Bay Area Clean Water Agencies
Nutrient Reduction Study

Group Annual Report

Nutrient Watershed Permit Annual Report

2022

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Appendices

Appendix A. Discharge Evaluation for Individual Dischargers

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1 Introduction

On May 8, 2019, the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) adopted the Nutrient Watershed Permit, also known as National Pollutant Discharge Elimination System (NPDES) Permit No. CA0038873, Regional Water Board Order No. R2-2019-0017. This permit replaces the previous permit under Order No. R2-2014-0014, which expired on June 30, 2019. The updated Nutrient Watershed Permit became effective on July 1, 2019, and it covers each municipal Publicly Owned Treatment Works (POTW) that discharges to the San Francisco Bay and its tributaries. The purpose of this Nutrient Watershed Permit is to track and evaluate treatment plant performance, fund nutrient research and monitoring programs, support load response modeling, and evaluate nutrient reduction potential of recycled water and natural systems.

One of the requirements of the Nutrient Watershed Permit is the reporting and analysis of influent and effluent nutrient monitoring data, and concentration and loading trends. Each agency's nutrient loads must also be compared to total POTW loads in their respective Subembayment, as defined in the permit. An annual report is required to provide an ongoing record of these data and analyses.

The purpose of this Group Annual Report is to fulfill the reporting and analysis requirement of the Nutrient Watershed Permit for the participating agencies for the period between Oct 1, 2012 and Sept 30, 2022. This report is focused on the addition of the most recent dataset from Oct 1, 2021 through Sept 30, 2022. This report includes the following sections:

- **Section 2 – Background.** This section includes relevant background information on the requirements of the Nutrient Watershed Permit.
- **Section 3 – Approach.** This section presents the approach to obtain data, the constituents of interest, data confirmation, seasonality analysis, and statistical trending.
- **Section 4 – Influent Data Review Findings.** This section presents the influent data for each discharger as well as the annual and dry season averages for the Influent Flow, Total Ammonia, Nitrite plus Nitrate, Total Inorganic Nitrogen, Total Kjeldahl Nitrogen, Total Nitrogen, and Total Phosphorus. In addition, the contributing flows and loads for each discharger are presented in comparison to the other dischargers in its respective Subembayment.
- **Section 5 – Discharge Data Review Findings.** This section presents the discharge data for each discharger as well as the annual and seasonal averages for the Discharge Flow, Total Ammonia, Nitrite plus Nitrate, Total Inorganic Nitrogen, and Total Phosphorus. In addition, the contributing flows and loads for each discharger are presented in comparison to the other dischargers in its respective Subembayment.
- **Section 6 – Recycled Water Data Review Findings.** This section presents the recycled water flows and loads for each discharger as well as the annual and dry season averages. The flows are listed as million gallons per day (mgd). Furthermore, the nutrient load reductions associated with recycled water volumes are included for Total Ammonia, Nitrite plus Nitrate, Total Inorganic Nitrogen, and Total Phosphorus. While reporting recycled water is not a permit requirement per se, quantifying such information will advance the understanding of volumes and potentially nutrient loads diverted from the Bay.

- **Section 7 – Discussion.** This section includes a discussion of the data presented in Sections 4, 5, and 6.
- **Section 8 – Summary.** This section provides a brief summary of the findings, discussion, and recommendations that will improve the data collection and analysis in future years.
- **Appendix.** A separate section is provided in the appendix to present the data and analysis for each of the 34 POTW dischargers to the Bay.

2 Background

The Nutrient Watershed Permit applies to the municipal wastewater dischargers and specific facilities identified in Table 2-1. In addition, the location of each discharger is shown in Figure 2-1.

Table 2-1. Municipal Wastewater Dischargers Included in the Nutrient Watershed Permit

Discharger Name (Abbreviation)	POTW Facility Name	Minor / Major[(a)]
American Canyon, City of (American Canyon)	Wastewater Treatment and Reclamation Facility	Major
Benicia, City of (Benicia)	Benicia Wastewater Treatment Plant	Major
Burlingame, City of (Burlingame)	Burlingame Wastewater Treatment Plant	Major
Central Contra Costa Sanitary District (CCCSD)	Central Contra Costa Sanitary District Wastewater Treatment Plant	Major
Central Marin Sanitation Agency (CMSA)	Central Marin Sanitation Agency Wastewater Treatment Plant	Major
Crockett Community Services District (Port Costa)	Port Costa Wastewater Treatment Plant	Minor
Delta Diablo (Delta Diablo)	Wastewater Treatment Plant	Major
East Bay Dischargers Authority (EBDA): Cities of Hayward and San Leandro; Oro Loma Sanitary District; Castro Valley Sanitary District; Union Sanitary District; East Bay Regional Parks District; Livermore-Amador Valley Water Management Agency; Dublin San Ramon Services District; and City of Livermore	EBDA Common Outfall	Major
	Hayward Water Pollution Control Facility	
	San Leandro Water Pollution Control Plant	
	Oro Loma/Castro Valley Sanitary Districts Water Pollution Control Plant	
	Raymond A. Boege Alvarado Wastewater Treatment Plant	
	Hayward Marsh	
	Livermore-Amador Valley Water Management Agency Export and Storage Facilities	
	Dublin San Ramon Services District Wastewater Treatment Plant	
	City of Livermore Water Reclamation Plant	
East Bay Municipal Utility District (EBMUD)	East Bay Municipal Utility District, Special District No. 1 Wastewater Treatment Plant	Major
Fairfield-Suisun Sewer District (FSSD)	Fairfield-Suisun Wastewater Treatment Plant	Major
Las Gallinas Valley Sanitary District (Las Gallinas)	Las Gallinas Valley Sanitary District Sewage Treatment Plant	Major
Marin County (Paradise Cove), Sanitary District No. 5 of	Paradise Cove Treatment Plant	Minor
Marin County (Tiburon), Sanitary District No. 5 of	Wastewater Treatment Plant	Minor
Millbrae, City of (Millbrae)	Water Pollution Control Plant	Major
Mt. View Sanitary District (Mt View)	Mt View Sanitary District Wastewater Treatment Plant	Major
Napa Sanitation District (Napa)	Soscol Water Recycling Facility	Major
Novato Sanitary District (Novato)	Novato Sanitary District Wastewater Treatment Plant	Major
Palo Alto, City of (Palo Alto)	Palo Alto Regional Water Quality Control Plant	Major

Discharger Name (Abbreviation)	POTW Facility Name	Minor / Major[(a)]
Petaluma, City of (Petaluma)	Municipal Wastewater Treatment Plant	Major
Pinole, City of (Pinole)	Pinole-Hercules Water Pollution Control Plant	Major
Rodeo Sanitary District (Rodeo)	Rodeo Sanitary District Water Pollution Control Facility	Major
San Francisco (San Francisco International Airport), City and County of (SFO Airport)	Mel Leong Treatment Plant, Sanitary Plant	Major
San Francisco (Southeast Plant), City and County of (SFPUC Southeast)	Southeast Water Pollution Control Plant	Major
San Jose/Santa Clara Water Pollution Control Plant and Cities of San Jose and Santa Clara (San Jose)	San Jose/Santa Clara Water Pollution Control Plant	Major
San Mateo, City of (San Mateo)	City of San Mateo Wastewater Treatment Plant	Major
Sausalito-Marin City Sanitary District (SMCSD)	Sausalito-Marin City Sanitary District Wastewater Treatment Plant	Major
Sewerage Agency of Southern Marin (SASM)	Sewerage Agency of Southern Marin Wastewater Treatment Plant	Major
Silicon Valley Clean Water (SVCW)	Silicon Valley Clean Water Wastewater Treatment Plant	Major
Sonoma Valley County Sanitary District (Sonoma Valley)	Municipal Wastewater Treatment Plant	Major
South San Francisco and San Bruno, Cities of (South SF)	South San Francisco and San Bruno Water Quality Control Plant	Major
Sunnyvale, City of (Sunnyvale)	Sunnyvale Water Pollution Control Plant	Major
U.S. Department of Navy (Treasure Island)	Treasure Island Wastewater Treatment Plant	Major
Vallejo Flood and Wastewater District (Vallejo)	Vallejo Wastewater Treatment Plant	Major
West County Agency (West County) (West County Wastewater District and City of Richmond Municipal Sewer District)	West County Agency Combined Outfall	Major
	West County Wastewater District Treatment Plant	
	Richmond Municipal Sewer District Water Pollution Control Plant	

(a) As defined in the Nutrient Watershed Permit (Minor dischargers have a permitted average dry weather flow (ADWF) capacity <1 mgd; Major dischargers have a permitted ADWF capacity ≥1 mgd).

The Nutrient Watershed Permit has specific influent and effluent monitoring requirements. Each agency covered by the Permit is required to monitor and report the following constituents in their effluent:

1. Flow
2. Ammonia as Nitrogen
3. Nitrate/Nitrite as Nitrogen
4. Total Inorganic Nitrogen as Nitrogen (Calculated Value)
5. Total Phosphorus

Each agency with a facility design flow of more than 10 million gallons per day (mgd) is required to monitor and report the following constituents in their influent:

1. Flow
2. Ammonia as Nitrogen
3. Nitrate/Nitrite as Nitrogen
4. Total Inorganic Nitrogen
5. Total Kjeldahl Nitrogen
6. Total Nitrogen
7. Total Phosphorus

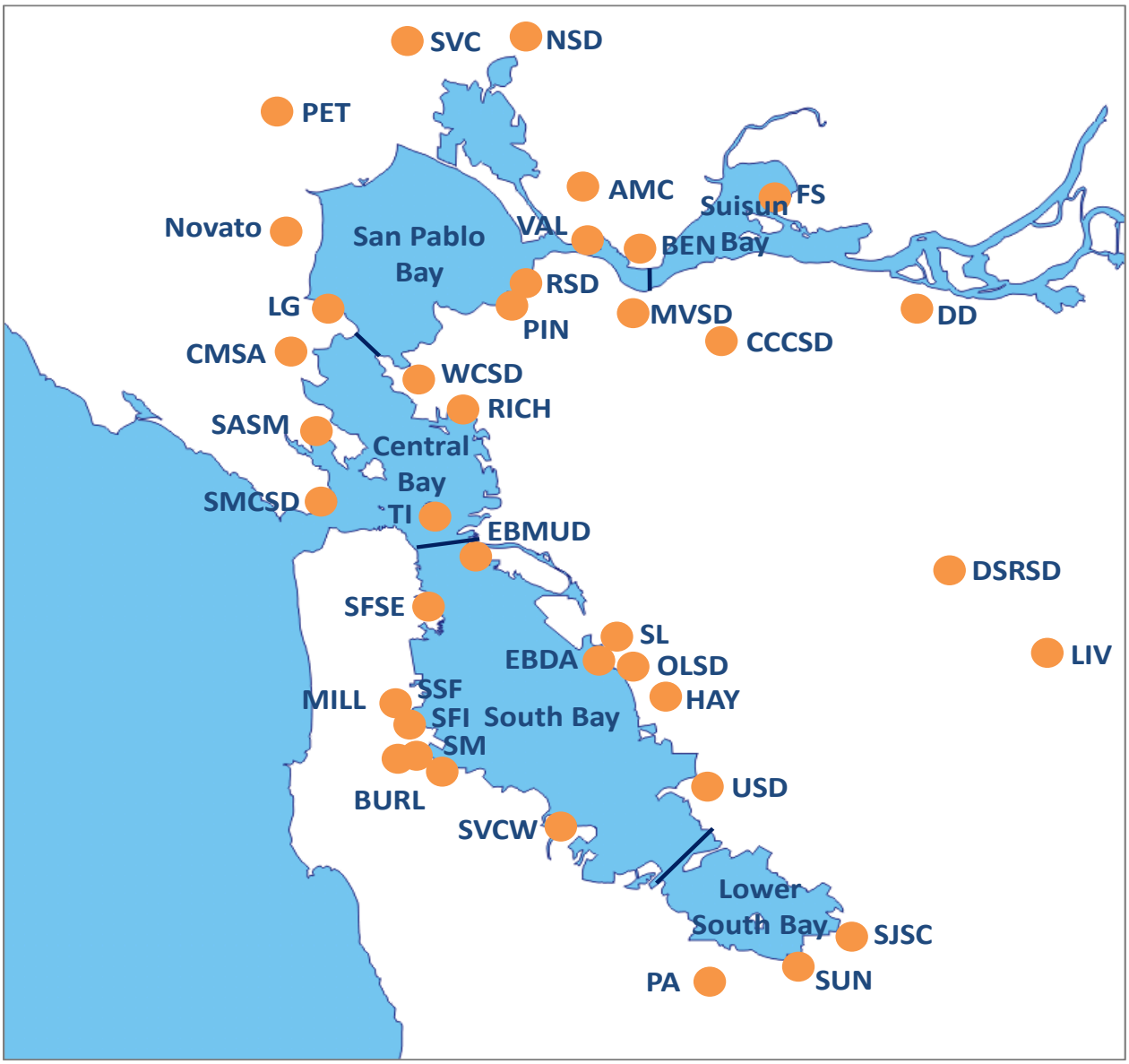

Figure 2-1. Location of Dischargers

Note: All Five Subembayments are shown with delineation by the dark blue solid line

Major municipal dischargers having a permitted or design flow greater than 10 mgd are required to sample effluent twice per month, and influent once per quarter. Major municipal dischargers having a flow greater than or equal to 1 mgd but less than or equal to 10 mgd are required to sample effluent once per month. Minor municipal discharges, defined as those with a flow less than 1 mgd, are required to monitor effluent twice per year. In addition, dischargers are required to sample only during the months of the year when they are discharging. The data collected must be submitted monthly on the Regional Water Board's California Integrated Water Quality System (CIWQS) online data reporting tool.

Prior to the sampling required under the Nutrient Watershed Permit, the dischargers were required to perform similar sampling and data collection. This early data collection was required under the Regional Water Board's Section 13267 Letter Data, dated March 2, 2012.[1]

Together, the Nutrient Watershed Permit data and the Section 13267 Letter Data, form the dataset for the analysis and reporting in this Group Annual Report. Additional information regarding the data sources and data confirmation is included in Section 3.

Per Attachment E, Section IV.B.1.b., of the Nutrient Watershed Permit, the Group Annual Report must include the following:

ii. Summary tables depicting the Discharger's annual and monthly flows, nutrient concentrations, and nutrient mass loads, calculated as described in Attachment G section VIII.A (Arithmetic Calculations) of individual NPDES permits. The summary tables shall cover October 1 before the preceding year through September 30 of the preceding year and at least the previous five years of available data. Each Discharger shall document its nutrient loads relative to other facilities covered by this Order that discharge into the same Subembayment (i.e., Suisun Bay, San Pablo Bay, Central Bay, South Bay, and Lower South Bay). These Subembayment delineations may be refined through Provision VI.C.4 of the Order, in which case each Discharger shall document loads relative to the most recent delineation. Nutrient data from other Dischargers may be obtained from the State Water Board's California Integrated Water Quality System (CIWQS) website (https://www.waterboards.ca.gov/ciwqs/index.html).

iii. Analysis of nutrient trends and load variability, and assessment as to whether nutrient mass discharges are increasing or decreasing.

iv. Status and plans for investigation if the trend analysis shows a significant change in nutrient loading. In such cases, the Discharger shall investigate the cause. In the annual reports, the Discharger shall set forth its plans for investigation and report its results, providing necessary updates in subsequent annual reports. The investigation shall include, at a minimum, whether treatment process changes, increasing or decreasing water reclamation, or changes in total influent flow related to water conservation, population growth, transient work community, new industry, or wet weather flows have reduced or increased nutrient discharges.

[1] Wolfe, Bruce. (2012) Letter: Water Code Section 13267 Technical Report Order Requiring Submittal of Information on Nutrients in Wastewater Discharges. March 2, 2012. https://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2019/R2-2019-0017.pdf

3 Approach

The sources of data, as well as the approach for data confirmation, analysis of seasonality, and statistical trending are presented in the subsections herein.

3.1 Data Sources

Data from Oct 2012 to Sept 2022 were compiled from two different sources: the Section 13267 Letter Data requirements and the subsequent Nutrient Watershed Permits. The Section 13267 Letter Data include the initial two years (Oct 2012 through June 2014) and the Nutrient Watershed Permits data include the subsequent years (July 2014 through Sept 2022). The sampling requirements and frequency differ between the two datasets. The Nutrient Watershed Permit data collection requirements were updated as of July 1, 2019 per the second Nutrient Watershed Permit. The updated NPDES permit (R2-2019-0017) included the following significant changes:

1) The yearly reporting period has been changed from Jul-Jun to Oct-Sep. This was implemented to more accurately reflect the seasonal changes from year to year (see Section 3.4 for discussion on Seasonality). As a result, the initial few months of the Section 13267 Letter Data (July 2012 through September 2013) were excluded from further analysis.
2) Soluble Reactive Phosphorus (Ortho-P) and TKN effluent data are no longer required.
3) Total Inorganic Nitrogen (TIN) will be calculated as the basis for effluent nitrogen concentration, as opposed to Total Nitrogen (TN).
4) Quarterly influent nutrient reporting is required for dischargers with a permitted or design flow of greater than 10 million gallons per day (n = 15 POTW dischargers out of 34 POTWs).

A comparison for the sampling requirements for each dataset is summarized in Table 3-1.

Table 3-1. Comparison of Sampling Requirements for the Section 13267 Letter Data and Nutrient Watershed Permits

Parameter	Section 13267 Letter Data	Nutrient Watershed Permit Data (2014; R2-2014-0014)	Nutrient Watershed Permit Data (2019; R2-2019-0017))
Major Dischargers and Sampling Frequency	1) Flows ≥5 mgd permitted capacity a. Year-round dischargers: Sample twice per month and two additional samples each wet season during peak wet weather flow conditions b. Seasonal dischargers: Sample twice per month during discharge (wet) season; sample once during non-discharge (dry) season 2) Flows between 1 and 5 mgd permitted capacity	1) Flows >10 mgd permitted capacity must sample effluent twice per month 2) Flows between 1 and 10 mgd permitted capacity must sample effluent once per month	1) Flows >10 mgd permitted capacity must sample effluent twice per month, and influent once per quarter. 2) Flows between 1 and 10 mgd permitted capacity must sample effluent once per month.

Parameter	Section 13267 Letter Data	Nutrient Watershed Permit Data (2014; R2-2014-0014)	Nutrient Watershed Permit Data (2019; R2-2019-0017))
	a. Year-round dischargers: Sample twice per month and two additional samples each wet season during peak wet weather flow conditions b. Seasonal dischargers: Sample twice per month during discharge (wet) season; sample once during non-discharge (dry) season		
Minor Dischargers and Sampling Frequency	1) Flows <1 mgd permitted capacity a. Year-round dischargers: Sample once per month b. Seasonal dischargers: Sample once per month during discharge (wet) season; sample once during non-discharge (dry) season	1) Flows <1 mgd permitted capacity must sample twice per year	1) Flows <1 mgd permitted capacity must sample twice per year
Non-Nutrient Sampling Parameters	Flow pH Temperature	Flow	Flow
Nitrogen Species and Sample Type	1) Total Ammonia (NH3 plus NH4+, reported as N) – Composite Sample 2) Total Dissolved Nitrogen (TDN, reported as N) – Composite Sample 3) Total Kjeldahl Nitrogen (TKN, reported as N) – Composite Sample 4) Soluble Kjeldahl Nitrogen (SKN, reported as N) – Composite Sample 5) Nitrate (NO3-, reported as N) – Composite Sample 6) Nitrite (NO2-, reported as N) – Composite Sample 7) Urea (limited to 5 largest dischargers, reported as N) – Composite Sample	1) Total Ammonia (NH3 plus NH4+, reported as N) – Composite Sample 2) Total Kjeldahl Nitrogen (TKN) – Composite Sample 3) Nitrate (NO3-) plus Nitrite (NO2-) (NOx, reported as N) – Composite Sample 4) Total Nitrogen (TN, calculated) – Composite Sample	Influent and Effluent: 1) Total Ammonia (NH3 plus NH4+, reported as N) – Composite Sample 2) Nitrate (NO3-) plus Nitrite (NO2-) (NOx, reported as N) – Composite Sample Influent Only: 1) Total Kjeldahl Nitrogen (TKN) – Composite Sample Effluent Only: 1) Total Inorganic Nitrogen (TIN) – Calculated, Total Ammonia + Nitrate and Nitrite

Parameter	Section 13267 Letter Data	Nutrient Watershed Permit Data (2014; R2-2014-0014)	Nutrient Watershed Permit Data (2019; R2-2019-0017))
Phosphorus Species and Sample Type	1) Total Phosphorus (TP) – Composite Sample 2) Soluble Total Phosphorus (STP; reported as P) – Composite Sample 3) Dissolved Orthophosphate (reported as P) – Composite or Grab Sample 4) Total Orthophosphate (reported as P) – Composite Sample	1) Soluble Reactive Phosphorus (SRP, reported as P) – Grab Sample 2) Total Phosphorus (TP) – Composite Sample	1) Total Phosphorus (TP) – Composite Sample
Recycled Water Volumes	Not required	Not required	Not required. Included in the Group Annual Report for Year 2022 and beyond.

3.2 Measurement Methodologies

A list of the measurement methodologies is presented in Table 3-2.

Table 3-2. List of Parameters, Methodology, and Sample Type

Parameter	Location	Measured or Calculated	Sample Type	Method [a,b]	Calculation
Flow	Influent, Effluent, and Recycled Water	Both (plant specific)	Continuous	--	--
Total Ammonia	Influent/Effluent	Measured[c]	24-hr Composite	4500-NH3 EPA 350.1	--
TKN	Influent Only	Both (plant-specific) [c]	24-hr Composite	4500-N(org)	--
NOx	Influent/Effluent	Measured[c]	24-hr Composite	4500-N	--
TIN	Effluent Only	Calculated[c]	24-hr Composite	Calculated	$TIN = Ammonia + NOx$
TN	Influent Only	Calculated[c]	24-hr Composite	Calculated	$TN = TKN + NOx$
TP	Influent/Effluent	Measured[c]	24-hr Composite	4500-P	--

a. Standard Methods for the Examination of Water and Wastewater 2017-23rd Edition, American Public Health Association/American Water Works Association/Water Environment Federation, Washington, D.C.
b. Dischargers may propose other U.S. EPA-approved analytical methods, if available, with detection limits low enough to quantify concentrations in wastewater.
c. For plants with only flow and concentration values available, loads were manually calculated for daily values and/or using average monthly flow and concentration values.

3.3 Data Confirmation

Once the data from each discharger were collected and compiled, the data were summarized and provided to each participating discharger for review and confirmation. The data presented in this Group Annual Report reflect additions and corrections provided by the participating agencies.

3.4 Seasonality

The seasonal variations in the data were examined by dividing the data into a dry and wet season. Understanding seasonality is critical for the analysis of nutrient discharges because of the following factors:

- The dry season is reflective of the base sanitary flows and loads from residential population and industrial contributions to wastewater. In contrast, the increased flows during wet weather events are attributed to inflow and infiltration (I&I) during such events, which can bias the discharge results.
- Wastewater treatment facilities are typically better suited to remove nutrient loads (if deemed necessary) during the warmer, dry season when the biological treatment kinetics are more favorable and there are fewer (if any) peak flow events.
- The Nutrient Management Strategy led by the San Francisco Estuary Institute (SFEI) is currently underway to evaluate San Francisco Bay's resilience to nutrients. It is expected to be less sensitive to nutrients during the wet season because the water is cooler, light irradiance in the Bay is reduced, turbidity in the Bay is elevated, and the hydraulic residence time in the Bay is reduced.

Seasonality is defined in the participating agencies' NPDES permits in different ways; furthermore, not all the permits have a seasonal definition. To provide a consistent basis for the purposes of this Group Annual Report, the seasonal definition presented in Table F-5 of the Nutrient Watershed Permit (R2-2019-0017; CA0038873) was used. The wet and dry seasons are defined as follows:

- Dry season: May 1 through September 30
- Wet season: October 1 through April 30

3.5 Subembayments

The historical delineation of Subembayments by geographic locations (specifically bridges) is used throughout this report. The Subembayment delineations are not reflective of the hydraulics across the Bay. The reader should use caution while comparing the various Subembayments. Rather, the intent of including the Subembayments as listed is to better understand the overall geographic distribution of flows and loads across the Bay.

3.6 Influent Data

Influent monitoring data were included for the first time as part of the 2020 Group Annual Report. The data are limited to plants that have a permitted ADWF capacity of greater than 10 mgd (n = 15 POTW dischargers out of 34 POTW dischargers). Note: these 15 POTWs with an ADWF permitted capacity of greater than 10 mgd represents approximately 90+/- percent of the overall baywide discharge flow. The influent sampling has been required quarterly beginning in in July 2019. For instances where dischargers provided more than the minimum influent sampling data requested, that information is provided in this report.

The influent data review focuses on the flows and nutrient loads. As the dataset expands with future Group Annual Reports, the analysis will expand to consider trending analysis and reduction across the plant (if possible).

3.7 Recycled Water

Recycled water volumes are included for the second time as part of this 2022 Group Annual Report. While not a permit requirement per se, recycled water volumes are of interest in nutrient management across the Bay to identify nutrient loads diverted from Bay discharge. Data was downloaded from the State Water Board's Recycled Water website for all 34 dischargers (https://www.waterboards.ca.gov/water_issues/programs/recycled_water/volumetric_annual_reporting.html).

Recycled water monthly volumes are listed as acre-feet and mgd. The volumes are not broken out by various recycled water user types within the main report. The basis for only showing the total volumes is the data is limited to total volumes for monthly values. While the State Water Board site does provide a break down by recycled water user type, it is limited to volumes over an entire calendar year (not by monthly volumes). In order to better understand recycled water uses for each individual discharger, the individual plant reports in Appendix A present the various recycled water user volumes by calendar year. The various recycled water uses as defined by the State Water Resources Control Board are as follows[2]:

- Golf course: includes irrigation of golf courses, whether public or private. Water used to maintain aesthetic impoundments within golf courses is also included with golf course irrigation.
- Landscape irrigation: includes parks, sports fields, green belts, landscaped areas. Irrigation of parks, schools, cemeteries, churches, residential, streetscapes, slope protection, or public facilities. Golf course irrigation is not included. Water to maintain aesthetic impoundments within landscaped areas is included with landscape irrigation. Fill stations primarily used for public use should be classified as landscape irrigation.
- Commercial: includes dual-plumbed projects, fire protection, other uses at commercial facilities not included in other categories. Includes uses by commercial water users, except landscape irrigation. A commercial water user is a water user that provides or distributes a product or service. Examples of commercial water uses are commercial building use (toilets, HVAC, etc.), car washes, laundries, and retail nurseries. Landscape irrigation of commercial building areas is to be classified as landscape irrigation if it is separately metered or if landscape is the dominant use of mixed uses served by a single meter. Fill stations, if they are primarily used for commercial use, should be classified as commercial use.
- Industrial: includes cooling towers and process water (including process water at wastewater treatment plants). Includes uses by industrial water users, except landscape irrigation and geothermal energy production. An industrial user is a water user that is primarily a manufacturer or processor of materials. Examples of industrial water uses are cooling towers, oil refining, process water, and mining. Landscape irrigation of industrial building

[2] State Water Resources Control Board. (2020) *Volumetric Annual Report of Wastewater and Recycled Water: Help Guide for Volumetric Annual Report in GeoTracker.* February 8, 2021. https://www.waterboards.ca.gov/water_issues/programs/recycled_water/docs/2020/var_helpguide.pdf

areas is to be classified as landscape irrigation if it is separately metered or if landscape is the dominant use of mixed uses served by a single meter.

- Agricultural: includes irrigation, frost protection, agricultural reservoir augmentation. Irrigation of food, fiber, and fodder crops, and pastureland. This also includes Christmas tree production, pasture for farm animals, and wholesale plant nurseries.
- Potable Reuse: represents groundwater recharge, surface water augmentation, or direct potable reuse.
- Other: represents any not listed

The total volumes for each month and overall are calculated.

3.8 Trend Analysis

The Nutrient Watershed Permit requires trending analysis with each report for both influent and effluent. Trending analysis was not performed on influent data in the past as the data was limited. This year's Group Annual Report includes trending analysis similar to the approach used for discharge. Details on the approach at the end of this subsection. Influent trending analysis includes quarterly data from July 2019 through September 2022 (13 quarters over 39 months). Note: the influent sampling is limited to POTWs with a permitted capacity of greater than 10 mgd.

The discharge data were evaluated to identify evidence of trends over the past ten years. Due to the change in sampling frequency between the Section 13267 Letter Data and both Watershed Permit requirements, there is an inconsistency in the reporting of flows and loads during the wet season. Specifically, the Section 13267 Letter Data required that in addition to normal monthly sampling, two additional samples be taken in the wet season during peak wet weather events. This requirement is not included in either Watershed Permits. As a result, an artificial bias has been introduced that was expected to overestimate the wet season load. A sensitivity analysis was performed several years back for each Subembayment to confirm this bias. Based on that analysis, it was confirmed that the peak wet weather events do impact the trend analysis because the dataset is not large enough to offset such a load. For example, there are a few instances (e.g., Lower South Bay ammonia loading) with the Section 13267 Letter Data that are several times greater than the annual average values and can skew the trending analysis. As a result, the trend analysis was limited to the dry season, which best represents the actual base sanitary wastewater flows and loads for each plant.

The approach used to evaluate trend significance was the slope of a regression line. The slope was determined using the method of least squares.[3] The sample set size varies for influent versus discharge (n = 13 for 3.25 years of influent sampling; n = 50 for the ten years of discharge data). An alpha of 0.05 was assumed which denotes that a 5 percent risk of concluding that a difference exists when there is no actual difference. A trend was denoted significant if the p-value was less than alpha. Furthermore, the percent change with respect to average value was included to serve as a reference or baseline for the extent of change over time.

[3] Montgomery, D.C.; Peck, E.A.; Vining, G.G. (2012) Introduction to Linear Regression Analysis. Published by John Wiley and Sons, Inc. Hoboken, NJ. Pages 12-66.

4 Influent Data Review Findings

This section presents a data discussion for the following Influent parameters:

1. Influent Flow (reported as mgd)
2. Total Ammonia (reported as kg N/d)
3. Nitrate plus Nitrite (NOx, reported as kg N/d)
4. Total Inorganic Nitrogen (TIN, reported as kg N/d)
5. Total Kjeldahl Nitrogen (TKN; reported as kg N/d)
6. Total Nitrogen (TN, reported as kg N/d)
7. Total Phosphorus (TP, reported as kg P/d)

The subsections that follow present data for each parameter as a historical plot for each Subembayment and the Bay, as well in a tabular format by POTW and for each of the five Subembayments. The data are presented for both the annual average (October 1 through September 30 of the following year) and dry season average (May 1 through September 30 of the same year).

There are several limitations for the overall influent dataset as follows:

- Small size of dataset (quarterly sampling began in July 2019; n = 13). Furthermore, the global pandemic impacts more than half of the sampling quarters.
- The data is limited to dischargers with a permitted ADWF capacity of greater than 10 mgd (15 out of a possible 34 dischargers; the permitted capacity for such dischargers represents 92 percent of the Bay discharge permitted capacity).
- Quarterly sampling was not conducted by all POTWs in the same month. To reconcile such time variance, a quarterly average was assumed while plotting loads (e.g., refer to Figure 4-2).
- There are a few instances where sampling for a particular nutrient did not occur (e.g., Palo Alto did not sample ammonia during the first quarter of sampling from July through September 2019). While the issue has improved, it has not been resolved entirely (e.g., Napa Sanitation District does not always sample influent during the dry season as they are not allowed to discharge during the dry season).
- Analytical issues with the influent sampling matrix. Specifically, the discharge matrix is relatively cleaner compared to raw influent and is subsequently less prone to analytical issues. There are a couple instances in particular for the 2020/2021 dataset where ammonia values were greater than TKN for the same sample. This indicates an analytical and/or sampling issue, since TKN is the sum of ammonia and organic nitrogen. Such analytical issues can skew the trending.

A discussion of the results is provided in Section 7.4.

4.1 Flow

The historical average monthly influent flows from July 2019 through September 2022 are presented in Figure 4-1. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) influent flows were calculated based on reported flows in Table 4-1 and Table 4-2, respectively. In addition, the annual average and dry season average monthly influent flows for each Subembayment are provided in Table 4-3 and Table 4-4, respectively.

A summary of the influent data review findings is as follows **(new findings for 2021/2022 in bold)**:

- The 2018/2019 dataset is limited to July 2019 through September 2019. As a result, annual average values were excluded for 2018/2019.
- All the dischargers were able to provide average monthly data for each month evaluated (July 2019 through September 2022; see Table 4-1 and Table 4-2).
- The impact on flows from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- The influent average monthly flows are the largest during the wet season (October 1 through April 30 of the following year; refer to Figure 4-1). This was anticipated as flows tend to increase during wet weather events. Given the relatively dry conditions since July 2019, the increase in flows during such wet weather events is not as pronounced as treatment plants have seen during wetter years (discussion provided in Section 7.2). **The relatively large wet weather events in October 2021 and December 2021 resulted in relatively large increases in average monthly flows (in particular December 2021). Despite such increases in flows, the average monthly flows returned to drought levels from January 2022 and onwards.**
- **Average Annual Flows: the average annual flows increased compared to the 2020/2021 dataset. The largest POTW (San Jose; Lower South Bay Discharger) had a nearly 10 percent reduction in influent flow (approximately 8 mgd reduction). Other large POTWs (EBMUD, SFPUC Southeast, and Central San) all had a three to four mgd increase in average annual flows. Most other POTWs had a nominal one to two mgd increase in average annual flows.**
- **Dry Season Flows: the 2021/2022 dry season average flows were the lowest since sampling began in July 2019. Of the large POTWs, San Jose (Lower South Bay Discharger) and EBDA (South Bay Discharger) had the most pronounced reduction in influent flow at three and five mgd, respectively. Several other POTWs had a nominal one to two mgd decrease in dry season average flows.**
- **Dry Season Trending: the dataset resulted in no dry season emerging trends. Note: the dataset is still limiting.**
- The South Bay and Lower South Bay together account for over half of the influent flows, regardless of season (see Table 4-3 and Table 4-4).

A discussion of the results is provided in Section 7.4.

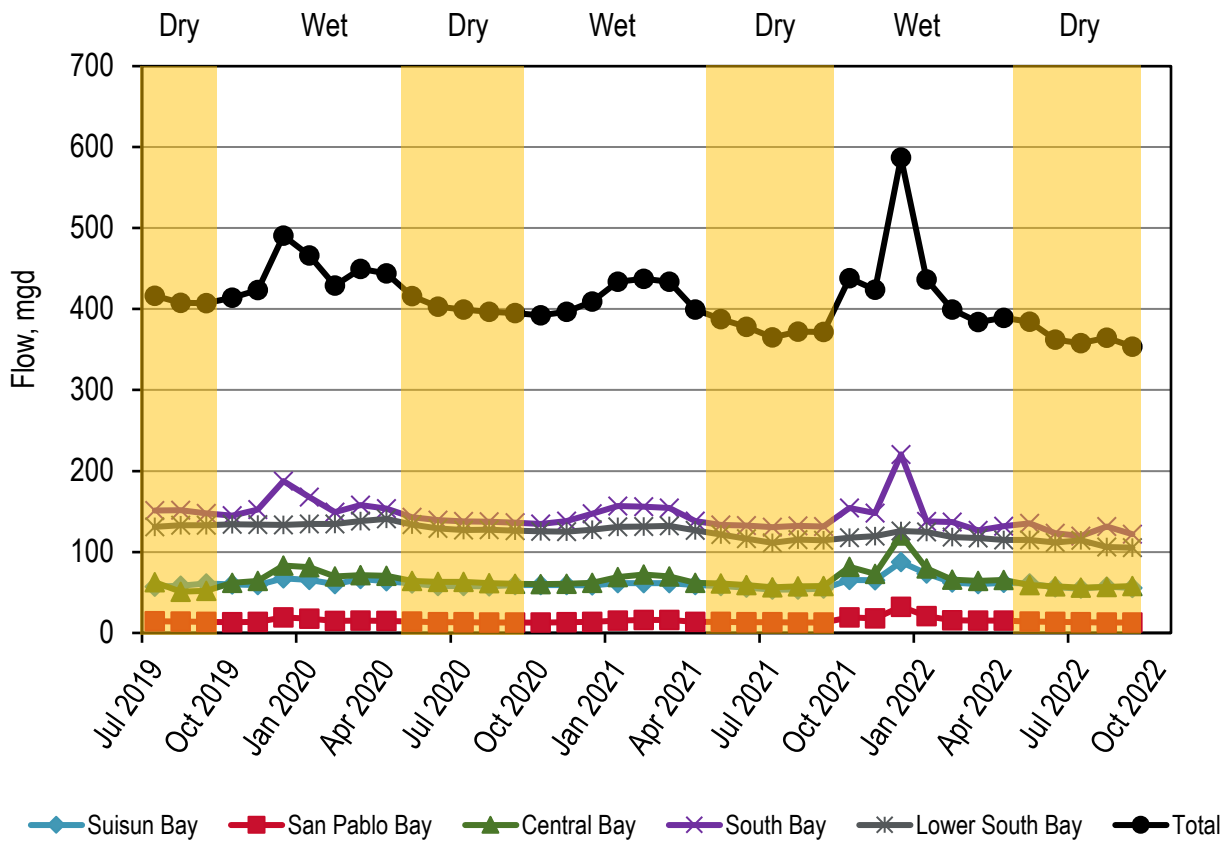

Figure 4-1. Influent: Historical Average Monthly Flow Values

Table 4-1. Influent: Annual Average Flows to each Plant (mgd)*

Discharger	Subembayment	Permitted Capacity [a]	2018/2019 [a], [b]	2019/2020 [b]	2020/2021 [b]	2021/2022 [b]
American Canyon	San Pablo Bay	2.5	*	--	--	--
Benicia	San Pablo Bay	4.5	*	--	--	--
Burlingame	South Bay	5.5	*	--	--	--
CCCSD	Suisun Bay	53.8	*	36.1	32.9	35.4
CMSA	Central Bay	10	*	--	--	--
Port Costa	San Pablo Bay	0.033	*	--	--	--
Delta Diablo	Suisun Bay	19.5	*	12.7	13.2	14.1
EBDA	South Bay	107.8	*	65.5	64.1	64.2
EBMUD	Central Bay	120	*	53.8	49.4	54.9
FSSD	Suisun Bay	23.7	*	12.6	11.9	13.9
Las Gallinas[c]	San Pablo Bay	2.92	*	--	--	--
Paradise Cove	Central Bay	0.04	*	--	--	--
Tiburon	Central Bay	0.98	*	--	--	--
Millbrae	South Bay	3	*	--	--	--
Mt. View	Suisun Bay	3.2	*	--	--	--
Napa[c]	San Pablo Bay	15.4	*	6.27	6.04	7.44
Novato	San Pablo Bay	7	*	--	--	--
Palo Alto	Lower South Bay	39	*	17.6	16.6	16.9
Petaluma[c]	San Pablo Bay	6.7	*	--	--	--
Pinole	San Pablo Bay	4.06	*	--	--	--
Rodeo	San Pablo Bay	1.14	*	--	--	--
SFO Airport	South Bay	2.2	*	--	--	--
SFPUC Southeast	South Bay	85.4	*	54.3	48.1	52.6
San Jose	Lower South Bay	167	*	102	94.3	86.7
San Mateo	South Bay	15.7	*	10.6	9.55	10.4
SMCSD	Central Bay	1.8	*	--	--	--
SASM	Central Bay	3.6	*	--	--	--
SVCW	South Bay	29	*	12.8	12.0	13.8
Sonoma Valley[c]	San Pablo Bay	3	*	--	--	--
South SF	South Bay	13	*	7.35	6.71	7.66
Sunnyvale	Lower South Bay	29.5	*	12.9	12.4	12.3
Treasure Island	Central Bay	2	*	--	--	--
Vallejo	San Pablo Bay	15.5	*	8.29	7.85	9.55
West County	Central Bay	28.5	*	14.1	12.9	12.9
Total [d]		**827**	*** [e]**	**427**	**398**	**413**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-2. Influent: Dry Season Average Flows to each Plant (mgd)*

Discharger	Subembayment	Permitted Capacity [a]	2019 [a], [b], *	2020 [a], [b]	2021 [a], [b]	2022 [a], [b]
American Canyon	San Pablo Bay	120	50.9	49.6	46.6	45.7
Benicia	San Pablo Bay	23.7	11.4	12.0	11.3	12.0
Burlingame	South Bay	2.92	--	--	--	--
CCCSD	Suisun Bay	0.04	--	--	--	--
CMSA	Central Bay	0.98	--	--	--	--
Port Costa	San Pablo Bay	3	--	--	--	--
Delta Diablo	Suisun Bay	3.2	--	--	--	--
EBDA	South Bay	15.4	6.28	5.50	5.60	5.94
EBMUD	Central Bay	7	--	--	--	--
FSSD	Suisun Bay	39	18.5	16.3	16.0	16.5
Las Gallinas[c]	San Pablo Bay	6.7	--	--	--	--
Paradise Cove	Central Bay	4.06	--	--	--	--
Tiburon	Central Bay	1.14	--	--	--	--
Millbrae	South Bay	2.2	--	--	--	--
Mt. View	Suisun Bay	85.4	51.6	45.3	42.4	44.4
Napa[c]	San Pablo Bay	167	101	99.8	87.9	82.3
Novato	San Pablo Bay	15.7	9.38	9.93	9.15	9.17
Palo Alto	Lower South Bay	1.8	--	--	--	--
Petaluma[c]	San Pablo Bay	3.6	--	--	--	--
Pinole	San Pablo Bay	29	12.5	12.1	11.1	11.9
Rodeo	San Pablo Bay	3	--	--	--	--
SFO Airport	South Bay	13	7.29	6.97	6.45	7.17
SFPUC Southeast	South Bay	29.5	12.6	12.6	12.1	11.7
San Jose	Lower South Bay	2	--	--	--	--
San Mateo	South Bay	15.5	7.74	7.75	7.66	7.42
SMCSD	Central Bay	28.5	12.6	12.9	11.8	11.8
SASM	Central Bay	120	50.9	49.6	46.6	45.7
SVCW	South Bay	23.7	11.4	12.0	11.3	12.0
Sonoma Valley[c]	San Pablo Bay	2.92	--	--	--	--
South SF	South Bay	0.04	--	--	--	--
Sunnyvale	Lower South Bay	0.98	--	--	--	--
Treasure Island	Central Bay	3	--	--	--	--
Vallejo	San Pablo Bay	3.2	--	--	--	--
West County	Central Bay	15.4	6.28	5.50	5.60	5.94
Total [d]		**827**	**419**	**402**	**375**	**372**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 4-3. Influent: Annual Average Flows by Subembayment, Flow (mgd)*

Subembayment	Permitted Capacity [a]	2018/2019 [a]	2019/2020 [a]	2020/2021 [a]	2021/2022 [a]
Suisun Bay	100	*	61.4	58.0	63.4
San Pablo Bay	62.8	*	14.6	13.9	17.0
Central Bay	167	*	67.9	62.3	67.8
South Bay	262	*	151	141	149
Lower South Bay	236	*	133	123	116
Total	**827**	*****	**427**	**398**	**413**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

Table 4-4. Influent: Dry Season Average Flows by Subembayment, Flow (mgd)*

Subembayment	Permitted Capacity [a]	2019 [a],*	2020 [a]	2021 [a]	2022 [a]	Trend [b]
Suisun Bay	100	58.7	58.8	55.2	57.0	None
San Pablo Bay	62.8	14.0	13.2	13.3	13.4	None
Central Bay	167	63.6	62.6	58.4	57.5	None
South Bay	262	150	139	132	133	None
Lower South Bay	236	132	129	116	110	None
Total	827	**419**	**402**	**375**	**372**	**None**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Trend analysis based on the approach discussed in Section 3.8.

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4.2 Total Ammonia

The historical average quarterly influent ammonia loads from July 2019 through September 2022 are presented in Figure 4-2. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) influent loads were calculated based on reported flows and concentrations in Table 4-5 and Table 4-6, respectively.

A summary of the influent data review findings is as follows **(new findings for 2021/2022 in bold)**:

- The 2018/2019 dataset is limited to July 2019 through September 2019. As a result, annual average values were excluded.
- There are a few instances of missing data per plant (see Table 4-5 and Table 4-6; primarily from 2019). Despite missing data in 2019, the average annual loads from 2019/2020 and dry season loads from 2019 represent the largest loads.
- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- The impact on loads from the on-going relatively dry years is unclear at this stage (discussion provided in Section 7.2).
- **The quarterly sampling makes it challenging to infer any impacts on influent nutrient loads from the relatively large wet weather events in October 2021 and December 2021.**
- **<u>Average Annual Loads:</u> overall decrease since last year of approximately 2,600 kg N/d. The largest decline was from SFPUC Southeast (South Bay Discharger) which had a 3,000 kg N/d decrease compared to the previous year. San Jose (Lower South Bay Discharger) also had a considerable reduction at 1,500 kg N/d as they continue to optimize the plant. In contrast, EBMUD (Central Bay Discharger) average annual loads increased approximately 1,150 kg N/d. EBMUD implementing full-scale demonstration testing over 2021 which decreased the loads (EBMUD 2021/2022 loads are comparable with 2019/2020).**
- **<u>Dry Season Loads:</u> overall decrease since last year of approximately 2,000 kg N/d. Similar to average annual loads, the SFPUC Southeast (South Bay Discharger) had the largest reduction in dry season loads since last year (approximately 3,500 kg N/d decline since last year). EBMUD (Central Bay Discharger) had a nearly 1,000 kg N/d increase due to the lack of full-scale demonstration testing carried out in year 2021. South San Francisco (South Bay Discharger) had an increase of approximately 400 kg N/d increase. Besides those listed, the other treatment plants all had modest increases/decreases of up to 200 kg N/d.**
- **<u>Dry Season Trending:</u> the dataset resulted in no dry season emerging trends. Note: the dataset is still limiting (excluded year 2019 as the dataset was incomplete).**
- Similar to flow, the South Bay and Lower South Bay together account for over half of the influent ammonia loads, regardless of season (see Table 4-7 and Table 4-8).

A discussion of the results is provided in Section 7.4.

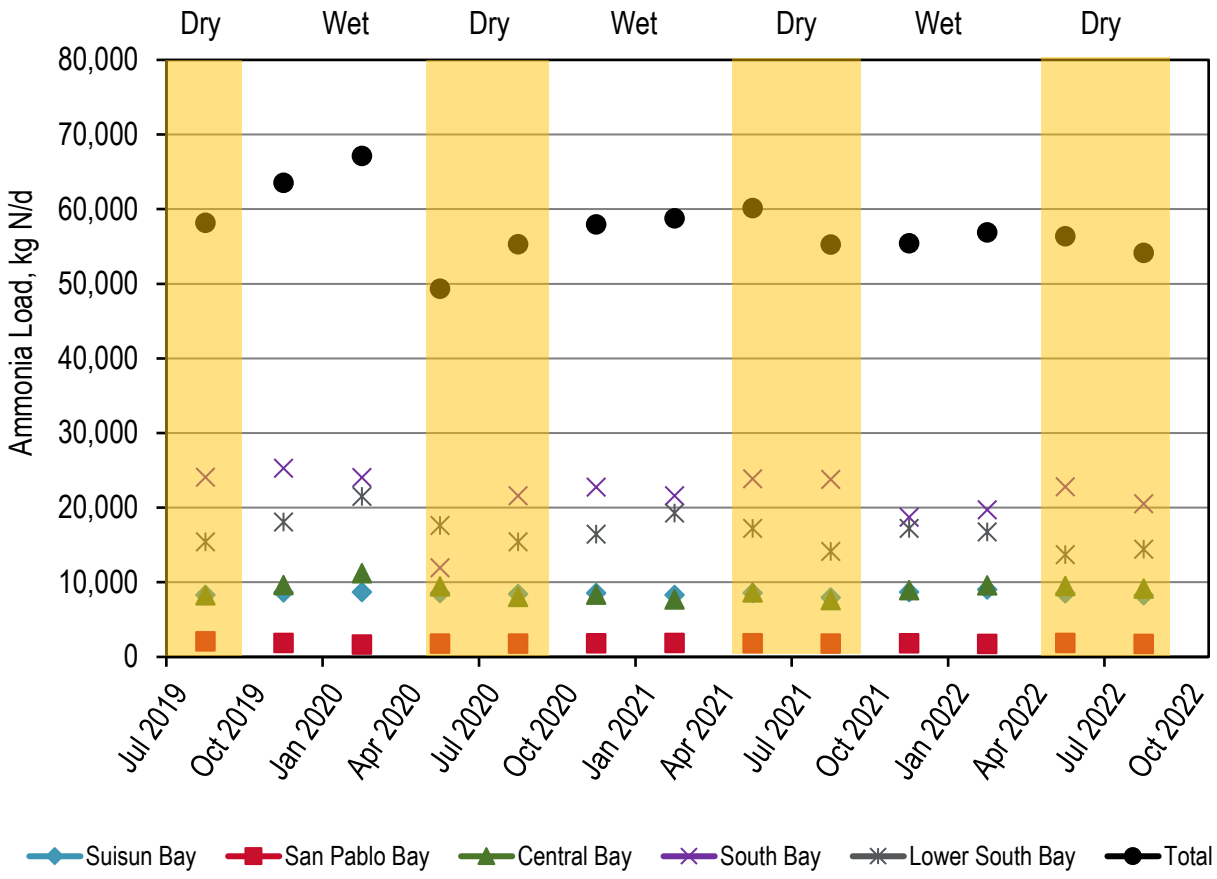

Figure 4-2. Influent: Historical Average Monthly Total Ammonia Loads

Table 4-5. Influent: Annual Average Loads to each Plant, Total Ammonia (kg N/d)

Discharger	Subembayment	Permitted Capacity [a]	2018/2019 [a], [b]	2019/2020 [b]	2020/2021 [b]	2021/2022 [b]
American Canyon	San Pablo Bay	2.5	*	--	--	--
Benicia	San Pablo Bay	4.5	*	--	--	--
Burlingame	South Bay	5.5	*	--	--	--
CCCSD	Suisun Bay	53.8	*	5,100	4,920	4,830
CMSA	Central Bay	10	*	--	--	--
Port Costa	San Pablo Bay	0.033	*	--	--	--
Delta Diablo	Suisun Bay	19.5	*	1,840	1,830	2,040
EBDA	South Bay	107.8	*	9,390	9,530	9,600
EBMUD	Central Bay	120	*	7,460	6,340	7,490
FSSD	Suisun Bay	23.7	*	1,640	1,600	1,760
Las Gallinas[c]	San Pablo Bay	2.92	*	--	--	--
Paradise Cove	Central Bay	0.04	*	--	--	--
Tiburon	Central Bay	0.98	*	--	--	--
Millbrae	South Bay	3	*	--	--	--
Mt. View	Suisun Bay	3.2	*	--	--	--
Napa[c]	San Pablo Bay	15.4	*	814	881	879
Novato	San Pablo Bay	7	*	--	--	--
Palo Alto	Lower South Bay	39	*	2,300	2,210	2,380
Petaluma[c]	San Pablo Bay	6.7	*	--	--	--
Pinole	San Pablo Bay	4.06	*	--	--	--
Rodeo	San Pablo Bay	1.14	*	--	--	--
SFO Airport	South Bay	2.2	*	--	--	--
SFPUC Southeast	South Bay	85.4	*	8,750	8,820	5,570
San Jose	Lower South Bay	167	*	14,300	13,200	11,700
San Mateo	South Bay	15.7	*	1,590	1,440	1,490
SMCSD	Central Bay	1.8	*	--	--	--
SASM	Central Bay	3.6	*	--	--	--
SVCW	South Bay	29	*	2,410	2,490	2,600
Sonoma Valley[c]	San Pablo Bay	3	*	--	--	--
South SF	South Bay	13	*	1,030	971	1,170
Sunnyvale	Lower South Bay	29.5	*	1,500	1,390	1,500
Treasure Island	Central Bay	2	*	--	--	--
Vallejo	San Pablo Bay	15.5	*	966	954	926
West County	Central Bay	28.5	*	1,850	1,760	1,760
Total [d]		**827**	*** [e]**	**60,900**	**58,300**	**55,700**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Totals not provided due to an incomplete dataset.

Table 4-6. Influent: Dry Season Average Loads to each Plant, Total Ammonia (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2019 [b], *	2020 [b]	2021 [b]	2022 [b]
American Canyon	San Pablo Bay	2.5	--	--	--	--
Benicia	San Pablo Bay	4.5	--	--	--	--
Burlingame	South Bay	5.5	--	--	--	--
CCCSD	Suisun Bay	53.8	4,810	4,980	4,700	4,790
CMSA	Central Bay	10	--	--	--	--
Port Costa	San Pablo Bay	0.033	--	--	--	--
Delta Diablo	Suisun Bay	19.5	1,820	1,910	1,830	1,880
EBDA	South Bay	107.8	6,580	8,880	9,420	9,370
EBMUD	Central Bay	120	6,530	6,760	6,410	7,540
FSSD	Suisun Bay	23.7	1,680	1,530	1,710	1,720
Las Gallinas[c]	San Pablo Bay	2.92	--	--	--	--
Paradise Cove	Central Bay	0.04	--	--	--	--
Tiburon	Central Bay	0.98	--	--	--	--
Millbrae	South Bay	3	--	--	--	--
Mt. View	Suisun Bay	3.2	--	--	--	--
Napa[c]	San Pablo Bay	15.4	1,050	799	888	897
Novato	San Pablo Bay	7	--	--	--	--
Palo Alto	Lower South Bay	39	[e]	2,110	2,240	2,470
Petaluma[c]	San Pablo Bay	6.7	--	--	--	--
Pinole	San Pablo Bay	4.06	--	--	--	--
Rodeo	San Pablo Bay	1.14	--	--	--	--
SFO Airport	South Bay	2.2	--	--	--	--
SFPUC Southeast	South Bay	85.4	10,000	8,330	9,750	6,250
San Jose	Lower South Bay	167	13,600	12,100	10,600	10,300
San Mateo	South Bay	15.7	1,440	1,430	1,390	1,320
SMCSD	Central Bay	1.8	--	--	--	--
SASM	Central Bay	3.6	--	--	--	--
SVCW	South Bay	29	2,550	2,090	2,660	2,460
Sonoma Valley[c]	San Pablo Bay	3	--	--	--	--
South SF	South Bay	13	1,020	988	909	1,310
Sunnyvale	Lower South Bay	29.5	1,820	1,180	1,340	1,530
Treasure Island	Central Bay	2	--	--	--	--
Vallejo	San Pablo Bay	15.5	1,060	988	908	883
West County	Central Bay	28.5	1,720	1,750	1,720	1,720
Total [d]		**827**	**58,200**	**55,800**	**56,400**	**54,400**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Permit required data not provided.

Table 4-7. Influent: Annual Average Total Ammonia Loads by Subembayment (kg N/d)*,**

Subembayment	2018/2019 [a]	2019/2020 [a]	2020/2021 [a]	2021/2022 [a]
Suisun Bay	*	8,580	8,350	8,620
San Pablo Bay	*	1,780	1,840	1,800
Central Bay	*	9,220	8,100	9,250
South Bay	*	23,200	23,200	20,400
Lower South Bay	*	18,200	16,800	15,500
Total	*****	**60,900**	**58,300**	**55,700**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

** Refer to Table 4-5 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

Table 4-8. Influent: Dry Season Average Total Ammonia Loads by Subembayment (kg N/d)*,**

Subembayment	2019 [a],*	2020 [a]	2021 [a]	2022 [a]	Trend [b]
Suisun Bay	8,300	8,420	8,240	8,380	None
San Pablo Bay	2,100	1,790	1,800	1,780	None
Central Bay	8,250	8,490	8,130	9,260	None
South Bay	24,100	21,700	24,100	20,700	None
Lower South Bay	15,400	15,400	14,100	14,300	None
Total	**58,200**	**55,800**	**56,400**	**54,400**	**None**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

** Refer to Table 4-6 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Trend analysis based on the approach discussed in Section 3.8.

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4.3 Nitrate + Nitrite (NOx)

The historical average quarterly influent NOx loads from July 2019 through September 2022 are presented in Figure 4-3. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) influent loads were calculated based on reported flows and concentrations in Table 4-9 and Table 4-10, respectively.

A summary of the influent data review findings is as follows **(new findings for 2021/2022 in bold)**:

- Influent NOx loads and concentrations have the smallest relative contribution for the nitrogen species measured. On average, the influent NOx loads contribute less than 2 percent to the influent total nitrogen loads (data not shown).
- The 2018/2019 dataset is limited to July 2019 through September 2019. As a result, annual average values were excluded.
- There are a few instances of missing data per plant (see Table 4-9 and Table 4-10; primarily from 2019). Note: Napa has not provided dry season loads since sampling began in July 2019. Despite missing data in 2019, the average annual loads from 2019/2020 and dry season loads from 2019 represent the largest loads.
- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- The impact on loads from the on-going relatively dry years is unclear at this stage (discussion provided in Section 7.2).
- While the 2018/2019 dry season dataset is limited (3 months), the SFPUC Southeast dry season loads reduced from 2018/2019 to 2019-2021by greater than 90 percent (see Table 4-10). San Jose also saw a nearly 70 percent reduction from 2019/2020 to 2020/2021. Additionally, EBMUD also saw a reduction of approximately 50 percent from 2019/2020 to 2020/2021. It is unclear whether such reductions relate to the limited sampling duration, the global pandemic (COVID-19), industry, relatively low precipitation, or others. **Influent sampling for this Group Annual suggests the decline after the 2018/2019 is real as the values for this past year's dry season loads are comparable to previous year.**
- **<u>Average Annual:</u> overall increase since last year of approximately 330 kg N/d. The largest increases since last year were from SFPUC Southeast (South Bay Discharger) and San Jose (Lower South Bay Discharger) at approximately 175 kg N/d and 75 kg N/d, respectively. Treatment plants with increases since last year of >20 kg N/d were EBDA, Palo Alto, SFPUC Southeast, San Jose, and SVCW. In contrast, EBMUD saw a 60 kg N/d decline in average annual loads.**
- **<u>Dry Season:</u> overall decrease since last year of approximately 50 kg N/d. The largest decline was from San Jose (Lower South Bay Discharger) at approximately 240 kg N/d since last year. Unlike average annual, SFPUC Southeast (South Bay Discharger) saw an increase of approximately 50 kg N/d. Despite an increase, this past dry season loads at SFPUC Southeast are still nearly a log less than the 2019 dry season loads. Treatment plants with increases since last year of >20 kg N/d were EBMUD, Palo Alto, SFPUC Southeast, and SVCW.**
- **<u>Dry Season Trending:</u> the dataset resulted in no dry season emerging trends. Note: the dataset is still limiting (excluded year 2019 as the dataset was incomplete).**

- The Central Bay and Lower South Bay together account for over half of the influent NOx loads, regardless of season (see Table 4-11 and Table 4-12).

A discussion of the results is provided in Section 7.4.

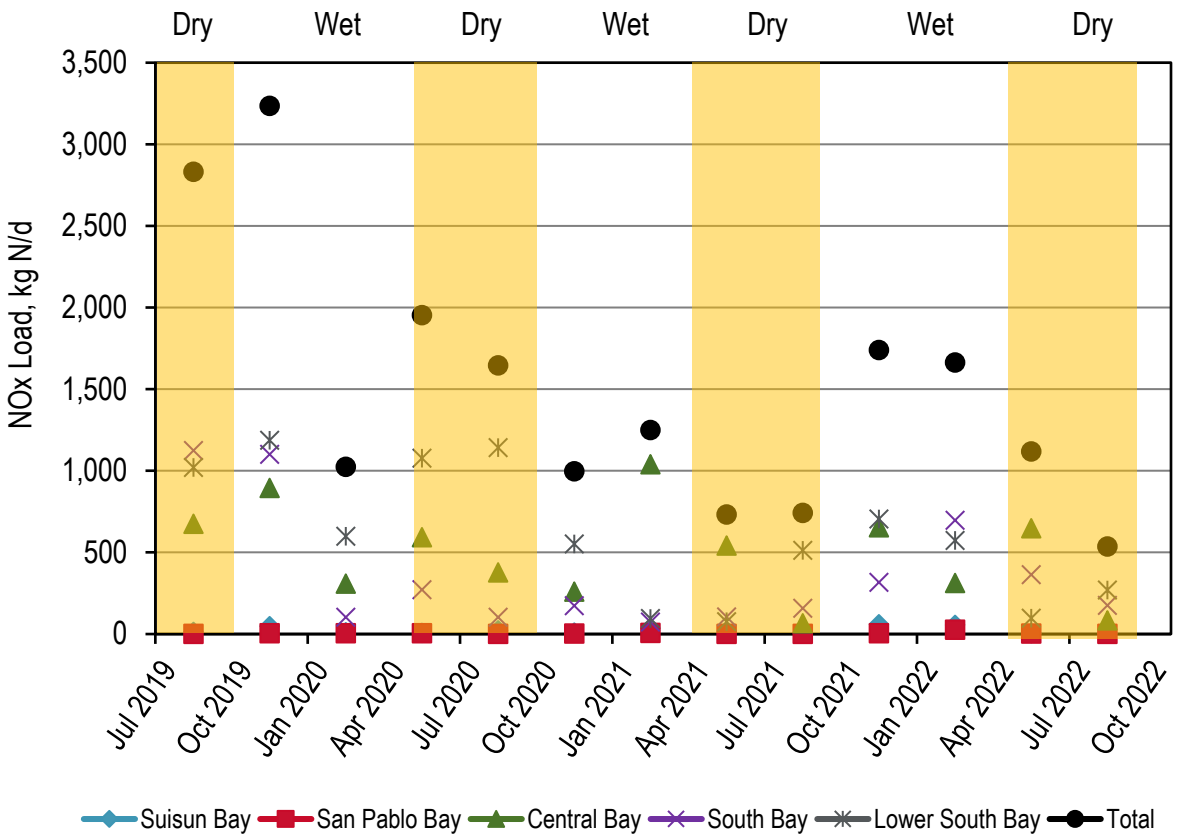

Figure 4-3. Influent: Historical Average Monthly NOx Loads

Table 4-9. Influent: Annual Average Loads to each Plant, NOx (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2018/2019 [a], [b]	2019/2020 [b]	2020/2021 [b]	2021/2022 [b]
American Canyon	San Pablo Bay	2.5	*	--	--	--
Benicia	San Pablo Bay	4.5	*	--	--	--
Burlingame	South Bay	5.5	*	--	--	--
CCCSD	Suisun Bay	53.8	*	1.89	2.94	7.58
CMSA	Central Bay	10	*	--	--	--
Port Costa	San Pablo Bay	0.033	*	--	--	--
Delta Diablo	Suisun Bay	19.5	*	12.8	5.31	24.3
EBDA	South Bay	107.8	*	46.9	84.0	114
EBMUD	Central Bay	120	*	520	450	390
FSSD	Suisun Bay	23.7	*	7.24	8.47	7.78
Las Gallinas[c]	San Pablo Bay	2.92	*	--	--	--
Paradise Cove	Central Bay	0.04	*	--	--	--
Tiburon	Central Bay	0.98	*	--	--	--
Millbrae	South Bay	3	*	--	--	--
Mt. View	Suisun Bay	3.2	*	--	--	--
Napa[c]	San Pablo Bay	15.4	*	2.30	1.54	3.34
Novato	San Pablo Bay	7	*	--	--	--
Palo Alto	Lower South Bay	39	*	16.4	7.29	34.1
Petaluma[c]	San Pablo Bay	6.7	*	--	--	--
Pinole	San Pablo Bay	4.06	*	--	--	--
Rodeo	San Pablo Bay	1.14	*	--	--	--
SFO Airport	South Bay	2.2	*	--	--	--
SFPUC Southeast	South Bay	85.4	*	295	41.7	218
San Jose	Lower South Bay	167	*	982	299	375
San Mateo	South Bay	15.7	*	22.3	4.61	7.59
SMCSD	Central Bay	1.8	*	--	--	--
SASM	Central Bay	3.6	*	--	--	--
SVCW	South Bay	29	*	47.0	4.95	47.9
Sonoma Valley[c]	San Pablo Bay	3	*	--	--	--
South SF	South Bay	13	*	6.48	3.73	2.39
Sunnyvale	Lower South Bay	29.5	*	2.87	2.98	2.00
Treasure Island	Central Bay	2	*	--	--	--
Vallejo	San Pablo Bay	15.5	*	2.01	1.37	6.36
West County	Central Bay	28.5	*	23.7	25.7	25.7
Total [d]		**827**	*** [e]**	**1,990**	**944**	**1,270**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Totals not provided due to an incomplete dataset.

Table 4-10. Influent: Dry Season Average Loads to each Plant, NOx (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2019 [a], [b], *	2020 [a], [b]	2021 [a], [b]	2022 [a], [b]
American Canyon	San Pablo Bay	2.5	--	--	--	--
Benicia	San Pablo Bay	4.5	--	--	--	--
Burlingame	South Bay	5.5	--	--	--	--
CCCSD	Suisun Bay	53.8	2.71	2.11	1.79	2.32
CMSA	Central Bay	10	--	--	--	--
Port Costa	San Pablo Bay	0.033	--	--	--	--
Delta Diablo	Suisun Bay	19.5	2.93	3.12	3.32	3.28
EBDA	South Bay	107.8	[e]	55.0	63.5	76.6
EBMUD	Central Bay	120	649	467	290	352
FSSD	Suisun Bay	23.7	7.18	11.1	6.76	7.78
Las Gallinas[c]	San Pablo Bay	2.92	--	--	--	--
Paradise Cove	Central Bay	0.04	--	--	--	--
Tiburon	Central Bay	0.98	--	--	--	--
Millbrae	South Bay	3	--	--	--	--
Mt. View	Suisun Bay	3.2	--	--	--	--
Napa[c]	San Pablo Bay	15.4	[e]	[e]	[e]	[e]
Novato	San Pablo Bay	7	--	--	--	--
Palo Alto	Lower South Bay	39	[e]	2.68	6.83	44.1
Petaluma[c]	San Pablo Bay	6.7	--	--	--	--
Pinole	San Pablo Bay	4.06	--	--	--	--
Rodeo	San Pablo Bay	1.14	--	--	--	--
SFO Airport	South Bay	2.2	--	--	--	--
SFPUC Southeast	South Bay	85.4	1,080	28.0	88.5	134
San Jose	Lower South Bay	167	1,020	1,130	501	261
San Mateo	South Bay	15.7	7.98	5.10	1.73	3.43
SMCSD	Central Bay	1.8	--	--	--	--
SASM	Central Bay	3.6	--	--	--	--
SVCW	South Bay	29	37.1	22.5	9.90	47.4
Sonoma Valley[c]	San Pablo Bay	3	--	--	--	--
South SF	South Bay	13	1.11	5.75	2.45	1.94
Sunnyvale	Lower South Bay	29.5	[e]	2.94	0.407	1.41
Treasure Island	Central Bay	2	--	--	--	--
Vallejo	San Pablo Bay	15.5	[e]	1.09	<1	1.40
West County	Central Bay	28.5	25.2	18.3	13.2	13.2
Total [d]		**827**	**2,830**	**1,760**	**990**	**949**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Permit required data not provided.

Table 4-11. Influent: Annual Average NOx Loads by Subembayment (kg N/d)* ,**

Subembayment	2018/2019 [a]	2019/2020 [a]	2020/2021 [a]	2021/2022 [a]
Suisun Bay	*	22.0	17.0	39.68
San Pablo Bay	*	4.31	2.91	9.70
Central Bay	*	543	476	416
South Bay	*	418	139	390
Lower South Bay	*	1,000	309	411
Total	*****	**1,990**	**944**	**1,270**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

** Refer to Table 4-9 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

Table 4-12. Influent: Dry Season Average NOx Loads by Subembayment (kg N/d)*,**

Subembayment	2019 [a],*	2020 [a]	2021 [a]	2022 [a]	Trend [b]
Suisun Bay	12.8	16.3	11.9	13.4	None
San Pablo Bay	<1	1.09	<1	1.40	None
Central Bay	674	485	303	365	None
South Bay	1,120	116	166	263	None
Lower South Bay	1,020	1,140	508	306	None
Total	**2,830**	**1,760**	**990**	**949**	**None**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

** Refer to Table 4-10 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Trend analysis based on the approach discussed in Section 3.8.

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4.4 Total Inorganic Nitrogen (TIN)

TIN is calculated by adding the ammonia and NOx concentrations. The historical average quarterly influent TIN loads from July 2019 through September 2022 are presented in Figure 4-4. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) influent loads were calculated based on reported flows and concentrations in Table 4-13 and Table 4-14, respectively.

A summary of the influent data review findings is as follows **(new findings for 2021/2022 in bold)**:

- Influent TIN loads and concentrations contribute on average approximately two-thirds of the total nitrogen concentrations and loads (data not shown).
- The 2018/2019 dataset is limited to July 2019 through September 2019. As a result, annual average values were excluded.
- There are a few instances of missing data per plant that inform the TIN calculation (TIN = ammonia + nitrate + nitrite; refer Table 4-13 and Table 4-14). As a result, the dry season TIN total loads for 2019 appear to be the lowest. However, several dischargers failed to report for the 2019 dry season (EBDA, Napa, Palo Alto, and Vallejo). Since failing to report in 2019, all dischargers except Napa have provided dry season load values. Note: Napa has not provided dry season loads since sampling began in July 2019.
- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- The impact on loads from the on-going relatively dry years is unclear at this stage (discussion provided in Section 7.2).
- **Average Annual Loads: this past year's loads are the lowest since sampling began in July 2019 (total reduction of approximately 2,200 kg N/d since last year and nearly 6,000 kg N/d since sampling began in 2019). The largest reductions are from SFPUC Southeast (nearly 3,100 kg N/d since last year; South Bay Discharger) and San Jose (approximately 1,500 kg N/d since last year; Lower South Bay Discharger). Both SFPUC Southeast and San Jose have decreased over 3,300 kg N/d since sampling in 2019/2020. It is unclear if such reductions at SFPUC Southeast and San Jose relate to the limited sampling frequency, the global pandemic (COVID-19), industry, relatively low precipitation, or others. Outside of SFPUC Southeast and San Jose, only Central San (Suisun Bay Discharger) saw a decrease of greater than 20 kg N/d since last year. However, several not treatment plants saw a load reduction of greater than 20 kg N/d since last year. In contrast, several dischargers had an increase of greater than 20 kg N/d since last year (Delta Diablo, EBDA, EBMUD, FSSD, Palo Alto, San Mateo, SVCW, South SF, and Sunnyvale). Of those listed, EBMUD saw the largest increase since last year (1,050 kg N/d), followed by EBDA at just over 3000 kg N/d and Palo Alto at just over 200 kg N/d.**
- **Dry Season Loads: this past year's loads are lower than the two previous dry seasons. While this past year is larger than the 2019 dry season, this is attributed to several dischargers not providing load data for the 2019 dry season as previously noted. Similar to average annual loads, the SFPUC Southeast (South Bay Discharger) had the largest load reduction at approximately 3,450 kg N/d since last year. San Jose (Lower South Bay Discharger) had the second largest reduction at 500 kg N/d since**

last year. Other dischargers with reductions since last year of greater than 20 kg N/d were San Mateo and SVCW. In contrast, plants with increases since last year of greater than 20 kg N/d were Central San, EBDA, EBMUD, Palo Alto, South SF, and Sunnyvale. Of those with increases, EBMUD had the largest increase since last year at approximately 1,190 kg N/d, followed by Palo Alto (230 kg N/d increase since last year), and Sunnyvale (190 kg N/d increase since last year). The others with increases since last year were all increases of less than 100 kg N/d.

- **Dry Season Trending: the dataset resulted in no dry season emerging trends. Note: the dataset is still limiting (excluded year 2019 as the dataset was incomplete).**
- Similar to flow and ammonia loads, the South Bay and Lower South Bay accounts for over half of the influent TIN loads, regardless of season (see Table 4-15 and Table 4-16).

A discussion of the results is provided in Section 7.4.

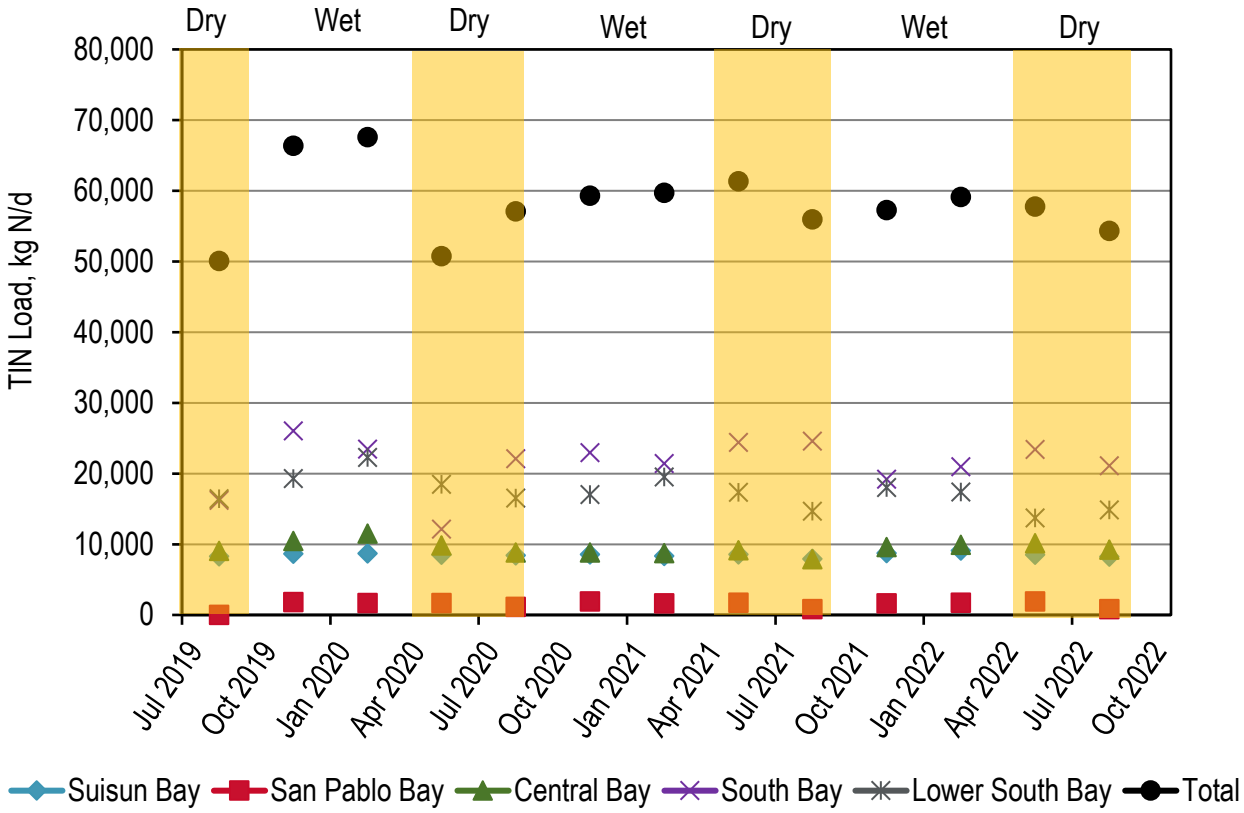

Figure 4-4. Influent: Historical Average Monthly TIN Loads

Table 4-13. Influent: Annual Average Loads to each Plant, TIN (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2018/2019 [a], [b]	2019/2020 [b]	2020/2021 [b]	2021/2022 [b]
American Canyon	San Pablo Bay	2.5	*	--	--	--
Benicia	San Pablo Bay	4.5	*	--	--	--
Burlingame	South Bay	5.5	*	--	--	--
CCCSD	Suisun Bay	53.8	*	5,100	4,930	4,840
CMSA	Central Bay	10	*	--	--	--
Port Costa	San Pablo Bay	0.033	*	--	--	--
Delta Diablo	Suisun Bay	19.5	*	1,850	1,840	2,060
EBDA	South Bay	107.8	*	9,250	9,780	10,100
EBMUD	Central Bay	120	*	8,260	6,830	7,880
FSSD	Suisun Bay	23.7	*	1,640	1,610	1,760
Las Gallinas[c]	San Pablo Bay	2.92	*	--	--	--
Paradise Cove	Central Bay	0.04	*	--	--	--
Tiburon	Central Bay	0.98	*	--	--	--
Millbrae	South Bay	3	*	--	--	--
Mt. View	Suisun Bay	3.2	*	--	--	--
Napa[c]	San Pablo Bay	15.4	*	815	871	859
Novato	San Pablo Bay	7	*	--	--	--
Palo Alto	Lower South Bay	39	*	2,330	2,270	2,490
Petaluma[c]	San Pablo Bay	6.7	*	--	--	--
Pinole	San Pablo Bay	4.06	*	--	--	--
Rodeo	San Pablo Bay	1.14	*	--	--	--
SFO Airport	South Bay	2.2	*	--	--	--
SFPUC Southeast	South Bay	85.4	*	9,050	8,860	5,790
San Jose	Lower South Bay	167	*	15,300	13,500	12,000
San Mateo	South Bay	15.7	*	1,610	1,450	1,500
SMCSD	Central Bay	1.8	*	--	--	--
SASM	Central Bay	3.6	*	--	--	--
SVCW	South Bay	29	*	2,460	2,490	2,660
Sonoma Valley[c]	San Pablo Bay	3	*	--	--	--
South SF	South Bay	13	*	1,010	1,020	1,160
Sunnyvale	Lower South Bay	29.5	*	1,510	1,400	1,500
Treasure Island	Central Bay	2	*	--	--	--
Vallejo	San Pablo Bay	15.5	*	978	891	887
West County	Central Bay	28.5	*	1,910	1,850	1,850
Total [d]		**827**	*** [e]**	**63,100**	**59,600**	**57,400**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Totals not provided due to an incomplete dataset.

Table 4-14. Influent: Dry Season Average Loads to each Plant, TIN (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2019 [a], [b], *	2020 [a], [b]	2021 [a], [b]	2022 [a], [b]
American Canyon	San Pablo Bay	2.5	--	--	--	--
Benicia	San Pablo Bay	4.5	--	--	--	--
Burlingame	South Bay	5.5	--	--	--	--
CCCSD	Suisun Bay	53.8	4,810	4,980	4,700	4,790
CMSA	Central Bay	10	--	--	--	--
Port Costa	San Pablo Bay	0.033	--	--	--	--
Delta Diablo	Suisun Bay	19.5	1,820	1,910	1,850	1,870
EBDA	South Bay	107.8	[e]	9,330	9,830	9,920
EBMUD	Central Bay	120	7,180	7,450	6,700	7,890
FSSD	Suisun Bay	23.7	1,690	1,540	1,710	1,720
Las Gallinas[c]	San Pablo Bay	2.92	--	--	--	--
Paradise Cove	Central Bay	0.04	--	--	--	--
Tiburon	Central Bay	0.98	--	--	--	--
Millbrae	South Bay	3	--	--	--	--
Mt. View	Suisun Bay	3.2	--	--	--	--
Napa[c]	San Pablo Bay	15.4	[e]	[e]	[e]	[e]
Novato	San Pablo Bay	7	--	--	--	--
Palo Alto	Lower South Bay	39	[e]	2,050	2,270	2,500
Petaluma[c]	San Pablo Bay	6.7	--	--	--	--
Pinole	San Pablo Bay	4.06	--	--	--	--
Rodeo	San Pablo Bay	1.14	--	--	--	--
SFO Airport	South Bay	2.2	--	--	--	--
SFPUC Southeast	South Bay	85.4	11,100	8,350	9,840	6,390
San Jose	Lower South Bay	167	14,600	13,200	11,100	10,600
San Mateo	South Bay	15.7	1,440	1,430	1,390	1,330
SMCSD	Central Bay	1.8	--	--	--	--
SASM	Central Bay	3.6	--	--	--	--
SVCW	South Bay	29	2,590	2,110	2,670	2,510
Sonoma Valley[c]	San Pablo Bay	3	--	--	--	--
South SF	South Bay	13	1,070	989	1,150	1,180
Sunnyvale	Lower South Bay	29.5	1,820	1,180	1,340	1,530
Treasure Island	Central Bay	2	--	--	--	--
Vallejo	San Pablo Bay	15.5	[e]	1,140	849	840
West County	Central Bay	28.5	1,900	1,900	1,850	1,850
Total [d]		**827**	**50,100**	**57,600**	**57,200**	**54,900**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Permit required data not provided.

Table 4-15. Influent: Annual Average TIN Loads by Subembayment (kg N/d)*,**

Subembayment	2018/2019 [a]	2019/2020 [a]	2020/2021 [a]	2021/2022 [a]
Suisun Bay	*	8,600	8,370	8,660
San Pablo Bay	*	1,790	1,760	1,750
Central Bay	*	10,200	8,680	9,720
South Bay	*	23,400	23,600	21,200
Lower South Bay	*	19,200	17,100	16,000
Total	*****	**63,100**	**59,600**	**57,400**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

** Refer to Table 4-13 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

Table 4-16. Influent: Dry Season Average TIN Loads by Subembayment (kg N/d)*,**

Subembayment	2019 [a],*	2020 [a]	2021 [a]	2022 [a]	Trend [b]
Suisun Bay	8,310	8,430	8,260	8,390	None
San Pablo Bay	0	1,140	849	840	None
Central Bay	9,080	9,350	8,550	9,740	None
South Bay	16,200	22,200	24,900	21,300	None
Lower South Bay	16,500	16,500	14,700	14,600	None
Total	**50,100**	**57,600**	**57,200**	**54,900**	**None**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

** Refer to Table 4-14 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Trend analysis based on the approach discussed in Section 3.8.

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4.5 Total Kjeldahl Nitrogen (TKN)

The TKN represents the sum of the total ammonia and organic nitrogen species. The historical average quarterly influent TKN loads from July 2019 through September 2022 are presented in Figure 4-5. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) influent loads were calculated based on reported flows and concentrations in Table 4-17 and Table 4-18, respectively.

A summary of the influent data review findings is as follows **(new findings for 2021/2022 in bold)**:

- Influent TKN loads and concentrations have the largest relative contribution for the nitrogen species measured. On average, the influent TKN loads contribute greater than 92 percent to the influent total nitrogen loads (data not shown).
- The 2018/2019 dataset is limited to July 2019 through September 2019. As a result, annual average values were excluded.
- There are a few instances of missing data per plant (Table 4-17 and Table 4-18; primarily from 2019). Note: Napa has not provided dry season loads since sampling began in July 2019. As a result of missing data in 2019, the dry season 2019 loads appear to be the lowest.
- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- The impact on loads from the on-going relatively dry years is unclear at this stage (discussion provided in Section 7.2).
- **Average Annual Loads: the overall loads have increased approximately 2,100 kg N/d since this past year. The largest increases occurred at EBMUD (Central Bay Discharger) and SFPUC Southeast (South Bay Discharger) with an increase of approximately 1,400 kg N/d and 760 kg N/d, respectively, since this past year. As previously noted, there are concerns that SFPUC Southeast data over the last couple of years might have a sampling artifact as there are samples whereby the TKN<Ammonia (despite ELAP certified samples). Other dischargers with increases since this past year of 200 kg N/d or greater were Delta Diablo (210 kg N/d), EBDA (400 kg N/d increase), Palo Alto (240 kg N/d), and San Mateo (250 kg N/d). In contrast, the largest reductions were from San Jose and Sunnyvale (both Lower South Bay Discharger) at 1,900 and 90 kg N/d, respectively.**
- **Dry Season Loads: the overall loads have increased approximately 6,200 kg N/d since this past year. The two largest contributors to the increase were EBMUD (Central Bay Discharger) and SFPUC Southeast (South Bay Discharger) with increases of approximately 2,300 and 4,460 kg N/d, respectively, since this past year. As previously noted, there are concerns that SFPUC Southeast data over the last couple of years might have a sampling artifact as there are samples whereby the TKN<Ammonia (despite ELAP certified samples). Despite such an increase at SFPUC Southeast, the values for this past year are still nearly 5,000 kg N/d lower than the initial quarter of sampling in 2019. Other notable dischargers with an increase greater than 200 kg N/d since this past year were Delta Diablo (210 kg N/d), SVCW (280 kg N/d), and South SF (310 kg N/d). In contrast, EBDA (South Bay Discharger) and San Jose (Lower South**

Bay Discharger) had a reduction compared to last year of approximately 400 and 2,800 kg N/d, respectively.

- **<u>Dry Season Trending:</u> the dataset resulted in no dry season emerging trends. Note: the dataset is still limiting (excluded year 2019 as the dataset was incomplete).**
- Similar to flow, ammonia, and TIN loads, the South Bay and Lower South Bay accounts for over half of the influent TKN loads, regardless of season (see Table 4-19 and Table 4-20).

A discussion of the results is provided in Section 7.4.

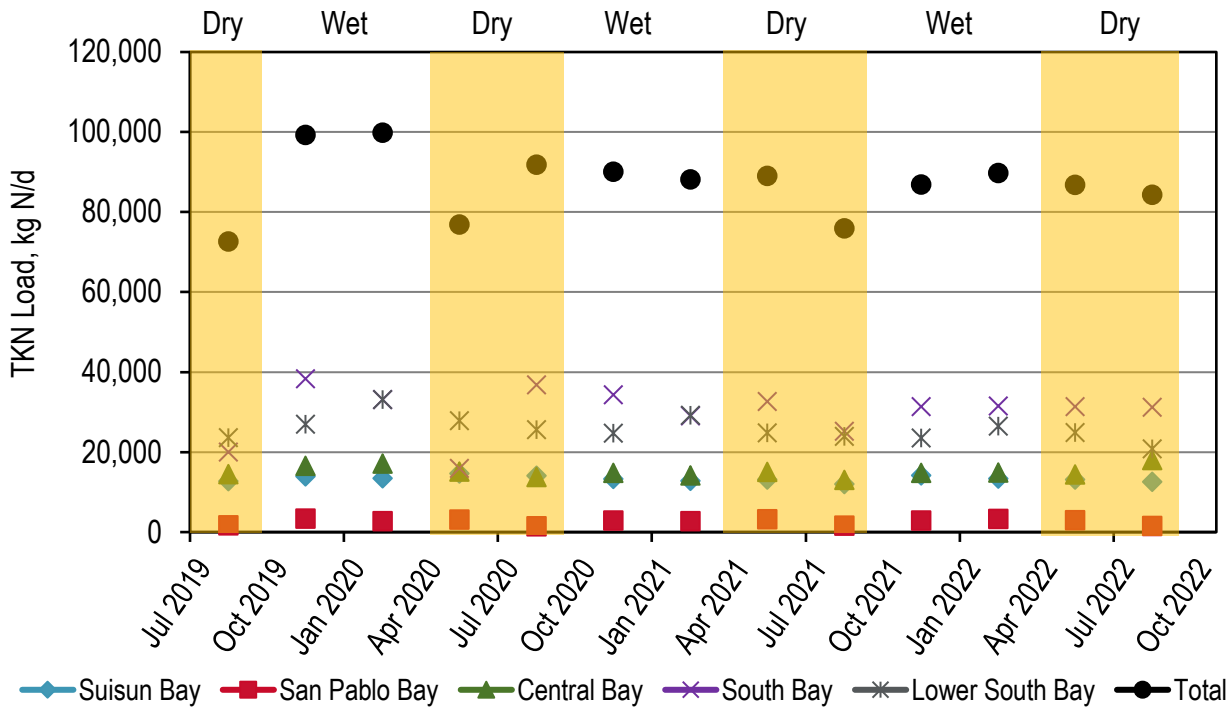

Figure 4-5. Influent: Historical Average Monthly TKN Loads

Table 4-17. Influent: Annual Average Loads to each Plant, TKN (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2018/2019 [a], [b]	2019/2020 [b]	2020/2021 [b]	2021/2022 [b]
American Canyon	San Pablo Bay	2.5	*	--	--	--
Benicia	San Pablo Bay	4.5	*	--	--	--
Burlingame	South Bay	5.5	*	--	--	--
CCCSD	Suisun Bay	53.8	*	7,440	6,870	7,010
CMSA	Central Bay	10	*	--	--	--
Port Costa	San Pablo Bay	0.033	*	--	--	--
Delta Diablo	Suisun Bay	19.5	*	3,530	3,210	3,420
EBDA	South Bay	107.8	*	16,600	15,100	15,500
EBMUD	Central Bay	120	*	12,500	11,400	12,800
FSSD	Suisun Bay	23.7	*	3,100	2,730	2,910
Las Gallinas[c]	San Pablo Bay	2.92	*	--	--	--
Paradise Cove	Central Bay	0.04	*	--	--	--
Tiburon	Central Bay	0.98	*	--	--	--
Millbrae	South Bay	3	*	--	--	--
Mt. View	Suisun Bay	3.2	*	--	--	--
Napa[c]	San Pablo Bay	15.4	*	1,480	1,370	1,410
Novato	San Pablo Bay	7	*	--	--	--
Palo Alto	Lower South Bay	39	*	4,070	3,490	3,730
Petaluma[c]	San Pablo Bay	6.7	*	--	--	--
Pinole	San Pablo Bay	4.06	*	--	--	--
Rodeo	San Pablo Bay	1.14	*	--	--	--
SFO Airport	South Bay	2.2	*	--	--	--
SFPUC Southeast	South Bay	85.4	*	12,000	7,910	8,670
San Jose	Lower South Bay	167	*	22,000	20,000	18,100
San Mateo	South Bay	15.7	*	2,500	2,090	2,340
SMCSD	Central Bay	1.8	*	--	--	--
SASM	Central Bay	3.6	*	--	--	--
SVCW	South Bay	29	*	2,840	2,980	3,210
Sonoma Valley[c]	San Pablo Bay	3	*	--	--	--
South SF	South Bay	13	*	1,420	1,400	1,590
Sunnyvale	Lower South Bay	29.5	*	2,360	2,180	2,090
Treasure Island	Central Bay	2	*	--	--	--
Vallejo	San Pablo Bay	15.5	*	1,600	1,630	1,660
West County	Central Bay	28.5	*	3,200	2,910	2,910
Total [d]		**827**	*** [e]**	**96,600**	**85,300**	**87,400**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Totals not provided due to an incomplete dataset.

Table 4-18. Influent: Dry Season Loads to each Plant, TKN (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2019 [a], [b], *	2020 [a], [b]	2021 [a], [b]	2022 [a], [b]
American Canyon	San Pablo Bay	2.5	--	--	--	--
Benicia	San Pablo Bay	4.5	--	--	--	--
Burlingame	South Bay	5.5	--	--	--	--
CCCSD	Suisun Bay	53.8	6,890	6,950	6,760	6,770
CMSA	Central Bay	10	--	--	--	--
Port Costa	San Pablo Bay	0.033	--	--	--	--
Delta Diablo	Suisun Bay	19.5	3,250	3,980	3,070	3,280
EBDA	South Bay	107.8	[e]	18,500	15,300	14,900
EBMUD	Central Bay	120	10,800	11,400	11,200	13,500
FSSD	Suisun Bay	23.7	2,630	3,110	2,690	2,820
Las Gallinas[c]	San Pablo Bay	2.92	--	--	--	--
Paradise Cove	Central Bay	0.04	--	--	--	--
Tiburon	Central Bay	0.98	--	--	--	--
Millbrae	South Bay	3	--	--	--	--
Mt. View	Suisun Bay	3.2	--	--	--	--
Napa[c]	San Pablo Bay	15.4	[e]	[e]	[e]	1,610
Novato	San Pablo Bay	7	--	--	--	--
Palo Alto	Lower South Bay	39	[e]	3,950	3,620	3,660
Petaluma[c]	San Pablo Bay	6.7	--	--	--	--
Pinole	San Pablo Bay	4.06	--	--	--	--
Rodeo	San Pablo Bay	1.14	--	--	--	--
SFO Airport	South Bay	2.2	--	--	--	--
SFPUC Southeast	South Bay	85.4	13,800	12,000	4,500	8,960
San Jose	Lower South Bay	167	20,800	19,000	18,200	15,600
San Mateo	South Bay	15.7	1,720	2,260	1,970	1,990
SMCSD	Central Bay	1.8	--	--	--	--
SASM	Central Bay	3.6	--	--	--	--
SVCW	South Bay	29	3,090	2,590	2,920	3,200
Sonoma Valley[c]	San Pablo Bay	3	--	--	--	--
South SF	South Bay	13	1,500	1,400	1,480	1,790
Sunnyvale	Lower South Bay	29.5	2,820	2,120	2,210	2,180
Treasure Island	Central Bay	2	--	--	--	--
Vallejo	San Pablo Bay	15.5	1,690	1,500	1,670	1,580
West County	Central Bay	28.5	3,760	3,120	2,860	2,860
Total [d]		**827**	**72,700**	**91,900**	**78,500**	**84,700**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Permit required data not provided.

Table 4-19. Influent: Annual Average TKN Loads by Subembayment (kg N/d)*,**

Subembayment	2018/2019 [a]	2019/2020 [a]	2020/2021 [a]	2021/2022 [a]
Suisun Bay	*	14,100	12,800	13,300
San Pablo Bay	*	3,090	3,010	3,070
Central Bay	*	15,700	14,300	15,700
South Bay	*	35,300	29,500	31,300
Lower South Bay	*	28,400	25,700	23,900
Total	*****	**96,600**	**85,300**	**87,400**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

** Refer to Table 4-17 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

Table 4-20. Influent: Dry Season Average TKN Loads by Subembayment (kg N/d)*,**

Subembayment	2019 [a],*	2020 [a]	2021 [a]	2022 [a]	Trend [b]
Suisun Bay	12,800	14,000	12,500	12,900	None
San Pablo Bay	1,690	1,500	1,670	3,190	None
Central Bay	14,600	14,500	14,100	16,400	None
South Bay	20,100	36,700	26,200	30,800	None
Lower South Bay	23,600	25,100	24,000	21,400	None
Total	**72,700**	**91,900**	**78,500**	**84,700**	**None**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

** Refer to Table 4-18 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Trend analysis based on the approach discussed in Section 3.8.

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4.6 Total Nitrogen (TN)

Total nitrogen is included as a metric for the influent (but not discharge) as it captures the organic nitrogen loading into the plant. The majority of influent organic nitrogen is oxidized to ammonia in the treatment plant. The historical average quarterly influent TN loads from July 2019 through September 2022 are presented in Figure 4-6. A relatively small portion of this organic nitrogen leaves with discharge as residual organic nitrogen (typically about 1.5 to 3.5 mg N/L). While this represents a relatively small proportion of discharge, it is an important component for the nitrogen balance within the treatment plant. It is calculated by adding the TKN and NOx concentrations.

The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) influent loads were calculated based on reported flows and concentrations in Table 4-21 and Table 4-22, respectively.

A summary of the influent data review findings is as follows **(new findings for 2021/2022 in bold)**:

- The 2018/2019 dataset is limited to July 2019 through September 2019. As a result, annual average values were excluded.
- There are a few instances of missing data per plant that inform the TN calculation (TN = TKN + nitrate + nitrite; refer Table 4-21 and Table 4-22). The missing data is primarily for 2019. Note: Napa has not provided dry season loads since sampling began in July 2019.
- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- The impact on loads from the on-going relatively dry years is unclear at this stage (discussion provided in Section 7.2).
- **<u>Average Annual Loads:</u> the overall loads increase by 2,400 kg N/d since this past year. Despite the increase, the loads are still approximately 10,000 kg N/d less than the 2019/2020 dataset. San Jose (Lower South Bay Discharger) had the largest reduction since last year at approximately 1,800 kg N/d. In fact, San Jose has seen a decrease in loads of approximately 4,500 kg N/d since 2019/2020 sampling. In contrast, SFPUC Southeast (South Bay Discharger) had an increase of approximately 940 kg N/d since last year. Despite such an increase, SFPUC Southeast has seen an overall reduction in loads since sampling began in 2019/2020 of approximately 3,340 kg N/d. The increase at SFPUC Southeast is likely due to a sampling artifact as there have been samples the last couple years whereby the TKN<Ammonia (despite ELAP certified samples). Regardless, there is an increase at SFPUC Southeast that is unclear (e.g., long-term impacts of COVID, sampling artifact, lack of industry, etc.). Other dischargers with reductions of greater than 50 kg N/d was limited to Sunnyvale (90 kg N/d reduction compared to last year). Dischargers with an increase since last year of greater than 250 kg N/d are EBDA, EBMUD, Palo Alto, San Mateo, and SVCW. Of those, EBMUD (Central Bay Discharger) had the largest increase at approximately 1,400 kg N/d, followed by EBDA (South Bay Discharger)at approximately 400 kg N/d since last year.**
- **<u>Dry Season Loads:</u> the overall loads increased by 4,400 kg N/d since this past year. Despite the increase, the loads are still approximately 9,400 kg N/d lower than the 2020 dry season. SFPUC Southeast (South Bay Discharger) and EBMUD (Central Bay**

Discharger) had the largest increases at approximately 4,400 kg N/d and 2,400 kg N/d, respectively. As previously noted, the increase at SFPUC Southeast is likely due to a sampling artifact as there have been samples the last couple years whereby the TKN<Ammonia (despite ELAP certified samples). Other dischargers with an increase of loads greater than 200 kg N/d since this past year are Delta Diablo, SVCW, and SSF. In contrast, San Jose (Lower South Bay Discharger) and EBDA (South Bay Discharger) saw reductions of approximately 2,800 and 400 kg N/d, respectively, since this past year.

- **<u>Dry Season Trending:</u> the dataset resulted in no dry season emerging trends. Note: the dataset is still limiting (excluded year 2019 as the dataset was incomplete).**
- Similar to flow, ammonia, TIN, and TKN loads, the South Bay and Lower South Bay accounts for over half of the influent TKN loads, regardless of season (see Table 4-23 and Table 4-24).

A discussion of the results is provided in Section 7.4.

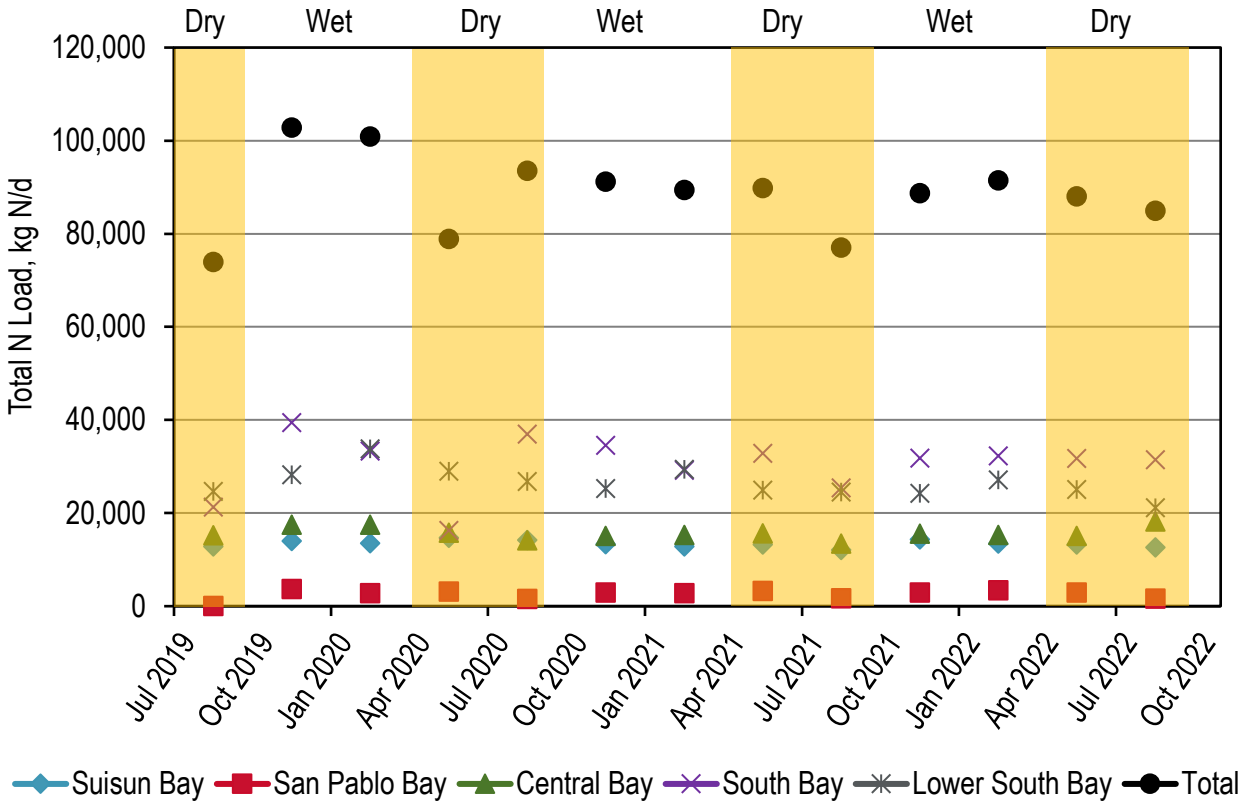

Figure 4-6. Influent: Historical Average Monthly Total N Loads

Table 4-21. Influent: Annual Average Loads to each Plant, TN (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2018/2019 [a], [b]	2019/2020 [b]	2020/2021 [b]	2021/2022 [b]
American Canyon	San Pablo Bay	2.5	*	--	--	--
Benicia	San Pablo Bay	4.5	*	--	--	--
Burlingame	South Bay	5.5	*	--	--	--
CCCSD	Suisun Bay	53.8	*	7,440	6,870	7,020
CMSA	Central Bay	10	*	--	--	--
Port Costa	San Pablo Bay	0.033	*	--	--	--
Delta Diablo	Suisun Bay	19.5	*	3,540	3,210	3,460
EBDA	South Bay	107.8	*	16,600	15,200	15,600
EBMUD	Central Bay	120	*	13,000	11,800	13,200
FSSD	Suisun Bay	23.7	*	3,110	2,740	2,920
Las Gallinas[c]	San Pablo Bay	2.92	*	--	--	--
Paradise Cove	Central Bay	0.04	*	--	--	--
Tiburon	Central Bay	0.98	*	--	--	--
Millbrae	South Bay	3	*	--	--	--
Mt. View	Suisun Bay	3.2	*	--	--	--
Napa[c]	San Pablo Bay	15.4	*	1,570	1,380	1,370
Novato	San Pablo Bay	7	*	--	--	--
Palo Alto	Lower South Bay	39	*	4,090	3,500	3,770
Petaluma[c]	San Pablo Bay	6.7	*	--	--	--
Pinole	San Pablo Bay	4.06	*	--	--	--
Rodeo	San Pablo Bay	1.14	*	--	--	--
SFO Airport	South Bay	2.2	*	--	--	--
SFPUC Southeast	South Bay	85.4	*	12,300	7,950	8,890
San Jose	Lower South Bay	167	*	23,000	20,300	18,500
San Mateo	South Bay	15.7	*	2,520	2,090	2,350
SMCSD	Central Bay	1.8	*	--	--	--
SASM	Central Bay	3.6	*	--	--	--
SVCW	South Bay	29	*	2,890	2,980	3,260
Sonoma Valley[c]	San Pablo Bay	3	*	--	--	--
South SF	South Bay	13	*	1,430	1,410	1,590
Sunnyvale	Lower South Bay	29.5	*	2,370	2,180	2,090
Treasure Island	Central Bay	2	*	--	--	--
Vallejo	San Pablo Bay	15.5	*	1,600	1,630	1,670
West County	Central Bay	28.5	*	3,220	3,010	3,010
Total [d]		**827**	*** [e]**	**98,700**	**86,300**	**88,700**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Totals not provided due to an incomplete dataset.

Table 4-22. Influent: Dry Season Average Loads to each Plant, TN (kg N/d)*

Discharger	Subembayment	Permitted Capacity [a]	2019 [a], [b], *	2020 [a], [b]	2021 [a], [b]	2022 [a], [b]
American Canyon	San Pablo Bay	2.5	--	--	--	--
Benicia	San Pablo Bay	4.5	--	--	--	--
Burlingame	South Bay	5.5	--	--	--	--
CCCSD	Suisun Bay	53.8	6,890	6,950	6,760	6,780
CMSA	Central Bay	10	--	--	--	--
Port Costa	San Pablo Bay	0.033	--	--	--	--
Delta Diablo	Suisun Bay	19.5	3,250	3,980	3,070	3,340
EBDA	South Bay	107.8	[e]	18,500	15,400	15,000
EBMUD	Central Bay	120	11,400	11,800	11,500	13,900
FSSD	Suisun Bay	23.7	2,640	3,120	2,700	2,830
Las Gallinas[c]	San Pablo Bay	2.92	--	--	--	--
Paradise Cove	Central Bay	0.04	--	--	--	--
Tiburon	Central Bay	0.98	--	--	--	--
Millbrae	South Bay	3	--	--	--	--
Mt. View	Suisun Bay	3.2	--	--	--	--
Napa[c]	San Pablo Bay	15.4	[e]	[e]	[e]	[e]
Novato	San Pablo Bay	7	--	--	--	--
Palo Alto	Lower South Bay	39	[e]	3,950	3,620	3,700
Petaluma[c]	San Pablo Bay	6.7	--	--	--	--
Pinole	San Pablo Bay	4.06	--	--	--	--
Rodeo	San Pablo Bay	1.14	--	--	--	--
SFO Airport	South Bay	2.2	--	--	--	--
SFPUC Southeast	South Bay	85.4	14,900	12,000	4,590	9,090
San Jose	Lower South Bay	167	21,800	20,200	18,700	15,900
San Mateo	South Bay	15.7	1,720	2,260	1,970	1,990
SMCSD	Central Bay	1.8	--	--	--	--
SASM	Central Bay	3.6	--	--	--	--
SVCW	South Bay	29	3,130	2,610	2,930	3,250
Sonoma Valley[c]	San Pablo Bay	3	--	--	--	--
South SF	South Bay	13	1,510	1,410	1,480	1,790
Sunnyvale	Lower South Bay	29.5	2,820	2,120	2,210	2,180
Treasure Island	Central Bay	2	--	--	--	--
Vallejo	San Pablo Bay	15.5	[e]	1,500	1,670	1,580
West County	Central Bay	28.5	3,790	3,140	3,020	3,020
Total [d]		**827**	**73,900**	**93,600**	**79,600**	**84,200**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Permit required data not provided.

Table 4-23. Influent: Annual Average TN Loads by Subembayment (kg N/d)*,**

Subembayment	2018/2019 [a]	2019/2020 [a]	2020/2021 [a]	2021/2022 [a]
Suisun Bay	*	14,100	12,800	13,400
San Pablo Bay	*	3,170	3,010	3,030
Central Bay	*	16,200	14,900	16,200
South Bay	*	35,700	29,600	31,700
Lower South Bay	*	29,400	26,000	24,400
Total	*****	**98,700**	**86,300**	**88,700**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

** Refer to Table 4-21 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

Table 4-24. Influent: Dry Season Average TN Loads by Subembayment (kg N/d)*,**

Subembayment	2019 [a],*	2020 [a]	2021 [a]	2022 [a]	Trend [b]
Suisun Bay	12,800	14,100	12,500	12,900	None
San Pablo Bay	0	1,500	1,670	1,580	None
Central Bay	15,200	15,000	14,500	16,900	None
South Bay	21,300	36,800	26,400	31,100	None
Lower South Bay	24,600	26,200	24,500	21,800	None
Total	**73,900**	**93,600**	**79,600**	**84,200**	**None**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

** Refer to Table 4-22 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Trend analysis based on the approach discussed in Section 3.8.

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4.7 Total Phosphorus (TP)

The historical average quarterly influent TP loads from July 2019 through September 2022 are presented in Figure 4-7. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) influent loads were calculated based on reported flows and concentrations in Table 4-25 and Table 4-26, respectively.

A summary of the influent data review findings is as follows **(new findings for 2021/2022 in bold)**:

- The 2018/2019 dataset is limited to July 2019 through September 2019. As a result, annual average values were excluded.
- There are a few instances of missing data per plant (refer to Table 4-25 and Table 4-26; primarily from 2019). Note: Napa has not provided dry season loads since sampling began in July 2019.
- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- The impact on loads from the on-going relatively dry years is unclear at this stage (discussion provided in Section 7.2).
- **Average Annual Loads: the overall increase compared to the past year was approximately 300 kg P/d. Despite an increase compared to last year, this past year's loads were still less than the 2019/2020 average annual value. The largest contributor to this increase was from EBMUD (Central Bay Discharger) whose load increased 380 kg P/d compared to last year. EBMUD relies on an anerobic selector for TP load reduction, which occasionally struggles to reliably reduce TP loads. Other notable increases were from FSSD (30 kg P/d greater than the last year) and Palo Alto (41 kg P/d greater than the last year. In contrast, San Jose (Lower South Bay Discharger) decreased 160 kg P/d compared to last year. Other notable reductions were from CCCSD (38 kg P/d decline compared to last year) and SVCW (21 kg P/d decline compared to last year).**
- **Dry Season Loads: the total load is the largest since sampling began in 2019. The overall increase compared to this past year was approximately 1,190 kg P/d. This was the first year that Napa (San Pablo Bay Discharger) provided a dry season sample (175 kg P/d). Even if the Napa load value were excluded from the total, the 2022 dry season would still have the largest load since sampling began in 2019. The largest contributor to this 2022 increase was from EBMUD (Central Bay Discharger) with an 810 kg P/d increase compared to last year. Other dischargers with increases compared to last year of greater than or equal to 50 kg P/d were Palo Alto (Lower South Bay Discharger) at a 50 kg P/d increase and San Jose (Lower South Bay Discharger) at a 240 kg P/d increase. In contrast, EBDA and SVCW (both South Bay Discharger) had reductions of 130 kg P/d and 24 kg P/d, respectively, compared to last year.**
- **Dry Season Trending: the dataset resulted in no dry season emerging trends. Note: the dataset is still limiting (excluded year 2019 as the dataset was incomplete).**
- Similar to flow, ammonia, TIN, TKN, and TN loads, the South Bay and Lower South Bay accounts for over half of the influent TKN loads, regardless of season (see Table 4-27 and

Table 4-28).

A discussion of the results is provided in Section 7.4.

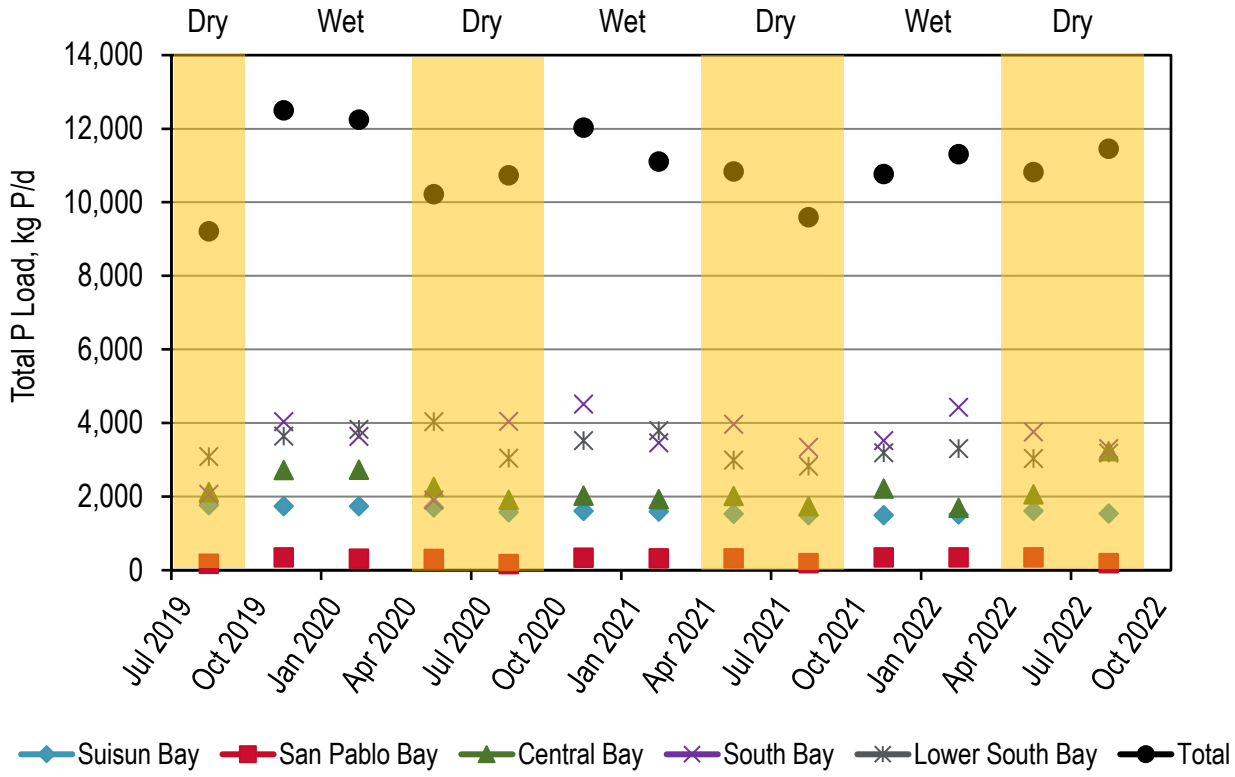

Figure 4-7. Influent: Historical Average Monthly Total P Loads for Evaluation Period

Table 4-25. Influent: Annual Average Loads to each Plant, TP (kg P/d)

Discharger	Subembayment	Permitted Capacity [a]	2018/2019 [a], [b]	2019/2020 [b]	2020/2021 [b]	2021/2022 [b]
American Canyon	San Pablo Bay	2.5	*	--	--	--
Benicia	San Pablo Bay	4.5	*	--	--	--
Burlingame	South Bay	5.5	*	--	--	--
CCCSD	Suisun Bay	53.8	*	981	823	785
CMSA	Central Bay	10	*	--	--	--
Port Costa	San Pablo Bay	0.033	*	--	--	--
Delta Diablo	Suisun Bay	19.5	*	339	362	353
EBDA	South Bay	107.8	*	1,620	1,630	1,650
EBMUD	Central Bay	120	*	1,960	1,580	1,960
FSSD	Suisun Bay	23.7	*	369	373	403
Las Gallinas[c]	San Pablo Bay	2.92	*	--	--	--
Paradise Cove	Central Bay	0.04	*	--	--	--
Tiburon	Central Bay	0.98	*	--	--	--
Millbrae	South Bay	3	*	--	--	--
Mt. View	Suisun Bay	3.2	*	--	--	--
Napa[c]	San Pablo Bay	15.4	*	146	150	160
Novato	San Pablo Bay	7	*	--	--	--
Palo Alto	Lower South Bay	39	*	410	368	409
Petaluma[c]	San Pablo Bay	6.7	*	--	--	--
Pinole	San Pablo Bay	4.06	*	--	--	--
Rodeo	San Pablo Bay	1.14	*	--	--	--
SFO Airport	South Bay	2.2	*	--	--	--
SFPUC Southeast	South Bay	85.4	*	1,330	1,270	1,260
San Jose	Lower South Bay	167	*	2,940	2,650	2,490
San Mateo	South Bay	15.7	*	246	226	242
SMCSD	Central Bay	1.8	*	--	--	--
SASM	Central Bay	3.6	*	--	--	--
SVCW	South Bay	29	*	387	390	369
Sonoma Valley[c]	San Pablo Bay	3	*	--	--	--
South SF	South Bay	13	*	234	224	232
Sunnyvale	Lower South Bay	29.5	*	283	267	280
Treasure Island	Central Bay	2	*	--	--	--
Vallejo	San Pablo Bay	15.5	*	173	185	191
West County	Central Bay	28.5	*	347	357	357
Total [d]		**827**	*** [e]**	**11,800**	**10,900**	**11,200**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Totals not provided due to an incomplete dataset.

Table 4-26. Influent: Dry Season Average Loads to each Plant, TP (kg P/d)*

Discharger	Subembayment	Permitted Capacity [a]	2019 [a], [b],*	2020 [a], [b]	2021 [a], [b]	2022 [a], [b]
American Canyon	San Pablo Bay	2.5	--	--	--	--
Benicia	San Pablo Bay	4.5	--	--	--	--
Burlingame	South Bay	5.5	--	--	--	--
CCCSD	Suisun Bay	53.8	1,030	875	783	793
CMSA	Central Bay	10	--	--	--	--
Port Costa	San Pablo Bay	0.033	--	--	--	--
Delta Diablo	Suisun Bay	19.5	361	367	367	380
EBDA	South Bay	107.8	[e]	1,670	1,700	1,570
EBMUD	Central Bay	120	1,800	1,690	1,530	2,340
FSSD	Suisun Bay	23.7	372	371	381	402
Las Gallinas[c]	San Pablo Bay	2.92	--	--	--	--
Paradise Cove	Central Bay	0.04	--	--	--	--
Tiburon	Central Bay	0.98	--	--	--	--
Millbrae	South Bay	3	--	--	--	--
Mt. View	Suisun Bay	3.2	--	--	--	--
Napa[c]	San Pablo Bay	15.4	[e]	[e]	[e]	175
Novato	San Pablo Bay	7	--	--	--	--
Palo Alto	Lower South Bay	39	[e]	352	377	422
Petaluma[c]	San Pablo Bay	6.7	--	--	--	--
Pinole	San Pablo Bay	4.06	--	--	--	--
Rodeo	San Pablo Bay	1.14	--	--	--	--
SFO Airport	South Bay	2.2	--	--	--	--
SFPUC Southeast	South Bay	85.4	1,300	1,550	960	947
San Jose	Lower South Bay	167	2,770	2,460	2,200	2,440
San Mateo	South Bay	15.7	223	218	207	212
SMCSD	Central Bay	1.8	--	--	--	--
SASM	Central Bay	3.6	--	--	--	--
SVCW	South Bay	29	329	367	370	346
Sonoma Valley[c]	San Pablo Bay	3	--	--	--	--
South SF	South Bay	13	209	228	226	255
Sunnyvale	Lower South Bay	29.5	322	245	269	302
Treasure Island	Central Bay	2	--	--	--	--
Vallejo	San Pablo Bay	15.5	175	167	191	193
West County	Central Bay	28.5	321	333	345	345
Total [d]		**827**	**9,210**	**10,900**	**9,910**	**11,100**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data not required as such dischargers have a permitted capacity of less than 10 mgd, whereas a "0" indicates a value of zero.

c. No discharge during a portion or all of the dry season months, except when necessary due to wet conditions.

d. The total values might vary from the sum of the listed values by plant due to rounding.

e. Permit required data not provided.

Table 4-27. Influent: Annual Average TP Loads by Subembayment (kg P/d)*,**

Subembayment	2018/2019 [a]	2019/2020 [a]	2020/2021 [a]	2021/2022 [a]
Suisun Bay	*	1,690	1,560	1,540
San Pablo Bay	*	319	334	350
Central Bay	*	2,310	1,940	2,320
South Bay	*	3,820	3,740	3,760
Lower South Bay	*	3,640	3,280	3,180
Total	*****	**11,800**	**10,900**	**11,200**

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

** Refer to Table 4-25 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

Table 4-28. Influent: Dry Season Average TP Loads by Subembayment (kg P/d)* ,**

Subembayment	2019 [a],*	2020 [a]	2021 [a]	2022 [a]	Trend [b]
Suisun Bay	1,770	1,610	1,530	1,580	None
San Pablo Bay	175	167	191	368	None
Central Bay	2,120	2,020	1,880	2,680	None
South Bay	2,060	4,040	3,470	3,330	None
Lower South Bay	3,090	3,060	2,840	3,170	None
Total	**9,210**	**10,900**	**9,910**	**11,100**	**None**

* 2019 dataset limited to July through September compared against May through September for 2020 and beyond.

** Refer to Table 4-26 for a list of dischargers that did not sample for each timeframe.

a. Based on ADWF permitted capacity. Influent flow and load analysis required for plants with a permitted capacity greater than 10 mgd.

b. Trend analysis based on the approach discussed in Section 3.8.

5 Discharge Data Review Findings

This section presents a discussion of the data for the following discharge parameters:

1. Discharge Flow (reported as mgd)
2. Total Ammonia (reported as kg N/d)
3. Nitrate plus Nitrite (NOx, reported as kg N/d)
4. Total Inorganic Nitrogen (reported as kg N/d)
5. Total Phosphorus (reported as kg P/d)

Data on flow (as mgd), load (as kg/d), and concentrations (mg/L) are summarized for each discharger (except concentrations), as well as for each of the five Subembayments. The data are also presented for both the annual average and dry season average. Data are presented based on the period of collection; for example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.

Following the subsections for each parameter, there is a subsection on the relative contribution of flow and loads by Subembayment for each discharger. This was not included with the influent as the data do not include all the POTWs.

As previously described, the trend analysis presented in the following subsections is based on the Dry Season (a minimum of 9 influent samples for dischargers with a permitted capacity of greater than 10 mgd ADWF; a minimum of 50samples for all major dischargers (>1 mgd permitted capacity ADWF)).

Since the first Group Annual Report submitted in 2015, there have been several data amendments within CIWQS and the Group Annual Reports as follows:

- Data from the City of Palo Alto, the City of San Mateo, and Napa Sanitation District submitted under the 2015 Group Annual Report Submittal were initially updated in the 2016 Report with updated data that are reflected in this report.
- Data from the Rodeo Sanitary District 2014-2016 datasets were updated with values that are reflected in this report.
- Ammonia data for June 2017 from Sausalito Marin City Sanitation District were updated with values that are reflected in this report.
- Flow data from Tiburon for the 2014/2015 and 2015/2016 were inaccurately reported in the 2017 Group Annual Report. This report reflects the accurate data from CIWQS.
- Flow data for Mt View Sanitary District for a portion of the 2018 dry season and the 2018/2019 dataset were inaccurately reported in the 2018 and 2019 Group Annual Reports. This report reflects the accurate data since updated in CIWQS.

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5.1 Flow

The historical average monthly discharge flows from October 2012 through September 2022 are presented in Figure 5-1. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) discharge flows were calculated based on reported flows in Table 5-1 and Table 5-2, respectively. In addition, the annual average and dry season average monthly discharge flows for each Subembayment are provided in Table 5-3 and Table 5-4, respectively.

A summary of the discharge data review findings is as follows **(new findings for 2021/2022 in bold)**:

- It is well documented that influent/discharge flows typically increase with precipitation (discussed in Section 7.2). During relatively wet years (e.g., 2016/2017), the average monthly discharge flows were the highest since sampling began in 2012. **This past year experienced two relatively wet months in October and December 2021. Such wet months resulted in an increase in average annual flows of 25 mgd compared to 2020/2021 values (refer to Table 5-3). 27 out of 34 dischargers had an increase in average annual flows. Of those, Napa (San Pablo Bay Discharger) had the largest increase compared to the previous year (about 250 percent larger than 2020/2021 values). Despite such an increase in total flows, the total annual average values are approximately 34 mgd less than the 10-year average (10/2012 through 09/2022).**
- **While the average annual flows increased compared to last year, the 2022 dry season flows were the lowest since sampling began in 2012 (refer to Table 5-4). The total average dry season value for 2022 were a modest 2 mgd less than the previous dry year, 2021. Such a modest decline suggests that the system might have reached a point of diminishing return on dry season flow reductions (unless recycled water volumes increase).**
- **Central Bay had the largest increase in the annual average discharge flow (11.3 mgd increase) as compared to 2020/2021. Lower South Bay had the largest decrease in average dry season discharge flow (14 mgd decrease) as compared to 2021.**
- Besides precipitation, the impact on flows from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- **<u>Dry Season Trending:</u> the dry season trending analysis suggests that San Pablo Bay, South Bay, Lower South Bay, and Baywide all have a downward trend when evaluated for the entire 10-year dry season.** This trending is based on the least-squares correlation test selected as the basis for trends analysis over the entire dry season dataset since sampling began in 2012 (see Section 3.8).
- Dischargers to South Bay and Lower South Bay Subembayments account for over half of discharge flow to San Francisco Bay (refer to Figure 5-1 and/or Table 5-3).

A discussion of the results is provided in Section 7.6.

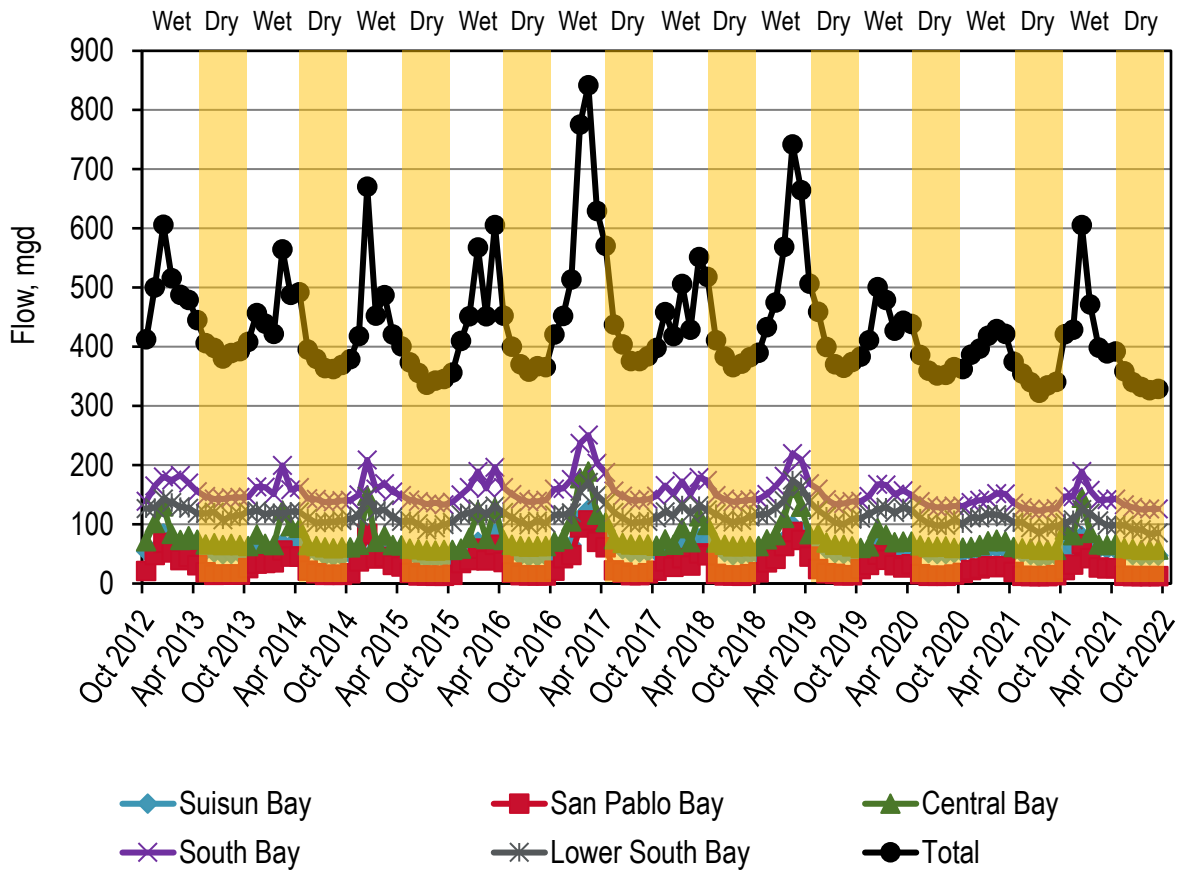

Figure 5-1. Discharge: Average Monthly Discharge Flows

Table 5-1. Discharge: Annual Average Flows by Discharger (mgd)

Discharger	Subembayment	Permitted Capacity [a]	2012/ 2013 [b,c]	2013/ 2014 [b,c]	2014/ 2015 [b,c]	2015/ 2016 [b,c]	2016/ 2017 [b,c]	2017/ 2018 [b,c]	2018/ 2019 [b,c]	2019/ 2020 [b,c]	2020/ 2021 [b,c]	2021/ 2022 [b,c]	10-Year Average
American Canyon	San Pablo Bay	2.5	1.47	1.36	1.45	1.44	1.77	1.39	1.58	1.22	1.13	1.27	1.41
Benicia	San Pablo Bay	4.5	2.18	2.04	1.98	2.00	2.46	1.99	2.23	1.80	1.67	1.79	2.01
Burlingame	South Bay	5.5	3.03	2.91	2.96	2.84	3.62	2.74	2.99	2.44	2.12	2.53	2.82
CCCSD	Suisun Bay	53.8	37.5	35.5	32.8	33.7	43.5	34.9	38.6	33.3	31.4	34.1	35.5
CMSA	Central Bay	10	7.66	5.84	6.97	8.05	13.4	9.16	12.0	9.01	7.42	9.53	8.91
Port Costa	San Pablo Bay	0.033	0.00682	0.00630	0.0102	0.0165	0.0308	0.0197	0.0240	0.0296	0.0145	0.0200	0.0179
Delta Diablo	Suisun Bay	19.5	6.83	6.12	7.38	7.21	9.88	9.04	8.74	8.17	7.41	7.84	7.86
EBDA	South Bay	107.8	62.2	58.5	59.1	61.0	68.1	60.5	65.0	62.1	60.2	62.0	61.9
EBMUD	Central Bay	120	58.3	56.2	51.5	53.4	66.1	52.0	58.0	48.1	45.3	51.5	54.0
FSSD	Suisun Bay	23.7	13.2	12.4	12.1	13.0	17.0	13.4	15.4	12.9	12.3	13.9	13.6
Las Gallinas[d]	San Pablo Bay	2.92	1.37	1.19	1.25	1.66	2.86	1.35	2.62	1.93	1.44	1.38	1.71
Paradise Cove	Central Bay	0.04	0.0144	0.0138	0.0135	0.0129	0.0148	0.0159	0.0166	0.0149	0.0144	0.0141	0.0145
Tiburon	Central Bay	0.98	0.587	0.592	0.665	0.551	0.791	0.641	0.670	0.573	0.526	0.592	0.619
Millbrae	South Bay	3	1.58	1.65	1.35	1.49	1.87	1.48	1.73	1.48	1.38	1.54	1.56
Mt. View	Suisun Bay	3.2	1.34	1.27	1.26	1.20	1.53	1.27	1.36	1.19	1.02	1.08	1.25
Napa[d]	San Pablo Bay	15.4	5.05	4.60	5.30	6.04	8.94	4.55	7.42	3.54	1.28	3.16	4.99
Novato[d]	San Pablo Bay	7	3.18	2.89	3.33	2.94	5.08	2.98	4.78	2.75	2.04	2.52	3.25
Palo Alto	Lower South Bay	39	21.5	19.2	18.9	22.4	23.2	19.1	21.9	19.5	17.1	17.0	20.0
Petaluma[d]	San Pablo Bay	6.7	3.67	4.32	3.18	2.83	4.63	3.18	4.02	2.89	1.61	2.25	3.26
Pinole	San Pablo Bay	4.06	2.57	2.60	2.39	2.40	2.98	2.50	2.78	2.27	2.20	2.73	2.54
Rodeo	San Pablo Bay	1.14	0.650	0.593	0.603	0.601	0.805	0.587	0.680	0.551	0.527	0.572	0.617
SFO Airport	South Bay	2.2	1.13	1.17	1.02	1.10	1.25	1.15	1.22	0.943	0.748	0.900	1.06
SFPUC Southeast	South Bay	85.4	56.9	58.9	55.3	56.6	63.0	56.5	55.5	46.8	42.2	44.3	53.6
San Jose	Lower South Bay	167	91.5	84.3	81.3	80.3	90.4	87.5	93.8	84.4	76.1	73.1	84.3
San Mateo	South Bay	15.7	10.8	9.73	10.2	10.3	12.3	10.4	11.6	9.92	9.19	9.99	10.4
SMCSD	Central Bay	1.8	1.52	1.25	1.19	1.27	1.52	1.14	1.30	1.03	1.09	1.09	1.24
SASM	Central Bay	3.6	2.19	2.69	2.35	2.49	3.09	2.26	2.67	2.14	2.08	2.43	2.44
SVCW	South Bay	29	12.9	12.2	12.8	14.1	16.0	13.9	15.6	13.7	12.5	13.1	13.7
Sonoma Valley[d]	San Pablo Bay	3	1.59	1.29	0.317	0.567	2.22	0	1.48	0	0	0.339	0.780
South SF	South Bay	13	8.99	8.68	8.43	8.25	8.98	7.60	8.55	7.34	6.72	7.66	8.12
Sunnyvale	Lower South Bay	29.5	10.8	10.8	10.2	10.2	11.9	10.5	11.6	10.1	10.7	10.6	10.7
Treasure Island	Central Bay	2	0.312	0.323	0.324	0.330	0.375	0.313	0.412	0.285	0.234	0.320	0.323
Vallejo	San Pablo Bay	15.5	10.4	9.14	10.0	9.70	12.6	9.06	10.1	8.51	7.80	9.55	9.68
West County	Central Bay	28.5	8.32	8.27	7.40	10.1	13.1	9.93	13.3	7.37	6.29	8.75	9.28
Total [e]		**827**	**451**	**428**	**415**	**430**	**515**	**433**	**480**	**408**	**374**	**399**	**433**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-2. Discharge: Dry Season Average Flows by Discharger (mgd)

Discharger	Subembayment	Permitted Capacity [a]	2013 [b,c]	2014 [b,c]	2015 [b,c]	2016 [b,c]	2017 [b,c]	2018 [b,c]	2019 [b,c]	2020 [b,c]	2021 [b,c]	2022 [b,c]	10-Year Average
American Canyon	San Pablo Bay	2.5	1.19	1.18	1.14	1.04	1.12	1.09	1.17	0.949	0.892	0.796	1.06
Benicia	San Pablo Bay	4.5	1.99	1.85	1.68	1.83	1.92	1.82	1.90	1.68	1.58	1.55	1.78
Burlingame	South Bay	5.5	2.82	2.55	2.57	2.54	2.84	2.49	2.49	2.20	1.91	2.03	2.44
CCCSD	Suisun Bay	53.8	34.1	32.6	28.1	30.1	33.9	31.2	32.8	31.5	28.7	29.5	31.3
CMSA	Central Bay	10	5.59	4.97	4.71	5.72	7.49	6.93	7.96	7.14	6.08	6.15	6.27
Port Costa	San Pablo Bay	0.033	0.00496	0.00400	0.00868	0.0157	0.0147	0.0208	0.0149	0.0149	0.0118	0.0188	0.0129
Delta Diablo	Suisun Bay	19.5	6.19	5.72	5.89	6.24	8.81	7.43	8.28	8.00	6.48	6.72	6.98
EBDA	South Bay	107.8	55.6	50.8	51.3	53.3	53.0	54.9	56.4	56.4	55.2	54.0	54.1
EBMUD	Central Bay	120	50.0	47.1	43.5	45.4	48.1	45.9	48.3	45.3	42.4	42.8	45.9
FSSD	Suisun Bay	23.7	10.3	10.2	9.12	10.2	12.2	11.7	12.8	11.3	10.8	11.4	11.0
Las Gallinas[d]	San Pablo Bay	2.92	0	0	0	0	0.407	0	0.750	0.405	0	0	0.156
Paradise Cove	Central Bay	0.04	0.0140	0.0130	0.0126	0.0129	0.0125	0.0183	0.0149	0.0154	0.0127	0.0132	0.0140
Tiburon	Central Bay	0.98	0.532	0.542	0.545	0.551	0.558	0.547	-	0.537	0.485	0.473	0.530
Millbrae	South Bay	3	1.53	1.25	1.19	1.40	1.42	1.30	1.48	1.37	1.32	1.33	1.36
Mt. View	Suisun Bay	3.2	1.14	1.21	1.12	1.22	1.25	1.19	1.20	1.11	0.979	1.00	1.14
Napa[d]	San Pablo Bay	15.4	0	1.20	0	0	0	0	0	0	0	0	0.120
Novato[d]	San Pablo Bay	7	0.806	0.743	0.736	0.763	2.28	0.779	2.30	0.503	0.264	0	0.918
Palo Alto	Lower South Bay	39	22.5	19.6	18.5	21.6	18.9	19.5	17.4	17.5	17.0	16.1	18.9
Petaluma[d]	San Pablo Bay	6.7	0	0	0	0	0	0	0	0	0	0	0
Pinole	San Pablo Bay	4.06	2.50	2.33	2.09	2.20	2.36	2.27	2.50	2.22	2.11	2.44	2.30
Rodeo	San Pablo Bay	1.14	0.572	0.551	0.491	0.523	0.552	0.526	0.550	0.540	0.496	0.486	0.529
SFO Airport	South Bay	2.2	1.07	1.13	0.949	1.06	1.14	1.12	1.17	0.665	0.688	0.915	0.992
SFPUC Southeast	South Bay	85.4	53.3	56.0	52.8	54.6	57.1	52.9	49.6	42.0	40.4	42.2	50.1
San Jose	Lower South Bay	167	83.6	77.2	72.1	74.6	80.1	81.9	83.4	77.2	68.3	64.3	76.3
San Mateo	South Bay	15.7	10.0	9.18	8.52	9.18	9.63	9.68	9.97	9.52	8.52	8.66	9.29
SMCSD	Central Bay	1.8	1.22	1.06	1.03	1.11	1.13	1.02	1.06	0.943	1.08	0.885	1.05
SASM	Central Bay	3.6	1.95	1.87	1.74	1.77	1.94	1.79	1.70	1.98	1.80	1.80	1.83
SVCW	South Bay	29	11.8	11.0	11.9	12.5	13.1	12.5	13.3	12.6	11.3	11.4	12.2
Sonoma Valley[d]	San Pablo Bay	3	0	0	0	0	0.0549	0	0	0	0	0	0.00549
South SF	South Bay	13	8.43	8.34	7.46	7.41	7.13	7.21	7.50	6.97	6.45	7.17	7.41
Sunnyvale	Lower South Bay	29.5	9.02	8.94	7.71	8.04	9.34	8.54	9.06	8.38	9.57	9.56	8.82
Treasure Island	Central Bay	2	0.281	0.296	0.275	0.273	0.277	0.306	0.307	0.253	0.238	0.272	0.278
Vallejo	San Pablo Bay	15.5	8.75	8.73	8.21	8.40	8.70	7.94	8.10	7.75	7.66	7.42	8.17
West County	Central Bay	28.5	6.55	6.09	5.61	8.74	8.65	8.67	10.2	6.16	5.76	5.53	7.19
Total [e]		**827**	**393**	**374**	**351**	**372**	**396**	**383**	**394**	**363**	**339**	**337**	**370**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Based on average values from May 1 through September 30.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-3. Discharge: Annual Average by Subembayment, Flow (mgd)

Subembayment	Permitted Capacity [a]	2012/ 2013 [b]	2013/ 2014 [b]	2014/ 2015 [b]	2015/ 2016 [b]	2016/ 2017 [b]	2017/ 2018 [b]	2018/ 2019 [b]	2019/ 2020 [b]	2020/ 2021 [b]	2021/ 2022 [b]	10-Year Average
Suisun Bay	100	58.9	55.3	53.5	55.1	71.9	58.6	64.1	55.6	52.1	56.9	58.2
San Pablo Bay [c]	62.8	32.1	30.0	29.8	30.2	44.4	27.6	37.7	25.5	19.7	25.6	30.3
Central Bay	167	78.9	75.2	70.3	75.9	98.3	75.3	88.4	68.5	62.9	74.2	76.9
South Bay	262	157	154	151	156	175	154	162	145	135	142	153
Lower South Bay	236	124	114	110	113	125	117	127	114	104	101	115
Total	**827**	**451**	**428**	**415**	**430**	**515**	**433**	**480**	**408**	**374**	**399**	**433**

a. Based on ADWF permitted capacity.
b. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
c. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-4. Discharge: Dry Season by Subembayment, Flow (mgd)

Subembayment	Permitted Capacity [a]	2013 [b]	2014 [b]	2015 [b]	2016 [b]	2017 [b]	2018 [b]	2019 [b]	2020 [b]	2021 [b]	2022 [b]	10-Year Average	Trend [d,e]
Suisun Bay	100	51.7	49.8	44.2	47.8	56.1	51.6	55.1	51.9	47.0	48.7	50.4	None
San Pablo Bay [c]	62.8	15.8	16.6	14.4	14.8	17.4	14.5	17.3	14.1	13.1	12.7	15.0	Down (-2.2%/yr)
Central Bay	167	66.1	61.9	57.3	63.5	68.2	64.9	69.5	62.4	57.9	58.0	63.0	None
South Bay	262	145	140	137	142	145	142	142	132	126	128	138	Down (-1.2%/yr)
Lower South Bay	236	115	106	98.3	104	108	110	110	103	94.9	90.0	104	Down (-1.5%/yr)
Total	**827**	**393**	**374**	**351**	**372**	**396**	**383**	**394**	**363**	**339**	**337**	**370**	**Down (-1.1%/yr)**

a. Based on ADWF permitted capacity.
b. Based on average values from May 1 through September 30.
c. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 50. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.
e. The percent change represents the change per year as a percentage of the average value over the entire dataset (2013-2022) (not considered if trend is “None”).

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5.2 Total Ammonia

The historical average monthly discharge loads from October 2012 through September 2022 are presented in Figure 5-2. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) discharge loads were calculated based on reported loads in Table 5-5 and Table 5-6, respectively. In addition, the annual average and dry season average monthly discharge loads and concentrations for each Subembayment are provided in Table 5-7 through Table 5-10, respectively.

A summary of the discharge data review findings is as follows **(new findings for 2021/2022 in bold)**:

- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- **Both the average annual and dry season values for this past year (refer to Table 5-5 and Table 5-6, respectively) increased as compared to the year 2020/2021 dataset. Note: the 2020/2021 dataset had the lowest loads since sampling began in 2012 (regardless of average annual or dry season).** The total annual average and dry season ammonia loads increased from 2012/2013 to 2016/2017 season, remained relatively steady between 2016/2017 and 2018/2019, declined to their lowest value in 2020/2021, **and increased through 2021/2022**.
- **Average Annual Loads: the overall loads increased approximately 1,900 kg N/d compared to last year. Despite an increase, this past year's dataset was still 500 kg N/d lower than the 10-year average. The two largest contributors to the increase were EBMUD (Central Bay Discharger) and SFPUC Southeast (South Bay Discharger) at 1,060 and 400 kg N/d, respectively, compared to last year. Note: EBMUD implemented a full-scale demonstration during the 2021 dry season. This demonstration was not implemented in 2022 and the ammonia loads reverted back to pre-COVID values such as those seen from 2017 to 2019. Other notable dischargers with increases greater than 150 compared to last year were SVCW (240 kg N/d increase), Pinole (160 kg N/d), and EBDA (340 kg N/d increase). Note: the increase at Pinole suggests that the recent upgrades to remove ammonia and TIN loads are not being implemented as designed. In contrast, several dischargers had a decline in loads compared to last year. Specifically, those with a decrease greater than 50 kg N/d compared to last year were CCCSD (140 kg N/d decrease), Delta Diablo (80 kg N/d decrease), South SF (90 kg N/d decrease), and Vallejo (59 kg N/d decrease). Note: Lower South Bay Dischargers already fully nitrify and thus one would not expect to see a decline in ammonia loads.**
- **Dry Season Loads: the overall loads increased approximately 2,200 kg N/d compared to last year. Despite this, the 2022 dry season loads were still 700 kg N/d less than the 10-year average. The two largest contributors to the increase were similar to the average annual, whereby EBMUD (Central Bay Discharger) and SFPUC Southeast (South Bay Discharger) increase 1,440 and 530 kg N/d compared to last year. As noted, EBMUD implemented a full-scale demonstration during the 2021 dry season. This demonstration was not implemented in 2022 and the ammonia loads reverted back to pre-COVID values such as those seen from 2017 to 2019. It is unclear why SFPUC Southeast had such a loading increase. Other notable load increases greater**

than 100 kg N/d compared to last year were from EBDA (increase of 240 kg N/d), Pinole (increase of 123 kg N/d), San Mateo (increase of 230 kg N/d), and South SF (increase of 160 kg N/d). As previously noted, the increase at Pinole suggests that the recent upgrades to remove ammonia and TIN loads are not being implemented as designed. In contrast, several of the dischargers saw a decline in loads compared to last year. Those with a reduction of at least 60 kg N/d compared to last year were Central San (decrease of 310 kg N/d), Vallejo (decrease of 92 kg N/d), and West County (decrease of 69 kg N/d).

- <u>Dry Season Trending:</u> **the dry season trending analysis suggests that Suisun Bay, San Pablo Bay, and Central Bay all have an upward trend when evaluated over the entire 10-years of dry season data. In contrast, the South Bay and Lower South Bay dry season trending suggests a downward trend. Note: all the Lower South Bay dischargers are required to fully nitrify so the loads are already relatively in this Subembayment (<<600 kg N/d, regardless of average annual or dry season). As for baywide, the trending analysis suggests no emerging trend over the entire 10-years of dry season data.** This trending is based on the least-squares correlation test selected as the basis for trends analysis over the entire dry season dataset since sampling began in 2012 (see Section 3.8).
  - **Suisun Bay: while the overall dataset suggests an upward trend, the dry season loads have been relatively flat since 2016 (with the exception of 2020 when the dry season loads peaked). The dry season loads started to decrease in 2020/2021 with a decline continuing in 2021/2022. The 2022 dry season loads reduced by 600 kg N/d since the 2020 dry season peak.**
  - **San Pablo Bay: while the overall dataset suggests an upward trend, the dry season loads show a decreasing trend since the peak in 2016. The 2022 dry season loads increased 10 kg N/d over the last year.**
  - **Central Bay: while the overall dataset suggests an upward trend, the dry season loads have continually reduced since the peak in 2017 (with the exception in 2022). The 2022 dry season loads showed a sudden increase of 1,100 kg N/d compared to the 2020 dry season loads. This increase is attributed to a blend of EBMUD not implementing full-scale nutrient removal demonstration as they did in the 2021 dry season.**
- Dischargers to the South Bay Subembayment account for over half of the load discharged to the Bay, regardless of annual or dry season average (refer to Figure 5-2, Table 5-7, or Table 5-8).
- The nutrient concentrations are calculated based on flow-weighted values (refer to Table 5-9 and Table 5-10). The key findings on concentrations are as follows:
  - **The most recent dataset has discharge concentrations that are at or near the highest levels for all Subembayments since sampling began in 2012 (except Lower South Bay). The relatively high discharge concentrations over the past year is attributed to the ongoing drought and water conservation as the baywide dry season flows were the lowest since monitoring began in 2012. Furthermore, all the Lower South Bay dischargers are required to fully nitrify (i.e., biologically convert ammonia to nitrite plus nitrate) which is why the concentrations have been reliably less than 1.3 mg N/L since sampling began in 2012.**

- Dischargers to Central Bay have the highest discharge concentrations of all the Subembayments. Several dischargers in the Central Bay Subembayment, such as EBMUD, receive trucked waste which can increase discharge concentrations/loads.

An overall discussion of the results is provided in Section 7.6.2.

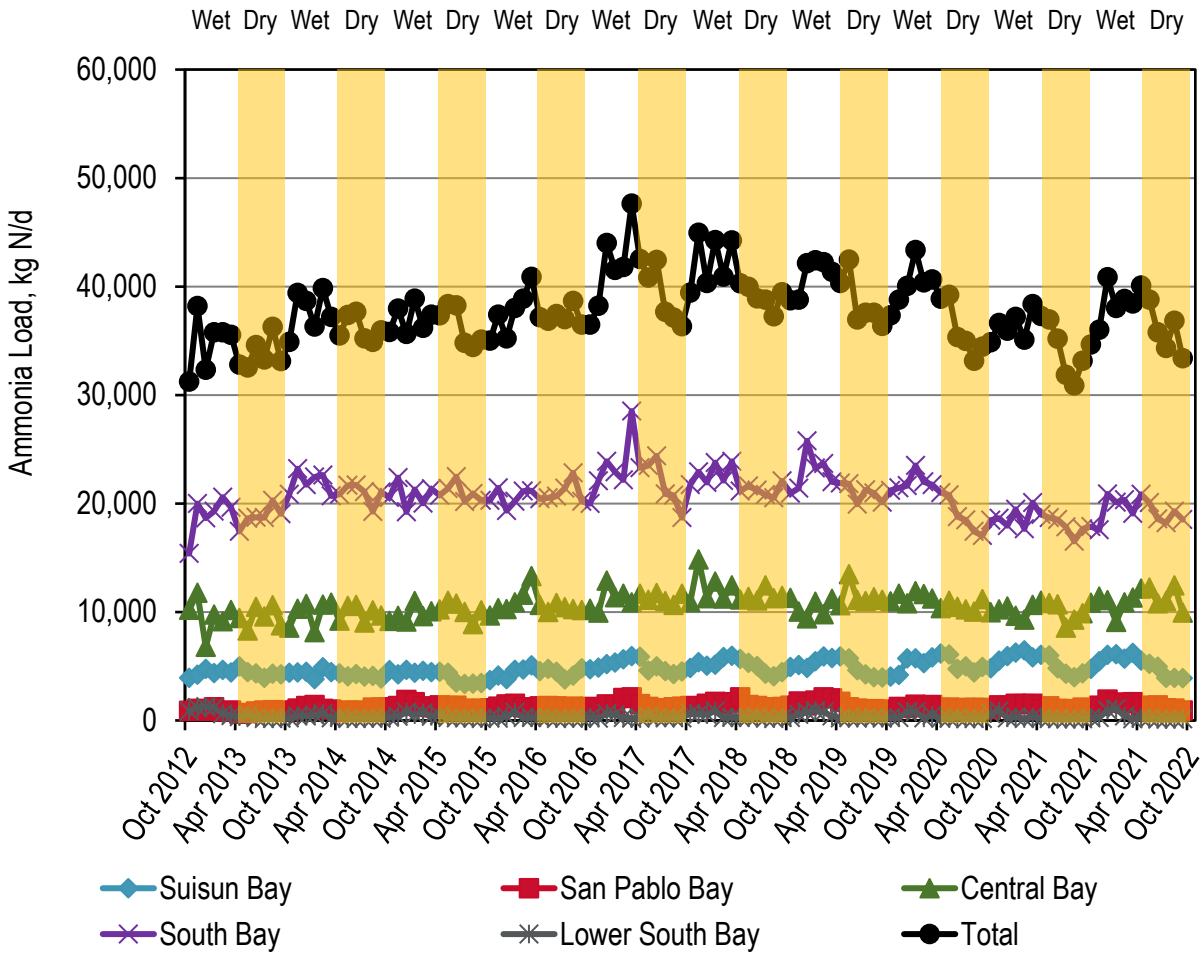

Figure 5-2. Discharge: Average Monthly Discharge Total Ammonia Loads

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Table 5-5. Discharge: Annual Average by Discharger, Total Ammonia (kg N/d)

Discharger	Subembayment	2012/ 2013 [a,b]	2013/ 2014 [a,b]	2014/ 2015 [a,b]	2015/ 2016 [a,b]	2016/ 2017 [a,b]	2017/ 2018 [a,b]	2018/ 2019 [a,b]	2019/ 2020 [a,b]	2020/ 2021 [a,b]	2021/ 2022 [a,b]	10-Year Average
American Canyon	San Pablo Bay	1.77	5.43	3.25	1.54	2.31	4.83	4.12	1.33	0.390	0.650	2.56
Benicia	San Pablo Bay	190	159	186	194	175	216	187	174	200	165	185
Burlingame	South Bay	305	251	259	274	323	320	351	240	243	284	285
CCCSD	Suisun Bay	3,610	3,510	3,210	3,490	3,610	3,560	3,530	3,870	4,210	4,070	3,670
CMSA	Central Bay	720	779	603	753	1,010	861	1,060	1,070	987	993	884
Port Costa	San Pablo Bay	0.255	0.337	0.344	0.431	0.716	0.885	0.565	3.65	0.793	0.594	0.857
Delta Diablo	Suisun Bay	757	740	903	873	1,420	1,500	1,480	1,290	1,130	1,050	1,110
EBDA	South Bay	6,820	7,010	7,320	7,330	7,320	7,830	7,680	8,070	6,670	7,010	7,310
EBMUD	Central Bay	8,070	8,350	8,630	9,010	9,390	10,100	8,810	8,920	8,130	9,190	8,860
FSSD	Suisun Bay	1.45	1.68	1.56	1.91	2.67	7.66	9.09	5.17	3.85	15.0	5.01
Las Gallinas[c]	San Pablo Bay	10.7	14.8	11.6	23.4	34.7	34.6	54.1	31.8	43.9	17.4	27.7
Paradise Cove	Central Bay	0.443	0.249	0.0102	1.35	0.0386	0.0197	0.0452	0.0624	0.155	0.367	0.274
Tiburon	Central Bay	40.2	48.3	53.0	55.0	33.6	55.1	48.7	29.4	32.3	31.8	42.7
Millbrae	South Bay	237	233	237	265	292	260	284	281	269	232	259
Mt. View	Suisun Bay	3.09	0.824	2.08	3.80	2.61	2.53	4.25	3.60	3.90	1.25	2.79
Napa[c]	San Pablo Bay	44.1	17.0	6.35	16.5	103	38.1	158	25.0	8.52	34.4	45.1
Novato[c]	San Pablo Bay	7.25	10.0	17.5	6.92	40.6	16.5	57.1	23.1	22.1	23.3	22.4
Palo Alto	Lower South Bay	13.4	12.8	17.7	17.6	12.0	15.8	10.6	8.90	12.3	9.11	13.0
Petaluma[c]	San Pablo Bay	3.22	7.17	2.82	5.43	2.57	3.15	7.47	2.94	2.22	4.42	4.14
Pinole	San Pablo Bay	187	202	229	258	242	273	115	171	218	381	228
Rodeo	San Pablo Bay	3.47	5.05	3.76	6.96	9.30	3.84	4.78	18.5	11.9	32.7	10.0
SFO Airport	South Bay	227	242	132	141	212	115	82.4	3.75	50.5	68.1	127
SFPUC Southeast	South Bay	7,280	9,580	8,630	8,400	9,780	8,460	8,380	7,110	6,400	6,800	8,080
San Jose	Lower South Bay	280	204	197	232	183	206	215	197	139	131	198
San Mateo	South Bay	1,320	1,300	1,210	1,110	1,250	1,320	1,520	1,210	1,250	1,250	1,270
SMCSD	Central Bay	51.0	41.6	50.2	44.7	73.7	94.8	72.8	73.2	75.8	60.6	63.9
SASM	Central Bay	49.5	45.5	39.0	62.2	26.7	67.2	107	85.6	91.8	116	69.1
SVCW	South Bay	1,900	1,980	2,240	2,540	2,390	2,670	2,610	2,560	2,380	2,620	2,390
Sonoma Valley[c]	San Pablo Bay	1.53	2.45	0.178	0.130	0.788	0	0.411	0	0	0.130	0.562
South SF	South Bay	772	828	863	746	1,030	1,000	1,010	943	1,110	1,020	931
Sunnyvale	Lower South Bay	305	86.5	163	30.0	101	171	196	116	133	184	149
Treasure Island	Central Bay	0.883	2.61	8.36	8.51	5.09	4.76	4.44	3.64	3.22	3.50	4.50
Vallejo	San Pablo Bay	426	622	854	749	784	845	849	732	733	674	727
West County	Central Bay	650	651	620	812	720	705	877	769	714	694	721
Total [d]		**34,300**	**37,000**	**36,700**	**37,500**	**40,600**	**40,800**	**39,800**	**38,000**	**35,300**	**37,200**	**37,700**

a. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
b. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
c. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-6. Discharge: Dry Season by Discharger, Total Ammonia (kg N/d)

Discharger	Subembayment	2013 [a,b]	2014 [a,b]	2015 [a,b]	2016 [a,b]	2017 [a,b]	2018 [a,b]	2019 [a,b]	2020 [a,b]	2021 [a,b]	2022 [a,b]	10-Year Average
American Canyon	San Pablo Bay	1.56	2.21	2.06	1.13	1.74	2.93	1.93	0.990	0.374	0.454	1.54
Benicia	San Pablo Bay	190	149	143	192	195	195	140	188	199	157	175
Burlingame	South Bay	311	209	241	246	220	366	224	219	214	216	247
CCCSD	Suisun Bay	3,540	3,390	2,960	3,510	3,240	3,250	3,170	3,740	3,830	3,520	3,420
CMSA	Central Bay	740	780	619	915	1,020	815	1,020	1,060	993	998	897
Port Costa	San Pablo Bay	0.319	0.0381	0.133	--	0.290	0.296	0.461	0.749	0.613	0.525	0.380
Delta Diablo	Suisun Bay	709	674	650	858	1,320	1,360	1,310	1,280	839	846	985
EBDA	South Bay	6,290	6,500	7,210	6,620	6,250	7,320	7,260	6,820	5,950	6,190	6,640
EBMUD	Central Bay	8,020	8,490	8,770	8,480	9,340	9,770	9,460	8,610	7,940	9,380	8,830
FSSD	Suisun Bay	0.938	1.27	1.02	1.26	1.84	6.83	7.41	3.18	3.47	12.1	3.93
Las Gallinas[c]	San Pablo Bay	0	0	0	0	2.32	0	11.2	0.722	0	0	1.42
Paradise Cove	Central Bay	0.0284	0.249	0.0119	1.35	0.0169	0.0197	0.0677	0.121	0.258	0.0541	0.218
Tiburon	Central Bay	32.2	48.3	46.2	55.0	29.4	57.2	-	27.5	43.3	33.2	41.4
Millbrae	South Bay	243	206	235	292	290	249	305	266	274	242	260
Mt. View	Suisun Bay	1.31	0.754	2.21	3.66	1.19	3.49	4.39	3.40	1.81	1.35	2.36
Napa[c]	San Pablo Bay	0	0.415	0	0	0	0	0	0	0	0	0.0415
Novato[c]	San Pablo Bay	0.305	2.39	1.20	0.902	18.0	2.40	20.5	5.15	1.44	0	5.26
Palo Alto	Lower South Bay	15.1	13.1	17.3	25.8	13.3	26.1	8.29	8.32	9.39	11.6	14.8
Petaluma[c]	San Pablo Bay	0	0	0	0	0	0	0	0	0	0	0
Pinole	San Pablo Bay	210	203	220	332	191	266	60.9	174	209	332	220
Rodeo	San Pablo Bay	0.780	3.66	2.14	5.44	5.24	1.26	3.80	36.2	13.8	19.8	9.19
SFO Airport	South Bay	234	263	142	192	337	48.9	146	3.84	61.7	82.5	151
SFPUC Southeast	South Bay	7,910	9,580	8,930	9,300	10,100	8,670	7,980	6,730	6,770	7,300	8,330
San Jose	Lower South Bay	229	158	182	162	197	211	222	172	116	94.5	174
San Mateo	South Bay	1,530	1,480	1,200	1,290	1,190	1,420	1,550	1,240	1,030	1,260	1,320
SMCSD	Central Bay	49.3	50.2	45.8	59.3	105	132	126	66.3	69.1	52.5	75.6
SASM	Central Bay	54.4	32.7	25.1	49.8	22.1	100	132	94.6	73.0	164	74.8
SVCW	South Bay	1,760	1,900	2,310	2,470	2,390	2,300	2,480	2,320	2,470	2,410	2,280
Sonoma Valley[c]	San Pablo Bay	0	0	0	0	0.0182	0	0	0	0	0	0.00182
South SF	South Bay	781	827	775	716	852	882	864	895	1,070	1,230	890
Sunnyvale	Lower South Bay	16.8	11.8	12.5	15.6	60.8	9.43	2.97	5.38	12.5	16.7	16.5
Treasure Island	Central Bay	1.23	4.55	10.5	4.16	4.05	6.65	3.41	3.81	3.73	3.01	4.51
Vallejo	San Pablo Bay	435	645	795	705	752	767	791	722	692	600	690
West County	Central Bay	653	639	665	815	725	678	871	712	714	645	712
Total [d]		**34,000**	**36,300**	**36,200**	**37,300**	**38,900**	**38,900**	**38,200**	**35,400**	**33,600**	**35,800**	**36,500**

a. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
b. Based on average values from May 1 through September 30.
c. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-7. Discharge: Annual Average by Subembayment, Total Ammonia (kg N/d)

Subembayment	2012/ 2013 [a]	2013/ 2014 [a]	2014/ 2015 [a]	2015/ 2016 [a]	2016/ 2017 [a]	2017/ 2018 [a]	2018/ 2019 [a]	2019/ 2020 [a]	2020/ 2021 [a]	2021/ 2022 [a]	10-Year Average
Suisun Bay	4,380	4,250	4,120	4,370	5,030	5,080	5,020	5,170	5,340	5,140	4,790
San Pablo Bay [b]	874	1,040	1,320	1,260	1,390	1,440	1,440	1,180	1,240	1,330	1,250
Central Bay	9,570	9,870	9,960	10,700	11,200	11,900	11,000	11,000	10,000	11,100	10,600
South Bay	18,900	21,400	20,900	20,800	22,600	22,000	21,900	20,400	18,400	19,300	20,700
Lower South Bay	598	303	378	280	296	393	421	321	284	325	360
Total	**34,300**	**37,000**	**36,700**	**37,500**	**40,600**	**40,800**	**39,800**	**38,000**	**35,300**	**37,200**	**37,800**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-8. Discharge: Dry Season by Subembayment, Total Ammonia (kg N/d)

Subembayment	2013 [a]	2014 [a]	2015 [a]	2016 [a]	2017 [a]	2018 [a]	2019 [a]	2020 [a]	2021 [a]	2022 [a]	10-Year Average	Trend [c,d]
Suisun Bay	4,250	4,070	3,610	4,380	4,570	4,620	4,500	5,020	4,680	4,380	4,410	Up (1.8%/yr)
San Pablo Bay [b]	835	1,000	1,160	1,240	1,160	1,230	1,030	1,130	1,120	1,110	1,100	Up (1.4%/yr)
Central Bay	9,540	10,000	10,200	10,300	11,200	11,600	11,600	10,600	9,840	11,300	10,600	Up (1.1%/yr)
South Bay	19,100	21,000	21,000	21,100	21,600	21,300	20,800	18,500	17,800	18,900	20,100	Down (-1.1%/yr)
Lower South Bay	260	183	212	203	271	246	233	186	138	123	206	Down (-4.8%/yr)
Total	**34,000**	**36,300**	**36,200**	**37,300**	**38,900**	**38,900**	**38,200**	**35,400**	**33,600**	**35,800**	**36,500**	**None**

a. Based on average values from May 1 through September 30.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 50. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.
d. The percent change represents the change per year as a percentage of the average value over the entire dataset (2013-2022) (not considered if trend is “None”).

Table 5-9. Discharge: Annual Average by Subembayment, Total Ammonia (mg N/L)

Subembayment	2012/ 2013 [a,b]	2013/ 2014 [a,b]	2014/ 2015 [a,b]	2015/ 2016 [a,b]	2016/ 2017 [a,b]	2017/ 2018 [a,b]	2018/ 2019 [a,b]	2019/ 2020 [a,b]	2020/ 2021 [a,b]	2021/ 2022 [a,b]	10 Year Average [b]
Suisun Bay	19.6	20.3	20.3	21.0	18.5	22.9	20.7	24.5	27.1	24	21.7
San Pablo Bay [c]	7.21	9.20	11.7	11.0	8.31	13.7	10.1	12.3	16.6	14	10.9
Central Bay	32.1	34.8	37.6	37.2	30.3	41.6	32.8	42.2	42.2	39	36.6
South Bay	31.6	36.8	36.5	35.3	34.1	37.6	35.7	37.3	36.0	36	35.6
Lower South Bay	1.28	0.701	0.905	0.654	0.624	0.886	0.875	0.745	0.723	1	0.827
Total	**20.1**	**22.8**	**23.4**	**23.0**	**20.8**	**24.9**	**21.9**	**24.6**	**24.9**	**24.6**	**23.0**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
b. Calculation based on a flow-weighted average values.
c. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-10. Discharge: Dry Season by Subembayment, Total Ammonia (mg N/L)

Subembayment	2013 [a,b]	2014 [a,b]	2015 [a,b]	2016 [a,b]	2017 [a,b]	2018 [a,b]	2019 [a,b]	2020 [a,b]	2021 [a,b]	2022 [a,b]	10-Year Average [b]
Suisun Bay	21.7	21.6	21.6	24.2	21.5	23.7	21.6	25.6	26.3	24	23.1
San Pablo Bay [d]	14.0	16.0	21.4	22.1	17.7	22.6	15.7	21.2	22.7	23	19.4
Central Bay	38.2	42.9	46.8	43.1	43.6	46.9	44.1	44.8	44.9	51	44.6
South Bay	34.9	39.5	40.7	39.3	39.3	39.5	38.8	37.1	37.5	39	38.6
Lower South Bay	0.598	0.458	0.569	0.516	0.662	0.592	0.560	0.476	0.383	0	0.523
Total	**22.8**	**25.6**	**27.3**	**26.5**	**26.0**	**26.8**	**25.6**	**25.8**	**26.2**	**28.1**	**26.0**

a. Based on average values from May 1 through September 30.
b. Calculation based on a flow-weighted average values.
c. Dry season trending not applied to concentrations as the emphasis is on load. Focusing on concentration is limiting as it does not consider the impact of flow.
d. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

5.3 Nitrate + Nitrite (NOx)

The historical average monthly discharge loads from October 2012 through September 2022 are presented in Figure **5-3**. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) discharge loads were calculated based on reported loads in Table 5-11 and Table 5-12, respectively. In addition, the annual average and dry season average monthly discharge loads and concentrations for each Subembayment are provided in Table 5-13 through Table 5-16, respectively.

A summary of the discharge data review findings is as follows **(new findings for 2021/2022 in bold):**

- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- **Both the annual average and dry season loads for the 2021/2022 dataset reflect the lowest loads since sampling began in 2012 (i.e., October 2012 through September 2022; refer to Table 5-11 through Table 5-14).**
- **<u>Average Annual Loads:</u> the overall loads decreased approximately 600 kg N/d compared to last year. In fact, this past year's dataset was 3,100 kg N/d lower than the 10-year average. The highest loads occurred during the first year of sampling and have subsequently decreased annually ever since (except for excursions in 2016/2017 and 2018/2019). The largest POTW (San Jose, Lower South Bay discharger) had a decrease of 620 kg N/d since last year. This reduction is attributed to San Jose continued optimization and focus on reducing NOx and related TIN discharge loads. Other notable reductions were from EBDA (decrease of 165 kg N/d) and Sunnyvale (decrease of 97 kg N/d). In both cases, the dischargers further optimized their facilities for TIN loads which directly reduced NOx loads. In contrast, Palo Alto (Lower South Bay Discharger) and FSSD (Suisun Bay Discharger) saw increases of 200 kg N/d and 100 kg N/d, respectively, compared to last year. In both cases, the increase in NOx loads is directly linked to an increase in discharge TIN loads.**
- **<u>Dry Season Loads:</u> the overall loads decreased approximately 790 kg N/d compared to last year. In fact, this past year's data was 2,800 kg N/d lower than the 10-year average. The highest loads occurred during the first year of sampling and have subsequently decreased annually ever since (except for an excursion in 2015). The largest POTW (San Jose, Lower South Bay discharger) had a decrease of 870 kg N/d since last year. This reduction is attributed to San Jose continued optimization and focus on reducing NOx and related TIN discharge loads. Other notable reductions were from EBDA (decrease of 230 kg N/d) and San Mateo (decrease of 112 kg N/d). The former optimized their facility (specifically Oro Loma/Castro Valley Sanitary District) for TIN loads which directly reduced NOx loads. Furthermore, SASM's loads decreased their loads 89 kg N/d compared to last year. SASM's loads decreased due to less efficient nitrification as the biological removal of ammonia results in the formation of NOx loads. SASM's biotowers that remove ammonia have struggled to perform since upgrades several years back. In contrast, Palo Alto (Lower South Bay Discharger) and FSSD (Suisun Bay Discharger) saw increases of 230 kg N/d and 129 kg N/d, respectively, compared to last year. In both cases, the increase in NOx loads is directly linked to an increase in discharge TIN loads.**

- **<u>Dry Season Trending:</u> the dry season trending analysis for all five Subembayments and baywide suggests a downward trend when evaluated over the entire 10-years of dry season data. This was anticipated given the steady decline in loads over time.** This trending is based on the least-squares correlation test selected as the basis for trends analysis over the entire dry season dataset since sampling began in 2012 (see Section 3.8).
- The nutrient concentrations are calculated based on flow-weighted values (refer to Table 5-15 and Table 5-16). The key findings on concentrations are as follows:
  - **The most recent dataset has the lowest total concentrations since sampling began in 2012 (regardless of average annual versus dry season).**
  - **Dischargers to Lower South Bay have the highest discharge concentrations compared to the dischargers to other Subembayments as all of them fully nitrify (i.e., biologically convert ammonia to nitrite plus nitrate).**
  - **Dischargers to both Suisun Bay and San Pablo Bay have flow-weighted discharge concentrations greater than 5 mg N/L as both Subembayments have some dischargers that fully nitrify and convert the ammonia to nitrite plus nitrate (e.g., Petaluma). Both Subembayments experienced an increase of NOx loads for both annual average and dry season compared to last year.**
  - **As agencies implement nitrification technologies (e.g., Oro Loma/Castro Valley Sanitary District), the discharge NOx concentrations (and loads) will increase as the ammonia is biologically converted to nitrite plus nitrate. In such instances, the TIN concentrations (and loads) are anticipated to decline.**

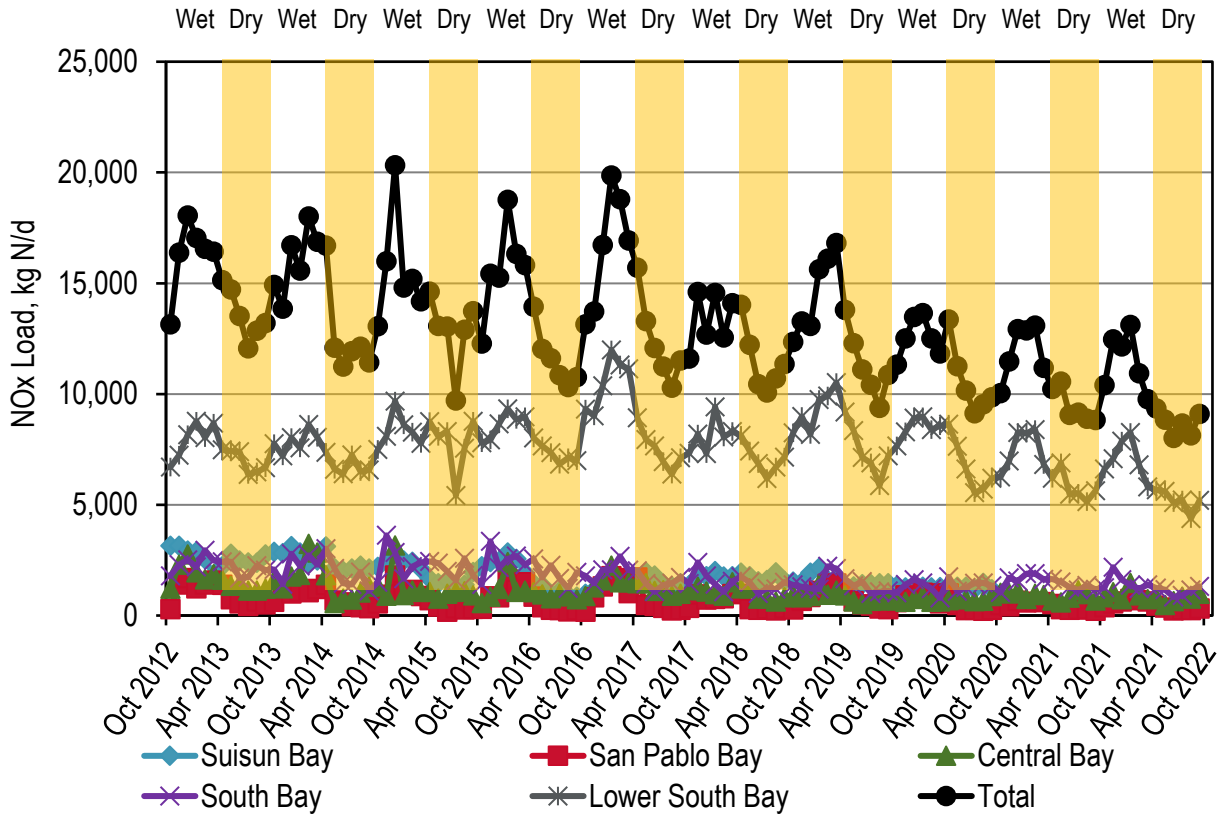

Figure 5-3. Discharge: Average Monthly Discharge NOx Loads

Table 5-11. Discharge: Annual Average Values by Discharger, NOx (kg N/d)

Discharger	Subembayment	2012/ 2013 [a,b]	2013/ 2014 [a,b]	2014/ 2015 [a,b]	2015/ 2016 [a,b]	2016/ 2017 [a,b]	2017/ 2018 [a,b]	2018/ 2019 [a,b]	2019/ 2020 [a,b]	2020/ 2021 [a,b]	2021/ 2022 [a,b]	10-Year Average
American Canyon	San Pablo Bay	68.6	74.9	41.2	30.6	39.1	31.9	33.2	31.8	17.5	18.3	38.7
Benicia	San Pablo Bay	35.1	45.5	47.5	39.3	67.9	35.2	34.5	37.3	28.4	46.2	41.7
Burlingame	South Bay	92.9	182	33.2	18.0	43.0	39.2	115	220	145	51.8	94.0
CCCSD	Suisun Bay	270	293	461	309	392	284	255	108	55.8	94.9	252
CMSA	Central Bay	124	67.2	158	115	171	125	58.4	95.2	104	70.3	109
Port Costa	San Pablo Bay	0	0	0	1.30	1.13	0.700	0.143	0.573	0.776	0.744	0.536
Delta Diablo	Suisun Bay	936	774	382	450	31.4	34.1	48.2	46.1	68.6	55.0	283
EBDA	South Bay	1,050	822	994	1,070	1,000	852	818	748	1,050	885	930
EBMUD	Central Bay	1,120	1,090	763	521	517	573	517	391	556	584	664
FSSD	Suisun Bay	1,310	1,330	1,030	874	914	1,290	1,120	1,030	1,010	1,110	1,100
Las Gallinas[c]	San Pablo Bay	118	104	85.9	97.7	104	101	114	136	96.5	44.5	100
Paradise Cove	Central Bay	1.64	0	2.53	0.180	2.21	2.11	1.77	1.65	1.39	0.599	1.41
Tiburon	Central Bay	18.6	7.78	4.81	7.60	11.5	0.382	1.04	22.5	0.581	17.5	9.23
Millbrae	South Bay	3.37	1.30	2.14	2.14	2.28	0.766	2.10	6.85	9.95	12.8	4.37
Mt. View	Suisun Bay	118	128	117	119	139	122	111	116	95.7	69.3	113
Napa[c]	San Pablo Bay	129	158	165	154	156	123	149	127	36.5	84.6	128
Novato[c]	San Pablo Bay	137	126	150	132	157	114	124	85.3	64.8	63.4	116
Palo Alto	Lower South Bay	2,340	2,150	2,110	2,630	2,550	2,160	2,300	2,220	1,940	2,140	2,250
Petaluma[c]	San Pablo Bay	22.0	4.61	20.4	10.1	13.8	1.72	16.7	3.74	3.09	2.71	9.89
Pinole	San Pablo Bay	114	93.1	48.4	51.4	78.1	44.1	104	60.3	54.7	28.6	67.7
Rodeo	San Pablo Bay	32.9	25.6	29.5	23.4	35.1	28.7	33.5	20.1	19.6	18.3	26.7
SFO Airport	South Bay	23.6	15.4	22.0	20.6	13.6	23.8	24.6	21.5	4.63	4.75	17.4
SFPUC Southeast	South Bay	645	757	963	648	484	401	399	122	112	94.8	462
San Jose	Lower South Bay	4,520	4,570	5,390	4,760	5,610	4,720	5,290	4,680	3,940	3,320	4,680
San Mateo	South Bay	129	102	94.8	190	105	112	12.7	121	122	139	113
SMCSD	Central Bay	77.4	76.2	76.8	87.6	62.3	41.4	62.3	50.5	63.0	55.1	65.3
SASM	Central Bay	162	158	134	172	138	110	92.7	115	124	99.6	131
SVCW	South Bay	75.7	67.3	62.3	53.0	68.8	23.3	25.9	23.9	33.9	51.4	48.6
Sonoma Valley[c]	San Pablo Bay	27.9	6.76	23.1	10.5	81.2	0	29.5	0	0	0.790	18.0
South SF	South Bay	211	104	76.8	151	44.1	34.0	32.7	61.0	13.5	55.7	78.4
Sunnyvale	Lower South Bay	589	611	563	562	852	707	769	694	766	669	678
Treasure Island	Central Bay	9.96	11.2	10.6	8.91	11.2	7.22	8.73	17.3	15.8	13.4	11.4
Vallejo	San Pablo Bay	341	224	106	153	122	95.0	105	114	111	152	152
West County	Central Bay	114	150	56.0	144	434	169	121	40.6	27.1	27.8	128
Total [d]		**14,900**	**14,300**	**14,200**	**13,600**	**14,500**	**12,400**	**12,900**	**11,600**	**10,700**	**10,100**	**12,900**

a. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
b. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
c. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-12. Discharge: Dry Season Discharges by Discharger, NOx (kg N/d)

Discharger	Subembayment	2013 [a,b]	2014 [a,b]	2015 [a,b]	2016 [a,b]	2017 [a,b]	2018 [a,b]	2019 [a,b]	2020 [a,b]	2021 [a,b]	2022 [a,b]	10-Year Average
American Canyon	San Pablo Bay	109	77.5	28.7	19.0	23.0	28.6	27.3	18.4	15.0	10.8	35.8
Benicia	San Pablo Bay	36.0	50.0	54.8	39.3	45.8	41.0	56.5	33.6	28.0	46.8	43.2
Burlingame	South Bay	125	78.2	31.6	27.9	50.6	22.7	227	243	48.5	81.5	93.6
CCCSD	Suisun Bay	181	243	417	196	368	302	247	154	64.4	175	235
CMSA	Central Bay	104	60.5	103	48.8	196	139	68.5	105	111	89.0	102
Port Costa	San Pablo Bay	--	--	--	--	--	--	0.203	0.769	--	--	0.324
Delta Diablo	Suisun Bay	925	807	219	69.0	27.0	47.2	51.0	47.4	107	99.9	240
EBDA	South Bay	880	696	656	821	685	712	616	821	926	696	751
EBMUD	Central Bay	888	581	614	478	418	472	421	368	481	505	523
FSSD	Suisun Bay	1,360	968	806	653	1,080	1,230	1,010	966	901	1,030	1,000
Las Gallinas[c]	San Pablo Bay	0	0	0	0	6.67	0	42.9	46.1	0	0	9.57
Paradise Cove	Central Bay	2.49	0.0374	2.60	0.180	2.60	2.11	2.09	0.848	0.545	0.783	1.43
Tiburon	Central Bay	14.5	7.78	6.99	7.60	15.6	0.339		26.3	0.0727	0.681	8.88
Millbrae	South Bay	4.31	1.20	1.58	0.672	0.887	0.923	2.32	9.60	1.64	2.53	2.57
Mt. View	Suisun Bay	99.6	112	101	118	115	107	101	123	88.5	40.3	101
Napa[c]	San Pablo Bay	0	49.7	0	0	0	0	0	0	0	0	4.97
Novato[c]	San Pablo Bay	39.6	39.9	36.3	37.3	80.1	40.7	62.0	17.9	6.77	0	36.1
Palo Alto	Lower South Bay	2,530	2,130	2,210	2,620	2,110	2,190	1,940	1,920	1,990	2,220	2,190
Petaluma[c]	San Pablo Bay	0	0	0	0	0	0	0	0	0	0	0
Pinole	San Pablo Bay	133	103	47.2	9.16	44.2	55.8	109	68.4	71.9	37.3	67.9
Rodeo	San Pablo Bay	25.6	24.4	24.8	22.8	26.3	28.2	32.0	10.2	20.2	19.6	23.4
SFO Airport	South Bay	23.1	21.8	23.3	13.1	6.26	40.3	23.1	15.6	6.68	8.06	18.1
SFPUC Southeast	South Bay	738	688	1,100	581	455	381	267	49.2	66.9	102	443
San Jose	Lower South Bay	3,990	4,180	5,100	4,250	4,530	4,290	4,540	4,030	3,310	2,440	4,070
San Mateo	South Bay	6.26	5.81	77.9	78.9	94.1	61.4	4.83	76.8	195	83.0	68.4
SMCSD	Central Bay	83.8	72.5	88.9	81.6	42.4	15.2	32.5	56.0	75.2	59.8	60.8
SASM	Central Bay	136	130	126	140	132	79.0	43.7	140	146	56.9	113
SVCW	South Bay	121	40.6	74.1	45.3	55.2	18.4	26.6	30.1	31.8	54.0	49.7
Sonoma Valley[c]	San Pablo Bay	0	0	0	0	4.20	0	0	0	0	0	0.420
South SF	South Bay	135	79.3	104	198	66.4	49.2	43.4	79.9	22.0	45.5	82.3
Sunnyvale	Lower South Bay	344	359	312	325	569	382	614	385	433	443	417
Treasure Island	Central Bay	8.69	9.76	10.4	9.86	10.6	6.94	10.7	16.7	15.7	16.9	11.6
Vallejo	San Pablo Bay	317	206	104	131	118	86.5	110	98.3	122	169	146
West County	Central Bay	9.57	23.9	18.2	102	315	128	84.2	45.9	9.05	12.7	74.9
Total [d]		**13,300**	**11,800**	**12,500**	**11,100**	**11,700**	**11,000**	**10,800**	**10,000**	**9,290**	**8,540**	**11,000**

a. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
b. Based on average values from May 1 through September 30.
c. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-13. Discharge: Annual Average by Subembayment, NOx (kg N/d)

Subembayment	2012/ 2013 [a]	2013/ 2014 [a]	2014/ 2015 [a]	2015/ 2016 [a]	2016/ 2017 [a]	2017/ 2018 [a]	2018/ 2019 [a]	2019/ 2020 [a]	2020/ 2021 [a]	2021/ 2022 [a]	10-Year Average
Suisun Bay	2,630	2,530	1,990	1,750	1,480	1,730	1,580	1,300	1,230	1,330	1,750
San Pablo Bay [b]	986	828	718	702	854	575	748	616	433	460	699
Central Bay	1,630	1,560	1,200	1,050	1,350	1,030	863	734	891	870	1,120
South Bay	2,230	2,050	2,250	2,150	1,770	1,490	1,430	1,320	1,490	1,300	1,750
Lower South Bay	7,450	7,330	8,070	7,960	9,010	7,590	8,350	7,590	6,650	6,130	7,610
Total	**14,900**	**14,300**	**14,200**	**13,600**	**14,500**	**12,400**	**12,900**	**11,600**	**10,700**	**10,100**	**13,200**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-14. Discharge: Dry Season by Subembayment, NOx (kg N/d)

Subembayment	2013 [a]	2014 [a]	2015 [a]	2016 [a]	2017 [a]	2018 [a]	2019 [a]	2020 [a]	2021 [a]	2022 [a]	10-Year Average	Trend [c,d]
Suisun Bay	2,560	2,130	1,540	1,040	1,590	1,690	1,410	1,290	1,160	1,350	1,580	Down (-6.8%/yr)
San Pablo Bay [b]	572	479	296	259	348	281	440	294	264	284	368	Down (-8.1%/yr)
Central Bay	1,240	879	965	862	1,120	843	663	758	838	742	895	Down (-4.6%/yr)
South Bay	2,030	1,610	2,070	1,770	1,410	1,290	1,210	1,330	1,300	1,070	1,510	Down (-6.6%/yr)
Lower South Bay	6,870	6,660	7,620	7,190	7,210	6,860	7,090	6,340	5,730	5,100	6,670	Down (-2.7%/yr)
Total	**13,300**	**11,800**	**12,500**	**11,100**	**11,700**	**11,000**	**10,800**	**10,000**	**9,290**	**8,500**	**11,300**	**Down (-3.7%/yr)**

a. Based on average values from May 1 through September 30.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 45. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.
d. The percent change represents the change per year as a percentage of the average value over the entire dataset (2013-2022) (not considered if trend is “None”).

Table 5-15. Discharge: Annual Average by Subembayment, NOx (mg N/L)

Subembayment	2012/ 2013 [a,b]	2013/ 2014 [a,b]	2014/ 2015 [a,b]	2015/ 2016 [a,b]	2016/ 2017 [a,b]	2017/ 2018 [a,b]	2018/ 2019 [a,b]	2019/ 2020 [a,b]	2020/ 2021 [a,b]	2021/ 2022 [a,b]	10 Year Average [b]
Suisun Bay	11.8	12.1	9.81	8.41	5.43	7.82	6.32	6.18	6.22	6.16	7.94
San Pablo Bay [c]	8.44	7.59	6.36	6.15	5.08	5.51	5.24	6.38	5.81	4.75	6.11
Central Bay	5.46	5.49	4.52	3.66	3.62	3.60	2.58	2.83	3.74	3.09	3.85
South Bay	3.75	3.53	3.93	3.65	2.66	2.55	2.33	2.42	2.92	2.41	3.02
Lower South Bay	15.9	17.0	19.3	18.6	19.0	17.1	17.3	17.6	16.9	16.1	17.5
Total	**8.77**	**8.84**	**9.05**	**8.37**	**7.41**	**7.57**	**7.12**	**7.48**	**7.56**	**6.67**	**7.88**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
b. Calculation based on a flow-weighted average values.
c. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-16. Discharge: Dry Season by Subembayment, NOx (mg N/L)

Subembayment	2013 [a,b]	2014 [a,b]	2015 [a,b]	2016 [a,b]	2017 [a,b]	2018 [a,b]	2019 [a,b]	2020 [a,b]	2021 [a,b]	2022 [a,b]	10-Year Average [b]
Suisun Bay	13.1	11.3	9.22	5.73	7.49	8.64	6.76	6.57	6.52	7.31	8.26
San Pablo Bay [d]	11.0	8.78	5.45	4.63	5.28	5.13	6.72	5.52	5.36	5.89	6.46
Central Bay	4.98	3.78	4.46	3.61	4.38	3.42	2.52	3.21	3.83	3.38	3.75
South Bay	3.72	3.04	3.99	3.28	2.57	2.39	2.25	2.66	2.73	2.22	2.89
Lower South Bay	15.8	16.7	20.5	18.2	17.6	16.5	17.0	16.2	16.0	15.0	16.9
Total	**8.98**	**8.36**	**9.41**	**7.89**	**7.81**	**7.56**	**7.26**	**7.28**	**7.25**	**6.69**	**7.86**

a. Based on average values from May 1 through September 30.
b. Calculation based on a flow-weighted average values.
c. Dry season trending not applied to concentrations as the emphasis is on load. Focusing on concentration is limiting as it does not consider the impact of flow.
d. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

5.4 Total Inorganic Nitrogen (TIN)

The historical average monthly discharge loads from October 2012 through September 2022 are presented in Figure 5-4. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) discharge loads were calculated based on reported loads in Table 5-17 and Table 5-18, respectively. In addition, the annual average and dry season average monthly discharge loads and concentrations for each Subembayment are provided in Table 5-19 through Table 5-22, respectively.

A summary of the discharge data review findings is as follows **(new findings for 2021/2022 in bold)**:

- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- **Both the average annual and dry season loads increased compared to last year (refer to Table 5-17 and Table 5-18, respectively). Note, the 2020/2021 loads were the lowest since sampling began in 2012.** The total annual average and dry season TIN discharge increased from 2012/2013 to 2016/2017 season, remained relatively steady between 2016/2017 and 2018/2019, followed by a decline through 2020/2021, **and the loads increased in 2021/2022.**
- **Average Annual Loads: the overall loads increased approximately 1,300 kg N/d compared to last year. Despite an increase, this past year's dataset was 3,400 kg N/d lower than the 10-year average. The largest contributor to the load increase was from EBMUD (Central Bay Discharger) at 1,260 kg N/d. As previously noted in Section 5.2, EBMUD implemented a full-scale demonstration during the 2021 dry season. This demonstration was not implemented in 2022 and the TIN loads reverted back to pre-2021 levels. The second largest contributor was SFPUC Southeast (South Bay Discharger) that had an increase of 380 kg N/d compared to last year. Other notable dischargers with an increase of at least 200 kg N/d compared to last were Palo Alto (increase of 200 kg N/d) and SVCW (increase of 260 kg N/d). Also, Pinole saw an increase of 137 kg N/d. As previously noted in Section 5.2, the increase at Pinole suggests that the recent upgrades to reduce ammonia and TIN loads are not being implemented as designed. In contrast, several dischargers had a decrease in loads. Those with a decrease of 100 kg N/d or more were Central San (decrease of 100 kg N/d), Delta Diablo (decrease of 110 kg N/d), and San Jose (decrease of 630 kg N/d). As previously noted, the relatively large reduction at San Jose is attributed continued optimization and focus on reducing NOx and TIN discharge loads.**
- **Dry Season Loads: similar to average annual loads, the overall dry season loads increased approximately 1,300 kg N/d compared to last year. Despite an increase, this past year's dataset was 3,100 kg N/d lower than the 10-year average. The largest contributor to the load increase was from EBMUD (Central Bay Discharger) at 1,550 kg N/d. As previously noted in Section 5.2, EBMUD implemented a full-scale demonstration during the 2021 dry season. This demonstration was not implemented in 2022 and the TIN loads reverted back to pre-COVID levels. The second largest contributor was SFPUC Southeast (South Bay Discharger) that had an increase of 560 kg N/d compared to last year. Other notable dischargers with an increase of at least 100 kg N/d compared to last were FSSD (increase of 135 kg N/d), Palo Alto (increase of**

230 kg N/d), and San Mateo (increase of 110 kg N/d). Also, Pinole saw an increase of 88 kg N/d. As previously noted in Section 5.2, the increase at Pinole suggests that the recent upgrades to reduce ammonia and TIN loads are not being implemented as designed. In contrast, several dischargers had a decrease in loads. Those with a decrease of 200 kg N/d or more were Central San (decrease of 210 kg N/d) and and San Jose (decrease of 900 kg N/d). As previously noted, the relatively large reduction at San Jose is attributed continued optimization and focus on reducing NOx and TIN discharge loads.

- <u>Dry Season Trending:</u> **the dry season trending analysis suggests that Central Bay has an upward trend when evaluated over the entire 10-years of dry season data. In contrast, the trending for the South Bay, Lower South Bay, and Total suggests a downward trend trending over the entire 10-years of dry season data. EBMUD contributes to the Central Bay which given the increase from last year at 1,550 kg N/d, it was anticipated that this Subembayment would have an upward trend.** This trending is based on the least-squares correlation test selected as the basis for trends analysis over the entire dry season dataset since sampling began in 2012 (see Section 3.8).
- The South Bay Subembayment accounts for nearly half of the load discharged to San Francisco Bay (refer to Figure 5-4 and/or Table 5-20). It experienced an increase of about 600 kg N/d for both average annual and dry season values in 2021/2022 as compared to 2020/2021.
- The discharge nutrient concentrations are calculated based on flow-weighted values (refer to Table 5-21 and Table 5-22). The key findings on concentrations are as follows:
  - **This past year's average annual concentrations (2021/2022) for all Subembayments and Baywide were more concentrated than the previous year (2020/2021).**
  - **This past year's dry season concentrations (2022) were Baywide more concentrated than the past year (2021). However, a comparison between last year and this year's levels for each Subembayment suggests levels either increase or decrease depending on Subembayment.**
  - Central Bay Dischargers have the highest flow-weighted discharge concentrations of the Subembayments. Several dischargers in the Central Bay Subembayment, such as EBMUD, receive trucked waste which can increase discharge concentrations/loads.

A discussion of the results is provided in Section 7.6.4.

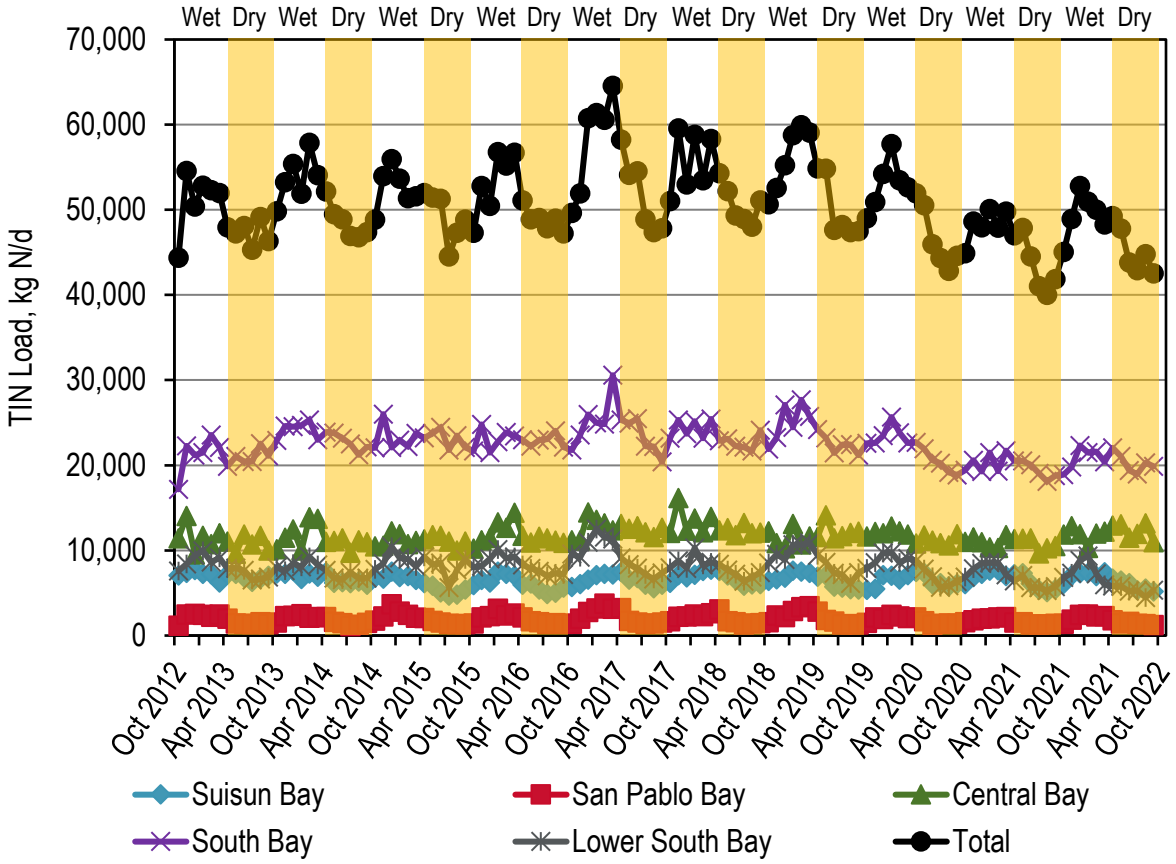

Figure 5-4. Discharge: Average Monthly Discharge TIN Loads

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Table 5-17. Discharge: Annual Average by Discharger, TIN (kg N/d)

Discharger	Subembayment	2012/ 2013 [a,b]	2013/ 2014 [a,b]	2014/ 2015 [a,b]	2015/ 2016 [a,b]	2016/ 2017 [a,b]	2017/ 2018 [a,b]	2018/ 2019 [a,b]	2019/ 2020 [a,b]	2020/ 2021 [a,b]	2021/ 2022 [a,b]	10-Year Average
American Canyon	San Pablo Bay	70.4	80.3	44.4	32.2	41.4	36.8	37.3	33.1	17.8	18.9	41.3
Benicia	San Pablo Bay	225	205	234	233	243	251	222	211	228	211	226
Burlingame	South Bay	397	433	292	292	366	359	466	460	402	349	382
CCCSD	Suisun Bay	3,880	3,810	3,680	3,800	4,000	3,840	3,790	3,980	4,260	4,160	3,920
CMSA	Central Bay	844	846	761	869	1,180	986	1,120	1,170	1,090	1,030	990
Port Costa	San Pablo Bay	0	0	0	1.52	2.06	1.99	0.705	1.45	1.29	2.22	1.12
Delta Diablo	Suisun Bay	1,690	1,510	1,290	1,320	1,450	1,520	1,500	1,330	1,210	1,100	1,390
EBDA	South Bay	7,880	7,830	8,320	8,400	8,320	8,700	8,570	8,950	7,710	7,900	8,260
EBMUD	Central Bay	9,190	9,440	9,390	9,530	9,910	10,700	9,340	9,320	8,630	9,890	9,530
FSSD	Suisun Bay	1,310	1,330	1,030	876	916	1,320	1,130	1,040	1,010	1,120	1,110
Las Gallinas[c]	San Pablo Bay	129	118	97.5	121	138	135	153	160	128	53.1	123
Paradise Cove	Central Bay	2.08	0.287	2.54	1.53	2.25	2.11	1.80	1.89	1.62	0.856	1.70
Tiburon	Central Bay	58.8	56.1	57.8	62.6	45.1	55.5	49.7	33.7	41.2	56.8	51.7
Millbrae	South Bay	241	234	239	267	294	261	286	288	278	245	263
Mt. View	Suisun Bay	121	129	119	122	142	125	115	112	99.2	70.6	115
Napa[c]	San Pablo Bay	173	175	172	170	259	161	309	152	41.1	119	174
Novato[c]	San Pablo Bay	144	136	167	139	197	130	198	112	94.5	92.2	141
Palo Alto	Lower South Bay	2,360	2,160	2,130	2,650	2,560	2,180	2,310	2,220	1,950	2,150	2,270
Petaluma[c]	San Pablo Bay	25.3	11.8	24.8	15.6	16.3	4.87	24.2	6.68	5.31	7.14	14.2
Pinole	San Pablo Bay	301	289	278	309	320	317	227	232	273	410	296
Rodeo	San Pablo Bay	36.4	30.6	33.3	30.4	45.4	32.6	38.3	38.7	31.4	50.8	36.8
SFO Airport	South Bay	250	257	154	162	226	139	107	25.2	55.1	72.8	145
SFPUC Southeast	South Bay	7,920	10,300	9,590	9,050	10,300	8,860	8,850	7,210	6,500	6,880	8,550
San Jose	Lower South Bay	4,800	4,770	5,590	5,000	5,790	4,920	5,500	4,880	4,080	3,450	4,880
San Mateo	South Bay	1,450	1,400	1,310	1,300	1,350	1,430	1,530	1,330	1,380	1,390	1,390
SMCSD	Central Bay	128	118	127	132	136	137	134	124	141	116	129
SASM	Central Bay	212	204	173	234	164	187	211	219	227	227	206
SVCW	South Bay	1,970	2,050	2,300	2,590	2,460	2,690	2,640	2,590	2,410	2,670	2,440
Sonoma Valley[c]	San Pablo Bay	29.5	9.21	23.3	10.6	82.0	0	29.9	0	0	0.871	18.5
South SF	South Bay	983	933	940	897	1,070	1,060	1,310	1,160	1,160	1,030	1,050
Sunnyvale	Lower South Bay	894	697	726	592	952	878	964	810	900	846	826
Treasure Island	Central Bay	10.8	13.9	19.0	17.4	16.3	12.0	13.9	20.9	19.0	16.9	16.0
Vallejo	San Pablo Bay	768	846	961	901	906	931	928	851	849	826	877
West County	Central Bay	764	801	676	956	1,150	873	997	799	761	763	854
Total [d]		**49,300**	**51,300**	**50,900**	**51,100**	**55,000**	**53,200**	**53,100**	**49,900**	**46,000**	**47,300**	**50,700**

a. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
b. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
c. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-18. Discharge: Dry Season by Discharger, TIN (kg N/d)

Discharger	Subembayment	2013 [a,b]	2014 [a,b]	2015 [a,b]	2016 [a,b]	2017 [a,b]	2018 [a,b]	2019 [a,b]	2020 [a,b]	2021 [a,b]	2022 [a,b]	10-Year Average
American Canyon	San Pablo Bay	111	79.7	30.7	20.1	24.7	31.8	29.2	19.4	15.4	11.3	37.3
Benicia	San Pablo Bay	226	199	198	231	240	236	197	221	227	204	218
Burlingame	South Bay	436	288	273	273	271	389	450	462	297	253	339
CCCSD	Suisun Bay	3,720	3,630	3,380	3,710	3,610	3,550	3,420	3,890	3,900	3,690	3,650
CMSA	Central Bay	844	841	721	964	1,220	954	1,090	1,170	1,100	1,090	999
Port Costa	San Pablo Bay	--	0.0381	--	--	--	--	0.552	2.15	--		0.913
Delta Diablo	Suisun Bay	1,630	1,480	869	927	1,350	1,370	1,310	1,320	979	944	1,220
EBDA	South Bay	7,170	7,190	7,870	7,440	6,940	8,080	7,880	7,700	6,870	6,890	7,400
EBMUD	Central Bay	8,910	9,070	9,390	8,960	9,760	10,200	9,900	8,960	8,410	9,960	9,350
FSSD	Suisun Bay	1,360	969	807	655	1,080	1,270	1,020	969	905	1,040	1,010
Las Gallinas[c]	San Pablo Bay	0	0	0	0	8.99	0	51.4	47.1	0	0	10.7
Paradise Cove	Central Bay	2.52	0.287	2.61	1.53	2.62	2.11	2.13	1.31	0.977	0.877	1.70
Tiburon	Central Bay	46.8	56.1	53.2	62.6	45.0	57.6		27.7	45.5	46.7	49.0
Millbrae	South Bay	247	207	236	293	291	250	307	276	276	245	263
Mt. View	Suisun Bay	101	112	103	122	116	110	106	108	90.4	41.6	101
Napa[c]	San Pablo Bay	0	50.1	0	0	0	0	0	0	0	0	5.01
Novato[c]	San Pablo Bay	39.9	42.3	37.5	38.2	98.2	43.1	100.0	23.1	8.21	0	43.1
Palo Alto	Lower South Bay	2,550	2,140	2,230	2,640	2,120	2,210	1,950	1,930	2,000	2,230	2,200
Petaluma[c]	San Pablo Bay	0	0	0	0	0	0	0	0	0	0	0
Pinole	San Pablo Bay	342	287	267	341	235	322	170	243	281	369	286
Rodeo	San Pablo Bay	26.4	28.1	26.9	28.2	31.9	29.4	35.8	46.2	33.8	39.2	32.6
SFO Airport	South Bay	257	285	165	205	343	89.2	169	19.4	68.4	90.5	169
SFPUC Southeast	South Bay	8,650	10,300	10,000	9,880	10,600	9,050	8,260	6,780	6,840	7,400	8,770
San Jose	Lower South Bay	4,220	4,330	5,280	4,410	4,730	4,510	4,760	4,200	3,430	2,530	4,240
San Mateo	South Bay	1,540	1,490	1,280	1,370	1,280	1,480	1,560	1,320	1,230	1,340	1,390
SMCSD	Central Bay	133	123	135	141	148	148	155	123	149	110	136
SASM	Central Bay	191	162	151	190	154	203	187	253	221	246	196
SVCW	South Bay	1,880	1,940	2,380	2,510	2,440	2,320	2,500	2,350	2,500	2,460	2,330
Sonoma Valley[c]	San Pablo Bay	0	0	0	0	4.21	0	0	0	0	0	0.421
South SF	South Bay	916	906	879	915	919	995	1,020	1,250	1,220	1,220	1,020
Sunnyvale	Lower South Bay	360	371	324	341	630	392	617	391	446	460	433
Treasure Island	Central Bay	9.92	14.3	20.9	14.0	14.6	13.6	14.1	20.5	19.4	19.9	16.1
Vallejo	San Pablo Bay	751	851	899	837	870	831	900	821	814	769	834
West County	Central Bay	663	663	683	918	1,040	806	955	731	734	692	789
Total [d]		**47,300**	**48,100**	**48,700**	**48,400**	**50,600**	**50,000**	**49,100**	**45,700**	**43,100**	**44,400**	**47,500**

a. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
b. Based on average values from May 1 through September 30.
c. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-19. Discharge: Annual Average by Subembayment, TIN (kg N/d)

Subembayment	2012/ 2013 [a]	2013/ 2014 [a]	2014/ 2015 [a]	2015/ 2016 [a]	2016/ 2017 [a]	2017/ 2018 [a]	2018/ 2019 [a]	2019/ 2020 [a]	2020/ 2021 [a]	2021/ 2022 [a]	10-Year Average
Suisun Bay	7,010	6,780	6,110	6,120	6,510	6,800	6,540	6,460	6,580	6,460	6,540
San Pablo Bay [b]	1,860	1,830	2,030	1,960	2,250	2,000	2,170	1,800	1,670	1,790	1,950
Central Bay	11,200	11,400	11,200	11,700	12,600	12,900	11,900	11,700	10,900	12,100	11,800
South Bay	21,100	23,500	23,100	23,000	24,400	23,500	23,800	22,000	19,900	20,500	22,500
Lower South Bay	8,050	7,630	8,440	8,240	9,310	7,980	8,770	7,910	6,930	6,450	7,970
Total	**49,300**	**51,300**	**50,900**	**51,100**	**55,000**	**53,200**	**53,100**	**49,900**	**46,000**	**47,300**	**51,100**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-20. Discharge: Dry Season by Subembayment, TIN (kg N/d)

Subembayment	2013 [a]	2014 [a]	2015 [a]	2016 [a]	2017 [a]	2018 [a]	2019 [a]	2020 [a]	2021 [a]	2022 [a]	10-Year Average	Trend [c,d]
Suisun Bay	6,810	6,200	5,160	5,410	6,160	6,300	5,850	6,290	5,870	5,720	5,980	None
San Pablo Bay [b]	1,410	1,390	1,460	1,500	1,510	1,490	1,480	1,420	1,380	1,390	1,470	None
Central Bay	10,800	10,900	11,100	11,200	12,300	12,400	12,300	11,300	10,700	12,200	11,500	Up (0.8%/yr)
South Bay	21,100	22,600	23,100	22,900	23,100	22,700	22,200	20,200	19,300	19,900	21,700	Down (-1.4%/yr)
Lower South Bay	7,130	6,850	7,840	7,390	7,480	7,110	7,320	6,520	5,870	5,220	6,870	Down (-2.7%/yr)
Total	**47,300**	**48,100**	**48,700**	**48,400**	**50,600**	**50,000**	**49,100**	**45,700**	**43,100**	**44,400**	**47,900**	**Down** (-0.8%/yr)

a. Based on average values from May 1 through September 30.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 45. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.
d. The percent change represents the change per year as a percentage of the average value over the entire dataset (2013-2022) (not considered if trend is “None”).

Table 5-21. Discharge: Annual Average by Subembayment, TIN (mg N/L)

Subembayment	2012/ 2013 [a,b]	2013/ 2014 [a,b]	2014/ 2015 [a,b]	2015/ 2016 [a,b]	2016/ 2017 [a,b]	2017/ 2018 [a,b]	2018/ 2019 [a,b]	2019/ 2020 [a,b]	2020/ 2021 [a,b]	2021/ 2022 [a,b]	10 Year Average [b]
Suisun Bay	31.4	32.4	30.2	29.4	23.9	30.7	26.9	30.7	33.4	30.0	29.7
San Pablo Bay [c]	15.6	16.7	18.0	17.2	13.4	19.2	15.2	18.6	22.4	18.5	17.0
Central Bay	37.6	40.3	42.1	40.9	33.9	45.2	35.5	45.0	45.8	43.1	40.5
South Bay	35.4	40.4	40.4	38.9	36.7	40.3	38.7	40.2	38.9	38.2	38.8
Lower South Bay	17.2	17.7	20.2	19.3	19.6	18.0	18.2	18.3	17.6	16.9	18.3
Total	**28.8**	**31.6**	**32.4**	**31.4**	**28.2**	**32.5**	**29.3**	**32.3**	**32.5**	**31.3**	**30.9**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
b. Calculation based on a flow-weighted average values.
c. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-22. Discharge: Dry Season by Subembayment, TIN (mg N/L)

Subembayment	2013 [a,b]	2014 [a,b]	2015 [a,b]	2016 [a,b]	2017 [a,b]	2018 [a,b]	2019 [a,b]	2020 [a,b]	2021 [a,b]	2022 [a,b]	10-Year Average [b]
Suisun Bay	34.8	32.9	30.8	29.9	29.0	32.3	28.0	32.0	33.0	31.1	31.3
San Pablo Bay [d]	25.0	24.5	26.9	26.8	23.0	27.3	22.7	26.7	28.0	28.9	25.8
Central Bay	43.2	46.6	51.3	46.8	48.0	50.3	46.7	47.8	48.8	55.5	48.4
South Bay	38.6	42.5	44.7	42.6	41.9	42.1	41.3	40.5	40.5	41.1	41.6
Lower South Bay	16.4	17.1	21.1	18.7	18.3	17.1	17.6	16.7	16.3	15.3	17.5
Total	**31.8**	**34.0**	**36.7**	**34.4**	**33.8**	**34.4**	**33.0**	**33.2**	**33.6**	**34.8**	**33.9**

a. Based on average values from May 1 through September 30.
b. Calculation based on a flow-weighted average values.
c. Dry season trending not applied to concentrations as the emphasis is on load. Focusing on concentration is limiting as it does not consider the impact of flow.
d. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

5.5 Total Phosphorus (TP)

The historical average monthly discharge loads from October 2012 through September 2022 are presented in Figure 5-5. The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) discharge loads were calculated based on reported loads in Table 5-23 and Table 5-24, respectively. In addition, the annual average and dry season average monthly discharge loads and concentrations for each Subembayment are provided in Table 5-25 and Table 5-28, respectively.

A summary of the discharge data review findings is as follows **(new findings for 2020/2021 in bold)**:

- The impact on loads from the global pandemic (COVID-19) is unclear at this stage (discussion provided in Section 7.1).
- **The 2020/2021 annual average loads were the lowest since nutrient sampling began in 2012 (refer to Table 5-23). Unlike the nitrogen species whose loads appear to be tied to precipitation, drought, etc., TP loads appear to be more random from year to year. Such variability is attributed to TP removal mechanisms. For example, facilities that occasionally use chemicals for odor control (e.g., ferric chloride in the collection system), the chemical addition binds a portion of TP and subsequently reduces loads when chemicals applied. Furthermore, facilities with anaerobic selectors in their activated sludge process to improve solids settleability also reduces TP loads. This biological feature can be "finicky" at plants and not translate to as pronounced of a TP load reduction.**
- **Average Annual Loads: the overall loads decreased approximately 170 kg P/d compared to last year. In fact, the 2021/2022 loads were 450 kg P/d lower than the 10-year average and the lowest since sampling began in 2012. The largest contributor to the decrease was EBMUD (Central Bay Discharger) at 157 kg P/d less than the previous year. EBMUD has an anerobic selector which as previously noted has the potential to remove a portion of TP loads. Other notable reductions were from San Jose (decrease of 23 kg P/d), South SF (decrease of 95 kg P/d), and Sunnyvale (decrease of 46 kg P/d). Note: South SF installed an anerobic selector in 2021 to improve solids settleability and their TP loads have also declined. In contrast, SFPUC Southeast (South Bay Discharger) had an increase of 85 kg P/d compared to last year. Similar to EBMUD, SFPUC Southeast has an anerobic selector which has the potential to remove a portion of TP loads.**
- **Dry Season Loads: the overall loads decreased approximately 380 kg P/d compared to last year. In fact, the 2022 loads were 410 kg P/d lower than the 10-year average and the lowest since sampling began in 2012. Similar to average annual, the largest contributor to the decrease was EBMUD (Central Bay Discharger) at 194 kg P/d less than the previous year. EBMUD has an anerobic selector which as previously noted has the potential to remove a portion of TP loads. Other notable reductions were from EBDA (decrease of 70 kg P/d), San Jose (decrease of 45 kg P/d), South SF (decrease of 164 kg P/d), and Sunnyvale (decrease of 33 kg P/d). As previously noted, South SF installed an anerobic selector in 2021 to improve solids settleability and their TP loads have also declined. In contrast, SFPUC Southeast (South Bay Discharger) had an**

increase of 111 kg P/d compared to last year. Similar to EBMUD, SFPUC Southeast has an anerobic selector which has the potential to remove a portion of TP loads.

- **Dry Season Trending: despite having the lowest TP loads since sampling began in 2012, the dry season trending analysis is variable across Subembayments and Baywide. The trending analysis suggests that Suisun Bay, San Pablo Bay, and Baywide has no trending over the entire 10-years of dry season data. The Lower South Bay data suggests downward trending over the entire 10-years of dry season data. In contrast, Central Bay and South Bay suggests an upwards trending over the entire 10-years of dry season data.** This trending is based on the least-squares correlation test selected as the basis for trends analysis over the entire dry season dataset since sampling began in 2012 (see Section 3.8).
- The Central Bay and South Bay Subembayments account for over half of the TP loads discharged to the Bay (refer to Figure 5-5 or Table 5-23).
- The nutrient discharge concentrations are calculated based on flow-weighted values (refer to Table 5-27 and Table 5-28).
  - Agencies across the Bay reduce phosphorus loads through a combination of chemical and biological processes.
  - **The most recent average annual and dry season datasets showed for most Subembayments a decline in concentrations compared to the previous year's dataset. Overall, the values are comparable to the 10-year average values (with a few exceptions).**
  - **Dischargers to the Central Bay have the highest discharge concentrations across the Subembayments. Several dischargers in the Central Bay Subembayment, such as EBMUD, receive trucked waste which can increase discharge concentrations/loads.**

A discussion of the results is provided in Section 7.6.5.

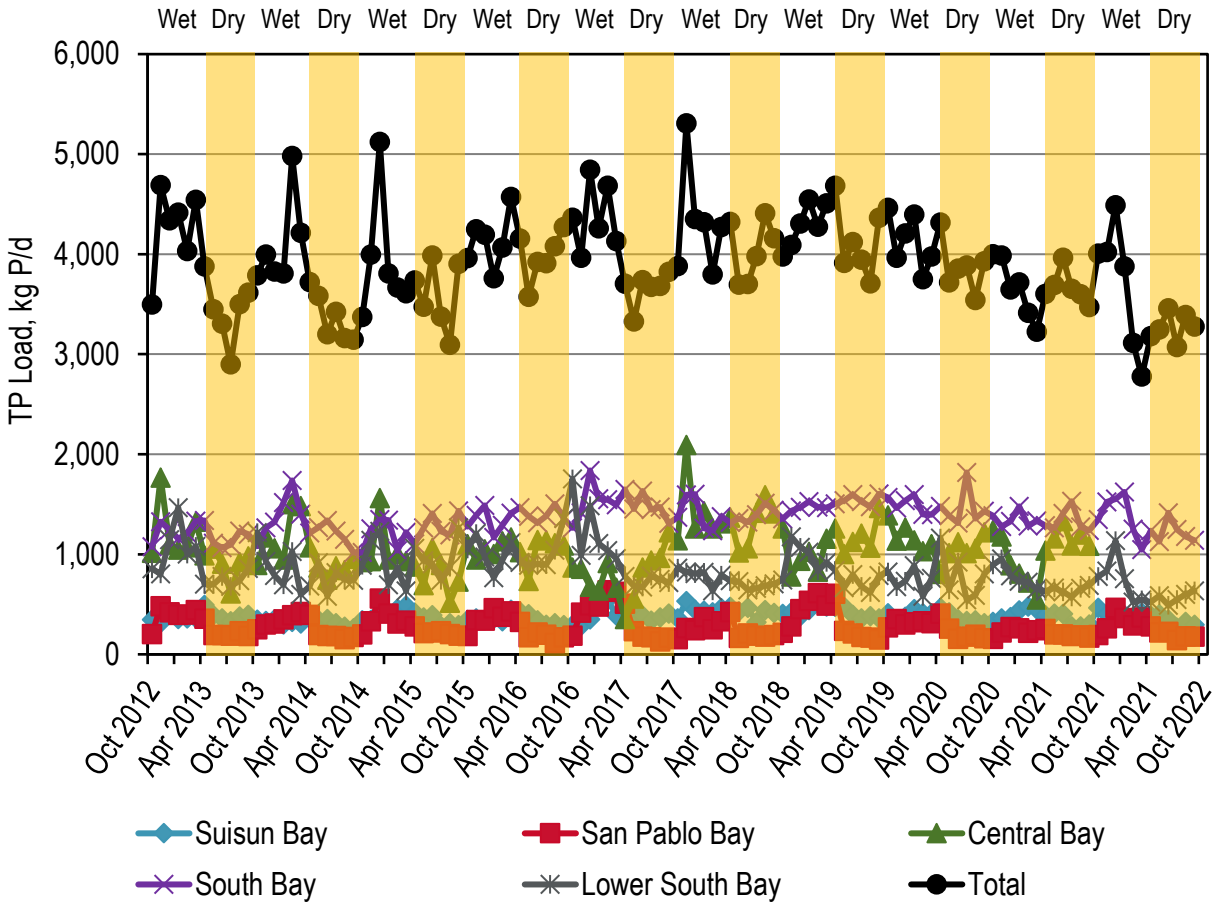

Figure 5-5. Discharge: Average Monthly Discharge TP Loads

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Table 5-23. Discharge: Annual Average by Discharger, TP (kg P/d)

Discharger	Subembayment	2012/ 2013 [a,b]	2013/ 2014 [a,b]	2014/ 2015 [a,b]	2015/ 2016 [a,b]	2016/ 2017 [a,b]	2017/ 2018 [a,b]	2018/ 2019 [a,b]	2019/ 2020 [a,b]	2020/ 2021 [a,b]	2021/ 2022 [a,b]	10-Year Average
American Canyon	San Pablo Bay	29.0	17.9	28.7	27.6	24.0	26.0	23.4	24.7	15.5	18.5	23.5
Benicia	San Pablo Bay	25.2	25.7	26.2	15.1	16.5	15.7	19.2	15.9	15.4	21.4	19.6
Burlingame	South Bay	101	110	25.4	22.2	29.2	32.4	31.0	36.1	33.2	30.2	45.1
CCCSD	Suisun Bay	133	87.7	127	109	127	122	137	121	141	146	125
CMSA	Central Bay	92.4	81.7	94.2	84.5	106	100	108	123	127	128	105
Port Costa	San Pablo Bay	0	0	0	0.598	0.479	0.352	0.226	0.777	0.200	0.289	0.292
Delta Diablo	Suisun Bay	31.1	27.1	36.7	29.4	51.5	60.6	42.6	50.3	33.6	22.8	38.6
EBDA	South Bay	544	534	501	551	642	534	534	583	636	603	566
EBMUD	Central Bay	843	824	718	827	538	1,100	818	856	775	618	792
FSSD	Suisun Bay	194	190	198	200	197	235	235	201	186	192	203
Las Gallinas[c]	San Pablo Bay	19.7	17.2	14.6	22.6	21.5	16.5	23.8	27.8	19.6	16.2	19.9
Paradise Cove	Central Bay	0.270	--	0.358	0.223	0.495	0.490	0.246	0.301	0.270	0.187	0.284
Tiburon	Central Bay	8.36	7.88	8.44	9.20	8.56	7.84	6.21	5.60	6.45	9.08	7.76
Millbrae	South Bay	16.5	13.5	13.0	12.0	11.9	7.41	17.9	19.8	15.6	13.9	14.2
Mt. View	Suisun Bay	18.2	17.0	16.2	15.4	13.5	15.2	10.0	12.0	12.6	11.3	14.1
Napa[c]	San Pablo Bay	22.5	14.4	25.3	34.6	58.7	22.4	86.1	37.8	8.98	25.4	33.6
Novato[c]	San Pablo Bay	15.7	10.9	20.6	9.59	12.9	2.74	13.9	6.62	1.62	7.26	10.2
Palo Alto	Lower South Bay	346	352	352	445	397	362	372	343	306	322	360
Petaluma[c]	San Pablo Bay	27.5	31.0	24.6	19.1	24.7	16.1	21.3	11.5	4.12	12.3	19.2
Pinole	San Pablo Bay	29.6	17.3	15.2	16.4	24.6	29.2	33.4	29.6	28.8	38.0	26.2
Rodeo	San Pablo Bay	8.36	8.01	7.95	8.37	8.75	7.58	9.43	9.17	7.50	5.83	8.10
SFO Airport	South Bay	17.5	13.4	8.97	9.69	16.2	32.0	35.5	18.2	7.10	4.33	16.3
SFPUC Southeast	South Bay	67.2	164	205	271	332	287	389	279	146	231	237
San Jose	Lower South Bay	354	246	370	368	322	154	243	220	162	139	258
San Mateo	South Bay	128	127	122	142	125	133	114	130	130	139	129
SMCSD	Central Bay	23.4	18.5	17.0	17.2	16.5	19.3	14.8	13.4	15.4	19.6	17.5
SASM	Central Bay	45.2	45.6	40.5	51.6	38.1	40.5	37.5	37.9	44.3	40.7	42.2
SVCW	South Bay	174	172	189	213	218	234	242	244	217	225	213
Sonoma Valley[c]	San Pablo Bay	16.5	10.5	2.83	2.51	21.3	0	5.35	0	0	1.87	6.08
South SF	South Bay	149	160	171	150	133	138	134	168	156	60.5	142
Sunnyvale	Lower South Bay	200	214	213	193	257	225	231	198	247	201	218
Treasure Island	Central Bay	1.57	3.01	3.70	4.10	4.50	3.32	3.08	3.32	2.82	2.93	3.23
Vallejo	San Pablo Bay	126	129	123	121	139	110	107	107	111	117	119
West County	Central Bay	53.4	60.7	46.6	67.6	88.5	101	110	71.9	57.6	76.6	73.3
Total [d]		**3,860**	**3,750**	**3,770**	**4,070**	**4,020**	**4,190**	**4,210**	**4,010**	**3,670**	**3,500**	**3,910**

a. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
b. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
c. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-24. Discharge: Dry Season by Discharger, TP (kg P/d)

Discharger	Subembayment	2013 [a,b]	2014 [a,b]	2015 [a,b]	2016 [a,b]	2017 [a,b]	2018 [a,b]	2019 [a,b]	2020 [a,b]	2021 [a,b]	2022 [a,b]	10-Year Average
American Canyon	San Pablo Bay	47.4	8.23	29.1	15.4	14.5	24.8	16.2	19.9	14.8	11.0	20.1
Benicia	San Pablo Bay	23.9	23.9	20.4	16.4	8.96	9.68	13.1	15.0	10.4	20.9	16.3
Burlingame	South Bay	125	32.4	31.5	13.9	18.1	26.4	27.5	31.4	19.1	31.3	35.7
CCCSD	Suisun Bay	125	90.3	112	108	107	116	111	93.6	117	116	110
CMSA	Central Bay	101	79.6	89.3	87.5	127	112	109	129	133	125	109
Port Costa	San Pablo Bay	--	0	--	--	--	--	0.138	0.587	--		0.241
Delta Diablo	Suisun Bay	27.7	27.2	27.8	28.1	51.1	51.2	47.0	49.5	24.0	18.7	35.2
EBDA	South Bay	490	494	480	546	533	505	555	592	627	557	538
EBMUD	Central Bay	668	668	576	813	643	1,030	938	820	905	711	777
FSSD	Suisun Bay	201	174	172	175	211	233	227	196	179	181	195
Las Gallinas[c]	San Pablo Bay	0	0	0	0	0.844	0	10.8	8.69	0	0	2.03
Paradise Cove	Central Bay	0.334	0.0384	0.377	0.223	0.592	0.490	0.305	0.303	0.232	0.252	0.315
Tiburon	Central Bay	7.62	7.88	8.34	9.20	8.18	8.90	--	4.61	6.00	8.01	7.64
Millbrae	South Bay	19.2	13.0	14.2	11.8	15.1	7.83	22.4	20.0	16.6	10.2	15.0
Mt. View	Suisun Bay	17.8	17.6	18.2	16.8	11.3	14.7	9.47	13.0	12.7	10.4	14.2
Napa[c]	San Pablo Bay	0	3.77	0	0	0	0	0	0	0	0	0.377
Novato[c]	San Pablo Bay	1.06	1.62	0.800	1.24	2.46	0.305	1.71	0.229	0.130	0	0.956
Palo Alto	Lower South Bay	386	381	381	450	354	382	311	296	327	334	360
Petaluma[c]	San Pablo Bay	0	0	0	0	0	0	0	0	0	0	0
Pinole	San Pablo Bay	30.6	18.7	17.6	16.3	21.1	34.2	33.4	30.7	37.7	42.2	28.2
Rodeo	San Pablo Bay	6.98	7.73	9.24	8.63	6.23	7.07	9.71	10.6	4.60	3.80	7.46
SFO Airport	South Bay	25.0	8.95	8.79	4.12	21.6	42.4	33.7	8.42	8.72	4.04	16.6
SFPUC Southeast	South Bay	24.0	184	263	322	395	321	433	287	149	260	264
San Jose	Lower South Bay	185	196	384	397	111	113	151	216	100	55.2	191
San Mateo	South Bay	128	136	129	137	129	139	127	122	128	126	130
SMCSD	Central Bay	24.8	20.0	18.5	18.9	19.0	19.3	17.2	13.9	17.3	19.6	18.8
SASM	Central Bay	50.3	43.3	40.5	43.0	40.2	40.9	32.9	43.0	43.4	35.3	41.3
SVCW	South Bay	185	161	217	191	211	237	226	225	210	214	208
Sonoma Valley[c]	San Pablo Bay	0	0	0	0	0.711	0	0	0	0	0	0.0711
South SF	South Bay	145	170	163	161	140	127	124	176	184	20.2	141
Sunnyvale	Lower South Bay	180	183	177	172	256	189	248	189	215	182	199
Treasure Island	Central Bay	1.27	2.84	3.99	4.46	4.74	3.61	2.80	3.34	2.98	2.58	3.26
Vallejo	San Pablo Bay	125	123	133	116	120	110	101	104	120	111	116
West County	Central Bay	45.5	42.0	46.5	75.2	72.9	94.1	72.4	73.3	68.5	85.8	67.6
Total [d]		**3,400**	**3,320**	**3,570**	**3,960**	**3,660**	**4,000**	**4,010**	**3,790**	**3,680**	**3,300**	**3,670**

a. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
b. Based on average values from May 1 through September 30.
c. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
d. The total values might vary from the sum of the listed values by plant due to rounding.

Table 5-25. Discharge: Annual Average by Subembayment, TP (kg P/d)

Subembayment	2012/ 2013 [a]	2013/ 2014 [a]	2014/ 2015 [a]	2015/ 2016 [a]	2016/ 2017 [a]	2017/ 2018 [a]	2018/ 2019 [a]	2019/ 2020 [a]	2020/ 2021 [a]	2021/ 2022 [a]	10-Year Average
Suisun Bay	377	322	378	354	389	434	426	385	373	372	381
San Pablo Bay [b]	307	275	289	277	352	247	343	270	213	264	286
Central Bay	1,070	1,030	923	1,050	793	1,370	1,100	1,110	1,030	900	1,040
South Bay	1,200	1,300	1,220	1,370	1,510	1,400	1,500	1,480	1,340	1,310	1,360
Lower South Bay	900	811	935	1,010	976	741	846	760	715	662	835
Total	**3,860**	**3,750**	**3,770**	**4,070**	**4,020**	**4,190**	**4,210**	**4,010**	**3,670**	**3,500**	**3,950**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-26. Discharge: Dry Season Average by Subembayment, TP (kg P/d)

Subembayment	2013 [a]	2014 [a]	2015 [a]	2016 [a]	2017 [a]	2018 [a]	2019 [a]	2020 [a]	2021 [a]	2022 [a]	10-Year Average	Trend [c,d]
Suisun Bay	372	309	330	328	381	415	394	352	333	327	354	None
San Pablo Bay [b]	197	177	210	174	175	186	186	189	188	189	192	None
Central Bay	894	858	778	1,040	909	1,310	1,170	1,090	1,180	990	1,020	Up (3.1%/yr)
South Bay	1,140	1,200	1,260	1,390	1,460	1,410	1,550	1,460	1,340	1,220	1,350	Up (1.3%/yr)
Lower South Bay	750	760	943	1,020	721	684	710	701	642	572	750	Down (-3.7%/yr)
Total	**3,400**	3,320	3,570	3,960	3,660	4,000	4,010	3,790	3,680	**3,300**	**3,710**	**None**

a. Based on average values from May 1 through September 30.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 45. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.
d. The percent change represents the change per year as a percentage of the average value over the entire dataset (2013-2022) (not considered if trend is “None”).

Table 5-27. Discharge: Annual Average by Subembayment, TP (mg P/L)

Subembayment	2012/ 2013 [a,b]	2013/ 2014 [a,b]	2014/ 2015 [a,b]	2015/ 2016 [a,b]	2016/ 2017 [a,b]	2017/ 2018 [a,b]	2018/ 2019 [a,b]	2019/ 2020 [a,b]	2020/ 2021 [a,b]	2021/ 2022 [a,b]	10 Year Average [b]
Suisun Bay	1.69	1.54	1.87	1.70	1.43	1.96	1.75	1.83	1.89	1.73	1.73
San Pablo Bay [c]	2.63	2.48	2.56	2.43	2.10	2.36	2.41	2.80	2.86	2.73	2.50
Central Bay	3.58	3.66	3.49	3.68	2.15	4.79	3.28	4.29	4.32	3.19	3.58
South Bay	2.01	2.23	2.16	2.32	2.27	2.40	2.44	2.70	2.62	2.43	2.35
Lower South Bay	1.92	1.88	2.24	2.35	2.06	1.67	1.76	1.76	1.82	1.74	1.92
Total	**2.26**	**2.31**	**2.40**	**2.50**	**2.06**	**2.56**	**2.32**	**2.59**	**2.60**	**2.32**	**2.38**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.
b. Calculation based on a flow-weighted average values.
c. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 5-28. Discharge: Dry Season by Subembayment, TP (mg P/L)

Subembayment	2013 [a,b]	2014 [a,b]	2015 [a,b]	2016 [a,b]	2017 [a,b]	2018 [a,b]	2019 [a,b]	2020 [a,b]	2021 [a,b]	2022 [a,b]	10-Year Average [b]
Suisun Bay	1.90	1.64	1.97	1.81	1.79	2.13	1.89	1.79	1.87	1.77	1.86
San Pablo Bay [d]	3.93	2.99	3.88	3.11	2.65	3.41	2.84	3.56	3.81	3.92	3.37
Central Bay	3.59	3.69	3.60	4.37	3.55	5.29	4.46	4.61	5.37	4.50	4.29
South Bay	2.08	2.26	2.52	2.58	2.66	2.61	2.88	2.93	2.82	2.52	2.58
Lower South Bay	1.72	1.90	2.53	2.58	1.76	1.64	1.71	1.80	1.79	1.68	1.91
Total	**2.28**	**2.34**	**2.69**	**2.81**	**2.44**	**2.76**	**2.69**	**2.76**	**2.87**	**2.58**	**2.62**

a. Based on average values from May 1 through September 30.
b. Calculation based on a flow-weighted average values.
c. Dry season trending not applied to concentrations as the emphasis is on load. Focusing on concentration is limiting as it does not consider the impact of flow.
d. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

5.6 Flows and Nutrient Loads Distribution by Subembayment

Flows and nutrient discharge loading for select nitrogen species and total phosphorus has been analyzed by Subembayment to demonstrate the relative contributions for each discharger. In this section, loading diagrams illustrate the discharge loads over time for the past ten years (Oct 2012 through Sept 2022).

The cumulative figures in the following subsections are organized by Subembayment and present the relative contribution of each discharger within its respective Subembayment for flow, ammonia, TIN, and TP.

5.6.1 Suisun Bay

The average monthly discharge to Suisun Bay by discharger for flow, ammonia, TIN, and TP is provided in Figure 5-6 through Figure 5-9. Flows to Suisun Bay are dominated by the CCCSD discharge and followed, in terms of magnitude, by FSSD and Delta Diablo. CCCSD also discharges the largest loads of ammonia and TIN. FSSD discharges the largest TP load to Suisun Bay, followed by CCCSD.

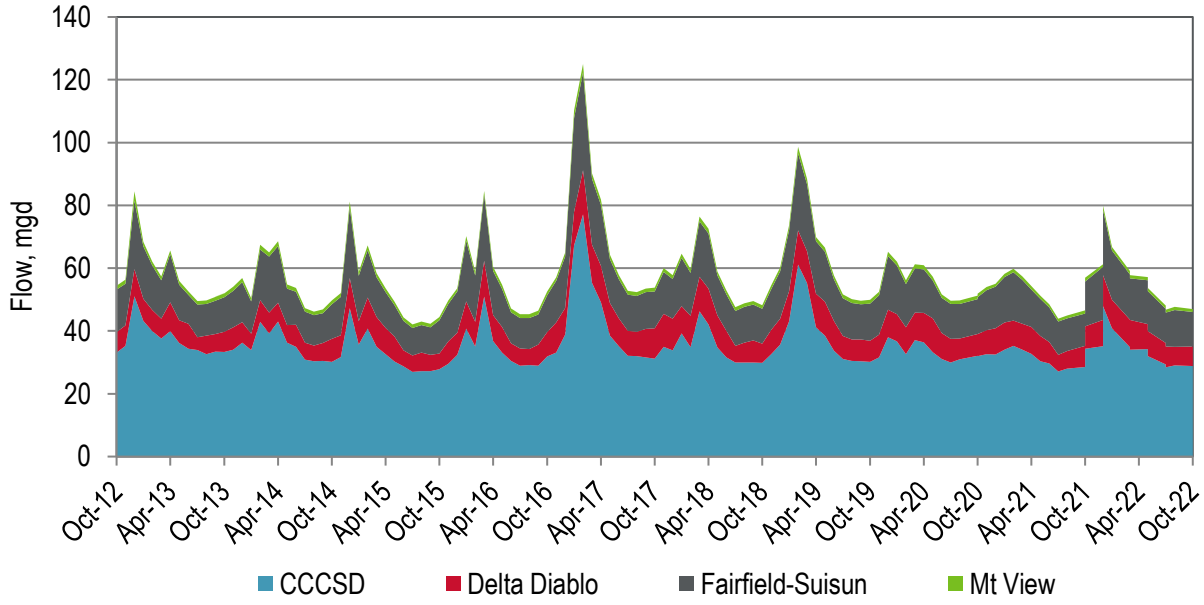

Figure 5-6. Flow Contribution by Discharger to Suisun Bay

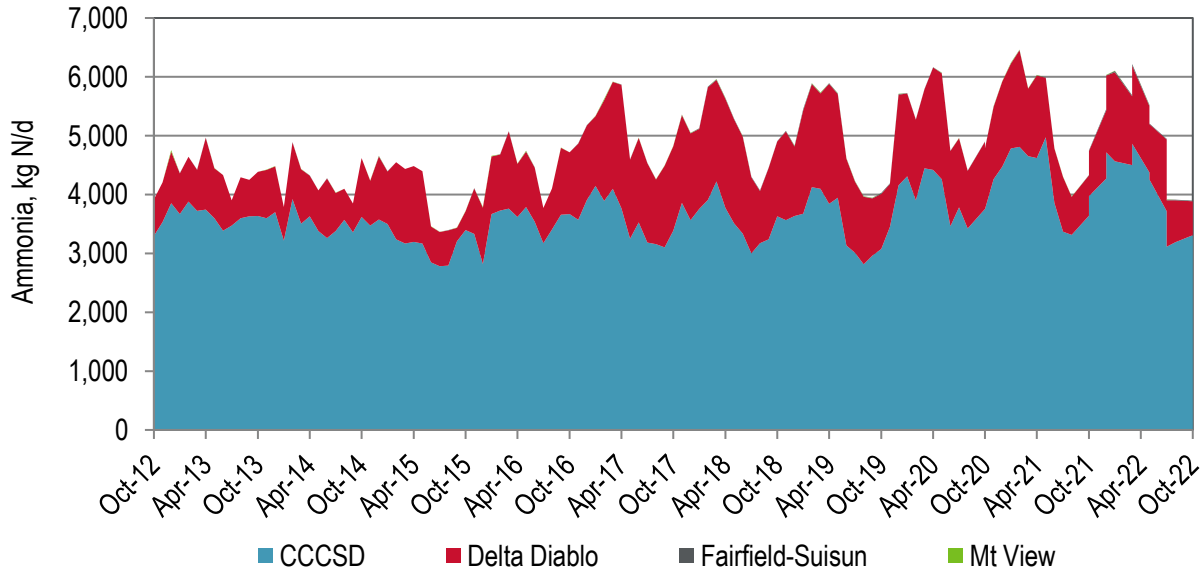

Figure 5-7. Ammonia Load Contribution by Discharger to Suisun Bay

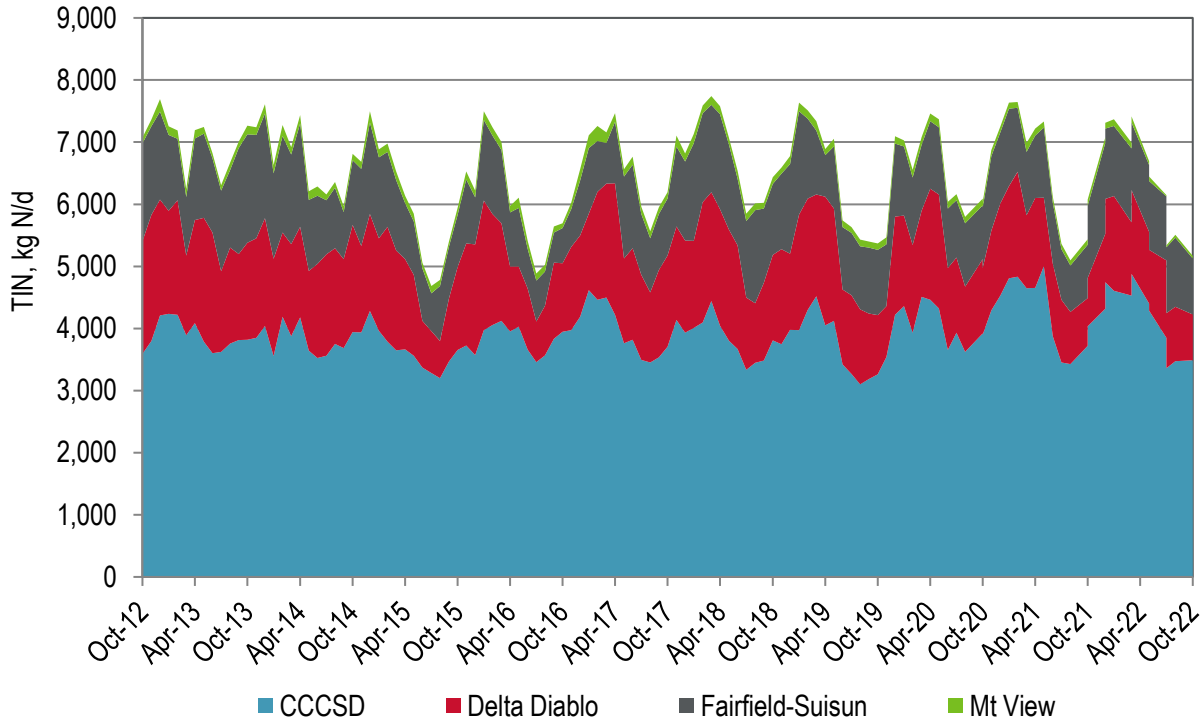

Figure 5-8. TIN Load Contribution by Discharger to Suisun Bay

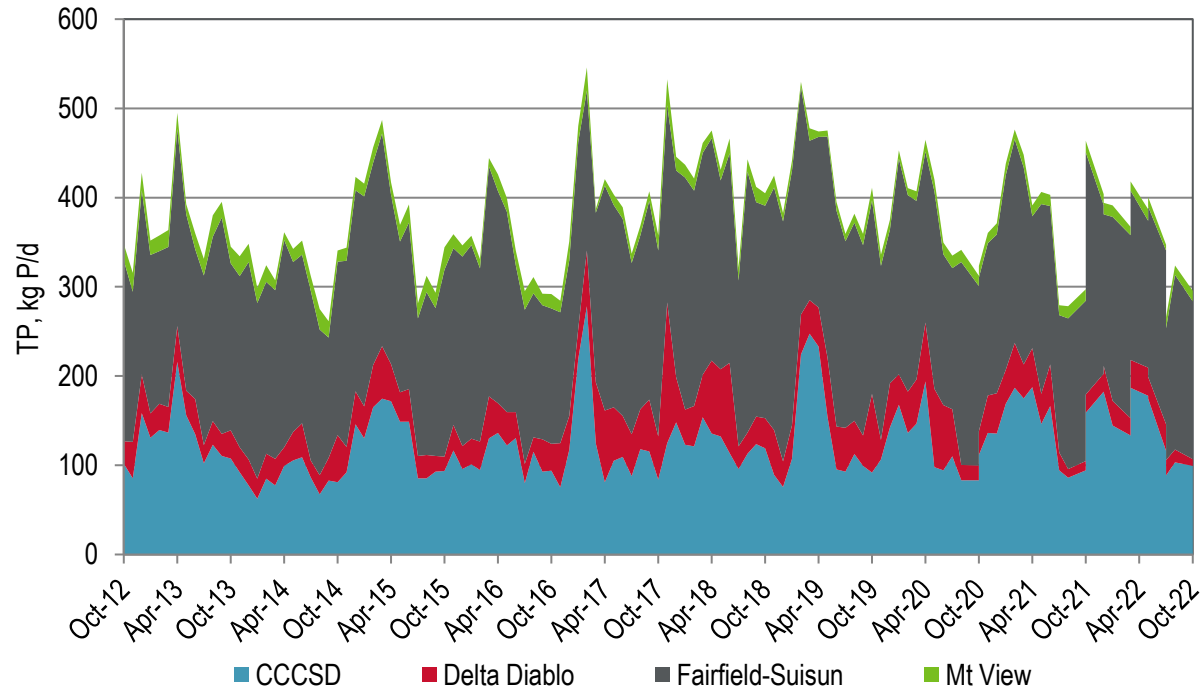

Figure 5-9. TP Load Contribution by Discharger to Suisun Bay

5.6.2 San Pablo Bay

The average monthly discharge to San Pablo Bay by discharger for discharge flows and loads are provided in Figure 5-10 through Figure 5-13. Figure 5-10 clearly demonstrates the seasonal discharges at Las Gallinas, Napa, Petaluma, and Sonoma Valley. Similar to flow, TIN and TP loads to San Pablo Bay appear to exhibit a significant seasonal pattern with higher wintertime loads.

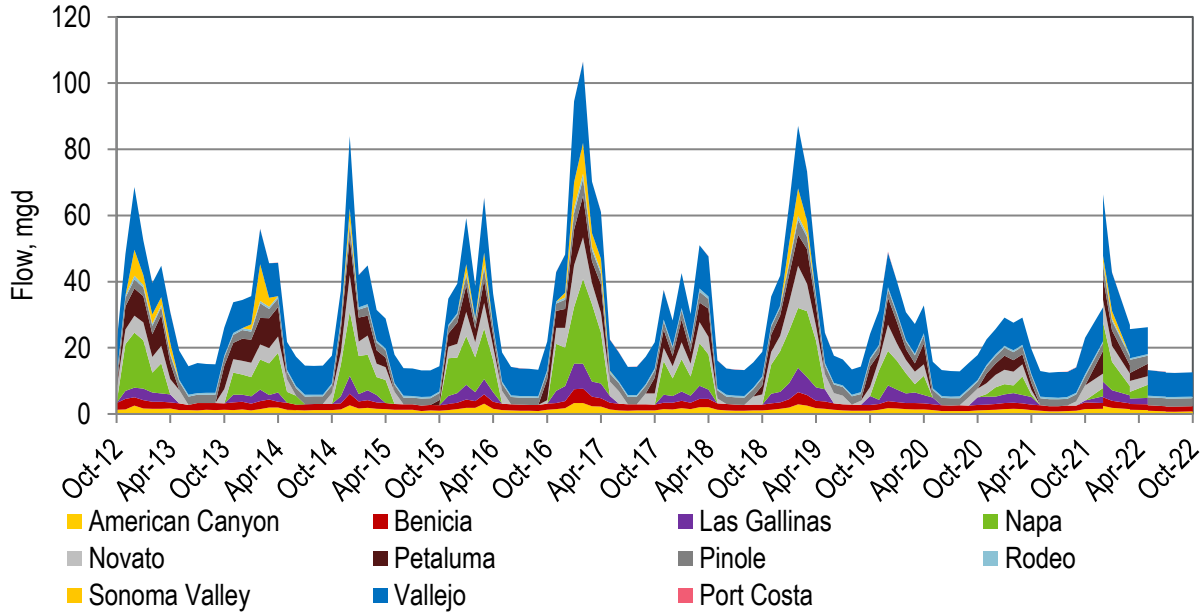

Figure 5-10. Flow Contribution by Discharger to San Pablo Bay

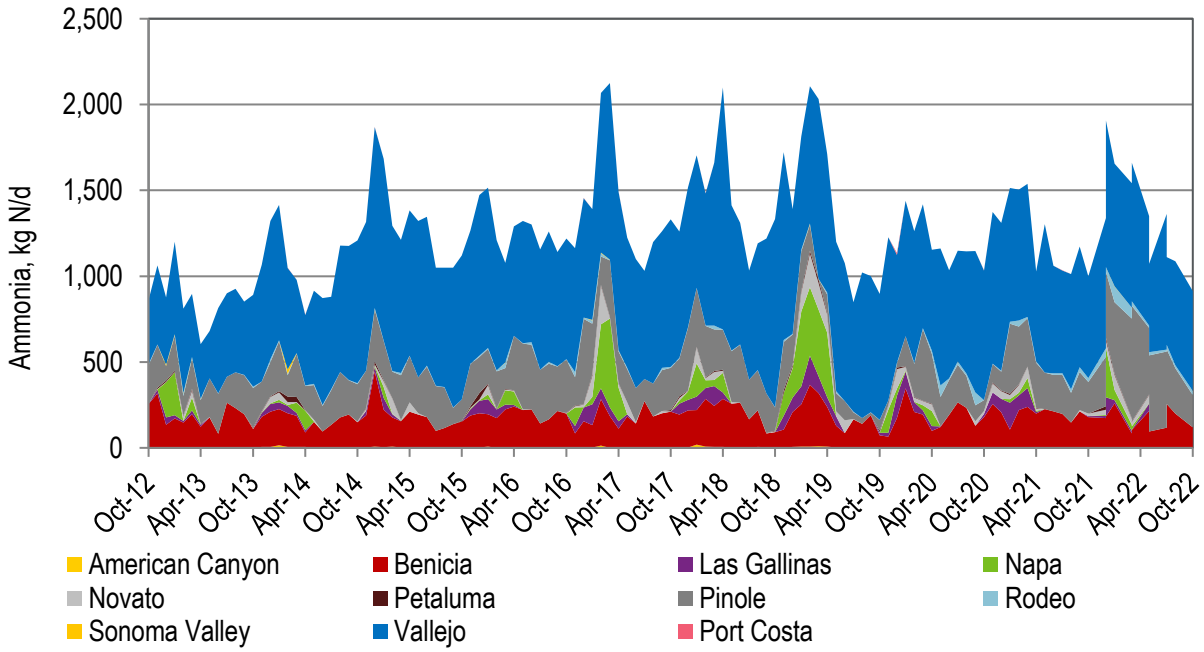

Figure 5-11. Ammonia Load Contribution by Discharger to San Pablo Bay

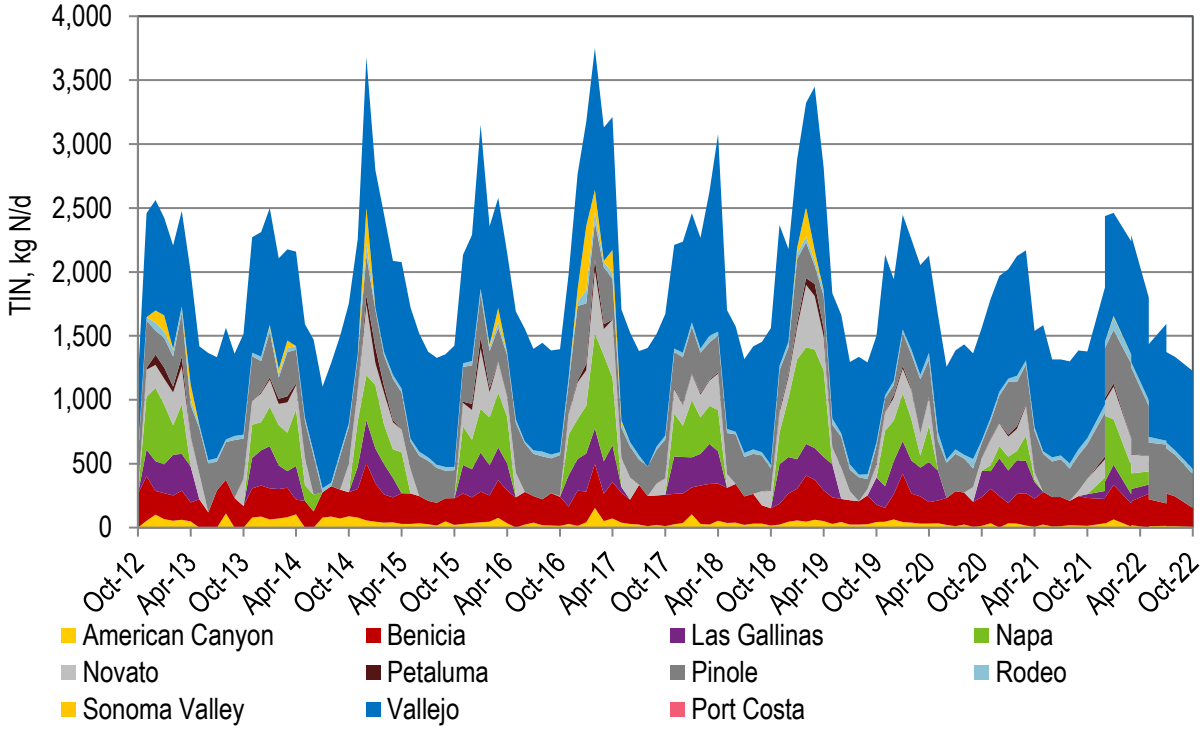

Figure 5-12. TIN Load Contribution by Discharger to San Pablo Bay

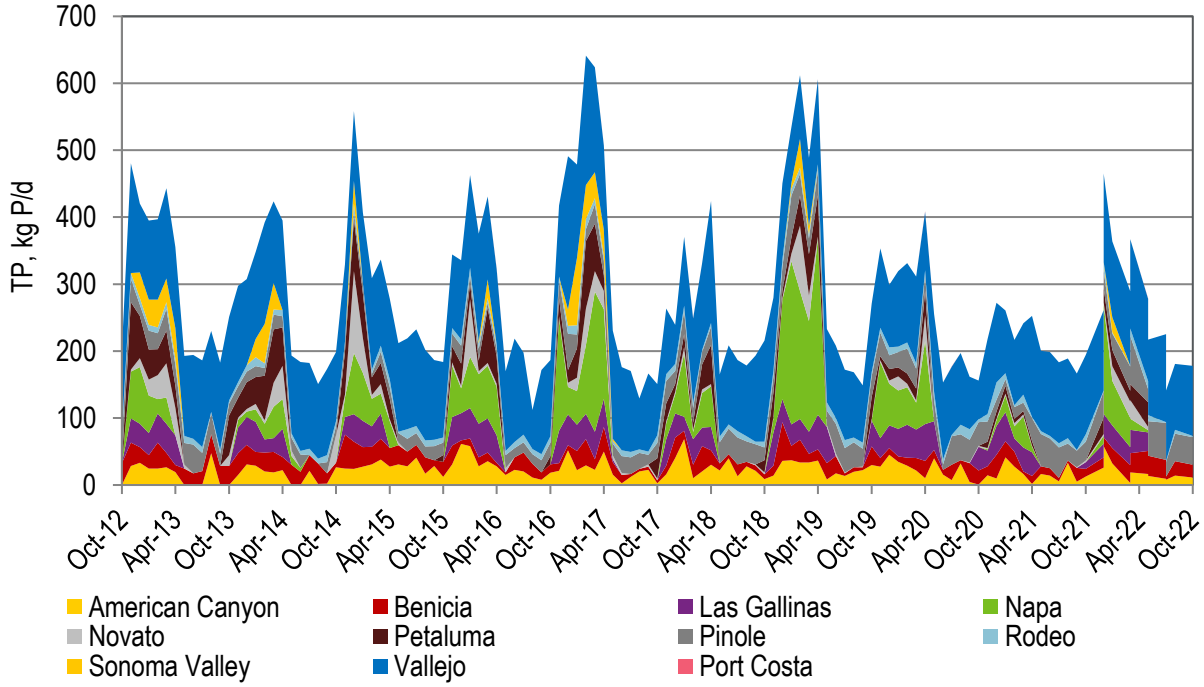

Figure 5-13. TP Load Contribution by Discharger to San Pablo Bay

5.6.3 Central Bay

The average monthly discharge to Central Bay by discharger for discharge flows and loads are provided in Figure 5-14 through Figure 5-17. Discharge flows and loads to the Central Bay are dominated by EBMUD.

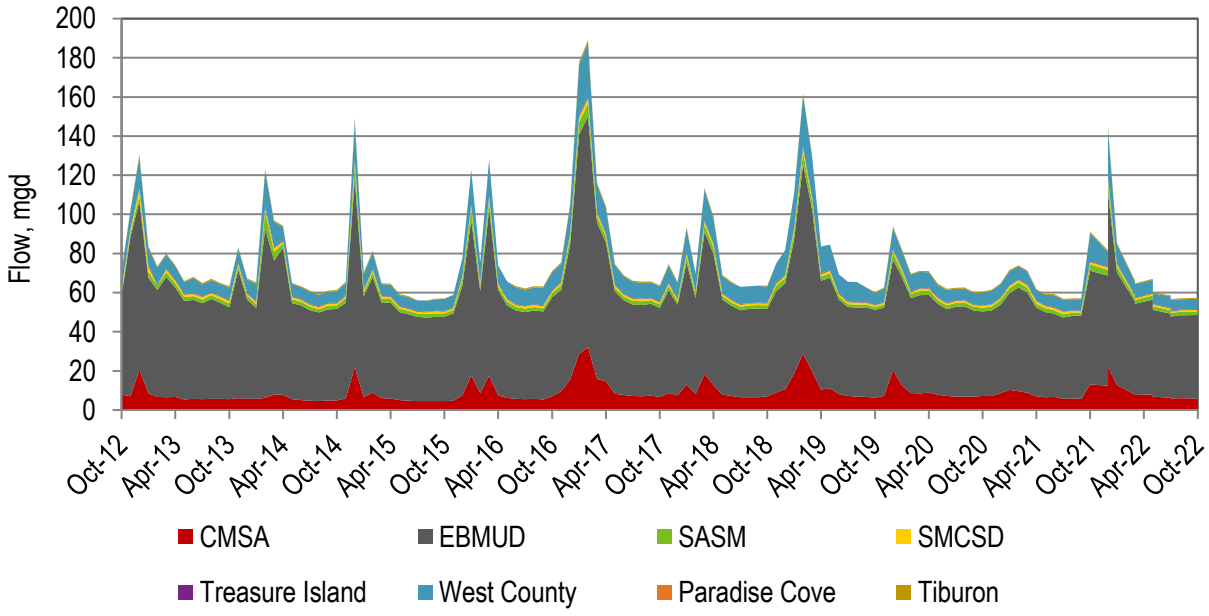

Figure 5-14. Flow Contribution by Discharger to Central Bay

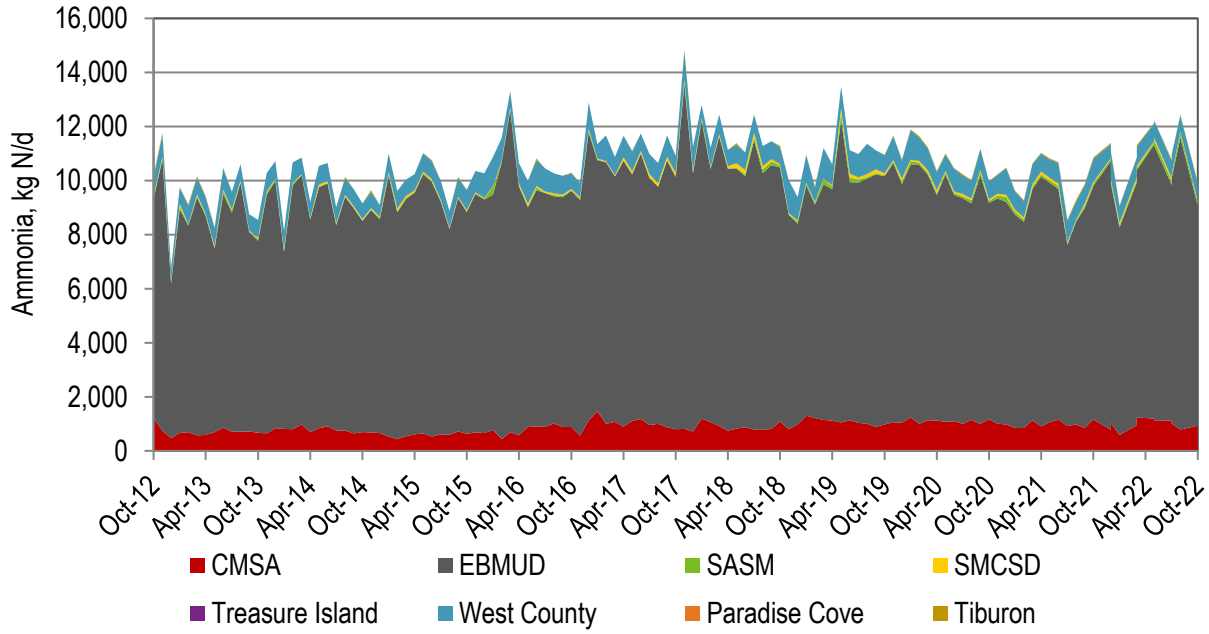

Figure 5-15. Ammonia Load Contribution by Discharger to Central Bay

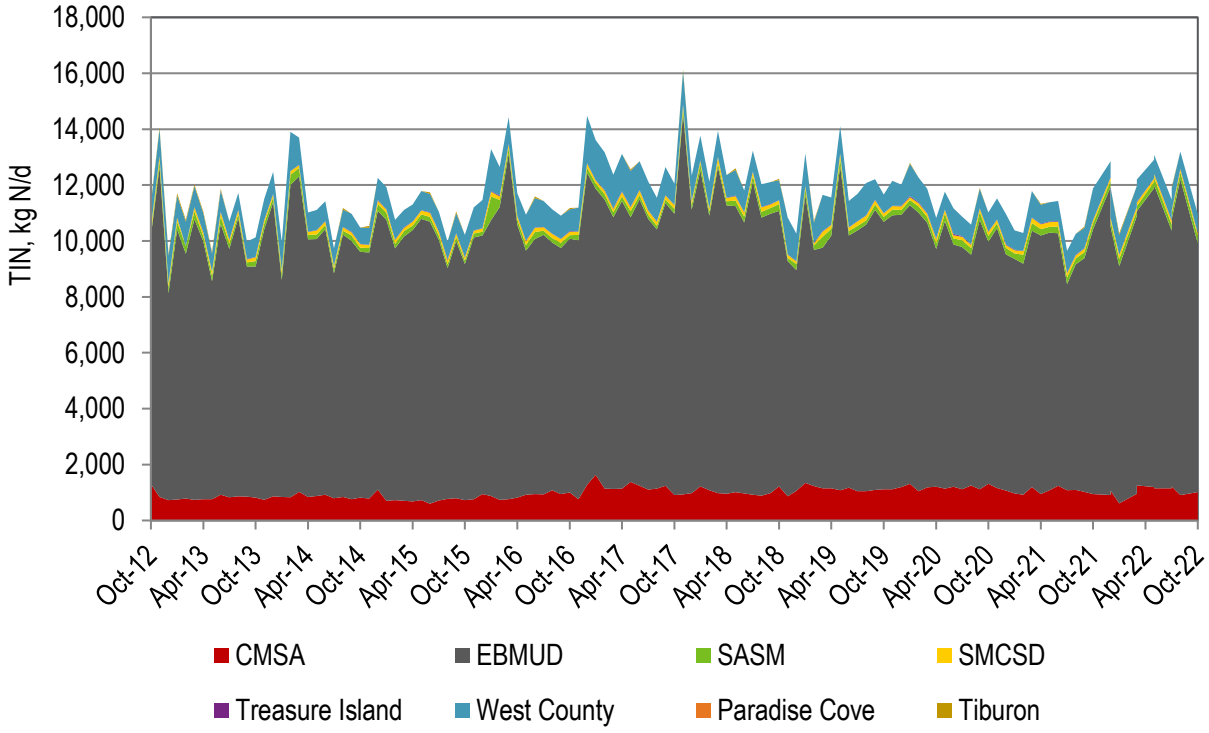

Figure 5-16. TIN Load Contribution by Discharger to Central Bay

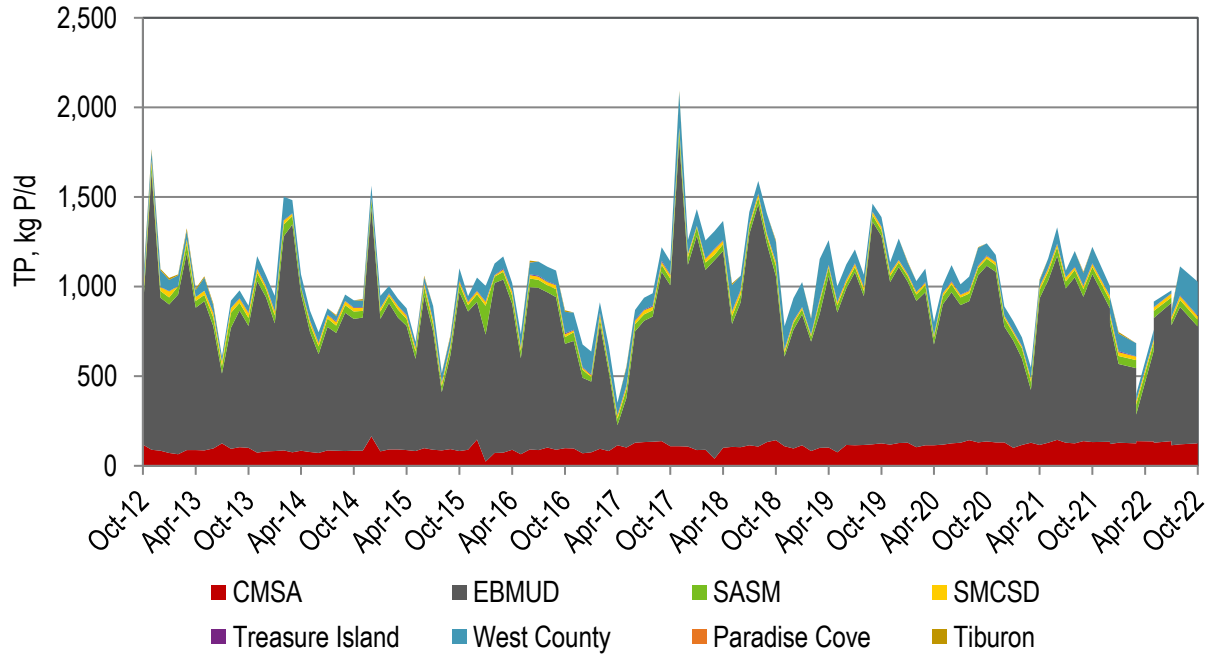

Figure 5-17. TP Load Contribution by Discharger to Central Bay

5.6.4 South Bay

The average monthly discharge to South Bay by discharger for discharge flows and loads are provided in Figure 5-18 through Figure 5-21. In the South Bay, the largest wastewater discharges are from the SFPUC Southeast Plant and EBDA. Ammonia and TIN loads to the South Bay are also largest from the SFPUC Southeast Plant and EBDA. The TP discharges to the South Bay have the largest contribution from EBDA, followed by relatively equal contributions between SFPUC Southeast Plant, San Mateo, SVCW, and South SF. SFPUC's TP loads are a lower proportion of the total compared to flow, ammonia, and TIN.

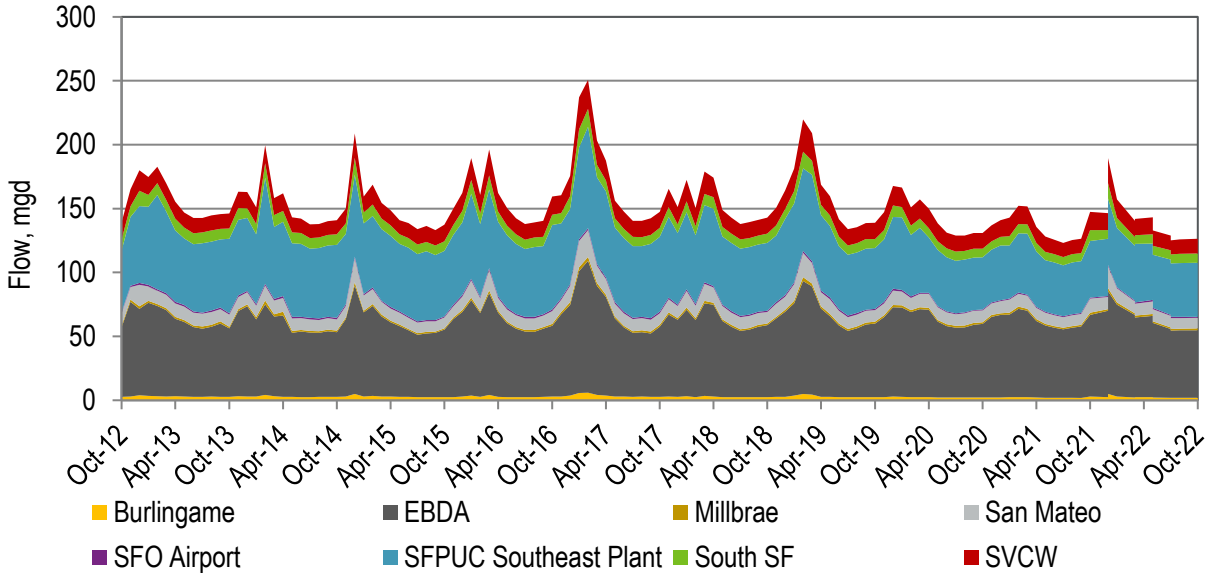

Figure 5-18. Flow Contribution by Discharger to South Bay

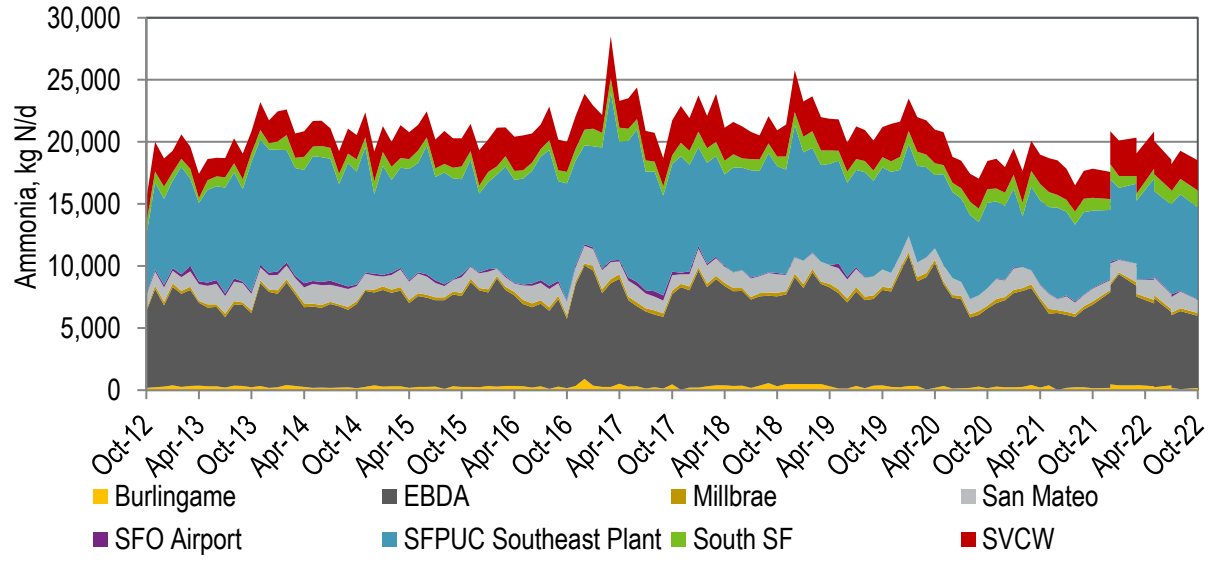

Figure 5-19. Ammonia Load Contribution by Discharger to South Bay

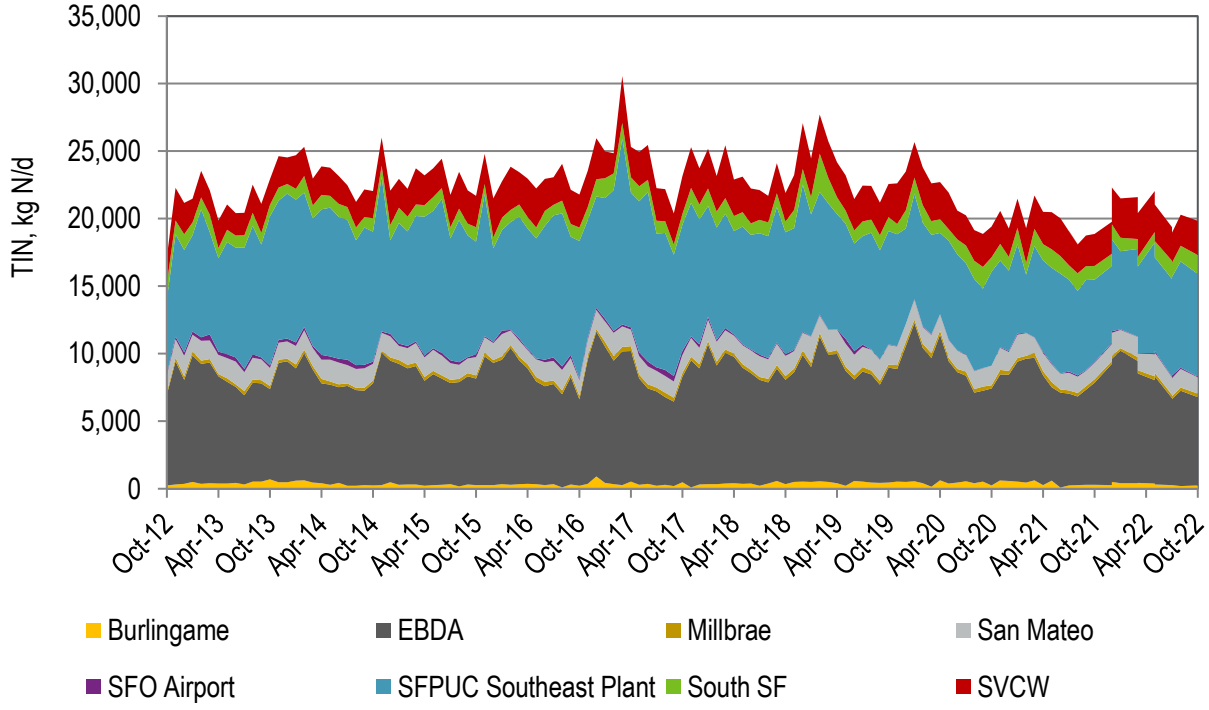

Figure 5-20. TIN Load Contribution by Discharger to South Bay

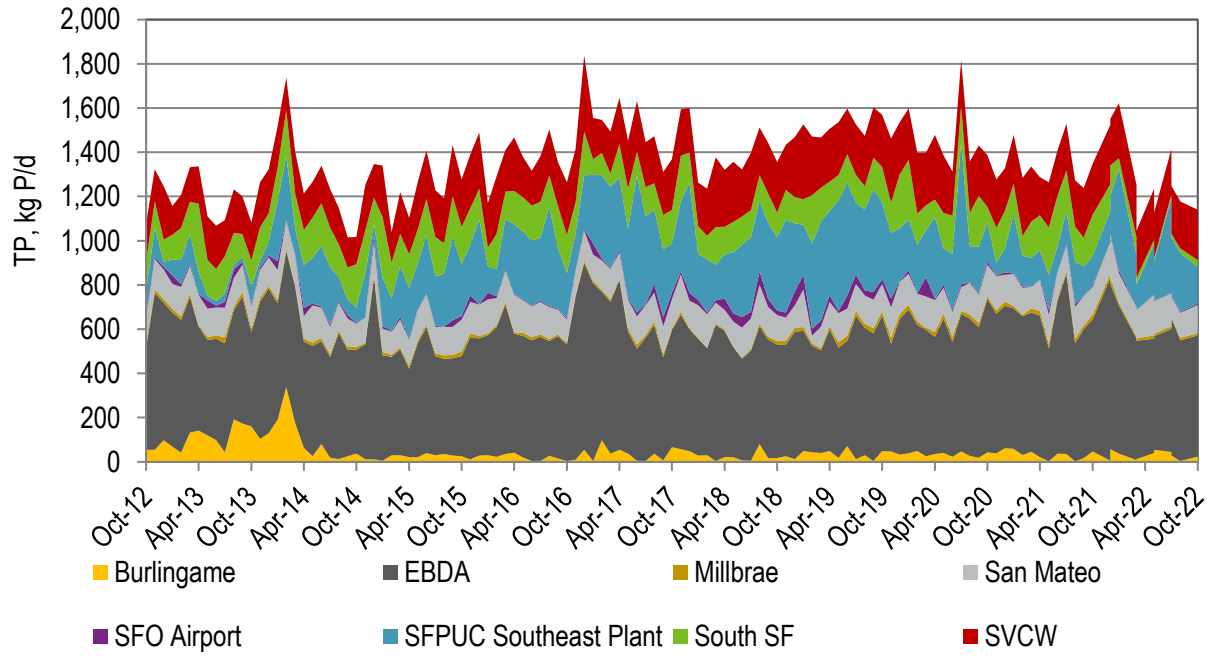

Figure 5-21. TP Load Contribution by Discharger to South Bay

5.6.5 Lower South Bay

The average monthly discharge to Lower South Bay by discharger for discharge flows and loads are provided in Figure 5-22 through Figure 5-25. Lower South Bay wastewater flows are dominated by San Jose. San Jose also discharges the largest TIN load. Sunnyvale and San Jose's ammonia loads exhibit a significant seasonal pattern. San Jose's TIN loads were sporadic (e.g., July 2015), which is likely attributed to the biological nitrogen removal step feed process, but it has been more stable in recent years. Palo Alto is the largest discharger of TP to Lower South Bay, followed by San Jose and Sunnyvale.

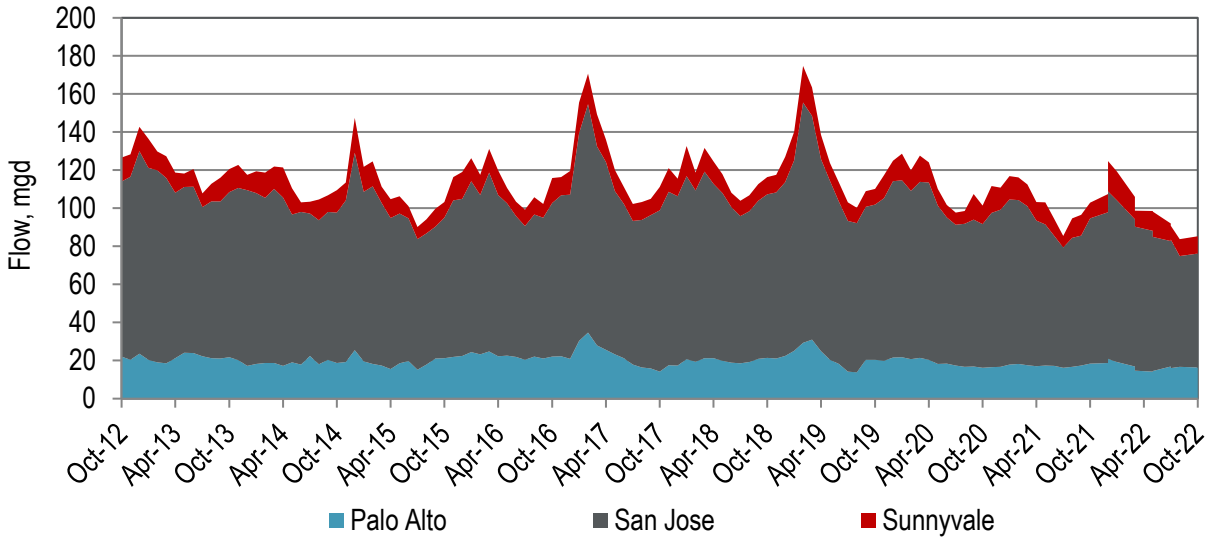

Figure 5-22. Flow Contribution by Discharger to Lower South Bay

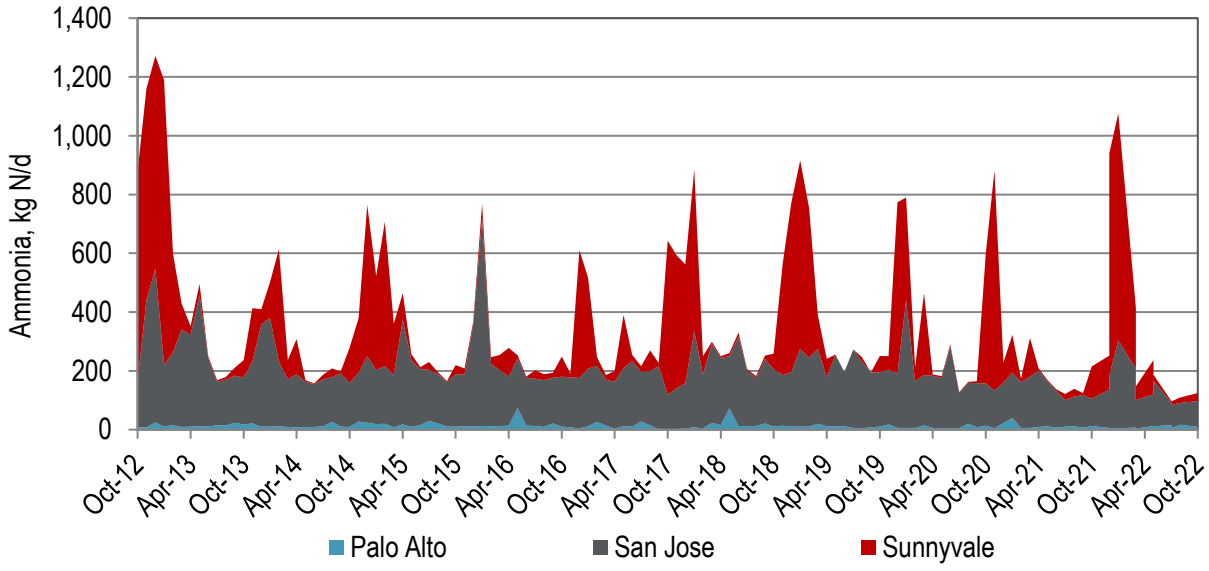

Figure 5-23. Ammonia Load Contribution by Discharger to Lower South Bay

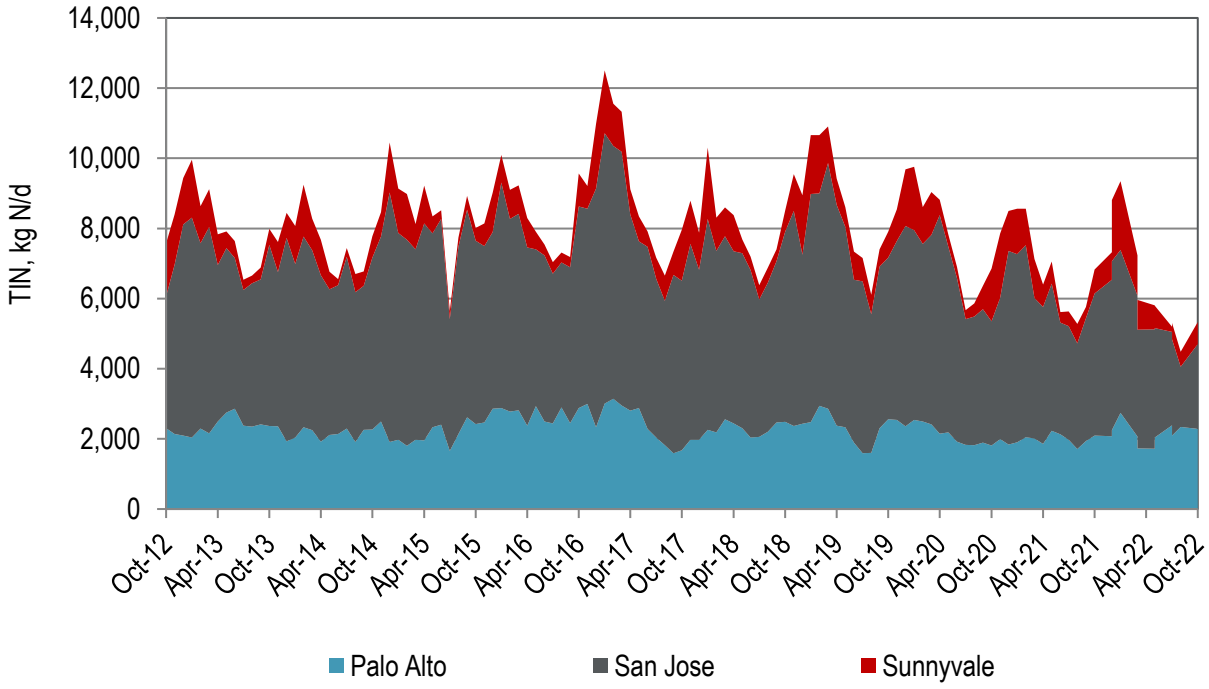

Figure 5-24. TIN Load Contribution by Discharger to Lower South Bay

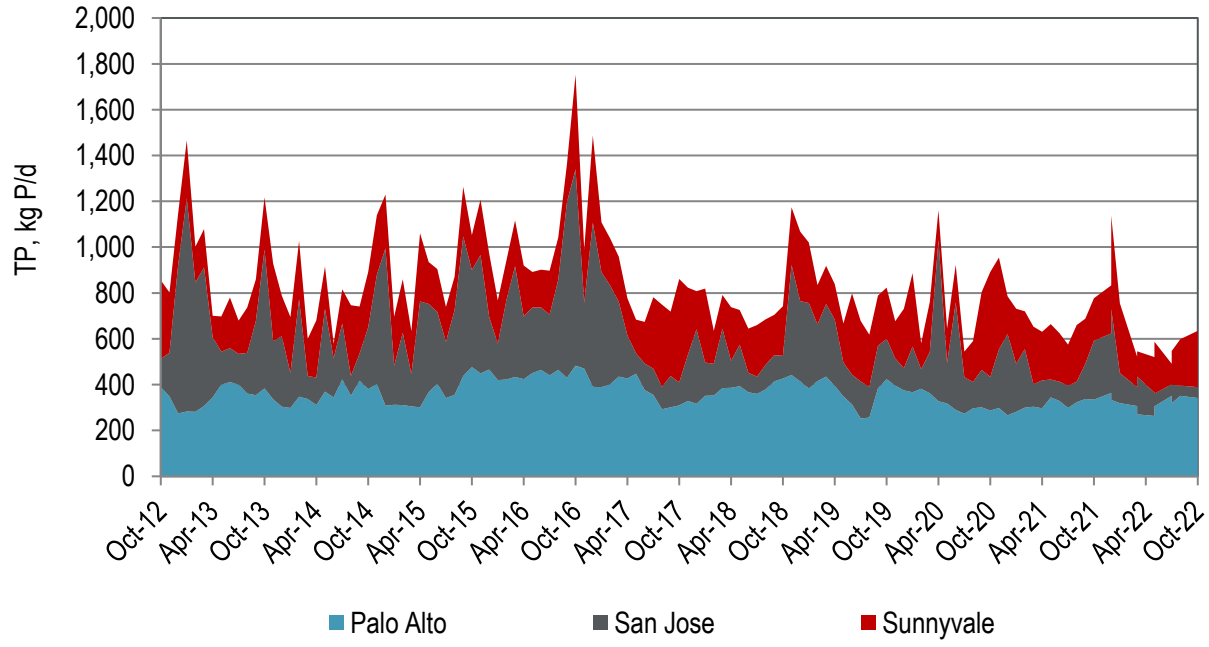

Figure 5-25. TP Load Contribution by Discharger to Lower South Bay

6 Recycled Water Data Review Findings

As previously noted in Section 3.7, this is the first Group Annual Report that includes data from the State Water Board.[2] It is important to note that this data source is one year behind the Group Annual Report. In addition to recycled water volumes, this Group Annual Report relied on the 2019/2020 and 2020/2021 datasets to quantify the corresponding load reductions to the Bay from recycled water. Similar to Sections 4 and 5, the average annual and dry season flows and loads are provided in the subsections that follow.

A summary of the recycled water data review findings is as follows:

- The recycled water volumes are presented as flow (mgd) to stay consistent with the other sections of this report.
- While calculating nutrient load diversions from the Bay associated with recycled water has potential challenge(s). One such challenge is there are situations where the load conveyed to recycled water users ends up in the Bay. For example, an industrial user might end up using recycled water for chillers which eventually ends up as blowdown with concentrated nutrients to the Bay. In addition, some agencies use recycled water for in-plant process water. Proper accounting is essential for nutrient management in the Bay. The load calculations in the subsections that follow attempt to account for such accounting challenges.
- The dry season represents 153 days. The duration is critical when one calculates the average flow (mgd) during the dry season or year-round (for average annual).

6.1 Flow

The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) recycled water flows are provided in Table 6-1 and Table 6-2, respectively. In addition, the annual average and dry season average monthly recycled water flows for each Subembayment are provided in Table 6-3 and Table 6-4, respectively. An additional set of tables is provided in Table 6-5 and Table 6-6 that offers the percent reduction of flow/load diverted from the Bay from recycled water.

A summary of the recycled water data review findings is as follows:

- The volume and percentage of water that is used by reuse customers is seasonally dependent. Example calculations for the percent of treated water that is diverted from the Bay and sent to reuse customers is as follows:
  - Average Annual (Example for 2020/2021 dataset): recycled water constitutes a diversion of approximately 12 percent of flow from the Bay (average annual flow = 374 mgd; recycled water = 49.0 mgd):

    $$12\ Percent = \frac{49.0\ \text{mgd}}{(49.0\ \text{mgd} + 374\ \text{mgd})}$$

  - Dry Season (Example for 2020/2021 dataset): recycled water constitutes a diversion of approximately 16 percent of flow from the Bay (dry season average flow = 339 mgd; recycled water dry season average flow = 65.2 mgd)

    $$16\ Percent = \frac{65.2\ \text{mgd}}{(65.2\ \text{mgd} + 339\ \text{mgd})}$$

- The recycled water flows are seasonally dependent as evidenced by an increase of approximately 30 percent from average annual to dry season volumes. Suisun and San Pablo Bays have the most pronounced seasonality impacts over the timeframe presented.
- During the dry season when recycled water volumes are at their peak, the recycled water volumes by Subembayment are as follows (based on the 3-year average): Lower South Bay > South Bay > San Pablo Bay > South Bay > Central Bay.
  - There are no potable reuse applications yet in the Bay Area
  - Lower South Bay relies primarily on a blend of landscape irrigation, industrial applications, and golf course irrigation.
  - South Bay has the most even distribution of recycled water volumes for agriculture, golf courses, commercial, and irrigation.
  - San Pablo Bay relies primarily on a blend of agriculture, golf courses, and irrigation.
  - Suisun Bay relies primarily on industrial customers, in particular the Calpine power production facility in Pittsburg-Antioch area.
  - Central Bay is limited to landscape irrigation and industrial recycled water users.

Table 6-1. Recycled Water: Annual Average Flows Diverted from the Bay (mgd)*

Discharger	Subembayment	Treatment Plant Permitted Capacity [a]	2019/ 2020 [b,c]	2020/ 2021 [b,c]	2-Year Average
American Canyon	San Pablo Bay	2.5	0.375	0.420	0.397
Benicia[f]	San Pablo Bay	4.5	--	--	--
Burlingame[f]	South Bay	5.5	--	--	--
CCCSD	Suisun Bay	53.8	1.56	1.72	1.64
CMSA	Central Bay	10	1.08	1.05	1.07
Port Costa[f]	San Pablo Bay	0.033	--	--	--
Delta Diablo[g]	Suisun Bay	19.5	5.08	6.06	5.57
EBDA	South Bay	107.8	8.37	9.20	8.79
EBMUD	Central Bay	120	5.45	3.47	4.46
FSSD	Suisun Bay	23.7	0.911	0.915	0.913
Las Gallinas[d]	San Pablo Bay	2.92	0.417	0.724	0.571
Paradise Cove[f]	Central Bay	0.04	--	--	--
Tiburon[f]	Central Bay	0.98	--	--	--
Millbrae[f]	South Bay	3	--	--	--
Mt. View[f]	Suisun Bay	3.2	--	--	--
Napa[d]	San Pablo Bay	15.4	2.74	3.49	3.11
Novato	San Pablo Bay	7	1.74	1.83	1.79
Palo Alto	Lower South Bay	39	0.645	0.663	0.654
Petaluma[d]	San Pablo Bay	6.7	1.71	2.12	1.91
Pinole[f]	San Pablo Bay	4.06	--	--	--
Rodeo[f]	San Pablo Bay	1.14	--	--	--
SFO Airport	South Bay	2.2	--	0.000	0.000
SFPUC Southeast[f]	South Bay	85.4	--	--	--
San Jose	Lower South Bay	167	11.0	11.7	11.3
San Mateo[f]	South Bay	15.7	--	--	--
SMCSD[f]	Central Bay	1.8	--	--	--
SASM	Central Bay	3.6	0.032	0.022	0.027
SVCW	South Bay	29	0.754	0.669	0.711
Sonoma Valley[d]	San Pablo Bay	3	1.18	1.44	1.31
South SF[f]	South Bay	13	--	--	--
Sunnyvale	Lower South Bay	29.5	0.777	0.757	0.767
Treasure Island[f]	Central Bay	2	--	--	--
Vallejo[f]	San Pablo Bay	15.5	--	--	--
West County	Central Bay	28.5	3.08	2.71	2.90
Total [e]		**827**	**46.9**	**49.0**	**47.9**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of flow from industrial application is not diverted from the Bay.

Table 6-2. Recycled Water: Dry Season Flows Diverted from the Bay (mgd)*

Discharger	Subembayment	Treatment Plant Permitted Capacity [a]	2019 [b,c]	2020 [b,c]	2021 [b,c]	3-Year Average
American Canyon	San Pablo Bay	2.5	0.373	0.559	0.645	0.526
Benicia[f]	San Pablo Bay	4.5	--	--	--	--
Burlingame[f]	South Bay	5.5	--	--	--	--
CCCSD	Suisun Bay	53.8	2.21	2.10	2.32	2.21
CMSA	Central Bay	10	1.06	1.11	1.11	1.10
Port Costa[f]	San Pablo Bay	0.033	--	--	--	--
Delta Diablo	Suisun Bay	19.5	4.63	5.31	7.07	5.67
EBDA	South Bay	107.8	13.50	12.70	13.30	13.10
EBMUD	Central Bay	120	5.22	5.55	2.46	4.41
FSSD	Suisun Bay	23.7	1.230	1.770	1.670	1.560
Las Gallinas[d]	San Pablo Bay	2.92	0.749	0.726	1.500	0.992
Paradise Cove[f]	Central Bay	0.04	--	--	--	--
Tiburon[f]	Central Bay	0.98	--	--	--	--
Millbrae[f]	South Bay	3	--	--	--	--
Mt. View[f]	Suisun Bay	3.2	--	--	--	--
Napa[d]	San Pablo Bay	15.4	3.82	4.61	5.88	4.77
Novato	San Pablo Bay	7	1.60	3.06	2.93	2.53
Palo Alto	Lower South Bay	39	1.050	1.060	1.050	1.050
Petaluma[d]	San Pablo Bay	6.7	2.29	3.24	3.38	2.97
Pinole[f]	San Pablo Bay	4.06	--	--	--	--
Rodeo[f]	San Pablo Bay	1.14	--	--	--	--
SFO Airport	South Bay	2.2	--	--	0.000	0.000
SFPUC Southeast[f]	South Bay	85.4	--	--	--	--
San Jose	Lower South Bay	167	15.1	15.7	15.6	15.5
San Mateo[f]	South Bay	15.7	--	--	--	--
SMCSD[f]	Central Bay	1.8	--	--	--	--
SASM	Central Bay	3.6	0.051	0.033	0.029	0.038
SVCW	South Bay	29	1.120	0.870	1.120	1.040
Sonoma Valley[d]	San Pablo Bay	3	1.55	1.70	1.95	1.74
South SF[f]	South Bay	13	--	--	--	--
Sunnyvale	Lower South Bay	29.5	0.926	1.190	0.757	0.957
Treasure Island[f]	Central Bay	2	--	--	--	--
Vallejo[f]	San Pablo Bay	15.5	--	--	--	--
West County	Central Bay	28.5	3.36	2.79	2.36	2.83
Total [e]		**827**	**59.8**	**64.0**	**65.2**	**63.0**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.

Table 6-3. Recycled Water: Annual Average Flows by Subembayment, Flow (mgd)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a]	2020/2021 [a]	2-Year Average
Suisun Bay	100	7.55	8.70	8.12
San Pablo Bay [b]	62.8	8.15	10.0	9.09
Central Bay	167	9.64	7.25	8.45
South Bay	262	9.13	9.87	9.50
Lower South Bay	236	12.4	13.1	12.8
Total	**827**	**46.9**	**49.0**	**47.9**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-4. Recycled Water: Dry Season Average Flows by Subembayment, Flow (mgd)

Subembayment	Treatment Plant Permitted Capacity	2019 [a]	2020 [a]	2021 [a]	3-Year Average
Suisun Bay	100	8.07	9.18	11.1	9.44
San Pablo Bay [b]	62.8	10.4	13.9	16.3	13.5
Central Bay	167	9.69	9.48	5.97	8.38
South Bay	262	14.6	13.5	14.4	14.2
Lower South Bay	236	17.0	17.9	17.5	17.5
Total	**827**	**59.8**	**64.0**	**65.2**	**63.0**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-5. Recycled Water: Percent of Annual Average Flows Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a,c] %	2020/2021 [a,c] %	2-Year Average %
Suisun Bay	100	12%	14%	12%
San Pablo Bay [b]	62.8	24%	34%	23%
Central Bay	167	12%	10%	10%
South Bay	262	6%	7%	6%
Lower South Bay	236	10%	11%	10%
Total	**827**	**10%**	**12%**	**10%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

Table 6-6. Recycled Water: Percent of Dry Season Average Flows Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019 [a,c] %	2020 [a,c] %	2021 [a,c] %	3-Year Average %
Suisun Bay	100	15%	16%	19%	16%
San Pablo Bay [b]	62.8	43%	52%	56%	47%
Central Bay	167	13%	14%	9%	12%
South Bay	262	10%	10%	10%	9%
Lower South Bay	236	14%	16%	16%	14%
Total	**827**	**14%**	**16%**	**16%**	**15%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

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6.2 Total Ammonia

The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) recycled water flows are provided in Table 6-7 and Table 6-8, respectively. In addition, the annual average and dry season average monthly recycled water flows for each Subembayment are provided in Table 6-9 and Table 6-10, respectively. An additional set of tables is provided in Table 6-11 and Table 6-12 that offers the percent reduction of flow/load diverted from the Bay from recycled water.

A summary of the recycled water data review findings is as follows:

- The volume and percentage of water that is used by reuse customers is seasonally dependent. Example calculations for the percent of treated water that is diverted from the Bay and sent to reuse customers is as follows:
  - Average Annual (Example for 2020/2021 dataset): recycled water constitutes a diversion of approximately 7 percent of ammonia load from the Bay (average annual discharge load = 35,300 kg N/d; recycled water average annual load = 2,580 kg N/d):

    $$7\ Percent = \frac{2{,}580\ \text{kg N/d}}{(2{,}580\ \text{kg N/d} + 35{,}300\ \text{kg N/d})}$$

  - Dry Season (Example for 2021 dataset): recycled water constitutes a diversion of approximately 8 percent of ammonia load from the Bay (dry season average discharge load = 33,600 kg N/d; recycled water dry season average load = 3,040 kg N/d)

    $$8\ Percent = 1 - \frac{3{,}040\ \text{kg N/d}}{(3{,}040\ \text{kg N/d} + 33{,}600\text{kg N/d})}$$

- The recycled water flows are seasonally dependent as evidenced by an increase of approximately 25 percent from average annual to dry season volumes. South and Lower South Bays have the most pronounced seasonality impacts over the timeframe presented.
- During the dry season when recycled water volumes are at their peak, the recycled water volumes by Subembayment are as follows (based on the 3-year average): South Bay > Central Bay > Suisun Bay > Lower South Bay > South Bay. Note: Despite having the highest dry season volume of water diverted to reuse, the Lower South Bay has the second to lowest amount of ammonia loads diverted from the Bay as all Lower South Bay dischargers reliably remove ammonia at the treatment plant.
- The percentage of loads diverted from the Bay by reuse ranges from 7 to 9 percent baywide (regardless of average annual or dry season averaging period; refer to Table 6-11 and Table 6-12).

Table 6-7. Recycled Water: Annual Average Total Ammonia Loads Diverted from the Bay (kg N/day)*

Discharger	Subembayment	2019/2020 [b,c]	2020/2021 [b,c]	2-Year Average
American Canyon	San Pablo Bay	0.322	0.153	0.238
Benicia[f]	San Pablo Bay	--	--	--
Burlingame[f]	South Bay	--	--	--
CCCSD	Suisun Bay	181	229	205
CMSA	Central Bay	142	147	144
Port Costa[f]	San Pablo Bay	--	--	--
Delta Diablo[g]	Suisun Bay	58.1	66.8	62.4
EBDA	South Bay	1,050	1,010	1,030
EBMUD	Central Bay	1,020	631	824
FSSD	Suisun Bay	0.302	0.279	0.291
Las Gallinas[d]	San Pablo Bay	1.47	0.915	1.19
Paradise Cove[f]	Central Bay	--	--	--
Tiburon[f]	Central Bay	--	--	--
Millbrae[f]	South Bay	--	--	--
Mt. View[f]	Suisun Bay	--	--	--
Napa[d]	San Pablo Bay	13.7	15.8	14.8
Novato	San Pablo Bay	3.73	7.61	5.67
Palo Alto	Lower South Bay	0.310	0.410	0.360
Petaluma[d]	San Pablo Bay	0.462	1.69	1.08
Pinole[f]	San Pablo Bay	--	--	--
Rodeo[f]	San Pablo Bay	--	--	--
SFO Airport	South Bay	--	0.017	0.017
SFPUC Southeast[f]	South Bay	--	--	--
San Jose	Lower South Bay	24.5	20.9	22.7
San Mateo[f]	South Bay	--	--	--
SMCSD[f]	Central Bay	--	--	--
SASM	Central Bay	1.42	0.909	1.17
SVCW	South Bay	138	139	138
Sonoma Valley[d]	San Pablo Bay	--	--	--
South SF[f]	South Bay	--	--	--
Sunnyvale	Lower South Bay	1.05	1.28	1.17
Treasure Island[f]	Central Bay	--	--	--
Vallejo[f]	San Pablo Bay	--	--	--
West County	Central Bay	328	307	317
Total [e]		**2,960**	**2,580**	**2,770**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of load from industrial application is not diverted from the Bay.

Table 6-8. Recycled Water: Dry Season Total Ammonia Loads Diverted from the Bay (kg N/day)*

Discharger	Subembayment	2019 [b]	2020 [b]	2021 [b]	3-Year Average
American Canyon	San Pablo Bay	0.598	0.475	0.265	0.446
Benicia[f]	San Pablo Bay	--	--	--	--
Burlingame[f]	South Bay	--	--	--	--
CCCSD	Suisun Bay	213	248	307	256
CMSA	Central Bay	139	166	182	162
Port Costa[f]	San Pablo Bay	--	--	--	--
Delta Diablo[g]	Suisun Bay	54.1	62.0	69.0	61.7
EBDA	South Bay	1,760	1,520	1,440	1,570
EBMUD	Central Bay	1,020	1,060	467	849
FSSD	Suisun Bay	0.662	0.497	0.516	0.558
Las Gallinas[d]	San Pablo Bay	2.53	1.03	--	1.78
Paradise Cove[f]	Central Bay	--	--	--	--
Tiburon[f]	Central Bay	--	--	--	--
Millbrae[f]	South Bay	--	--	--	--
Mt. View[f]	Suisun Bay	--	--	--	--
Napa[d]	San Pablo Bay	--	--	--	--
Novato	San Pablo Bay	6.29	9.50	9.90	8.56
Palo Alto	Lower South Bay	0.475	0.504	0.604	0.528
Petaluma[d]	San Pablo Bay	--	--	--	--
Pinole[f]	San Pablo Bay	--	--	--	--
Rodeo[f]	San Pablo Bay	--	--	--	--
SFO Airport	South Bay	--	--	0.026	0.026
SFPUC Southeast[f]	South Bay	--	--	--	--
San Jose	Lower South Bay	40.6	34.7	25.9	33.8
San Mateo[f]	South Bay	--	--	--	--
SMCSD[f]	Central Bay	--	--	--	--
SASM	Central Bay	3.71	1.55	1.18	2.15
SVCW	South Bay	211	157	245	204
Sonoma Valley[d]	San Pablo Bay	--	--	--	--
South SF[f]	South Bay	--	--	--	--
Sunnyvale	Lower South Bay	2.76	0.909	1.28	1.65
Treasure Island[f]	Central Bay	--	--	--	--
Vallejo[f]	San Pablo Bay	--	--	--	--
West County	Central Bay	294	322	293	303
Total [e]		**3,750**	**3,580**	**3,040**	**3,460**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of load from industrial application is not diverted from the Bay.

Table 6-9. Recycled Water: Annual Average Total Ammonia Loads by Subembayment, Flow (kg N/d)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a]	2020/2021 [a]	2-Year Average
Suisun Bay	100	239	296	268
San Pablo Bay [b]	62.8	19.7	26.2	22.9
Central Bay	167	1,490	1,090	1,290
South Bay	262	1,190	1,150	1,170
Lower South Bay	236	25.8	22.6	24.2
Total	**827**	**2,960**	**2,580**	**2,770**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-10. Recycled Water: Dry Season Average Total Ammonia Loads by Subembayment, Flow (kg N/d)

Subembayment	Treatment Plant Permitted Capacity	2019 [a]	2020 [a]	2021 [a]	3-Year Average
Suisun Bay	100	267	311	377	318
San Pablo Bay [b]	62.8	9.41	11.0	10.2	10.2
Central Bay	167	1,460	1,550	942	1,320
South Bay	262	1,970	1,680	1,680	1,780
Lower South Bay	236	43.9	36.1	27.8	35.9
Total	**827**	**3,750**	**3,580**	**3,040**	**3,460**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-11. Recycled Water: Percent of Annual Average Total Ammonia Loads Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a,c] %	2020/2021 [a,c] %	2-Year Average %
Suisun Bay	100	4%	5%	5%
San Pablo Bay [b]	62.8	2%	2%	2%
Central Bay	167	12%	10%	11%
South Bay	262	6%	6%	6%
Lower South Bay	236	7%	7%	7%
Total	**827**	**7%**	**7%**	**7%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

Table 6-12. Recycled Water: Percent of Dry Season Average Total Ammonia Loads Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019 [a,c] %	2020 [a,c] %	2021 [a,c] %	3-Year Average %
Suisun Bay	100	6%	6%	7%	6%
San Pablo Bay [b]	62.8	1%	1%	1%	1%
Central Bay	167	11%	13%	9%	11%
South Bay	262	9%	8%	9%	9%
Lower South Bay	236	16%	16%	17%	16%
Total	**827**	**9%**	**9%**	**8%**	**9%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

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6.3 Nitrate + Nitrite (NOx)

The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) recycled water flows are provided in Table 6-13 and Table 6-14, respectively. In addition, the annual average and dry season average monthly recycled water flows for each Subembayment are provided in Table 6-15 and Table 6-16, respectively. An additional set of tables is provided in Table 6-17 and Table 6-18 that offers the percent reduction of flow/load diverted from the Bay from recycled water.

A summary of the recycled water data review findings is as follows:

- The volume and percentage of water that is used by reuse customers is seasonally dependent. Example calculations for the percent of treated water that is diverted from the Bay and sent to reuse customers is as follows:
  - Average Annual (Example for 2020/2021 dataset): recycled water constitutes a diversion of approximately 9 percent of NOx load from the Bay (average annual discharge load = 10,700 kg N/d; recycled water average annual load = 1,090 kg N/d):

    $$9\ Percent = \frac{1{,}090\ \text{kg N/d}}{(1{,}090\ \text{kg N/d} + 10{,}700\ \text{kg N/d})}$$

  - Dry Season (Example for 2021 dataset): recycled water constitutes a diversion of approximately 14 percent of NOx load from the Bay (dry season average discharge load = 9,290 kg N/d; recycled water dry season average load = 1,550 kg N/d)

    $$14\ Percent = 1 - \frac{1{,}550\ \text{kg N/d}}{(1{,}550\ \text{kg N/d} + 9{,}290\text{kg N/d})}$$

- The recycled water flows are seasonally dependent as evidenced by an increase of approximately 40 percent from average annual to dry season volumes. Suisun Bay has the most pronounced seasonality impact over the timeframe presented.
- During the dry season when recycled water volumes are at their peak, the recycled water volumes by Subembayment are as follows (based on the 3-year average): Lower South Bay > Suisun Bay > South Bay > Central Bay > San Pablo Bay. Unlike ammonia, the Lower South Bay has both the largest flow and NOx loads diverted from the Bay by reuse as all Lower South Bay dischargers reliably remove ammonia and form NOx at their treatment plants.
- The percentage of loads diverted from the Bay by reuse ranges from 8 to 14 percent baywide (regardless of average annual or dry season averaging period; refer to Table 6-17 and Table 6-18). The higher percentages compared to ammonia is the effluent treatment plant concentration for POTWs that remove ammonia is reliably less than 1 mg N/L, whereby those that remove NOx are routinely higher than ammonia.

Table 6-13. Recycled Water: Annual Average Nitrate + Nitrite Loads Diverted from the Bay (kg N/day)*

Discharger	Subembayment	2019/2020 [b,c]	2020/2021 [b,c]	2-Year Average
American Canyon	San Pablo Bay	8.97	6.43	7.70
Benicia[f]	San Pablo Bay	--	--	--
Burlingame[f]	South Bay	--	--	--
CCCSD	Suisun Bay	6.19	3.50	4.85
CMSA	Central Bay	12.7	16.2	14.5
Port Costa[f]	San Pablo Bay	--	--	--
Delta Diablo[g]	Suisun Bay	2.34	5.27	3.80
EBDA	South Bay	110	156	133
EBMUD	Central Bay	44.5	45.5	45.0
FSSD	Suisun Bay	76.7	75.4	76.1
Las Gallinas[d]	San Pablo Bay	22.1	4.4	13.3
Paradise Cove[f]	Central Bay	--	--	--
Tiburon[f]	Central Bay	--	--	--
Millbrae[f]	South Bay	--	--	--
Mt. View[f]	Suisun Bay	--	--	--
Napa[d]	San Pablo Bay	39.3	47.0	43.2
Novato	San Pablo Bay	19.7	27.1	23.4
Palo Alto	Lower South Bay	72.2	76.8	74.5
Petaluma[d]	San Pablo Bay	0.267	2.48	1.37
Pinole[f]	San Pablo Bay	--	--	--
Rodeo[f]	San Pablo Bay	--	--	--
SFO Airport	South Bay	--	0.001	0.001
SFPUC Southeast[f]	South Bay	--	--	--
San Jose	Lower South Bay	588	583	586
San Mateo[f]	South Bay	--	--	--
SMCSD[f]	Central Bay	--	--	--
SASM	Central Bay	2.27	1.64	1.96
SVCW	South Bay	1.66	1.77	1.72
Sonoma Valley[d]	San Pablo Bay	--	--	--
South SF[f]	South Bay	--	--	--
Sunnyvale	Lower South Bay	36.5	33.4	34.9
Treasure Island[f]	Central Bay	--	--	--
Vallejo[f]	San Pablo Bay	--	--	--
West County	Central Bay	16.6	11.8	14.2
Total [e]		**1,060**	**1,100**	**1,080**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of load from industrial application is not diverted from the Bay.

Table 6-14. Recycled Water: Dry Season Nitrate + Nitrite Loads Diverted from the Bay (kg N/day)*

Discharger	Subembayment	2019 [b]	2020 [b]	2021 [b]	3-Year Average
American Canyon	San Pablo Bay	8.65	10.4	10.4	9.82
Benicia[f]	San Pablo Bay	--	--	--	--
Burlingame[f]	South Bay	--	--	--	--
CCCSD	Suisun Bay	17.3	10.6	5.26	7.95
CMSA	Central Bay	10.5	16.5	21.5	19.0
Port Costa[f]	San Pablo Bay	--	--	--	--
Delta Diablo[g]	Suisun Bay	45.4	46.3	163	105
EBDA	South Bay	145	185	223	204
EBMUD	Central Bay	46.2	45.4	27.8	36.6
FSSD	Suisun Bay	104	151	137	144
Las Gallinas[d]	San Pablo Bay	9.71	65.7	--	65.7
Paradise Cove[f]	Central Bay	--	--	--	--
Tiburon[f]	Central Bay	--	--	--	--
Millbrae[f]	South Bay	--	--	--	--
Mt. View[f]	Suisun Bay	--	--	--	--
Napa[d]	San Pablo Bay	--	--	--	--
Novato	San Pablo Bay	37.7	33.1	46.5	39.8
Palo Alto	Lower South Bay	117	115	124	120
Petaluma[d]	San Pablo Bay	--	--	--	--
Pinole[f]	San Pablo Bay	--	--	--	--
Rodeo[f]	San Pablo Bay	--	--	--	--
SFO Airport	South Bay	--	--	0.001	0.001
SFPUC Southeast[f]	South Bay	--	--	--	--
San Jose	Lower South Bay	811	804	751	778
San Mateo[f]	South Bay	--	--	--	--
SMCSD[f]	Central Bay	--	--	--	--
SASM	Central Bay	1.47	2.33	2.28	2.30
SVCW	South Bay	2.04	2.16	3.13	2.65
Sonoma Valley[d]	San Pablo Bay	--	--	--	--
South SF[f]	South Bay	--	--	--	--
Sunnyvale	Lower South Bay	60.6	50.4	33.4	41.9
Treasure Island[f]	Central Bay	--	--	--	--
Vallejo[f]	San Pablo Bay	--	--	--	--
West County	Central Bay	25.9	20.6	3.7	12.1
Total [e]		**1,440**	**1,560**	**1,550**	**1,590**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of load from industrial application is not diverted from the Bay.

Table 6-15. Recycled Water: Annual Average Nitrate + Nitrite Loads by Subembayment, Flow (kg N/d)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a]	2020/2021 [a]	2-Year Average
Suisun Bay	100	85.2	84.2	84.7
San Pablo Bay [b]	62.8	81.3	81.1	81.2
Central Bay	167	76.1	75.1	75.6
South Bay	262	112	158	135
Lower South Bay	236	697	693	695
Total	**827**	**1,050**	**1,090**	**1,070**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-16. Recycled Water: Dry Season Average Nitrate + Nitrite Loads by Subembayment, Flow (kg N/d)

Subembayment	Treatment Plant Permitted Capacity	2019 [a]	2020 [a]	2021 [a]	3-Year Average
Suisun Bay	100	167.0	208	305	227
San Pablo Bay [b]	62.8	56.1	109	56.9	74.1
Central Bay	167	84.1	84.8	55.2	74.7
South Bay	262	147	187	226	187
Lower South Bay	236	989	970	909	956
Total	**827**	**1,440**	**1,560**	**1,550**	**1,520**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-17. Recycled Water: Percent of Annual Average Nitrate + Nitrite Loads Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a,c] %	2020/2021 [a,c] %	2-Year Average %
Suisun Bay	100	6%	6%	5%
San Pablo Bay [b]	62.8	12%	16%	10%
Central Bay	167	9%	8%	6%
South Bay	262	8%	10%	7%
Lower South Bay	236	8%	9%	8%
Total	**827**	**8%**	**9%**	**7%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

Table 6-18. Recycled Water: Percent of Dry Season Average Nitrate + Nitrite Loads Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019 [a,c] %	2020 [a,c] %	2021 [a,c] %	3-Year Average %
Suisun Bay	100	11%	15%	18%	13%
San Pablo Bay [b]	62.8	16%	29%	17%	17%
Central Bay	167	10%	9%	7%	8%
South Bay	262	10%	13%	17%	11%
Lower South Bay	236	13%	14%	15%	13%
Total	**827**	**13%**	**14%**	**15%**	**12%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

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6.4 Total Inorganic Nitrogen (TIN)

The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) recycled water flows are provided in Table 6-19 and Table 6-20, respectively. In addition, the annual average and dry season average monthly recycled water flows for each Subembayment are provided in Table 6-21 and Table 6-22, respectively. An additional set of tables is provided in Table 6-23 and Table 6-24 that offers the percent reduction of flow/load diverted from the Bay from recycled water.

A summary of the recycled water data review findings is as follows:

- The volume and percentage of water that is used by reuse customers is seasonally dependent. Example calculations for the percent of treated water that is diverted from the Bay and sent to reuse customers is as follows:
  - Average Annual (Example for 2020/2021 dataset): recycled water constitutes a diversion of approximately 7 percent of TIN load from the Bay (average annual discharge load = 46,000 kg N/d; recycled water average annual load = 3,680 kg N/d):

    $$7\ Percent = \frac{3{,}680\ \text{kg N/d}}{(3{,}680\ \text{kg N/d} + 46{,}000\ \text{kg N/d})}$$

  - Dry Season (Example for 2021 dataset): recycled water constitutes a diversion of approximately 9 percent of TIN load from the Bay (dry season average discharge load = 43,100 kg N/d; recycled water dry season average load = 4,440 kg N/d)

    $$9\ Percent = 1 - \frac{4{,}440\ \text{kg N/d}}{(4{,}440\ \text{kg N/d} + 43{,}100\text{kg N/d})}$$

- The recycled water flows are seasonally dependent as evidenced by an increase of approximately 30 percent from average annual to dry season volumes. South Bay has the most pronounced seasonality impact over the timeframe presented.
- During the dry season when recycled water volumes are at their peak, the recycled water volumes by Subembayment are as follows (based on the 3-year average): South Bay > Central Bay > Lower South Bay > Suisun Bay > San Pablo Bay.
- The percentage of loads diverted from the Bay by reuse ranges from 7 to 10 percent baywide (regardless of average annual or dry season averaging period; refer to Table 6-23 and Table 6-24). The percentages are more in alignment with ammonia values associated with recycled water.

Table 6-19. Recycled Water: Annual Average TIN Loads Diverted from the Bay (kg N/day)*

Discharger	Subembayment	2019/2020 [b,c]	2020/2021 [b,c]	2-Year Average
American Canyon	San Pablo Bay	9.29	6.58	7.93
Benicia[f]	San Pablo Bay	--	--	--
Burlingame[f]	South Bay	--	--	--
CCCSD	Suisun Bay	187	232	210
CMSA	Central Bay	154	163	159
Port Costa[f]	San Pablo Bay	--	--	--
Delta Diablo[g]	Suisun Bay	60.4	72.9	66.7
EBDA	South Bay	1,170	1,170	1,170
EBMUD	Central Bay	1,060	671	866
FSSD	Suisun Bay	77.0	75.7	76.4
Las Gallinas[d]	San Pablo Bay	23.2	4.98	14.1
Paradise Cove[f]	Central Bay	--	--	--
Tiburon[f]	Central Bay	--	--	--
Millbrae[f]	South Bay	--	--	--
Mt. View[f]	Suisun Bay	--	--	--
Napa[d]	San Pablo Bay	53.1	56.2	54.6
Novato	San Pablo Bay	23.4	36.3	29.8
Palo Alto	Lower South Bay	72.5	77.2	74.8
Petaluma[d]	San Pablo Bay	0.729	4.17	2.45
Pinole[f]	San Pablo Bay	--	--	--
Rodeo[f]	San Pablo Bay	--	--	--
SFO Airport	South Bay	--	0.018	0.018
SFPUC Southeast[f]	South Bay	--	--	--
San Jose	Lower South Bay	612	604	608
San Mateo[f]	South Bay	--	--	--
SMCSD[f]	Central Bay	--	--	--
SASM	Central Bay	4.05	2.64	3.34
SVCW	South Bay	139	141	140
Sonoma Valley[d]	San Pablo Bay	--	--	--
South SF[f]	South Bay	--	--	--
Sunnyvale	Lower South Bay	37.6	34.6	36.1
Treasure Island[f]	Central Bay	--	--	--
Vallejo[f]	San Pablo Bay	--	--	--
West County	Central Bay	339	327	333
Total [e]		**4,030**	**3,680**	**3,850**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of load from industrial application is not diverted from the Bay.

Table 6-20. Recycled Water: Dry Season TIN Loads Diverted from the Bay (kg N/day)*

Discharger	Subembayment	2019 [b]	2020 [b]	2021 [b]	3-Year Average
American Canyon	San Pablo Bay	9.25	10.9	10.7	10.3
Benicia[f]	San Pablo Bay	--	--	--	--
Burlingame[f]	South Bay	--	--	--	--
CCCSD	Suisun Bay	230	259	313	267
CMSA	Central Bay	149	182	203	178
Port Costa[f]	San Pablo Bay	--	--	--	--
Delta Diablo[g]	Suisun Bay	55.3	64.8	80.9	67.0
EBDA	South Bay	1,910	1,720	1,660	1,760
EBMUD	Central Bay	1,070	1,100	494	889
FSSD	Suisun Bay	105.0	151.0	137.0	131.0
Las Gallinas[d]	San Pablo Bay	11.6	67.1	--	39.3
Paradise Cove[f]	Central Bay	--	--	--	--
Tiburon[f]	Central Bay	--	--	--	--
Millbrae[f]	South Bay	--	--	--	--
Mt. View[f]	Suisun Bay	--	--	--	--
Napa[d]	San Pablo Bay	--	--	--	--
Novato	San Pablo Bay	49.7	42.6	56.4	49.6
Palo Alto	Lower South Bay	118	116	125	119
Petaluma[d]	San Pablo Bay	--	--	--	--
Pinole[f]	San Pablo Bay	--	--	--	--
Rodeo[f]	San Pablo Bay	--	--	--	--
SFO Airport	South Bay	--	--	0.027	0.027
SFPUC Southeast[f]	South Bay	--	--	--	--
San Jose	Lower South Bay	852	839	777	823
San Mateo[f]	South Bay	--	--	--	--
SMCSD[f]	Central Bay	--	--	--	--
SASM	Central Bay	5.58	4.17	3.51	4.42
SVCW	South Bay	213	159	248	207
Sonoma Valley[d]	San Pablo Bay	--	--	--	--
South SF[f]	South Bay	--	--	--	--
Sunnyvale	Lower South Bay	61.6	51.3	34.6	49.2
Treasure Island[f]	Central Bay	--	--	--	--
Vallejo[f]	San Pablo Bay	--	--	--	--
West County	Central Bay	320	330	300	317
Total [e]		**5,160**	**5,100**	**4,440**	**4,910**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of load from industrial application is not diverted from the Bay.

Table 6-21. Recycled Water: Annual Average TIN Loads by Subembayment, Flow (kg N/d)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a]	2020/2021 [a]	2-Year Average
Suisun Bay	100	325	381	353
San Pablo Bay [b]	62.8	100	108	104
Central Bay	167	1,560	1,160	1,360
South Bay	262	1,310	1,310	1,310
Lower South Bay	236	723	716	719
Total	**827**	**4,020**	**3,680**	**3,850**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-22. Recycled Water: Dry Season Average TIN Loads by Subembayment, Flow (kg N/d)

Subembayment	Treatment Plant Permitted Capacity	2019 [a]	2020 [a]	2021 [a]	3-Year Average
Suisun Bay	100	390	475	531	465
San Pablo Bay [b]	62.8	71	121	67	86
Central Bay	167	1,550	1,620	1,000	1,390
South Bay	262	2,120	1,880	1,910	1,970
Lower South Bay	236	1,030	1,010	937	991
Total	**827**	**5,160**	**5,100**	**4,440**	**4,900**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-23. Recycled Water: Percent of Annual Average TIN Loads Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a,c] %	2020/2021 [a,c] %	2-Year Average %
Suisun Bay	100	5%	5%	5%
San Pablo Bay [b]	62.8	5%	6%	5%
Central Bay	167	12%	10%	10%
South Bay	262	6%	6%	6%
Lower South Bay	236	8%	9%	8%
Total	**827**	**7%**	**7%**	**7%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

Table 6-24. Recycled Water: Percent of Dry Season Average TIN Loads Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019 [a,c] %	2020 [a,c] %	2021 [a,c] %	3-Year Average %
Suisun Bay	100	6%	7%	8%	7%
San Pablo Bay [b]	62.8	5%	8%	5%	6%
Central Bay	167	12%	13%	8%	11%
South Bay	262	10%	9%	9%	8%
Lower South Bay	236	14%	15%	15%	13%
Total	**827**	**10%**	**11%**	**9%**	**9%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

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6.5 Total Phosphorus

The annual average (i.e., twelve months from October 1 to September 30) and dry season average monthly (i.e., May 1 through September 30) recycled water flows are provided in Table 6-25 and Table 6-26, respectively. In addition, the annual average and dry season average monthly recycled water flows for each Subembayment are provided in Table 6-27 and Table 6-28, respectively. An additional set of tables is provided in Table 6-29 and Table 6-30 that offers the percent reduction of flow/load diverted from the Bay from recycled water.

A summary of the recycled water data review findings is as follows:

- The volume and percentage of water that is used by reuse customers is seasonally dependent. Example calculations for the percent of treated water that is diverted from the Bay and sent to reuse customers is as follows:
  - Average Annual (Example for 2020/2021 dataset): recycled water constitutes a diversion of approximately 8 percent of Total P load from the Bay (average annual discharge load = 3,670 kg P/d; recycled water average annual load = 321 kg P/d):

    $$8\ Percent = \frac{321\ \text{kg P/d}}{(321\ \text{kg P/d} + 3{,}670\ \text{kg P/d})}$$

  - Dry Season (Example for 2021 dataset): recycled water constitutes a diversion of approximately 10 percent of Total P load from the Bay (dry season average discharge load = 3,680 kg P/d; recycled water dry season average load = 393 kg P/d)

    $$10\ Percent = 1 - \frac{393\ \text{kg P/d}}{(393\ \text{kg N/d} + 3{,}680\ \text{kg N/d})}$$

- The recycled water flows are seasonally dependent as evidenced by an increase of approximately 25 percent from average annual to dry season volumes. South and Suisun Bays have the most pronounced seasonality impacts over the timeframe presented.
- During the dry season when recycled water volumes are at their peak, the recycled water volumes by Subembayment are as follows (based on the 3-year average): South Bay > Central Bay > Lower South Bay > Suisun Bay > San Pablo Bay. This ranking aligns with the TIN loads diverted by recycled water.
- The percentage of loads diverted from the Bay by reuse ranges from 8 to 11 percent baywide (regardless of average annual or dry season averaging period; refer to Table 6-29 and Table 6-30). The percentages are more in alignment with ammonia and TIN load values associated with recycled water.

Table 6-25. Recycled Water: Annual Average Total P Loads Diverted from the Bay (kg P/day)*

Discharger	Subembayment	2019/2020 [b,c]	2020/2021 [b,c]	2-Year Average
American Canyon	San Pablo Bay	7.39	6.00	6.69
Benicia[f]	San Pablo Bay	--	--	--
Burlingame[f]	South Bay	--	--	--
CCCSD	Suisun Bay	5.35	7.48	6.41
CMSA	Central Bay	16.4	19.1	17.8
Port Costa[f]	San Pablo Bay	--	--	--
Delta Diablo[g]	Suisun Bay	2.22	1.90	2.06
EBDA	South Bay	83.2	102	92.7
EBMUD	Central Bay	97.8	61.9	79.8
FSSD	Suisun Bay	15.3	14.3	14.8
Las Gallinas[d]	San Pablo Bay	4.20	1.07	2.64
Paradise Cove[f]	Central Bay	--	--	--
Tiburon[f]	Central Bay	--	--	--
Millbrae[f]	South Bay	--	--	--
Mt. View[f]	Suisun Bay	--	--	--
Napa[d]	San Pablo Bay	18.2	14.1	16.1
Novato	San Pablo Bay	1.26	0.721	0.989
Palo Alto	Lower South Bay	11.2	12.3	11.7
Petaluma[d]	San Pablo Bay	2.17	2.95	2.56
Pinole[f]	San Pablo Bay	--	--	--
Rodeo[f]	San Pablo Bay	--	--	--
SFO Airport	South Bay	--	0.002	0.002
SFPUC Southeast[f]	South Bay	--	--	--
San Jose	Lower South Bay	29.0	22.3	25.7
San Mateo[f]	South Bay	--	--	--
SMCSD[f]	Central Bay	--	--	--
SASM	Central Bay	0.713	0.525	0.619
SVCW	South Bay	13.2	12.0	12.6
Sonoma Valley[d]	San Pablo Bay	--	--	--
South SF[f]	South Bay	--	--	--
Sunnyvale	Lower South Bay	15.1	18.0	16.6
Treasure Island[f]	Central Bay	--	--	--
Vallejo[f]	San Pablo Bay	--	--	--
West County	Central Bay	30.2	24.3	27.3
Total [e]		**353**	**321**	**337**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of load from industrial application is not diverted from the Bay.

Table 6-26. Recycled Water: Dry Season Total P Loads Diverted from the Bay (kg P/day)*

Discharger	Subembayment	2019 [b]	2020 [b]	2021 [b]	3-Year Average
American Canyon	San Pablo Bay	6.28	10.6	11.1	9.30
Benicia[f]	San Pablo Bay	--	--	--	--
Burlingame[f]	South Bay	--	--	--	--
CCCSD	Suisun Bay	7.37	6.30	9.47	7.71
CMSA	Central Bay	15.2	20.2	24.5	20.0
Port Costa[f]	San Pablo Bay	--	--	--	--
Delta Diablo[g]	Suisun Bay	1.92	2.03	1.80	1.92
EBDA	South Bay	136	133	154	141
EBMUD	Central Bay	103	101	53.2	85.8
FSSD	Suisun Bay	22.6	30.3	27.3	26.7
Las Gallinas[d]	San Pablo Bay	2.44	12.4	--	7.40
Paradise Cove[f]	Central Bay	--	--	--	--
Tiburon[f]	Central Bay	--	--	--	--
Millbrae[f]	South Bay	--	--	--	--
Mt. View[f]	Suisun Bay	--	--	--	--
Napa[d]	San Pablo Bay	--	--	--	--
Novato	San Pablo Bay	1.04	0.422	0.891	0.785
Palo Alto	Lower South Bay	18.9	17.7	20.2	18.9
Petaluma[d]	San Pablo Bay	--	--	--	--
Pinole[f]	San Pablo Bay	--	--	--	--
Rodeo[f]	San Pablo Bay	--	--	--	--
SFO Airport	South Bay	--	--	0.004	0.004
SFPUC Southeast[f]	South Bay	--	--	--	--
San Jose	Lower South Bay	27.8	43.8	23.3	31.6
San Mateo[f]	South Bay	--	--	--	--
SMCSD[f]	Central Bay	--	--	--	--
SASM	Central Bay	1.01	0.722	0.699	0.810
SVCW	South Bay	19.1	15.2	20.9	18.4
Sonoma Valley[d]	San Pablo Bay	--	--	--	--
South SF[f]	South Bay	--	--	--	--
Sunnyvale	Lower South Bay	25.8	23.8	18.0	22.6
Treasure Island[f]	Central Bay	--	--	--	--
Vallejo[f]	San Pablo Bay	--	--	--	--
West County	Central Bay	23.9	33.0	27.5	28.2
Total [e]		**412**	**451**	**393**	**421**

a. Based on ADWF permitted capacity.
b. Data are presented in detail and summarized for each plant in the Appendix. A "--" indicates data were not available, whereas a "0" indicates a value of zero.
c. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
d. No discharge during a portion or all the dry season months, except when necessary due to wet conditions.
e. The total values might vary from the sum of the listed values by plant due to rounding.
f. This discharger does not produce recycled water.
g. Assumes that a portion of load from industrial application is not diverted from the Bay.

Table 6-27. Recycled Water: Annual Average Total P Loads by Subembayment, Flow (kg P/d)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a]	2020/2021 [a]	2-Year Average
Suisun Bay	100	22.9	23.7	23.3
San Pablo Bay [b]	62.8	33.2	24.8	29.0
Central Bay	167	145	106	125
South Bay	262	96.4	114	105
Lower South Bay	236	55.3	52.6	53.9
Total	**827**	**353**	**321**	**337**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-28. Recycled Water: Dry Season Average Total P Loads by Subembayment, Flow (kg P/d)

Subembayment	Treatment Plant Permitted Capacity	2019 [a]	2020 [a]	2021 [a]	3-Year Average
Suisun Bay	100	31.9	38.7	38.6	36.4
San Pablo Bay [b]	62.8	9.8	23.3	12.0	15.0
Central Bay	167	143	155	106	135
South Bay	262	155	149	175	159
Lower South Bay	236	72.5	85.3	61.5	73.1
Total	**827**	**412**	**451**	**393**	**419**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.

Table 6-29. Recycled Water: Percent of Annual Average Total P Loads Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019/2020 [a,c] %	2020/2021 [a,c] %	2-Year Average %
Suisun Bay	100	6%	6%	6%
San Pablo Bay [b]	62.8	11%	10%	9%
Central Bay	167	12%	9%	11%
South Bay	262	6%	8%	7%
Lower South Bay	236	7%	7%	6%
Total	**827**	**8%**	**8%**	**8%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

Table 6-30. Recycled Water: Percent of Dry Season Average Total P Loads Diverted from each Subembayment, Flow (%)

Subembayment	Treatment Plant Permitted Capacity	2019 [a,c] %	2020 [a,c] %	2021 [a,c] %	3-Year Average %
Suisun Bay	100	8%	10%	11%	9%
San Pablo Bay [b]	62.8	5%	11%	6%	7%
Central Bay	167	12%	12%	10%	12%
South Bay	262	10%	10%	13%	11%
Lower South Bay	236	9%	12%	10%	9%
Total	**827**	**10%**	**11%**	**11%**	**10%**

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. Several of the plants that discharge to San Pablo Bay have no discharge during a portion or all the dry season months, except when necessary due to wet conditions.
c. The percent diverted is based on the recycled water value divided by the sum of recycled water value and discharge value.

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7 Discussion

A plot of the historical monthly average of daily discharge flow, ammonia, NOx, TIN, and TP loads are presented in Figure 7-1. In general, the 2020/2021 flows and loads decreased from the 2019/2020 dataset with the lowest since sampling began in 2012 (except for TP loads). This overall reduction is attributed to a combination of the i) global pandemic, ii) several treatment plants implementing nutrient load reduction strategies (e.g., Pinole), iii) optimization of treatment plants for nutrient management (e.g., San Jose), and iv) a relatively dry year (implications focused on the wet season).

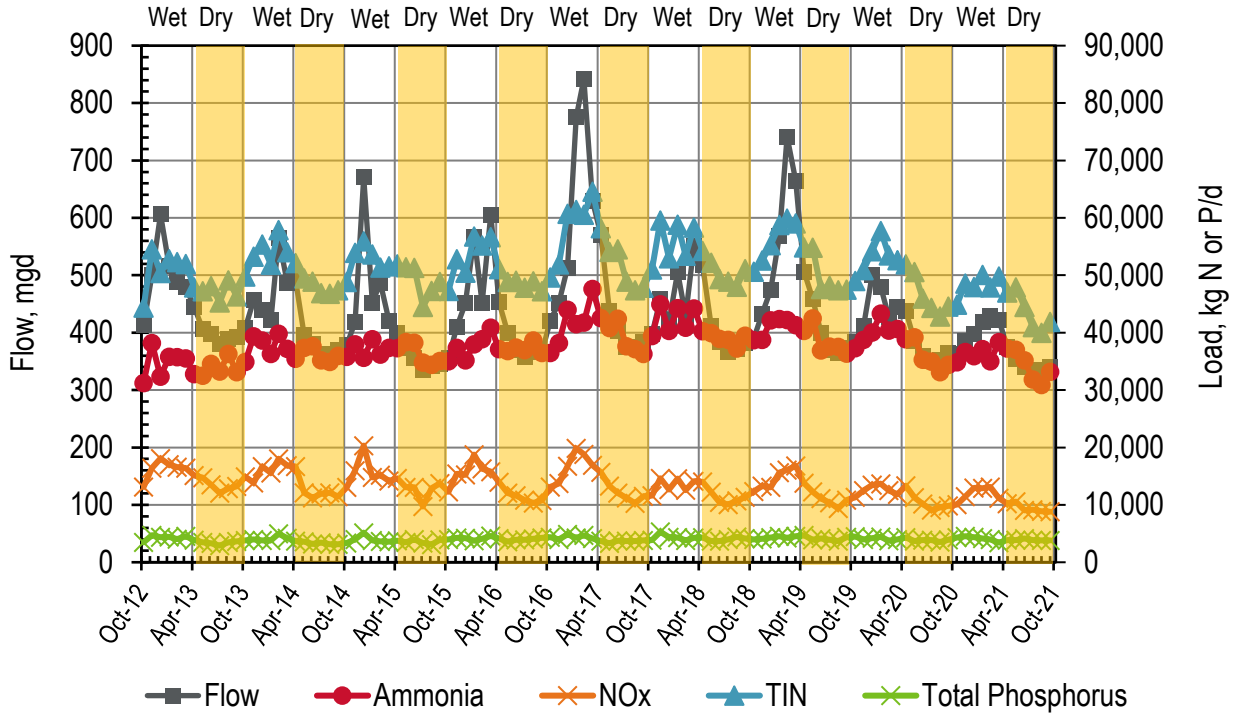

Figure 7-1. Historical Average Monthly Daily Discharge Flows and Loads

Historically, the ammonia, NOx, and TIN loads tend to track with the flows. For example, during peak wet weather events, both the flow and nitrogen loads typically increase. However, the limited dataset during wet weather events restricts confidence in the strength of this relationship. It is unknown whether the trend would be as evident with increased sampling frequency where the impacts from an initial scouring event in the collection system due to wet weather would be reduced and dilution increased (similar to the “first flush” in stormwater collection systems). Additional data are needed to further understand the correlation between flow and loads during peak wet weather events.

The following subsections present a discussion of how the global pandemic may have impacted the flows and loads, observations of the newly added influent data, and finally, observations of each parameter considered, including outliers, seasonality, and the role of the largest dischargers.

7.1 Global Pandemic (COVID-19)

The Bay Area initiated shelter in place in March 2020 and has ever since likely had impacts from COVID-19 on wastewater generation rates. Since the initial shelter in place, there have been numerous changes to our daily lives that would likely impact wastewater generation rates, as well as a shift from one geographic location to another. Such shifts are still relevant for the 2021/2022 dataset, but not as pronounced as the start of shelter in place. While these changes and their implications will likely be the subject of numerous future studies, some anecdotal examples are as follows:

- New safety measures and guidelines (e.g., frequent hand washing and more disinfection) may lead to increased wastewater generation rates and new loads associated with such cleaning products.
- A reduction in commuters that would typically travel into the Bay Area for work may reduce generation rates or shift geographical locations.
- Distance learning for schools might impact geographic locations. Note: distance learning not as common as the 2019/2020 and 2020/2021 reports.
- Shutdown or a reduction in commercial and industrial users, such as restaurants, office complexes, etc. that normally would contribute flows and loads to treatment plants. Similar to distance learning, the impacts are not as profound compared to the 2019/2020 and 2020/2021 datasets.
- Reduction in travelers/tourist that typically visit the Bay Area. Similar to distance learning, the impacts are not as profound compared to the 2019/2020 and 2020/2021 datasets.
- Bay Area residents leaving temporarily and/or permanently due to the lack of need to work in person. Similar to distance learning, the impacts are not as profound compared to the 2019/2020 and 2020/2021 datasets. A portion of residents that temporarily left have thought to have returned.
- Reduction of and/or no events, such as sporting events, that normally would attract a population and contribute flows and loads to treatment plants. Similar to distance learning, the impacts are not as profound compared to the 2019/2020 and 2020/2021 datasets.
- Others

It is still unclear when life will return to pre-pandemic conditions (if ever). Given that, the future of influent/discharge flows and loads is unclear and the trends that have been tracked for the past several years may be impacted. Future group annual reports will continue to discuss this issue as the global pandemic evolves.

7.2 Annual Precipitation

A plot of the historical precipitation for the nutrient sampling period (October, 2012 through September, 2022present) is provided in Figure 7-2. Based on the data source, the October 2020 through September 2021 precipitation dataset is lowest since sampling began in 2012. The precipitation this past year (Oct 1, 2021 to Sept 30, 2022) was nearly equal to the two previous years combined (Oct 1, 2019 to Sept 30, 2021). Note: the amount of rainfall seen across the Bay Area will

vary and the data in Figure 7-2 are limited to a single location. However, the overall trends are relatively stable across the Bay Area.

The impacts of relatively low precipitation are well-documented on wastewater treatment plants. The most notable impact is relatively low peak flows with respect to ADWF. While the influent data should capture such variability, the available dataset is limited so it is more prudent to review the discharge flow data. While several agencies do not discharge all of their influent, it remains a reasonable metric for comparing the impact of historical precipitation.

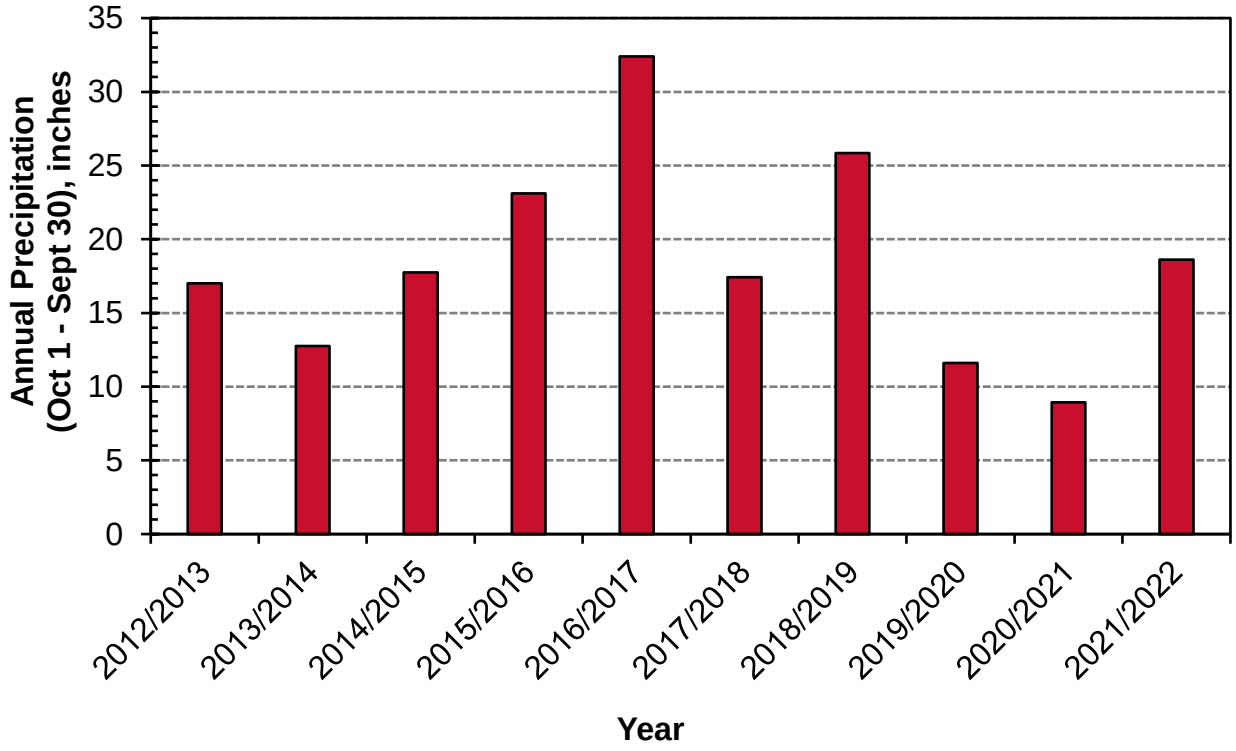

Figure 7-2. Historical Annual Precipitation in the Bay Area (Adapted from Golden Gate Weather Services)

A review of the discharge flow data (see Figure 5-1) suggests that the 2020/2021 dataset had the lowest discharge annual volume since data collection began in 2012. The lack of rain for the 2020/2021 dataset influenced the relatively flat average monthly peaking factors which reduced the average monthly discharge flows during the wet season. While the 2021/2022 saw an increase in precipitation, the total dry season discharge volumes were the lowest since sampling began in 2012 (albeit a modest 2 mgd less than the 2021 dry season). This was attributed to the on-going drought.

7.3 Trending Statistics

The method of least squares trend analysis is intended to identify potential significant trends. Verifying the trends would require a more rigorous statistical approach than applied for this report. While effective as a first step for identifying potential significant trends, the method of least squares does not verify whether regression assumptions of normality and independence of errors have been satisfied. The recommended next steps if trend verification is required are as follows:

1) Evaluate whether the data need to be transformed (e.g., natural log) to provide context on whether data are conforming to the distributional assumptions of the modeling errors. A probability plot of errors will provide context on whether data are conforming to the errors.

2) Perform a more thorough statistical analysis to validate data and perform a more rigorous statistical analysis for a time series correlation.

Given that that data since shelter in place (March 2020) might be outliers (due to the global pandemic), all of the identified trends will need to be carefully watched in the coming years to see how they evolve.

7.4 Agencies that have Implemented Nutrient Load Management Upgrades and/or Optimization

Multiple agencies have designed and implemented nutrient load management upgrades over the last several years as follows (listed alphabetically):

- **Oro Loma/Castro Valley Sanitary Districts Water Pollution Control Plant:**
  - Implemented an ammonia and TIN load reduction technology by modifying and expanding their existing activated sludge system in the Summer of 2020. The technology upgrade is known as the Modified Ludzack-Ettinger system.
  - Implemented a sidestream full-scale unit known using Microvi's MicroNiche Engineering™ (MNE) technology that reduces the ammonia load associated with their biosolids dewatering return stream. This is anticipated to come to a halt sometime in year 2023.
- **Palo Alto Regional Water Quality Control Plant:** is beginning construction in 2023 on a nearly $200 Mil treatment plant upgrade. The upgrade includes replacement of various aged equipment and other capital improvements, including expansion of the activated sludge process to reduce TIN loads, construction of a new headworks facility, and relining of an aging joint intercepting sewer. While Palo Alto already reliably removes ammonia, these upgrades will reduce their TIN loads. The upgrades are anticipated to take approximately 5-years to implement.
- **Pinole-Hercules Water Pollution Control Plant:** Implemented an ammonia and TIN load reduction technology by modifying and expanding their existing activated sludge system in Spring 2019. The technology upgrade is known as the Modified Ludzack-Ettinger system. This year's dataset suggests that this facility is not operating the facility in nutrient removal mode.
- **San Jose-Santa Clara Regional Wastewater Facility:** beginning in 2019, optimization of nitrogen removal in the existing Biological Nutrient Removal (BNR) system have been tested and subsequently improved upon in 2020, 2021, and 2022. Optimization of TIN load reduction has been achieved by the following:
  - Reduction in DO set-points for the BNR aeration basins, implemented through reduced fine-bubble diffuser aeration. The reduced DO along with reconfiguring aeration basins with baffles to improve mixing under reduced aeration conditions has increased denitrification zones and fostered additional TIN reduction.

- Reduced aeration in the mixed liquor channels has also fostered additional TIN and TP load reductions.
- In addition, secondary blowers, meters, process controls, and clarifiers have been or are currently undergoing substantial rehabilitation or replacement as part of the Facility CIP, which has aided further reduction of nutrient loads by providing better process control.

The results of the recent optimizations are evident as both nitrogen species loads and phosphorus loads continue to decline. For example, the 2021 dry season TIN and TP loads are approximately 20% and 50%, respectively, less than the 2020 dry season loads.

- **San Leandro Water Pollution Control Plant:** In the process of implementing a nature-based solution which should support sea level rise, habitat restoration, and nutrient management. This project is in construction and expected to be completed in year 2023.
- **San Mateo Wastewater Treatment Plant:** Began construction in 2021 for a plant upgrade that will incorporate nutrient management technologies.
- **South San Francisco - San Bruno Water Quality Control Plant:** completed construction the first half 2022 of an anaerobic selector within their activated sludge process. The anaerobic selector was added to improve solids settleability in their secondary clarifiers. The anaerobic selector also facilitates enhanced biological phosphorus removal as evidenced by a TP load reduction of greater than 85 percent since commissioning.
- **West County Treatment Plant:** Completed several plant expansion and upgrade projects in late 2017. The expansion and upgrades increased nutrient load reduction by enhancing the nitrification reliability and facilitated denitrification by a Modified Ludzack-Ettinger process configuration. The plant is in the design for further plant treatment performance improvements that should impact nutrient discharge loads.

This list is limited to agencies that are in construction and/or optimized their nutrient load management strategies. There are several agencies that are in the process of designing and/or construction nutrient load management upgrades.

7.5 Influent Analysis

Overall, the inclusion of influent data has bolstered the evaluation and it offer a means to track load reduction across dischargers. At this stage, the dataset has several limitations as follows:

- Limited to 13 samples (quarterly sampling began in July 2019).
- The global pandemic impacts more than half of the sampling quarters.
- Since dischargers sample during different months, developing historical load plots requires plotting quarterly averages (e.g., refer to Figure 4-2 for an example plot).
- There are a few instances during the first year of sampling where sampling for a particular nutrient did not occur (e.g., Palo Alto did not sample ammonia during the first quarter of sampling from July through September 2019). This issue seems to have sorted itself out this past year (except for dry season sampling at Napa).
- Analytical measuring issues with the influent sampling matrix. Specifically, the discharge matrix is considerably cleaner compared to raw influent and as a result is less prone to analytical issues. There are a couple instances where ammonia values this past year were

greater than TKN for the same sample. This defies water quality practice as TKN is the sum of ammonia and organic nitrogen. Such analytical issues can skew the trending.

At this stage, the dataset is still limited, and the aforementioned challenges are still being reconciled. As such challenges are addressed and the dataset grows, the analysis will be more exhaustive, and it will provide valuable information to inform the nutrient management conversation.

Despite the data challenges, dry season trending analysis was performed. In all cases, no emerging trends were observed. Note, the trending analysis was performed on all four dry seasons for flow, whereas the nutrient trending analysis excluded the 2019 dataset due to the missing nutrient samples. Furthermore, the dry season trending is limited to a single quarterly sample, so it is limiting. As the dataset grows, this trending analysis will be more relevant.

7.6 Discharge Analysis

The discharge analysis includes subsections for each parameter monitored.

7.6.1 Flow

The total annual average discharge ranged from 374 mgd to 515 mgd for the ten-year period (average of 433 mgd). The dry season discharge flows to the Bay declined from 2012/2013 to 2014/2015, increased in 2015/2016 and 2016/2017 due to the unusually high precipitation during these periods, stayed relatively steady until 2018/2019, declined to record low values until 20202/2021 due to the ongoing drought, and increased this past year (2021/2022). The increase this past year was primarily attributed to the wet weather events in October 2021 and December 2021.

The dry season discharge ranged from 337 mgd to 394 mgd for the ten-year period (average of 370 mgd). The total dry season discharge flows continue to decline since reaching their peak in 2019. This past year yielded the lowest flows over the ten-year period. The last three years of decline (2020, 2021, and 2022) are attributed to a combination of relative dry years, water conservation, the global pandemic, etc.

The South Bay and Lower South Bay Subembayments received the highest flows, making up approximately 65 percent of the total flow discharged to the Bay. The largest discharger is San Jose, followed by EBDA, EBMUD, and SFPUC Southeast. San Pablo Bay has the largest portion of recycled water diversion during the dry season; several plants divert all flow and have zero dry season discharge. For example, discharge flows to San Pablo Bay for the dry season are approximately 50 percent less than average annual discharge flows to San Pablo Bay.

The dry season flow trends suggest a downward trend for San Pablo Bay, South Bay, Lower South Bay, and Baywide. The other Subembayments (Suisun and Central Bays) suggest no significant trending for flow.

7.6.2 Total Ammonia

The total annual average ammonia discharge ranged from approximately 34,300 kg N/d to 40,800 kg N/d over the ten-year period (average of 37,800 kg N/d). The dry season average ammonia discharge ranged from approximately 34,000 kg N/d to 38,900 kg N/d over the ten-year period (average of 36,500 kg N/d). Both the average annual and dry season values increased compared to the past year. Note: the 2020/2021 dataset were the second lowest since sampling began in 2012.

The past year's values were within 600 kg N/d of the 10-year average (regardless of average annual or dry season averaging period).

The Central Bay and South Bay Subembayments receive the highest ammonia load contributions across the Bay, making up 55 to 60 percent of the total ammonia discharged to the Bay. The largest overall ammonia discharger is EBMUD which makes up 20 to 25 percent of the total ammonia discharged to the Bay, followed by EBDA and SFPUC Southeast (each making up 15 to 25 percent of the total ammonia discharged to the Bay).

The dry season ammonia loads over the entire ten-year dry season dataset appear to be statistically trending upwards for Suisun, San Pablo, and Central Bays. It is important to note that the dry season ammonia loads declined this past year for Suisun and Central Bays, whereas San Pablo Bay increased at 1,460 kg N/d). In contrast, South and Lower South Bays loads over the entire ten-year dry season dataset appear to be statistically trending downwards. Baywide, there do not appear to any emerging trends.

There are several agencies that have brought online new systems (e.g., Pinole, Oro Loma/Castro Valley Sanitary District, etc.) and/or are in the design/construction phase (e.g., San Mateo, San Leandro, etc.) for ammonia and TIN load reduction. Such changes should result in reductions in future ammonia and TIN loads, albeit with the potential to increase in NOx loads.

7.6.3 Nitrate + Nitrite (NOx)

The total annual average NOx discharge ranged from approximately 10,100 kg N/d to 14,900 kg N/d over the ten-year period (average of 13,200 kg N/d). The total dry season average ammonia discharge ranged from approximately 8,500 kg N/d to 13,300 kg N/d over the ten-year period (average of 11,300 kg N/d). Both the average annual and dry season loads for this year's data (2021/2022) were the lowest since sampling began in 2012. This past year's loads were reliably at least 2,800 kg N/d less than the 10-year average (regardless of average annual or dry season averaging period).

The Lower South Bay Subembayment receives the highest NOx load contributions across the Bay, making up 50 to 65 percent of the total NOx discharged to the Bay. The relatively large contribution compared to other Subembayments was anticipated as all three POTWs in the Lower South Bay are required to fully nitrify and remove ammonia. The ammonia load is converted to NOx and subsequently removed for those plants that perform denitrification. The largest overall NOx discharger is San Jose which makes up 30 to 35 percent of NOx discharged to the Bay, followed by Palo Alto which contributes 15 to 20 percent of the NOx discharged to the Bay).

The dry season NOx loads over the entire ten-year dry season dataset appear to be statistically trending downwards for all the Subembayments, as well as Baywide.

There are several agencies that have brought online new systems (e.g., Pinole, Oro Loma/Castro Valley Sanitary District, etc.) and/or are in the design/construction phase (e.g., San Mateo, San Leandro, etc.) for ammonia and TIN load reduction. Such changes should result in reductions in future ammonia and TIN loads, albeit with the potential to increase in NOx loads.

7.6.4 Total Inorganic Nitrogen (TIN)

The total annual average TIN discharge ranged from 46,000 kg N/d to 55,000 kg N/d for the ten-year period (average of 51,100 kg N/d). The total dry season average TIN discharge ranged from 43,100 kg N/d to 50,600 kg N/d for the ten-year period (average of 47,900 kg N/d). Similar to total ammonia,

both the average annual and dry season values increased compared to the past year. Note: the 2020/2021 dataset were the lowest since sampling began in 2012, whereas the 2021/2022 dataset were the second lowest since sampling began in 2012.

The Central Bay and South Bay Subembayments receive the highest TIN loads, making up 65 to 75 of the TIN loads discharged to the Bay. The largest overall discharger of TIN on an annual average basis is EBMUD which contributes 15 to 20 percent of the overall Bay discharger, followed by SFPUC Southeast and EBDA.

There are instances where the TIN values do not necessarily reflect the sum of ammonia and NOx (as discussed in Section 3.2). Such instances occur when agencies sample for only one of the nitrogen species that are used to calculate TIN (ammonia and NOx). In most cases, the agencies sample more frequently for ammonia. The average monthly ammonia loads are based on the average for each sampling event during that particular month. In contrast, TIN loads are only calculated for sampling days when both ammonia and NOx are sampled. Such a discrepancy in sampling frequency can result in average monthly values where TIN does not equal ammonia plus NOx.

The last four years of data have seen an overall decline in TIN loads (for both average annual and dry season; albeit with an excursion this past year). It is important to note that EBMUD implemented a full-scale demonstration for ammonia/TIN load reduction during the 2021 dry season. This effort resulted in a reduction of ammonia/TIN loads of over 1,000 kg N/d during the dry season. EBMUD did not implement this full-scale demonstration in the 2022 dry season which is a key reason for the increase in loads since last year.

The seasonal difference in TIN discharges from the wet to the dry season (based on the percent difference) are most pronounced in San Pablo Bay and the Lower South Bay. San Pablo Bay has the most significant seasonal load reduction, as evidenced by an approximately 25 percent reduction from the wet to the dry season. Similar to ammonia, this is attributed to a combination of more effective nitrification/denitrification during the dry season and seasonal use of recycled water, which diverts loads for the Bay. A large proportion of POTWs that discharge to San Pablo Bay do not discharge during the dry season (e.g., Petaluma).

The dry season TIN loads over the entire ten-year dataset appear to be statistically decreasing for the South Bay, Lower South Bay, and Baywide. In contrast, the Central Bay dry season data over the entire ten-year dataset suggests an upward trend. Suisun Bay and San Pablo Bay showed no significant trending over the entire dry season ten-year dataset.

There are several agencies that have brought online new systems (e.g., Pinole, Oro Loma/Castro Valley Sanitary District, etc.) and/or are in the design/construction phase (e.g., San Mateo, San Leandro, etc.) for ammonia and TIN load reduction. Such changes should result in reductions in future ammonia and TIN loads, albeit with the potential to increase in NOx loads.

7.6.5 Total Phosphorus (TP)

The total annual average TP discharge ranged from approximately 3,500 kg P/d to 4,210 kg P/d for the ten-year period (average of 3,950 kg P/d). The total dry season average TP discharge ranged from approximately 3,300 kg P/d to 40,010 kg P/d over the ten-year period (average of 3,710 kg P/d). Both the average annual and dry season loads for this year's data (2021/2022) were the lowest since sampling began in 2012. This past year's loads were reliably at least 400 kg P/d less than the 10-year average (regardless of average annual or dry season averaging period).

The Central Bay and South Bay Subembayments receive the highest TP load contributions across the Bay, making up 55 to 65 percent of the TP discharged to the Bay. The largest overall TP discharger is EBMUD which makes up 15 to 20 percent of the TP discharged to the Bay, followed by EBDA which makes up 10 to 15 percent of the TP discharged to the Bay

The Central Bay and South Bay Subembayments both have an emerging dry season upward trend. Baywide dry season TP loads are also trending upward. A possible basis for this upward trend is that dischargers that implemented nitrification/denitrification (e.g., Oro Loma/Castro Valley Sanitary District) that currently perform biological phosphorus removal are likely sacrificing TP load reduction as they perform nitrification/denitrification. In contrast, the Lower South Bay dry season data over the entire ten-year dataset suggests a downward trend. Suisun Bay, San Pablo Bay, and Baywide showed no significant trending over the entire dry season ten-year dataset.

During the first half of the 2022 calendar year, South San Francisco completed construction of an anaerobic selector within their activated sludge process. Since commissioning the anaerobic selector, South San Francisco has enhanced their TP load reduction as evidenced by removal rates of 85 percent or higher.

7.7 Recycled Water Analysis

The inclusion of recycled water flows and nutrient loads diverted from the Bay is not a watershed permit requirement per se, but it has been included to assist with nutrient management efforts. Last year's Group Annual Report (submitted in February 2022) included recycled water volumes and flows. This year's Group Annual Report includes both flows and the corresponding nutrient loads. Furthermore, last year's Group Annual Report (submitted in February 2022) was based on a request for information developed for this effort. Rather than relying on this resource intensive approach, the decision was made for this and future Group Annual Reports to rely on the readily available recycled water volumes from the State Water Board.[2]

The distribution of recycled water volumes/flows by Subembayments are as follows: Lower South Bay > San Pablo Bay > Suisun Bay > South Bay > Central Bay. Note: the order can adjust from year to year. Furthermore, a summary of the dominant recycled water users by Subembayment is as follows:

- There are no potable reuse applications yet in the Bay Area
- Lower South Bay relies primarily on a blend of landscape irrigation, industrial applications, and golf course irrigation.
- South Bay has the most even distribution of recycled water volumes for agriculture, golf courses, commercial, and irrigation.
- San Pablo Bay relies primarily on a blend of agriculture, golf courses, and irrigation.
- Suisun Bay relies primarily on industrial customers, in particular the Calpine power production facility in Pittsburg-Antioch area.
- Central Bay is limited to landscape irrigation and industrial recycled water users.

The annual average percent flow and loads diverted from the Bay due to recycled water ranges from 7 to 12 percent (regardless of parameter). Of the parameters, flow has the highest percentage diverted from the Bay due to reuse, followed by NOx loads. As for the dry season, the percent flow

and loads diverted from the Bay due to recycled water increases compared to average annual as evidenced by values that range from 8 to 16 percent (regardless of parameter). Similar to average annual, flow has the highest percentage diverted from the Bay due to reuse, followed by NOx loads.

8 Summary

The 2022 Group Annual Report includes data from October 2012 through September 2022. Influent flows and loads are now required under the new permit for plants with a permitted ADWF capacity of greater than 10 mgd. The influent dataset is limited because the new permit came into effect in July 2019. Subsequent reports will include an influent analysis once more data are available, and sampling related challenges are addressed. Sampling challenges are a blend of confidence in the results, as well as obtaining all the quarterly sampling data. Additionally, this is the first Group Annual Report that includes recycled water data. While not a permit requirement, the recycled water component is included to assist with informing nutrient management across the Bay.

It is important to recognize that a portion of the 2019/2020 and all of the 2020/2021 dataset includes data since the global pandemic (COVID-19) started in March 2020. Given that, the trend analysis will need to be carefully considered in the coming years to evaluate whether the 2019/2020 and 2020/2021 datasets were outliers. It is unclear when life will return to pre-pandemic conditions (if ever). As a result, the future of influent/discharge flows and loads is unclear and the trends that have been tracked for the past several years may be impacted. Future group annual reports will continue to discuss this issue as the global pandemic evolves.

The 2020/2021 dataset includes data for the driest year since sampling began for this report in 2012. Such low precipitation can impact both flows and loads. As previously stated in Section 7.2, the total dry season discharge volumes were the lowest since sampling began in 2012.

8.1 Influent

Table 8-1 and Table 8-2 present overall summaries of the annual average and dry season influent flows and nutrient loads, respectively, between July 2019 and September 2022. Similarly, Table 8-3 and Table 8-4 present summaries of the corresponding dry season and annual average constituent concentrations, respectively, for the same period. The concentrations were calculated by dividing the loads by the flows for the appropriate averaging period.

As previously noted, the influent data are limited both in timeframe for the initial dataset (July 2019 through September 2022), sampling frequency (required quarterly), and the sample set only includes POTWs that have a permitted ADWF capacity of greater than 10 mgd. During the initial year of sampling, several dischargers had missing data. Since this initial year, all the dischargers have addressed sampling requirements (except for Napa which has not provided dry season NOx, TIN, or TP load values since the 2019 dry season).

Given that the initial dry season dataset is limited to a partial dry season (July 2019 through September 2019) and three complete dry seasons (2020 through 2022), the trending analysis is somewhat limiting (refer to Section 7.5). Despite this limitation, trending was applied for the quarterly dry season data. The trending analysis resulted in having no emerging dry season trends. Future group annual reports will have a more extensive dataset.

Table 8-1. Influent: Summary of Average Annual Flow and Loads *

Constituent	2018 / 2019 (a,b) *	2019 / 2020 (a,b)	2020 / 2021 (a,b)	2021 / 2022 (a,b)	3-Year Average (a,b)
Flow, mgd	*	426	398	413	412
Ammonia, kg N/d	*	60,900	58,300	55,700	58,300
NOx, kg N/d	*	1,990	944	1,270	1,400
TIN, kg N/d (c)	*	63,000	59,600	57,400	60,000
TKN, kg N/d	*	96,300	85,300	87,400	89,700
TN, kg N/d	*	98,400	86,300	88,700	91,200
TP, kg P/d	*	11,800	10,900	11,200	11,300

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Limited to POTWs with a permitted capacity greater than 10 mgd.

b. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.

c. The TIN values do not necessarily equal ammonia plus NOx due to instances when ammonia was sampled more frequently than NOx.

Table 8-2. Influent: Summary of Dry Season Flow and Loads *

Constituent	2019 (a,b) *	2020 (a,b)	2021 (a,b)	2022 (a,b)	4-Year Average (a,b)	Trend (d)
Flow, mgd	419	401	375	372	392	None
Ammonia, kg N/d	58,200	55,800	56,400	54,400	56,200	None
NOx, kg N/d	2,830	1,750	990	949	1,631	None
TIN, kg N/d (c)	50,100	57,600	57,200	54,900	54,900	None
TKN, kg N/d	72,700	91,600	78,500	84,700	81,900	None
TN, kg N/d	73,900	93,500	79,600	84,200	82,800	None
TP, kg P/d	9,210	10,900	9,910	11,100	10,300	None

* 2019 dataset limited to July through September compared against May through September for 2019/2020.

a. Limited to POTWs with a permitted capacity greater than 10 mgd.

b. The dry season represents May 1 through September 30 for each calendar year.

c. The TIN values do not necessarily equal ammonia plus NOx due to instances when ammonia was sampled more frequently than NOx.

d. Trend analysis based on the approach discussed in Section 3.8. Note: the trending analysis is limited to dry season data for 2020, 2021, and 2022 as several data was missing for the 2019 dry season.

Table 8-3. Influent: Summary of Average Annual Flow and Concentrations *

Constituent	2018 / 2019 (a,b) *	2019 / 2020 (a,b,c)	2020 / 2021 (a,b,c)	2021 / 2022 (a,b,c)	3-Year Average (a,b,c)
Flow, mgd	*	426	398	413	412
Ammonia, mg N/L	*	37.8	38.7	35.6	37.4
NOx, mg N/L	*	1.23	0.626	0.810	0.897
TIN, mg N/L (d)	*	39.1	39.5	36.7	38.4
TKN, mg N/L	*	59.7	56.6	55.9	57.4
TN, mg N/L	*	61.0	57.3	56.8	58.4
TP, mg P/L	*	7.31	7.21	7.14	7.22

* Values for 2018/2019 are not shown as they are limited to July 2019 through September 2019.

a. Limited to POTWs with a permitted capacity greater than 10 mgd.

b. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.

c. The concentrations calculation is based on a flow-weighted average (limited to agencies that provided load data for the averaging period).

d. The TIN values do not necessarily equal ammonia plus NOx due to instances when ammonia was sampled more frequently than NOx.

Table 8-4. Influent: Summary of Dry Season Flow and Concentrations *

Constituent	2019 (a,b,c) **	2020 (a,b,c)	2021 (a,b,c)	2022 (a,b,c)	4-Year Average (a,b,c)
Flow, mgd	419	401	375	372	392
Ammonia, mg N/L	36.7	36.8	39.8	38.7	37.9
NOx, mg N/L	1.79	1.16	0.698	0.675	1.100
TIN, mg N/L (d)	31.6	37.9	40.3	39.0	37.1
TKN, mg N/L	45.9	60.4	55.3	60.2	55.2
TN, mg N/L	46.6	61.6	56.1	59.9	55.9
TP, mg P/L	5.81	7.19	6.99	7.90	6.94

* Dry season trending not applied to concentrations as the emphasis is on load. Focusing on concentration is limiting as it does not consider the impact of flow.

** 2019 dataset limited to July through September compared against May through September for 2019/2020

a. Limited to POTWs with a permitted capacity greater than 10 mgd.

b. The dry season represents May 1 through September 30 for each calendar year.

c. The concentrations calculation is based on a flow-weighted average (limited to agencies that provided load data for the averaging period).

d. The TIN values do not necessarily equal ammonia plus NOx due to instances when ammonia was sampled more frequently than NOx.

8.2 Discharge

Table 8-5 and Table 8-6 present overall summaries of the annual average and dry season discharge flows and nutrient loads discharged to the San Francisco Bay, respectively, between October 2012 and September 2022. Similarly, Table 8-7 and Table 8-8 present summaries of the corresponding dry season and annual average constituent concentrations, respectively, for the same period. The concentrations were calculated by dividing the loads by the flows for the appropriate averaging period.

The largest dischargers dominate the nutrient loading. Generally, three to four large dischargers contribute more than 70 percent of the nutrient loads. The loading of ammonia and NOx is impacted by plants that nitrify. Those plants that nitrify have the lowest ammonia discharge concentrations (e.g., all the plants that discharge to the Lower South Bay) and conversely the highest NOx concentrations (e.g., Palo Alto).

Seasonal variations are pronounced, albeit not as pronounced with the relatively dry last few years. In general, dry season loads are lower than wet season loads. This is attributed to two factors: 1) the higher flows experienced during wet weather events impact the wet season flows, as well as the loads during such events due to scouring in the collection system and 2) during the dry season, water reuse diverts nutrient loads away from the Bay. In some instances, agencies have achieved zero discharge during the summer months (e.g., Petaluma). The recycled water sections capture the extent of such nutrient load diversions from the Bay (e.g., refer to Section 8.3).

As for overall trends, the flows and loads reached the highest levels for both dry season average and annual average for the 2016/2017 dataset. The 2016/2017 dataset represents one of the wettest years on record for Northern California (refer to Section 7.2). As such, it represents the highest annual average flow for the period, which also led to higher groundwater levels and in turn higher flows during the dry season. Since 2016/2017, the loads have remained relatively stable and/or declined over the last several years. The 2021/2022 flow (limited to average annual), ammonia, and TIN loads increased compared to the 2020/2021 dataset. Such increases are attributed to a combination of a relatively wet months in October 2021 and December 2021 and EBMUD not implementing full-scale ammonia/TIN load reduction as they had done in the 2021 dry season.

As previously stated, the decline in flows and loads from 2018/2019 to present needs to be carefully considered in the coming years to evaluate whether the last two years are outliers. It is unclear when life will return to pre-pandemic conditions (if ever; refer to Section 7.1). Future group annual reports will address this issue as the global pandemic evolves.

Table 8-5. Discharge: Summary of Average Annual Flow and Loads to the Bay

Constituent	2012 / 2013 [a]	2013 / 2014 [a]	2014 / 2015 [a]	2015 / 2016 [a]	2016 / 2017 [a]	2017 / 2018 [a]	2018 / 2019 [a]	2019 / 2020 [a]	2020 / 2021 [a]	2021 / 2022[a]	10-Year Average
Flow, mgd	451	428	415	430	515	433	480	408	374	399	433
Ammonia, kg N/d	34,300	37,000	36,700	37,500	40,600	40,800	39,800	38,000	35,300	37,200	37,700
NOx, kg N/d	14,900	14,300	14,200	13,600	14,500	12,400	12,900	11,600	10,700	10,100	12,900
TIN, kg N/d [b]	49,300	51,300	50,900	51,100	55,000	53,200	53,100	49,900	46,000	47,300	50,700
TP, kg P/d	3,860	3,750	3,770	4,070	4,020	4,190	4,210	4,010	3,670	3,500	3,910

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/2013 represents the period between October 1, 2012 and September 30, 2013.

b. The TIN values do not necessarily equal ammonia plus NOx due to a combination of rounding and instances when ammonia was sampled more frequently than NOx.

Table 8-6. Discharge: Summary of Dry Season Flow and Loads to the Bay

Constituent	2013 [a]	2014 [a]	2015 [a]	2016 [a]	2017 [a]	2018 [a]	2019 [a]	2020 [a]	2021 [a]	2022 [a]	Trend [b, c]	10-Year Average
Flow, mgd	393	374	351	372	396	383	394	363	339	337	Down (-1.1%/yr)	370
Ammonia, kg N/d	34,000	36,300	36,200	37,300	38,900	38,900	38,200	35,400	33,600	35,800	None	36,500
NOx, kg N/d	13,300	11,800	12,500	11,100	11,700	11,000	10,800	10,000	9,290	8,540	Down (-4.1%/yr)	11,010
TIN, kg N/d [d]	47,300	48,100	48,700	48,400	50,600	50,000	49,200	45,700	43,100	44,400	Down (-1.0%/yr)	47,500
TP, kg P/d	3,400	3,320	3,570	3,960	3,660	4,000	4,010	3,790	3,680	3,300	None	3,670

a. The dry season represents May 1 through September 30 for each calendar year.

b. Trend analysis is based on average monthly values. Discernible trends were identified based on the slope of a regression line determined using the method of least squares to fit the data (alpha = 0.05). Sample size is 45. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the change per year as a percentage of the average value over the entire dataset (2012-2022) (not considered if trend is “None”).

d. The TIN values do not necessarily equal ammonia plus NOx due to a combination of rounding and instances when ammonia was sampled more frequently than NOx.

Table 8-7. Discharge: Summary of Average Annual Flow and Concentrations to the Bay

Constituent	2012 / 2013 [a]	2013 / 2014 [a]	2014 / 2015 [a]	2015 / 2016 [a]	2016 / 2017 [a]	2017 / 2018 [a]	2018 / 2019 [a]	2019 / 2020 [a]	2020 / 2021 [a]	2021 / 2022 [a]	10-Year Average
Flow, mgd	451	428	415	430	515	433	480	408	374	399	433
Ammonia, mg N/L	20.1	22.8	23.4	23.0	20.8	24.9	21.9	24.6	24.9	24.6	23.0
NOx, mg N/L	8.77	8.84	9.05	8.37	7.41	7.57	7.12	7.48	7.56	6.67	7.94
TIN, mg N/L [b]	28.8	31.6	32.4	31.4	28.2	32.5	29.3	32.3	32.5	31.3	31.0
TP, mg P/L	2.26	2.31	2.40	2.50	2.06	2.56	2.32	2.59	2.60	2.32	2.39

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2012/13 represents the period between October 1, 2012 and September 30, 2013.

b. The TIN values do not necessarily equal ammonia plus NOx due to instances when ammonia was sampled more frequently than NOx.

Table 8-8. Discharge: Summary of Dry Season Flow and Concentrations to the Bay*

Constituent	2013 [a]	2014 [a]	2015 [a]	2016 [a]	2017 [a]	2018 [a]	2019 [a]	2020 [a]	2021 [a]	2022 [a]	Trend [b, c]	10-Year Average
Flow, mgd	393	374	351	372	396	383	393	363	339	337	None	370
Ammonia, mg N/L	22.8	25.6	27.3	26.5	26.0	26.8	25.6	25.8	26.2	28.1	Up (0.7%/yr)	26.1
NOx, mg N/L	8.98	8.36	9.41	7.89	7.81	7.56	7.26	7.28	7.25	6.69	Down (-3.1%/yr)	7.85
TIN, mg N/L [b]	31.8	34.0	36.7	34.4	33.8	34.4	33.0	33.2	33.6	34.8	None	34.0
TP, mg P/L	2.28	2.34	2.69	2.81	2.44	2.76	2.69	2.76	2.87	2.58	None	2.62

** Dry season trending not applied to concentrations as the emphasis is on load. Focusing on concentration is limiting as it does not consider the impact of flow.

a. The dry season represents May 1 through September 30 for each calendar year.

b. The TIN values do not necessarily equal ammonia plus NOx due to instances when ammonia was sampled more frequently than NOx.

8.3 Recycled Water

As previously stated in Section 7.7, this and future Group Annual Reports to rely on the readily available recycled water volumes from the State Water Board.[2] This report couples those recycled water volumes with effluent nutrient concentrations from this effort to quantify the corresponding recycled water nutrient loads.

The distribution of recycled water volumes/flows by Subembayments are as follows: Lower South Bay > San Pablo Bay > Suisun Bay > South Bay > Central Bay. Note: the order can adjust from year to year. Furthermore, a summary of the dominant recycled water users by Subembayment is as follows:

- There are no potable reuse applications yet in the Bay Area
- Lower South Bay relies primarily on a blend of landscape irrigation, industrial applications, and golf course irrigation.
- South Bay has the most even distribution of recycled water volumes for agriculture, golf courses, commercial, and irrigation.
- San Pablo Bay relies primarily on a blend of agriculture, golf courses, and irrigation.
- Suisun Bay relies primarily on industrial customers, in particular the Calpine power production facility in Pittsburg-Antioch area.
- Central Bay is limited to landscape irrigation and industrial recycled water users.

Table 8-9 and Table 8-10 present overall summaries of the annual average and dry season recycled water flows and nutrient loads diverted from the San Francisco Bay, respectively, between October 2019 and September 2021. For all parameters, the daily average flow and/or loads increase from average annual to dry season conditions. This was anticipated due to the seasonal nature of recycled water, whereby reuse demands are typically highest during the dry season.

To better understand the contribution that recycled water has on nutrient management, Table 8-11 and Table 8-12 provide the percent flow and loads diverted from the San Francisco Bay due to recycled water. The percent diverted were calculated by dividing the recycled water load by the sum of the recycled water and discharge loads. An example calculation based on the average annual 2020/2021 dataset (average annual flow = 374 mgd; recycled water = 49.0 mgd) is as follows:

$$12\ Percent = \frac{49.0\ \text{mgd}}{(49.0\ \text{mgd} + 374\ \text{mgd})}$$

The annual average percent flow and loads diverted from the Bay due to recycled water ranges from 7 to 12 percent (regardless of parameter). Of the parameters, flow has the highest percentage diverted from the Bay due to reuse, followed by NOx loads. As for the dry season, the percent flow and loads diverted from the Bay due to recycled water increases compared to average annual as evidenced by values that range from 8 to 16 percent (regardless of parameter). Similar to average annual, flow has the highest percentage diverted from the Bay due to reuse, followed by NOx loads.

Table 8-9. Recycled Water: Annual Average Flow and Loads Diverted from the Bay

Parameter	2019/2020 [a]	2020/2021 [a]	2-Year Average
Flow, mgd	46.9	49.0	47.9
Ammonia, kg N/d	2,960	2,580	2,770
NOx, kg N/d	1,050	1,090	1,070
TIN, kg N/d [b]	4,020	3,680	3,850
Total P, kg P/d	353	321	337

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. The TIN values do not necessarily equal ammonia plus NOx due to a combination of rounding and instances when ammonia was sampled more frequently than NOx.

Table 8-10. Recycled Water: Dry Season Average Flow and Loads Diverted from the Bay

Parameter	2019 [a]	2020 [a]	2021 [a]	3-Year Average
Flow, mgd	59.8	64.0	65.2	63.0
Ammonia, kg N/d	3,750	3,580	3,040	3,460
NOx, kg N/d	1,440	1,560	1,550	1,520
TIN, kg N/d [b]	5,160	5,100	4,440	4,900
Total P, kg P/d	412	451	393	419

a. The dry season represents May 1 through September 30 for each calendar year.
b. The TIN values do not necessarily equal ammonia plus NOx due to a combination of rounding and instances when ammonia was sampled more frequently than NOx.

Table 8-11. Recycled Water: Percent of Annual Average Flow and Loads Diverted from the Bay (%)

Parameter	2019/2020 [a,c] %	2020/2021 [a,c] %	2-Year Average %
Flow	10%	12%	10%
Ammonia	7%	7%	7%
NOx	8%	9%	9%
TIN [b]	7%	7%	7%
Total P	8%	8%	8%

a. Each reporting year represents the period between October 1 of the first year and September 30 of the second year. For example, 2019/2020 represents the period between October 1, 2019 and September 30, 2020.
b. The TIN values do not necessarily equal ammonia plus NOx due to a combination of rounding and instances when ammonia was sampled more frequently than NOx.
c. The percent diverted from the Bay due to recycled water is based on the recycled water value divided by the sum of recycled water value and discharge value.

Table 8-12. Recycled Water: Percent of Dry Season Average Flow and Loads Diverted from the Bay (%)

Parameter	2019 [a,c] %	2020 [a,c] %	2021 [ac] %	3-Year Average %
Flow	14%	16%	16%	15%
Ammonia	9%	9%	8%	9%
NOx	12%	13%	14%	13%
TIN [b]	10%	10%	9%	10%
Total P	9%	11%	10%	10%

a. The dry season represents May 1 through September 30 for each calendar year.
b. The TIN values do not necessarily equal ammonia plus NOx due to a combination of rounding and instances when ammonia was sampled more frequently than NOx.
c. The percent diverted from the Bay due to recycled water is based on the recycled water value divided by the sum of recycled water value and discharge value.

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Appendix A. Discharge Evaluation for Individual Dischargers

Individual Agencies are reviewing these and providing the HDR team with final comments. HDR will compile all of these as part of the final GAR submittal.

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