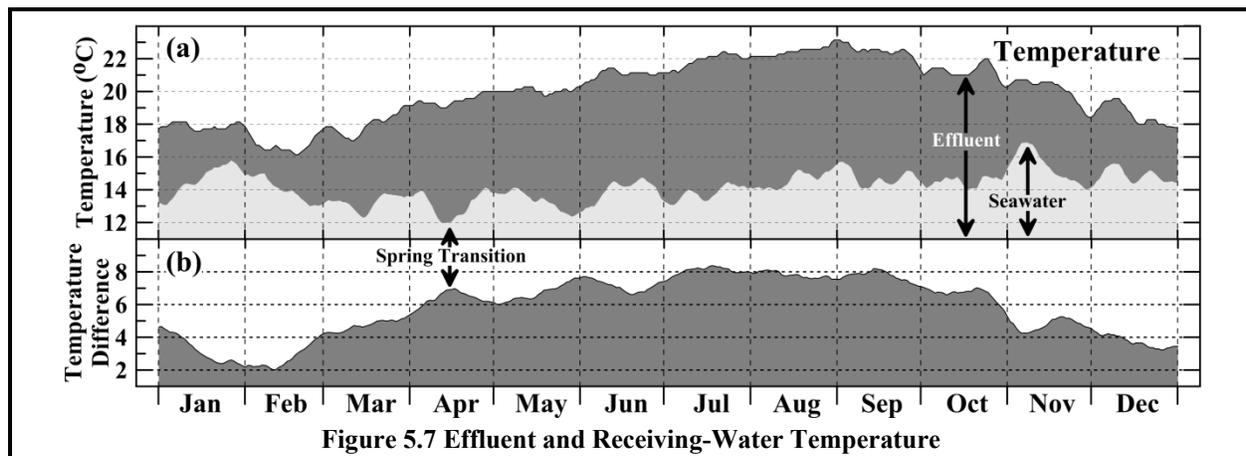


Figure 5.7 Effluent and Receiving-Water Temperature

Because of the strong and sustained influence of upwelling during 2019, seawater temperatures, shown by the light shading in Figure 5.7a, did not track the seasonal-insolation trend seen in effluent temperature. As described in conjunction with Figure 5.2 on Page 5-5, the onset of intense northwesterly winds in mid-April brought cool deep seawater to the sea surface near the discharge location. Upwelling counteracted the warming effects of solar insolation on seawater throughout spring and into summer, and seawater temperatures were actually lower than winter temperatures during that period.

The difference in timing of insolation and upwelling produced a period of large thermal contrast, which persisted from April through mid-October (dark shading in Figure 5.7ab). Effluent temperatures were at least 6°C higher throughout most of this period. However, from mid-July through mid-September, the thermal contrast was much larger. It regularly reached 8°C as onshore surface waters (and effluent) continued to warm while seawater temperature was suppressed by upwelling.

This large thermal contrast would normally enhance buoyancy-induced dispersion of the effluent plume significantly. However, upwelling also causes water-column stratification, which can limit vertical movement of the plume and offset the buoyancy-enhanced turbulence to some extent. The strength of

¹ The influent pH had a 1.9% CV (coefficient of variation), while the effluent CV was 1.8%.

upwelling winds began to slowly decline after mid-June and sea-surface temperatures began a gradual increase that extended through mid-September. Thus, buoyancy-induced vertical mixing of the discharge plume was greatest during the early summer of 2019 when thermal contrasts were still large and water-column stratification had decreased.

5.6 AMMONIA

The current permit's monitoring requirements reduced the ammonia sampling frequency from monthly to annually. As a result, only one ammonia measurement, collected on January 16th, was available for analysis in 2019. Its ammonia as nitrogen (NH₃-N) concentration of 29 mg/L was low compared to those measured in the prior six years, when annual average ammonia exceeded 39 mg/L (Table 2.1 on Page 2-3). Nevertheless, the long history of low ammonia concentrations demonstrates that there is no reasonable potential for ammonia to exceed water-quality objectives, so the ammonia effluent limit was removed from the current permit's discharge requirements. The 2019 ammonia concentration was less than half of the most stringent limit specified in the prior permit, which was 80.4 mg/L for the six-month median.

5.7 RESIDUAL CHLORINE

Total residual chlorine (TRC) quantifies the amount of chlorine remaining in effluent grab samples, which are collected after disinfection with sodium hypochlorite and subsequent dechlorination, or buffering, with sodium bisulfite. Effluent grab samples are collected when flow reaches its daily maximum, and concentrations of effluent constituents, as well as hypochlorite and bisulfite dosage, are expected to be at their highest levels. However, the daily TRC concentrations reported during 2019 were all below the 0.05-mg/L detection limit.

Because none of the 365 samples collected during 2019 had a detectable concentration of TRC, they easily complied with all the permit limits irrespective of averaging period. Namely, even if the actual TRC concentrations in all the 2019 samples were just under the detection limit, they would have to be five-fold higher to approach the six-month median limit of 0.268 mg/L.

The complete absence of detectable TRC concentrations during 2019 resulted from a careful balancing of the complex chlorination and dechlorination processes to obtain adequate disinfection (coliform reduction) without dosing the marine environment with excess chlorine. The complexity arises because chlorine demand is constantly changing due to continuous variations in flow and organic loading within the wastestream. Hypochlorite and bisulfite dose is normally controlled by both total-chlorine-residual and flow-paced pumps that automatically inject precisely measured amounts of these chemicals into the wastestream. However, the disinfection process occasionally requires direct operator intervention on short notice. An auto-dialing alarm system is linked to the process to notify operators by phone immediately upon detecting an unusual excursion in TRC at any time day or night. A narrow range on the alarm points facilitates a quick response, but at the expense of increased numbers false alarms.

5.8 COLIFORM BACTERIA

The efficacy of the disinfection process is tracked by the measurement of coliform populations within effluent samples collected on a regular basis. As part of the NPDES permit provisions, samples collected on five consecutive days each week were analyzed for the most probable number of total coliform organisms per 100 ml (MPN/100 ml). Figure 5.8b on the next page shows that when there are detectable coliform populations (black bars), their densities vary widely among individual measurements. WWTP personnel strive to maintain densities at or below the detection limit. During 2019, nearly one-third (82) of the 260 effluent samples had an undetectable coliform density.

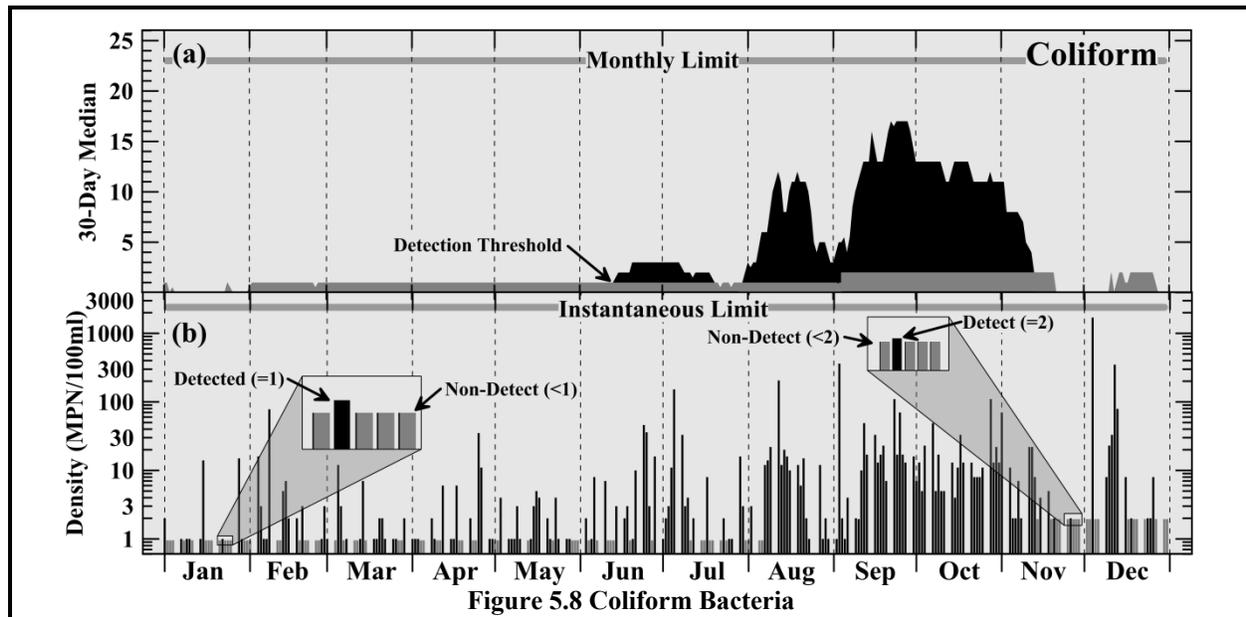


Figure 5.8 Coliform Bacteria

The detection limit increased from 1 MPN/100 ml to 2 MPN/100 on September 9th (see the insets in Figure 5.8b) after a change in analysis method was instituted. The subcontract laboratory, Abalone Coast Analytical, changed to the Multiple Tube Fermentation analysis method after matrix interference produced an unreliable reading using the Quanti-Tray method in the effluent sample collected on August 26th.¹

Due to the complexities of the disinfection process, slightly elevated coliform density is occasionally observed within individual samples. The timing of these unusually elevated densities tends to be randomly distributed, indicating that their occurrence is not related to an ongoing issue with the plant process, or to some external factor. For example, the highest population density (1,700 MPN/100 ml) was measured on December 4th, when other samples contained little or no detectable coliform density. Similarly, the next highest density (362 MPN/100 ml) occurred on September 3th, when other samples were close to the detection limit. Both of these extrema were below the 2,400-MPN/100 ml permit limit on instantaneous coliform density (Figure 5.8b).²

Because of the numerous non-detects, the median coliform density (2 MPN/100) for the year was close to the detection threshold and an order-of-magnitude below the 23-MPN/100 ml monthly permit limit (Table 5.1 on Page 5-2). This also was the case for median monthly densities during nine months of the year. However, clusters of detectable coliform densities led to three periods when the running 30-day median density increased above detectable levels (Figure 5.8a). Nevertheless, the running median remained below the 23-MPN/100 ml monthly permit limit, as did the associated month-end medians used for the determination of compliance (Table 5.1).³

¹ This unusable measurement resulted in an unavoidable exception to the five-days-per-week coliform reporting requirement in the discharge permit.

² Note the logarithmic density scale in the figure.

³ Retrospective monthly compliance evaluations are required to be submitted after the end of each month and thus, cannot include results from samples that are yet to be collected (in the subsequent month). Because the 30-day moving median is centered on each day of interest, it is a more informative measure of the performance of disinfection process because it can be correlated with process changes or external events. Compliance with the 30-day bacterial requirement is evaluated at the end of each month using a 30-day look-back period. This effectively shifts the clusters shown in Figure 8a to the right by 15 days.

5.9 TOXICITY

Chronic-toxicity bioassays measure the effluent’s potential to impact a variety of marine organisms by exposing those organisms to a range of effluent dilutions in the laboratory. These toxicity studies have been conducted for 27 years (Table 2.1 on Page 2-3). All have found consistently low effluent toxicity, with levels far less than those allowed by the discharge permit, including the study conducted in July 2019 (Table 5.2).

Table 5.2 Comparison of Measured Chronic Toxicity Levels with Permit Limits

Sample Dates	Bioassay Test	End Point (%)	Concentration (TUc)	Limit (TUc)
23 July	Red Abalone (<i>Haliotis rufescens</i>) Larval Development	3.2	31.2	134
23 July	Giant Kelp (<i>Macrocystis pyrifera</i>)			
	Kelp Spore Germination	10.	10.0	134
	Kelp Germ Tube Growth	10.	10.0	134
22 July	Topsmelt (<i>Atherinops affinis</i>)			
	Larval Survival	32.	3.12	134
	Larval Growth	32.	3.12	134

Three separate sets of toxicity studies have been conducted on multiple species to determine which species was most sensitive to MBCSD effluent exposure (see the footnotes in the “Chronic Toxicity” column of Table 2.1 on Page 2-3). Bioassays conducted after two sets of screening studies were completed in 1993 and 2010 then assessed toxicity using only the most sensitive species. The toxicity screening studies conducted in 1993 indicated that giant kelp (*Macrocystis pyrifera*) was more sensitive to MBCSD effluent than other species typically used in bioassays at that time, namely, the larvae of the inland silverside (*Menidia beryllina*) and the bay mussel (*Mytilus edulis*) (MRS 1994). Over the following 16 years, MBCSD bioassays repeatedly demonstrated that giant kelp zoospores were only minimally affected by exposure to the treatment plant effluent.

The prior discharge permit (RWQCB-USEPA 2009) required a new set of screening studies, which were conducted on effluent samples collected in July 2009 and January 2010 (MRS 2010 2011). Those screening assays assessed the effluent’s effect on the development of larval red abalone (*Haliotis rufescens*) in addition to that of giant kelp. They demonstrated that larval abalone were slightly more sensitive to MBCSD effluent than kelp zoospores. During eight subsequent years of monitoring, bioassays were conducted using larval abalone, at least through January 2018, when the previous discharge permit was still in effect.

The current permit requires that a three-species chronic-toxicity screening study be conducted during three consecutive annual monitoring events, during July 2018, 2019, and 2020. They assess: 1) the development of larval red abalone (*Haliotis rufescens*); 2) the germination of kelp (*Macrocystis pyrifera*) spores and the growth of kelp germ tubes; and 3) the survival and growth of larval topsmelt (*Atherinops affinis*). The screening study conducted on composite effluent samples collected in July 2018 again confirmed that larval Red Abalone were more sensitive than two other marine species (MRS 2019c).

The second screening study, which was conducted on composite effluent samples collected in July 2019, again confirmed that larval Red Abalone were more sensitive than the two other marine species (Table 5.2). Although all three these organisms are highly sensitive to contaminants, adverse effects were not observed within effluent-seawater mixtures that were at least four times more concentrated than that allowed by the discharge permit (ratio of permitted and measured TUc for the Red Abalone End Point in Table 5.2).

Prior discharge permits explicitly allowed laboratory seawater to be used in the control chambers, and to be used to dilute effluent in the test chambers. The current discharge permit requires that the dilution and control water be collected “*from an area of the receiving waters, typically upstream, which is unaffected by the discharge,*” unless the receiving water itself exhibits toxicity. This was the case for the 20 gallons of receiving seawater collected near the outfall on the morning of 23 July 2019 (MRS 2019c). As with the July 2018 bioassays, it was collected and transported to the bioassay laboratory for use as dilution and control water in the toxicity tests. However, the 2019 receiving-water samples exhibited a distinctive red tinge indicative of the presence of a harmful algal bloom (HAB), or red tide, which was occurring throughout the region around the time of collection. Bioassays conducted on pure receiving-water samples exhibited significant toxicity to the red abalone specimens, and those test specimens exhibited gross anatomical irregularities during subsequent microscopic examination. Shellfish are known to be particularly susceptible to HAB toxicity. Its presence in the bioassay’s dilution and control water invalidated toxicity test results because of unacceptably high toxicity in the control samples. Therefore, the results reported in Table 5.2 were based on bioassays using laboratory seawater for control and dilution.

5.10 NUTRIENTS

During the review process for the prior MBCSD discharge permit, concerns were raised regarding the relative contribution of nutrients discharged to the ocean by coastal treatment plants and their potential role in the promotion of harmful algal blooms (HABs). Because increased human activity and pollution are now thought to be contributing factors to the recently observed increase in the frequency and intensity of HABs, the USEPA proposed a conservation measure for “*Regular monitoring of nutrient loading from the [MBCSD] facility’s ocean outfall*” in their biological evaluation (USEPA 2007).

Historically, open-ocean dischargers, such as the MBCSD treatment plant, have not been required to monitor for bio-stimulatory nutrients because energetic, well-flushed marine environments rapidly dilute and disperse discharged nutrients, preventing their accumulation to deleterious levels. For this reason, there are no numerical objectives for nutrient compounds (except ammonia) promulgated in the COP. However, in response to the USEPA conservation measure regarding nutrient loading and its potential for HAB stimulation, MRS (2008) designed and instituted a nutrient-monitoring requirement for the MBCSD effluent monitoring program that included the semiannual analyses of nitrate [NO_3^-], urea [$\text{CO}(\text{NH}_2)_2$], ortho-phosphate [$(\text{PO}_4)^{3-}$], and dissolved silica [SiO_2]. These particular compounds were selected because they represent limiting macronutrients for phytoplankton growth within the euphotic zone of the ocean, and have been associated with the stimulation of phytoplankton growth (Kudela and Cochlan 2000).

Ammonia [NH_3] is another nitrogen compound typically associated with phytoplankton growth. However, ammonia concentrations are already regularly measured as part of the MBCSD discharge permit’s waste-discharge requirements. RWQCB staff retained the nutrient-monitoring requirement in the current permit because nutrient discharge continues to be a concern along the central California coastal region, where agriculture is a major activity, and where other wastewater treatment plants are required to monitor for nutrients.

HABs occur when periodic explosions of growth in naturally occurring algae result in extensive monoculture blooms of particular species that are harmful to humans and other life. In addition to harm caused through the production of toxins by these species, large phytoplankton blooms can negatively affect the marine ecosystem simply from their accumulated biomass. Historically, processes such as coastal upwelling and river runoff have been implicated as the primary factors that create physical and chemical conditions (e.g., high nutrient concentrations) conducive to the development of phytoplankton

blooms (Trainer et al. 2002, Kudela et al. 2004). In particular, the upwelling process, which is prevalent within western U.S. coastal waters, has been chiefly implicated in the generation of HABs along the central California coastline (Trainer et al. 2000, Kudela et al. 2005).

However, over the last decade, the extent and duration of phytoplankton blooms have been increasing within the upwelling zones along central and southern California coastlines (Nezlin et al. 2012). Additionally, upwelling alone cannot account for the recent observed distributions, suggesting that anthropogenic nutrient input could be a contributing factor in the stimulation of phytoplankton biomass that promote HABs. Within highly localized nearshore areas adjacent to large wastewater dischargers offshore southern California, nutrient loads within the discharges are comparable to the nutrient flux associated with upwelling (Howard et al. 2014).

In fulfillment of the current permit requirement, an assay of nutrients within MBCSD effluent was conducted on grab samples collected in July 2019. The results were consistent with those of prior years, and demonstrate that nutrient concentrations within the MBCSD effluent, and their mass loading to the marine environment from discharge, are small compared to: 1) other central- and southern-California coastal dischargers, 2) the contribution from regional streams and rivers, and 3) the nitrogen flux from localized upwelling (Table 5.3).

Table 5.3 Nutrient Concentrations and Loading from Central-Coast Ocean Discharges

Source	Concentration (mg/L)				Mass Emission (kg)			
	Nitrate	Urea	Phosphate	Silica	Nitrate	Urea	Phosphate	Silica
MBCSD	≈0.02	0.143	2.6	11.0	≈31.	224.	4,080.	17,300.
Santa Cruz	9.52	0.087	7.7	30.2	139,000.	1,360.	117,000.	489,000.
Watsonville	10.52	0.110	13.6	35.6	105,000.	1,250.	154,000.	364,000.
Monterey	4.82	0.084	3.4	41.0	85,600.	1,100.	30,300.	488,000.
Streams and Rivers ¹	3.58	0.021	0.14	25.6	1,660,000.	33,500.	340,000.	25,200,000.
Localized Upwelling ²	9.53	—	2.0	—	1,818,000.	—	377,000.	—

Although the urea concentration (0.143 mg/L) within the MBCSD effluent sample was slightly higher than that of the three large central-coast WWTP’s to the north (≤ 0.110 mg/L), the concentrations of nitrate, phosphate, and silica within MBCSD effluent were all substantially less than those of the other dischargers. The MBCSD nitrate levels, in particular, were two orders of magnitude lower than those of the other WWTP’s within the central-coast region. Nitrate and silica concentrations within MBCSD effluent were also less than the average concentrations found within central-coast rivers and streams; although, urea and phosphate concentrations were higher, as was the case for the other central-coast WWTP’s.

Irrespective of effluent nutrient concentrations, potential marine bio-stimulatory effects from nutrient discharge are dictated by the total nutrient mass emission contributed by the various sources (right side of Table 5.3). After accounting for the relatively small volume of wastewater discharged by the MBCSD, its total nutrient loading³ to the marine environment during 2019 was 28-times smaller than any of the three large WWTP’s, all of which discharge into the waters of the Monterey Bay National Marine Sanctuary. Similarly, total nutrient loading from the MBCSD discharge was three orders-of-magnitude smaller than

¹ Average concentrations and total emissions from fourteen streams and rivers discharging to the northern central coast from July 2005 and June 2006 (CClean 2007)

² McLaughlin et al. 2017 found that the nitrate volume discharged by the Orange County Sanitation District was comparable to the nitrogen flux from localized upwelling.

³ Sum of the emissions from the four nutrient compounds listed on the right side of the Table

the contribution from runoff within the central-coast region. Lastly, and most relevant for evaluating the potential impacts on HAB stimulation, the nitrogen flux from the MBCSD outfall was four orders of magnitude smaller than the flux from the Orange County discharge, which was found to be comparable to that of localized upwelling (last row in Table 5.3).

6.0 CHEMICAL CONSTITUENTS

In addition to the effluent properties and bioassay results described above, 78 chemical contaminants are regulated by the COP, and have their effluent concentrations limited in the discharge permit (SWRCB 2015; RWQCB 2018a). Prior to 2019, effluent and benthic sediment samples were regularly analyzed for the presence of these toxic chemical compounds, which include trace metals, chlorinated and nonchlorinated phenolic compounds, volatile organic compounds, organochlorine pesticides, PCBs, cyanide, base-neutral compounds, and radionuclides. The COP regulates the discharge of these compounds for the protection of marine life and human health from exposure to both carcinogenic and noncarcinogenic substances.

The historical record of 3,802 effluent chemical assays spanning 26 years of MBCSD effluent monitoring have detected only a few ubiquitous compounds with concentrations below regulatory limits. As part of the current discharge permit, a statistical analysis of a five-year subset of these data found only TRC had a reasonable potential for an excursion above a COP water quality objective. The reasonable potential was inconclusive for many chemical contaminants because the five-year span did not have enough measurements (degrees of freedom) and because many reported concentrations were censored, namely below their respective detection limit or minimum reporting level (ML).¹ As is customary, the permit established a once-in-the-life-of-the-permit monitoring frequency for all effluent chemical compounds regulated by the COP other than metals and metalloids. That monitoring requirement was satisfied by the comprehensive chemical assays of effluent samples collected in July 2018 (MRS 2018c). Other chemical compounds that require annual or more frequent monitoring include ammonia and nutrients, and results from the 2019 analyses of those compounds are summarized in the previous chapter.

Ten metallic and metalloid elements also have annual sampling requirement. Their concentrations within the effluent sample collected in July 2019 are summarized below. The annual effluent self-monitoring report (MRS 2019c) provides a detailed discussion of effluent chemistry and toxicity analyses conducted on the July 2019 sample. This includes compliance with permit limits, minimum reporting levels, laboratory data sheets, pertinent QA/QC data, and chains of custody.

The presence of seven of the ten annually-monitored metallic and metalloid elements were detected within the July 2019 effluent sample (Table 6.1 on the following page). Only four were present in a quantifiable amount, and their concentrations are shown in bold typeface in the Table. Three additional elements, arsenic, nickel, and selenium were present within the sample, but at concentrations that were too low to be reliably quantified. Specifically, the concentrations of these compounds were higher than the MDL but lower than the ML. Reporting of these detected-but-not-quantified concentrations is required under the current NPDES discharge permit; although they are not compared to effluent limits for compliance determinations, except when the effluent limit itself is less than the MDL or ML, which was not the case for any of those three elements.

The quantifiable concentrations of hexavalent chromium, copper, lead, and zinc found within the July-2019 effluent sample were considerably below the limits specified in the NPDES discharge permit. This is not surprising because the aforementioned reasonable potential analysis found that copper, lead, and zinc did not exhibit a potential for exceeding their respective permit limits. Copper concentrations within

¹ The Minimum Level (ML) for individual chemical compounds are as specified in the COP, and represent the method-specific minimum concentration of a substance that can be reliably measured in a sample given the current analytical performance level achieved by most certified laboratories within California.

Table 6.1 Chemical Elements Detected within Effluent Samples

Element	Concentration (µg/L)		Mass Emission (kg/vr)	
	Limit	Measured	Goal	Measured
Arsenic	670.	≈1.5 ¹	17.	≈2.35
Chromium VI	270.	0.65	93.	1.02
Copper	140. ²	17.	690.	26.7
Lead	270. ²	0.74	465.	1.16
Nickel	670.	≈5.1	142.	≈8.00
Selenium	2,010. ²	≈1.5	65.	≈2.35
Zinc	1,620. ²	52.	244.	81.6.

the July 2019 sample would need to be eight-fold higher to be of concern for the protection of marine aquatic life. Zinc concentrations would need to be 32-times higher, and lead 365-times higher, to be of environmental concern. The mass emissions of all three metals were also well below the goals established in the discharge permit. Quantifiable concentrations of these three metals are routinely measured within effluent and biosolids samples because they enter the wastewater collection system through erosion of natural metal-rich mineral deposits along the central California coast. They also enter the system through corrosion of household plumbing systems. These three metals have been detected at quantifiable levels within more than half of the effluent samples collected during the last 26 years; therefore, they do not represent a new or increased source of contaminants entering the collection system.

Hexavalent chromium was the only other chemical constituent with a low-but-quantifiable concentration within the July 2019 effluent sample. At 0.65 µg/L, its concentration was 400-times smaller than the 270-µg/L threshold deemed deleterious to marine organisms. Nevertheless, its sudden measurable presence in the July 2019 effluent sample was noteworthy because it departed from the undetectable and non-quantifiable concentrations found in the 39 prior effluent samples that were collected over the past two decades.

However, the quantifiable chromium concentration in the July 2019 sample did not arise because of a change in effluent quality. Instead, it was purely an artifact of a change in the chemical analysis method that was necessitated when the current discharge permit became effective in 2018. Footnotes in the COP and in prior MBCSD permits allowed compliance with hexavalent chromium objective to be evaluated using total chromium, rather than the concentration associated with the +6 oxidation state alone. That footnote appears to have been inadvertently omitted in the current MBCSD discharge permit. As a result, the more costly and sensitive EPA Method 218.6 was required to determine hexavalent chromium concentrations in the July 2019 chemical assay. Its 0.2-µg/L quantification limit is 50-times lower than the 10-µg/L limit associated with the total chromium methodology. Thus, the 0.65-µg/L chromium concentration found in the July 2019 sample would not have been detected, much less quantified, using the historical EPA Method 200.7 for total chromium.

¹ The “*approximation*” symbol (≈) indicates that the detected concentration, designated with an “*as estimated*” qualifier, was too low to be reliably quantified, namely, it was below the prescribed Minimum concentration Level (ML). Accurately quantified “*as measured*” concentrations are indicated by bold typeface.

² Effluent limitations for copper, lead, selenium, and zinc were removed in the current discharge permit based on reasonable potential analyses of historical effluent data.

7.0 BIOSOLIDS

The monitoring and reporting requirements of the current NPDES permit (RWQCB 2018a) stipulate characterization of biosolids in accordance with 40 CFR 503 (USGPO 1997b). To that end, a complete description of sludge production and disposal activities covering 2019 was submitted by the MBCSD to the USEPA, RWQCB, and SLO EHS (MBCSD 2020). That letter-report and its eight attachments are incorporated in this annual monitoring report by reference. The November 2019 disposition of the 135 dry MT tons of biosolids generated by the WWTP from June 2018 through and August 2019 is briefly summarized in this Chapter. This Chapter also discusses the major chemical compounds that were found within the biosolids produced by the plant, because they lend insight into the performance of the WWTP and because they determine the suitability of biosolids for composting and land application (MRS 2019d).

7.1 SOLIDS TREATMENT PROCESS

Solids removed by the clarifiers (Figure 3.3 on Page 3-12) are processed as shown in the schematic of Figure 7.1. Sludge is stabilized within two mixed-primary digesters in series with a secondary digester. Sludge is heated to temperatures between 95°F and 98°F (35°C to 37°C) in the primary digesters. Heated sludge is transferred to a unmixed and unheated secondary digester. Solids settle in the secondary digester and the supernate is returned to the wastewater treatment process. The sludge is transferred to solar drying beds. The primary digester's capacities are 170,544 gallons and 191,500 gallons, and the secondary digester's capacity is 166,056 gallons, giving a total capacity of 528,100 gallons (2 megaL).

Stabilized sludge drawn from the secondary digester was transferred to one of 12 sludge-drying beds. Each of these 5,200 ft² (483 m²) beds has an under-drain and decanting system that recirculates drainage through the treatment process. Once dried, the biosolids were removed from the beds and stored in a concrete containment area that also drained rainfall runoff through the treatment system. Biosolids were stored in this area until they were removed from the WWTP. Biosolids storage times are generally less than one year.

On November 25th, 26th, and 27th, all 135 dry MT of biosolids in storage at the WWTP were hauled to the Liberty Composting Facility, which operates under Solid Waste Information System Permit No. 15-AA-0287. The biosolids transferred to the Liberty Composting Facility were used for soil amendment after composting was completed at the facility. Prior to shipping, the MBCSD provided a Title 22 Certification for Non-hazardous Materials and a Class-B biosolid certification statement, based in part on the chemical analyses described below.

7.2 CHEMICAL COMPOUNDS

In compliance with the Monitoring and Reporting Program, chemical analyses were conducted on a composite of biosolid samples collected from the drying beds on 28 August 2019. Those beds contained

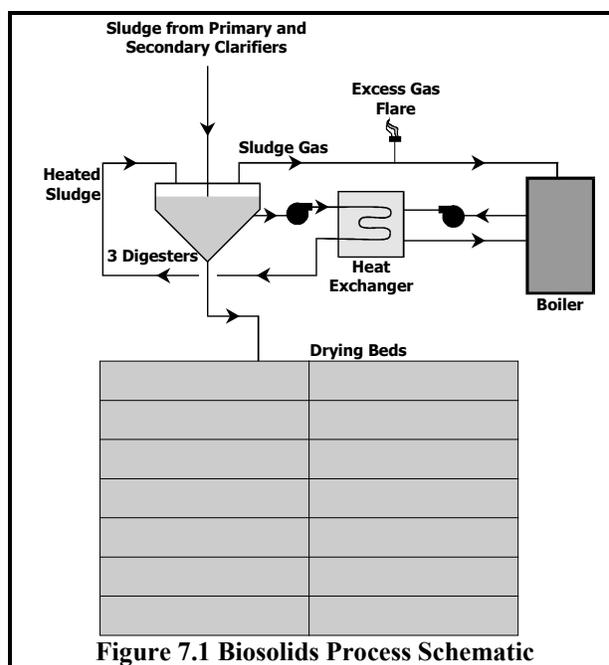


Figure 7.1 Biosolids Process Schematic

all the biosolids that were ready for shipment from the WWTP at the time. The full laboratory results, including chains of custody, instrument calibration reports, and analyses of method blanks and spikes, were reported by MRS (2019d). They are compared with regulatory limits in Table 7.1.

The data in the table show that biosolid contaminant concentrations were significantly less than regulatory thresholds that would designate them as hazardous, or that would limit their use for land application or composting. The analyses tested for the presence of more than 150 potential contaminants and measured seven other properties and nutrients within the biosolid sample. Nevertheless, only a few compounds were detected, primarily naturally occurring trace metals.

All trace-metal concentrations were below the total threshold limit concentrations (TTLC) that would designate the biosolids as hazardous. Dry-weight concentrations for all detected metals in the biosolid sample were well below the federally mandated thresholds, including the monthly limit for materials suitable for agricultural land application (as represented in the three right-most columns of Table 7.1). The other compounds listed in Table 7.1 further characterize the biosolids, as mandated in the waste discharge requirements. Additionally, a modified WET test (STLC) for Hexavalent chromium and total dissolved solids was conducted in response to a request from the composter.

Table 7.1. Comparison between Measured Biosolid Concentrations and State and Federal Limits

Constituent	Units	Wet Weight				Dry Weight		
		Measured		Limit		Measured Bulk	Limit	
		Bulk	WET ¹	STLC ²	TTLC ³		Monthly ⁴	Ceiling ⁵
Solids	%	81.9	— ⁶	—	—	—	—	—
Cyanide	ppm	3.4	—	—	—	4.1	—	—
Antimony	ppm	≈2.1 ⁷	—	15.	500.	≈2.6	—	—
Arsenic	ppm	3.1	—	5.	500.	3.8	41.	75.
Barium	ppm	190.	—	100.	10,000.	240.	—	—
Beryllium	ppm	ND	—	0.75	75.	ND	—	—
Boron	ppm	17	—	—	—	21.	—	—
Cadmium	ppm	1.2	—	1.	100.	1.5	39.	85.
Chromium (Total)	ppm	30.	—	560.	2,500.	37.	1,200.	3,000.
Chromium (Hexavalent)	ppm	≈0.64	ND	5.	500.	≈0.78	—	—
Cobalt	ppm	≈2.5	—	80.	8,000.	≈3.0	—	—
Copper	ppm	270.	2.5	25.	2,500.	330.	1,500.	4,300.
Lead	ppm	17.	≈0.18	5.	1,000.	21.	300.	840.
Mercury	ppm	0.85	—	0.2	20.	1.	17.	57.
Molybdenum	ppm	9.3	—	350.	3,500.	11.	18.	75.
Nickel	ppm	22.	—	20.	2,000.	27.	420.	420.
Selenium	ppm	2.1	—	1.	100.	2.5	36.	100.
Silver	ppm	1.2	—	5.	500.	1.5	—	—
Thallium	ppm	ND	—	7.	700.	ND	—	—
Vanadium	ppm	15.	—	24.	2,400.	18.	—	—
Zinc	ppm	760.	—	250.	5,000.	920.	2,800.	7,500.
Hydrogen-Ion	pH	6.60	—	—	—	—	—	—
Phosphate	ppm	69,000.	—	—	—	84,000.	—	—
Ammonia	ppm	8,600.	—	—	—	10,000.	—	—
TKN	ppm	32,000.	—	—	—	39,000.	—	—
Organic Nitrogen	ppm	23,400.	—	—	—	29,000.	—	—
Nitrate as NO ₃	ppm	470.	—	—	—	580.	—	—
Oil & Grease	ppm	26,000.	—	—	—	32,000.	—	—
Total Dissolved Solids	ppm	—	7,200.	—	—	—	—	—

¹ Waste Extraction Tests (WETs) measure the soluble leachate or the extractable amount of a substance contained within a bulk sample of biosolids. A WET is indicated if the bulk wet-weight concentration of a contaminant exceeds 10 times the STLC.

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- ² Soluble Threshold Limit Concentrations (STLC) apply to the measured concentration in the liquid extract from a biosolid sample, as determined by a WET. Biosolids with leachate concentrations exceeding the STLC are classified as hazardous in the State of California, as described in the California Code of Regulations (CCR 2003).
- ³ Total Threshold Limit Concentrations (TTLC) apply to the total wet-weight concentration of a contaminant within a bulk biosolid sample consisting of the entire millable solid matrix, rather than just the leachate. Biosolids are designated as hazardous wastes in the State of California if measured bulk concentrations exceed the TTLC, as described in the CCR (2003).
- ⁴ Federally mandated dry-weight limits imposed on biosolids suitable for application on agricultural land apply to monthly average concentrations as defined in Table 3 of the Code of Federal Regulations (USGPO 1997b). [40 CFR §503.13(b)(1)].
- ⁵ Federally mandated dry-weight ceiling concentrations above which biosolids are considered hazardous waste as defined in Table 1 USGPO (1997b).
- ⁶ “—” indicates that the measurement was not required or its limit was not specified.
- ⁷ Concentrations preceded by an “*approximation*” symbol (\approx) were too low to be reliably quantified and represent estimated concentrations because they were reported below the minimum level (ML) but above the method detection limit (MDL).

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Appendix A WWTP Specifications

Parameter	Quantity
Waste Loading	
Flow (MGD)	
Average dry-weather flow	2.06
PSDWF	2.36
Peak dry-weather flow	6.64
PWWF	6.60
Strength	
BOD ₅ (mg/L)	280
Suspended solids (mg/L)	280
Grit (ft ³ /mg)	10
Waste quantities at PSDWF	
BOD ₅ (mt/day)	2.5
Suspended Solids (mt/day)	2.5
Grit (ft ³ /day)	23.6
Preliminary Treatment	
Mechanically Cleaned Bar Screen	
Number	1
Capacity (MGD)	8.2
Channel Monster	
Number	1
Capacity (MGD)	7.0
Influent Pumps (variable speed)	
Number	3
Capacity each (MGD)	3.3
Total head (m)	9.6
Aerated Grit-Removal Tanks	
Number	1
Length (m)	9.1
Width (m)	4.9
Depth (m)	2.4
Detention time at PWWF (min)	6.3
Grit Pumps	
Number	2
Capacity (gpm)	250
Primary Treatment	
Sedimentation Tanks	
Number	2
Diameter (m)	
Tank 1	15.2
Tank 2	12.2
Average side water depth (m)	
Tank 1	2.74

Parameter	Quantity
Tank 2	2.74
Surface loading rate PSDWF (10 ³ L/m ² /day)	29.74
Detention time at PWWF (hr.)	2.2
Total Treatment	
Overall treatment efficiencies (%)	
BOD ₅	57
Suspended solids	75
Expected effluent quality (mg/L)	
BOD ₅	120
Suspended solids	70
Solids stabilization	
Anaerobic digester loading (mt/day)	
Primary solids	1.6
Secondary solids	0.4
Assumed sludge volatile content (%)	
Primary solids	70
Secondary solids	82
Sludge volume (m ³ /day)	50.7
Digester 1 (existing, fixed cover)	
Diameter (m)	12.2
Side water depth (m)	4.9
Volume (m ³)	629
Digester 2 (existing, fixed cover)	
Diameter (m)	12.2
Side water depth (m)	5.8
Volume (m ³)	725
Digester 3 (new, floating cover)	
Diameter (m)	10.7
Side water depth (m)	6.9
Volume (m ³)	646
Hydraulic detention time based on net volume of digesters 2 and 3 (days)	23
Assumed volatile solids reduction (%)	55
Expected sludge gas production (m ³ /day)	804
Sludge Drying Beds	
Number	12
Length each (m)	49.4
Width each (m)	9.8
Solids Loadings (kg ft ⁻¹ yr ⁻¹)	78.3

Parameter	Quantity
Assumed removal efficiency (%)	
BOD ₅	35
Suspended solids	65
Primary effluent quality (mg/L)	
BOD ₅	182
Suspended solids	98
Secondary treatment	
Biofilters (existing, in partial secondary treatment mode of operation)	
Flow distribution at PSDWF (MGD)	
Biofilter 1	0.39
Biofilter 2	0.58
Diameter (m)	
Biofilter 1	18.3
Biofilter 2	21.3
Net media surface area (m ²)	
Biofilter 1	262
Biofilter 2	350
Average media height (m)	
Biofilter 1	1.4
Biofilter 2	1.5
Media Volume (m ³)	
Biofilter 1	360
Biofilter 2	532
Specific organic loading rate (lbs BOD ₅ /day/1000 ft ³)	47
Circulated flow (MGD)	
Biofilter 1	1.37
Biofilter 2	2.04
Hydraulic loading rate (gpm/ft ² media surface)	
Biofilter 1	0.34
Biofilter 2	0.38
Circulation Pumps	
Biofilter 1	
Capacity (gpm)	950
Total head (m)	3.4
Biofilter 2	
Capacity (gpm)	1420
Total head (m)	4.3
Stand-by (2-speed)	
Capacity (gpm)	960
	1660
Total head (m)	3.4
	4.4

Parameter	Quantity
Interstage pumping	
Biofilter Effluent Pumps (variable speed)	
Number	2
Capacity each (gpm)	2300
Total head (m)	8.2
Secondary sedimentation Tanks	
Number	1
Diameter (m)	16.8
Tank surface area (m ²)	221
Tank volume (m ³)	3125
Average water depth (m)	4.6
Overflow rate at PSDWF (10 ³ L/m ² /day)	16.6
Expected secondary treatment effluent quality (mg/L)	
BOD ₅	30
Suspended Solids	30
Chlorination	
Chlorine Contact Tank (existing)	
Number of passes	2
Length (m)	
Pass 1	16.8
Pass 2	22.9
Width each pass (m)	4.6
Average depth (m)	2.3
Total volume (m ³)	413
Detention time at PDWF (min)	24
Chlorinators	
Pre-chlorinator	
Number	1
Initial capacity (kg/day)	227.3
Ultimate capacity (kg/day)	909.1
RAS chlorinator	
Number	1
Capacity (kg/day)	227.3
Ultimate capacity (kg/day)	90.9
Sodium Hypochlorite Post Chlorinator	
Chemical feed pumps	3
Combined Capacity (kg/day)	5450
Dechlorination	
Sodium Bisulfite System	
Chemical feed pumps	3
Combined Capacity (kg/day)	1226

Appendix B

Morro Bay/Cayucos Wastewater Treatment Plant Outfall/Diffuser Annual Report

Name of Discharger: MBCSD
NPDES Permit Number: R3-2017-0050

Name of Diver/Inspector: ANDRES FUJARDO / Craig Porter
Firm & Address: Porter Diving 343 Quintana rd Morro Bay CA 93442

Telephone Number: (805) 674-6702

Outfall Length: 5160 Feet Depth of Water: 51' Feet

Design of Diffuser (physical dimensions, shape, include sketch):

Number of Ports: 34 Number Ports Open: 28 Diffuser Level? 1"-36"

End of Diffuser Open? _____ Closed? X

Outfall Marked by Bouys? Yes: X No: _____ Type: SPAR

Diffusers Operating as Designed? Yes: X No: _____

Breaks in Outfall Line Noted? Yes: _____ No: X if yes, describe

Describe Problems Noted: NONE

Corrected Action Needed: NONE

Physical Description of Environment Around Outfall (i.e. fish noted, debris, sediment, etc.):

lots of mussels, anemones, Halibut (small), SAND DOLLARS

Direction of Plume in Relationship to Shoreline: NO surface plume noted

Pictures Taken? Yes: X Video provided No: _____ (Include copies if taken)

[Signature]
Signature of Diver/Inspection

12-16-19
Date

[Signature]
Signature of Diver/Inspection

12-16-19
Date

Appendix C Adjustments to Previously-Reported Daily Flow (MGD)

Date	Reported	Corrected	Reduction	Reason
14-Mar	1.3770	1.1847	0.1923	Effluent instead of Influent flow reported
15-Mar	1.1820	1.1877	-0.0057	Typographical Error: 2 entered instead of 7
26-Mar	1.3170	1.1293	0.1877	Recording Time Offset
27-Mar	1.0810	1.2699	-0.1889	Recording Time Offset
4-Apr	1.1261	1.0567	0.0694	Typographical Error: prior day's flow reported
10-Apr	1.1401	1.0989	0.0412	Transcription error
18-May	1.0913	1.3631	-0.2718 ¹	Recording Time Offset ¹
19-May	1.5520	1.2802	0.2718 ¹	Recording Time Offset ¹
26-Aug	1.0220	1.0887	-0.0667	Transcription error
1-Sep	1.6950	1.3002	0.3948	Recording Time Offset
2-Sep	0.7560	1.1515	-0.3955	Recording Time Offset
3-Sep	0.9950	0.9092	0.0858	Recording Time Offset
4-Sep	0.8150	0.9012	-0.0862	Recording Time Offset
29-Sep	0.9970	0.9124	0.0846	Influent Bottomed Out
2-Oct	0.9710	0.8921	0.0789	Influent Bottomed Out
3-Oct	0.9220	0.8491	0.0729	Influent Bottomed Out
6-Oct	1.0550	0.9546	0.1004	Influent Bottomed Out
8-Oct	0.9490	0.8719	0.0771	Influent Bottomed Out
9-Oct	0.9240	0.8600	0.0640	Transcription error
10-Oct	0.9660	0.8828	0.0832	Influent Bottomed Out
16-Oct	0.9380	0.8474	0.0906	Influent Bottomed Out
19-Oct	1.0800	0.9866	0.0934	Influent Bottomed Out
20-Oct	1.0190	0.8896	0.1294	Influent Bottomed Out
22-Oct	0.9090	0.8263	0.0827	Influent Bottomed Out
23-Oct	0.9090	0.8423	0.0667	Influent Bottomed Out
27-Oct	1.0250	0.9318	0.0932	Influent Bottomed Out
1-Nov	0.9400	0.8626	0.0774	Influent Bottomed Out
2-Nov	1.0960	1.0094	0.0866	Influent Bottomed Out
3-Nov	0.9670	0.8626	0.1044	Influent Bottomed Out
5-Nov	0.8910	0.7655	0.1255	Influent Bottomed Out
6-Nov	0.8720	0.7976	0.0744	Influent Bottomed Out
7-Nov	0.8810	0.8077	0.0733	Influent Bottomed Out
8-Nov	0.9720	0.8719	0.1001	Influent Bottomed Out
9-Nov	1.0390	0.9005	0.1385	Influent Bottomed Out
10-Nov	1.1160	0.9841	0.1319	Influent Bottomed Out
11-Nov	0.9130	0.8398	0.0732	Influent Bottomed Out
12-Nov	0.8810	0.7647	0.1163	Influent Bottomed Out
13-Nov	0.8870	0.7942	0.0928	Influent Bottomed Out
14-Nov	0.8540	0.7832	0.0708	Influent Bottomed Out
16-Nov	1.0430	0.9495	0.0935	Influent Bottomed Out
17-Nov	0.8440	0.7275	0.1165	Influent Bottomed Out
18-Nov	0.8820	0.8288	0.0532	Transcription error
19-Nov	0.8850	0.8865	-0.0015	Transcription error
20-Nov	0.8530	0.7301	0.1229	Influent Bottomed Out
21-Nov	0.8490	0.7242	0.1248	Influent Bottomed Out
22-Nov	0.9890	0.9065	0.0825	Influent Bottomed Out
23-Nov	0.9130	0.7714	0.1416	Influent Bottomed Out

¹ Differences in the time-of-day the influent and effluent meter readings were taken does not affect annual average flow estimates because flow discrepancies tend to be offset by opposite discrepancies on the preceding or following days. However, these adjustments are necessary for accurate determination of the effluent meter overtotalization.

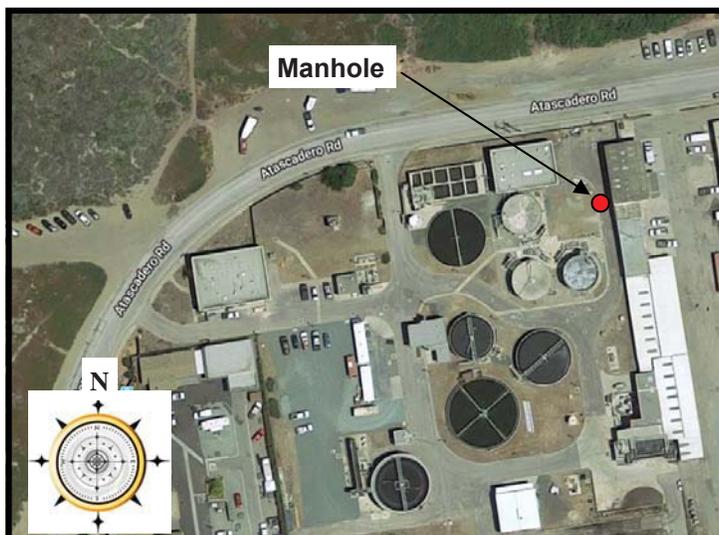
Date	Reported	Corrected	Reduction	Reason
25-Nov	0.9810	0.9039	0.0771	Influent Bottomed Out
26-Nov	1.2200	1.1242	0.0958	Influent Bottomed Out
28-Nov	1.1490	0.9698	0.1792	Effluent instead of Influent reported
29-Nov	1.1710	0.9883	0.1827	Effluent instead of Influent reported
30-Nov	1.5730	1.3582	0.2148	Effluent instead of Influent reported
3-Dec	1.0540	0.9613	0.0927	Influent Bottomed Out
5-Dec	1.0360	0.9563	0.0797	Influent Bottomed Out
6-Dec	0.9250	0.8583	0.0667	Influent Bottomed Out
7-Dec	1.0430	0.9672	0.0758	Influent Bottomed Out
8-Dec	1.2150	1.0947	0.1203	Influent Bottomed Out
10-Dec	1.0040	0.8794	0.1246	Flume Calibration
11-Dec	0.9280	0.8145	0.1135	Influent Bottomed Out
13-Dec	0.9810	0.8870	0.0940	Influent Bottomed Out
15-Dec	1.0000	0.8938	0.1062	Influent Bottomed Out
16-Dec	0.9450	0.8617	0.0833	Influent Bottomed Out
21-Dec	1.0520	0.8879	0.1641	Effluent instead of Influent reported
22-Dec	1.8970	1.6579	0.2391	Effluent instead of Influent reported
23-Dec	1.1990	1.0795	0.1195	Influent Bottomed Out

Morro Bay WWTP - 27" Influent Palmer Bowlus

MH Location: **Morro Bay**
Wastewater Treatment Plant
160 Atascadero Road
Morro Bay, CA 93442

Pipe Size: **30"**

Time Period: **12-10-2019, 8:00 - 11:30 a.m.**



Transducer in Manhole



Site/Vault Condition

- 30" influent line transitions into a 27" Palmer Bowlus flume with a drop on the effluent into a 30" line. This system does very well at preventing a downstream surcharge.
- Influent flow is laminar with very little turbulence.
- There was approximately 2 inches of silt and rocks on the influent side of the flume. Before the calibration this was jetted, the jetting did not remove all of the sand and rock.
- It was noted that there had been a back-up inside of the flume manhole due to high water marks and debris on the ladder and fiberglass grate.

Flow Meter



Siemens LUT 430 flow meter with an XRS-5 ultrasonic transducer.

- Transmitter is mounted inside of a NEMA 4X cabinet.
- Conduit into cabinet has been sealed with silicone to help prevent H₂S intrusion
- Cable and wiring penetrations into the LUT were open, all wiring was removed, wire ferrules and cord grips were installed to help prevent H₂S intrusion and for good wire connections.
- A Hobo 4 channel data logger is connected to this meter to log all flow data.



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FLOW MONITORING SYSTEM CALIBRATION CERTIFICATE

Company Name: Morro Bay Wastewater Treatment Facility I.W. Permit #: _____

Discharge/Calibration Address: 160 Atascadero Drive, Morro Bay, CA

Mailing Address: _____

Service Date: 12-10-19 Time: 8:45 Expires: 12-10-20 Calibration Type: Hydraulic Instrument: X

Open Channel: X Closed Pressurized Pipe: _____ Influent Pipe Size: 30" Effluent Pipe Size: 30"

Primary Measuring Device

Manufacturer: American Sigma Weir: Type & Size: _____

Flume: Parshall Palmer-Bowlus 27" Trapezoidal Cut Throat: Other

Flume Depth – Top of Flume to Top of M.H.: 11'-6" Max. Head: 21" Flow at Max Head: 7083.333

Instrument Information: Secondary Device GPS Coordinates: 35.3797, -120.8604

Manufacturer: Siemens Hydromanager 200 HMI Serial Number: PBD/FO190143

Meter Type: Bubbler Ultrasonic X Electromagnetic Area Velocity

Transducer Height: 40.125" Blanking Distance: 11.8" Recorder 100% Span 7083.333 GPM

Totalizer on Arrival 13419140 Totalizer on Departure 13420434 Totalizer Multiplier x100

Sampling Signal Contact Closure Frequency: 1 Closure per n/a Gallons Discharged _____

Flow Rate and Level On Arrival: 724 GPM @ 6.1" Flow Rate and Level On Departure: 1079 GPM @ 7.6"

CALIBRATING SYSTEM		EXISTING METER			ERROR		
Head in Inches	GPM	Instrument Head in Inches	Flow Rate GPM Indicator Recorder		Total Discharge Gallons	Recorder (Level)	Totalizer (Flow)
0	0	0	0		0	0	0
3.00"	209.4	2.9"	209			3.39%	0.19%
6.50"	780	6.4"	786	787		1.55%	0.77%
9.0"	1371	9.0"	1415	1418		0.00%	3.37%
15.6"	3926	15.6"	3958	3969		0.00%	0.81%

Method of Calibration: Manhole was entered to measure the distance to the bottom of the flume to the transducer face. At this time we manually measured the level of flow and compared it to the meter reading. We measured 5.75" the meter was reading 5.73". The transducer was then removed and brought to surface where it was placed on an ultrasonic calibration stand and stepped through various levels to simulate flow. The above chart shows the results of this test.

Corrective Measures: A slight layer of sand and gravel are in the influent side of the flume and should be removed. This meter is in very good operating conditions.

Signature: Jim McCrory