Bay Area Clean Water Agencies
Nutrient Reduction Study

# Group Annual Report

## Nutrient Watershed Permit Annual Report

*2017*

October 1, 2017

BACWA
BAY AREA
CLEAN WATER
AGENCIES

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# 1 Introduction

On April 9, 2014 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. R2-2014-0014. The Nutrient Watershed Permit became effective on July 1, 2014 and 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 conduct treatment plant optimization and upgrade studies for nutrient removal.

One of the requirements of the Nutrient Watershed Permit is the reporting and analysis of 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 July 1, 2012 and June 30, 2017. 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 – Results.** This section presents the data for each discharger as well as the annual and seasonal averages for the Effluent Flow, Ammonia, Total Kjeldahl Nitrogen, Nitrate plus Nitrite, Total Nitrogen, Orthophosphate, 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 – Discussion.** This section includes a discussion of the data presented in Section 4.
- **Section 6 – 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 thirty-three dischargers.

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# 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) (City of Hayward, City of San Leandro, Oro Loma Sanitary District, Castro Valley Sanitary District, Union Sanitary 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 | |
| | 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 |
| Petaluma, City of (Petaluma) | Ellis Creek Water Recycling Facility | Major |

| Discharger Name (Abbreviation) | POTW Facility Name | Minor / Major[(a)] |
|---|---|---|
| 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 |
| Sonoma Valley County Sanitary District (Sonoma Valley) | Municipal Wastewater Treatment Plant | Major |
| Silicon Valley Clean Water (SVCW) | SVCW 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) | Wastewater Treatment Plant | Major |
| Vallejo Sanitation and Flood Control District (Vallejo) | Vallejo Sanitation and Flood Control District 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 |

(a) As defined in the Nutrient Watershed Permit.

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

1. Ammonia as Nitrogen
2. Total Kjeldahl Nitrogen
3. Nitrate/Nitrite as Nitrogen
4. Total Nitrogen as Nitrogen
5. Soluble Reactive Phosphorus as Phosphorus
6. Total Phosphorus


**Figure 2-1. Location of Dischargers**

Major municipal dischargers having a permitted or design flow greater than 10 million gallons per day (mgd), are required to sample twice per month. Major municipal dischargers having a flow less than 10 mgd, are required to sample once per month. Minor municipal discharges, which are those with a flow less than 1 mgd, are required to monitor twice per year. In addition, dischargers are required to sample only during the portion 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, 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 Section VIII.1 Arithmetic Calculations of Standard Provisions (Attachment G of individual permits) covering July 1 through June 30 of the preceding year. Each individual Discharger shall document its nutrient loads relative to other facilities covered by this Order that discharge to the same subembayment, i.e., Suisun Bay, San Pablo Bay, Central Bay, South Bay, and Lower South Bay.

iii. An analysis of nutrient trends, load variability, and an assessment as to whether or not nutrient mass discharges are increasing or decreasing.

iv. If trend analysis shows a significant change in load, the Discharger shall investigate the cause and shall report its results, or status, or plans for investigation, in the annual report or in subsequent annual reports. This investigation shall include, at a minimum, whether treatment process changes have reduced or increased nutrient discharges, changes in nutrient loads related to water reclamation (increasing or decreasing), and changes in total influent flow resulted to water conservation, population growth, transient work community, new industry, and/or changes in wet weather flows.

[1] Wolfe, Bruce. (2012) Letter: Water Code Section 13267 Technical Report Order Requiring Submittal of Information on Nutrients in Wastewater Discharges. March 2, 2012. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/amendments/estuarineNNE/Nutrients%2013267%20Order%20-%203-12.pdf

# 3 Approach

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

## 3.1 Data Sources

Data from July 2012 to June 2017 was collected from two different sources, including that compiled for the Section 13267 Letter requirements and the subsequent Nutrient Watershed Permit data. The Section 13267 Letter data includes the initial two years (July 2012 through June 2014) and the Nutrient Watershed Permit data includes the subsequent years (July 2014 through June 2017).

The sampling requirements and frequency differ between the two data sets. The requirements for each are summarized in Table 3-1.

Table 3-1. Comparison of Section 13267 Letter and Nutrient Watershed Permit Requirements

| Parameter | Section 13267 Letter Data | Nutrient Watershed Permit Data |
|---|---|---|
| Major Dischargers and Sampling Frequency | 1) Flows ≥5 mgd permitted capacity<br>a. Year round dischargers: Sample twice per month and two additional samples each wet season during peak wet weather flow conditions<br>b. Seasonal dischargers: Sample twice per month during discharge (wet) season; sample once during non-discharge (dry) season<br>2) Flows between 1 and 5 mgd permitted capacity<br>a. Year round dischargers: Sample twice per month and two additional samples each wet season during peak wet weather flow conditions<br>b. Seasonal dischargers: Sample twice per month during discharge (wet) season; sample once during non-discharge (dry) season | 1) Flows >10 mgd permitted capacity must sample twice per month<br>2) Flows between 1 and 10 mgd permitted capacity must sample once per month |
| Minor Dischargers and Sampling Frequency | 1) Flows <1 mgd permitted capacity<br>a. Year round dischargers: Sample once per month<br>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 |
| Non-Nutrient Sampling Parameters | Flow<br>pH<br>Temperature | Flow |
| Nitrogen Species and Sample Type | 1) Total Ammonia (NH3 plus NH4+, reported as N) – Composite Sample<br>2) Total Dissolved Nitrogen (TDN, reported as N) – Composite Sample<br>3) Total Kjeldahl Nitrogen (TKN, reported as N) – Composite Sample<br>4) Soluble Kjeldahl Nitrogen (SKN, reported as N) – Composite Sample | 1) Total Ammonia (NH3 plus NH4+, reported as N) – Composite Sample<br>2) Total Kjeldahl Nitrogen (TKN) – Composite Sample<br>3) Nitrate (NO3-) plus Nitrite (NO2-) (NOx, reported as N) – Composite Sample<br>4) Total Nitrogen (TN, calculated) – Composite Sample |

| Parameter | Section 13267 Letter Data | Nutrient Watershed Permit Data |
|---|---|---|
| | 5) Nitrate (NO3-, reported as N) – Composite Sample<br>6) Nitrite (NO2-, reported as N) – Composite Sample<br>7) Urea (limited to 5 largest dischargers, reported as N) – Composite Sample | |
| Phosphorus Species and Sample Type | 1) Total Phosphorus (TP) – Composite Sample<br>2) Soluble Total Phosphorus (STP; reported as P) – Composite Sample<br>3) Dissolved Orthophosphate (reported as P) – Composite or Grab Sample<br>4) Total Orthophosphate (reported as P) – Composite Sample | 1) Soluble Reactive Phosphorus (SRP, reported as P) – Grab Sample<br>2) Total Phosphorus (TP) – Composite Sample |

## 3.2 Parameters of Interest

A list of the parameters required by both the Section 13267 Letter and the Nutrient Watershed Permit and their respective measurement methodology is presented in Table 3-2. With the exception of orthophosphate (measured as soluble reactive phosphorus, SRP), the samples for all other parameters were 24 hour composites. The orthophosphate sample type was a composite or grab for the Section 13267 Letter data and a grab sample for the Nutrient Watershed Permit data.

Table 3-2. List of Parameters, Methodology, and Sample Type Required for both Datasets

| Parameter | Measured or Calculated | Sample Type | Method[a,b] | Calculation |
|---|---|---|---|---|
| Flow | Both (plant specific) | Continuous | | $Flow\ (mgd) = \frac{Load\ (\frac{kg}{d})}{Conc\ (\frac{mg}{L}) * 3.78}$ |
| Total Ammonia | Measured[c] | 24-hr Composite | 4500-NH3 | |
| TKN | Both (plant specific)[c] | 24-hr Composite | 4500-N(org) | |
| NOx | Measured[c] | 24-hr Composite | 4500-N | |
| TN | Calculated[c] | 24-hr Composite | Calculated | $TN = TKN + NOx$ |
| SRP (referred to as Ortho-P[d] from herein) | Measured[c] | 24-hr Composite or Grab for Section 13267 Letter data; Grab for Nutrient Watershed Permit | 4500-P | |
| TP | 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.
d. Dissolved orthophosphate if available and total orthophosphate if dissolved not available.

The phosphorus species are different for the Section 13267 Letter data and the Nutrient Watershed Permit data. The Section 13267 Letter data requires sampling for a suite of phosphorus species (total phosphorus, soluble total phosphorus, dissolved orthophosphate and total orthophosphate). In contrast, the Watershed Permit requires soluble reactive phosphorus which is unclear, as a specific method of analysis was not defined. As a result, the phosphorus species reported under the Watershed Permit varies by discharger. The species listed in CIWQS, available for reporting, includes: total phosphate, dissolved orthophosphate, total orthophosphate, and dissolved phosphorus. The majority of agencies reported as dissolved orthophosphate (28 out of the 33 discharging agencies). The remaining dischargers reported total orthophosphate.

In order to provide consistency, the analysis presented in this Group Annual Report is based on:

- Dissolved orthophosphate from the Section 13267 Letter dataset;
- FY14/15: Dissolved orthophosphate, if available, and total orthophosphate otherwise; and
- FY15/16: Orthophosphate is reported as soluble reactive phosphorus.

In this Group Annual Report, SRP is referred to as orthophosphate (ortho-P).

## 3.3 Data Confirmation

Once the datasets were collected and compiled, the data for each plant was summarized and provided to each participating discharger for review and confirmation. The data presented in this Group Annual Report reflects 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 is attributed to inflow and infiltration (I&I) during such events which can bias the discharge results, especially for small datasets such as this.
- Wastewater treatment facilities are better able to remove nutrient loads (if deemed necessary) during the warmer, dry season when the kinetics of biological treatment are more favorable and there are fewer (if any) peak flow events.
- A Nutrient Management Study 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. In order to provide a consistent basis for the purposes

of this Group Annual Report, the seasonal definition presented in the approved Scoping and Evaluation Plan[2] 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 Trend Analysis

The effluent data was evaluated to identify evidence of trends over the past five years. Due to the change in sampling frequency between the Section 13267 Letter and 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 the Watershed Permit. As a result, an artificial bias has been introduced which was expected to overestimate the wet season load. A sensitivity analysis was performed 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 average annual 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 was 5 samples per year (n = 25 in total for the five years of effluent 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 the initial three years of data was included to serve as a reference or baseline for the extent of change over time.

[2] Bay Area Clean Water Agencies (2015) Scoping and Evaluation Plan for Potential Nutrient Reduction by Treatment Optimization and Treatment Upgrades. Order No. R2-2014-0014, NPDES Permit No. CA0038873.

[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 Results

This section presents a discussion of the dataset limitations as well as the data results for the following effluent parameters:

1. Flow
2. Total Ammonia (reported as N)
3. Total Kjeldahl Nitrogen
4. Nitrate plus Nitrite (NOx, reported as N))
5. Total Nitrogen (reported as N)
6. Orthophosphate (reported as P)
7. Total Phosphorus

Data are summarized for each discharger, 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 July 1, 2012 and June 30, 2013.

In addition, the relative contribution of flow and loads for each discharger is provided for each subembayment.

## 4.1 Dataset Limitations

There are some limitations in the overall dataset for the period between July 2012 and June 2017. The sampling frequency requirements vary by size of discharger, ranging from once per dry season for minor plants to twice per month for plants larger than 10 mgd. It is further complicated by the earlier Section 13267 Letter requirement to sample twice per wet season during peak wet weather events. This variation in data collection creates inconsistencies in the datasets and presents limitations on statistical analysis for the purposes of trending. Given the relatively small dataset (n = 60 for most dischargers), a few additional samples from wet weather events can artificially exaggerate the average monthly load values during the wet period as previously discussed in Section 3.5. In order to have more confidence in the trend analysis, a larger dataset is desired, which will be developed over the course of the Watershed Permit.

As previously described, the trend analysis presented in the following subsections is based on the Dry Season (n = 25 for most dischargers).

Since the first Group Annual Report submitted in 2015, there have been several data changes 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 was initially updated in the 2016 Report with updated data that is reflected in this report.
- Total Nitrogen data from the Las Gallinas 2015-2016 dataset was updated with values 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 is in the process of being updated in CIWQS. This report reflects the updated data.

## 4.2 Flows

The annual average and dry season average effluent flows are presented in Table 4-1 and Table 4-2, respectively. The annual average and dry season effluent flows discharged to each subembayment are presented in Table 4-3 and Table 4-4, respectively.

**Table 4-1. Annual Average Daily Effluent Flows by Discharger (mgd)**

| Discharger | Sub-embayment[a] | Permitted Capacity[b] | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|---|---|
| American Canyon | SPB | 2.5 | 1.5 | 1.4 | 1.5 | 1.5 | 1.7 |
| Benicia | SPB | 4.5 | 2.2 | 2.1 | 2.0 | 2.0 | 2.4 |
| Burlingame | SB | 5.5 | 3.0 | 3.0 | 3.0 | 2.8 | 3.6 |
| CCCSD | SUB | 53.8 | 37.4 | 36.2 | 33.7 | 33.2 | 42.8 |
| CMSA | CB | 10 | 7.7 | 6.1 | 7.0 | 7.8 | 13.0 |
| Port Costa | SPB | 0.033 | 0.01 | 0.01 | 0.01 | 0.02 | 0.03 |
| Delta Diablo | SUB | 19.5 | 6.9 | 6.1 | 7.3 | 7.1 | 9.3 |
| EBDA | SB | 107.8 | 62.2 | 59.6 | 59.4 | 60.5 | 68.5 |
| EBMUD | CB | 120 | 58.8 | 57.2 | 52.2 | 52.9 | 65.6 |
| FSSD | SUB | 23.7 | 13.6 | 12.6 | 12.3 | 12.8 | 15.0 |
| Las Gallinas[c] | SPB | 2.92 | 1.4 | 1.2 | 1.3 | 1.7 | 2.9 |
| Millbrae | SB | 3 | 1.5 | 1.7 | 1.4 | 1.4 | 1.9 |
| Mt. View | SUB | 3.2 | 1.4 | 1.3 | 1.3 | 1.2 | 1.5 |
| Napa[c] | SPB | 15.4 | 5.0 | 4.6 | 5.3 | 6.0 | 8.9 |
| Novato[c] | SPB | 7 | 3.2 | 2.9 | 3.3 | 2.9 | 4.8 |
| Palo Alto | LSB | 39 | 21.7 | 19.5 | 19.4 | 21.6 | 24.3 |
| Paradise Cove | CB | 0.04 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Petaluma[c] | SPB | 6.7 | 3.7 | 4.3 | 3.2 | 2.8 | 4.6 |
| Pinole | SPB | 4.06 | 2.6 | 2.6 | 2.5 | 2.4 | 2.9 |
| Rodeo | SPB | 1.14 | 0.6 | 0.6 | 0.6 | 0.6 | 0.7 |
| San Jose | LSB | 167 | 92.5 | 85.6 | 83.0 | 79.3 | 89.2 |
| San Mateo | SB | 15.7 | 10.8 | 10.0 | 10.4 | 10.1 | 12.2 |
| SASM | CB | 3.6 | 2.2 | 2.7 | 2.4 | 2.5 | 3.0 |
| SFO Airport | SB | 2.2 | 1.1 | 1.2 | 1.1 | 1.1 | 1.2 |
| SFPUC Southeast | SB | 84.5 | 56.8 | 58.6 | 56.0 | 56.3 | 62.3 |
| SMCSD | CB | 1.8 | 1.5 | 1.3 | 1.2 | 1.3 | 1.5 |
| Sonoma Valley[c] | SPB | 3 | 1.6 | 1.3 | 0.3 | 0.6 | 2.2 |
| South SF | SB | 13 | 9.0 | 8.7 | 8.6 | 8.3 | 9.1 |
| Sunnyvale | LSB | 29.5 | 10.3 | 11.0 | 10.4 | 10.1 | 11.7 |
| SVCW | SB | 29 | 13.2 | 12.4 | 12.4 | 14.1 | 15.9 |
| Tiburon | CB | 0.98 | 0.58 | 0.59 | 0.54 | 0.67 | 0.79 |
| Treasure Island | CB | 2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 |
| Vallejo | SPB | 15.5 | 10.4 | 9.1 | 10.2 | 9.7 | 12.5 |
| West County | CB | 28.5 | 8.5 | 8.3 | 7.5 | 9.3 | 13.2 |
| | | | | | | | |
| **Total** | | **826** | **453** | **434** | **421** | **425** | **510** |

a. SB = Suisun Bay; SPB = San Pablo Bay; CB = Central Bay; SB = South Bay; LSB = Lower South Bay
b. Based on ADWF permitted capacity. Data is presented in detail and summarized for each plant in the Appendix.
c. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

## Table 4-2. Dry Season Average Daily Flows by Discharger (mgd)

| Discharger | Sub-embayment[a] | Permitted Capacity[b] | 2012/13[c] | 2013/14[c] | 2014/15[c] | 2015/16[c] | 2016/17[c] |
|---|---|---|---|---|---|---|---|
| American Canyon | SPB | 2.5 | 1.2 | 1.2 | 1.2 | 1.1 | 1.1 |
| Benicia | SPB | 4.5 | 1.9 | 2.0 | 1.8 | 1.8 | 1.9 |
| Burlingame | SB | 5.5 | 2.7 | 2.7 | 2.7 | 2.4 | 2.7 |
| CCCSD | SUB | 53.8 | 33.8 | 34.2 | 30.2 | 29.0 | 32.1 |
| CMSA | CB | 10 | 5.7 | 5.5 | 4.8 | 5.1 | 6.5 |
| Port Costa | SPB | 0.033 | 0.006 | 0.005 | 0.006 | 0.015 | 0.012 |
| Delta Diablo | SUB | 19.5 | 6.4 | 5.7 | 5.8 | 6.0 | 7.3 |
| EBDA | SB | 107.8 | 55.6 | 53.4 | 51.9 | 52.1 | 54.1 |
| EBMUD | CB | 120 | 51.4 | 49.3 | 45.4 | 44.2 | 47.0 |
| FSSD | SUB | 23.7 | 11.1 | 10.6 | 9.7 | 9.6 | 11.1 |
| Las Gallinas[d] | SPB | 2.92 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 |
| Millbrae | SB | 3 | 1.4 | 1.5 | 1.2 | 1.3 | 1.4 |
| Mt. View | SUB | 3.2 | 1.3 | 1.2 | 1.2 | 1.2 | 1.2 |
| Napa[d] | SPB | 15.4 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 |
| Novato[d] | SPB | 7 | 0.8 | 0.7 | 0.7 | 0.8 | 1.6 |
| Palo Alto | LSB | 39 | 23.1 | 20.3 | 19.9 | 19.7 | 21.6 |
| Paradise Cove | CB | 0.04 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Petaluma[d] | SPB | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pinole | SPB | 4.06 | 2.7 | 2.4 | 2.2 | 2.1 | 2.3 |
| Rodeo | SPB | 1.14 | 0.6 | 0.6 | 0.5 | 0.5 | 0.5 |
| San Jose | LSB | 167 | 86.0 | 80.2 | 76.3 | 72.2 | 77.2 |
| San Mateo | SB | 15.7 | 10.2 | 9.8 | 8.9 | 8.7 | 9.4 |
| SASM | CB | 3.6 | 2.0 | 1.9 | 1.8 | 1.8 | 1.8 |
| SFO Airport | SB | 2.2 | 1.0 | 1.1 | 1.1 | 0.9 | 1.1 |
| SFPUC Southeast | SB | 84.5 | 52.9 | 55.2 | 54.4 | 53.9 | 55.4 |
| SMCSD | CB | 1.8 | 1.2 | 1.1 | 1.1 | 1.1 | 1.2 |
| Sonoma Valley[d] | SPB | 3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| South SF | SB | 13 | 8.6 | 8.5 | 7.9 | 7.5 | 7.3 |
| Sunnyvale | LSB | 29.5 | 7.9 | 9.5 | 8.2 | 7.7 | 8.9 |
| SVCW | SB | 29 | 12.5 | 11.6 | 11.0 | 12.6 | 12.8 |
| Tiburon | CB | 0.98 | 0.51 | 0.55 | 0.54 | 0.55 | 0.56 |
| Treasure Island | CB | 2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Vallejo | SPB | 15.5 | 8.9 | 8.7 | 8.6 | 8.3 | 8.6 |
| West County | CB | 28.5 | 7.0 | 6.3 | 5.8 | 6.9 | 9.0 |
| | | | | | | | |
| **Total** | | **826** | **399** | **387** | **365** | **359** | **387** |

a. SB = Suisun Bay; SPB = San Pablo Bay; CB = Central Bay; SB = South Bay; LSB = Lower South Bay
b. Based on ADWF permitted capacity.
c. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
d. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

### Table 4-3. Annual Average Daily Discharges by Subembayment, Flow (mgd)

| Subembayment | Permitted Capacity[a] | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|---|
| Suisun Bay | 100.2 | 59.3 | 56.1 | 54.6 | 54.3 | 68.5 |
| San Pablo Bay | 62.8 | 32.2 | 30.2 | 30.1 | 30.1 | 43.9 |
| Central Bay | 166.9 | 79.7 | 76.5 | 71.3 | 74.7 | 97.6 |
| South Bay | 260.7 | 157.6 | 155.1 | 152.2 | 154.6 | 174.6 |
| Lower South Bay | 235.5 | 124.6 | 116.0 | 112.9 | 111.0 | 125.1 |
| | | | | | | |
| **Total** | **826** | **453** | **434** | **421** | **425** | **510** |

a. Based on ADWF permitted capacity.

### Table 4-4. Dry Season Average Daily Discharges by Subembayment, Flow (mgd)

| Subembayment | Permitted Capacity[a] | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | Trend[b,c] |
|---|---|---|---|---|---|---|---|
| Suisun Bay | 100.2 | 52.6 | 51.7 | 46.8 | 45.8 | 51.8 | None |
| San Pablo Bay | 62.8 | 16.1 | 16.9 | 15.1 | 14.6 | 16.4 | None |
| Central Bay | 166.9 | 68.1 | 65.0 | 59.7 | 59.9 | 66.4 | None |
| South Bay | 260.7 | 144.9 | 143.7 | 139.0 | 139.3 | 144.3 | None |
| Lower South Bay | 235.5 | 116.9 | 110.0 | 104.4 | 99.6 | 107.7 | Decreasing (-3% Change) |
| | | | | | | | |
| **Total** | **826** | **399** | **387** | **365** | **359** | **387** | **None** |

a. Based on ADWF permitted capacity.

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 25. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the 2016/17 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The historical average monthly daily discharge flows are presented in Figure 4-1. The 2016/2017 dry season flows were the second highest since nutrient sampling began in July 2012 and the 2016/2017 average annual flows were the highest since nutrient sampling began in July 2012. The South Bay and Lower South Bay Subembayments account for over half of the flow discharged to the San Francisco Bay (see Table 4-3).

The total dry season discharge flows were decreasing in the first 4 years, but increased this past year which was relatively wet in terms of precipitation. On a dry season basis (Table 4-4, Figure 4-1), the average dry season flow 2016/2017 total values increased to 2013/2014 to levels. In terms of dry season statistical trending, the Lower South Bay is the only Subembayment that showed any significance. This trending is based on the least squares correlation test selected as the basis for trends analysis.

A discussion of the results is provided in Section 5.2.

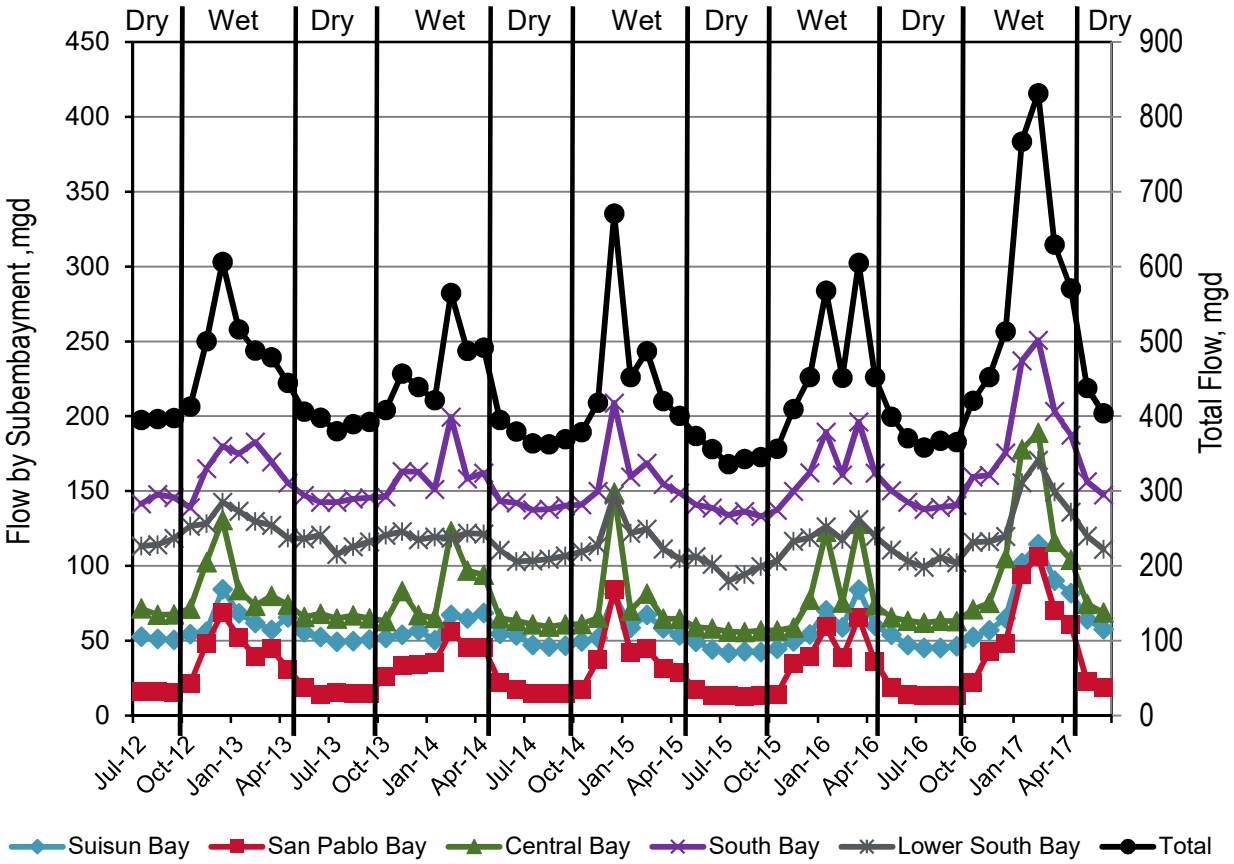


**Figure 4-1. Historical Average Monthly Daily Discharge Flow Values**

## 4.3 Ammonia

The annual average and dry season average effluent ammonia loads are presented in Table 4-5 and Table 4-6, respectively. The annual average and dry season loadings to each subembayment are presented in Table 4-7 and Table 4-8, respectively.

**Table 4-5. Annual Average Daily Discharges by Discharger, Ammonia (kg N/d)**

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 1.7 | 6.3 | 3.5 | 1.5 | 2.4 |
| Benicia | San Pablo Bay | 182 | 175 | 199 | 180 | 164 |
| Burlingame | South Bay | 284 | 274 | 254 | 273 | 341 |
| CCCSD | Suisun Bay | 3,544 | 3,545 | 3,341 | 3,370 | 3,671 |
| CMSA | Central Bay | 750 | 778 | 623 | 682 | 1,005 |
| Port Costa | San Pablo Bay | 0.2 | 0.4 | 0.3 | 0.4 | 0.9 |
| Delta Diablo | Suisun Bay | 769 | 746 | 925 | 788 | 1,303 |
| EBDA | South Bay | 6,714 | 6,942 | 7,158 | 7,454 | 7,499 |
| EBMUD | Central Bay | 7,890 | 8,359 | 8,606 | 8,952 | 9,207 |
| FSSD | Suisun Bay | 1.5 | 1.6 | 1.6 | 1.8 | 2.2 |
| Las Gallinas[b] | San Pablo Bay | 11 | 15 | 12 | 23 | 35 |
| Millbrae | South Bay | 226 | 250 | 225 | 256 | 287 |
| Mt. View | Suisun Bay | 3.1 | 0.8 | 1.6 | 4.2 | 2.6 |
| Napa[b] | San Pablo Bay | 44 | 17 | 6 | 16 | 103 |
| Novato[b] | San Pablo Bay | 7 | 10 | 17 | 7 | 40 |
| Palo Alto | Lower South Bay | 12 | 13 | 17 | 19 | 12 |
| Paradise Cove | Central Bay | 0.4 | - | 0.3 | 0.7 | 0.0 |
| Petaluma[b] | San Pablo Bay | 3.2 | 7.2 | 2.8 | 5.4 | 2.6 |
| Pinole | San Pablo Bay | 218 | 196 | 235 | 233 | 270 |
| Rodeo | San Pablo Bay | 5.3 | 4.7 | 4.0 | 6.3 | 8.3 |
| San Jose | Lower South Bay | 280 | 201 | 197 | 233 | 176 |
| San Mateo | South Bay | 1,233 | 1,331 | 1,315 | 1,031 | 1,291 |
| SASM | Central Bay | 44 | 48 | 45 | 56 | 31 |
| SFO Airport | South Bay | 215 | 223 | 167 | 117 | 181 |
| SFPUC Southeast | South Bay | 7,194 | 9,313 | 8,822 | 8,115 | 9,915 |
| SMCSD | Central Bay | 54 | 42 | 49 | 42 | 60 |
| Sonoma Valley[b] | San Pablo Bay | 1.5 | 2.5 | 0.2 | 0.1 | 0.8 |
| South SF | South Bay | 822 | 818 | 884 | 743 | 1,009 |
| Sunnyvale | Lower South Bay | 307 | 86 | 165 | 28 | 98 |
| SVCW | South Bay | 1,858 | 2,001 | 2,073 | 2,558 | 2,412 |
| Tiburon | Central Bay | 41 | - | 54 | 50 | 34 |
| Treasure Island | Central Bay | 0.6 | 1.6 | 7.1 | 10 | 4.9 |
| Vallejo | San Pablo Bay | 401 | 567 | 842 | 755 | 774 |
| West County | Central Bay | 652 | 653 | 606 | 789 | 721 |
| | | | | | | |
| **Total [c]** | | **33,770** | **36,628** | **36,858** | **36,801** | **40,664** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

## Table 4-6. Dry Season Average Daily Discharges by Discharger, Ammonia (kg N/d)

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 1.2 | 1.6 | 2.7 | 0.9 | 2.0 |
| Benicia | San Pablo Bay | 171 | 187 | 173 | 158 | 168 |
| Burlingame | South Bay | 261 | 264 | 229 | 244 | 263 |
| CCCSD | Suisun Bay | 3,366 | 3,467 | 3,265 | 3,222 | 3,402 |
| CMSA | Central Bay | 813 | 778 | 666 | 743 | 1,014 |
| Port Costa | San Pablo Bay | 0.3 | 0.1 | 0.1 | - | - |
| Delta Diablo | Suisun Bay | 739 | 690 | 700 | 654 | 1,043 |
| EBDA | South Bay | 6,028 | 6,338 | 6,816 | 6,923 | 6,683 |
| EBMUD | Central Bay | 7,592 | 8,517 | 8,714 | 8,343 | 8,896 |
| FSSD | Suisun Bay | 1.2 | 1.2 | 1.2 | 1.1 | 1.5 |
| Las Gallinas[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 2.3 |
| Millbrae | South Bay | 215 | 246 | 205 | 272 | 277 |
| Mt. View | Suisun Bay | 1.3 | 0.8 | 1.1 | 4.6 | 1.2 |
| Napa[b] | San Pablo Bay | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 |
| Novato[b] | San Pablo Bay | 0.3 | 2.4 | 1.2 | 0.9 | 15 |
| Palo Alto | Lower South Bay | 11 | 14 | 14 | 30 | 13 |
| Paradise Cove | Central Bay | 0.2 | 0.0 | 0.4 | 0.7 | 0.0 |
| Petaluma[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pinole | San Pablo Bay | 283 | 188 | 234 | 271 | 258 |
| Rodeo | San Pablo Bay | 5.1 | 2.8 | 2.7 | 3.8 | 3.7 |
| San Jose | Lower South Bay | 229 | 153 | 182 | 165 | 179 |
| San Mateo | South Bay | 1,323 | 1,550 | 1,447 | 1,110 | 1,294 |
| SASM | Central Bay | 41 | 38 | 40 | 34 | 33 |
| SFO Airport | South Bay | 206 | 216 | 227 | 134 | 262 |
| SFPUC Southeast | South Bay | 7,716 | 8,924 | 9,388 | 8,610 | 10,441 |
| SMCSD | Central Bay | 57 | 50 | 43 | 53 | 71 |
| Sonoma Valley[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| South SF | South Bay | 900 | 801 | 826 | 710 | 813 |
| Sunnyvale | Lower South Bay | 22 | 10 | 16 | 10 | 54 |
| SVCW | South Bay | 1,666 | 1,942 | 1,909 | 2,510 | 2,430 |
| Tiburon | Central Bay | 38 | 0.0 | 48 | 50 | 29 |
| Treasure Island | Central Bay | 0.6 | 2.0 | 7.5 | 8.3 | 3.6 |
| Vallejo | San Pablo Bay | 373 | 513 | 767 | 719 | 728 |
| West County | Central Bay | 658 | 644 | 634 | 759 | 727 |
| | | | | | | |
| **Total [c]** | | **32,719** | **35,541** | **36,560** | **35,745** | **39,108** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

### Table 4-7. Annual Average Daily Discharges by Subembayment, Ammonia (kg N/d)

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|
| Suisun Bay | 4,318 | 4,293 | 4,269 | 4,164 | 4,979 |
| San Pablo Bay | 875 | 1,001 | 1,322 | 1,228 | 1,401 |
| Central Bay | 9,432 | 9,882 | 9,990 | 10,582 | 11,063 |
| South Bay | 18,546 | 21,152 | 20,898 | 20,547 | 22,935 |
| Lower South Bay | 599 | 300 | 379 | 280 | 286 |
| | | | | | |
| **Total** | **33,770** | **36,628** | **36,858** | **36,801** | **40,664** |

### Table 4-8. Dry Season Average Daily Discharges by Subembayment, Ammonia (kg N/d)

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | Trend[a,b] |
|---|---|---|---|---|---|---|
| Suisun Bay | 4,108 | 4,159 | 3,967 | 3,882 | 4,448 | None |
| San Pablo Bay | 834 | 895 | 1,181 | 1,154 | 1,177 | Increasing (18% Change) |
| Central Bay | 9,200 | 10,029 | 10,153 | 9,991 | 10,774 | Increasing (9% Change) |
| South Bay | 18,315 | 20,281 | 21,047 | 20,513 | 22,463 | Increasing (11% Change) |
| Lower South Bay | 262 | 177 | 212 | 205 | 246 | None |
| | | | | | | |
| **Total** | **32,719** | **35,541** | **36,560** | **35,745** | **39,108** | **Increasing (11% Change)** |

a. 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 25. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.

b. The percent change represents the 2016/17 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The historical average monthly daily discharge ammonia loads are presented in Figure 4-2. The 2016/2017 dry and average annual loads were the highest since nutrient sampling began in July 2012. The South Bay Subembayment accounts for over half of the load discharged to the San Francisco Bay (see Table 4-7). On a dry season basis, ammonia loads appear to be trending upwards for San Pablo Bay, Central Bay, and South Bay Subembayments based on the least squares correlation analysis.

A discussion of the results is provided in Section 5.3.

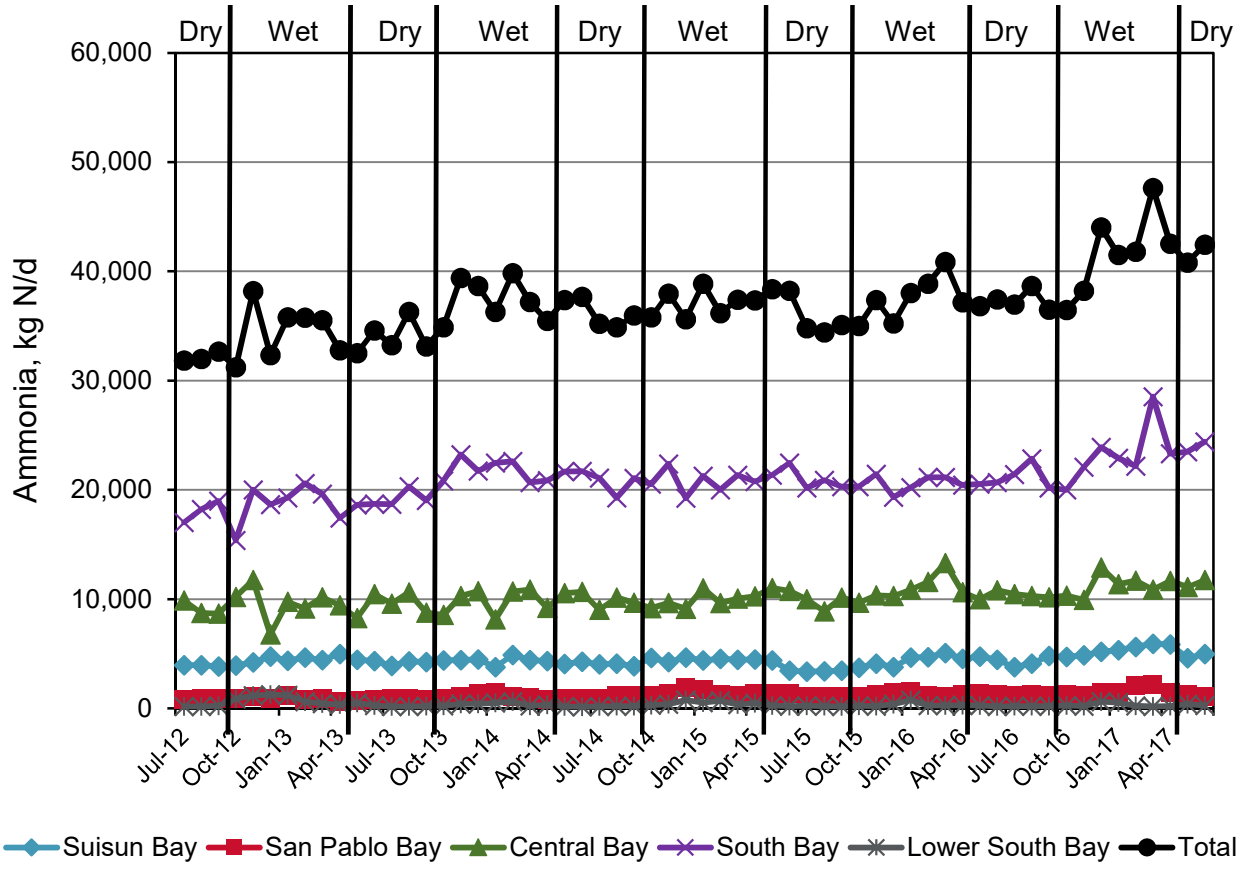


**Figure 4-2. Historical Average Monthly Daily Discharge Ammonia Load Values**

## 4.4 Total Kjeldahl Nitrogen (TKN)

The annual average and dry season average effluent TKN loads are presented in Table 4-9 and Table 4-10, respectively. The annual average and dry season effluent loads to each subembayment are presented in Table 4-11 and Table 4-12, respectively.

**Table 4-9. Annual Average Daily Discharges by Discharger, TKN (kg N/d)**

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 7.5 | 4.3 | 10.9 | 10.1 | 11.1 |
| Benicia | San Pablo Bay | 179 | 177 | 202 | 180 | 169 |
| Burlingame | South Bay | 394 | 328 | 310 | 368 | 461 |
| CCCSD | Suisun Bay | 3,910 | 3,858 | 3,597 | 3,676 | 3,935 |
| CMSA | Central Bay | 793 | 884 | 839 | 830 | 1,082 |
| Port Costa | San Pablo Bay | - | - | - | 0.3 | 1.0 |
| Delta Diablo | Suisun Bay | 805 | 695 | 1,024 | 860 | 1,436 |
| EBDA | South Bay | 7,476 | 7,816 | 7,765 | 8,406 | 8,563 |
| EBMUD | Central Bay | 9,113 | 9,717 | 9,579 | 9,820 | 10,374 |
| FSSD | Suisun Bay | 31 | 18 | 15 | 24 | 53 |
| Las Gallinas[b] | San Pablo Bay | 16 | 18 | 17 | 37 | 46 |
| Millbrae | South Bay | 244 | 286 | 263.5 | 301 | 329 |
| Mt. View | Suisun Bay | 6.4 | 1.7 | 2.0 | 4.7 | 7.4 |
| Napa[b] | San Pablo Bay | 89 | 51 | 46.8 | 76 | 172 |
| Novato[b] | San Pablo Bay | 25 | 18 | 30 | 23 | 84 |
| Palo Alto | Lower South Bay | 76 | 19 | 151 | 33 | 46 |
| Paradise Cove | Central Bay | 0.5 | - | 0.3 | 0.8 | 0.1 |
| Petaluma[b] | San Pablo Bay | 18 | 31 | 29 | 20 | 20 |
| Pinole | San Pablo Bay | 243 | 215 | 268 | 273 | 317 |
| Rodeo | San Pablo Bay | 8.4 | 7.8 | 9.2 | 8.0 | 12.3 |
| San Jose | Lower South Bay | 683 | 529 | 504 | 480 | 388 |
| San Mateo | South Bay | 1,363 | 1,509 | 1,554 | 1,235 | 1,492 |
| SASM | Central Bay | 68 | 83 | 70 | 93 | 62 |
| SFO Airport | South Bay | 213 | 207 | 146 | 103 | 143 |
| SFPUC Southeast | South Bay | 7,705 | 9,161 | 9,860 | 9,402 | 9,463 |
| SMCSD | Central Bay | 71 | 58 | 66 | 66 | 78 |
| Sonoma Valley[b] | San Pablo Bay | 6.3 | 6.5 | 1.3 | 0.9 | 5.9 |
| South SF | South Bay | 977 | 1,013 | 1,063 | 971 | 1,205 |
| Sunnyvale | Lower South Bay | 380 | 170 | 246 | 107 | 180 |
| SVCW | South Bay | 2,042 | 2,158 | 2,066 | 2,532 | 2,633 |
| Tiburon | Central Bay | 45 | - | 66 | 62 | 42 |
| Treasure Island | Central Bay | 3.7 | 4.9 | 6.1 | 12.3 | 9.5 |
| Vallejo | San Pablo Bay | 492 | 674 | 1,019 | 988 | 1,112 |
| West County | Central Bay | 730 | 800 | 755 | 1,014 | 872 |
| | | | | | | |
| **Total [c]** | | **38,213** | **40,519** | **41,582** | **42,017** | **44,804** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

## Table 4-10. Dry Season Average Daily Discharges by Discharger, TKN (kg N/d)

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 5.8 | 2.1 | 9.1 | 7.4 | 7.2 |
| Benicia | San Pablo Bay | 157 | 191 | 173 | 182 | 159 |
| Burlingame | South Bay | 313 | 263 | 272 | 328 | 329 |
| CCCSD | Suisun Bay | 3,683 | 3,770 | 3,546 | 3,535 | 3,694 |
| CMSA | Central Bay | 853 | 891 | 796 | 918 | 1,198 |
| Port Costa | San Pablo Bay | - | - | - | - | - |
| Delta Diablo | Suisun Bay | 794 | 636 | 692 | 776 | 1,196 |
| EBDA | South Bay | 6,795 | 7,040 | 7,327 | 7,669 | 7,409 |
| EBMUD | Central Bay | 8,678 | 9,791 | 9,601 | 9,323 | 10,049 |
| FSSD | Suisun Bay | 23 | 16 | 13 | 19 | 22.2 |
| Las Gallinas[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 |
| Millbrae | South Bay | 240 | 271 | 241 | 329 | 310 |
| Mt. View | Suisun Bay | 4.8 | 2.1 | 0.9 | 6.0 | 5.6 |
| Napa[b] | San Pablo Bay | 0.0 | 7.6 | 0.0 | 0.0 | 0.0 |
| Novato[b] | San Pablo Bay | 6.7 | 2.1 | 6.5 | 2.7 | 25 |
| Palo Alto | Lower South Bay | 73 | 18 | 17 | 35 | 36 |
| Paradise Cove | Central Bay | 0.3 | - | 0.4 | 0.8 | 0.0 |
| Petaluma[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pinole | San Pablo Bay | 312 | 205 | 267 | 316 | 297 |
| Rodeo | San Pablo Bay | 8.0 | 6.8 | 7.1 | 5.2 | 4.1 |
| San Jose | Lower South Bay | 529 | 436 | 444 | 424 | 376 |
| San Mateo | South Bay | 1,521 | 1,735 | 1,662 | 1,364 | 1,429 |
| SASM | Central Bay | 66 | 65 | 52 | 61 | 68 |
| SFO Airport | South Bay | 234 | 182 | 180 | 93 | 170 |
| SFPUC Southeast | South Bay | 8,031 | 8,959 | 9,954 | 9,391 | 10,248 |
| SMCSD | Central Bay | 75 | 63 | 61 | 80 | 95 |
| Sonoma Valley[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| South SF | South Bay | 990 | 1,064 | 972 | 867 | 1,095 |
| Sunnyvale | Lower South Bay | 104 | 122 | 119 | 87 | 125 |
| SVCW | South Bay | 1,922 | 2,046 | 1,884 | 2,414 | 2,490 |
| Tiburon | Central Bay | 44 | - | 57 | 62 | 34 |
| Treasure Island | Central Bay | 3.9 | 3.6 | 6.7 | 13.7 | 9.9 |
| Vallejo | San Pablo Bay | 483 | 624 | 946 | 944 | 989 |
| West County | Central Bay | 742 | 739 | 737 | 955 | 872 |
| | | | | | | |
| **Total [c]** | | **36,692** | **39,152** | **40,044** | **40,208** | **42,743** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

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

### Table 4-11. Annual Average Daily Discharges by Subembayment, TKN (kg N/d)

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|
| Suisun Bay | 4,752 | 4,573 | 4,638 | 4,565 | 5,431 |
| San Pablo Bay | 1,084 | 1,203 | 1,634 | 1,616 | 1,950 |
| Central Bay | 10,824 | 11,547 | 11,381 | 11,898 | 12,520 |
| South Bay | 20,414 | 22,478 | 23,028 | 23,318 | 24,289 |
| Lower South Bay | 1,139 | 718 | 901 | 620 | 614 |
| | | | | | |
| **Total** | **38,213** | **40,519** | **41,582** | **42,017** | **44,804** |

### Table 4-12. Dry Season Average Daily Discharges by Subembayment, TKN (kg N/d)

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | Trend[a,b] |
|---|---|---|---|---|---|---|
| Suisun Bay | 4,505 | 4,424 | 4,252 | 4,336 | 4,918 | None |
| San Pablo Bay | 973 | 1,039 | 1,409 | 1,457 | 1,482 | Increasing (23% Change) |
| Central Bay | 10,462 | 11,553 | 11,311 | 11,414 | 12,326 | Increasing (10% Change) |
| South Bay | 20,046 | 21,560 | 22,492 | 22,455 | 23,480 | Increasing (9% Change) |
| Lower South Bay | 706 | 576 | 580 | 546 | 537 | None |
| | | | | | | |
| Total | **36,692** | **39,152** | **40,044** | **40,208** | **42,743** | **Increasing (10% Change)** |

a. 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 25. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.
b. The percent change represents the 2016/17 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The average monthly daily discharge TKN loads since the 2012/13 season are presented in Figure 4-3. The 2016/2017 dry or average annual loads were the highest since nutrient sampling began in July 2012. The South Bay Subembayment accounts for over half of the load discharged to the San Francisco Bay (see Table 4-11). On a dry season basis, ammonia loads appear to be trending upwards for San Pablo Bay, Central Bay, and South Bay Subembayments based on the least squares correlation analysis.

A discussion of the results is provided in Section 5.4.

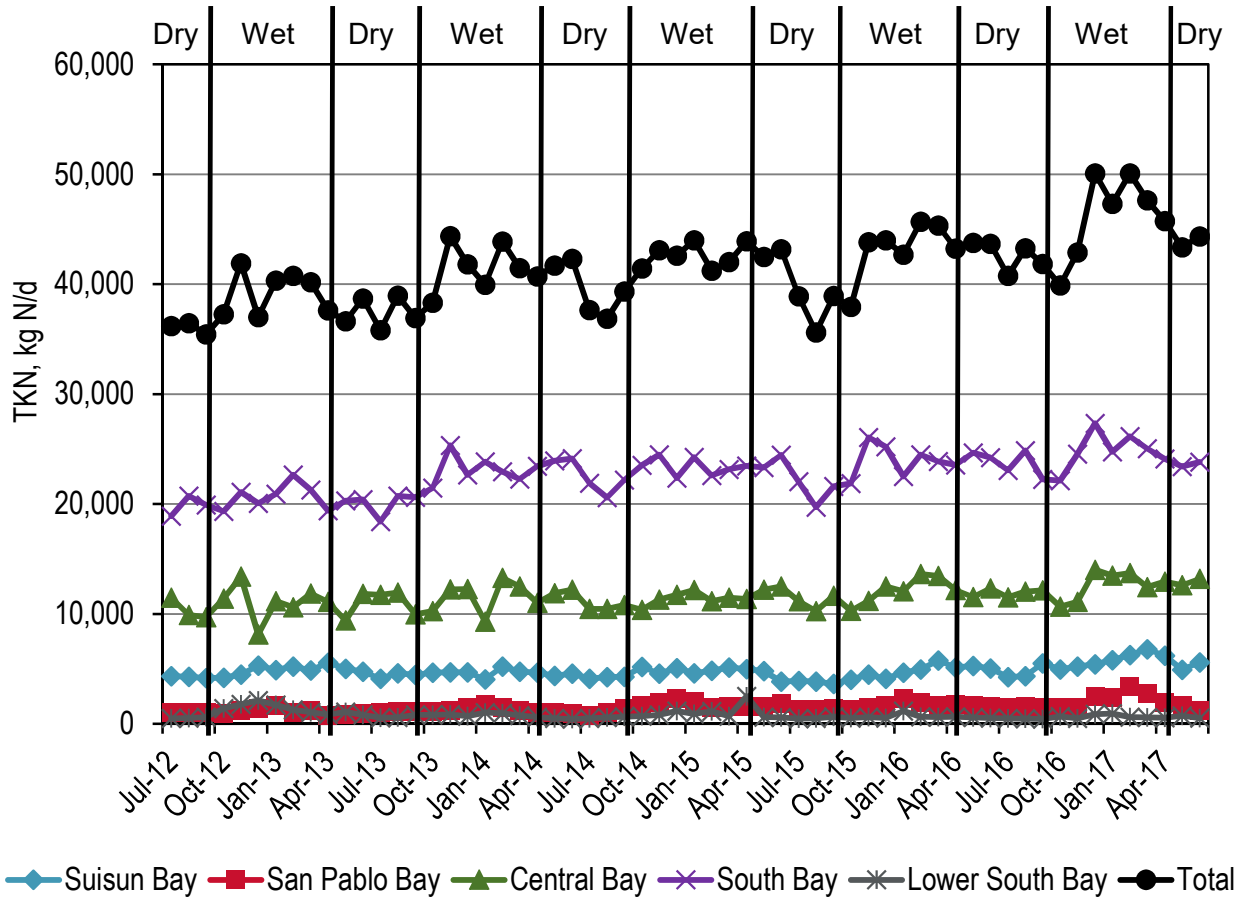


**Figure 4-3. Historical Average Monthly Daily Discharge TKN Load Values**

## 4.5 Nitrite plus Nitrate (NOx)

The annual average and dry season average effluent NOx loads are presented in Table 4-13 and Table 4-14, respectively. The annual average and dry season effluent loads to each subembayment are presented in Table 4-15 and Table 4-16, respectively.

**Table 4-13. Annual Average Daily Discharges by Discharger, NOx (kg N/d)**

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 59 | 79 | 53 | 32 | 41 |
| Benicia | San Pablo Bay | 37 | 40 | 45 | 43 | 70 |
| Burlingame | South Bay | 64 | 215 | 29 | 23 | 29 |
| CCCSD | Suisun Bay | 265 | 277 | 421 | 355 | 358 |
| CMSA | Central Bay | 110 | 80 | 148 | 131 | 131 |
| Port Costa | San Pablo Bay | - | - | - | 1.3 | 1.1 |
| Delta Diablo | Suisun Bay | 907 | 736 | 554 | 502 | 46 |
| EBDA | South Bay | 1,044 | 866 | 1,011 | 1,025 | 1,036 |
| EBMUD | Central Bay | 1,245 | 1,114 | 779 | 565 | 524 |
| FSSD | Suisun Bay | 1,278 | 1,467 | 1050 | 935 | 789 |
| Las Gallinas[b] | San Pablo Bay | 118 | 104 | 86 | 98 | 104 |
| Millbrae | South Bay | 2.4 | 2.2 | 2.2 | 2.4 | 2.3 |
| Mt. View | Suisun Bay | 121 | 131 | 116 | 117 | 138 |
| Napa[b] | San Pablo Bay | 129 | 158 | 165 | 154 | 156 |
| Novato[b] | San Pablo Bay | 137 | 126 | 150 | 132 | 150 |
| Palo Alto | Lower South Bay | 2,326 | 2,201 | 2116 | 2,517 | 2,744 |
| Paradise Cove | Central Bay | 1.6 | - | 1.6 | 1.5 | 2.1 |
| Petaluma[b] | San Pablo Bay | 22 | 4.6 | 20 | 10 | 14 |
| Pinole | San Pablo Bay | 104 | 104 | 44 | 65 | 70 |
| Rodeo | San Pablo Bay | 33 | 26 | 29 | 23 | 36 |
| San Jose | Lower South Bay | 4,501 | 4,475 | 5,248 | 4,944 | 5,545 |
| San Mateo | South Bay | 138 | 102 | 64 | 203 | 94 |
| SASM | Central Bay | 162 | 154 | 133 | 172 | 142 |
| SFO Airport | South Bay | 23 | 15 | 20 | 25 | 16 |
| SFPUC Southeast | South Bay | 554 | 783 | 873 | 764 | 475 |
| SMCSD | Central Bay | 72 | 80 | 73 | 88 | 78 |
| Sonoma Valley[b] | San Pablo Bay | 28 | 6.8 | 23 | 10 | 84 |
| South SF | South Bay | 199 | 120 | 66 | 146 | 65 |
| Sunnyvale | Lower South Bay | 681 | 584 | 586 | 563 | 763 |
| SVCW | South Bay | 62 | 78 | 57 | 58 | 71 |
| Tiburon | Central Bay | 16 | - | 4.4 | 8.4 | 12 |
| Treasure Island | Central Bay | 9.3 | 11 | 10 | 10 | 11 |
| Vallejo | San Pablo Bay | 343 | 251 | 127 | 154 | 118 |
| West County | Central Bay | 120 | 148 | 54 | 122 | 412 |
| | | | | | | |
| **Total [c]** | | **14,911** | **14,538** | **14,158** | **13,999** | **14,327** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

## Table 4-14. Dry Season Average Daily Discharges by Discharger, NOx (kg N/d)

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 41 | 109 | 57 | 23 | 26 |
| Benicia | San Pablo Bay | 40 | 38 | 48 | 48 | 51 |
| Burlingame | South Bay | 57 | 159 | 23 | 40 | 18 |
| CCCSD | Suisun Bay | 168 | 205 | 321 | 305 | 286 |
| CMSA | Central Bay | 70 | 91 | 79 | 86 | 100 |
| Port Costa | San Pablo Bay | - | - | - | - | - |
| Delta Diablo | Suisun Bay | 855 | 716 | 631 | 195 | 61 |
| EBDA | South Bay | 858 | 800 | 698 | 712 | 762 |
| EBMUD | Central Bay | 1,183 | 636 | 652 | 585 | 435 |
| FSSD | Suisun Bay | 1,293 | 1,296 | 861 | 776 | 870 |
| Las Gallinas[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 6.7 |
| Millbrae | South Bay | 1.9 | 3.5 | 1.6 | 1.2 | 0.9 |
| Mt. View | Suisun Bay | 108 | 119 | 97 | 114 | 110 |
| Napa[b] | San Pablo Bay | 0.0 | 50 | 0.0 | 0.0 | 0.0 |
| Novato[b] | San Pablo Bay | 40 | 40 | 36 | 37 | 64 |
| Palo Alto | Lower South Bay | 2,494 | 2,262 | 2,225 | 2,337 | 2,578 |
| Paradise Cove | Central Bay | 1.8 | - | 1.2 | 1.5 | 2.7 |
| Petaluma[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pinole | San Pablo Bay | 109 | 126 | 32 | 43 | 25 |
| Rodeo | San Pablo Bay | 26 | 24 | 25 | 22 | 28 |
| San Jose | Lower South Bay | 3,944 | 3,946 | 4,753 | 4,681 | 4,377 |
| San Mateo | South Bay | 28 | 5.9 | 4.9 | 110 | 69 |
| SASM | Central Bay | 134 | 120 | 125 | 140 | 142 |
| SFO Airport | South Bay | 21 | 20 | 19 | 24 | 13 |
| SFPUC Southeast | South Bay | 519 | 750 | 881 | 859 | 434 |
| SMCSD | Central Bay | 71 | 81 | 80 | 83 | 79 |
| Sonoma Valley[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 4.8 |
| South SF | South Bay | 105 | 118 | 78 | 187 | 117 |
| Sunnyvale | Lower South Bay | 565 | 295 | 366 | 328 | 357 |
| SVCW | South Bay | 88 | 67 | 61 | 58 | 60 |
| Tiburon | Central Bay | 10 | - | 6.3 | 8.4 | 16 |
| Treasure Island | Central Bay | 7.2 | 9.1 | 10 | 13 | 9.0 |
| Vallejo | San Pablo Bay | 322 | 270 | 152 | 135 | 108 |
| West County | Central Bay | 24 | 19 | 12 | 50 | 260 |
| | | | | | | |
| **Total [c]** | | **13,184** | **12,375** | **12,337** | **12,002** | **11,471** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

### Table 4-15. Annual Average Daily Discharges by Subembayment, NOx (kg N/d)

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|
| Suisun Bay | 2,571 | 2,611 | 2,141 | 1,909 | 1,331 |
| San Pablo Bay | 1,010 | 899 | 742 | 722 | 843 |
| Central Bay | 1,736 | 1,587 | 1,203 | 1,098 | 1,311 |
| South Bay | 2,086 | 2,181 | 2,122 | 2,246 | 1,790 |
| Lower South Bay | 7,508 | 7,260 | 7,950 | 8,024 | 9,052 |
| | | | | | |
| **Total** | **14,911** | **14,538** | **14,158** | **13,999** | **14,327** |

### Table 4-16. Dry Season Average Daily Discharges by Subembayment, NOx (kg N/d)

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | Trend[a,b] |
|---|---|---|---|---|---|---|
| Suisun Bay | 2,424 | 2,336 | 1,910 | 1,390 | 1,327 | Decreasing (-67% Change) |
| San Pablo Bay | 578 | 657 | 350 | 308 | 314 | Decreasing (-69% Change) |
| Central Bay | 1,501 | 956 | 966 | 967 | 1,044 | Decreasing (-9% Change) |
| South Bay | 1,678 | 1,923 | 1,767 | 1,991 | 1,474 | None |
| Lower South Bay | 7,003 | 6,503 | 7,344 | 7,346 | 7,312 | None |
| | | | | | | |
| **Total** | **13,184** | **12,375** | **12,337** | **12,002** | **11,471** | **None** |

a. 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 25. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.
b. The percent change represents the 2016/17 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The average monthly daily discharge NOx loads since the 2012/13 season are presented in Figure 4-4. The 2016/2017 average annual loads were the highest since the 2013/2014 dataset. The 2016/2017 dry season loads were the lowest since nutrient sampling began in July 2012. The Lower South Bay Subembayment accounts for over half of the load discharged to the San Francisco Bay (see Table 4-15). The reason for this is all the dischargers in the Lower South Bay fully nitrify (i.e., convert ammonia to NOx) year-round.

On a dry season basis, NOx loads appear to be trending downwards for Suisun Bay, San Pablo Bay, and South Bay Subembayments. The total effluent NOx to San Francisco Bay shows no significant trend based on the least squares correlation trend analysis. The loading appears to be more random than the other parameters of interest (e.g., sudden load reduction in July 2015). It is unclear what is causing this.

A discussion of the results is provided in Section 5.5.

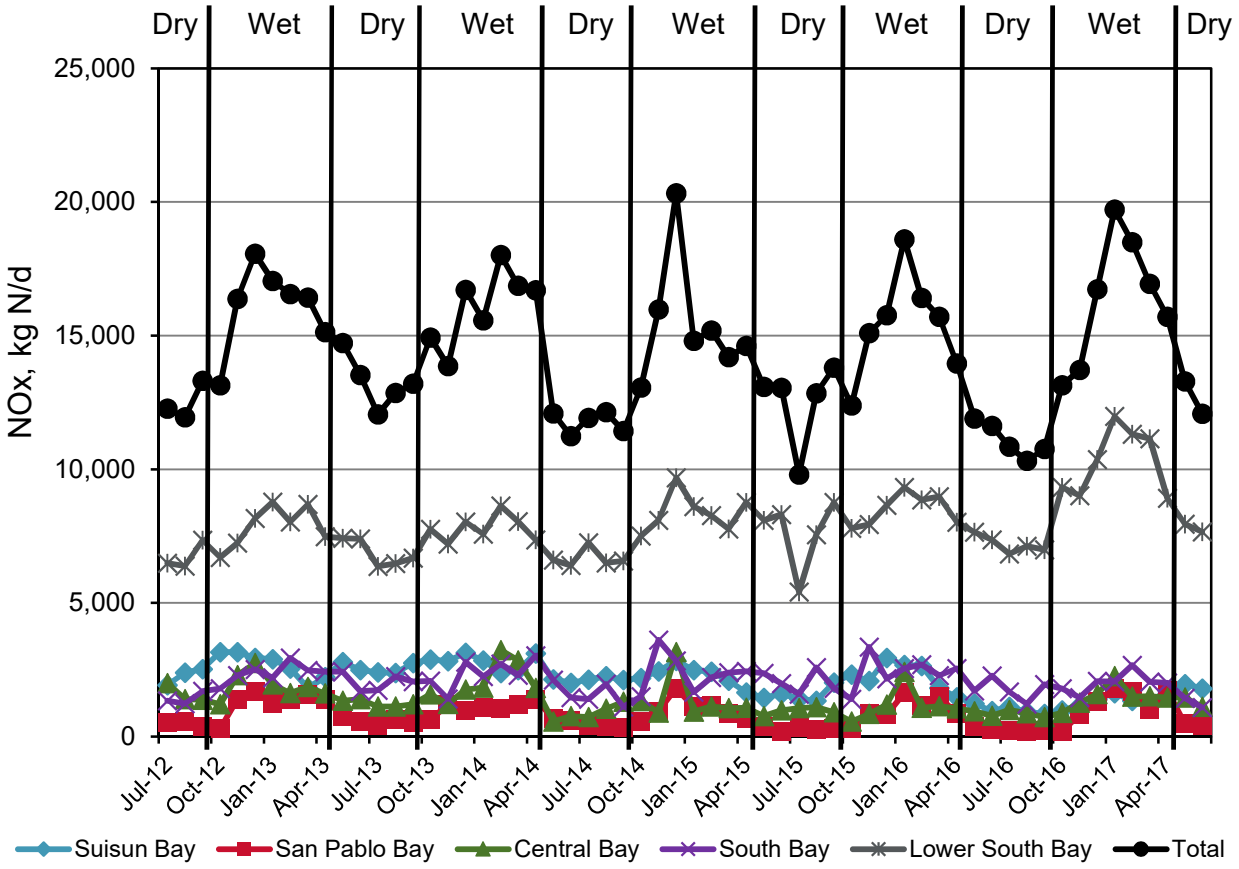


**Figure 4-4. Historical Average Monthly Daily Discharge NOx Load Values**

## 4.6 Total Nitrogen (TN)

The annual average and dry season average effluent TN loads are presented in Table 4-17 and Table 4-18, respectively. The annual average and dry season effluent TN loads by subembayment are presented in Table 4-19 and Table 4-20, respectively.

**Table 4-17. Annual Average Daily Discharges by Discharger, TN (kg N/d)**

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 66 | 83 | 64 | 42 | 52 |
| Benicia | San Pablo Bay | 215 | 218 | 245 | 222 | 230 |
| Burlingame | South Bay | 458 | 544 | 337 | 391 | 465 |
| CCCSD | Suisun Bay | 4,175 | 4,135 | 4,002 | 4,044 | 4,293 |
| CMSA | Central Bay | 903 | 964 | 992 | 961 | 1,214 |
| Port Costa | San Pablo Bay | - | - | - | 1.6 | 2.1 |
| Delta Diablo | Suisun Bay | 1,712 | 1,431 | 1,571 | 1,362 | 1,477 |
| EBDA | South Bay | 8,483 | 8,664 | 8,777 | 8,996 | 9,599 |
| EBMUD | Central Bay | 10,356 | 10,831 | 10,361 | 10,382 | 10,898 |
| FSSD | Suisun Bay | 1,308 | 1,442 | 1,083 | 959 | 819 |
| Las Gallinas[b] | San Pablo Bay | 135 | 122 | 103 | 135 | 150 |
| Millbrae | South Bay | 246 | 288 | 266 | 303 | 331.3 |
| Mt. View | Suisun Bay | 128 | 133 | 118 | 122 | 145 |
| Napa[b] | San Pablo Bay | 218 | 209 | 212 | 230 | 328 |
| Novato[b] | San Pablo Bay | 162 | 144 | 180 | 155 | 234 |
| Palo Alto | Lower South Bay | 2,402 | 2,220 | 2,268 | 2,549 | 2,790 |
| Paradise Cove | Central Bay | 2.1 | - | 1.9 | 2.4 | 2.1 |
| Petaluma[b] | San Pablo Bay | 40 | 35 | 51 | 30 | 34 |
| Pinole | San Pablo Bay | 347 | 319 | 315 | 338 | 387 |
| Rodeo | San Pablo Bay | 41 | 33 | 39 | 31 | 49 |
| San Jose | Lower South Bay | 5,185 | 5,004 | 5,752 | 5,280 | 5,934 |
| San Mateo | South Bay | 1,501 | 1,611 | 1,619 | 1,438 | 1,586 |
| SASM | Central Bay | 230 | 237 | 203 | 266 | 204 |
| SFO Airport | South Bay | 236 | 222 | 166 | 128 | 160 |
| SFPUC Southeast | South Bay | 8,258 | 9,944 | 10,733 | 10,166 | 9,939 |
| SMCSD | Central Bay | 143 | 138 | 140 | 154 | 156 |
| Sonoma Valley[b] | San Pablo Bay | 34 | 13 | 25 | 11 | 90 |
| South SF | South Bay | 1,176 | 1,134 | 1,129 | 1,117 | 1,270 |
| Sunnyvale | Lower South Bay | 1,060 | 754 | 868 | 670 | 911 |
| SVCW | South Bay | 2,113 | 2,237 | 2,123 | 2,591 | 2,577 |
| Tiburon | Central Bay | 61 | - | 70 | 71 | 53 |
| Treasure Island | Central Bay | 13 | 16 | 17 | 22 | 20 |
| Vallejo | San Pablo Bay | 836 | 925 | 1,145 | 1,142 | 1,230 |
| West County | Central Bay | 850 | 948 | 808 | 1,136 | 1,284 |
| | | | | | | |
| **Total [c]** | | **53,093** | **54,998** | **55,784** | **55,448** | **58,913** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

## Table 4-18. Dry Season Average Daily Discharges by Discharger, TN (kg N/d)

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 47 | 111 | 67 | 30 | 34 |
| Benicia | San Pablo Bay | 196 | 229 | 222 | 228 | 188 |
| Burlingame | South Bay | 370 | 422 | 295 | 368 | 285 |
| CCCSD | Suisun Bay | 3,851 | 3,975 | 3,852 | 3,843 | 3,980 |
| CMSA | Central Bay | 922 | 982 | 875 | 1,004 | 1,298 |
| Port Costa | San Pablo Bay | - | - | - | - | - |
| Delta Diablo | Suisun Bay | 1,649 | 1,352 | 1,308 | 971 | 1,255 |
| EBDA | South Bay | 7,611 | 7,796 | 8,024 | 8,381 | 8,171 |
| EBMUD | Central Bay | 9,862 | 10,428 | 10,263 | 9,908 | 10,484 |
| FSSD | Suisun Bay | 1,315 | 1,312 | 919 | 795 | 837 |
| Las Gallinas[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 7.3 |
| Millbrae | South Bay | 242 | 274 | 243 | 330 | 311 |
| Mt. View | Suisun Bay | 113 | 121 | 98 | 120 | 116 |
| Napa[b] | San Pablo Bay | 0.0 | 57 | 0.0 | 0.0 | 0.0 |
| Novato[b] | San Pablo Bay | 46 | 42 | 43 | 40 | 89 |
| Palo Alto | Lower South Bay | 2,567 | 2,281 | 2,242 | 2,371 | 2,614 |
| Paradise Cove | Central Bay | 2.2 | - | 1.6 | 2.4 | 2.8 |
| Petaluma[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pinole | San Pablo Bay | 421 | 331 | 304 | 359 | 322 |
| Rodeo | San Pablo Bay | 34 | 31 | 32 | 27 | 32 |
| San Jose | Lower South Bay | 4,473 | 4,382 | 5,196 | 5,105 | 4,753 |
| San Mateo | South Bay | 1,549 | 1,741 | 1,667 | 1,475 | 1,498 |
| SASM | Central Bay | 200 | 185 | 176 | 201 | 210 |
| SFO Airport | South Bay | 255 | 202 | 199 | 117 | 183 |
| SFPUC Southeast | South Bay | 8,550 | 9,709 | 10,835 | 10,250 | 10,682 |
| SMCSD | Central Bay | 146 | 144 | 143 | 163 | 174 |
| Sonoma Valley[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 5.5 |
| South SF | South Bay | 1,096 | 1,182 | 1,050 | 1,054 | 1,212 |
| Sunnyvale | Lower South Bay | 669 | 417 | 566 | 415 | 407 |
| SVCW | South Bay | 2,033 | 2,113 | 1,946 | 2,471 | 2,252 |
| Tiburon | Central Bay | 54 | - | 64 | 71 | 49 |
| Treasure Island | Central Bay | 11 | 13 | 17 | 27 | 19 |
| Vallejo | San Pablo Bay | 805 | 895 | 1,098 | 1,079 | 1,097 |
| West County | Central Bay | 766 | 758 | 749 | 1,004 | 1,132 |
| | | | | | | |
| **Total [c]** | | **49,855** | **51,485** | **52,495** | **52,209** | **53,700** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

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

### Table 4-19. Annual Average Daily Discharges by Subembayment, TN (kg N/d)

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|
| Suisun Bay | 7,323 | 7,141 | 6,774 | 6,487 | 6,734 |
| San Pablo Bay | 2,094 | 2,101 | 2,379 | 2,338 | 2,786 |
| Central Bay | 12,558 | 13,134 | 12,593 | 12,994 | 13,831 |
| South Bay | 22,471 | 24,644 | 25,150 | 25,130 | 25,927 |
| Lower South Bay | 8,647 | 7,978 | 8,888 | 8,499 | 9,635 |
| | | | | | |
| **Total** | **53,093** | **54,998** | **55,784** | **55,448** | **58,913** |

### Table 4-20. Dry Season Average Daily Discharges by Subembayment, TN (kg N/d)

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | Trend[a,b] |
|---|---|---|---|---|---|---|
| Suisun Bay | 6,928 | 6,760 | 6,177 | 5,729 | 6,188 | None |
| San Pablo Bay | 1,549 | 1,696 | 1,766 | 1,763 | 1,775 | Increasing (6% Change) |
| Central Bay | 11,963 | 12,510 | 12,289 | 12,380 | 13,369 | Increasing (8% Change) |
| South Bay | 21,706 | 23,439 | 24,259 | 24,446 | 24,594 | Increasing (6% Change) |
| Lower South Bay | 7,709 | 7,080 | 8,004 | 7,891 | 7,774 | None |
| | | | | | | |
| **Total** | **49,855** | **51,485** | **52,495** | **52,209** | **53,700** | **Increasing (5% Change)** |

a. 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 25. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.
b. The percent change represents the 2016/17 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The average monthly daily discharge TN loads since the 2012/13 season are presented in Figure 4-5. The 2016/2017 dry and average annual loads were the highest since nutrient sampling began in July 2012. The South Bay Subembayment accounts for over half of the load discharged to the San Francisco Bay (see Table 4-19). On a dry season basis, TN loads appear to be trending upwards for San Pablo Bay, Central Bay, and South Bay Subembayments based on the least squares correlation trend analysis. The overall Bay is showing an increase in TN discharge loads.

A discussion of the results is provided in Section 5.6.

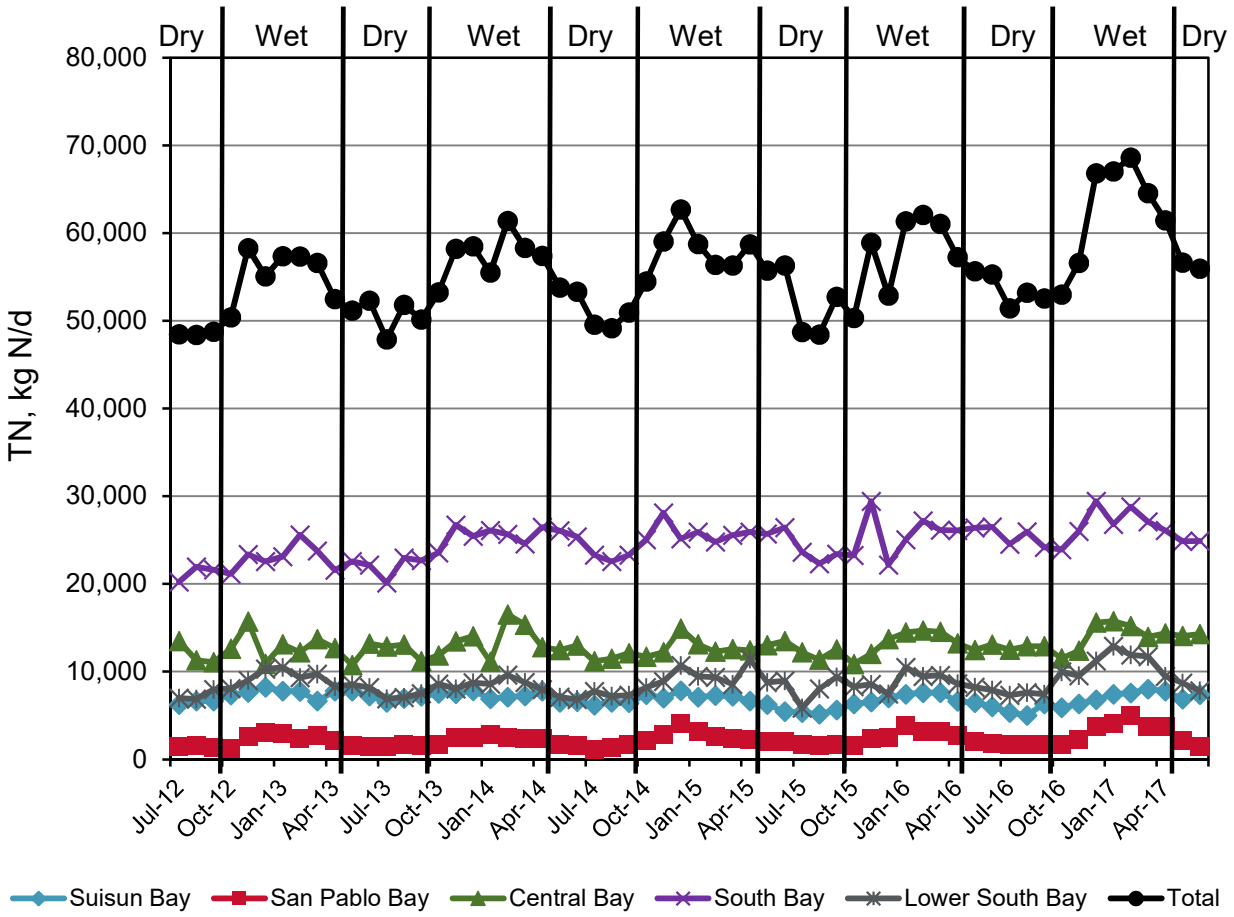


**Figure 4-5. Historical Average Monthly Daily Discharge TN Load Values**

## 4.7 Orthophosphate (Ortho-P)

The annual average and dry season average effluent ortho-P loads are presented in Table 4-21 and Table 4-22, respectively. The annual average and dry season effluent ortho-P loads discharge to each subembayment are presented in Table 4-23 and Table 4-24, respectively.

**Table 4-21. Annual Average Daily Discharges by Discharger, Ortho-P (kg P/d)**

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 23 | 34 | 25 | 27 | 23 |
| Benicia | San Pablo Bay | 22 | 25 | 21 | 13 | 18 |
| Burlingame | South Bay | 162 | 110 | 18 | 24 | 18 |
| CCCSD | Suisun Bay | 80 | 47 | 58 | 52 | 65 |
| CMSA | Central Bay | 138 | 109 | 84 | 76 | 86 |
| Port Costa | San Pablo Bay | - | - | - | 0.2 | 0.3 |
| Delta Diablo | Suisun Bay | 32 | 27 | 18 | 12 | 31 |
| EBDA | South Bay | 597 | 629 | 422 | 417 | 448 |
| EBMUD | Central Bay | 944 | 805 | 501 | 501 | 342 |
| FSSD | Suisun Bay | 224 | 321 | 185 | 194 | 184 |
| Las Gallinas[b] | San Pablo Bay | 18 | 26 | 15 | 21 | 18 |
| Millbrae | South Bay | 21 | 18 | 6.0 | 6.8 | 4.6 |
| Mt. View | Suisun Bay | 17 | 15 | 15 | 14 | 15 |
| Napa[b] | San Pablo Bay | 24 | 7.6 | 8.2 | 19 | 47 |
| Novato[b] | San Pablo Bay | 26 | 14 | 18 | 6.8 | 6.0 |
| Palo Alto | Lower South Bay | 342 | 333 | 342 | 403 | 413 |
| Paradise Cove | Central Bay | 0.3 | - | 0.3 | 0.3 | 0.2 |
| Petaluma[b] | San Pablo Bay | 28 | 31 | 24 | 19 | 25 |
| Pinole | San Pablo Bay | 48 | 30 | 12 | 17 | 18 |
| Rodeo | San Pablo Bay | 15 | 9.6 | 7.5 | 8.0 | 10 |
| San Jose | Lower South Bay | 374 | 276 | 280 | 289 | 376 |
| San Mateo | South Bay | 159 | 219 | 134 | 119 | 102 |
| SASM | Central Bay | 72 | 92 | 36 | 35 | 34 |
| SFO Airport | South Bay | 14 | 21 | 5.7 | 9.3 | 7.2 |
| SFPUC Southeast | South Bay | 340 | 313 | 197 | 233 | 299 |
| SMCSD | Central Bay | 38 | 37 | 15 | 15 | 16 |
| Sonoma Valley[b] | San Pablo Bay | 16 | 10 | 3.0 | 2.4 | 20 |
| South SF | South Bay | 189 | 219 | 110 | 115 | 84 |
| Sunnyvale | Lower South Bay | 200 | 172 | 215 | 177 | 201 |
| SVCW | South Bay | 259 | 316 | 164 | 238 | 200 |
| Tiburon | Central Bay | 8.8 | - | 7.1 | 7.2 | 10 |
| Treasure Island | Central Bay | 3.6 | 3.7 | 4.1 | 4.1 | 4.3 |
| Vallejo | San Pablo Bay | 106 | 108 | 87 | 90 | 84 |
| West County | Central Bay | 82 | 86 | 32 | 47 | 77 |
| | | | | | | |
| **Total** [c] | | **4,623** | **4,464** | **3,071** | **3,212** | **3,287** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

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

## Table 4-22. Dry Season Average Daily Discharges by Discharger, Ortho-P (kg P/d)

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 24 | 62 | 23 | 23 | 13 |
| Benicia | San Pablo Bay | 20 | 24 | 18 | 16 | 12 |
| Burlingame | South Bay | 160 | 96 | 20 | 25 | 14 |
| CCCSD | Suisun Bay | 90 | 61 | 49 | 57 | 57 |
| CMSA | Central Bay | 126 | 111 | 85 | 80 | 101 |
| Port Costa | San Pablo Bay | - | - | - | - | - |
| Delta Diablo | Suisun Bay | 30 | 33 | 12 | 8.1 | 26 |
| EBDA | South Bay | 503 | 559 | 450 | 415 | 424 |
| EBMUD | Central Bay | 692 | 601 | 435 | 370 | 481 |
| FSSD | Suisun Bay | 246 | 335 | 163 | 165 | 186 |
| Las Gallinas[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 |
| Millbrae | South Bay | 23 | 21 | 7.9 | 8.3 | 7.8 |
| Mt. View | Suisun Bay | 17 | 16 | 18 | 16 | 14 |
| Napa[b] | San Pablo Bay | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 |
| Novato[b] | San Pablo Bay | 1.9 | 1.4 | 0 | 0.4 | 0.3 |
| Palo Alto | Lower South Bay | 383 | 350 | 378 | 396 | 422 |
| Paradise Cove | Central Bay | 0.4 | - | 0.2 | 0.3 | 0.2 |
| Petaluma[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pinole | San Pablo Bay | 52 | 38 | 12 | 22 | 20 |
| Rodeo | San Pablo Bay | 16 | 6.6 | 9.3 | 8.3 | 6.8 |
| San Jose | Lower South Bay | 121 | 215 | 214 | 315 | 286 |
| San Mateo | South Bay | 130 | 230 | 122 | 128 | 112 |
| SASM | Central Bay | 73 | 89 | 37 | 34 | 35 |
| SFO Airport | South Bay | 15 | 27 | 8.0 | 7.0 | 4.0 |
| SFPUC Southeast | South Bay | 387 | 400 | 212 | 250 | 315 |
| SMCSD | Central Bay | 48 | 50 | 18 | 17 | 17 |
| Sonoma Valley[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 |
| South SF | South Bay | 218 | 217 | 112 | 122 | 106 |
| Sunnyvale | Lower South Bay | 202 | 133 | 208 | 164 | 162 |
| SVCW | South Bay | 323 | 381 | 168 | 274 | 224 |
| Tiburon | Central Bay | 7.3 | - | 7.3 | 7.2 | 13 |
| Treasure Island | Central Bay | 3.7 | 3.6 | 4.5 | 4.1 | 4.2 |
| Vallejo | San Pablo Bay | 108 | 104 | 104 | 99 | 87 |
| West County | Central Bay | 83 | 61 | 29 | 49 | 69 |
| | | | | | | |
| **Total [c]** | | **4,104** | **4,227** | **2,923** | **3,081** | **3,220** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

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

**Table 4-23. Annual Average Daily Discharges by Subembayment, Ortho-P (kg P/d)**

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|
| Suisun Bay | 353 | 410 | 276 | 272 | 295 |
| San Pablo Bay | 326 | 295 | 221 | 223 | 269 |
| Central Bay | 1,287 | 1,133 | 680 | 686 | 570 |
| South Bay | 1,741 | 1,845 | 1,057 | 1,162 | 1,163 |
| Lower South Bay | 916 | 781 | 837 | 869 | 990 |
| | | | | | |
| **Total** | **4,623** | **4,464** | **3,071** | **3,212** | **3,287** |

**Table 4-24. Dry Season Average Daily Discharges by Subembayment, Ortho-P (kg P/d) [a]**

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|
| Suisun Bay | 384 | 445 | 242 | 246 | 283 |
| San Pablo Bay | 222 | 237 | 166 | 169 | 141 |
| Central Bay | 1,033 | 916 | 616 | 562 | 720 |
| South Bay | 1,759 | 1,931 | 1,099 | 1,229 | 1,206 |
| Lower South Bay | 706 | 698 | 800 | 875 | 870 |
| | | | | | |
| **Total** | **4,104** | **4,227** | **2,923** | **3,081** | **3,220** |

a. Trending for Ortho-P was not performed due to the different data sources between the Section 13267 Letter data and the Nutrient Watershed Permit. More details on these discrepancies are provided in Section 5.7.

The average monthly daily discharge Ortho-P loads since the 2012/13 season are presented in Figure 4-6. The dry season ortho-P loads discharged to the Bay generally appear to exhibit a decreasing trend which may be attributed to different two different sampling requirements under the Section 13267 Letter and the Nutrient Watershed Permit.

A discussion of the results is provided in Section 5.7.

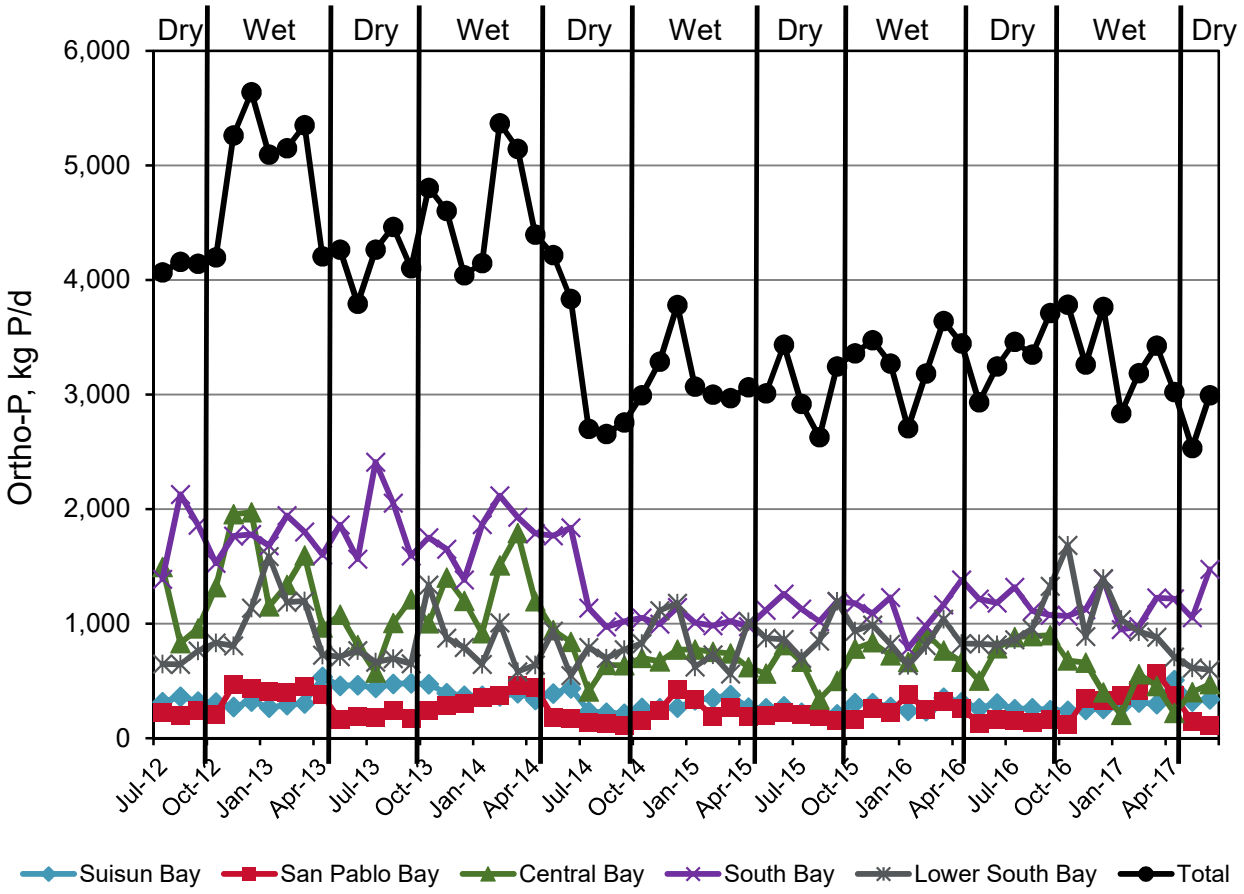


**Figure 4-6. Historical Average Monthly Daily Discharge Ortho-P Load Values**

## 4.8 Total Phosphorus (TP)

The annual average and dry season average effluent TP loads are presented in Table 4-25 and Table 4-26, respectively. The annual average and dry season effluent TP load discharged by subembayment is presented in Table 4-27 and Table 4-28, respectively.

**Table 4-25. Annual Average Daily Discharges by Discharger, TP (kg P/d)**

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 26 | 26 | 24 | 31 | 23 |
| Benicia | San Pablo Bay | 26 | 26 | 28 | 14 | 20 |
| Burlingame | South Bay | 81 | 140 | 22 | 26 | 29 |
| CCCSD | Suisun Bay | 139 | 96 | 125 | 107 | 124 |
| CMSA | Central Bay | 89 | 88 | 93 | 83 | 95 |
| Port Costa | San Pablo Bay | - | - | - | 0.6 | 0.5 |
| Delta Diablo | Suisun Bay | 33 | 28 | 36 | 29 | 45 |
| EBDA | South Bay | 539 | 539 | 517 | 524 | 644 |
| EBMUD | Central Bay | 933 | 800 | 769 | 735 | 564 |
| FSSD | Suisun Bay | 195 | 203 | 197 | 198 | 179 |
| Las Gallinas[b] | San Pablo Bay | 20 | 17 | 15 | 23 | 22 |
| Millbrae | South Bay | 16 | 16 | 12 | 13 | 11 |
| Mt. View | Suisun Bay | 18 | 17 | 17 | 15 | 15 |
| Napa[b] | San Pablo Bay | 23 | 14 | 25 | 35 | 59 |
| Novato[b] | San Pablo Bay | 16 | 11 | 21 | 9.6 | 13 |
| Palo Alto | Lower South Bay | 349 | 346 | 357 | 429 | 429 |
| Paradise Cove | Central Bay | 0.3 | - | 0.3 | 0.3 | 0.4 |
| Petaluma[b] | San Pablo Bay | 28 | 31 | 25 | 19 | 25 |
| Pinole | San Pablo Bay | 34 | 19 | 14 | 17 | 23 |
| Rodeo | San Pablo Bay | 9.3 | 7.1 | 7.7 | 8.5 | 9.3 |
| San Jose | Lower South Bay | 326 | 261 | 306 | 351 | 412 |
| San Mateo | South Bay | 124 | 128 | 122 | 139 | 126 |
| SASM | Central Bay | 41 | 49 | 42 | 51 | 39 |
| SFO Airport | South Bay | 15 | 17 | 8.6 | 11 | 10 |
| SFPUC Southeast | South Bay | 100 | 134 | 172 | 257 | 329 |
| SMCSD | Central Bay | 23 | 20 | 17 | 17 | 16 |
| Sonoma Valley[b] | San Pablo Bay | 16 | 10 | 2.8 | 2.5 | 22 |
| South SF | South Bay | 154 | 155 | 169 | 150 | 140 |
| Sunnyvale | Lower South Bay | 214 | 202 | 225 | 191 | 223 |
| SVCW | South Bay | 172 | 177 | 176 | 249 | 218 |
| Tiburon | Central Bay | 8.2 | - | 8.3 | 8.7 | 8.6 |
| Treasure Island | Central Bay | 1.9 | 2.6 | 3.3 | 4.0 | 4.3 |
| Vallejo | San Pablo Bay | 128 | 130 | 121 | 129 | 138 |
| West County | Central Bay | 57 | 62 | 41 | 62 | 91 |
| | | | | | | |
| **Total [c]** | | **3,954** | **3,772** | **3,720** | **3,939** | **4,107** |

a. Data is presented in detail and summarized for each plant in the Appendix.
b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.
c. The total values might vary from the sum of the listed values by plant due to rounding.

## Table 4-26. Dry Season Average Daily Discharges by Discharger, TP (kg P/d)

| Discharger | Subembayment | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] |
|---|---|---|---|---|---|---|
| American Canyon | San Pablo Bay | 26 | 47 | 17 | 25 | 11 |
| Benicia | San Pablo Bay | 27 | 25 | 24 | 15 | 18 |
| Burlingame | South Bay | 76 | 103 | 23 | 24 | 18 |
| CCCSD | Suisun Bay | 141 | 110 | 107 | 103 | 100 |
| CMSA | Central Bay | 92 | 94 | 86 | 85 | 102 |
| Port Costa | San Pablo Bay | - | - | - | - | - |
| Delta Diablo | Suisun Bay | 32 | 28 | 27 | 27 | 36 |
| EBDA | South Bay | 477 | 505 | 519 | 482 | 539 |
| EBMUD | Central Bay | 885 | 610 | 698 | 590 | 704 |
| FSSD | Suisun Bay | 202 | 204 | 169 | 171.8 | 186 |
| Las Gallinas[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 |
| Millbrae | South Bay | 17 | 19 | 12 | 14.8 | 13 |
| Mt. View | Suisun Bay | 18 | 18 | 19 | 17 | 15 |
| Napa[b] | San Pablo Bay | 0.0 | 3.8 | 0.0 | 0.0 | 0.0 |
| Novato[b] | San Pablo Bay | 1.1 | 1.6 | 0.8 | 1.2 | 1.7 |
| Palo Alto | Lower South Bay | 393 | 366 | 410 | 410 | 432 |
| Paradise Cove | Central Bay | 0.3 | - | 0.2 | 0.3 | 0.4 |
| Petaluma[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pinole | San Pablo Bay | 40 | 23 | 17 | 18 | 18 |
| Rodeo | San Pablo Bay | 9.2 | 5.6 | 8.6 | 9.0 | 7.6 |
| San Jose | Lower South Bay | 119 | 233 | 229 | 357 | 326 |
| San Mateo | South Bay | 117 | 137 | 130 | 132 | 131 |
| SASM | Central Bay | 40 | 51 | 44 | 40 | 43 |
| SFO Airport | South Bay | 19 | 18 | 7.8 | 8.4 | 7.7 |
| SFPUC Southeast | South Bay | 103 | 112 | 183 | 289 | 388 |
| SMCSD | Central Bay | 24 | 23 | 19 | 18 | 19 |
| Sonoma Valley[b] | San Pablo Bay | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 |
| South SF | South Bay | 156 | 158 | 158 | 162 | 157 |
| Sunnyvale | Lower South Bay | 214 | 155 | 207 | 167 | 173 |
| SVCW | South Bay | 181 | 173 | 181 | 276 | 212 |
| Tiburon | Central Bay | 7.8 | - | 8.1 | 8.7 | 8.2 |
| Treasure Island | Central Bay | 2.0 | 1.9 | 3.1 | 4.3 | 4.3 |
| Vallejo | San Pablo Bay | 130 | 126 | 127 | 134 | 118 |
| West County | Central Bay | 54 | 45 | 32 | 61 | 78 |
| | | | | | | |
| **Total [c]** | | **3,603** | **3,396** | **3,448** | **3,650** | **3,869** |

a. Data is presented in detail and summarized for each plant in the Appendix. A "-" indicates data was not available, whereas a "0" indicates a value of zero.

b. No discharge during a portion or all of the dry season months, except with authorization under emergency conditions.

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

**Table 4-27. Annual Average Daily Discharges by Subembayment, TP (kg P/d)**

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|---|---|
| Suisun Bay | 385 | 344 | 375 | 349 | 363 |
| San Pablo Bay | 326 | 291 | 284 | 289 | 355 |
| Central Bay | 1,153 | 1,022 | 974 | 961 | 818 |
| South Bay | 1,201 | 1,306 | 1,199 | 1,369 | 1,507 |
| Lower South Bay | 889 | 809 | 888 | 971 | 1,064 |
| | | | | | |
| **Total** | **3,954** | **3,772** | **3,720** | **3,939** | **4,107** |

**Table 4-28. Dry Season Average Daily Discharges by Subembayment, TP (kg P/d)**

| Subembayment | 2012/13 | 2013/14 | 2014/15 | 2015/16 | 2016/17 | Trend(a,b) |
|---|---|---|---|---|---|---|
| Suisun Bay | 393 | 360 | 322 | 319 | 337 | None |
| San Pablo Bay | 233 | 232 | 194 | 202 | 176 | None |
| Central Bay | 1,105 | 825 | 890 | 807 | 959 | None |
| South Bay | 1,146 | 1,225 | 1,214 | 1,388 | 1,466 | Increasing (18% Change) |
| Lower South Bay | 726 | 754 | 828 | 934 | 931 | Increasing (17% Change) |
| | | | | | | |
| **Total** | **3,603** | **3,396** | **3,448** | **3,650** | **3,869** | **None** |

a. 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 25. Where "None" is stated, the limited dataset does not indicate a statistically relevant trend.
b. The percent change represents the 2016/17 value in comparison to the average of the initial three years of data (2012/2013 through 2014/2015).

The average monthly daily discharge Ortho-P loads since the 2012/13 season are presented in Figure 4-7. The 2016/2017 average annual TP loads were the second highest since nutrient sampling began in July 2012. The 2016/2017 dry season TP loads were the highest since nutrient sampling began in July 2012. The South Bay Subembayment received is the largest TP load and accounts for approximately one-third of the TP load discharged to the San Francisco Bay (see Table 4-27).

The dry season TP loads discharged to the Bay exhibit a decreasing trend for Suisun Bay and an increasing trend for the South Bay and Lower South Bay based on the least squares correlation test selected as the basis for trends analysis. There is no statistically significant trend for the San Francisco Bay.

The reported ortho-P values were greater than TP values in several cases (compare values in Table 4-21 and Table 4-25 for specific plants.). It is especially pronounced for certain plants, such as the SFPUC Southeast Plant, who communicated this issue with the Regional Water Board in the summer of 2015. This issue is attributed to a combination of sampling methodology (composite versus grab) and the analytical methodology for measuring phosphorus, which suffers from matrix

issues.[4] The issue has since been resolved by using a different analytical technique (Inductively Coupled Plasma – Atomic Emission Spectroscopy) and is not expected to be an issue in the future.

A discussion of the results is provided in Section 5.8.

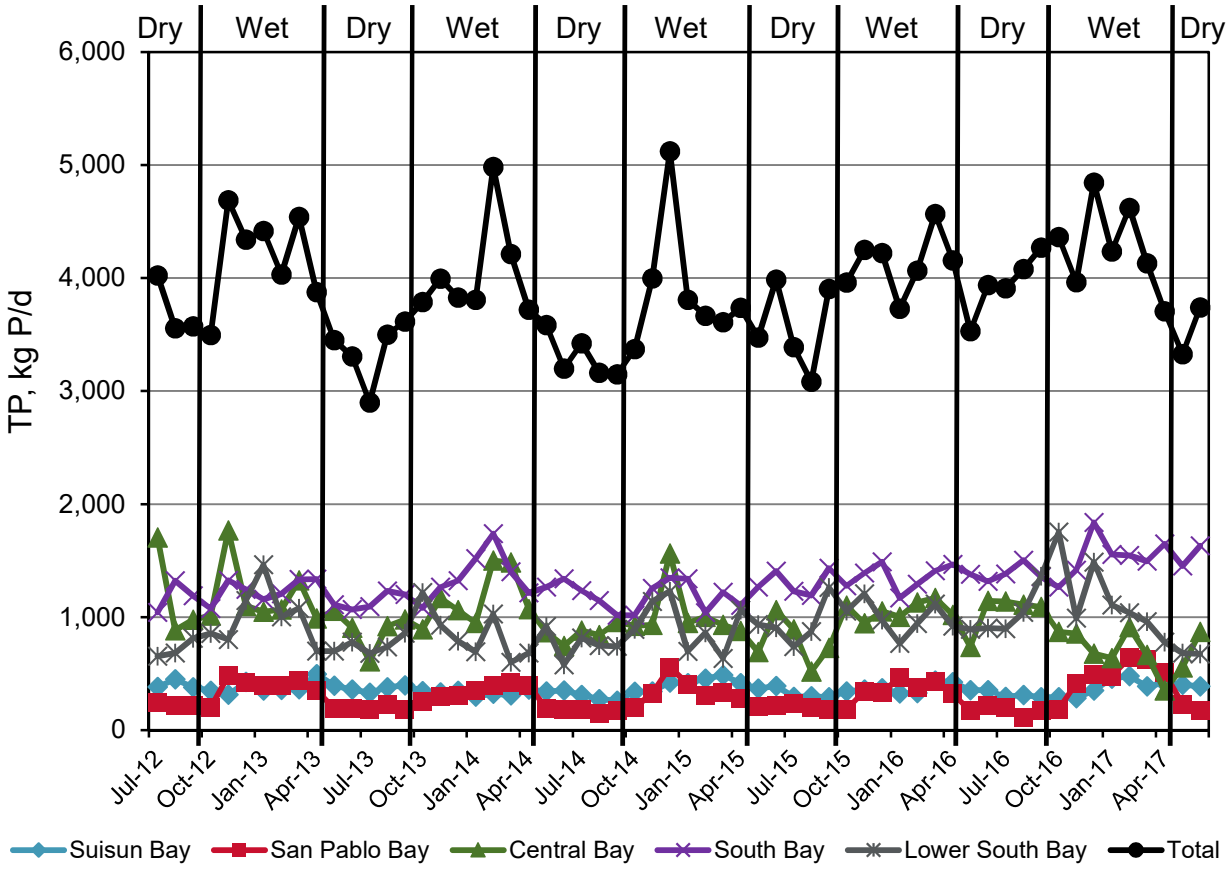


**Figure 4-7. Historical Average Monthly Daily Discharge TP Load Values**

## 4.9 Subembayment Nutrient Loading

Nutrient effluent loading for select nitrogen and phosphorus species 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 five years.

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, total nitrogen and total phosphorus.

[4] Neal, C.; Neal, M; and Wickham, H. (2000) Phosphate measurement in natural waters: two examples of analytical problems associated with silica interference using phosphomolybdic acid methodologies. Science of the Total Environment, 251-252:511-522. Also Eleuterio, L. and Neethling, J.B., "Low Phosphorus Analytical Measurement Study" WERF Nutrient Removal Challenge Report NUTR1R06F, 2009.

### 4.9.1 Suisun Bay

The average monthly discharge to Suisun Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-8, Figure 4-9, Figure 4-10, and Figure 4-11, respectively. 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 total nitrogen. FSSD discharges the largest phosphorus load to Suisun Bay, followed by CCCSD.

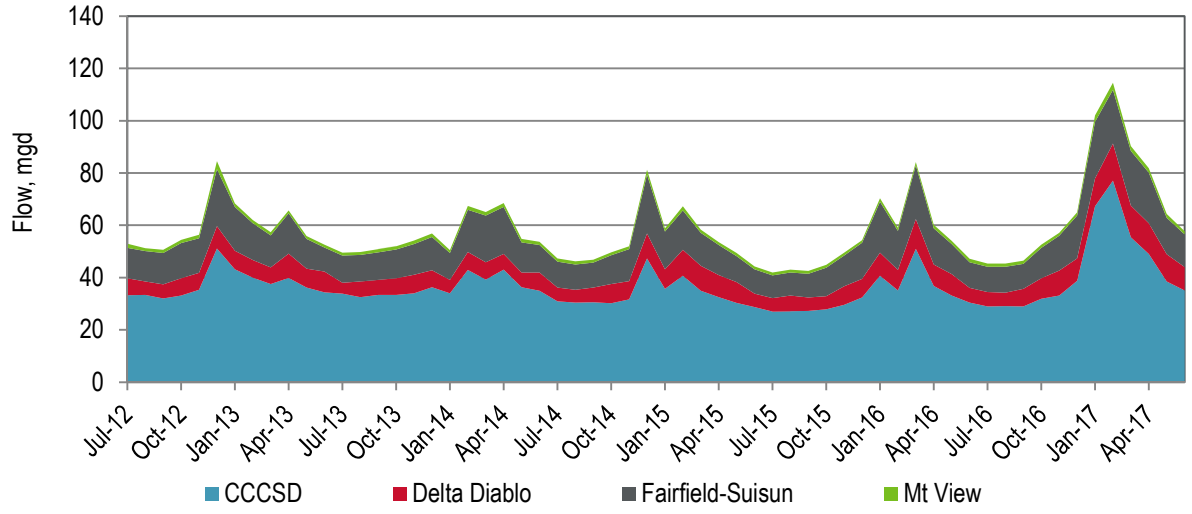


**Figure 4-8. Flow Contribution by Discharger to Suisun Bay**

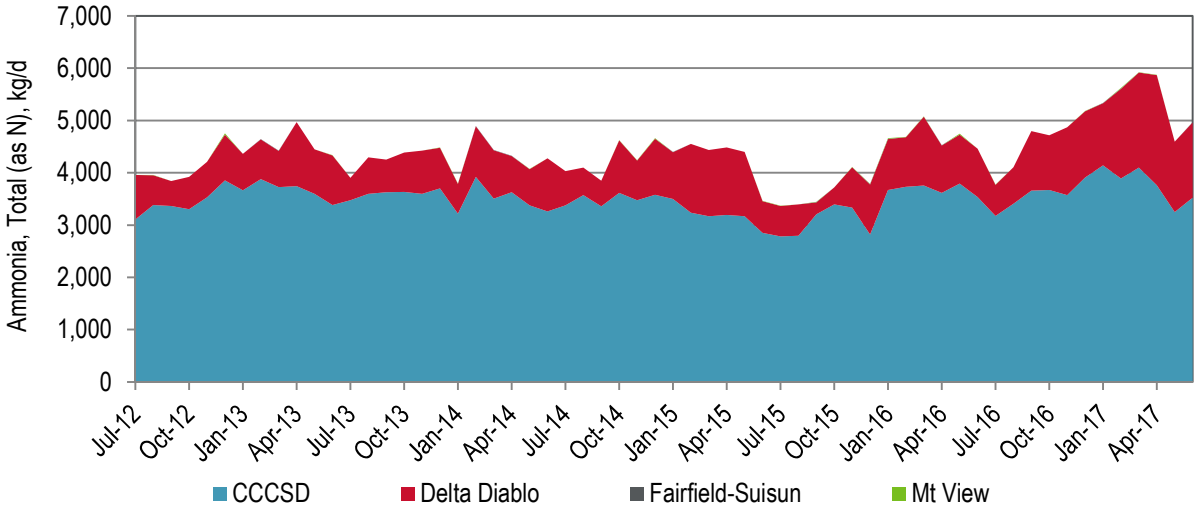


**Figure 4-9. Ammonia Load Contribution by Discharger to Suisun Bay**

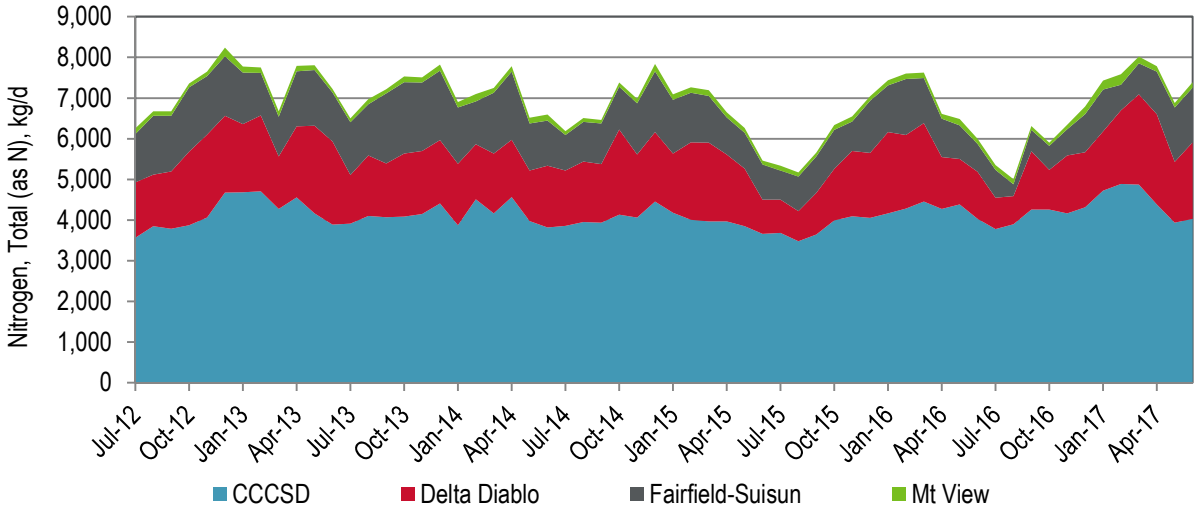


**Figure 4-10. Total Nitrogen Load Contribution by Discharger to Suisun Bay**

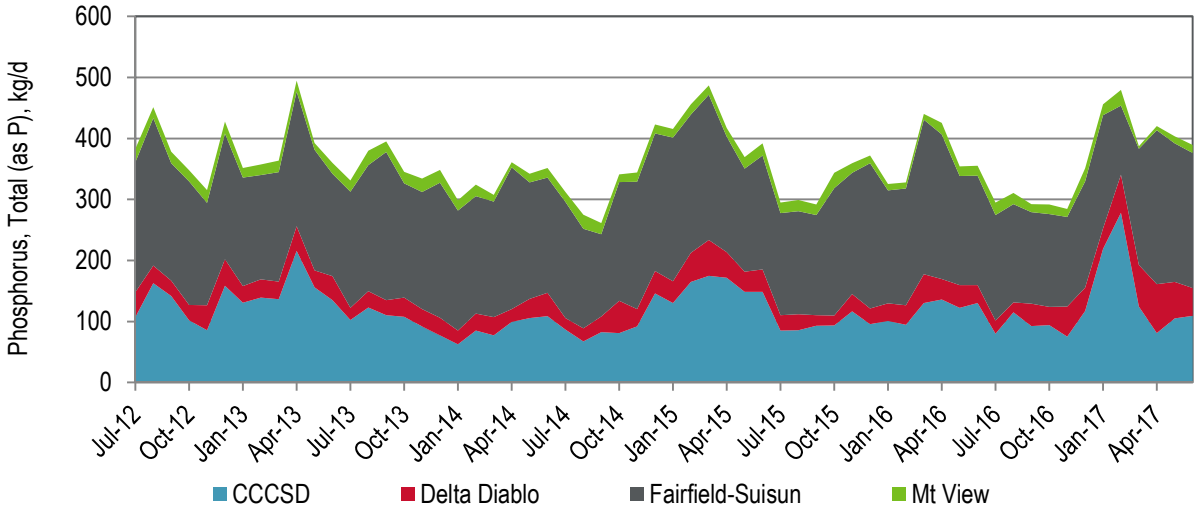


**Figure 4-11. Total Phosphorus Load Contribution by Discharger to Suisun Bay**

### 4.9.2 San Pablo Bay

The average monthly discharge to San Pablo Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-12, Figure 4-13, Figure 4-14, and Figure 4-15, respectively. Figure 4-12 clearly demonstrates the seasonal discharges at Sonoma Valley, Napa, Las Gallinas, and Petaluma. The relative ammonia load contribution from Vallejo increased over the past few years. Similar to flow, total nitrogen and total phosphorus loads to San Pablo Bay appear to exhibit a significant seasonal pattern with higher wintertime loads.

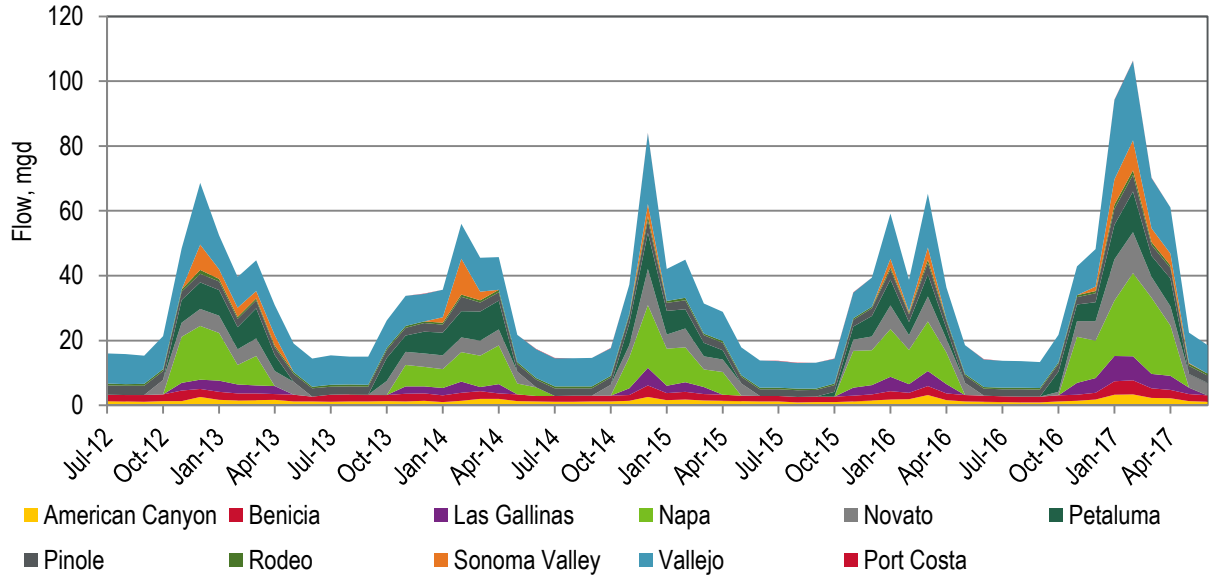


**Figure 4-12. Flow Contribution by Discharger to San Pablo Bay**

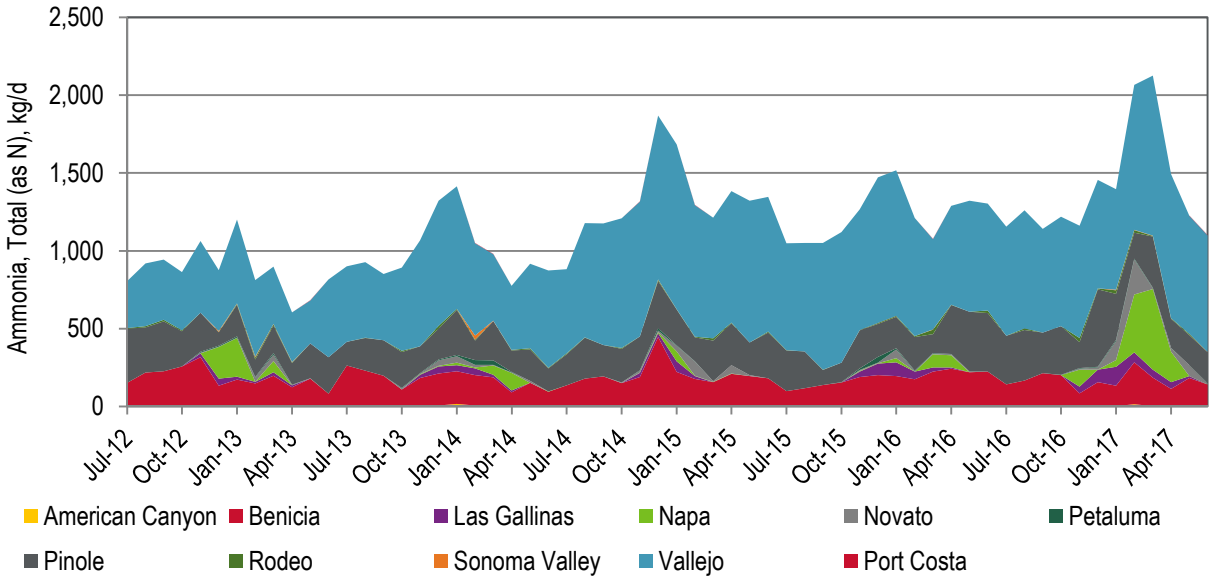


**Figure 4-13. Ammonia Load Contribution by Discharger to San Pablo Bay**

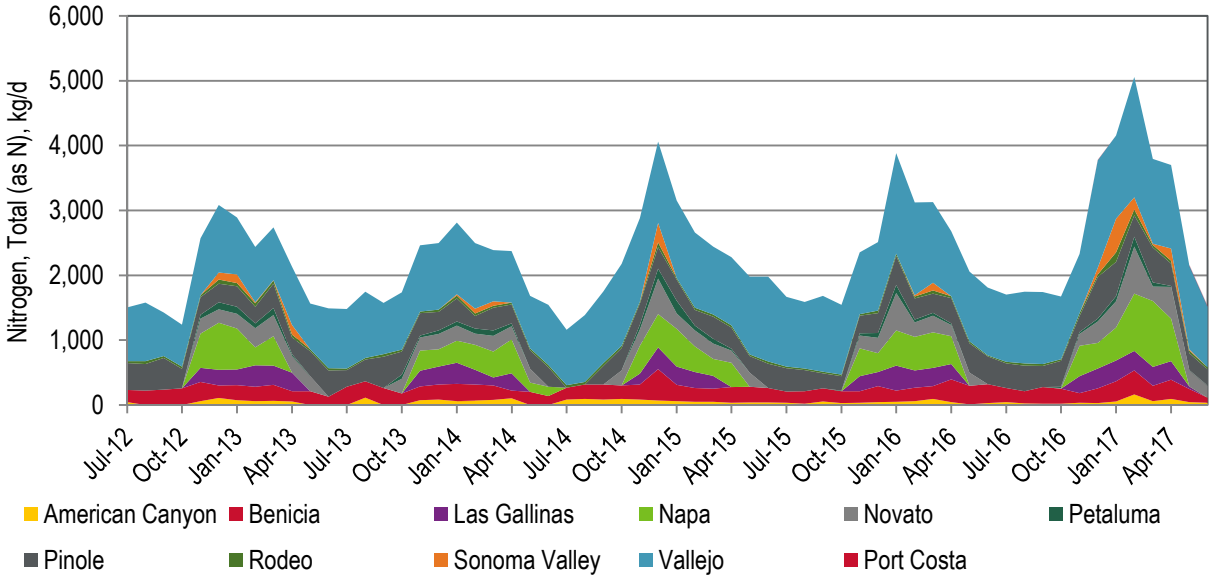


**Figure 4-14. Total Nitrogen Load Contribution by Discharger to San Pablo Bay**

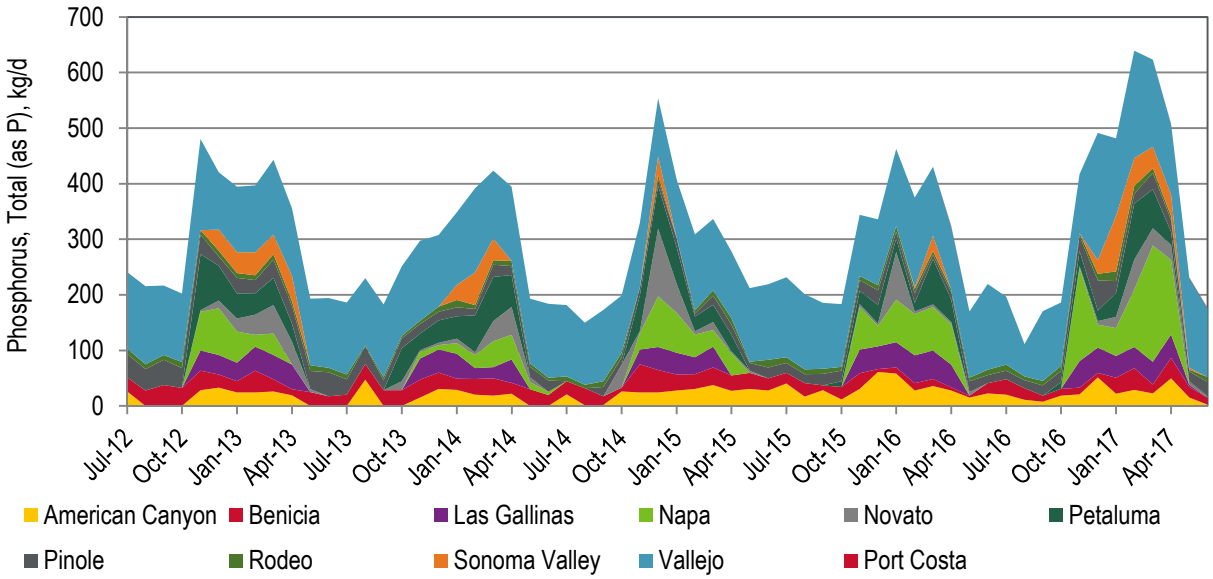


**Figure 4-15. Total Phosphorus Load Contribution by Discharger to San Pablo Bay**

### 4.9.3 Central Bay

The average monthly discharge to Central Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-16, Figure 4-17, Figure 4-18, and Figure 4-19, respectively. Discharge flows and loads to the Central Bay are dominated by EBMUD.

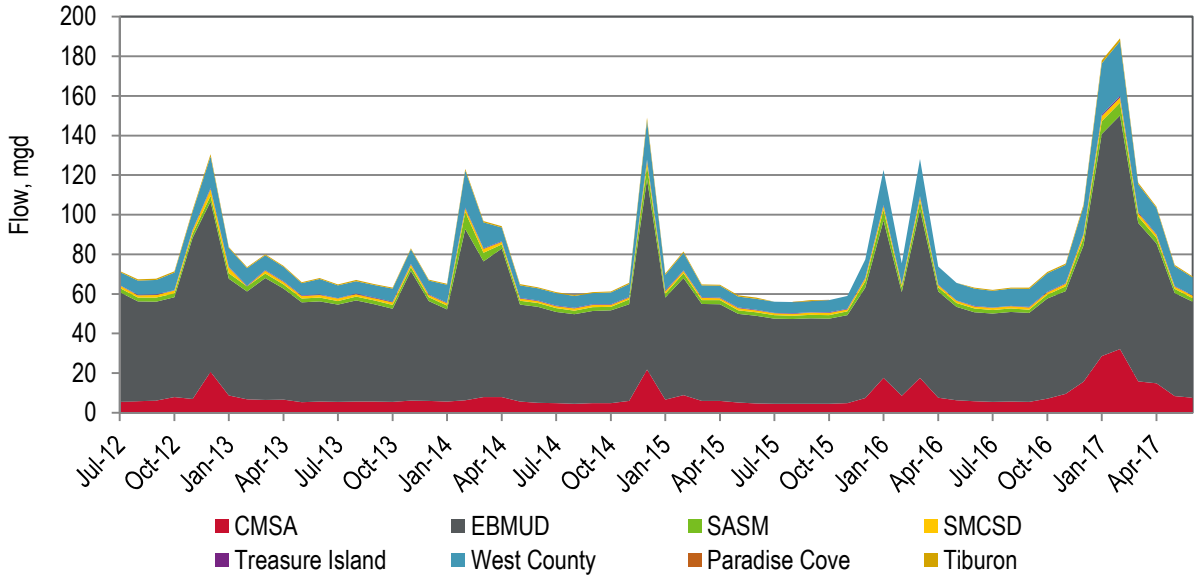


**Figure 4-16. Flow Contribution by Discharger to Central Bay**

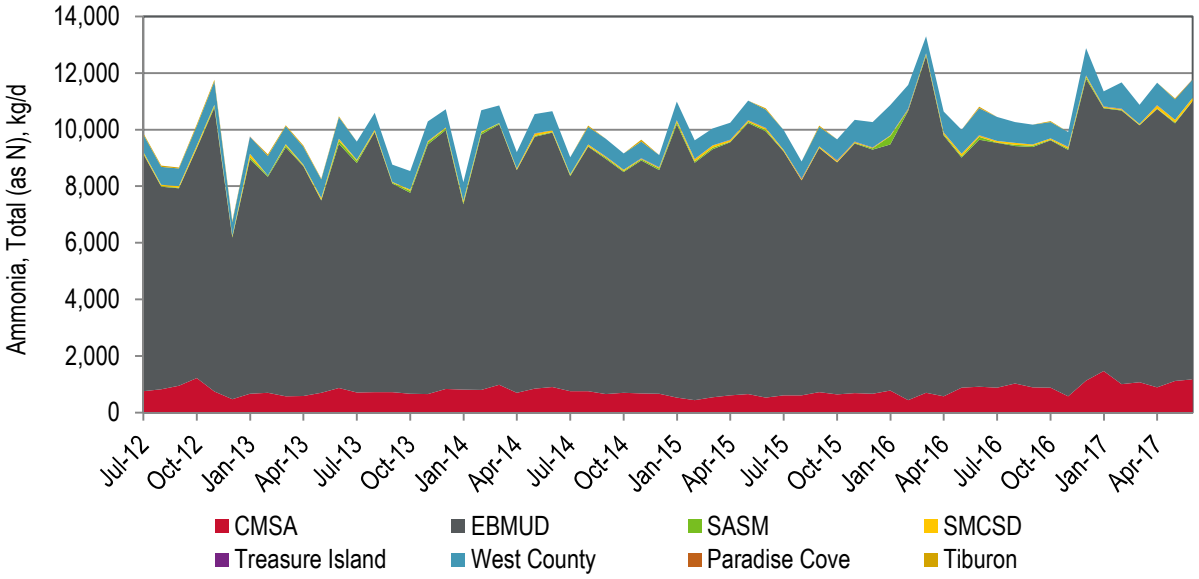


**Figure 4-17. Ammonia Load Contribution by Discharger to Central Bay**

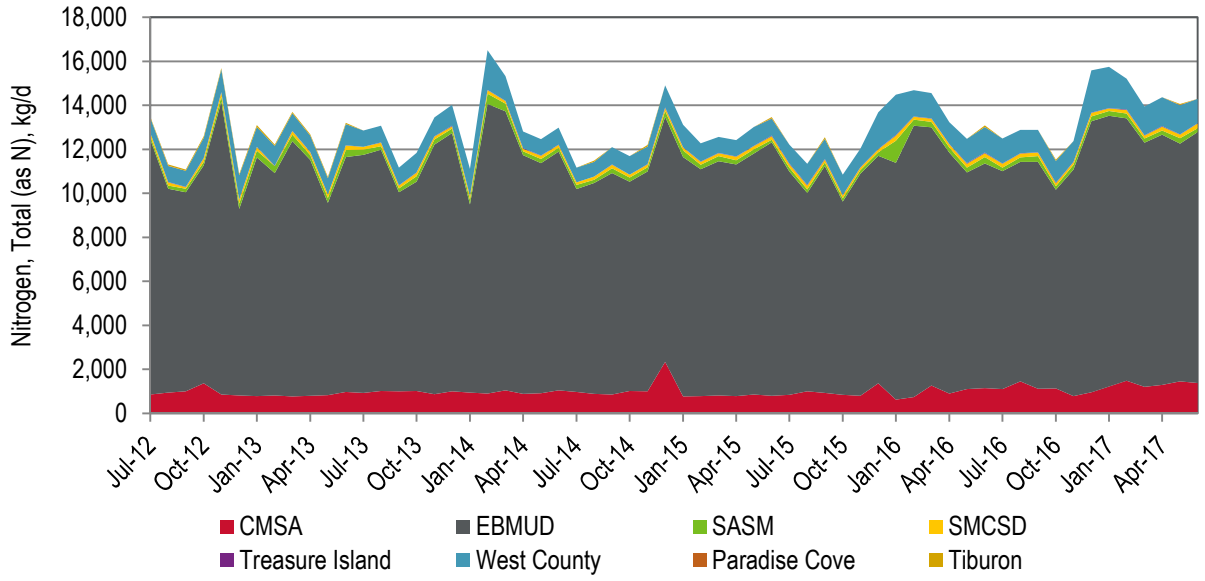


**Figure 4-18. Total Nitrogen Load Contribution by Discharger to Central Bay**

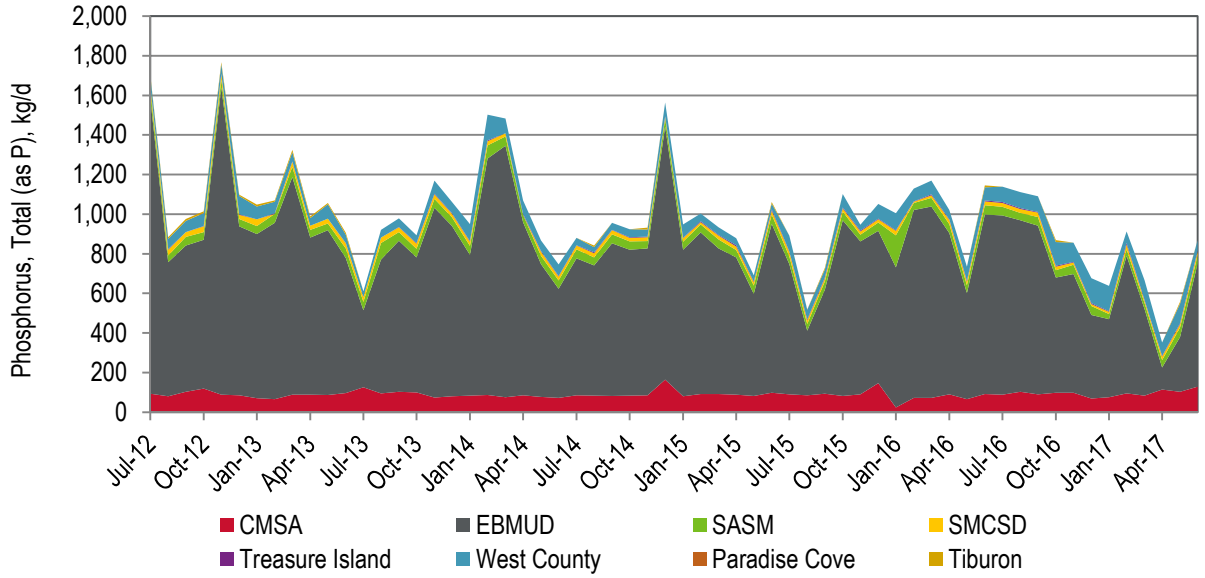


**Figure 4-19. Total Phosphorus Load Contribution by Discharger to Central Bay**

### 4.9.4 South Bay

The average monthly discharge to the South Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-20, Figure 4-21, Figure 4-22, and Figure 4-23, respectively. In the South Bay, the largest wastewater discharges are from the SFPUC Southeast Plant and EBDA. Ammonia and total nitrogen loads to the South Bay are also largest from the SFPUC Southeast Plant and EBDA. The total phosphorus discharges to the South Bay are more evenly distributed between EBDA, SFPUC Southeast Plant, San Mateo, and SVCW. SFPUC's total phosphorus loads are a lower proportion of the total compared to flow, ammonia, and total nitrogen.

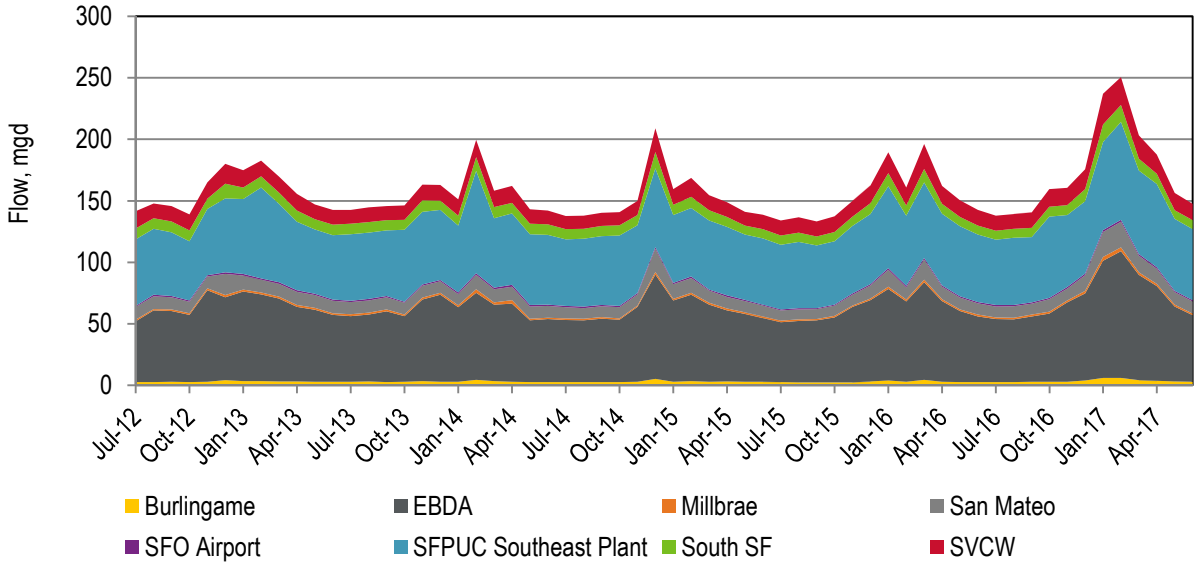


**Figure 4-20. Flow Contribution by Discharger to South Bay**

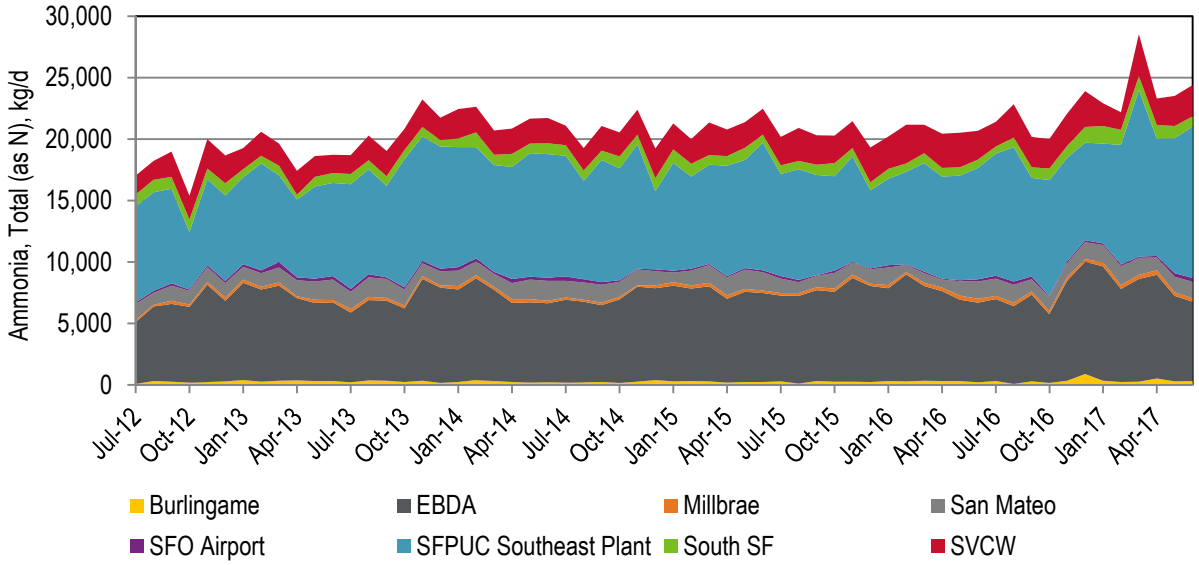


**Figure 4-21. Ammonia Load Contribution by Discharger to South Bay**

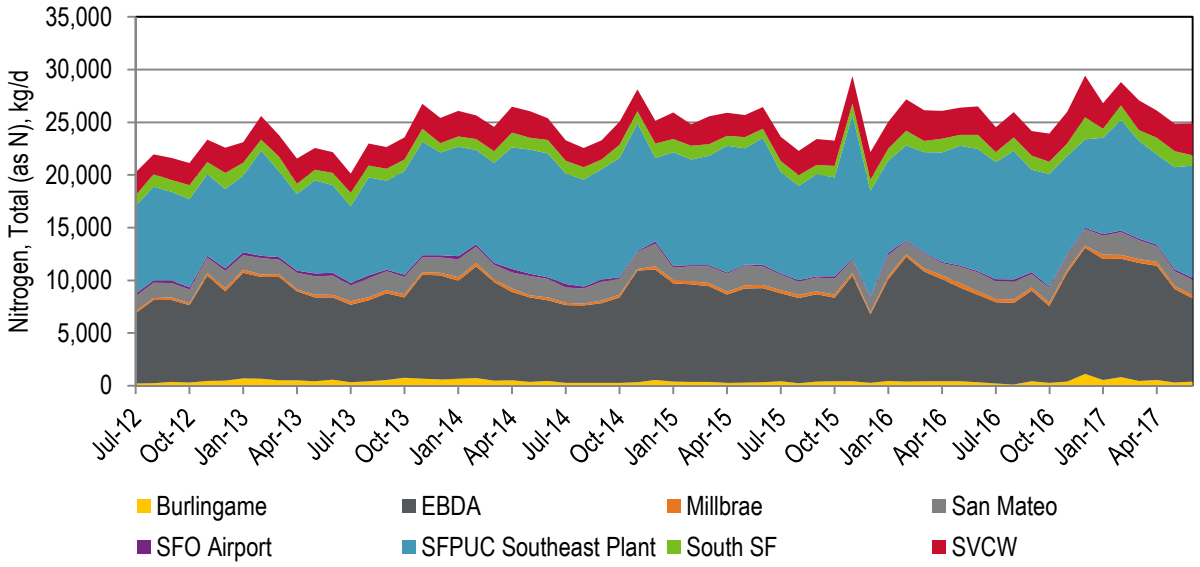


**Figure 4-22. Total Nitrogen Load Contribution by Discharger to South Bay**

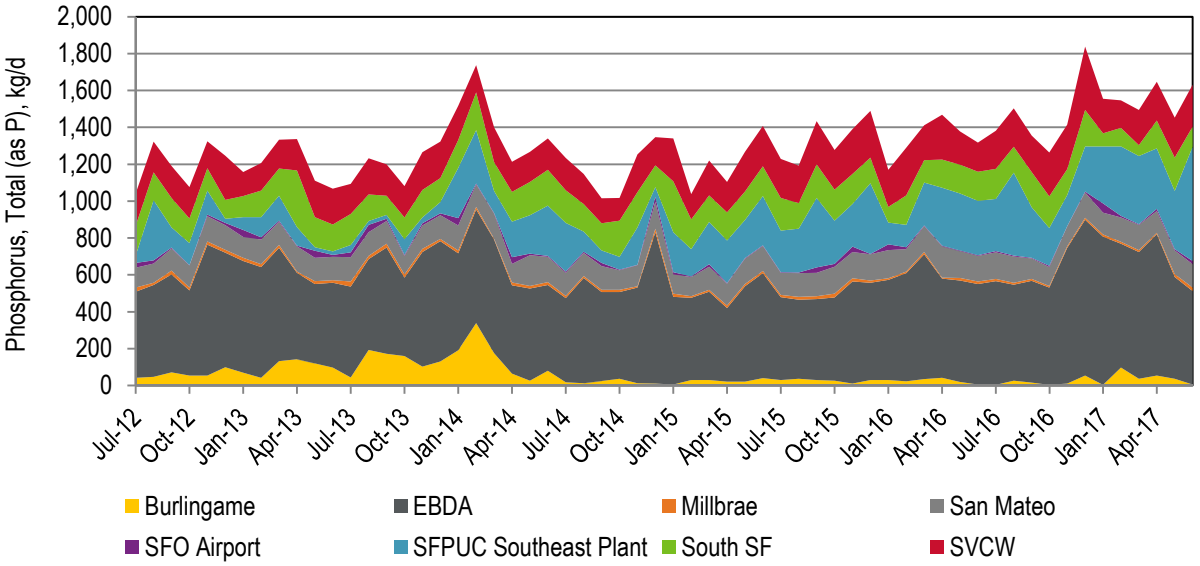


**Figure 4-23. Total Phosphorus Load Contribution by Discharger to South Bay**

### 4.9.5 Lower South Bay

The average monthly discharge to Lower South Bay by discharger for flow, ammonia, TN and TP is provided in Figure 4-24, Figure 4-25, Figure 4-26, and Figure 4-27, respectively. Lower South Bay wastewater flows are dominated by San Jose. San Jose also discharges the largest total nitrogen load. Sunnyvale and San Jose's ammonia loads exhibit a significant seasonal pattern. San Jose's total nitrogen loads are sporadic (e.g., July 2015), which is likely attributed to the biological nitrogen removal step feed process.

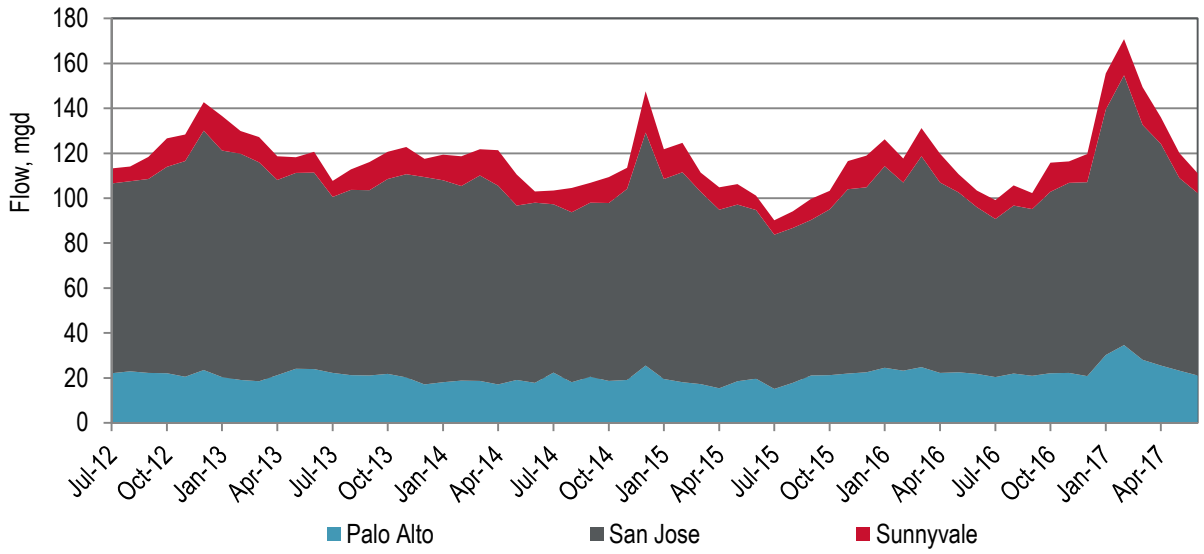


**Figure 4-24. Flow Contribution by Discharger to Lower South Bay**

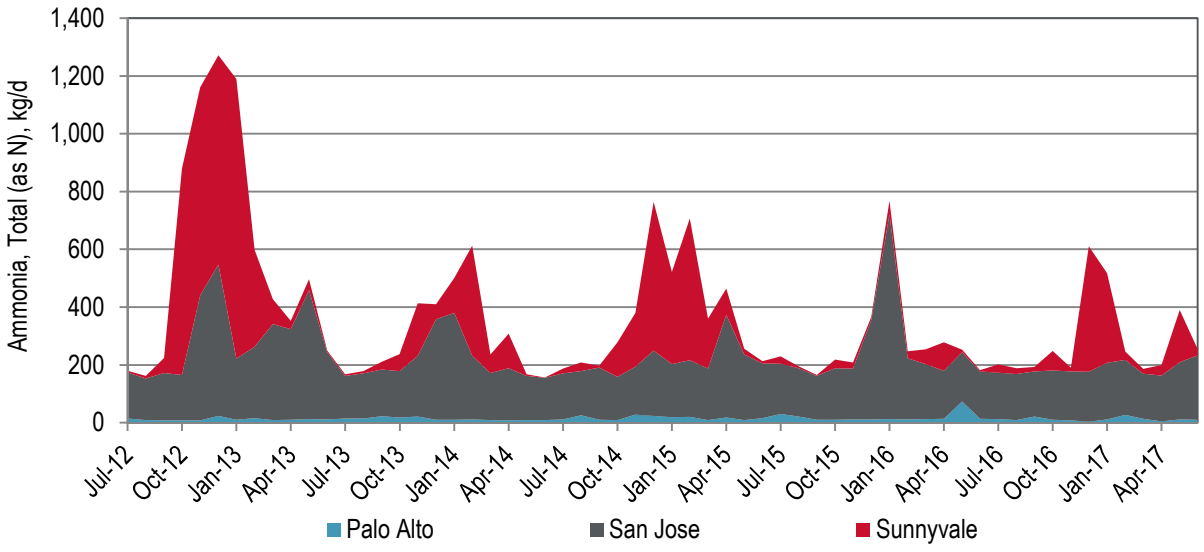


**Figure 4-25. Ammonia Load Contribution by Discharger to Lower South Bay**

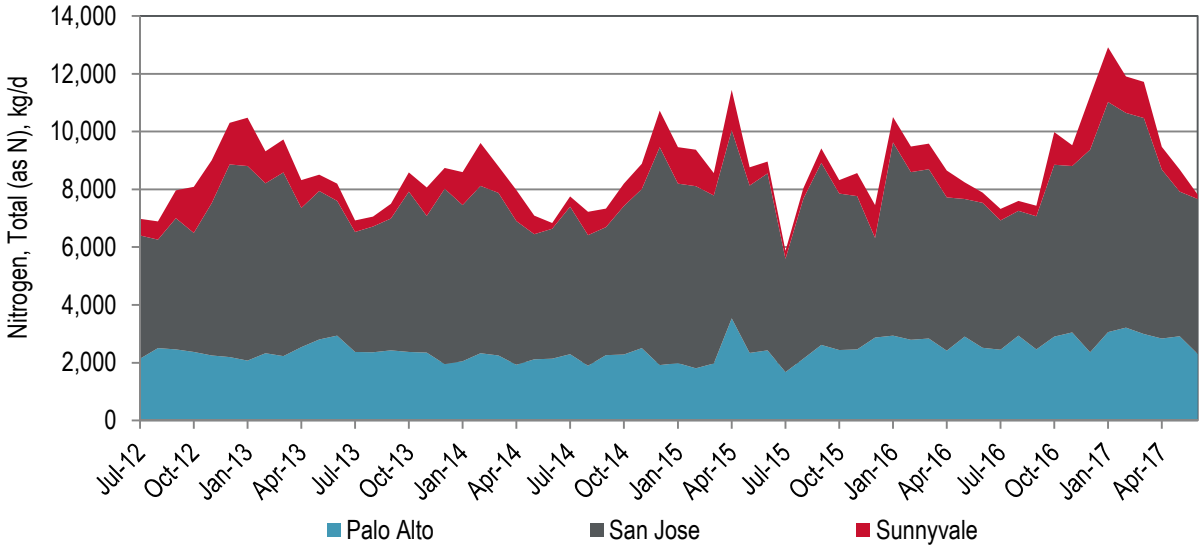


**Figure 4-26. Total Nitrogen Load Contribution by Discharger to Lower South Bay**

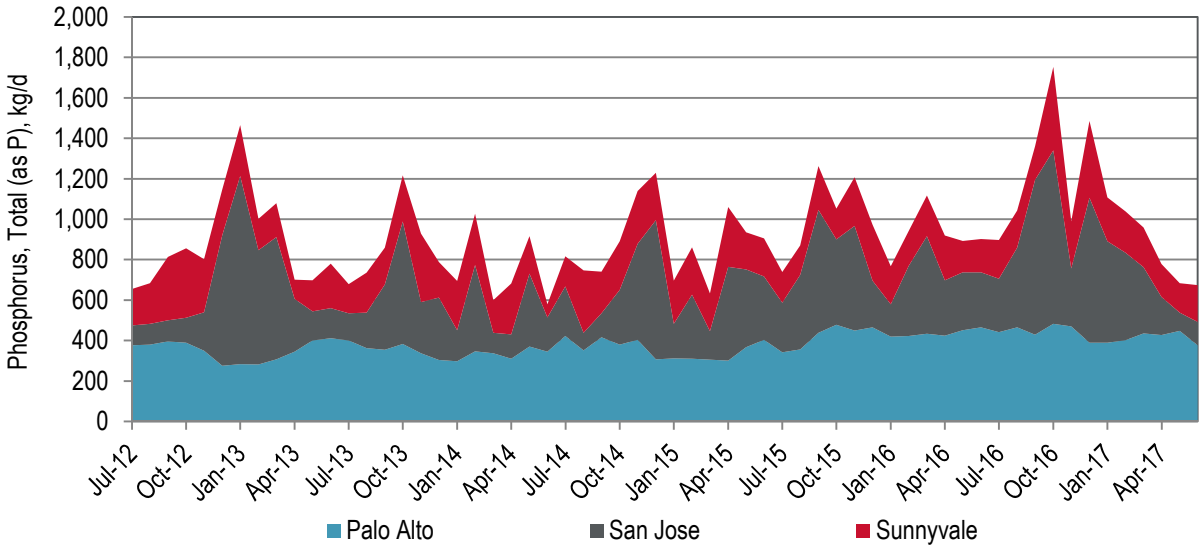


**Figure 4-27. Total Phosphorus Load Contribution by Discharger to Lower South Bay**

# 5 Discussion

The 2016/2017 dataset is one of the wettest years on record for Northern California. As a result, the average annual flows during the 2016/2017 wet season were the highest since sampling began in July 2012. Average annual loads for all parameters (except NOx and Ortho-P) were also the highest since sampling began in July 2012.

A plot of the historical average monthly daily discharge flow, ammonia, and TN loads are presented in Figure 5-1. In general, total nitrogen loads tend to track with the flows. For example, during peak wet weather events, both the flow and total nitrogen loads typically increase. However, the limited dataset makes it difficult to have confidence that this relation is strong. In other words, 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 (similar to the "first flush" stormwater collection systems) would be reduced and dilution increased. Additional data is needed to further understand the correlation between flow and loads during peak wet weather events.

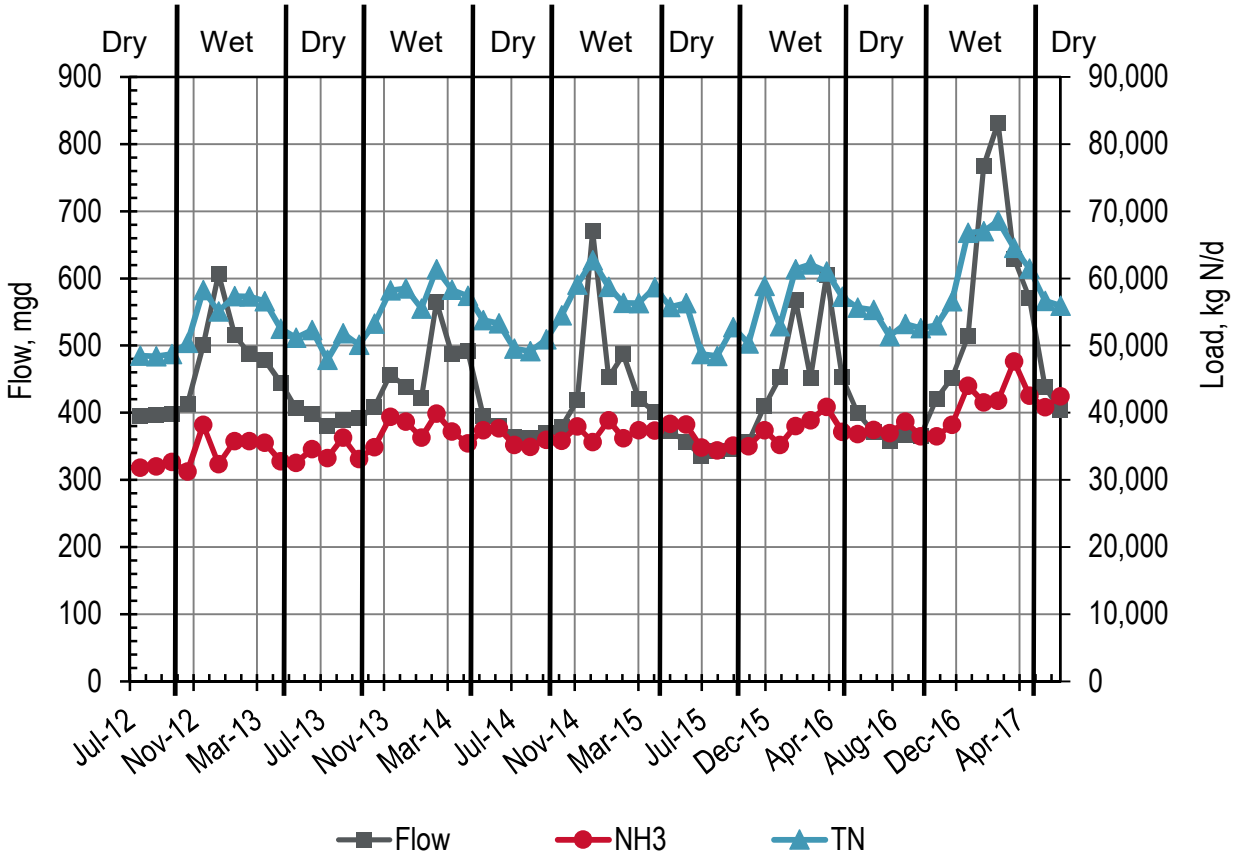


**Figure 5-1. Historical Average Monthly Daily Discharge Flows and Loads**

The 2016/17 dry season flows and loads had similar trends as the average annual values. The 2016/17 dry season flows returned to pre-drought levels as evidenced by flows comparable to 2013/2014 flows. Additionally, all the 2016/2017 dry season loads (except NOX and ortho-P) are the highest since sampling began in July 2012.

This increase in 2016/2017 flows and loads is likely due to a combination of the following:

- Population increase in the Bay Area as well as a robust labor market drawing more outside the Bay Area commuters.
- Improvement in general economic conditions in the Bay Area,
- The 2016/2017 dry season includes July 2016 through September 2016 and May 2017 through June 2017. The wet year more than likely increased the groundwater table in May and June 2017 that resulted in increased inflow and infiltration (I&I) and in turn flows. Next year's dataset will include the second half of the 2017 dry season which could quantify the extent of flow reduction as the groundwater table subsided over the course of the dry season.
- The high rainfall potentially scoured previously accumulated material within collection systems.
- Increased residential water usage as drought concerns were reduced as a result of a relatively wet year.
- Industrial impacts as more treatment plants across the Bay import organics for energy production.
- Infrequent sampling frequency (twice per month for Major Dischargers) can result in biased results. For example, if a plants two sampling events were during peak flow events in could result in values that do not necessarily reflect day to day values for that particular month.
- Sampling requirements between Section 13267 Letter data and Watershed Permit as discussed in Section 3.

The following subsections present observations of each parameter considered, including outliers, seasonality, and the role of the largest dischargers.

## 5.1 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 is as follows:

1) Verify the correlation of errors (e.g., Durbin-Watson correlation of errors).
2) Evaluate whether the data needs to be transformed (e.g., natural log) to provide context on whether data is conforming to the distributional assumptions of the modeling errors. A probability plot of errors will provide context on whether data is conforming to the errors.
3) Use the Cochrane–Orkut regression model to adjust the data for a time series correlation in the error term.

## 5.2 Flow Analysis

Although the total ADWF permitted capacity of the POTW dischargers in the San Francisco Bay is 826 mgd, the total average annual discharge ranged from 421 mgd to 510 mgd for the five year period. The ADWF flows declined from 2012/2013 to 2014/2015, but increased in 2015/2016 and 2016/2017. The 2016/2017 dry season flows exhibit the largest increase in flow from one year to the next. The basis for this increase is captured at the beginning of Section 5 with the wet 2016/2017 season being the main contributor to this flow increase.

The South Bay and Lower South Bay Subembayments received the highest flows, making up approximately 60 percent of the total flow discharged to the Bay. The largest discharger is San Jose, followed by SFPUC Southeast, EBDA, and EBMUD. San Pablo Bay has the largest portion of recycled water diversion during the dry season; several plants divert all flow and have a zero dry season discharge.

The dry season flow trends for all Subembayments are not statistically significant except for the Lower South Bay Subembayment which is trending downward. The 2016/2017 wet season flows increased to the extent that several Subembayments previously identified as having a significant downward dry season trend rebounded to having no significant dry season trend (e.g., Suisun Bay). Other possible reasons that could contribute to this increase is discussed at the start of Section 5.

## 5.3 Ammonia Analysis

The total average annual ammonia discharge ranged from approximately 33,770 kg N/d to 40,660 kg N/d for the five year period. The Central Bay and South Bay Subembayments receive the highest ammonia loads, making up over 80 percent of the total ammonia discharged to the Bay. The largest overall ammonia discharger is the SFPUC Southeast Plant, followed by EBMUD and EBDA.

The dry season ammonia loads appear to be statistically increasing for San Pablo Bay, Central Bay, South Bay, and Baywide. Despite receiving the second highest flows, the Lower South Bay ammonia loads are about an order of magnitude lower than any other Subembayment, making up less than one percent of the total ammonia load to the Bay. This is because the three dischargers that make up the Lower South Bay are required to fully nitrify at their plants due to their shallow water discharges. Ammonia removal addresses ammonia related toxicity; however, a portion of the nitrogen is still present as nitrate in the effluent.

The seasonal variation of discharged ammonia load from the wet to the dry season (based on the percent difference) are most pronounced for the Lower South Bay and San Pablo Bay. The Lower South Bay has the most significant seasonal load reduction as evidenced by about a 50 percent reduction from the wet to the dry season. Similar to the seasonal variation in flow, these seasonal load variations are attributed to a combination of seasonal diversion of recycled water, pond dredging, colder temperatures, and seasonal nitrification. Nitrification is less effective at the cooler wet season temperatures; as a result, a few of the dischargers appear to experience increased ammonia concentrations during the wet season. Recycling water has the potential to divert loads from the Bay when used for consumptive purposes (e.g., irrigation).

Agencies with nitrifying trickling filters (e.g., Sunnyvale), have variable wet weather ammonia concentrations which are attributed to temperature variations that impact the nitrification process. As a result, these plants appear to have difficulty maintaining a consistent effluent ammonia load during winter months.

## 5.4 TKN Analysis

The total average annual TKN discharge ranged from approximately 38,200 kg N/d to just under 44,800 kg N/d for the five year period. TKN loads exhibit similar patterns to ammonia, except the seasonal difference in the Lower South Bay Subembayment is not as pronounced.

## 5.5 NOx Analysis

The total average annual NOx discharge ranged from approximately 14,000 kg N/d to nearly 14,910 kg N/d for the five year period and illustrated an overall downward dry season trend until this past year's dataset (2016/2017), in which it increased to levels comparable to the prior year. The Lower South Bay receives the highest NOx load, making up approximately 60 percent of the total NOx load discharged to the Bay. The largest overall discharger of NOx is San Jose, averaging 4,940 kg N/d for the five year period, which is about 34 percent of the total NOx load to the Bay.

The Lower South Bay has the highest loads, regardless of season. As previously stated, this is attributed to nitrification of ammonia at all three plants in the Lower South bay. A portion of the ammonia converted to NOx is discharged as NOx. The overwhelming majority of NOx discharged is nitrate.

The seasonal variation of discharged NOx load from the wet to the dry season (based on the percent difference) is most pronounced (in order) on a percentile load basis for San Pablo Bay, Central Bay, and South Bay. San Pablo Bay has the largest variation due to the lack of dry season dischargers coupled with several of the plants in San Pablo Bay perform nitrification. There are also occasional spikes of NOx in the dry season from agencies that have intermittent nitrification, specifically for under-loaded trickling filter plants.

## 5.6 Total Nitrogen Analysis

The total average annual TN discharge ranged from 53,100 kg N/d to 58,900 kg N/d for the five year period. The Central Bay and South Bay Subembayments receive the highest total nitrogen loads, making up over 65 percent of the total nitrogen discharged to the Bay. The largest overall discharger of TN on an average annual basis is EBMUD, followed by SFPUC Southeast and EBDA.

There appears to be a Baywide upward dry and wet season trend in total nitrogen loads, which is largely attributed to increasing loads for all Subembayments (except Suisun Bay and the Lower South Bay Subembayments). SFPUC and EBDA are the primary contributors to the load increase in the South Bay. Suisun Bay and the Lower South Bay load values suggest no statistical significance trend in dry season total nitrogen loads.

The seasonal difference in TN discharges from the wet to the dry season (based on the percent difference) are most pronounced are San Pablo Bay and the Central Bay. San Pablo Bay has the most significant seasonal load reduction as evidenced by an approximately 35 percent reduction from the wet to the dry season. Similar to TKN and 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.

## 5.7 Orthophosphate Analysis

The total average annual ortho-P discharge ranged from approximately 3,070 kg P/d to 4,620 kg P/d for the five year period and demonstrated an overall downward trend. There appears to be a distinct

reduction in load values from the two different sampling requirements under the Section 13267 Letter (2012/13 through 2013/14 data) and the subsequent Nutrient Watershed Permit (2014/15 through 2016/17 data). The basis for this load reduction might be due to the sampling requirements under the two different sampling requirements. Composite or grab samples were required for the Section 13267 Letter and grab samples under the Nutrient Watershed Permit. Ortho-P is time sensitive for analysis, especially for non-filtered samples. Due to this difference in sampling requirements, it is difficult to draw any conclusions from the overall dataset.

The South Bay received the highest ortho-P load. The largest overall discharger of ortho-P is EBMUD, followed by EBDA and Palo Alto.

## 5.8 Total Phosphorus Analysis

The total average annual TP discharge ranged from approximately 3,720 kg P/d to 4,110 kg P/d for the five year period. Unlike the ortho-P sampling, the TP sampling are composite for both the Section 13267 Letter data and the Nutrient Watershed Permit. However, the Section 13267 Letter data required sampling during peak flows as previously discussed.

The dry season trending by Subembayments are either flat or increasing. Of the Subembayments, the South Bay received the largest TP load and it is trending upwards for the dry season. The largest overall discharger of TP based on average annual loads is EBMUD, followed by EBDA and Palo Alto.

The seasonal variation of TP discharge loads from the wet to dry season (based on the percent difference) are most pronounced for San Pablo Bay, Central Bay, and Lower South Bay Subembayments. In contrast, the South Bay and Suisun Subembayments do not appear to have a significant variation in TP loading between the wet and dry season.

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# 6 Summary

Table 6-1 and Table 6-2 present an overall summary of the average annual and dry season flows and nutrient loads discharged to the San Francisco Bay, respectively, between July 2012 and June 2017. Similarly, Table 6-3 and Table 6-4 present a summary of the corresponding dry season and average annual constituent concentrations, respectively, for the same period. The concentrations were calculated by dividing the loads by the flows for the appropriate averaging period.

The 2016/2017 dataset was one of the wettest years on record for Northern California. In almost all cases, the flows and loads for the most recent year of data was higher than the prior year (with the exception of dry season NOx loads). This increase is attributed to the wet year in the 2016/2017 dataset, increasing population in the Bay Area and a robust work force, as well as the other items discussion in Section 5.

Ammonia, TKN, TN, and TP loads discharged to the San Francisco Bay have increased from the prior year for both dry season and average annual conditions. The nutrient concentrations all decreased in 2016/2017 with respect to the prior year's dataset (2015/2016) except for dry season ammonia. This reduction in concentration is likely due to dilution as the flows increased with respect to the previous year.

The analysis did not evaluate influent flows and loadings to the dischargers over the five-year period. Plant influent flows and loadings were collected since the 2015/2016 data request but not all plants provided influent information. It is anticipated that influent flows and loads will be available for all the plants in future datasets. As this influent database grows, effluent trends can be compared to influent trends.

Changes in the data collection procedures during the five year period created some uncertainty about the resulting trends. The data collection requirements were different in the initial two years, under the Section 13267 Letter data requirements, which disproportionately emphasized the importance of wet weather loading and potentially skewed the resulting trends. As a result, trends for each discharge were limited to the Dry Season, which limited the number of data points for use in the trend analysis (most agencies had 25). Future data will increase the size of the sample set and improve the level of confidence in the trends.

In addition to the wet weather sampling, there were observed issues with the reporting of soluble reactive phosphorus (SRP) as addressed in the 2015 Group Annual Report Submittal. This sampling issue was addressed in the 2016 Group Annual Report Submittal as all the dischargers are collecting grab samples.

As expected, 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 and the highest NOx concentrations.

Seasonal variations are pronounced. Dry season load variability are generally lower than wet season loads. This is attributed to two factors. First, the higher flows and sampling procedures amplify the wet season discharges. Secondly, during the dry season, water reuse diverts much of the nutrient load away from the Bay. In some instances, agencies have achieved zero discharge during the summer months. It is recommended that in future years, agencies report the flow diverted for recycled water use as well as any return streams (e.g., cooling tower blow down, advanced

purification concentrate, etc.) such that the total quantity of recycled water can be clearly quantified, as well as the associated nutrient loads being diverted from the San Francisco Bay.

### Table 6-1. Summary of Average Annual Flow and Load Discharges to the Bay

| Constituent | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] | Trend[b,c] | 5 Year Average |
|---|---|---|---|---|---|---|---|
| Flow, mgd | 453 | 434 | 421 | 425 | 510 | None | 449 |
| Ammonia, kg N/d | 33,770 | 36,628 | 36,858 | 36,801 | 40,664 | Increasing (12% Change) | 36,944 |
| TKN, kg N/d | 38,213 | 40,519 | 41,582 | 42,017 | 44,804 | Increasing (10% Change) | 41,427 |
| NOx, kg N/d | 14,911 | 14,538 | 14,158 | 13,999 | 14,327 | None | 14,386 |
| TN, kg N/d | 53,093 | 54,998 | 55,784 | 55,448 | 58,913 | Increasing (7% Change) | 55,647 |
| Ortho-P, kg P/d | 4,623 | 4,464 | 3,071 | 3,212 | 3,287 | | 3,731 |
| TP, kg P/d | 3,954 | 3,772 | 3,720 | 3,939 | 4,107 | None | 3,898 |

a. 2012/13 represents the period between July 1, 2012 and June 30, 2013; 2013/14 represents the period between July 1, 2013, June 30, 2014; 2014/15 represents the period between July 1, 2014 and June 30, 2015; 2015/16 represents the period between July 1, 2015 and June 30, 2016; and 2016/17 represents the period between July 1, 2016 and June 30, 2017.

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 25. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the 2016/17 value in comparison to the average of the initial four years of data (2012/2013 through 2015/2016).

### Table 6-2. Summary of Dry Season Flow and Load Discharges to the Bay

| Constituent | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] | Trend[b,c] | 5 Year Average |
|---|---|---|---|---|---|---|---|
| Flow, mgd | 399 | 387 | 365 | 359 | 387 | None | 379 |
| Ammonia, kg N/d | 32,719 | 35,541 | 36,560 | 35,745 | 39,108 | Increasing (11% Change) | 35,935 |
| TKN, kg N/d | 36,692 | 39,152 | 40,044 | 40,208 | 42,743 | Increasing (10% Change) | 39,768 |
| NOx, kg N/d | 13,184 | 12,375 | 12,337 | 12,002 | 11,471 | None | 12,274 |
| TN, kg N/d | 49,855 | 51,485 | 52,495 | 52,209 | 53,700 | Increasing (5% Change) | 51,949 |
| Ortho-P, kg P/d | 4,104 | 4,227 | 2,923 | 3,081 | 3,220 | | 3,511 |
| TP, kg P/d | 3,603 | 3,396 | 3,448 | 3,650 | 3,869 | None | 3,593 |

a. 2012/13 represents the period between July 1, 2012 and June 30, 2013; 2013/14 represents the period between July 1, 2013, June 30, 2014; 2014/15 represents the period between July 1, 2014 and June 30, 2015, 2015/16 represents the period between July 1, 2015 and June 30, 2016, and 2016/17 represents the period between July 1, 2016 and June 30, 2017.

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 25. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the 2016/17 value in comparison to the average of the initial four years of data (2012/2013 through 2014/2015).

## Table 6-3. Summary of Average Annual Flow and Constituent Concentrations Discharged to the Bay

| Constituent | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] | Trend[b,c] | 5 Year Average |
|---|---|---|---|---|---|---|---|
| Flow, mgd | 453 | 434 | 421 | 425 | 510 | None | 449 |
| Ammonia, mg N/L | 20 | 22 | 23 | 23 | 21 | None | 22 |
| TKN, mg N/L | 22 | 25 | 26 | 26 | 23 | None | 24 |
| NOx, mg N/L | 8.7 | 8.8 | 8.8 | 8.7 | 7.4 | Decreasing (-19% Change) | 8.5 |
| TN, mg N/L | 31 | 33 | 35 | 34 | 31 | None | 33 |
| Ortho-P, mg P/L | 2.7 | 2.7 | 1.9 | 2.0 | 1.7 | | 2.2 |
| TP, mg P/L | 2.3 | 2.3 | 2.3 | 2.4 | 2.1 | None | 2.3 |

a. 2012/13 represents the period between July 1, 2012 and June 30, 2013; 2013/14 represents the period between July 1, 2013, June 30, 2014; 2014/15 represents the period between July 1, 2014 and June 30, 2015; 2015/16 represents the period between July 1, 2015 and June 30, 2016; and 2016/17 represents the period between July 1, 2016 and June 30, 2017.

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 25. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change represents the 2016/17 value in comparison to the average of the initial four years of data (2012/2013 through 2014/2015).

## Table 6-4. Summary of Dry Season Flow and Constituent Concentrations Discharged to the Bay

| Constituent | 2012/13[a] | 2013/14[a] | 2014/15[a] | 2015/16[a] | 2016/17[a] | Trend[b,c] | 4 Year Average |
|---|---|---|---|---|---|---|---|
| Flow, mgd | 399 | 387 | 365 | 359 | 387 | None | 379 |
| Ammonia, mg N/L | 22 | 24 | 26 | 26 | 27 | Increasing (8% Change) | 25 |
| TKN, mg N/L | 24 | 27 | 29 | 30 | 29 | Increasing (6% Change) | 28 |
| NOx, mg N/L | 8.7 | 8.4 | 8.9 | 8.8 | 7.8 | None | 8.5 |
| TN, mg N/L | 33 | 35 | 38 | 38 | 37 | Increasing (2% Change) | 36 |
| Ortho-P, mg P/L | 2.7 | 2.9 | 2.1 | 2.3 | 2.2 | | 2.4 |
| TP, mg P/L | 2.4 | 2.3 | 2.5 | 2.7 | 2.6 | None | 2.5 |

a. 2012/13 represents the period between July 1, 2012 and June 30, 2013; 2013/14 represents the period between July 1, 2013 and June 30, 2014; 2014/15 represents the period between July 1, 2014 and June 30, 2015; 2015/16 represents the period between July 1, 2015 and June 30, 2016; and 2016/17 represents the period between July 1, 2016 and June 30, 2017.

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 20. Where “None” is stated, the limited dataset does not indicate a statistically relevant trend.

c. The percent change with respect to the average of the initial four years of data (2012/2013 through 2014/2015).

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# Appendix

# Discharge Evaluation for Individual Dischargers

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# Contents

# Tables

# Figures

# 1 City of American Canyon

American Canyon discharges to San Pablo Bay, and serves approximately 5,562 connections. The plant is rated for an ADWF capacity of 2.5 mgd and a peak permitted wet weather flow of 5 mgd. It has a current ADWF flow of approximately 1.2 mgd. The plant is a nitrifying and denitrifying MBR plant.

The following observations are made based upon the figures and table in the subsequent pages:

- There are 10 missing monthly average nutrient load samples per nutrient up to June 2014, which may be attributed to seasonal discharge restrictions.
- Based on the table and figures with the average monthly values, there does not appear to be any emerging dry season trends for flow, ammonia or phosphorus loads. NOx and total nitrogen dry season loads show a decreasing trend.
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant nitrifies.
- Total phosphorus concentrations are wide ranging with values from less than 1 mg P/L to over 10 mg P/L.
- The distribution of phosphorus species is predominantly ortho-P.

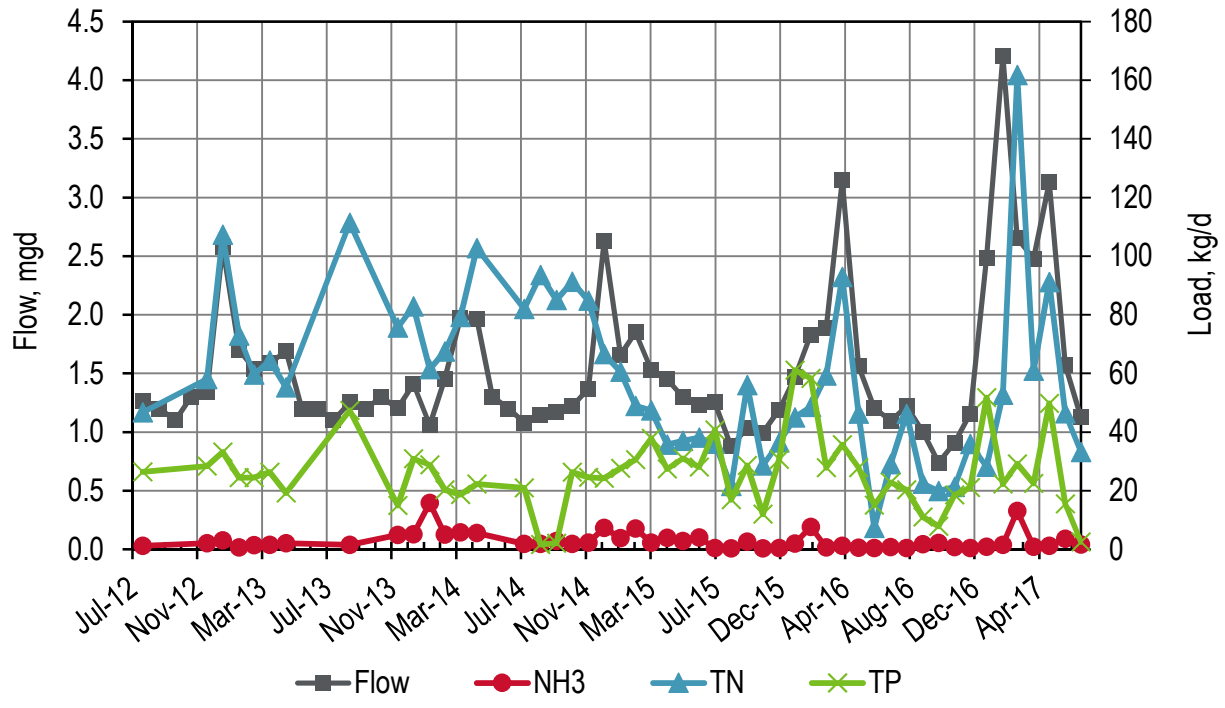


**Figure 1-1. American Canyon Monthly Flows and Loads**

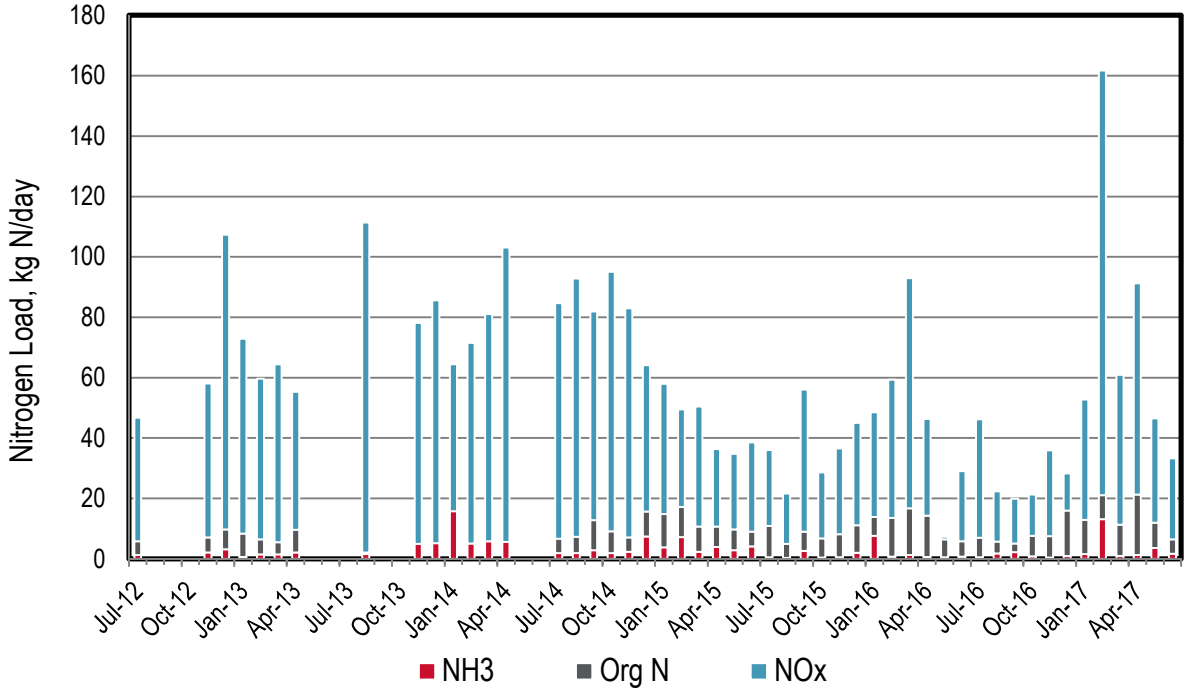


**Figure 1-2. American Canyon Monthly Nitrogen Loads**

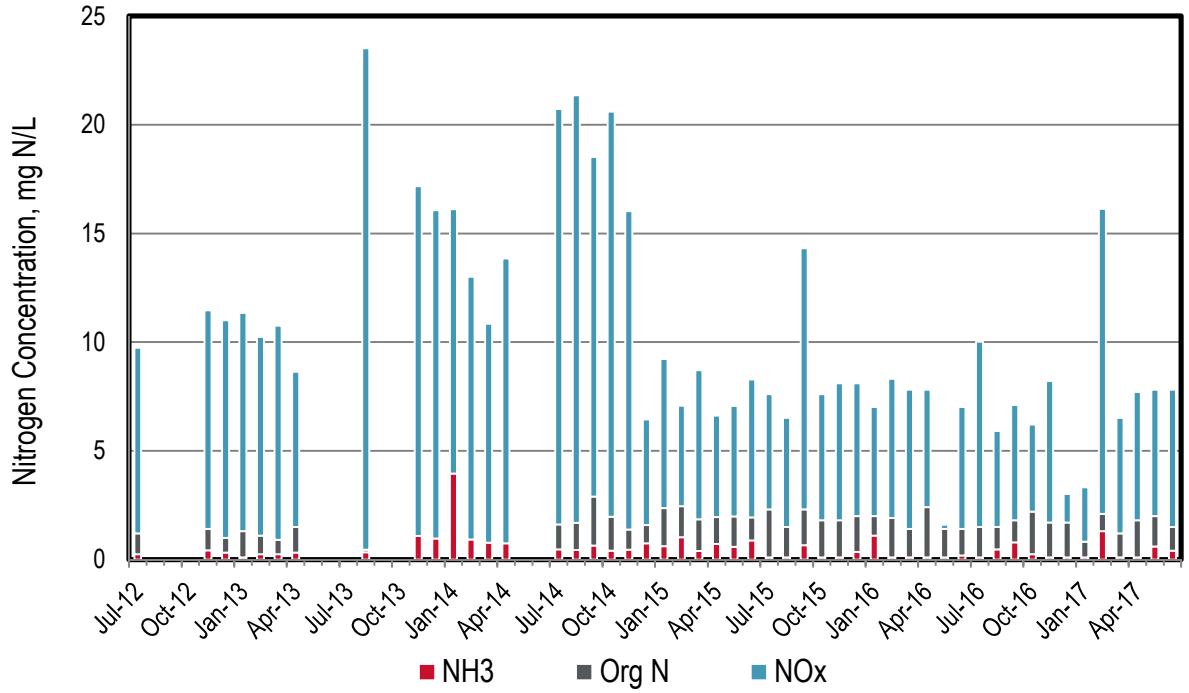


**Figure 1-3. American Canyon Monthly Nitrogen Concentrations**

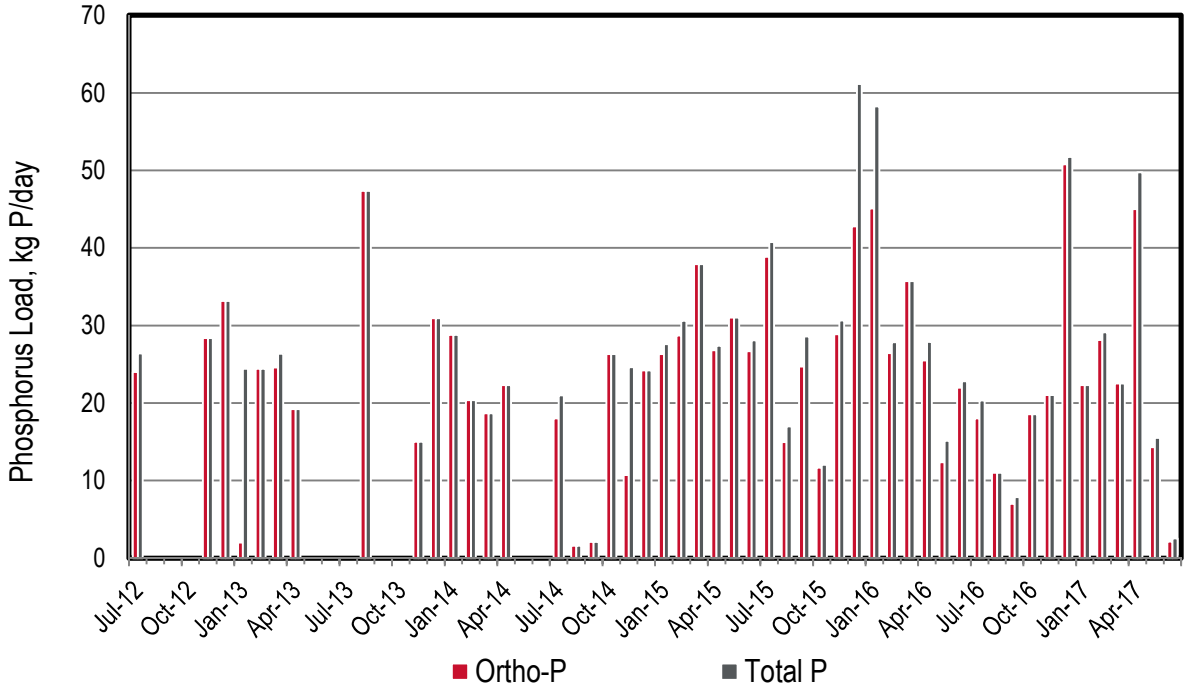


**Figure 1-4. American Canyon Monthly Phosphorus Loads**

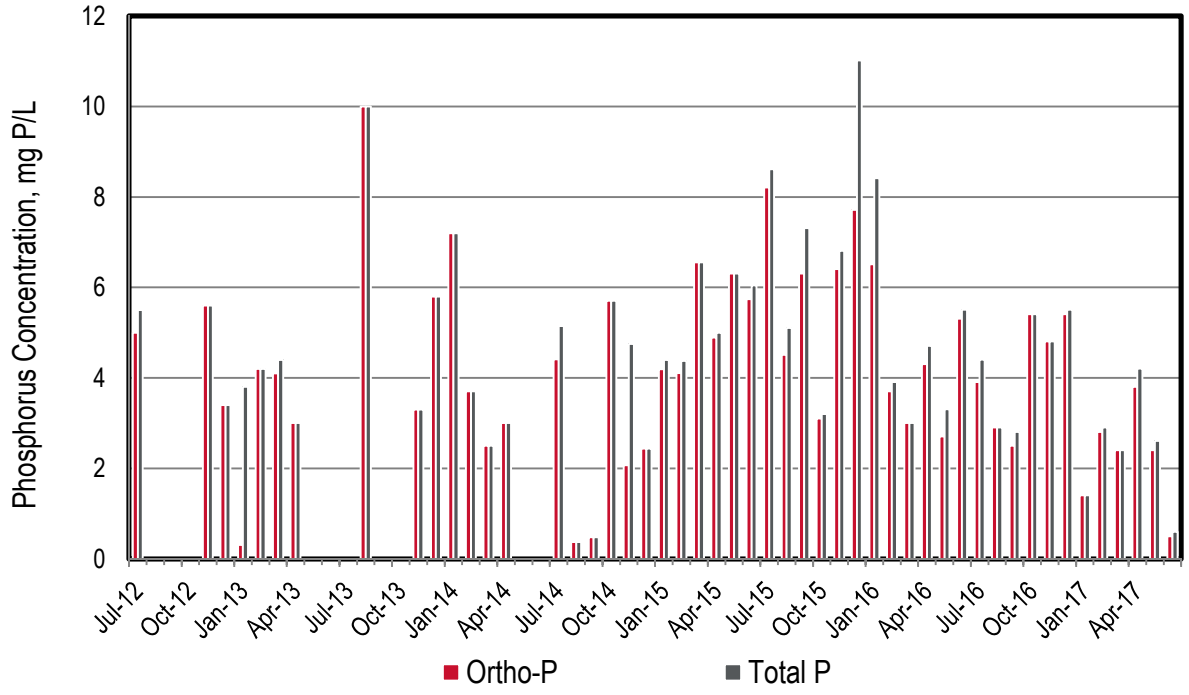


**Figure 1-5. American Canyon Monthly Phosphorus Concentrations**

## Table 1-1. American Canyon Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 1.3 | 1 | 6 | 41 | 47 | 24 | 26 |
| Aug-12 | 1.2 | | | | | | |
| Sep-12 | 1.1 | | | | | | |
| Oct-12 | 1.3 | | | | | | |
| Nov-12 | 1.3 | 2 | 7 | 51 | 58 | 31 | 28 |
| Dec-12 | 2.6 | 3 | 10 | 98 | 107 | 37 | 33 |
| Jan-13 | 1.7 | 1 | 8 | 65 | 73 | 2 | 24 |
| Feb-13 | 1.5 | 1 | 6 | 53 | 60 | 24 | 24 |
| Mar-13 | 1.6 | 1 | 5 | 59 | 64 | 25 | 26 |
| Apr-13 | 1.7 | 2 | 10 | 46 | 55 | 20 | 19 |
| May-13 | 1.2 | | | | | | |
| Jun-13 | 1.2 | | | | | | |
| Jul-13 | 1.1 | | | | | | |
| Aug-13 | 1.3 | 2 | 2 | 109 | 111 | 62 | 47 |
| Sep-13 | 1.2 | | | | | | |
| Oct-13 | 1.3 | | | | | | |
| Nov-13 | 1.2 | 5 | 2 | 73 | 76 | 18 | 15 |
| Dec-13 | 1.4 | 5 | 2 | 81 | 83 | 33 | 31 |
| Jan-14 | 1.1 | 16 | 13 | 49 | 61 | 42 | 29 |
| Feb-14 | 1.5 | 5 | 1 | 66 | 67 | 35 | 20 |
| Mar-14 | 2.0 | 6 | 4 | 75 | 79 | 24 | 19 |
| Apr-14 | 2.0 | 6 | 5 | 98 | 103 | 28 | 22 |
| May-14 | 1.3 | | | | | | |
| Jun-14 | 1.2 | | | | | | |
| Jul-14 | 1.1 | 2 | 7 | 78 | 82 | 18 | 21 |
| Aug-14 | 1.2 | 2 | 7 | 86 | 94 | 24 | 2 |
| Sep-14 | 1.2 | 3 | 13 | 69 | 85 | 18 | 2 |
| Oct-14 | 1.2 | 2 | 9 | 86 | 91 | 27 | 26 |
| Nov-14 | 1.4 | 2 | 7 | 76 | 85 | 11 | 25 |
| Dec-14 | 2.6 | 7 | 16 | 48 | 67 | 27 | 24 |
| Jan-15 | 1.7 | 4 | 15 | 43 | 61 | 26 | 28 |
| Feb-15 | 1.9 | 7 | 17 | 32 | 49 | 29 | 31 |
| Mar-15 | 1.5 | 2 | 11 | 40 | 47 | 38 | 38 |
| Apr-15 | 1.5 | 4 | 11 | 26 | 36 | 27 | 27 |
| May-15 | 1.3 | 3 | 10 | 25 | 37 | 31 | 31 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 1.2 | 4 | 9 | 30 | 38 | 27 | 28 |
| Jul-15 | 1.3 | 0 | 11 | 25 | 36 | 39 | 41 |
| Aug-15 | 0.9 | 0 | 5 | 17 | 22 | 15 | 17 |
| Sep-15 | 1.0 | 3 | 9 | 47 | 56 | 25 | 29 |
| Oct-15 | 1.0 | 0 | 7 | 22 | 29 | 12 | 12 |
| Nov-15 | 1.2 | 0 | 8 | 28 | 37 | 29 | 31 |
| Dec-15 | 1.5 | 2 | 11 | 34 | 45 | 43 | 61 |
| Jan-16 | 1.8 | 8 | 14 | 35 | 49 | 45 | 58 |
| Feb-16 | 1.9 | 1 | 14 | 46 | 59 | 26 | 28 |
| Mar-16 | 3.1 | 1 | 17 | 76 | 93 | 36 | 36 |
| Apr-16 | 1.6 | 1 | 14 | 32 | 46 | 26 | 28 |
| May-16 | 1.2 | 0 | 6 | 1 | 7 | 12 | 15 |
| Jun-16 | 1.1 | 1 | 6 | 23 | 29 | 22 | 23 |
| Jul-16 | 1.2 | 0 | 7 | 39 | 46 | 18 | 20 |
| Aug-16 | 1.0 | 2 | 6 | 17 | 22 | 22 | 11 |
| Sep-16 | 0.7 | 2 | 5 | 15 | 20 | 7 | 8 |
| Oct-16 | 0.9 | 1 | 8 | 14 | 21 | 19 | 19 |
| Nov-16 | 1.2 | 0 | 7 | 28 | 36 | 21 | 21 |
| Dec-16 | 2.5 | 1 | 16 | 12 | 28 | 51 | 52 |
| Jan-17 | 4.2 | 2 | 13 | 40 | 53 | 22 | 22 |
| Feb-17 | 2.7 | 13 | 21 | 141 | 162 | 28 | 29 |
| Mar-17 | 2.5 | 1 | 11 | 50 | 61 | 23 | 23 |
| Apr-17 | 3.1 | 1 | 21 | 70 | 91 | 45 | 50 |
| May-17 | 1.6 | 4 | 12 | 35 | 46 | 14 | 15 |
| Jun-17 | 1.1 | 2 | 6 | 27 | 33 | 2 | 3 |
| | | | | | | | |
| **Dry Season Average** | **1.2** | **2** | **7** | **40** | **48** | **22** | **20** |
| **Dry Season Trend **** | **None** | **None** | **None** | **Down** | **Down** | **-** | **None** |
| **Wet Season Average** | **1.8** | **3** | **10** | **54** | **65** | **28** | **29** |
| **Average Annual** | **1.5** | **3** | **9** | **49** | **59** | **26** | **26** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 2 City of Benicia

Benicia discharges to San Pablo Bay, and serves approximately 9,569 service connections. The plant has a permitted ADWF capacity of 4.5 mgd and 18 mgd one-hour peak wet weather design flow capacity. It has a current ADWF flow of approximately 1.9 mgd. The plant performs secondary treatment using a combination of activated sludge and rotating biological contractors.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table and figures with the average monthly values, there appears to be an emerging dry season downward trend for total phosphorus loads.
- Nitrogen loads increase with flow during wet weather events.
- Wet season loads are greater and more variable year to year than the dry season loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- Ammonia concentrations vary in the range of 8 to 32 mg/L throughout the year.
- Total phosphorus concentrations range from less than 1 mg P/L to over 7 mg P/L.
- The distribution of phosphorus species is predominantly ortho-P. Since the Regional Watershed Permit sampling began in July 2014, the ortho-P values are occasionally greater than total phosphorus. This discrepancy is likely due to ortho-P being measured on grab samples, while total phosphorus is measured for 24-hour composite samples.

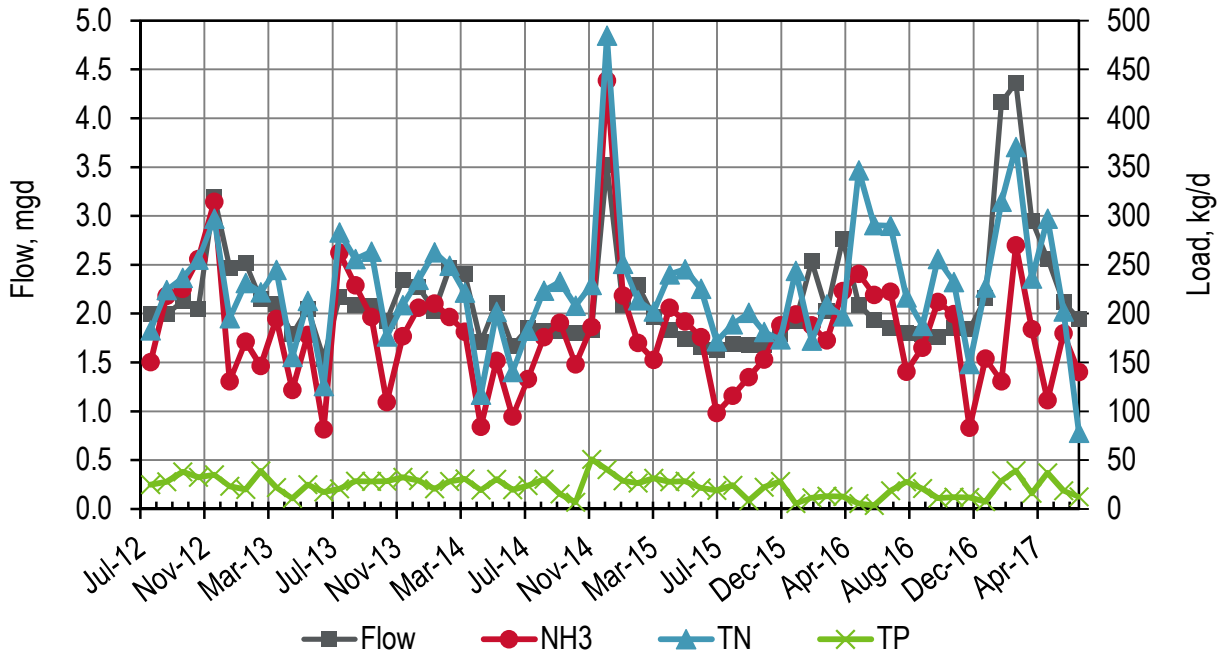


**Figure 2-1. Benicia Monthly Flows and Loads**

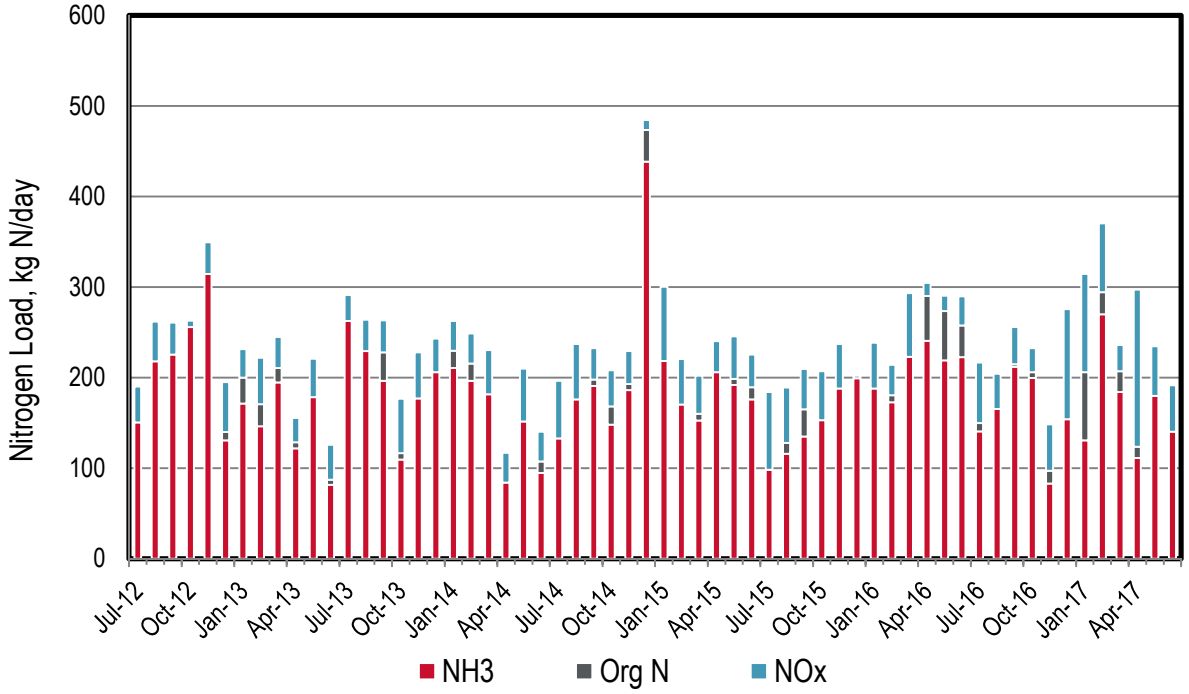


**Figure 2-2. Benicia Monthly Nitrogen Loads**

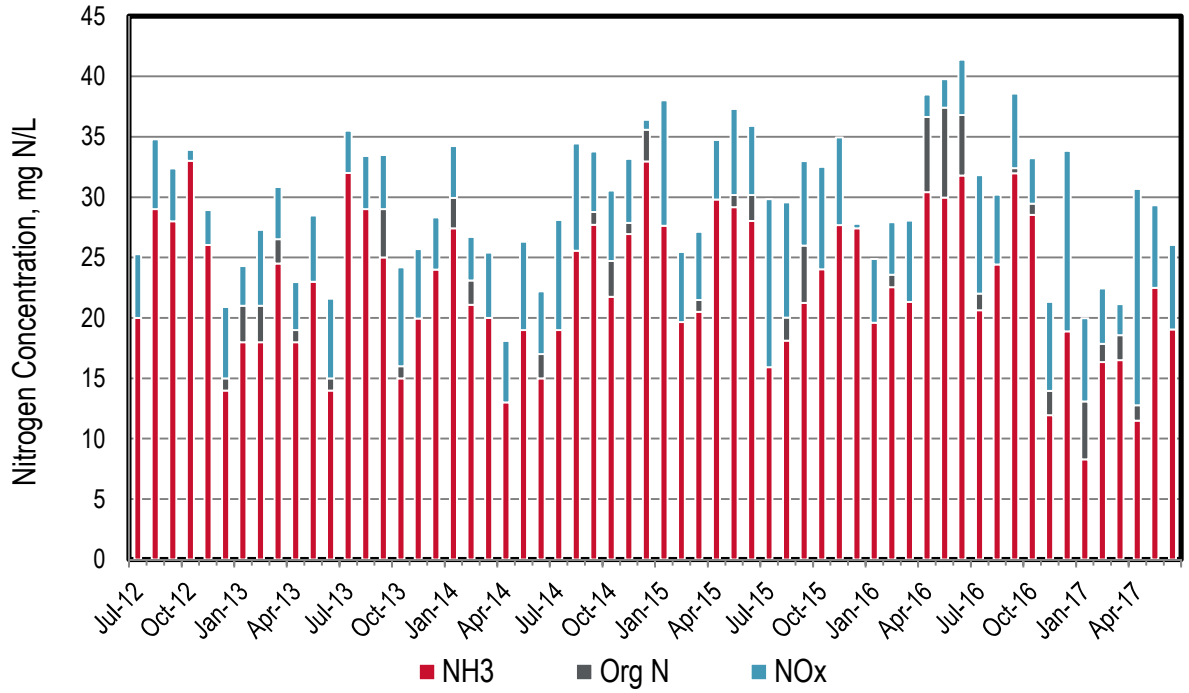


**Figure 2-3. Benicia Monthly Nitrogen Concentrations**

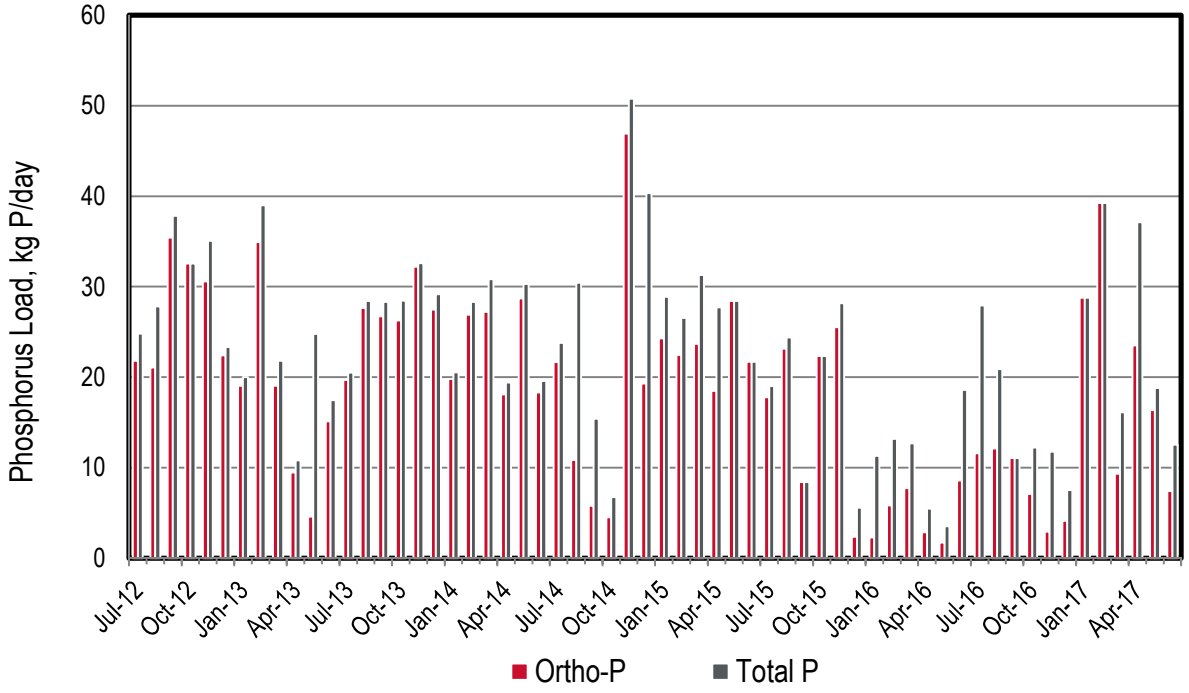


**Figure 2-4. Benicia Monthly Phosphorus Loads**

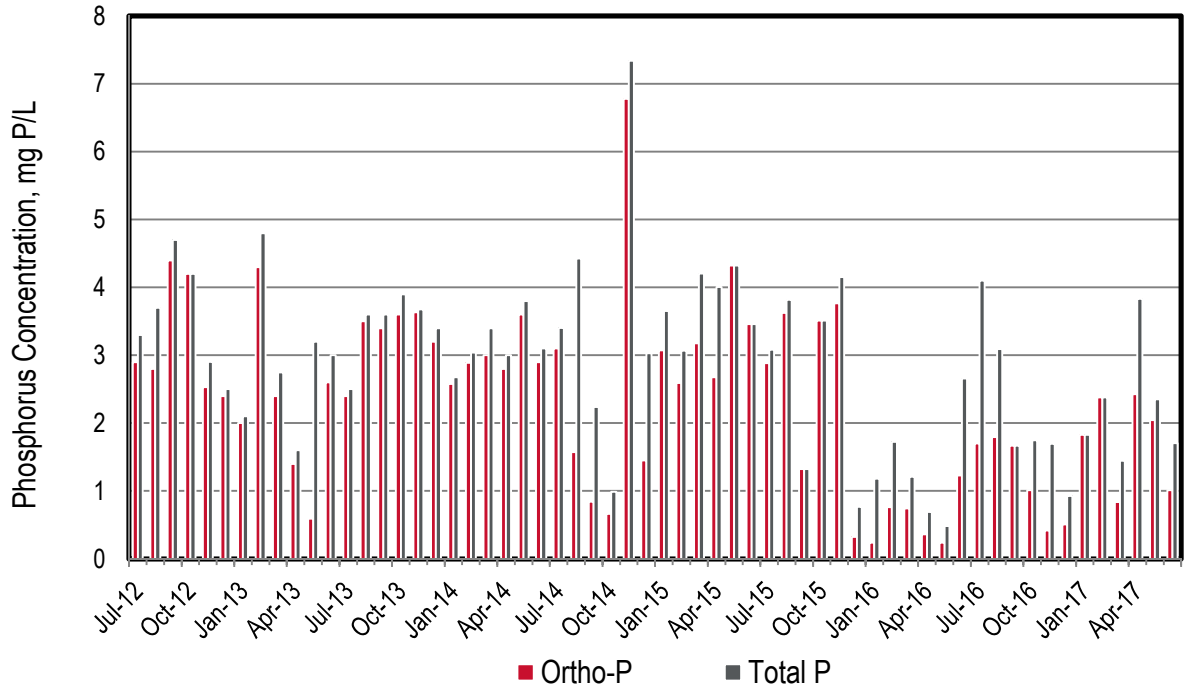


**Figure 2-5. Benicia Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 2-1. Benicia Monthly Flows and Loads*

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day** | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 2.0 | 150 | 143 | 40 | 183 | 22 | 25 |
| Aug-12 | 2.0 | 218 | 181 | 44 | 224 | 21 | 28 |
| Sep-12 | 2.1 | 225 | 201 | 35 | 236 | 35 | 38 |
| Oct-12 | 2.1 | 256 | 248 | 7 | 255 | 33 | 33 |
| Nov-12 | 3.2 | 314 | 262 | 35 | 297 | 31 | 35 |
| Dec-12 | 2.5 | 131 | 140 | 55 | 195 | 22 | 23 |
| Jan-13 | 2.5 | 171 | 200 | 31 | 231 | 19 | 20 |
| Feb-13 | 2.2 | 146 | 171 | 51 | 222 | 35 | 39 |
| Mar-13 | 2.1 | 195 | 210 | 34 | 245 | 19 | 22 |
| Apr-13 | 1.8 | 122 | 129 | 27 | 155 | 9 | 11 |
| May-13 | 2.1 | 178 | 170 | 43 | 213 | 5 | 25 |
| Jun-13 | 1.5 | 81 | 87 | 38 | 126 | 15 | 17 |
| Jul-13 | 2.2 | 262 | 254 | 29 | 283 | 20 | 21 |
| Aug-13 | 2.1 | 229 | 221 | 35 | 256 | 28 | 28 |
| Sep-13 | 2.1 | 197 | 228 | 35 | 263 | 27 | 28 |
| Oct-13 | 1.9 | 109 | 117 | 60 | 177 | 26 | 28 |
| Nov-13 | 2.3 | 177 | 158 | 51 | 209 | 32 | 33 |
| Dec-13 | 2.3 | 206 | 197 | 37 | 235 | 27 | 29 |
| Jan-14 | 2.0 | 210 | 230 | 33 | 263 | 20 | 21 |
| Feb-14 | 2.5 | 196 | 215 | 33 | 249 | 27 | 28 |
| Mar-14 | 2.4 | 181 | 172 | 49 | 221 | 27 | 31 |
| Apr-14 | 1.7 | 84 | 84 | 33 | 117 | 18 | 19 |
| May-14 | 2.1 | 152 | 144 | 58 | 202 | 29 | 30 |
| Jun-14 | 1.7 | 95 | 107 | 33 | 140 | 18 | 20 |
| Jul-14 | 1.9 | 133 | 119 | 64 | 183 | 22 | 24 |
| Aug-14 | 1.8 | 176 | 162 | 61 | 223 | 11 | 30 |
| Sep-14 | 1.8 | 191 | 198 | 34 | 232 | 6 | 15 |
| Oct-14 | 1.8 | 148 | 168 | 40 | 208 | 5 | 7 |
| Nov-14 | 1.8 | 186 | 193 | 37 | 229 | 47 | 51 |
| Dec-14 | 3.5 | 438 | 474 | 11 | 484 | 19 | 40 |
| Jan-15 | 2.1 | 218 | 194 | 82 | 251 | 24 | 29 |
| Feb-15 | 2.3 | 170 | 163 | 50 | 214 | 22 | 27 |
| Mar-15 | 2.0 | 153 | 160 | 42 | 202 | 24 | 31 |
| Apr-15 | 1.8 | 206 | 206 | 34 | 240 | 19 | 28 |
| May-15 | 1.7 | 192 | 198 | 47 | 245 | 29 | 28 |
| Jun-15 | 1.7 | 176 | 189 | 36 | 225 | 22 | 22 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day** | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 1.6 | 98 | 86 | 86 | 172 | 18 | 19 |
| Aug-15 | 1.7 | 116 | 128 | 61 | 189 | 23 | 24 |
| Sep-15 | 1.7 | 135 | 165 | 44 | 201 | 27 | 8 |
| Oct-15 | 1.7 | 153 | 151 | 54 | 181 | 34 | 22 |
| Nov-15 | 1.8 | 188 | 153 | 49 | 174 | 26 | 28 |
| Dec-15 | 1.9 | 199 | 177 | 3 | 244 | 2 | 6 |
| Jan-16 | 2.5 | 188 | 144 | 50 | 172 | 2 | 11 |
| Feb-16 | 2.0 | 173 | 181 | 33 | 209 | 6 | 13 |
| Mar-16 | 2.8 | 223 | 155 | 70 | 197 | 8 | 13 |
| Apr-16 | 2.1 | 241 | 290 | 15 | 347 | 3 | 5 |
| May-16 | 1.9 | 219 | 273 | 17 | 291 | 2 | 4 |
| Jun-16 | 1.9 | 223 | 258 | 32 | 290 | 9 | 19 |
| Jul-16 | 1.8 | 141 | 150 | 67 | 217 | 12 | 28 |
| Aug-16 | 1.8 | 165 | 148 | 39 | 187 | 12 | 21 |
| Sep-16 | 1.8 | 212 | 215 | 41 | 256 | 14 | 11 |
| Oct-16 | 1.8 | 199 | 206 | 26 | 232 | 7 | 12 |
| Nov-16 | 1.8 | 83 | 97 | 51 | 148 | 3 | 12 |
| Dec-16 | 2.2 | 154 | 105 | 122 | 227 | 4 | 8 |
| Jan-17 | 4.2 | 131 | 206 | 109 | 314 | 58 | 29 |
| Feb-17 | 4.4 | 270 | 294 | 76 | 370 | 52 | 39 |
| Mar-17 | 3.0 | 184 | 207 | 29 | 236 | 9 | 16 |
| Apr-17 | 2.6 | 111 | 124 | 173 | 297 | 24 | 37 |
| May-17 | 2.1 | 180 | 147 | 55 | 202 | 16 | 19 |
| Jun-17 | 1.9 | 140 | 133 | 51 | 78 | 7 | 13 |
| | | | | | | | |
| **Dry Season Average** | **1.9** | **171** | **172** | **45** | **213** | **18** | **22** |
| **Dry Season Trend ***** | **None** | **None** | **None** | **None** | **None** | **-** | **Down** |
| **Wet Season Average** | **2.3** | **186** | **188** | **48** | **236** | **21** | **24** |
| **Average Annual** | **2.1** | **180** | **181** | **47** | **226** | **20** | **23** |

* The City of Benicia has sampled more intensively since September 2015 than required under the Nutrient Watershed Permit. This data represents the average monthly loads during this intensive sampling period.

** The Total Nitrogen value is calculated by adding the TKN and the NOx values.

*** Refer to the Section 3.5 in the main report for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main body for a detailed discussion on this issue.

# 3 City of Burlingame

Burlingame discharges to South Bay, and serves approximately 16,000 service connections. The plant has a permitted ADWF capacity of 5.5 mgd and a peak permitted wet weather flow of 16 mgd. It has a current ADWF flow of approximately 2.6 mgd. The plant performs secondary treatment using activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table and figures with the average monthly values, there appears to be a dry season downward trend for TP loads, with a stark drop beginning in spring 2014.
- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- Wet season loads are greater and more variable year to year than the dry season loads.
- Ammonia is typically the majority of the nitrogen species discharged, regardless of season. However, from about August 2013 through June 2014, the NOx load and concentration was significantly higher than in the preceding or subsequent year, indicating the potential occurrence of nitrification.
- Ammonia concentrations are relatively consistent throughout the year (with the exception of January 2017).
- Total phosphorus concentrations were typically above 10 mg P/L in the first two reporting years and then dropped to less than 5 mg P/L in the most recent three years. This decrease in concentration is largely attributed to the change in sampling methodology between the Section 13267 Letter data and the Nutrient Watershed Permit dataset.
- The distribution of phosphorus species is predominantly ortho-P.

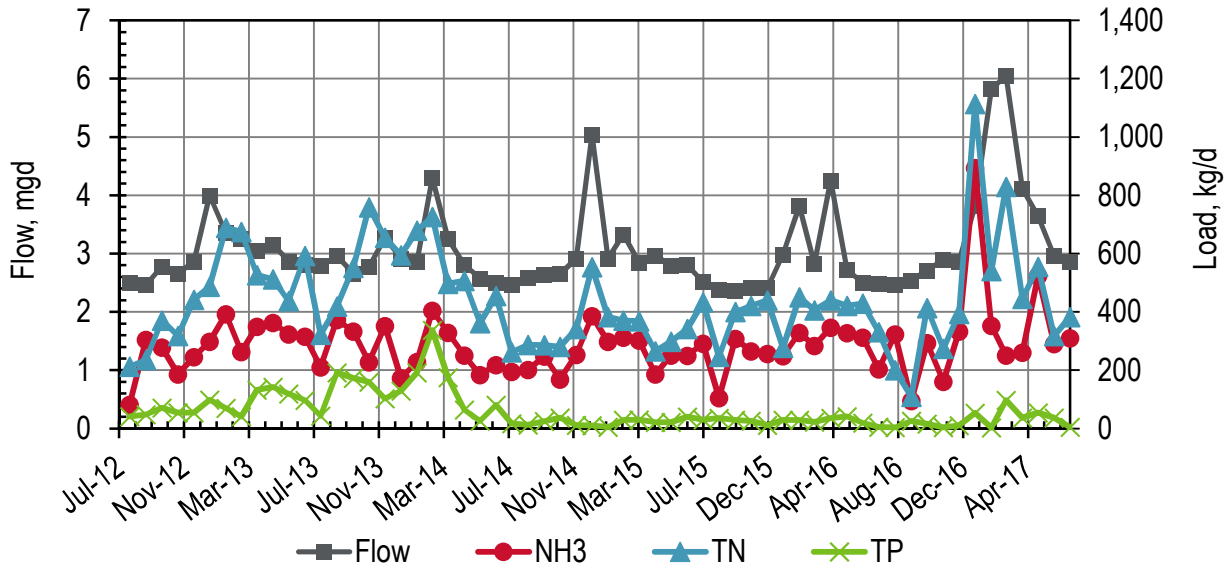


**Figure 3-1. Burlingame Monthly Flows and Loads**

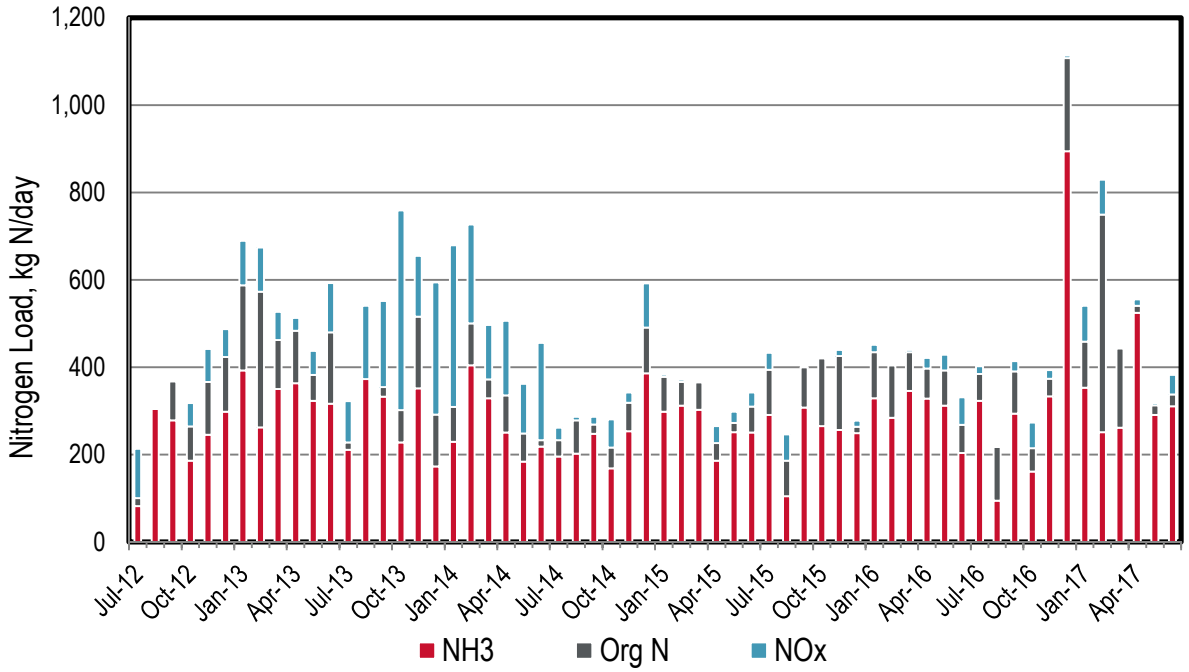


**Figure 3-2. Burlingame Monthly Nitrogen Loads**

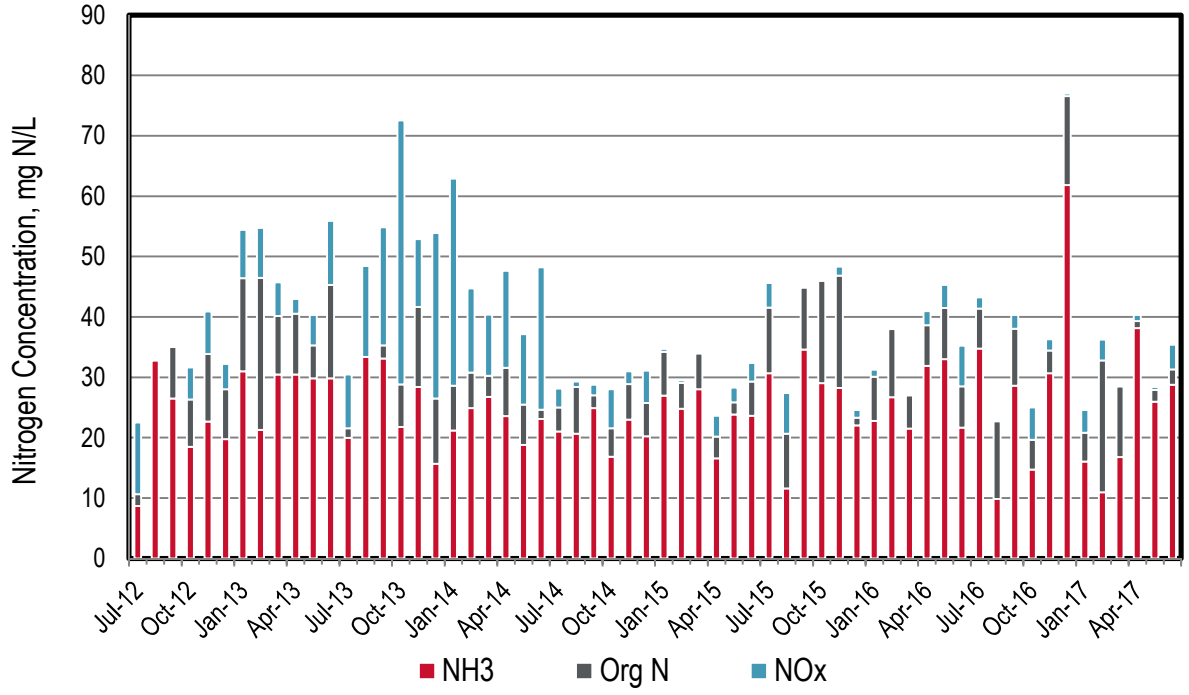


**Figure 3-3. Burlingame Monthly Nitrogen Concentrations**

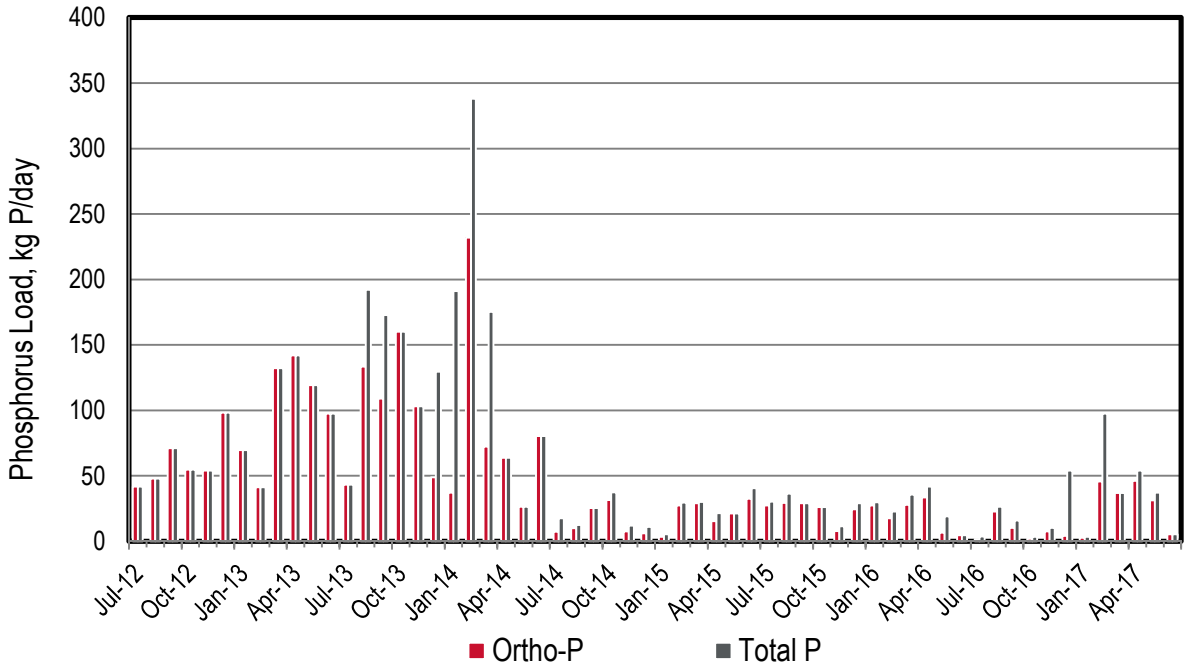


**Figure 3-4. Burlingame Monthly Phosphorus Loads**

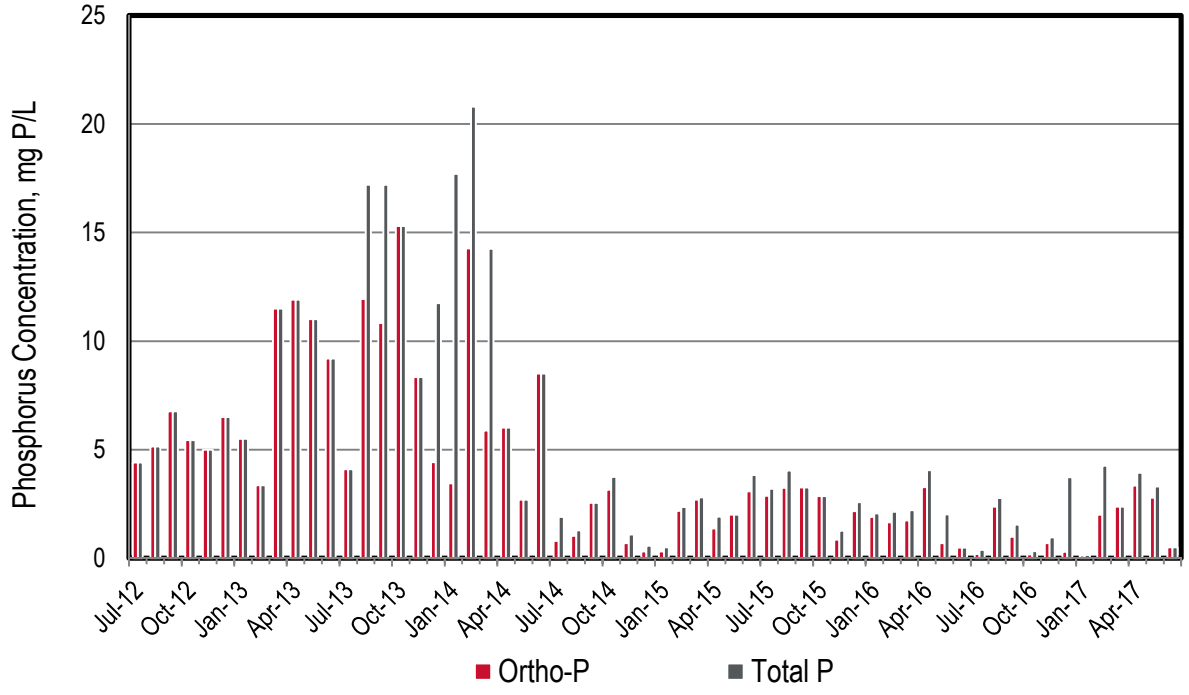


**Figure 3-5. Burlingame Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 3-1. Burlingame Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 2.5 | 82 | 101 | 112 | 213 | 127 | 42 |
| Aug-12 | 2.5 | 305 | 235 | 1 | 236 | 158 | 48 |
| Sep-12 | 2.8 | 279 | 368 | 3 | 371 | 111 | 71 |
| Oct-12 | 2.7 | 186 | 265 | 54 | 318 | 122 | 55 |
| Nov-12 | 2.9 | 245 | 366 | 76 | 442 | 122 | 54 |
| Dec-12 | 4.0 | 299 | 423 | 64 | 487 | 238 | 98 |
| Jan-13 | 3.4 | 393 | 588 | 101 | 689 | 185 | 70 |
| Feb-13 | 3.3 | 263 | 573 | 101 | 674 | 167 | 41 |
| Mar-13 | 3.0 | 350 | 462 | 64 | 526 | 142 | 132 |
| Apr-13 | 3.2 | 363 | 483 | 29 | 513 | 170 | 142 |
| May-13 | 2.9 | 323 | 383 | 55 | 437 | 222 | 119 |
| Jun-13 | 2.8 | 316 | 480 | 112 | 593 | 185 | 98 |
| Jul-13 | 2.8 | 211 | 228 | 94 | 322 | 60 | 43 |
| Aug-13 | 3.0 | 373 | 251 | 168 | 419 | 133 | 192 |
| Sep-13 | 2.7 | 333 | 355 | 197 | 551 | 109 | 173 |
| Oct-13 | 2.8 | 228 | 302 | 457 | 759 | 212 | 160 |
| Nov-13 | 3.3 | 351 | 516 | 139 | 655 | 111 | 103 |
| Dec-13 | 2.9 | 173 | 292 | 303 | 594 | 49 | 130 |
| Jan-14 | 2.9 | 229 | 309 | 370 | 679 | 37 | 191 |
| Feb-14 | 4.3 | 405 | 501 | 226 | 727 | 232 | 338 |
| Mar-14 | 3.3 | 329 | 372 | 125 | 497 | 72 | 175 |
| Apr-14 | 2.8 | 251 | 336 | 171 | 506 | 125 | 64 |
| May-14 | 2.6 | 184 | 249 | 114 | 362 | 46 | 26 |
| Jun-14 | 2.5 | 218 | 233 | 223 | 456 | 131 | 80 |
| Jul-14 | 2.5 | 195 | 233 | 29 | 262 | 7 | 18 |
| Aug-14 | 2.6 | 202 | 278 | 9 | 287 | 10 | 13 |
| Sep-14 | 2.6 | 248 | 269 | 17 | 286 | 27 | 25 |
| Oct-14 | 2.7 | 169 | 216 | 65 | 281 | 32 | 37 |
| Nov-14 | 2.9 | 254 | 319 | 23 | 342 | 8 | 12 |
| Dec-14 | 5.0 | 386 | 491 | 101 | 554 | 6 | 11 |
| Jan-15 | 2.9 | 298 | 378 | 5 | 383 | 3 | 6 |
| Feb-15 | 3.3 | 312 | 366 | 5 | 371 | 27 | 30 |
| Mar-15 | 2.9 | 302 | 366 | 3 | 368 | 29 | 30 |
| Apr-15 | 3.0 | 186 | 227 | 39 | 266 | 15 | 22 |
| May-15 | 2.8 | 251 | 273 | 26 | 298 | 22 | 21 |
| Jun-15 | 2.8 | 250 | 310 | 32 | 342 | 33 | 41 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 2.5 | 291 | 394 | 39 | 433 | 27 | 30 |
| Aug-15 | 2.4 | 105 | 186 | 60 | 246 | 29 | 36 |
| Sep-15 | 2.4 | 308 | 400 | 1 | 400 | 32 | 29 |
| Oct-15 | 2.4 | 266 | 421 | 1 | 421 | 27 | 26 |
| Nov-15 | 2.4 | 257 | 426 | 14 | 439 | 8 | 12 |
| Dec-15 | 3.0 | 249 | 263 | 14 | 278 | 25 | 29 |
| Jan-16 | 3.8 | 329 | 434 | 17 | 451 | 27 | 30 |
| Feb-16 | 2.8 | 284 | 405 | 2 | 406 | 18 | 23 |
| Mar-16 | 4.3 | 346 | 435 | 5 | 440 | 28 | 36 |
| Apr-16 | 2.7 | 328 | 397 | 24 | 421 | 34 | 42 |
| May-16 | 2.5 | 312 | 393 | 36 | 428 | 7 | 19 |
| Jun-16 | 2.5 | 204 | 268 | 63 | 331 | 28 | 5 |
| Jul-16 | 2.5 | 323 | 385 | 17 | 201 | 2 | 4 |
| Aug-16 | 2.5 | 95 | 218 | 0 | 109 | 23 | 26 |
| Sep-16 | 2.7 | 294 | 391 | 23 | 414 | 10 | 16 |
| Oct-16 | 2.9 | 161 | 215 | 58 | 273 | 2 | 4 |
| Nov-16 | 2.9 | 333 | 373 | 20 | 394 | 7 | 10 |
| Dec-16 | 3.8 | 894 | 1,107 | 6 | 1,113 | 4 | 54 |
| Jan-17 | 5.8 | 353 | 459 | 82 | 541 | 3 | 3 |
| Feb-17 | 6.0 | 251 | 750 | 80 | 829 | 46 | 97 |
| Mar-17 | 4.1 | 261 | 443 | 2 | 445 | 37 | 37 |
| Apr-17 | 3.6 | 525 | 541 | 14 | 555 | 46 | 54 |
| May-17 | 3.0 | 291 | 313 | 5 | 318 | 31 | 37 |
| Jun-17 | 2.9 | 311 | 338 | 44 | 382 | 6 | 5 |
| | | | | | | | |
| **Dry Season Average** | **2.6** | **252** | **301** | **59** | **348** | **63** | **49** |
| **Dry Season Trend **** | **None** | **None** | **None** | **None** | **None** | **-** | **Down** |
| **Wet Season Average** | **3.4** | **309** | **423** | **82** | **504** | **69** | **67** |
| **Average Annual** | **3.1** | **285** | **372** | **72** | **439** | **67** | **60** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 4 Central Contra Costa Sanitary District (CCCSD)

CCCSD discharges to Suisun Bay, and serves approximately 115,100 service connections. The plant has a permitted ADWF capacity of 53.8 mgd and a peak wet weather influent design flow of 250 mgd. It has a current ADWF flow of approximately 32 mgd. The plant performs secondary treatment using activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table and figures with the average monthly values, there appears to be an upward trend for NOx loads.
- Ammonia, TKN and TN loads increase with flow during wet weather events.
- Wet season loads are greater than the dry season loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not fully nitrify.
- Ammonia concentrations are greatest during the dry season and it becomes more pronounced towards the end of the dry season.
- Total phosphorus concentrations are generally less than 1.5 mg P/L, which is lower than typical effluent concentrations of 4 to 6 mg P/L. This indicates the plant is reliably removing phosphorus.

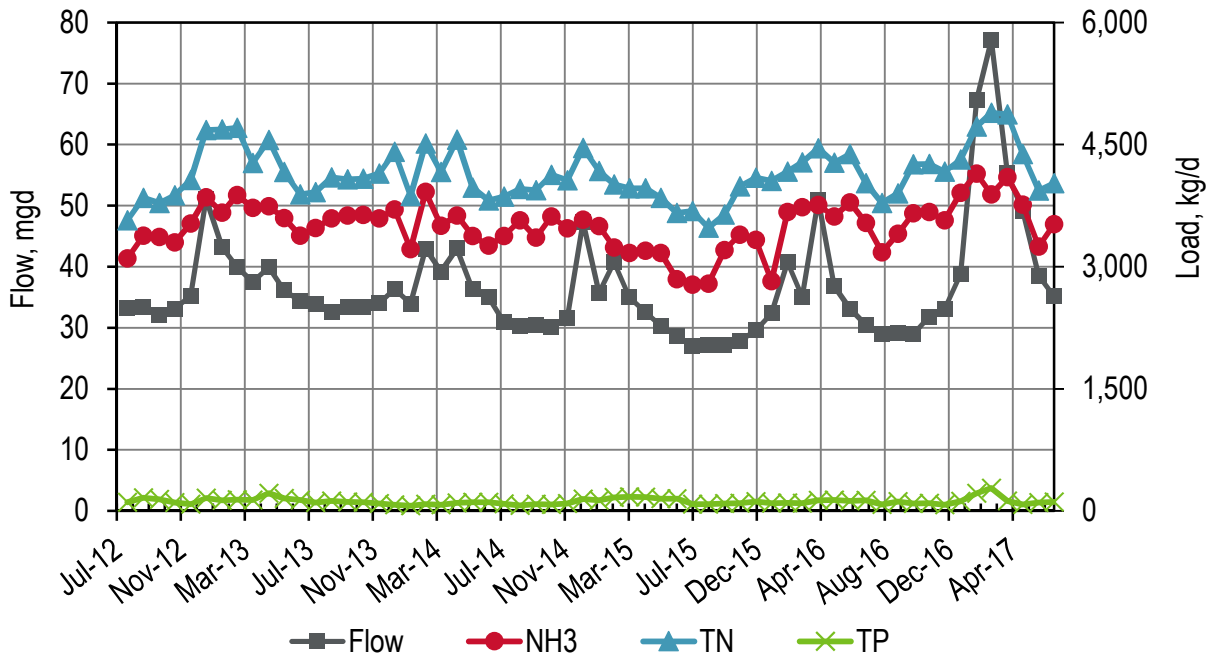


**Figure 4-1. CCCSD Monthly Flows and Loads**

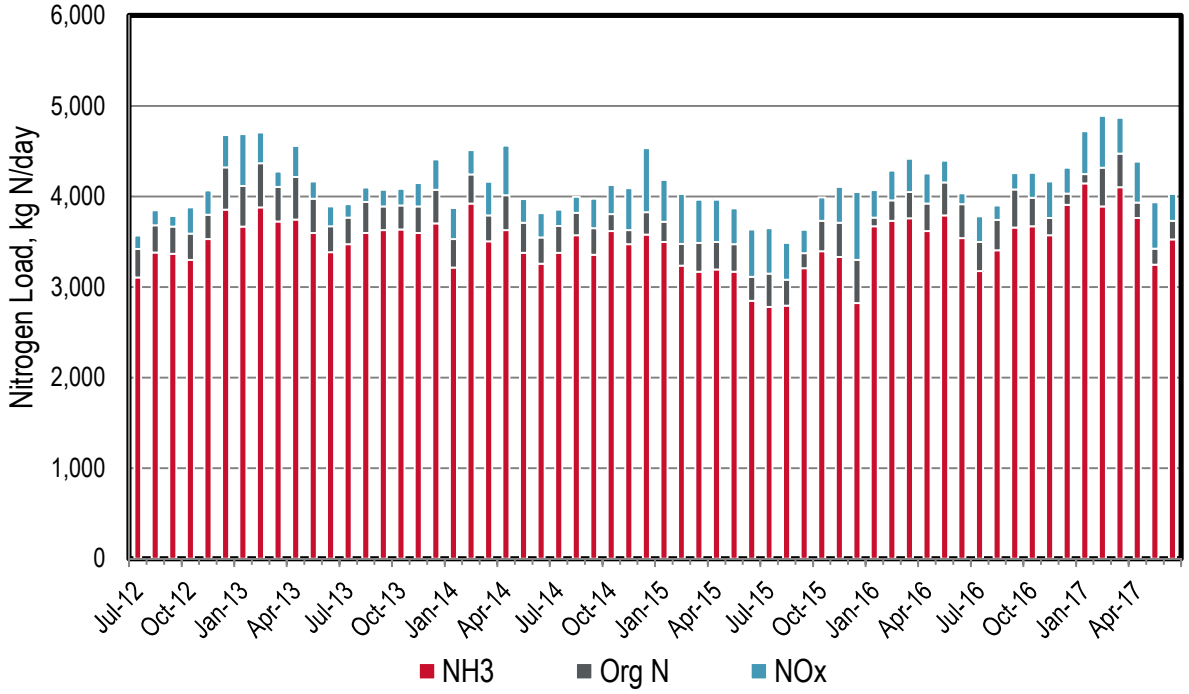


**Figure 4-2. CCCSD Monthly Nitrogen Loads**

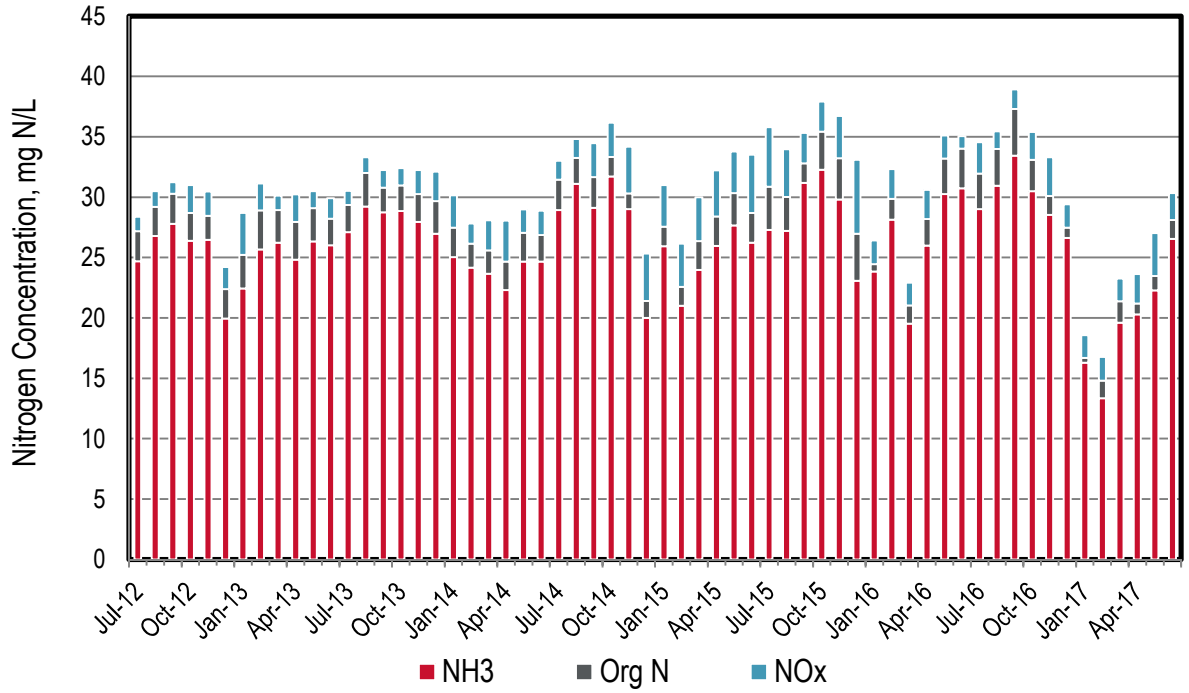


**Figure 4-3. CCCSD Monthly Nitrogen Concentrations**

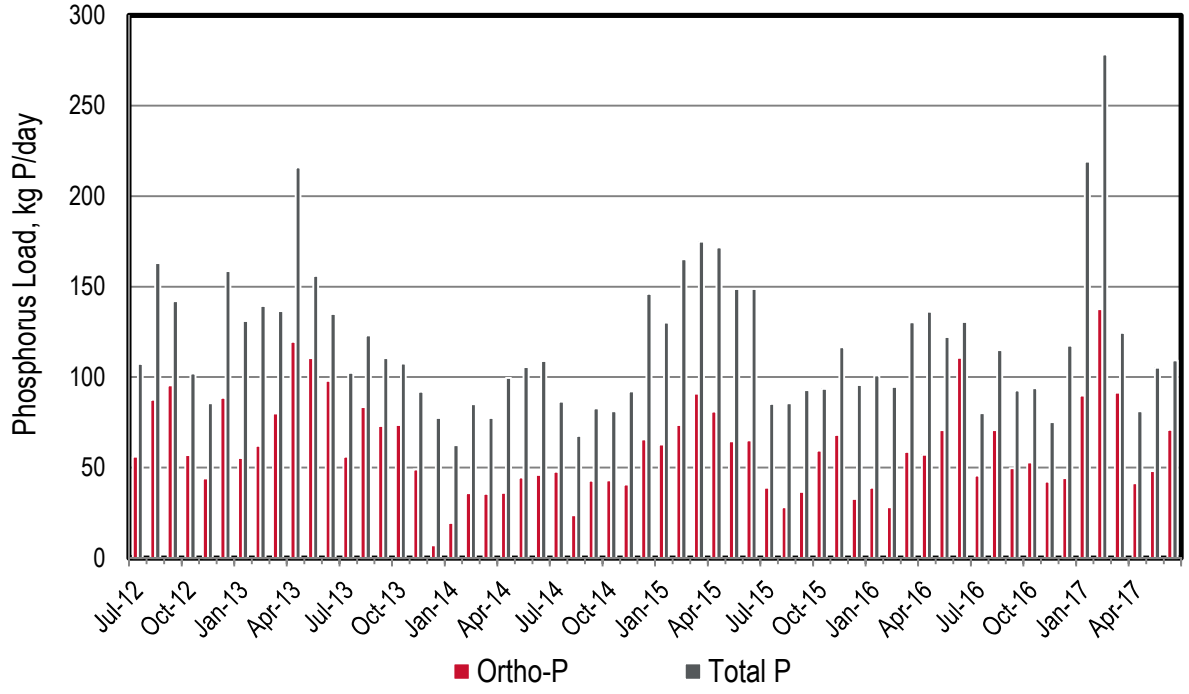


**Figure 4-4. CCCSD Monthly Phosphorus Loads**

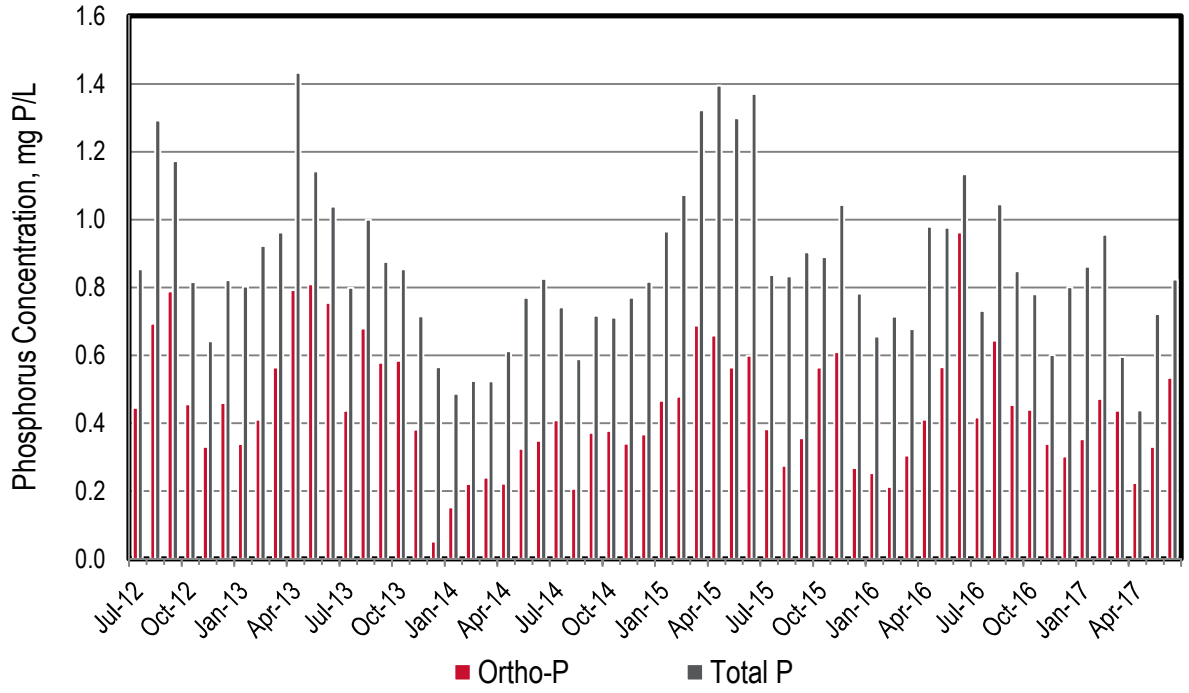


**Figure 4-5. CCCSD Monthly Phosphorus Concentrations**

## Table 4-1. CCCSD Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 33.3 | 3,104 | 3,420 | 150 | 3,570 | 56 | 107 |
| Aug-12 | 33.4 | 3,381 | 3,683 | 165 | 3,847 | 88 | 163 |
| Sep-12 | 32.0 | 3,367 | 3,669 | 116 | 3,784 | 96 | 142 |
| Oct-12 | 33.1 | 3,301 | 3,588 | 290 | 3,877 | 57 | 102 |
| Nov-12 | 35.3 | 3,530 | 3,797 | 269 | 4,065 | 44 | 86 |
| Dec-12 | 51.1 | 3,855 | 4,322 | 357 | 4,678 | 89 | 159 |
| Jan-13 | 43.2 | 3,666 | 4,117 | 569 | 4,686 | 55 | 131 |
| Feb-13 | 40.0 | 3,879 | 4,366 | 340 | 4,706 | 62 | 139 |
| Mar-13 | 37.6 | 3,723 | 4,106 | 170 | 4,276 | 80 | 137 |
| Apr-13 | 39.9 | 3,744 | 4,214 | 344 | 4,558 | 120 | 216 |
| May-13 | 36.1 | 3,598 | 3,975 | 191 | 4,165 | 111 | 156 |
| Jun-13 | 34.4 | 3,383 | 3,669 | 220 | 3,888 | 98 | 135 |
| Jul-13 | 33.9 | 3,474 | 3,765 | 149 | 3,914 | 56 | 102 |
| Aug-13 | 32.6 | 3,596 | 3,940 | 160 | 4,099 | 84 | 123 |
| Sep-13 | 33.4 | 3,630 | 3,890 | 184 | 4,073 | 73 | 111 |
| Oct-13 | 33.3 | 3,636 | 3,902 | 182 | 4,083 | 74 | 108 |
| Nov-13 | 34.0 | 3,596 | 3,892 | 255 | 4,146 | 49 | 92 |
| Dec-13 | 36.3 | 3,704 | 4,074 | 336 | 4,410 | 7 | 78 |
| Jan-14 | 34.0 | 3,216 | 3,529 | 342 | 3,871 | 20 | 63 |
| Feb-14 | 42.9 | 3,922 | 4,243 | 270 | 4,513 | 36 | 85 |
| Mar-14 | 39.2 | 3,505 | 3,793 | 370 | 4,163 | 36 | 78 |
| Apr-14 | 43.0 | 3,628 | 4,013 | 550 | 4,563 | 36 | 100 |
| May-14 | 36.3 | 3,379 | 3,709 | 264 | 3,972 | 45 | 106 |
| Jun-14 | 35.0 | 3,259 | 3,548 | 268 | 3,816 | 46 | 109 |
| Jul-14 | 30.9 | 3,378 | 3,673 | 182 | 3,861 | 48 | 87 |
| Aug-14 | 30.4 | 3,572 | 3,818 | 178 | 3,954 | 24 | 68 |
| Sep-14 | 30.5 | 3,358 | 3,650 | 325 | 3,939 | 43 | 83 |
| Oct-14 | 30.2 | 3,618 | 3,805 | 323 | 4,129 | 43 | 81 |
| Nov-14 | 31.7 | 3,472 | 3,627 | 465 | 4,061 | 41 | 92 |
| Dec-14 | 47.3 | 3,578 | 3,827 | 705 | 4,458 | 66 | 146 |
| Jan-15 | 35.7 | 3,499 | 3,719 | 463 | 4,177 | 63 | 130 |
| Feb-15 | 40.7 | 3,236 | 3,476 | 550 | 4,009 | 74 | 165 |
| Mar-15 | 35.0 | 3,168 | 3,486 | 479 | 3,964 | 91 | 175 |
| Apr-15 | 32.6 | 3,195 | 3,497 | 467 | 3,965 | 81 | 172 |
| May-15 | 30.3 | 3,168 | 3,474 | 395 | 3,847 | 65 | 149 |
| Jun-15 | 28.7 | 2,848 | 3,113 | 524 | 3,659 | 65 | 149 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 27.0 | 2,782 | 3,148 | 501 | 3,682 | 39 | 85 |
| Aug-15 | 27.2 | 2,794 | 3,081 | 406 | 3,481 | 28 | 86 |
| Sep-15 | 27.2 | 3,206 | 3,373 | 260 | 3,642 | 37 | 93 |
| Oct-15 | 27.8 | 3,395 | 3,729 | 260 | 3,989 | 59 | 94 |
| Nov-15 | 29.6 | 3,331 | 3,710 | 393 | 4,092 | 68 | 116 |
| Dec-15 | 32.4 | 2,823 | 3,301 | 747 | 4,053 | 33 | 96 |
| Jan-16 | 40.7 | 3,671 | 3,766 | 302 | 4,166 | 39 | 101 |
| Feb-16 | 35.1 | 3,730 | 3,959 | 327 | 4,280 | 28 | 95 |
| Mar-16 | 50.9 | 3,758 | 4,050 | 365 | 4,456 | 59 | 130 |
| Apr-16 | 36.8 | 3,617 | 3,922 | 333 | 4,276 | 57 | 136 |
| May-16 | 33.1 | 3,790 | 4,156 | 239 | 4,384 | 71 | 122 |
| Jun-16 | 30.5 | 3,538 | 3,916 | 120 | 4,028 | 111 | 130 |
| Jul-16 | 29.0 | 3,176 | 3,498 | 283 | 3,781 | 46 | 80 |
| Aug-16 | 29.1 | 3,405 | 3,741 | 159 | 3,900 | 71 | 115 |
| Sep-16 | 28.9 | 3,656 | 4,078 | 178 | 4,257 | 50 | 93 |
| Oct-16 | 31.8 | 3,671 | 3,984 | 277 | 4,261 | 53 | 94 |
| Nov-16 | 33.1 | 3,570 | 3,764 | 402 | 4,167 | 42 | 75 |
| Dec-16 | 38.8 | 3,907 | 4,031 | 284 | 4,316 | 44 | 117 |
| Jan-17 | 67.3 | 4,144 | 4,247 | 475 | 4,722 | 90 | 219 |
| Feb-17 | 77.1 | 3,889 | 4,317 | 574 | 4,891 | 137 | 278 |
| Mar-17 | 55.4 | 4,100 | 4,472 | 397 | 4,870 | 91 | 124 |
| Apr-17 | 49.1 | 3,764 | 3,931 | 454 | 4,385 | 41 | 81 |
| May-17 | 38.6 | 3,248 | 3,422 | 515 | 3,937 | 48 | 105 |
| Jun-17 | 35.1 | 3,525 | 3,731 | 296 | 4,027 | 71 | 109 |
| | | | | | | | |
| **Dry Season Average** | **31.9** | **3,345** | **3,646** | **257** | **3,900** | **63** | **112** |
| **Dry Season Trend **** | **None** | **None** | **None** | **Up** | **None** | **-** | **None** |
| **Wet Season Average** | **40.1** | **3,601** | **3,902** | **391** | **4,294** | **59** | **123** |
| **Average Annual** | **36.6** | **3,494** | **3,795** | **335** | **4,130** | **60** | **118** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 5 Central Marin Sanitation Agency (CMSA)

CMSA discharges to the Central Bay Subembayment, and serves approximately 52,200 service connections. The plant has a permitted ADWF capacity of 10.0 mgd. It has a current ADWF flow of approximately 5.5 mgd. The plant performs secondary treatment using a trickling filter and activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- Based on the table and figures with the average monthly values, there appears to be an upward dry season trend for ammonia, TKN, and total nitrogen loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since the plant was not designed to nitrify (some nitrification does occur in the secondary process, most likely in the biotowers).
- Ammonia, TKN, and total nitrogen concentrations increase during the dry weather season as flows decrease and temperatures increase.
- Total phosphorus concentrations range from less than 1 mg P/L to 6 mg P/L.
- The distribution of phosphorus species predominantly ortho-P.

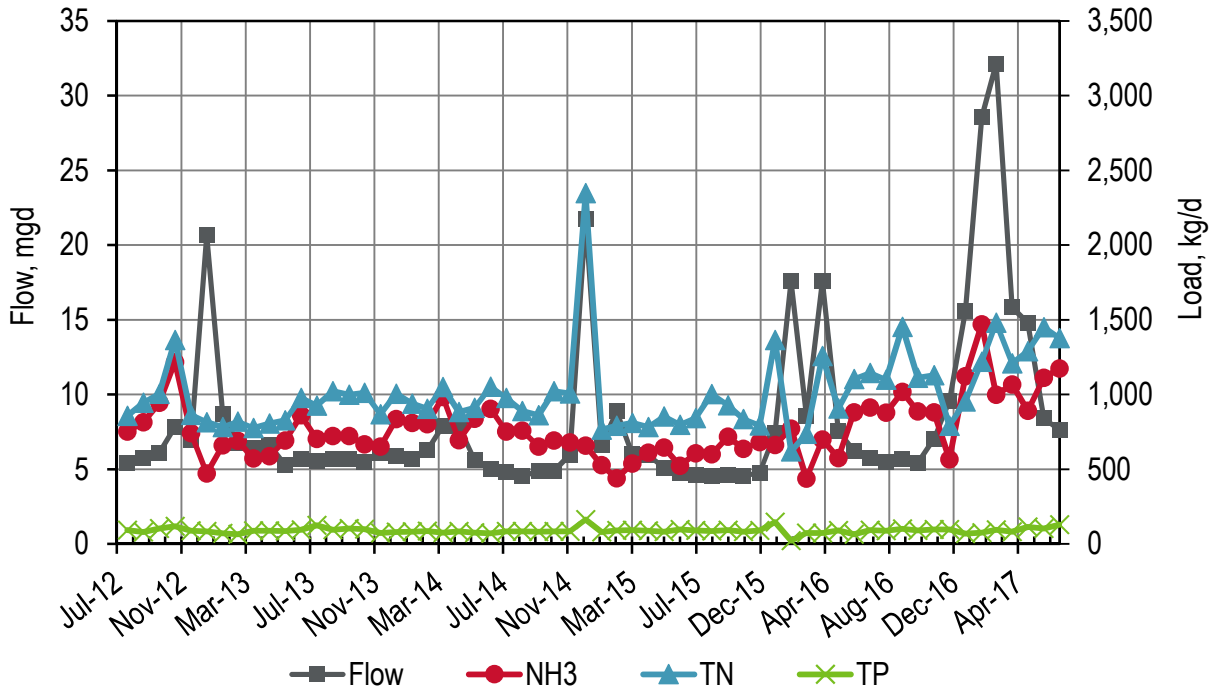


**Figure 5-1. CMSA Monthly Flows and Loads**

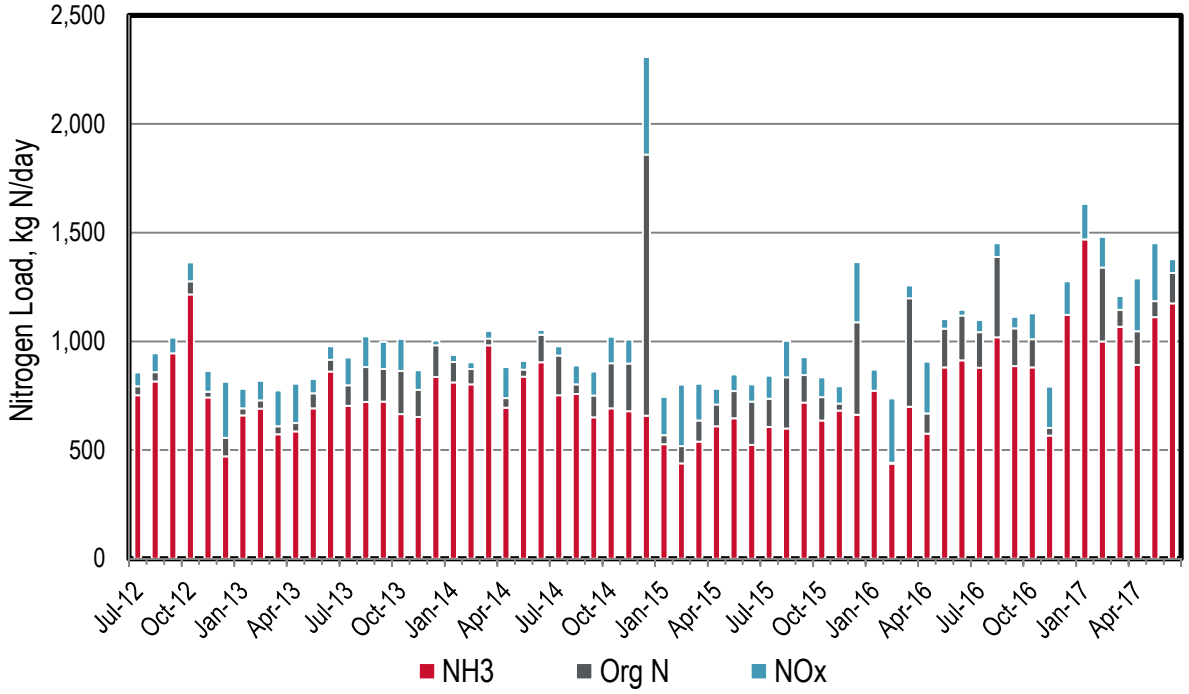


**Figure 5-2. CMSA Monthly Nitrogen Loads**

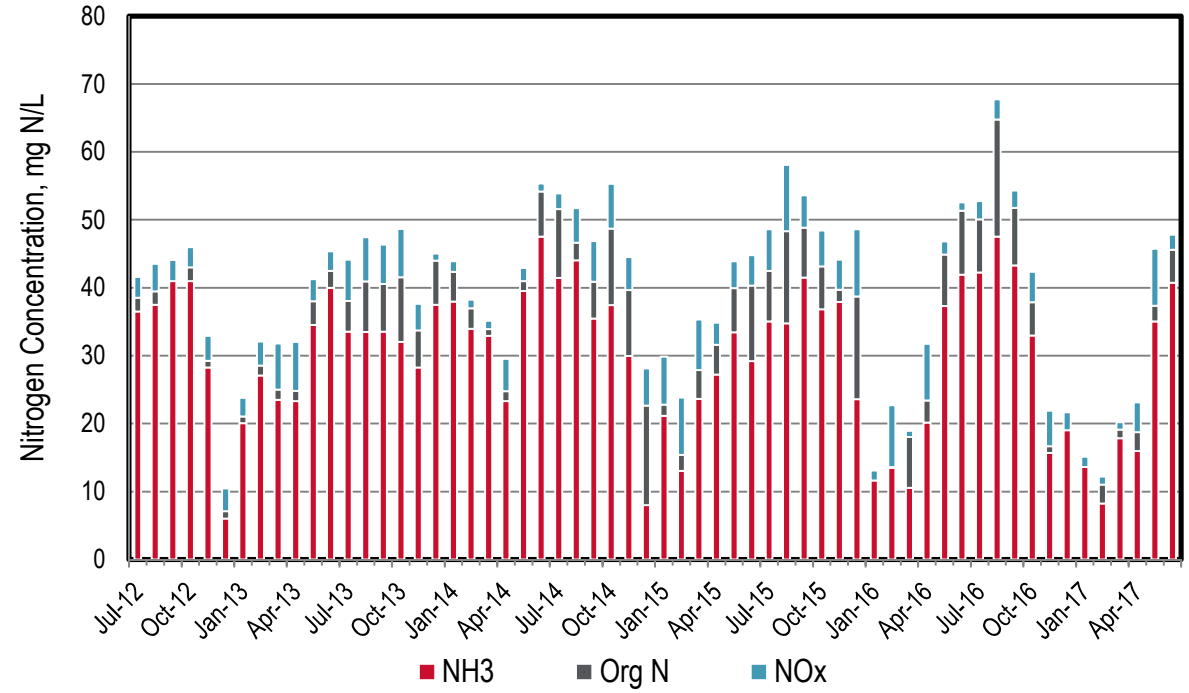


**Figure 5-3. CMSA Monthly Nitrogen Concentrations**

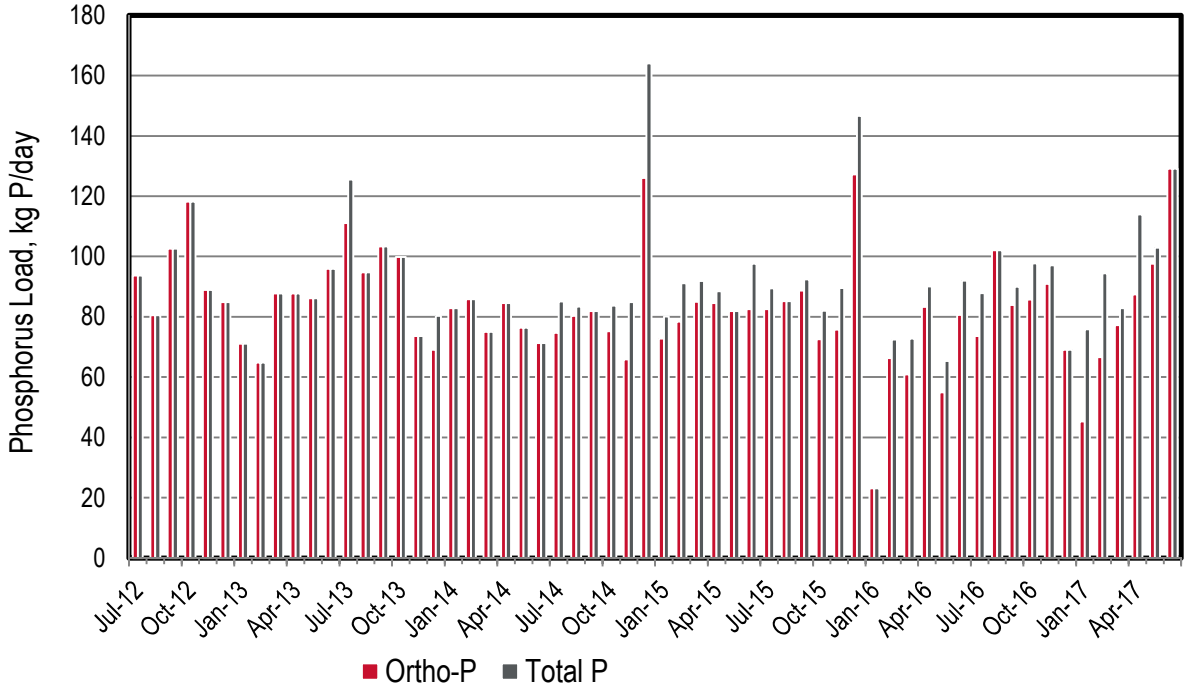


**Figure 5-4. CMSA Monthly Phosphorus Loads**

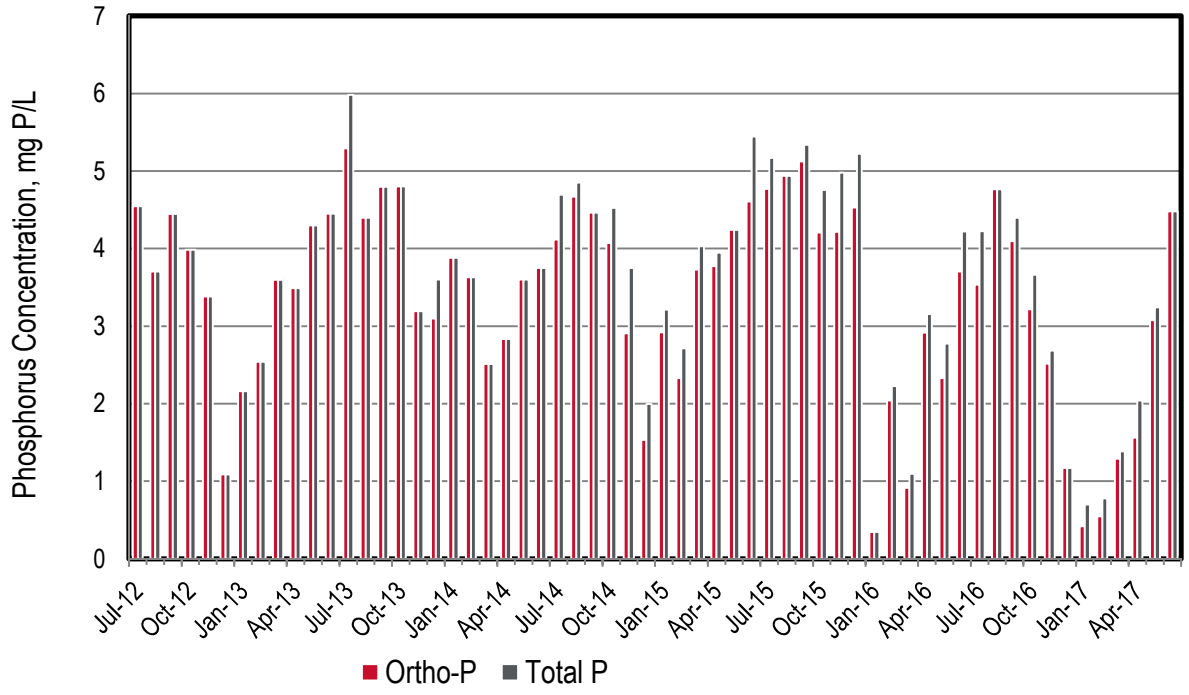


**Figure 5-5. CMSA Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 5-1. CMSA Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 5.5 | 752 | 793 | 63 | 857 | 125 | 94 |
| Aug-12 | 5.8 | 815 | 858 | 87 | 946 | 103 | 81 |
| Sep-12 | 6.1 | 945 | 934 | 72 | 1,006 | 142 | 103 |
| Oct-12 | 7.9 | 1,217 | 1,276 | 88 | 1,363 | 178 | 118 |
| Nov-12 | 7.0 | 742 | 768 | 96 | 864 | 102 | 89 |
| Dec-12 | 20.7 | 471 | 556 | 258 | 814 | 322 | 85 |
| Jan-13 | 8.7 | 660 | 692 | 89 | 782 | 86 | 71 |
| Feb-13 | 6.8 | 691 | 729 | 90 | 819 | 89 | 65 |
| Mar-13 | 6.5 | 573 | 610 | 165 | 775 | 128 | 88 |
| Apr-13 | 6.7 | 586 | 624 | 180 | 805 | 128 | 88 |
| May-13 | 5.3 | 692 | 762 | 65 | 827 | 125 | 86 |
| Jun-13 | 5.7 | 862 | 916 | 62 | 977 | 132 | 96 |
| Jul-13 | 5.6 | 703 | 798 | 128 | 926 | 111 | 126 |
| Aug-13 | 5.7 | 721 | 882 | 140 | 1,022 | 125 | 95 |
| Sep-13 | 5.7 | 722 | 874 | 125 | 999 | 137 | 103 |
| Oct-13 | 5.5 | 666 | 863 | 148 | 1,011 | 148 | 100 |
| Nov-13 | 6.1 | 652 | 778 | 89 | 867 | 116 | 74 |
| Dec-13 | 5.9 | 836 | 981 | 22 | 1,004 | 69 | 80 |
| Jan-14 | 5.7 | 810 | 905 | 33 | 937 | 105 | 83 |
| Feb-14 | 6.3 | 802 | 873 | 31 | 904 | 99 | 86 |
| Mar-14 | 7.9 | 982 | 1,012 | 36 | 1,049 | 99 | 75 |
| Apr-14 | 7.9 | 695 | 739 | 143 | 882 | 113 | 85 |
| May-14 | 5.6 | 838 | 869 | 41 | 910 | 108 | 76 |
| Jun-14 | 5.0 | 903 | 1,030 | 23 | 1,053 | 72 | 71 |
| Jul-14 | 4.8 | 752 | 935 | 42 | 977 | 75 | 85 |
| Aug-14 | 4.5 | 757 | 802 | 88 | 889 | 80 | 83 |
| Sep-14 | 4.9 | 651 | 751 | 110 | 861 | 82 | 82 |
| Oct-14 | 4.9 | 692 | 900 | 122 | 1,022 | 75 | 84 |
| Nov-14 | 6.0 | 678 | 898 | 110 | 1,008 | 66 | 85 |
| Dec-14 | 21.7 | 658 | 1,859 | 449 | 2,347 | 126 | 164 |
| Jan-15 | 6.6 | 527 | 568 | 176 | 766 | 73 | 80 |
| Feb-15 | 8.9 | 439 | 518 | 283 | 792 | 78 | 91 |
| Mar-15 | 6.0 | 539 | 636 | 169 | 809 | 85 | 92 |
| Apr-15 | 5.9 | 610 | 709 | 72 | 783 | 85 | 89 |
| May-15 | 5.1 | 645 | 771 | 77 | 852 | 106 | 82 |
| Jun-15 | 4.7 | 524 | 723 | 80 | 798 | 83 | 98 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 4.6 | 607 | 736 | 106 | 842 | 83 | 89 |
| Aug-15 | 4.6 | 600 | 834 | 168 | 1,002 | 94 | 85 |
| Sep-15 | 4.6 | 718 | 845 | 83 | 928 | 89 | 92 |
| Oct-15 | 4.6 | 636 | 744 | 91 | 835 | 73 | 82 |
| Nov-15 | 4.8 | 681 | 713 | 80 | 793 | 76 | 90 |
| Dec-15 | 7.4 | 663 | 1,088 | 277 | 1,364 | 127 | 147 |
| Jan-16 | 17.6 | 772 | 521 | 98 | 619 | 25 | 23 |
| Feb-16 | 8.6 | 438 | 441 | 296 | 737 | 66 | 72 |
| Mar-16 | 17.6 | 700 | 1,199 | 59 | 1,257 | 61 | 73 |
| Apr-16 | 7.5 | 575 | 668 | 238 | 906 | 83 | 90 |
| May-16 | 6.2 | 880 | 1,058 | 45 | 1,103 | 55 | 65 |
| Jun-16 | 5.8 | 913 | 1,118 | 27 | 1,145 | 81 | 92 |
| Jul-16 | 5.5 | 879 | 1,042 | 56 | 1,098 | 74 | 88 |
| Aug-16 | 5.7 | 1,018 | 1,388 | 64 | 1,452 | 110 | 102 |
| Sep-16 | 5.4 | 887 | 1,060 | 53 | 1,112 | 84 | 90 |
| Oct-16 | 7.1 | 880 | 1,010 | 120 | 1,130 | 86 | 98 |
| Nov-16 | 9.6 | 567 | 602 | 189 | 791 | 91 | 97 |
| Dec-16 | 15.6 | 1,122 | 800 | 154 | 954 | 73 | 69 |
| Jan-17 | 28.6 | 1,470 | 1,055 | 163 | 1,219 | 45 | 76 |
| Feb-17 | 32.1 | 999 | 1,340 | 141 | 1,481 | 67 | 94 |
| Mar-17 | 15.8 | 1,067 | 1,145 | 64 | 1,209 | 77 | 83 |
| Apr-17 | 14.8 | 892 | 1,047 | 243 | 1,290 | 87 | 114 |
| May-17 | 8.4 | 1,111 | 1,184 | 267 | 1,451 | 98 | 103 |
| Jun-17 | 7.6 | 1,175 | 1,314 | 63 | 1,378 | 139 | 129 |
| | | | | | | | |
| **Dry Season Average** | **5.5** | **803** | **931** | **85** | **1,016** | **100** | **92** |
| **Dry Season Trend **** | **None** | **Up** | **Up** | **None** | **Up** | **-** | **None** |
| **Wet Season Average** | **10.3** | **742** | **853** | **145** | **1,000** | **97** | **88** |
| **Average Annual** | **8.3** | **768** | **886** | **120** | **1,007** | **99** | **90** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 6 Crockett Community Services District - Port Costa

The Crockett Community Services District serves two distinct separate communities, the town of Crockett and the town of Port Costa, each with their own treatment plant facilities. The Crockett Sanitary Department is excluded from the requirements of the Nutrient NPDES Order No. R2-2014-0014 as it shares use of an industrial wastewater treatment plant with C&H Sugar which has submitted its own sampling plan. The town of Port Costa has its own municipal wastewater treatment plant which is covered under the Nutrient NPDES Order. This analysis focuses on Port Costa.

The Community of Port Costa uses the Port Costa Wastewater Treatment Plant to discharge to the Carquinez Straight, which is connected to San Pablo Bay. The service area population is approximately 250 people. The plant has a permitted ADWF capacity of 0.033 mgd. It has a current ADWF flow of approximately 0.008 mgd. The plant performs secondary treatment using a septic tank for solids separation, followed by filtration and disinfection.

Port Costa was exempt from the Section 13267 Letter sampling requirements due to their permitted capacity flow (<1 mgd). The following observations are made based upon the available data presented in figures and table in the subsequent pages:

- The dataset is limited to flow, ammonia a few times per year, and most recently a few TN and TP samples. Based on the average monthly values in the table and figures below, there appears to be an emerging upward dry season trend for flow. There is insufficient dry season nutrient data to perform trend analysis.
- Ammonia loads typically increase with flow during wet weather events. There is insufficient TN and TP data to comment on trends.

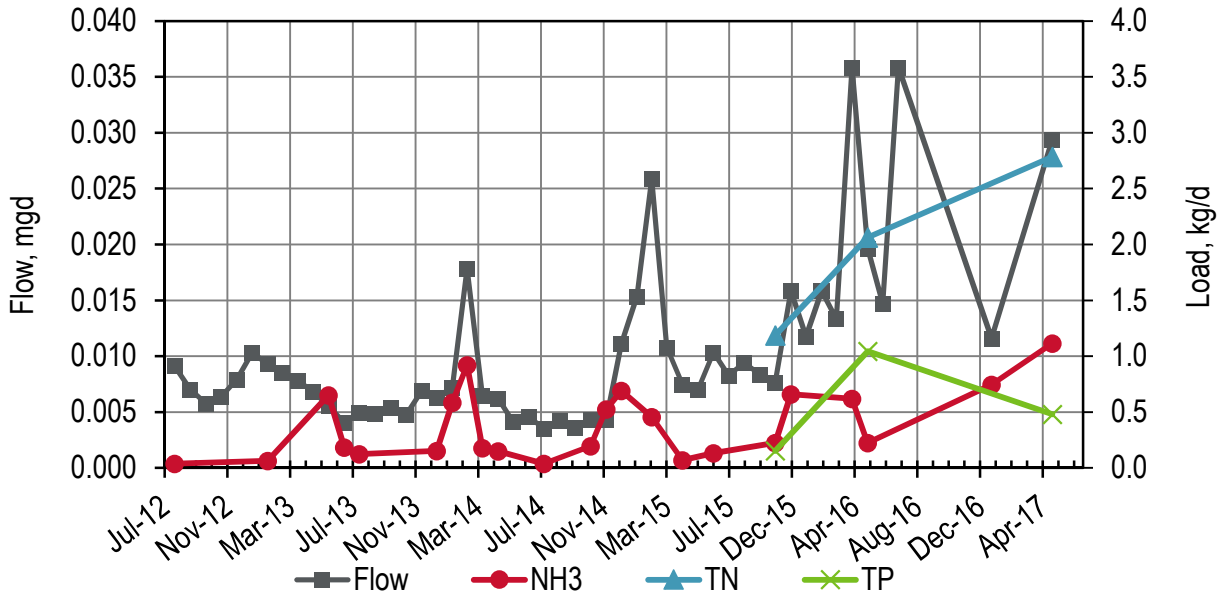


**Figure 6-1. Port Costa Monthly Flows and Loads**

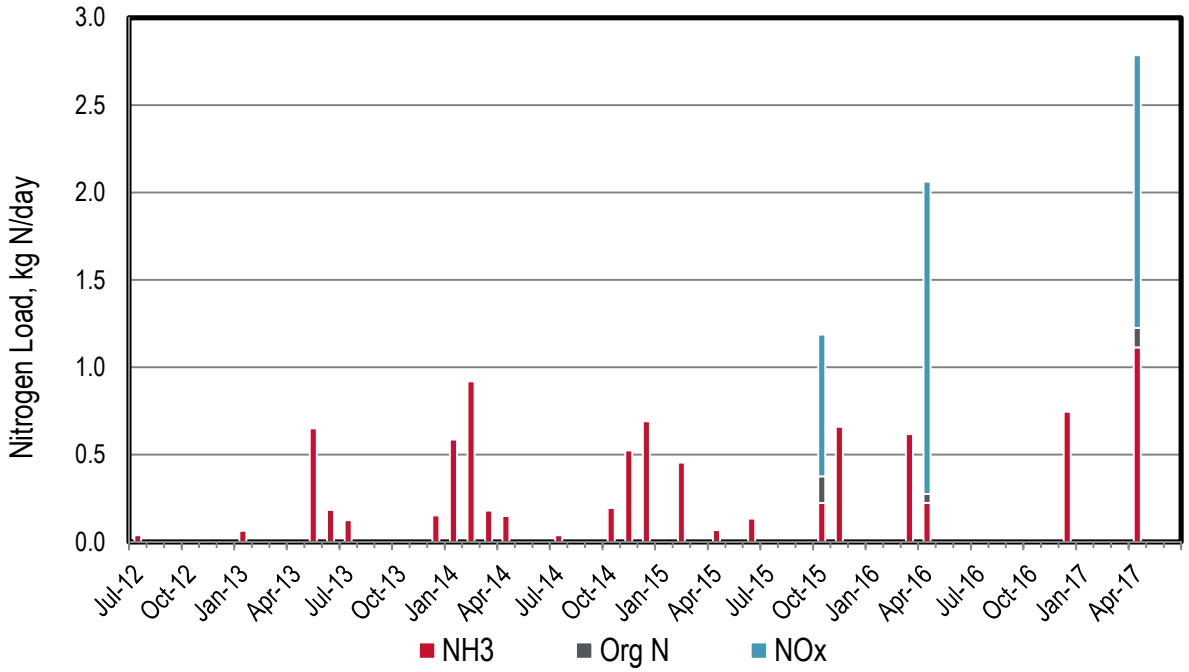


**Figure 6-2. Port Costa Monthly Ammonia Loads**

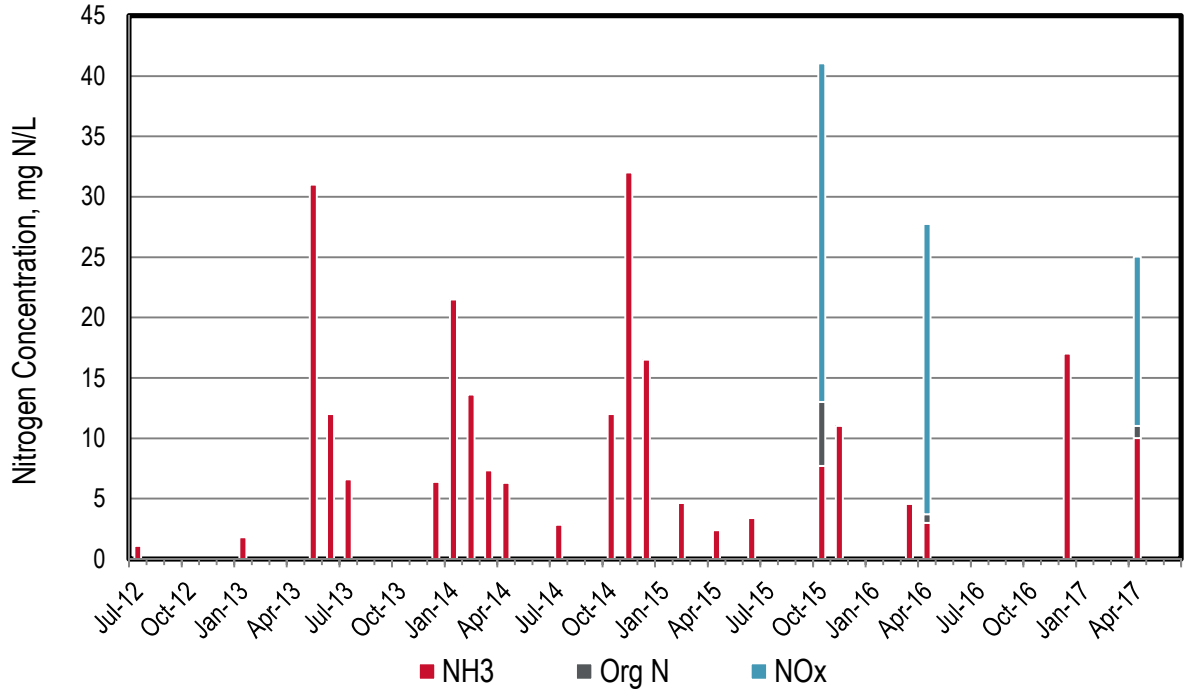


**Figure 6-3. Port Costa Monthly Ammonia Concentrations**

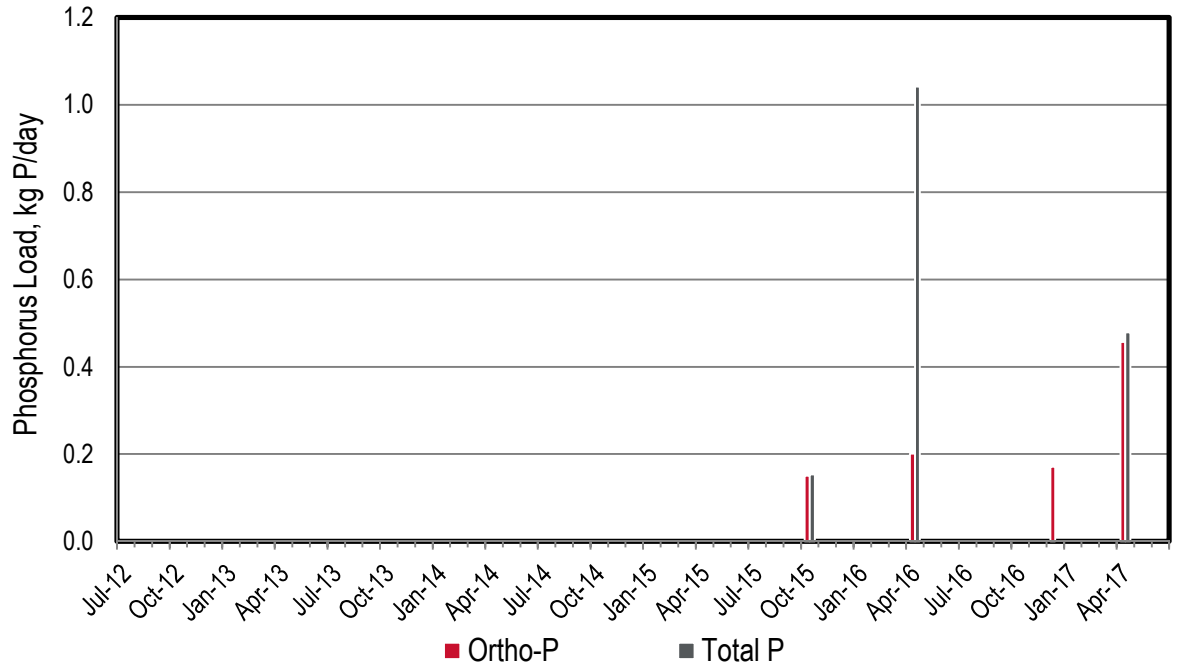


**Figure 6-4. Port Costa Monthly Phosphorus Loads**

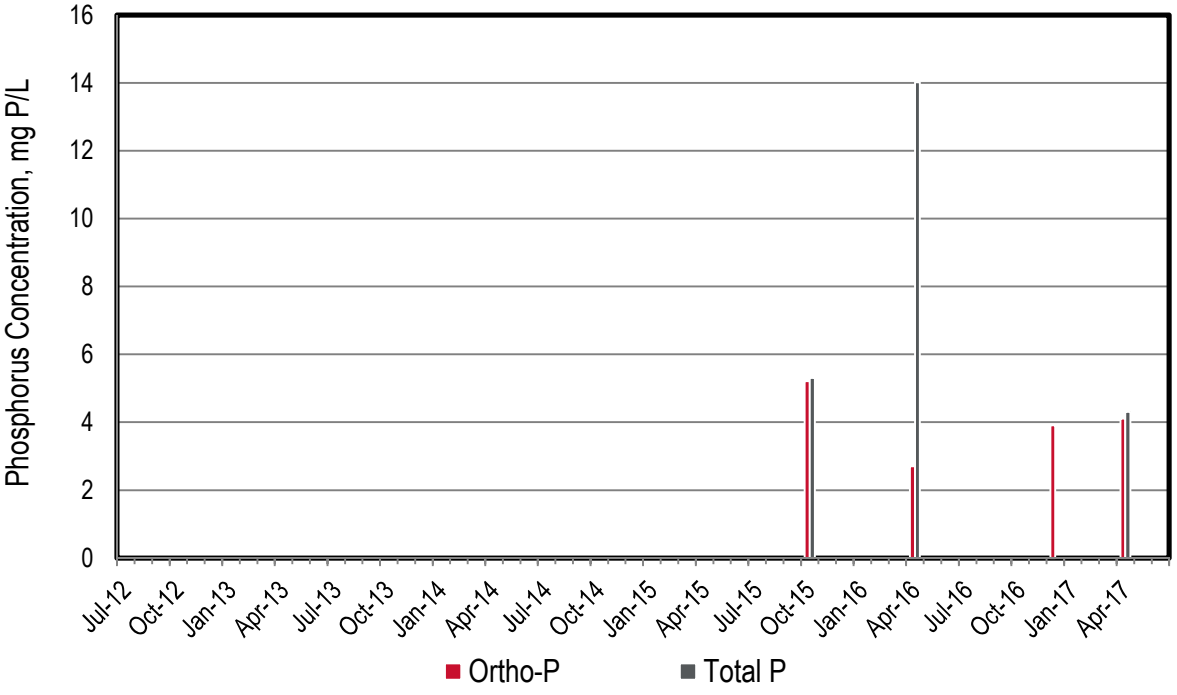


**Figure 6-5. Port Costa Monthly Phosphorus Concentrations**

## Table 6-1. Port Costa Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.009 | 0.0 | | | | | |
| Aug-12 | 0.007 | | | | | | |
| Sep-12 | 0.006 | | | | | | |
| Oct-12 | 0.006 | | | | | | |
| Nov-12 | 0.008 | | | | | | |
| Dec-12 | 0.010 | | | | | | |
| Jan-13 | 0.009 | 0.1 | | | | | |
| Feb-13 | 0.009 | | | | | | |
| Mar-13 | 0.008 | | | | | | |
| Apr-13 | 0.007 | | | | | | |
| May-13 | 0.006 | 0.7 | | | | | |
| Jun-13 | 0.004 | 0.2 | | | | | |
| Jul-13 | 0.005 | 0.1 | | | | | |
| Aug-13 | 0.005 | | | | | | |
| Sep-13 | 0.005 | | | | | | |
| Oct-13 | 0.005 | | | | | | |
| Nov-13 | 0.007 | | | | | | |
| Dec-13 | 0.006 | 0.2 | | | | | |
| Jan-14 | 0.007 | 0.6 | | | | | |
| Feb-14 | 0.018 | 0.9 | | | | | |
| Mar-14 | 0.006 | 0.2 | | | | | |
| Apr-14 | 0.006 | 0.1 | | | | | |
| May-14 | 0.004 | | | | | | |
| Jun-14 | 0.005 | | | | | | |
| Jul-14 | 0.004 | 0.0 | | | | | |
| Aug-14 | 0.004 | | | | | | |
| Sep-14 | 0.004 | | | | | | |
| Oct-14 | 0.004 | 0.2 | | | | | |
| Nov-14 | 0.004 | 0.5 | | | | | |
| Dec-14 | 0.011 | 0.7 | | | | | |
| Jan-15 | 0.015 | | | | | | |
| Feb-15 | 0.026 | 0.5 | | | | | |
| Mar-15 | 0.011 | | | | | | |
| Apr-15 | 0.007 | 0.1 | | | | | |
| May-15 | 0.007 | | | | | | |
| Jun-15 | 0.010 | 0.1 | | | | | |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 0.008 | | | | | | |
| Aug-15 | 0.009 | | | | | | |
| Sep-15 | 0.008 | | | | | | |
| Oct-15 | 0.008 | 0.2 | 0.4 | 0.8 | 1.2 | 0.2 | 0.2 |
| Nov-15 | 0.016 | 0.7 | | | | | |
| Dec-15 | 0.012 | | | | | | |
| Jan-16 | 0.016 | | | | | | |
| Feb-16 | 0.013 | | | | | | |
| Mar-16 | 0.036 | 0.6 | | | | | |
| Apr-16 | 0.020 | 0.2 | 0.3 | 1.8 | 2.1 | 0.2 | 1.0 |
| May-16 | 0.015 | | | | | | |
| Jun-16 | 0.036 | | | | | | |
| Jul-16 | 0.010 | | | | | | |
| Aug-16 | 0.010 | | | | | | |
| Sep-16 | 0.009 | | | | | | |
| Oct-16 | 0.013 | | | | | | |
| Nov-16 | 0.014 | | | | | | |
| Dec-16 | 0.012 | 0.7 | 0.7 | 0.7 | 1.4 | 0.2 | -- |
| Jan-17 | 0.070 | | | | | | |
| Feb-17 | 0.107 | | | | | | |
| Mar-17 | 0.050 | | | | | | |
| Apr-17 | 0.029 | 1.1 | 1.2 | 1.6 | 2.8 | 0.5 | 0.5 |
| May-17 | 0.017 | | | | | | |
| Jun-17 | 0.016 | | | | | | |
| | | | | | | | |
| **Dry Season Average** | **0.009** | **0.2** | | | | | |
| **Dry Season Trend **** | **Up** | **None** | **-** | **-** | **-** | **-** | **-** |
| **Wet Season Average** | **0.017** | **0.4** | **0.7** | **1.2** | **1.9** | **0.2** | **0.6** |
| **Average Annual** | **0.014** | **0.4** | **0.7** | **1..2** | **1.9** | **0.2** | **0.6** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 7 Delta Diablo

Delta Diablo discharges to New York Slough (part of the Suisun Bay) and serves approximately 57,700 service connections throughout Antioch, Pittsburg and Bay Point. The plant has a permitted ADWF capacity of 19.5 mgd. It has a current ADWF discharge of approximately 6.3 mgd. The plant performs secondary treatment using trickling filters, followed by activated sludge. Secondary effluent (up to 12.8 mgd) is diverted upstream of the disinfection process and sent for tertiary treatment prior to distribution to recycled water users. Approximately 90% of the recycled water is sent to two power plants for use in their cooling towers. The blowdown from the cooling towers is returned to the secondary treatment plant, blended with secondary effluent, and disinfected prior to discharge.

The following observations are made based upon the figures and table in the subsequent pages:

- NOx dry weather loads appear to trend downwards. In contrast, ammonia and TKN dry season loads appear to trend upwards.
- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- The variability of the distribution of the nitrogen species in the effluent is due to the power plant cooling towers going in and out of nitrification and possible denitrification occurring sporadically. Since the summer of 2016, the predominant form of nitrogen has been the ammonia species due to the cessation of nitrification in the power plant cooling towers.
- Ammonia concentrations are lowest during the dry season, with a four-year low of approximately 12 mg N/L. TN concentrations are variable, ranging from 32 to 80 mg N/L.
- Ortho-P values are occasionally greater than TP values for the Section 13257 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value twice. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- TP concentrations are generally less than 2 mg P/L, which is lower than typical effluent concentrations of 4 to 6 mg P/L. This indicates the plant is removing phosphorus.
- Effluent flow increased significantly in the 2016/2017 reporting period because one or both of the power plants were offline for a significant period of time.

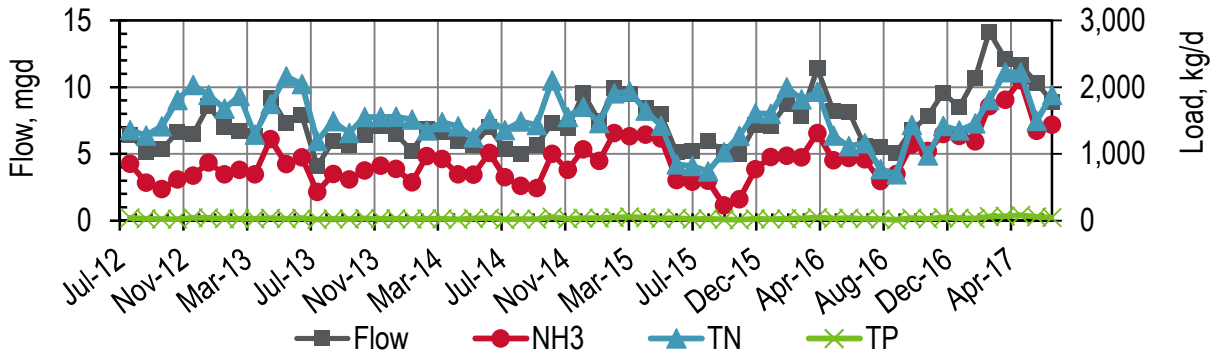


**Figure 7-1. Delta Diablo Monthly Flows and Loads**

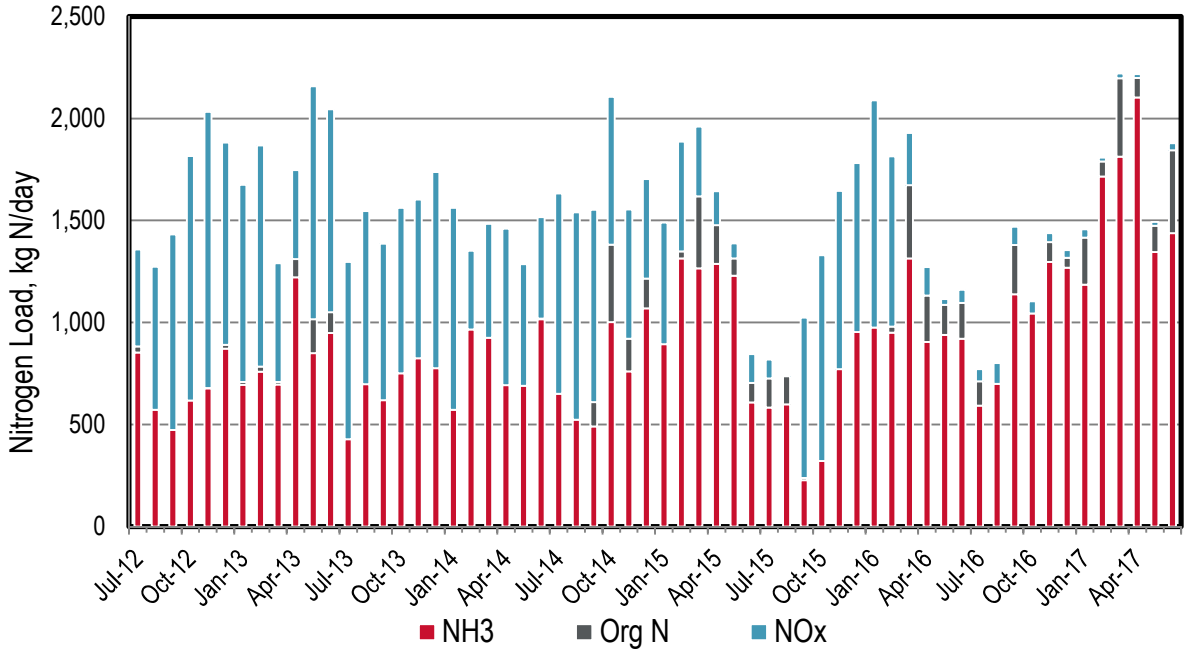


**Figure 7-2. Delta Diablo Monthly Nitrogen Loads**

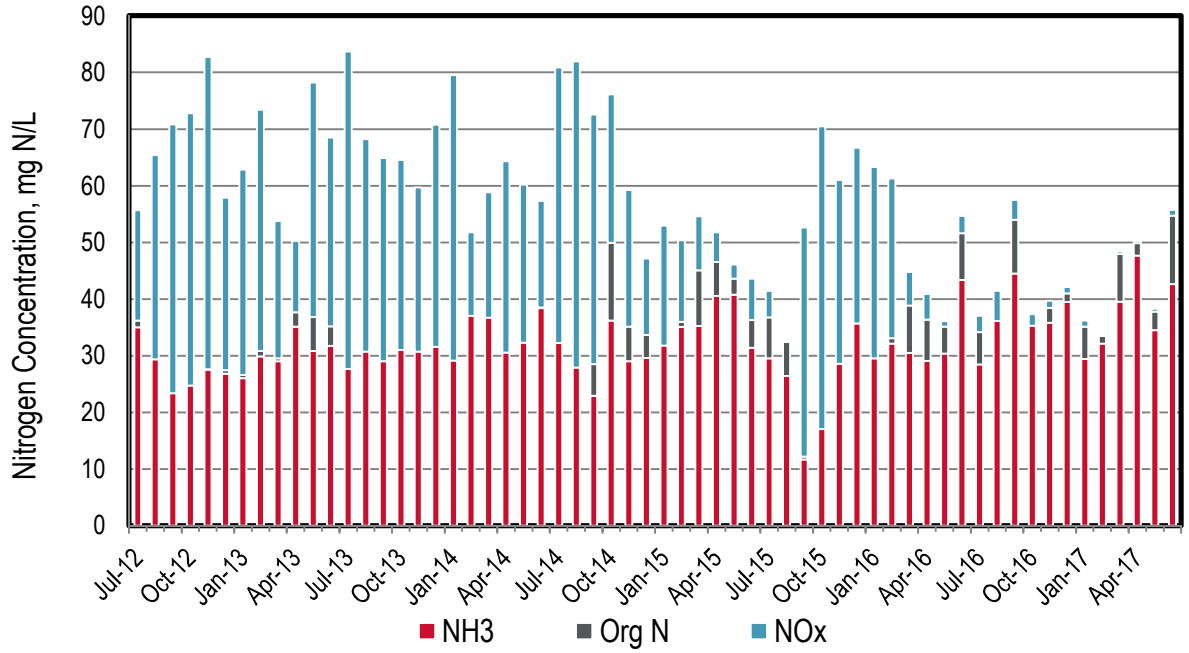


**Figure 7-3. Delta Diablo Monthly Nitrogen Concentrations**

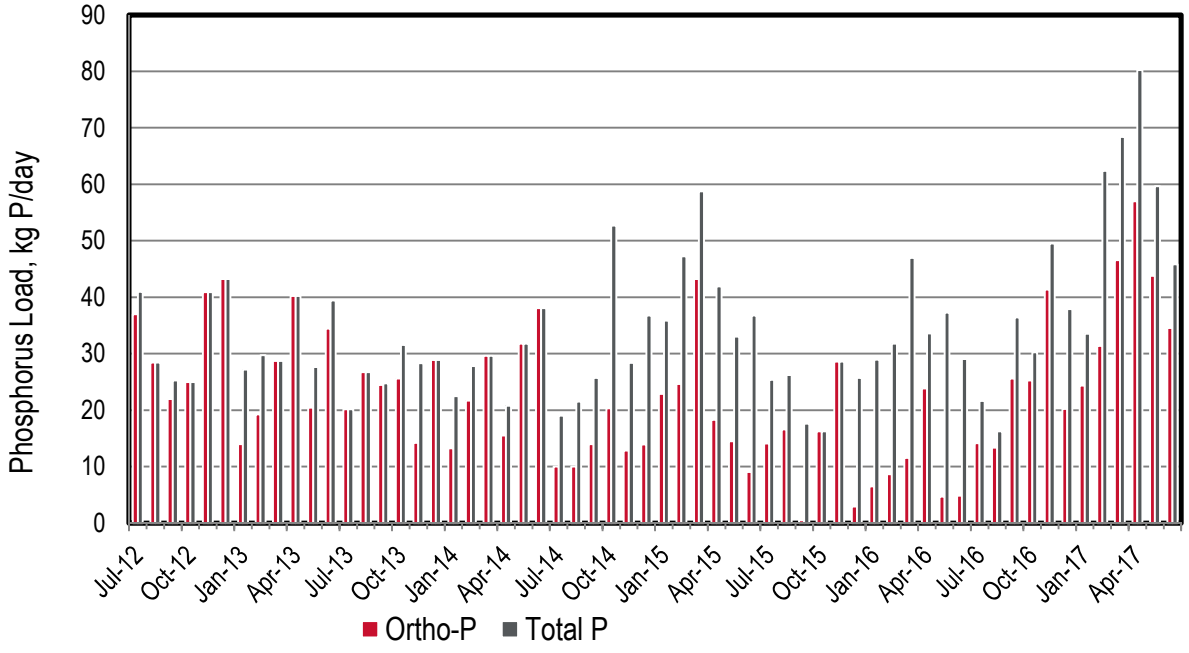


**Figure 7-4. Delta Diablo Monthly Phosphorus Loads**

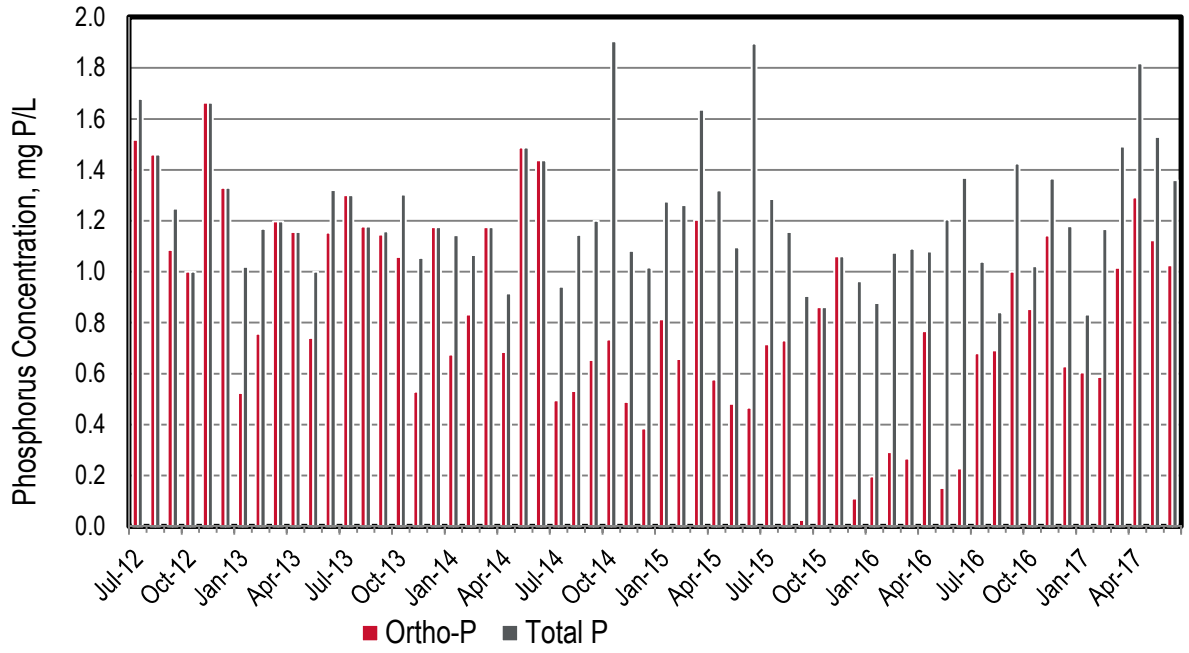


**Figure 7-5. Delta Diablo Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 7-1. Delta Diablo Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 6.5 | 853 | 882 | 476 | 1,358 | 37 | 41 |
| Aug-12 | 5.2 | 572 | 572 | 701 | 1,273 | 43 | 28 |
| Sep-12 | 5.4 | 473 | 452 | 959 | 1,412 | 22 | 25 |
| Oct-12 | 6.6 | 618 | 607 | 1,199 | 1,805 | 29 | 25 |
| Nov-12 | 6.5 | 677 | 679 | 1,354 | 2,033 | 44 | 41 |
| Dec-12 | 8.6 | 872 | 891 | 991 | 1,882 | 43 | 43 |
| Jan-13 | 7.1 | 694 | 708 | 967 | 1,675 | 14 | 27 |
| Feb-13 | 6.7 | 760 | 784 | 1,084 | 1,868 | 19 | 30 |
| Mar-13 | 6.4 | 697 | 708 | 582 | 1,290 | 36 | 29 |
| Apr-13 | 9.2 | 1,221 | 1,310 | 437 | 1,747 | 43 | 40 |
| May-13 | 7.3 | 850 | 1,015 | 1,143 | 2,159 | 20 | 28 |
| Jun-13 | 7.9 | 948 | 1,050 | 995 | 2,045 | 34 | 39 |
| Jul-13 | 4.1 | 429 | 323 | 868 | 1,191 | 22 | 20 |
| Aug-13 | 6.0 | 697 | 641 | 850 | 1,491 | 31 | 27 |
| Sep-13 | 5.7 | 619 | 548 | 767 | 1,315 | 24 | 25 |
| Oct-13 | 6.4 | 750 | 739 | 812 | 1,550 | 26 | 32 |
| Nov-13 | 7.1 | 824 | 775 | 778 | 1,553 | 14 | 28 |
| Dec-13 | 6.5 | 776 | 594 | 963 | 1,557 | 30 | 29 |
| Jan-14 | 5.2 | 573 | 525 | 990 | 1,515 | 13 | 22 |
| Feb-14 | 6.9 | 966 | 966 | 385 | 1,351 | 22 | 28 |
| Mar-14 | 6.7 | 925 | 916 | 559 | 1,475 | 39 | 30 |
| Apr-14 | 6.0 | 693 | 647 | 767 | 1,414 | 16 | 21 |
| May-14 | 5.7 | 690 | 648 | 596 | 1,244 | 40 | 32 |
| Jun-14 | 7.0 | 1,015 | 1,019 | 498 | 1,517 | 48 | 38 |
| Jul-14 | 5.3 | 651 | 414 | 982 | 1,355 | 10 | 19 |
| Aug-14 | 5.0 | 524 | 418 | 1,016 | 1,487 | 10 | 22 |
| Sep-14 | 5.7 | 490 | 611 | 942 | 1,433 | 14 | 26 |
| Oct-14 | 7.3 | 1,001 | 1,381 | 725 | 2,098 | 20 | 53 |
| Nov-14 | 6.9 | 761 | 921 | 633 | 1,554 | 13 | 28 |
| Dec-14 | 9.6 | 1,070 | 1,215 | 488 | 1,707 | 14 | 37 |
| Jan-15 | 7.4 | 894 | 865 | 595 | 1,461 | 23 | 36 |
| Feb-15 | 9.9 | 1,313 | 1,348 | 538 | 1,905 | 25 | 47 |
| Mar-15 | 9.5 | 1,266 | 1,619 | 341 | 1,937 | 43 | 59 |
| Apr-15 | 8.4 | 1,288 | 1,477 | 167 | 1,649 | 18 | 42 |
| May-15 | 8.0 | 1,229 | 1,314 | 74 | 1,422 | 14 | 33 |
| Jun-15 | 5.1 | 609 | 704 | 142 | 842 | 9 | 37 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 5.2 | 583 | 725 | 93 | 818 | 14 | 25 |
| Aug-15 | 6.0 | 599 | 736 | 1 | 738 | 17 | 26 |
| Sep-15 | 5.2 | 228 | 237 | 787 | 1,024 | 1 | 18 |
| Oct-15 | 5.0 | 322 | 262 | 1,008 | 1,270 | 19 | 16 |
| Nov-15 | 7.1 | 771 | 734 | 875 | 1,608 | 31 | 29 |
| Dec-15 | 7.1 | 954 | 772 | 828 | 1,600 | 3 | 26 |
| Jan-16 | 8.7 | 975 | 884 | 1,114 | 1,998 | 6 | 29 |
| Feb-16 | 7.8 | 951 | 980 | 834 | 1,814 | 9 | 32 |
| Mar-16 | 11.4 | 1,314 | 1,673 | 256 | 1,930 | 12 | 47 |
| Apr-16 | 8.2 | 905 | 1,131 | 141 | 1,272 | 24 | 34 |
| May-16 | 8.2 | 940 | 1,086 | 28 | 1,115 | 5 | 37 |
| Jun-16 | 5.6 | 921 | 1,096 | 64 | 1,160 | 5 | 29 |
| Jul-16 | 5.5 | 593 | 712 | 60 | 772 | 14 | 22 |
| Aug-16 | 5.1 | 699 | 569 | 102 | 692 | 13 | 16 |
| Sep-16 | 6.8 | 1,138 | 1,380 | 90 | 1,434 | 26 | 36 |
| Oct-16 | 7.8 | 1,044 | 943 | 60 | 975 | 25 | 30 |
| Nov-16 | 9.6 | 1,296 | 1,394 | 44 | 1,419 | 41 | 50 |
| Dec-16 | 8.5 | 1,269 | 1,318 | 37 | 1,349 | 20 | 38 |
| Jan-17 | 10.7 | 1,186 | 1,416 | 41 | 1,457 | 24 | 34 |
| Feb-17 | 14.1 | 1,716 | 1,789 | 19 | 1,808 | 31 | 62 |
| Mar-17 | 12.1 | 1,813 | 2,197 | 23 | 2,221 | 47 | 68 |
| Apr-17 | 11.7 | 2,102 | 2,199 | 20 | 2,218 | 57 | 80 |
| May-17 | 10.3 | 1,346 | 1,473 | 20 | 1,493 | 44 | 60 |
| Jun-17 | 8.9 | 1,438 | 1,844 | 35 | 1,882 | 35 | 46 |
| | | | | | | | |
| **Dry Season Average** | **6.3** | **765** | **819** | **492** | **1,307** | **22** | **30** |
| **Dry Season Trend **** | **None** | **Up** | **Up** | **Down** | **None** | **-** | **None** |
| **Wet Season Average** | **8.1** | **1,007** | **1,068** | **590** | **1,656** | **26** | **37** |
| **Average Annual** | **7.4** | **906** | **964** | **549** | **1,511** | **24** | **34** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 8 East Bay Dischargers Authority (EBDA)

EBDA discharges to the South Bay. The EBDA permitted ADWF capacity of 107.8 mgd and a peak wet weather capacity of 189.1 mgd. It has a current ADWF flow of approximately 53 mgd. The EBDA plants have various types of secondary treatment.

The following observations are made based upon the figures and table in the subsequent pages:

- The flows reduce 10 to 20 mgd from the wet to the dry season due to a combination of recycled water demand during the dry season and a lack of inflow and infiltration.
- Based on the average monthly values table, there appears to be an upward dry season trend for ammonia, TKN, and total nitrogen loads. The increase in concentrations over time supports this trend as the dry season flows are relatively flat.
- Ammonia, total nitrogen, and phosphorus loads increase with flow during wet weather events. The increase in loads during a wet weather event is less pronounced with months where there are back to back months with storms, such as December 2014 and January 2015. This is attributed to a lack of scouring in the collection system during the latter month.
- Wet season loads are greater and more variable than the dry season loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since the EBDA plants were not designed to nitrify.
- Total phosphorus concentrations are relatively flat and range from approximately 2 mg P/L to 3 mg P/L. Such values are lower than typical effluent concentrations of 4 to 6 mg P/L. This was expected as a portion of the EBDA plants perform either biological P removal using an anaerobic selector or chemical removal at the headworks, primaries, or filters.

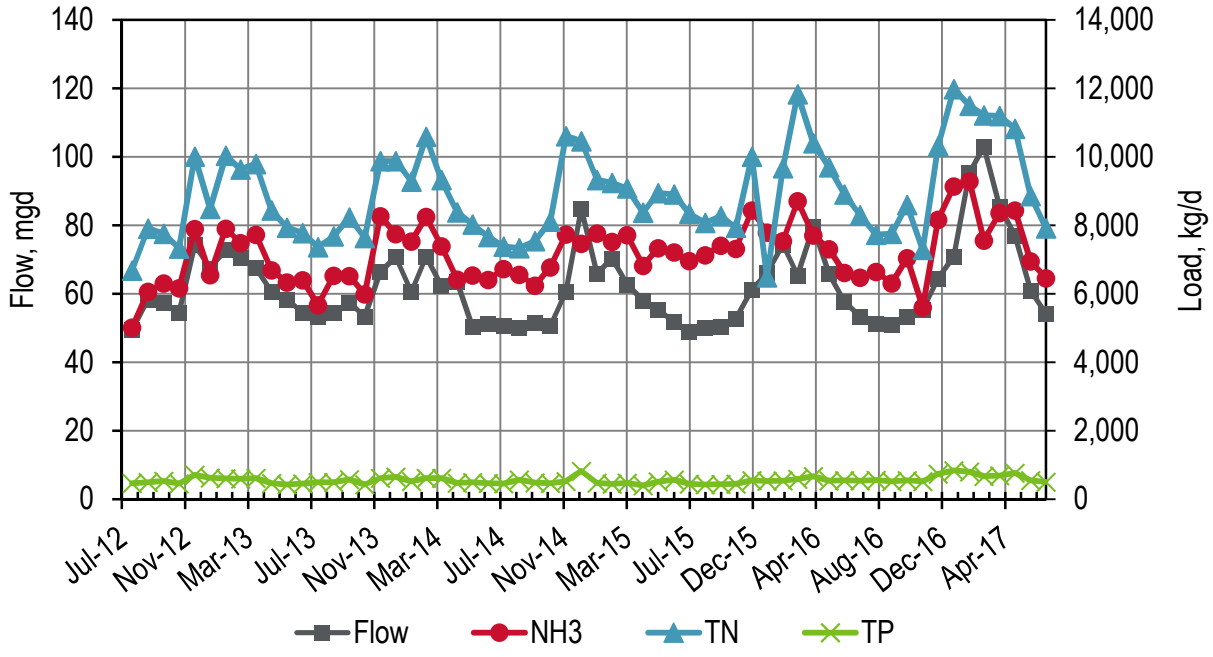


**Figure 8-1. EBDA Monthly Flows and Loads**

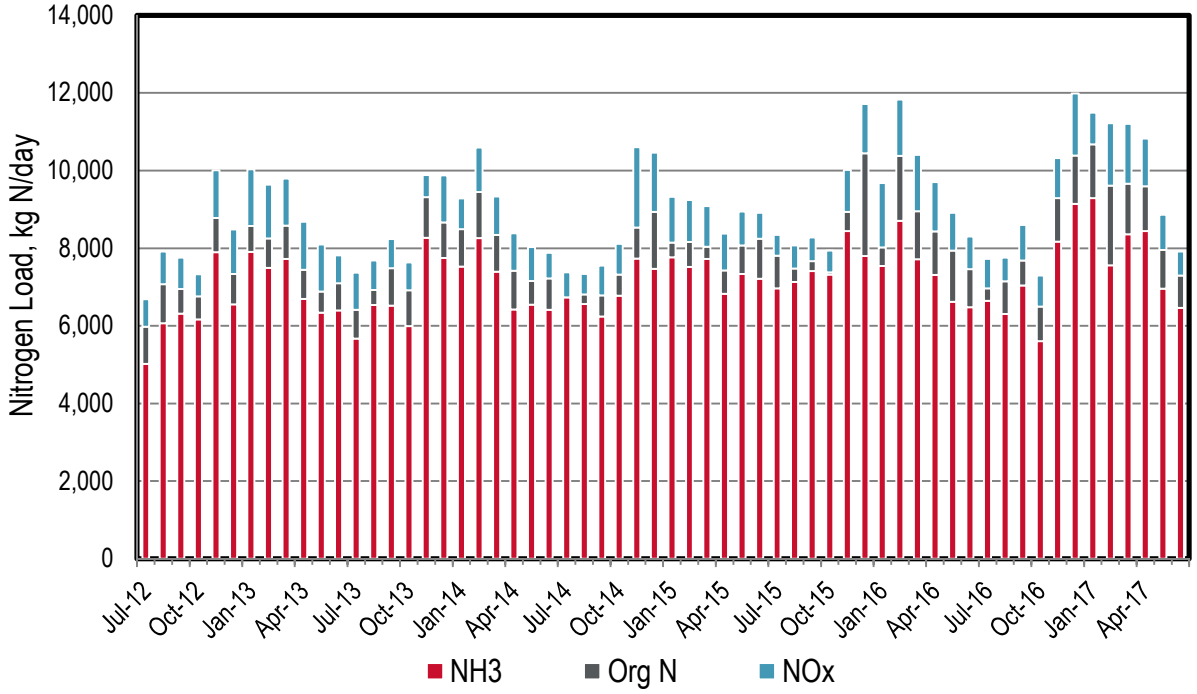


**Figure 8-2. EBDA Monthly Nitrogen Loads**

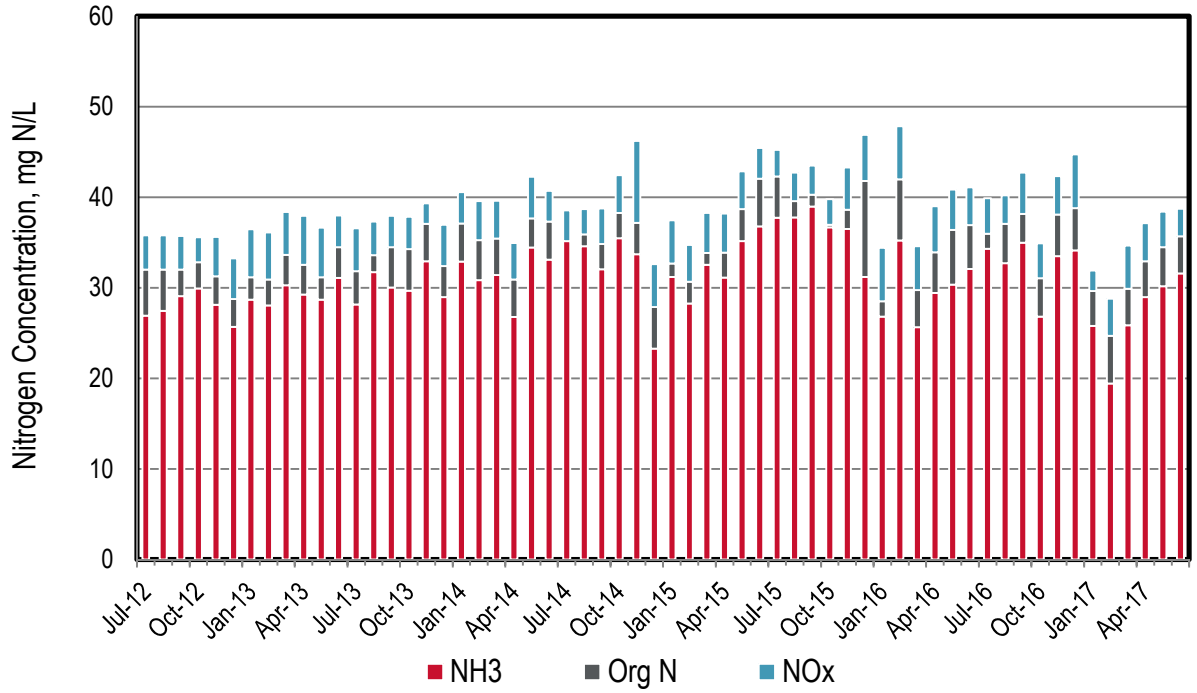


**Figure 8-3. EBDA Monthly Nitrogen Concentrations**

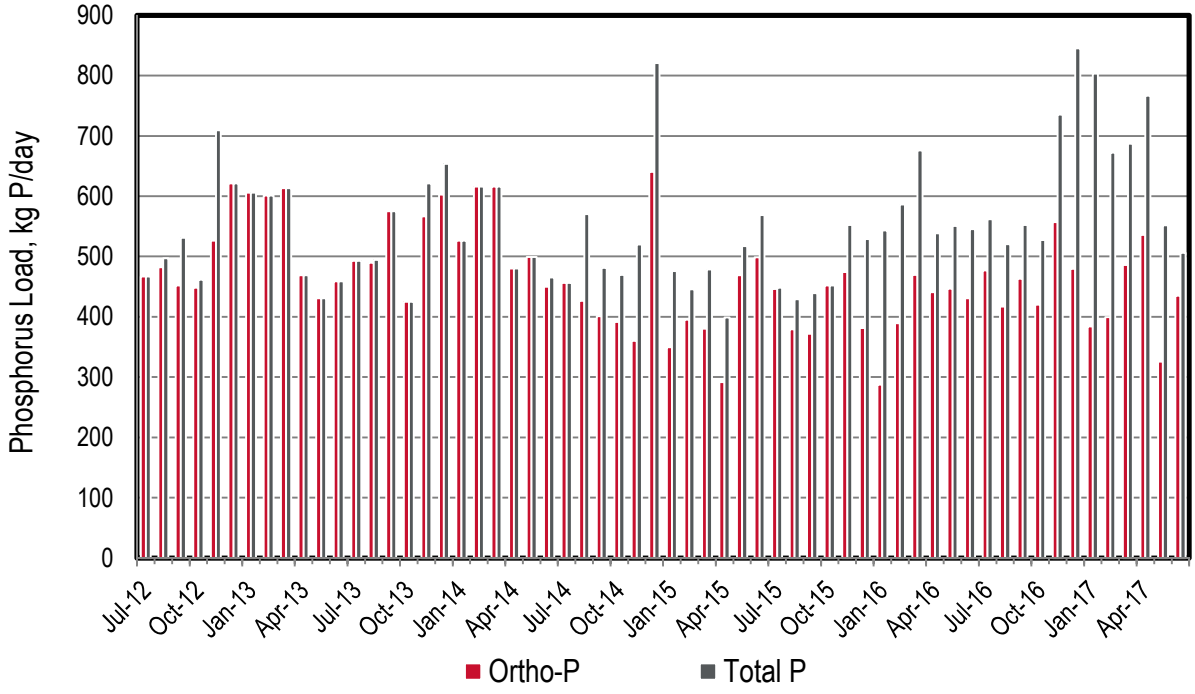


**Figure 8-4. EBDA Monthly Phosphorus Loads**

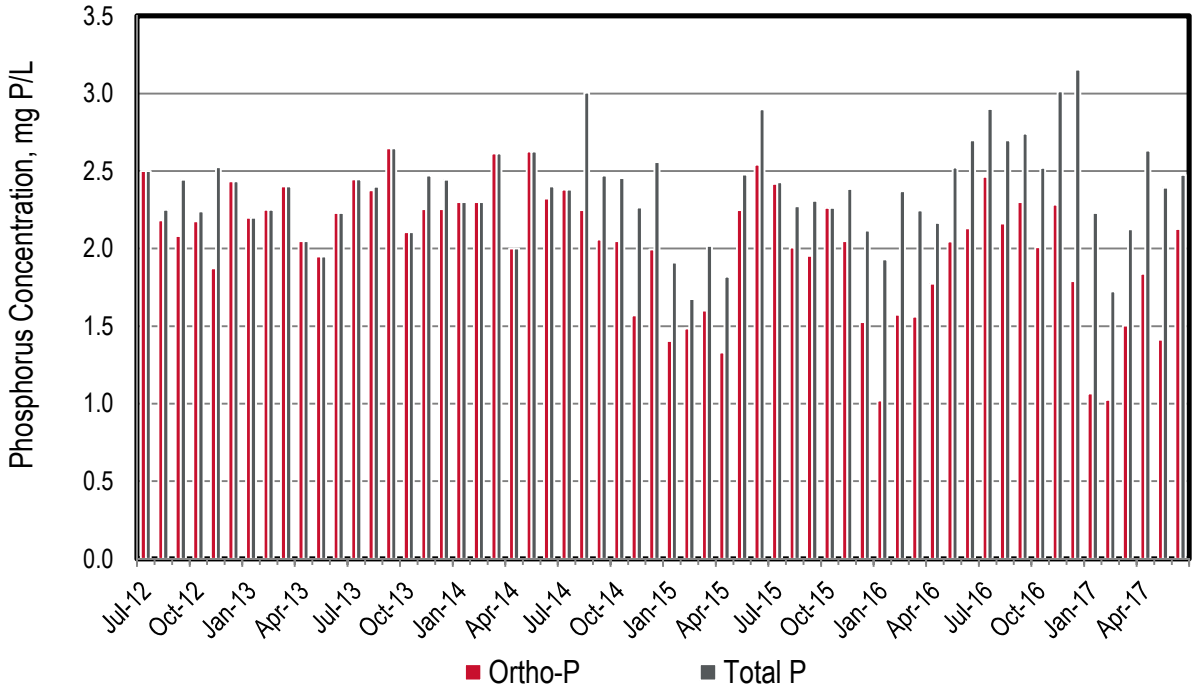


**Figure 8-5. EBDA Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 8-1. EBDA Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 49.4 | 5,023 | 5,975 | 710 | 6,685 | 476 | 467 |
| Aug-12 | 58.5 | 6,065 | 7,070 | 840 | 7,910 | 482 | 497 |
| Sep-12 | 57.5 | 6,311 | 6,949 | 804 | 7,754 | 452 | 531 |
| Oct-12 | 54.5 | 6,164 | 6,759 | 568 | 7,327 | 448 | 462 |
| Nov-12 | 74.3 | 7,898 | 8,781 | 1,228 | 10,009 | 526 | 710 |
| Dec-12 | 67.5 | 6,550 | 7,333 | 1,152 | 8,485 | 813 | 621 |
| Jan-13 | 72.9 | 7,904 | 8,577 | 1,459 | 10,036 | 778 | 606 |
| Feb-13 | 70.7 | 7,491 | 8,252 | 1,388 | 9,640 | 802 | 601 |
| Mar-13 | 67.6 | 7,727 | 8,583 | 1,212 | 9,795 | 714 | 613 |
| Apr-13 | 60.6 | 6,691 | 7,446 | 1,237 | 8,442 | 568 | 469 |
| May-13 | 58.5 | 6,341 | 6,882 | 1,215 | 7,932 | 530 | 431 |
| Jun-13 | 54.5 | 6,399 | 7,099 | 719 | 7,777 | 573 | 459 |
| Jul-13 | 53.3 | 5,670 | 6,413 | 953 | 7,366 | 627 | 493 |
| Aug-13 | 54.5 | 6,538 | 6,922 | 763 | 7,685 | 490 | 494 |
| Sep-13 | 57.5 | 6,523 | 7,487 | 750 | 8,236 | 677 | 575 |
| Oct-13 | 53.4 | 5,990 | 6,920 | 715 | 7,635 | 686 | 425 |
| Nov-13 | 66.5 | 8,272 | 9,313 | 567 | 9,880 | 567 | 621 |
| Dec-13 | 70.7 | 7,745 | 8,661 | 1,217 | 9,878 | 603 | 654 |
| Jan-14 | 60.6 | 7,530 | 8,492 | 789 | 9,282 | 644 | 526 |
| Feb-14 | 70.9 | 8,258 | 9,446 | 1,148 | 10,593 | 751 | 616 |
| Mar-14 | 62.3 | 7,395 | 8,344 | 986 | 9,329 | 883 | 616 |
| Apr-14 | 63.5 | 6,425 | 7,420 | 966 | 8,387 | 624 | 480 |
| May-14 | 50.3 | 6,546 | 7,158 | 873 | 8,031 | 550 | 499 |
| Jun-14 | 51.2 | 6,413 | 7,221 | 660 | 7,661 | 450 | 465 |
| Jul-14 | 50.7 | 6,731 | 6,733 | 649 | 7,382 | 456 | 456 |
| Aug-14 | 50.2 | 6,560 | 6,806 | 534 | 7,340 | 427 | 570 |
| Sep-14 | 51.5 | 6,239 | 6,783 | 765 | 7,547 | 401 | 481 |
| Oct-14 | 50.6 | 6,780 | 7,318 | 795 | 8,113 | 392 | 470 |
| Nov-14 | 60.7 | 7,736 | 8,531 | 2,074 | 10,605 | 360 | 520 |
| Dec-14 | 84.9 | 7,472 | 8,939 | 1,519 | 10,458 | 640 | 821 |
| Jan-15 | 65.9 | 7,766 | 8,143 | 1,184 | 9,327 | 350 | 476 |
| Feb-15 | 70.4 | 7,520 | 8,158 | 1,083 | 9,241 | 395 | 446 |
| Mar-15 | 62.8 | 7,723 | 8,036 | 1,046 | 9,082 | 380 | 479 |
| Apr-15 | 58.0 | 6,824 | 7,427 | 948 | 8,375 | 292 | 399 |
| May-15 | 55.2 | 7,335 | 8,068 | 874 | 8,942 | 469 | 517 |
| Jun-15 | 51.9 | 7,215 | 8,245 | 667 | 8,911 | 499 | 569 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 48.8 | 6,966 | 7,806 | 540 | 8,346 | 446 | 448 |
| Aug-15 | 50.0 | 7,134 | 7,478 | 594 | 8,072 | 379 | 429 |
| Sep-15 | 50.3 | 7,414 | 7,666 | 609 | 8,275 | 372 | 439 |
| Oct-15 | 52.8 | 7,319 | 7,374 | 564 | 7,938 | 481 | 452 |
| Nov-15 | 61.2 | 8,445 | 8,933 | 1,082 | 10,015 | 474 | 552 |
| Dec-15 | 66.1 | 7,795 | 10,441 | 1,271 | 6,491 | 381 | 529 |
| Jan-16 | 74.4 | 7,545 | 8,017 | 1,660 | 9,677 | 287 | 543 |
| Feb-16 | 65.4 | 8,708 | 10,381 | 1,451 | 11,831 | 389 | 586 |
| Mar-16 | 79.6 | 7,715 | 8,949 | 1,453 | 10,402 | 469 | 676 |
| Apr-16 | 65.8 | 7,313 | 8,434 | 1,264 | 9,699 | 441 | 539 |
| May-16 | 57.7 | 6,619 | 7,938 | 972 | 8,910 | 446 | 550 |
| Jun-16 | 53.5 | 6,482 | 7,456 | 845 | 8,301 | 431 | 545 |
| Jul-16 | 51.2 | 6,646 | 6,966 | 763 | 7,728 | 477 | 562 |
| Aug-16 | 51.0 | 6,307 | 7,145 | 608 | 7,754 | 417 | 520 |
| Sep-16 | 53.3 | 7,043 | 7,685 | 916 | 8,601 | 463 | 552 |
| Oct-16 | 55.3 | 5,605 | 6,493 | 802 | 7,295 | 420 | 527 |
| Nov-16 | 64.5 | 8,167 | 9,287 | 1,037 | 10,324 | 557 | 736 |
| Dec-16 | 70.9 | 9,143 | 10,385 | 1,597 | 11,982 | 480 | 845 |
| Jan-17 | 95.3 | 9,288 | 10,674 | 819 | 11,494 | 384 | 803 |
| Feb-17 | 103.0 | 7,561 | 9,614 | 1,601 | 11,216 | 399 | 672 |
| Mar-17 | 85.5 | 8,362 | 9,657 | 1,545 | 11,202 | 486 | 687 |
| Apr-17 | 77.1 | 8,443 | 9,596 | 1,224 | 10,820 | 536 | 767 |
| May-17 | 61.0 | 6,958 | 7,954 | 905 | 8,859 | 326 | 552 |
| Jun-17 | 54.1 | 6,460 | 7,297 | 617 | 7,915 | 435 | 506 |
| | | | | | | | |
| **Dry Season Average** | **53.4** | **6,558** | **7,248** | **766** | **7,997** | **470** | **504** |
| **Dry Season Trend **** | **None** | **Up** | **Up** | **None** | **Up** | **-** | **None** |
| **Wet Season Average** | **68.2** | **7,579** | **8,546** | **1,161** | **9,552** | **526** | **587** |
| **Average Annual** | **62.0** | **7,153** | **8,005** | **997** | **8,904** | **503** | **553** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 9 East Bay Municipal Utility District (EBMUD)

EBMUD discharges to the Central Bay. They have an ADWF permitted capacity of 120 mgd and a peak wet weather capacity of 320 mgd. It has a current ADWF flow of approximately 48 mgd. The plant performs secondary treatment using a high purity oxygen system. This plant accepts high-strength (organic) trucked wastes to its anaerobic digesters for renewable energy production. These wastes contribute to the plant discharge nutrient loads.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table and figures below, there appears to be a downward dry season trend for flows, TP and NOx loads. The decrease in flow is likely attributed to a combination of recycled water and water conservation.
- There appears to be an upward dry season trend for ammonia and TKN loads, however there is no trend for total nitrogen loads, due to the falling NOx loads.
- The July 2012 (i.e., first nutrient sampling event) has the largest dry season flow and nutrient loads for NOx, TN, ortho-P, and TP.
- Wet season loads are greater and more variable than the dry season loads.
- Nitrogen loads increase with flow during wet weather events.
- The effluent TN concentrations are relatively strong with occasional exceedance of 60 mg N/L.
- Ammonia is the majority of the nitrogen species discharged, regardless of season since EBMUD does not nitrify.
- Ortho-P is the predominant phosphorus species.

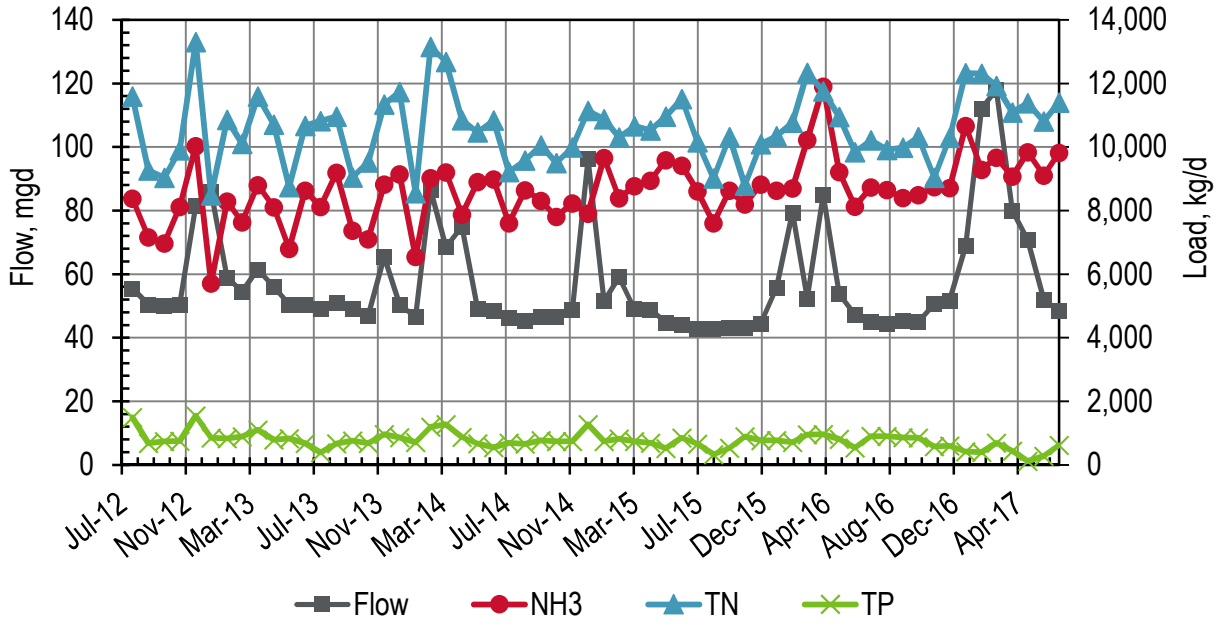


**Figure 9-1. EBMUD Monthly Flows and Loads**

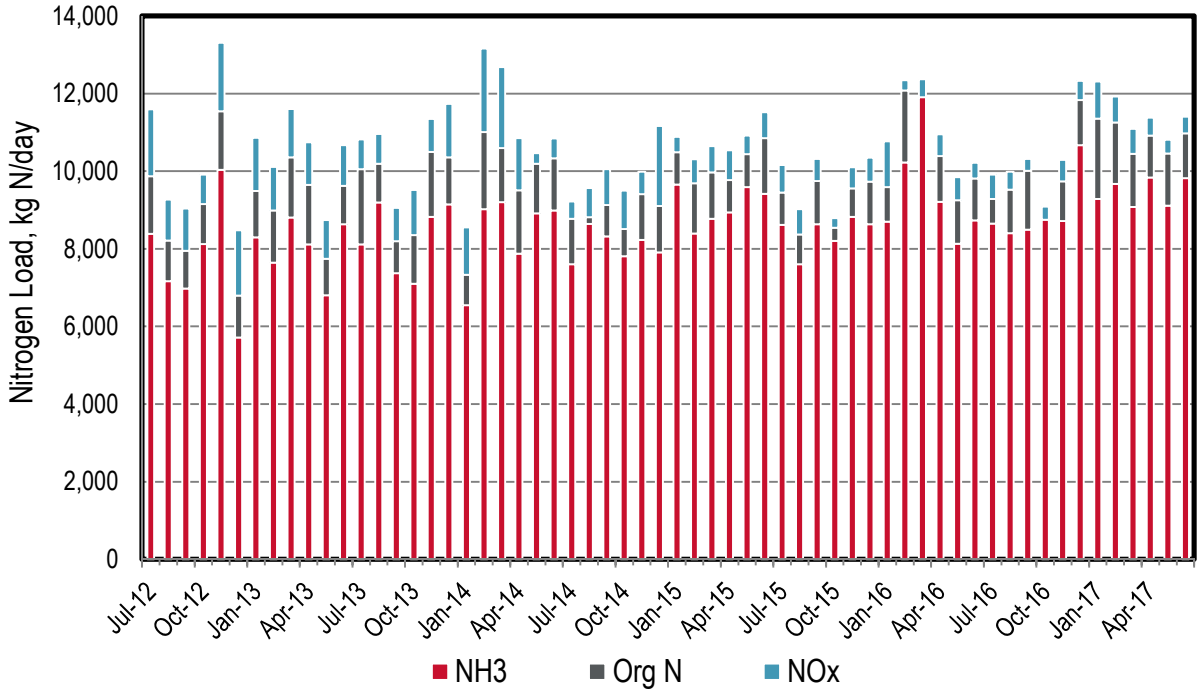


**Figure 9-2. EBMUD Monthly Nitrogen Loads**

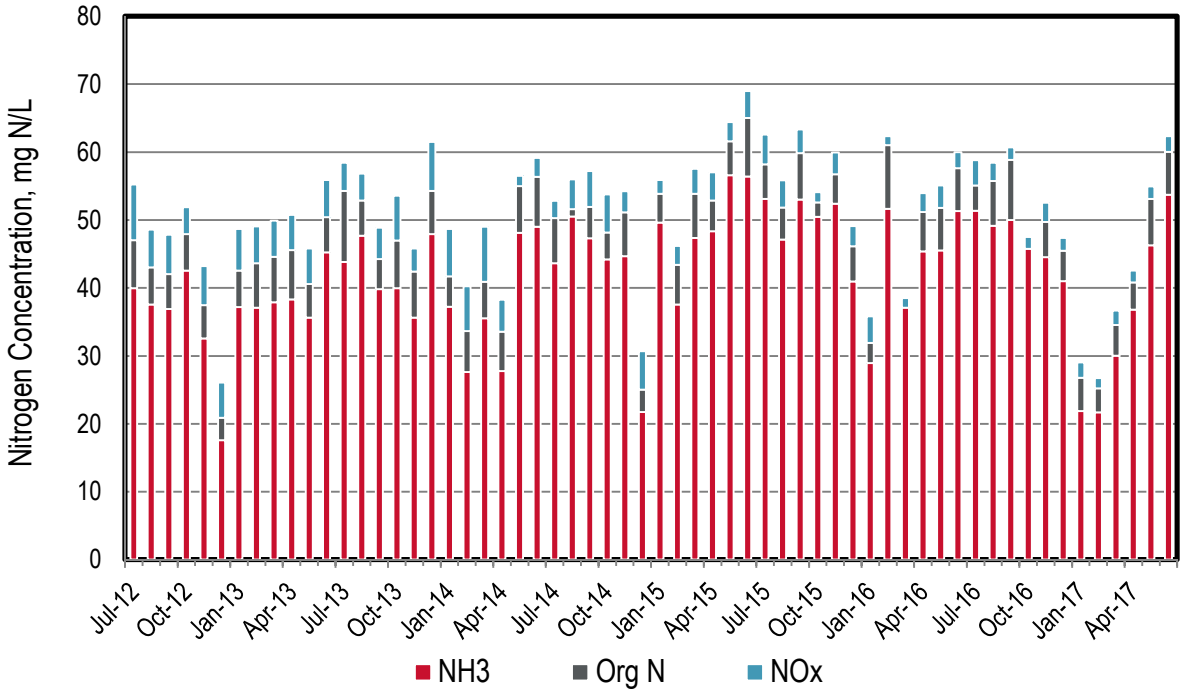


**Figure 9-3. EBMUD Monthly Nitrogen Concentrations**

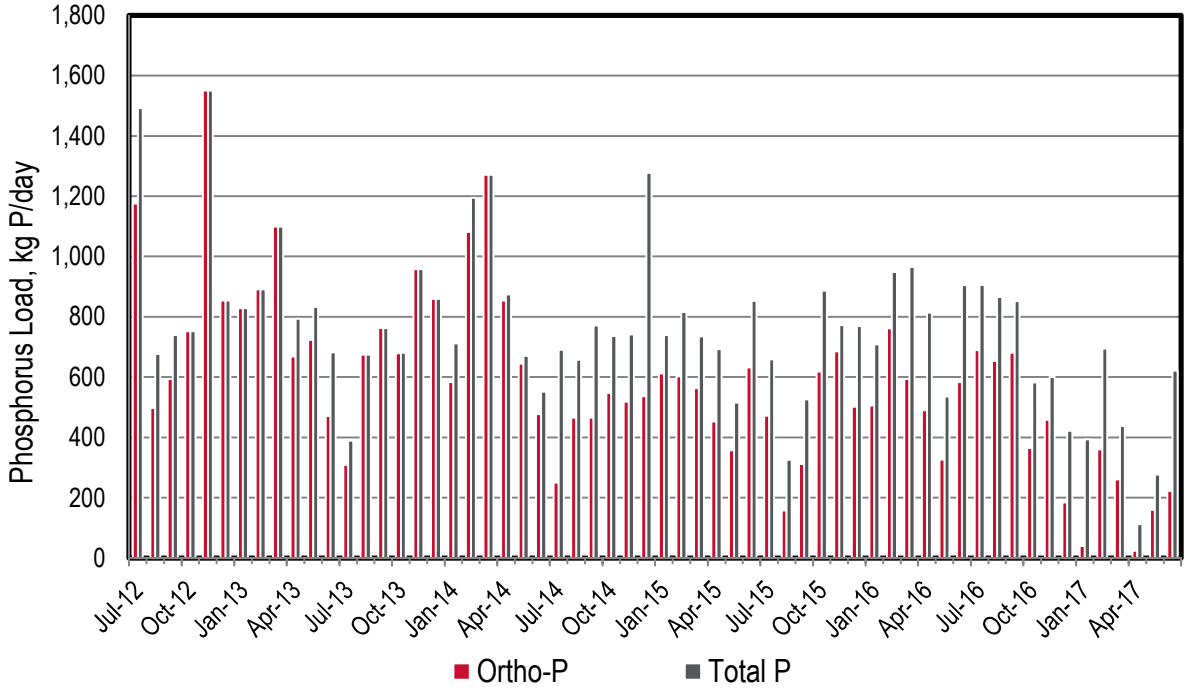


**Figure 9-4. EBMUD Monthly Phosphorus Loads** (Refer to Table 9-1)**

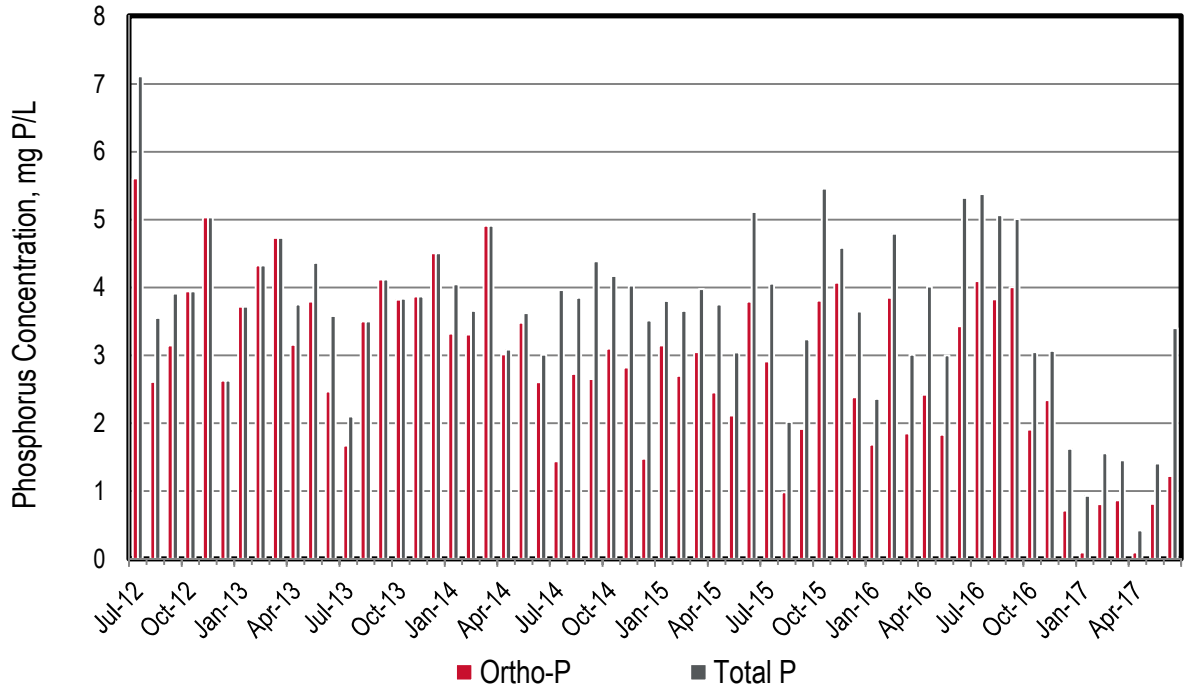


**Figure 9-5. EBMUD Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 9-1. EBMUD Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day *** | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 55.5 | 8,383 | 9,870 | 1,719 | 11,589 | 1,176 | 1,491 |
| Aug-12 | 50.5 | 7,168 | 8,210 | 1,060 | 9,270 | 498 | 677 |
| Sep-12 | 50.0 | 6,975 | 7,946 | 1,095 | 9,041 | 594 | 739 |
| Oct-12 | 50.5 | 8,121 | 9,151 | 756 | 9,907 | 903 | 752 |
| Nov-12 | 81.5 | 10,037 | 11,540 | 1,767 | 13,307 | 1,631 | 1,551 |
| Dec-12 | 86.0 | 5,711 | 6,791 | 1,690 | 8,480 | 1,435 | 854 |
| Jan-13 | 59.0 | 8,291 | 9,487 | 1,367 | 10,855 | 908 | 829 |
| Feb-13 | 54.5 | 7,641 | 8,991 | 1,115 | 10,107 | 1,048 | 891 |
| Mar-13 | 61.5 | 8,803 | 10,359 | 1,238 | 11,597 | 1,277 | 1,100 |
| Apr-13 | 56.0 | 8,115 | 9,649 | 1,094 | 10,711 | 668 | 794 |
| May-13 | 50.5 | 6,801 | 7,746 | 996 | 8,743 | 723 | 832 |
| Jun-13 | 50.5 | 8,635 | 9,621 | 1,045 | 10,666 | 471 | 683 |
| Jul-13 | 49.0 | 8,116 | 10,052 | 767 | 10,819 | 309 | 389 |
| Aug-13 | 51.0 | 9,196 | 10,188 | 771 | 10,960 | 695 | 675 |
| Sep-13 | 49.0 | 7,375 | 8,194 | 858 | 9,051 | 878 | 762 |
| Oct-13 | 47.0 | 7,103 | 8,351 | 1,167 | 9,518 | 679 | 681 |
| Nov-13 | 65.5 | 8,824 | 10,497 | 847 | 11,344 | 1,075 | 958 |
| Dec-13 | 50.5 | 9,146 | 10,359 | 1,375 | 11,734 | 931 | 859 |
| Jan-14 | 46.5 | 6,545 | 7,332 | 1,220 | 8,552 | 584 | 711 |
| Feb-14 | 86.5 | 9,024 | 11,005 | 2,150 | 13,155 | 1,081 | 1,195 |
| Mar-14 | 68.5 | 9,205 | 10,595 | 2,090 | 12,685 | 1,458 | 1,271 |
| Apr-14 | 75.0 | 7,876 | 9,510 | 1,341 | 10,850 | 854 | 874 |
| May-14 | 49.0 | 8,910 | 10,190 | 277 | 10,467 | 645 | 671 |
| Jun-14 | 48.5 | 8,986 | 10,333 | 509 | 10,842 | 477 | 551 |
| Jul-14 | 46.1 | 7,605 | 8,771 | 444 | 9,215 | 251 | 691 |
| Aug-14 | 45.2 | 8,639 | 8,818 | 749 | 9,575 | 466 | 658 |
| Sep-14 | 46.5 | 8,316 | 9,128 | 927 | 10,055 | 466 | 771 |
| Oct-14 | 46.7 | 7,810 | 8,511 | 992 | 9,502 | 547 | 737 |
| Nov-14 | 48.7 | 8,227 | 9,408 | 574 | 9,992 | 519 | 742 |
| Dec-14 | 96.2 | 7,907 | 9,104 | 2,061 | 11,140 | 537 | 1,278 |
| Jan-15 | 51.5 | 9,659 | 10,491 | 392 | 10,883 | 613 | 740 |
| Feb-15 | 59.1 | 8,392 | 9,687 | 623 | 10,310 | 603 | 816 |
| Mar-15 | 49.0 | 8,770 | 9,968 | 679 | 10,656 | 564 | 736 |
| Apr-15 | 48.9 | 8,941 | 9,774 | 765 | 10,530 | 453 | 693 |
| May-15 | 44.8 | 9,591 | 10,437 | 479 | 10,956 | 358 | 516 |
| Jun-15 | 44.2 | 9,419 | 10,853 | 664 | 11,516 | 633 | 854 |
| Jul-15 | 42.9 | 8,616 | 9,446 | 708 | 10,154 | 472 | 658 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day *** | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Aug-15 | 42.7 | 7,605 | 8,365 | 652 | 9,017 | 158 | 326 |
| Sep-15 | 43.1 | 8,633 | 9,742 | 570 | 10,312 | 312 | 526 |
| Oct-15 | 43.0 | 8,204 | 8,546 | 247 | 8,793 | 619 | 887 |
| Nov-15 | 44.6 | 8,824 | 9,555 | 543 | 10,098 | 686 | 772 |
| Dec-15 | 55.8 | 8,634 | 9,726 | 624 | 10,350 | 502 | 769 |
| Jan-16 | 79.5 | 8,702 | 9,591 | 1,174 | 10,765 | 506 | 709 |
| Feb-16 | 52.4 | 10,227 | 12,083 | 259 | 12,342 | 762 | 948 |
| Mar-16 | 85.0 | 11,907 | 11,330 | 457 | 11,750 | 594 | 966 |
| Apr-16 | 53.7 | 9,214 | 10,392 | 557 | 10,949 | 491 | 814 |
| May-16 | 47.3 | 8,131 | 9,248 | 595 | 9,843 | 327 | 535 |
| Jun-16 | 45.0 | 8,733 | 9,812 | 400 | 10,213 | 583 | 905 |
| Jul-16 | 44.6 | 8,653 | 9,282 | 629 | 9,911 | 690 | 906 |
| Aug-16 | 45.2 | 8,399 | 9,527 | 458 | 9,985 | 653 | 866 |
| Sep-16 | 45.0 | 8,496 | 10,007 | 309 | 10,316 | 681 | 852 |
| Oct-16 | 50.6 | 8,744 | 8,693 | 340 | 9,032 | 365 | 583 |
| Nov-16 | 51.8 | 8,716 | 9,737 | 554 | 10,291 | 458 | 600 |
| Dec-16 | 68.8 | 10,670 | 11,834 | 494 | 12,328 | 185 | 422 |
| Jan-17 | 112.2 | 9,285 | 11,356 | 953 | 12,310 | 41 | 393 |
| Feb-17 | 118.0 | 9,672 | 11,255 | 669 | 11,924 | 360 | 695 |
| Mar-17 | 80.0 | 9,081 | 10,450 | 640 | 11,089 | 260 | 438 |
| Apr-17 | 70.7 | 9,837 | 10,914 | 463 | 11,377 | 25 | 112 |
| May-17 | 52.1 | 9,110 | 10,452 | 357 | 10,810 | 160 | 277 |
| Jun-17 | 48.4 | 9,821 | 10,977 | 423 | 11,400 | 223 | 622 |
| | | | | | | | |
| **Dry Season Average** | **47.5** | **8,412** | **9,489** | **698** | **10,189** | **516** | **697** |
| **Dry Season Trend **** | **Down** | **Up** | **Up** | **Down** | **None** | **-** | **Down** |
| **Wet Season Average** | **64.4** | **8,739** | **9,886** | **951** | **10,835** | **692** | **805** |
| **Average Annual** | **57.4** | **8,603** | **9,721** | **846** | **10,566** | **619** | **760** |

- * The Total Nitrogen value is calculated by adding the TKN and the NOx values.
- ** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.
- *** The mass loading for ortho-P was calculated by using the peak flow during the day when a grab sample was taken under the Section 13267 Letter data (July 2012 through June 2014). The sampling protocol changed under the Nutrient Watershed Permit (July 2014 through June 2016) where the flowrate that occurred during the grab sample was used for calculating the load. There was also a change in field filtering for ortho-P samples when EBMUD transitioned from the 13267 study to the Nutrients Permit study. The ortho-P samples were filtered in the lab outside of the 15-minute time required for filtration during 2012-2014 (Section 13267 Letter Data), but in the field within 15 minutes of collection during 2014-2016 (Watershed Permit).
- Numbers in this table are slightly different compared to those reported in the CIWQS, due to rounding of conversion factors used. In addition, the monthly flow here is calculated as the average; while in the CIWQS it is the median.

# 10 Fairfield-Suisun Sewer District (FSSD)

FSSD discharges to waterways in the Suisun Marsh that flow more than 13 miles before reaching Suisun Bay. FSSD serves approximately 40,300 service connections. The plant has a permitted ADWF capacity of 23.7 mgd and a peak wet weather capacity of 52.9 mgd. The current ADWF flow is approximately 10 mgd. The plant nitrifies using a combination of trickling filters and conventional activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging dry season downward trend for NOx, and TN loads.
- Nitrogen loads typically increase with flow during wet weather events, whereas the phosphorus loads are relatively flat year round.
- Nitrogen wet season loads are typically greater and more variable than the dry season loads (with the exception of TN spikes in September 2013, May 2017, and June 2017).
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant reliably nitrifies year round.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations are wide ranging from approximately 1.5 to 6 mg P/L. Typical effluent TP concentrations are 4 to 6 mg P/L

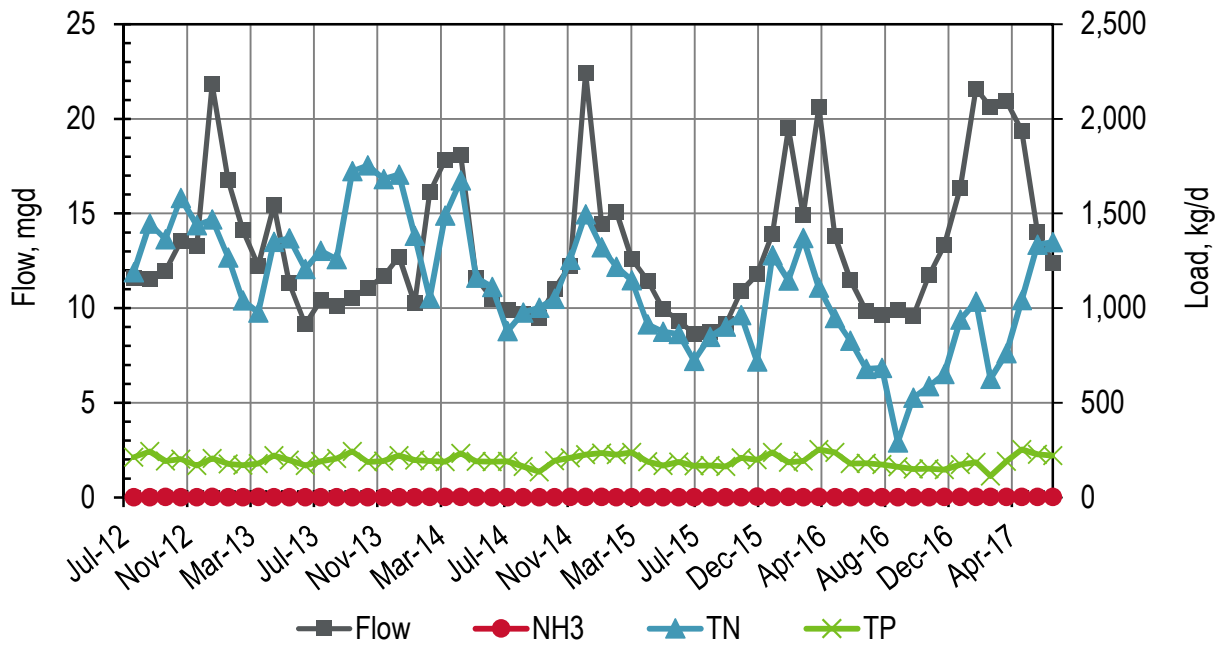


**Figure 10-1. Fairfield-Suisun Monthly Flows and Loads**

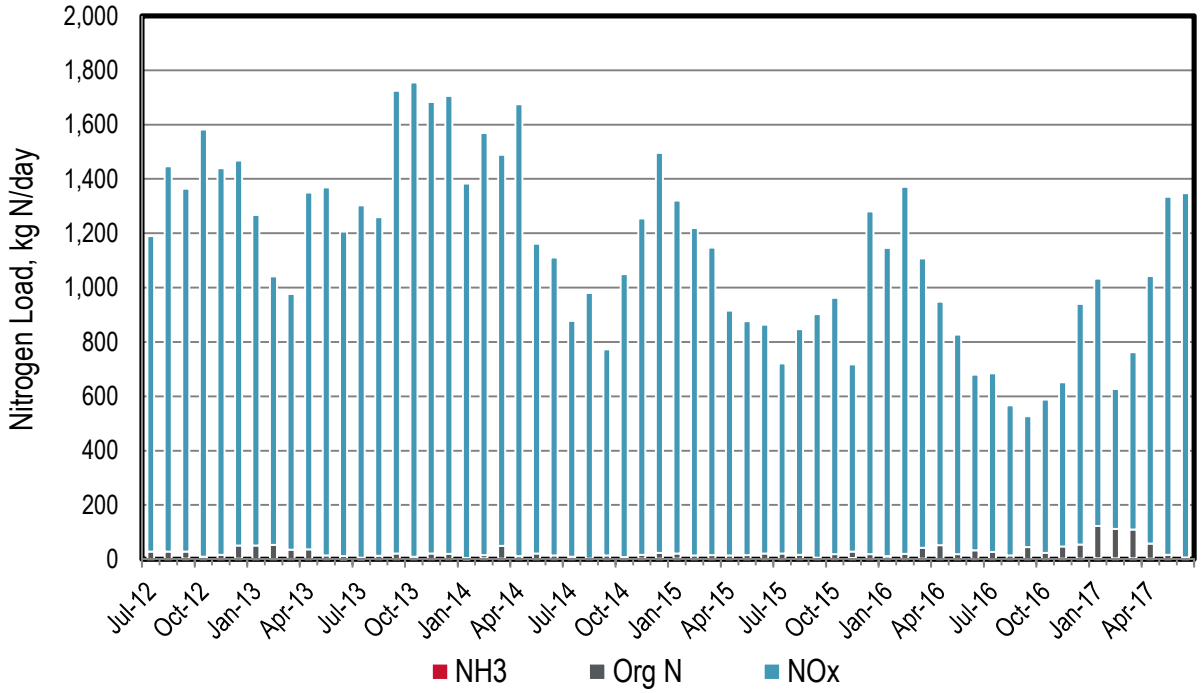


**Figure 10-2. Fairfield-Suisun Monthly Nitrogen Loads**

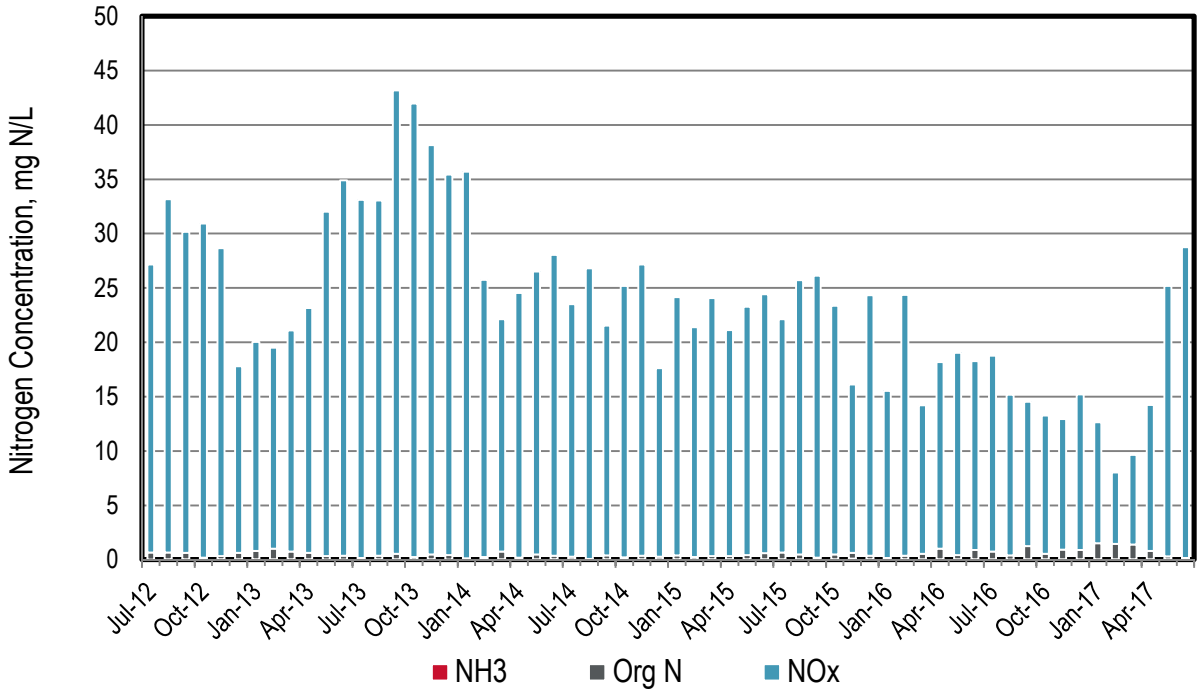


**Figure 10-3. Fairfield-Suisun Monthly Nitrogen Concentrations**

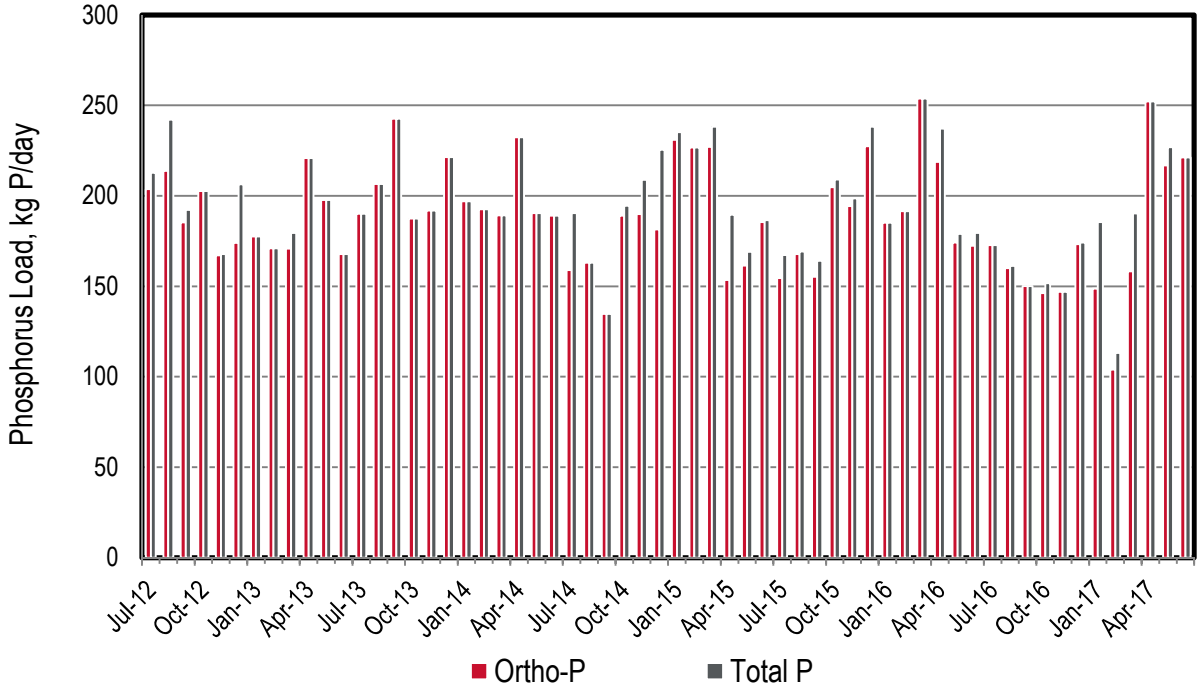


**Figure 10-4. Fairfield-Suisun Monthly Phosphorus Loads**

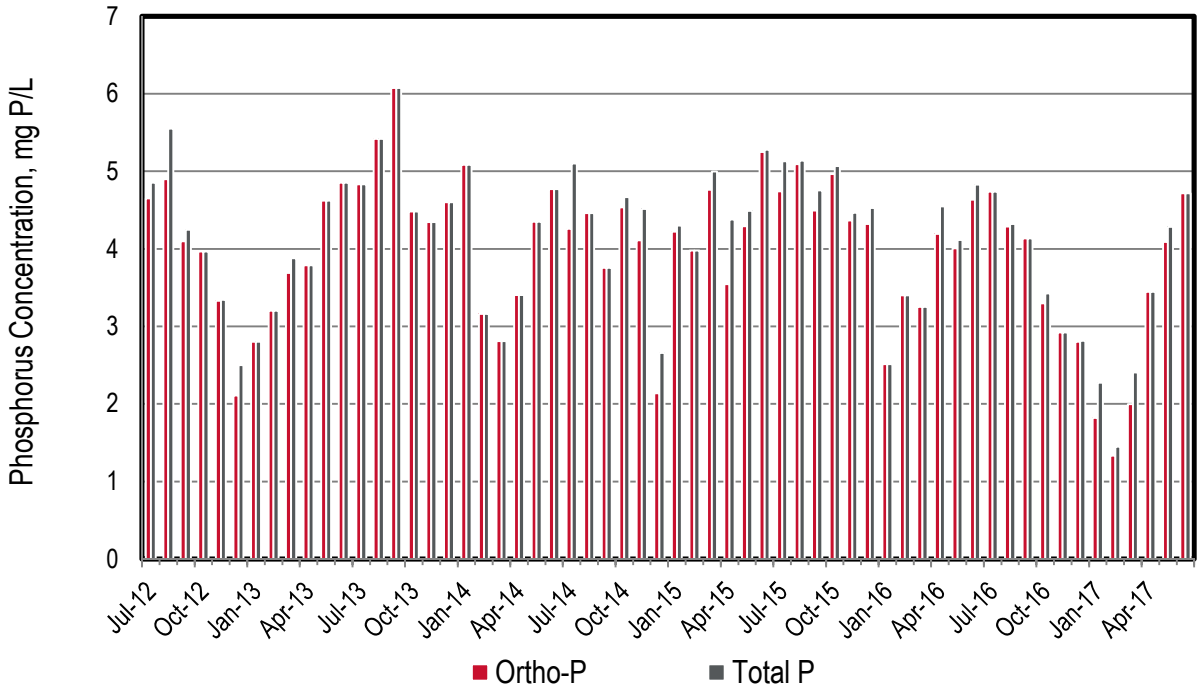


**Figure 10-5. Fairfield-Suisun Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 10-1. Fairfield-Suisun Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 11.6 | 1 | 29 | 1,162 | 1,190 | 204 | 213 |
| Aug-12 | 11.5 | 1 | 28 | 1,418 | 1,447 | 214 | 242 |
| Sep-12 | 12.0 | 2 | 29 | 1,336 | 1,365 | 185 | 192 |
| Oct-12 | 13.5 | 1 | 10 | 1,572 | 1,582 | 213 | 203 |
| Nov-12 | 13.3 | 2 | 17 | 1,422 | 1,439 | 167 | 168 |
| Dec-12 | 21.8 | 3 | 51 | 1,417 | 1,468 | 174 | 206 |
| Jan-13 | 16.7 | 2 | 51 | 1,216 | 1,267 | 179 | 177 |
| Feb-13 | 14.1 | 2 | 53 | 987 | 1,041 | 192 | 171 |
| Mar-13 | 12.2 | 2 | 35 | 941 | 977 | 171 | 179 |
| Apr-13 | 15.4 | 1 | 36 | 1,314 | 1,350 | 356 | 221 |
| May-13 | 11.3 | 1 | 15 | 1,354 | 1,368 | 315 | 198 |
| Jun-13 | 9.1 | 1 | 12 | 1,194 | 1,206 | 313 | 168 |
| Jul-13 | 10.4 | 1 | 7 | 1,296 | 1,302 | 349 | 190 |
| Aug-13 | 10.1 | 1 | 14 | 1,245 | 1,259 | 340 | 206 |
| Sep-13 | 10.6 | 1 | 22 | 1,703 | 1,724 | 366 | 243 |
| Oct-13 | 11.1 | 1 | 10 | 1,745 | 1,755 | 355 | 187 |
| Nov-13 | 11.7 | 1 | 22 | 1,661 | 1,682 | 309 | 192 |
| Dec-13 | 12.7 | 1 | 21 | 1,684 | 1,705 | 318 | 221 |
| Jan-14 | 10.3 | 1 | 5 | 1,378 | 1,383 | 323 | 197 |
| Feb-14 | 16.1 | 4 | 15 | 1,554 | 1,053 | 292 | 193 |
| Mar-14 | 17.8 | 3 | 50 | 1,439 | 1,489 | 307 | 189 |
| Apr-14 | 18.1 | 3 | 12 | 1,662 | 1,675 | 275 | 232 |
| May-14 | 11.6 | 2 | 21 | 1,139 | 1,161 | 292 | 191 |
| Jun-14 | 10.5 | 1 | 14 | 1,097 | 1,111 | 325 | 189 |
| Jul-14 | 9.9 | 1 | 10 | 868 | 878 | 159 | 190 |
| Aug-14 | 9.7 | 1 | 3 | 977 | 977 | 168 | 163 |
| Sep-14 | 9.5 | 1 | 14 | 759 | 1,002 | 142 | 135 |
| Oct-14 | 11.0 | 2 | 8 | 1,041 | 1,050 | 189 | 195 |
| Nov-14 | 12.2 | 2 | 16 | 1,239 | 1,255 | 190 | 209 |
| Dec-14 | 22.4 | 3 | 24 | 1,472 | 1,496 | 182 | 225 |
| Jan-15 | 14.5 | 2 | 21 | 1,300 | 1,321 | 231 | 235 |
| Feb-15 | 15.1 | 2 | 14 | 1,205 | 1,219 | 235 | 227 |
| Mar-15 | 12.6 | 1 | 16 | 1,131 | 1,147 | 227 | 238 |
| Apr-15 | 11.5 | 1 | 14 | 901 | 915 | 154 | 190 |
| May-15 | 10.0 | 1 | 16 | 860 | 876 | 162 | 169 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 9.3 | 1 | 21 | 842 | 863 | 186 | 187 |
| Jul-15 | 8.6 | 1 | 22 | 699 | 721 | 155 | 167 |
| Aug-15 | 8.7 | 1 | 16 | 831 | 848 | 168 | 169 |
| Sep-15 | 9.1 | 1 | 7 | 895 | 902 | 155 | 164 |
| Oct-15 | 10.9 | 1 | 20 | 943 | 962 | 205 | 209 |
| Nov-15 | 11.8 | 5 | 28 | 690 | 718 | 194 | 199 |
| Dec-15 | 13.9 | 2 | 19 | 1,261 | 1,280 | 227 | 238 |
| Jan-16 | 19.5 | 3 | 12 | 1,134 | 1,146 | 188 | 185 |
| Feb-16 | 14.9 | 2 | 20 | 1,351 | 1,371 | 191 | 191 |
| Mar-16 | 20.6 | 2 | 43 | 1,065 | 1,108 | 276 | 254 |
| Apr-16 | 13.8 | 2 | 52 | 896 | 948 | 219 | 237 |
| May-16 | 11.5 | 1 | 19 | 809 | 827 | 174 | 179 |
| Jun-16 | 9.8 | 1 | 33 | 646 | 679 | 172 | 180 |
| Jul-16 | 9.6 | 1 | 27 | 657 | 684 | 173 | 173 |
| Aug-16 | 9.9 | 1 | 15 | 552 | 291 | 160 | 161 |
| Sep-16 | 9.6 | 1 | 45 | 482 | 527 | 158 | 150 |
| Oct-16 | 11.7 | 2 | 23 | 565 | 588 | 146 | 152 |
| Nov-16 | 13.3 | 3 | 47 | 604 | 651 | 152 | 147 |
| Dec-16 | 16.4 | 2 | 55 | 885 | 940 | 173 | 174 |
| Jan-17 | 21.6 | 3 | 123 | 910 | 1,033 | 149 | 186 |
| Feb-17 | 20.6 | 4 | 112 | 514 | 627 | 104 | 113 |
| Mar-17 | 20.9 | 3 | 110 | 653 | 762 | 158 | 190 |
| Apr-17 | 19.4 | 3 | 58 | 984 | 1,043 | 401 | 252 |
| May-17 | 14.0 | 2 | 17 | 1,318 | 1,335 | 217 | 227 |
| Jun-17 | 12.4 | 2 | 7 | 1,341 | 1,348 | 221 | 221 |
| | | | | | | | |
| **Dry Season Average** | **10.4** | **1** | **18** | **1,019** | **1,036** | **219** | **187** |
| **Dry Season Trend **** | **None** | **None** | **None** | **Down** | **Down** | **-** | **None** |
| **Wet Season Average** | **15.2** | **2** | **35** | **1,164** | **1,184** | **223** | **200** |
| **Average Annual** | **13.2** | **2** | **28** | **1,104** | **1,122** | **222** | **194** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 11 Las Gallinas Valley Sanitary District

Las Gallinas discharges to Miller Creek that is connected to San Pablo Bay. The plant has approximately 15,800 service connections; it has a permitted capacity of 2.92 mgd ADWF and a peak wet weather secondary treatment capacity of 8.0 mgd. The plant performs secondary treatment using two rock trickling filters and nitrification using a third trickling filter equipped with plastic media.. Discharge to Miller Creek is prohibited June 1 through October 31.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table, there are no emerging dry season trends as Las Gallinas does not typically discharge during the dry season.
- Wet season trends analyzed (statistical data not shown) and there is an emerging upward trend for flow, ammonia loads, and TKN loads. This trend is likely attributed to the most recent wet season that had relatively high levels of precipitation However, TN loads are relatively consistent over the years shown.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through during the colder months. This increases the ammonia contribution during such months.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.5 to 5.3 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L.

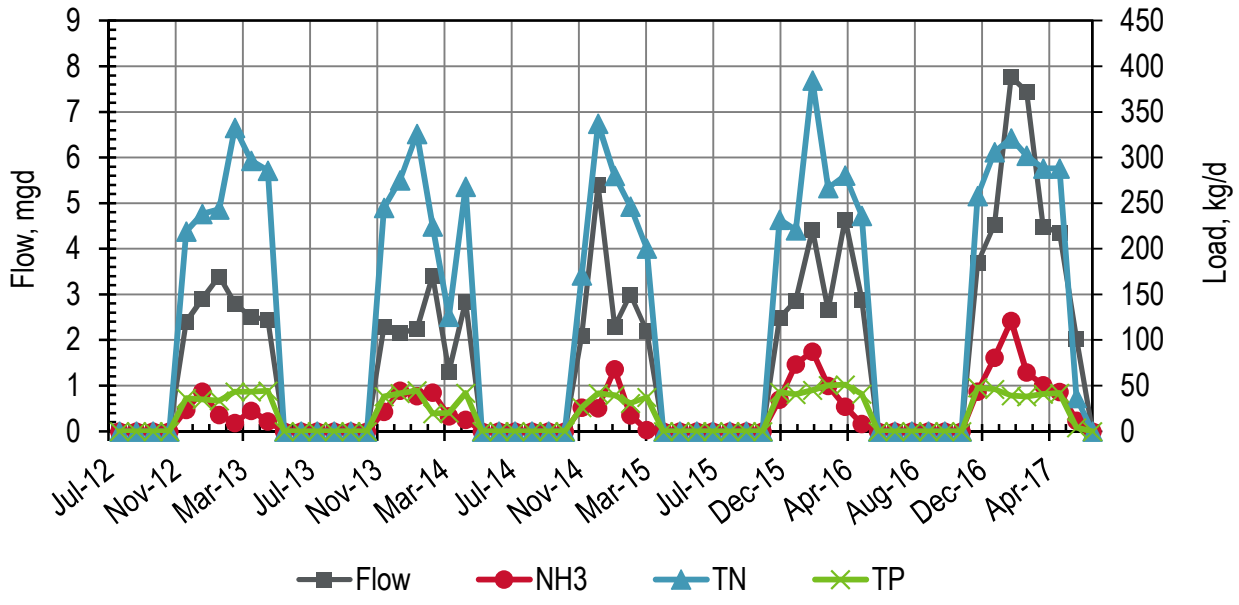


**Figure 11-1. Las Gallinas Monthly Flows and Loads**

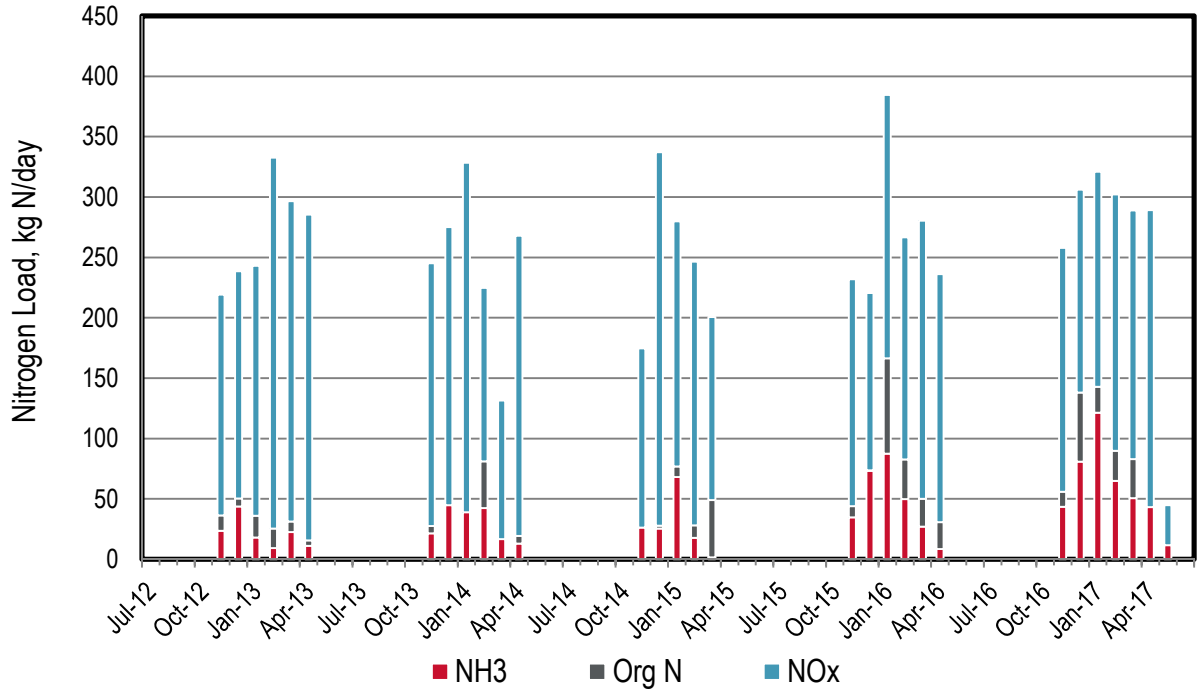


**Figure 11-2. Las Gallinas Monthly Nitrogen Loads**

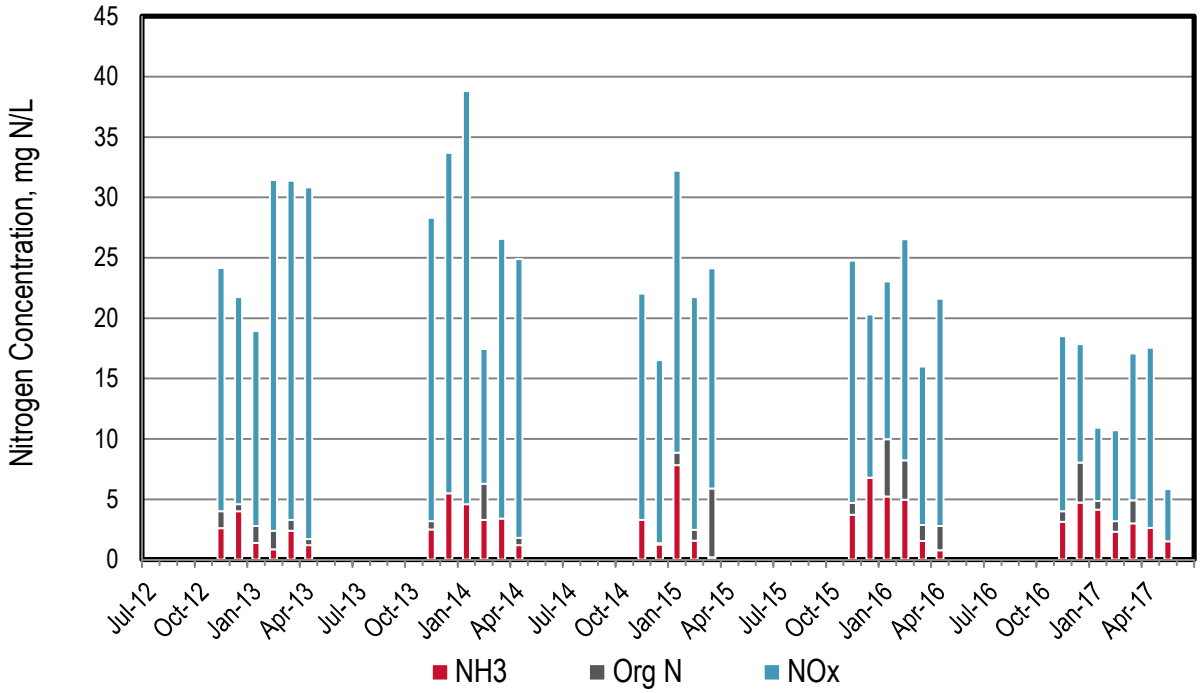


**Figure 11-3. Las Gallinas Monthly Nitrogen Concentrations**

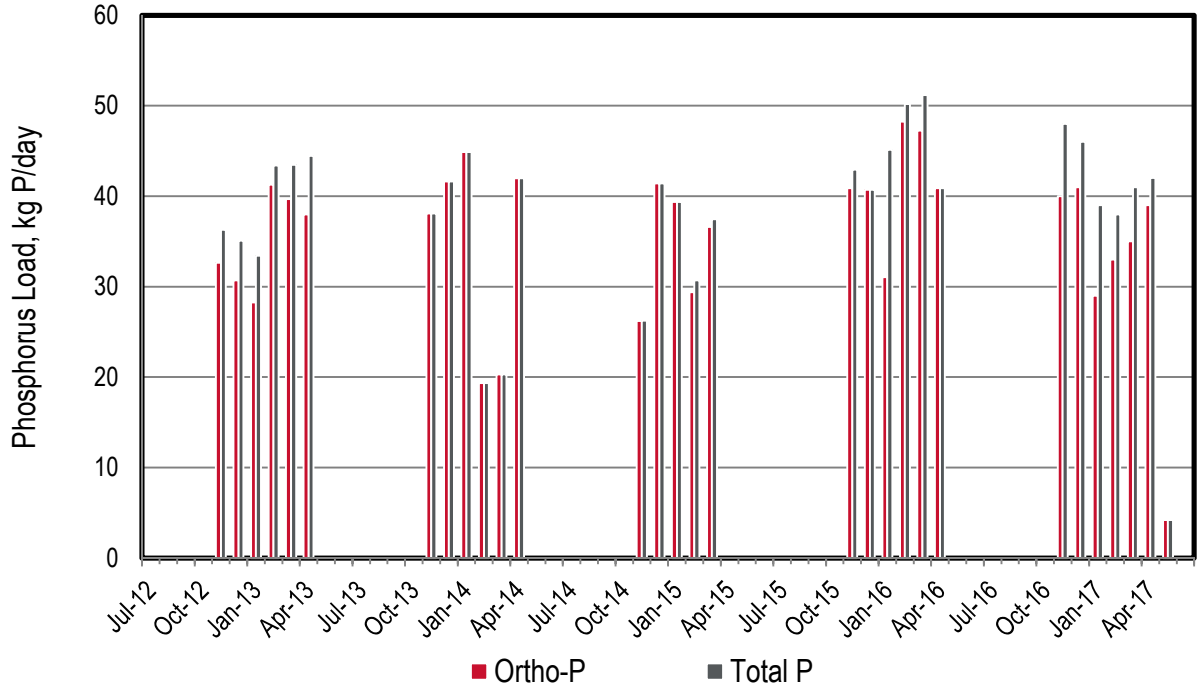


**Figure 11-4. Las Gallinas Monthly Phosphorus Loads**

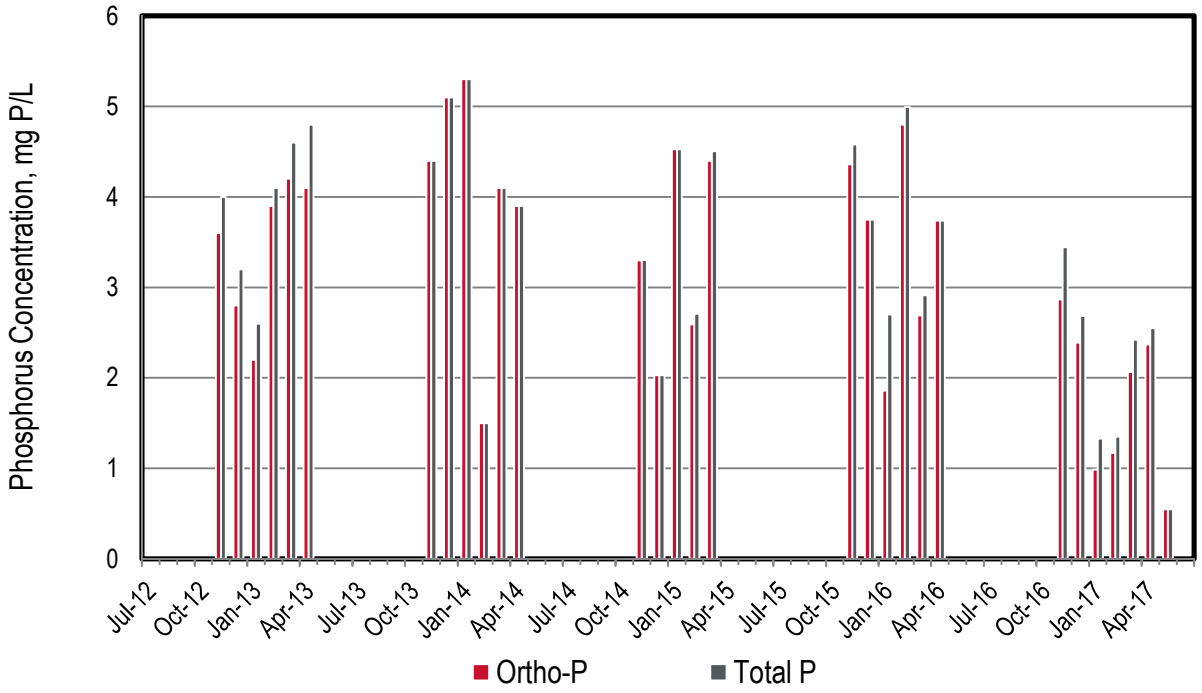


**Figure 11-5. Las Gallinas Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 11-1. Las Gallinas Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-12 | 2.4 | 24 | 36 | 183 | 219 | 33 | 36 |
| Dec-12 | 2.9 | 44 | 50 | 188 | 238 | 31 | 35 |
| Jan-13 | 3.4 | 18 | 36 | 207 | 243 | 28 | 33 |
| Feb-13 | 2.8 | 9 | 25 | 307 | 333 | 41 | 43 |
| Mar-13 | 2.5 | 23 | 31 | 265 | 296 | 40 | 43 |
| Apr-13 | 2.5 | 11 | 16 | 270 | 286 | 38 | 44 |
| May-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-13 | 2.3 | 22 | 28 | 217 | 245 | 57 | 38 |
| Dec-13 | 2.2 | 45 | 45 | 230 | 275 | 52 | 42 |
| Jan-14 | 2.2 | 39 | 36 | 289 | 326 | 71 | 45 |
| Feb-14 | 3.4 | 43 | 81 | 144 | 225 | 27 | 19 |
| Mar-14 | 1.3 | 17 | 11 | 115 | 126 | 49 | 20 |
| Apr-14 | 2.8 | 13 | 19 | 249 | 268 | 62 | 42 |
| May-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-14 | 2.1 | 26 | 22 | 149 | 171 | 26 | 26 |
| Dec-14 | 5.4 | 25 | 28 | 309 | 337 | 43 | 41 |
| Jan-15 | 2.3 | 68 | 77 | 203 | 280 | 40 | 39 |
| Feb-15 | 3.0 | 18 | 28 | 218 | 247 | 29 | 31 |
| Mar-15 | 2.2 | 2 | 49 | 152 | 201 | 37 | 37 |
| Apr-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-15 | 2.5 | 35 | 44 | 188 | 232 | 41 | 43 |
| Dec-15 | 2.9 | 73 | 74 | 147 | 220 | 42 | 41 |
| Jan-16 | 4.4 | 87 | 167 | 218 | 385 | 31 | 45 |
| Feb-16 | 2.7 | 50 | 83 | 184 | 267 | 48 | 50 |
| Mar-16 | 4.6 | 27 | 50 | 230 | 280 | 47 | 51 |
| Apr-16 | 2.9 | 8 | 31 | 206 | 236 | 41 | 41 |
| May-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-16 | 3.7 | 44 | 56 | 202 | 258 | 40 | 48 |
| Dec-16 | 4.5 | 81 | 138 | 168 | 306 | 41 | 46 |
| Jan-17 | 7.8 | 121 | 143 | 178 | 321 | 29 | 39 |
| Feb-17 | 7.5 | 65 | 90 | 212 | 302 | 33 | 38 |
| Mar-17 | 4.5 | 51 | 83 | 206 | 288 | 35 | 41 |
| Apr-17 | 4.4 | 43 | 42 | 246 | 288 | 39 | 42 |
| May-17 | 2.0 | 12 | 3 | 33 | 37 | 4 | 4 |
| Jun-17 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | |
| **Dry Season Average **** | **0.1** | **0** | **0** | **1** | **1** | **0** | **0** |
| **Dry Season Trend ***** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Wet Season Average** | **2.8** | **32** | **46** | **174** | **220** | **33** | **33** |
| **Average Annual** | **1.7** | **19** | **27** | **102** | **129** | **20** | **19** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** The dry season average is so much lower than the wet season due to only having one month with a dry season discharge (May 2017).

*** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 12 City of Millbrae

Millbrae discharges to the South Bay. The plant has approximately 6,500 service connections and it has a permitted capacity of 3.0 mgd ADWF. The current plant flows are 1.3 mgd ADWF. The plant performs secondary treatment using an activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging dry season downward trend for phosphorus loads.
- Based on the table with the average monthly values, there appears to be an emerging dry season upward trend for ammonia, TKN, and total nitrogen loads.
- Both nitrogen and phosphorus loads increase with flow during wet weather events. However, the loads typically stay elevated after the flows decline back to typical values.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- Ortho-P values are occasionally greater than TP values for the Section 13267 Letter data (pre-July 2014) based on the composite sampling issue and use of dissolved reactive phosphorus as discussed in the main report body. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has not exceeded the TP value.
- Total phosphorus concentrations range from 0.8 to 4.7 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is thought to be the anaerobic selector in the activated sludge process.

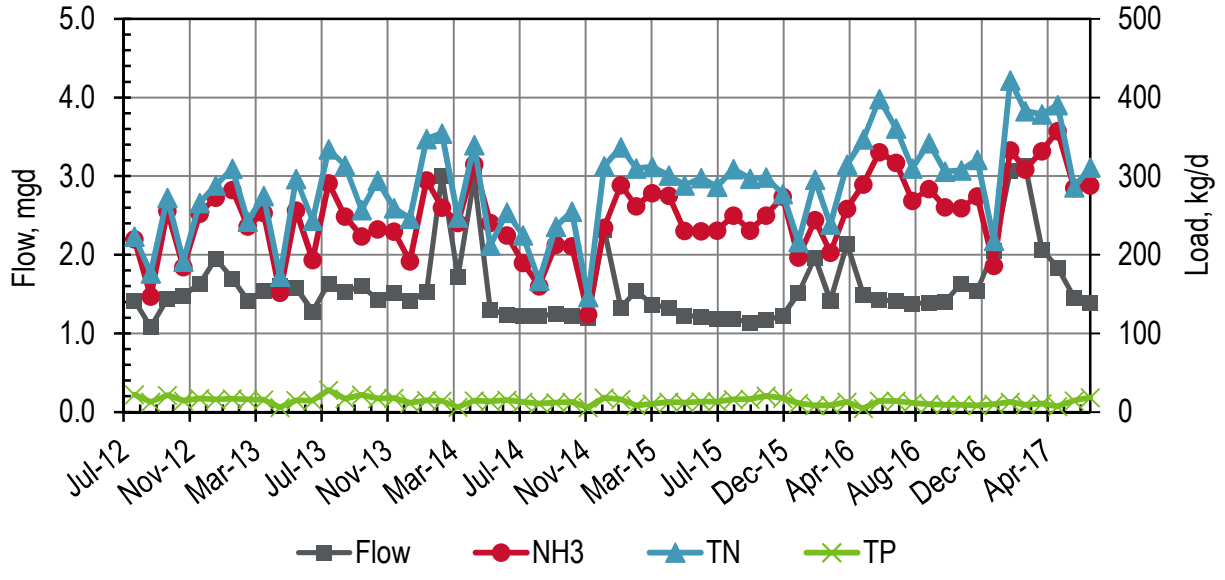


**Figure 12-1. Millbrae Monthly Flows and Loads**

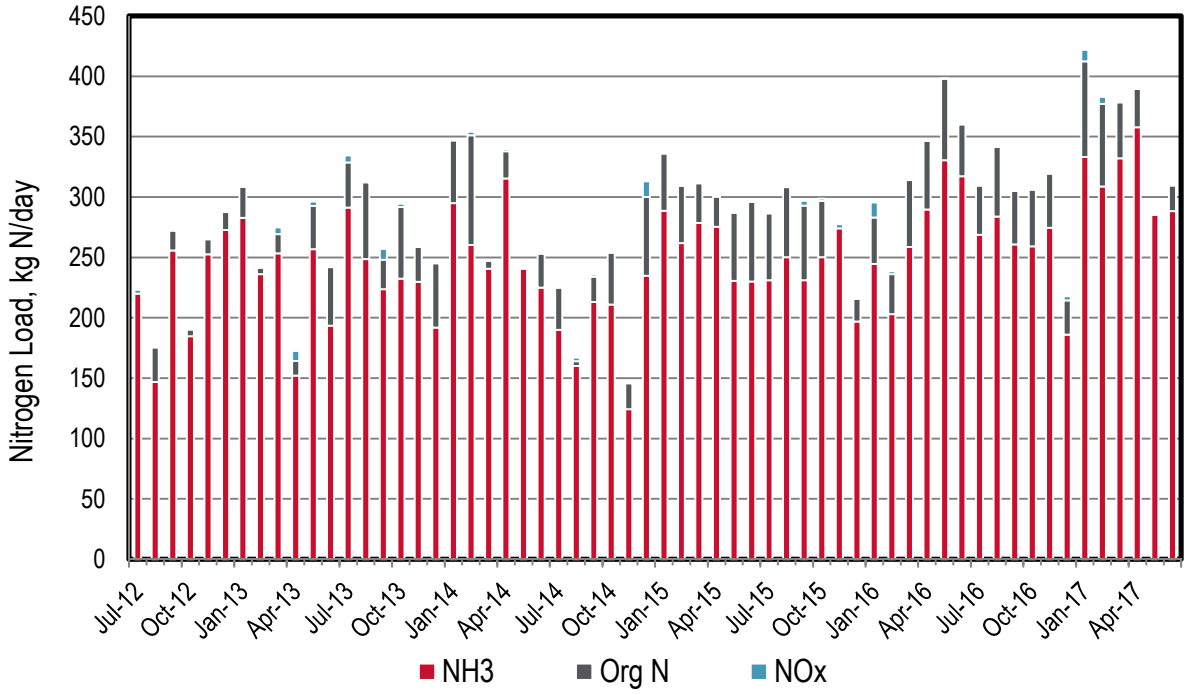


**Figure 12-2. Millbrae Monthly Nitrogen Loads**

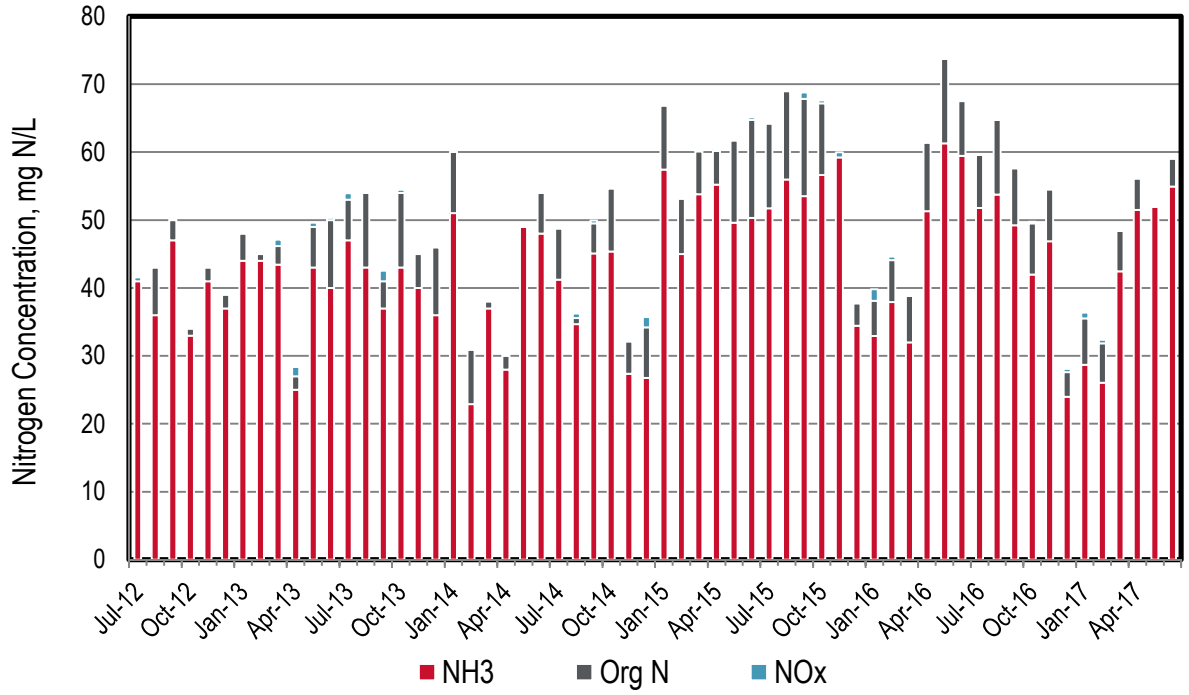


**Figure 12-3. Millbrae Monthly Nitrogen Concentrations**

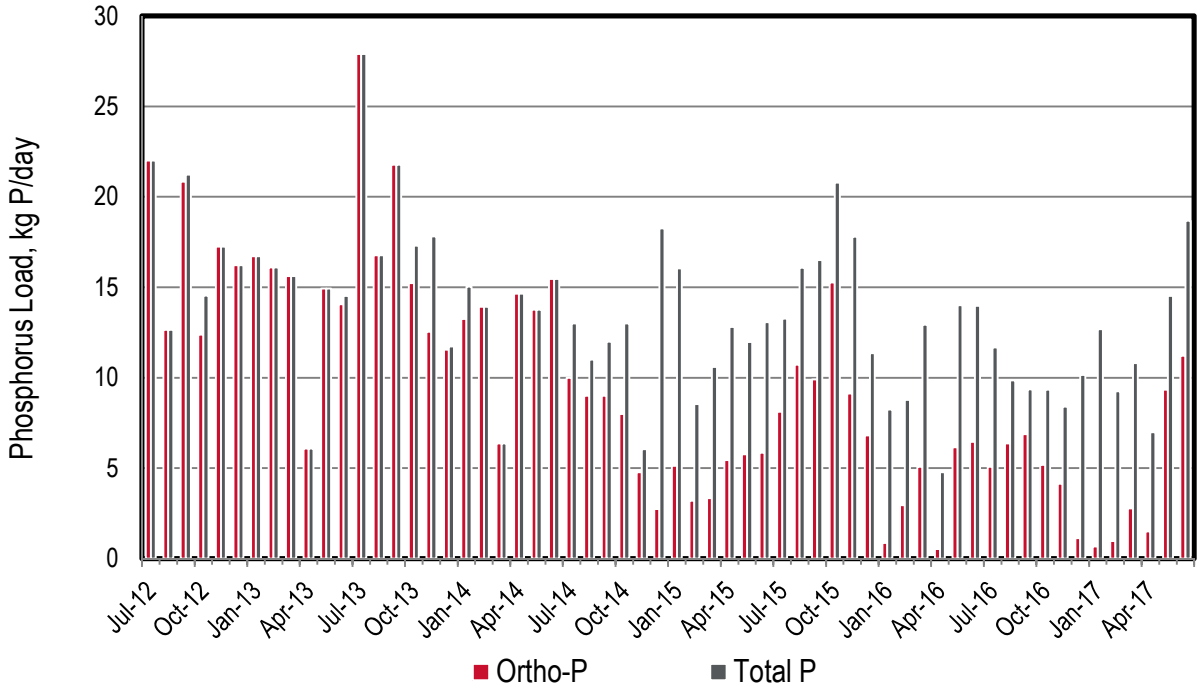


**Figure 12-4. Millbrae Monthly Phosphorus Loads**

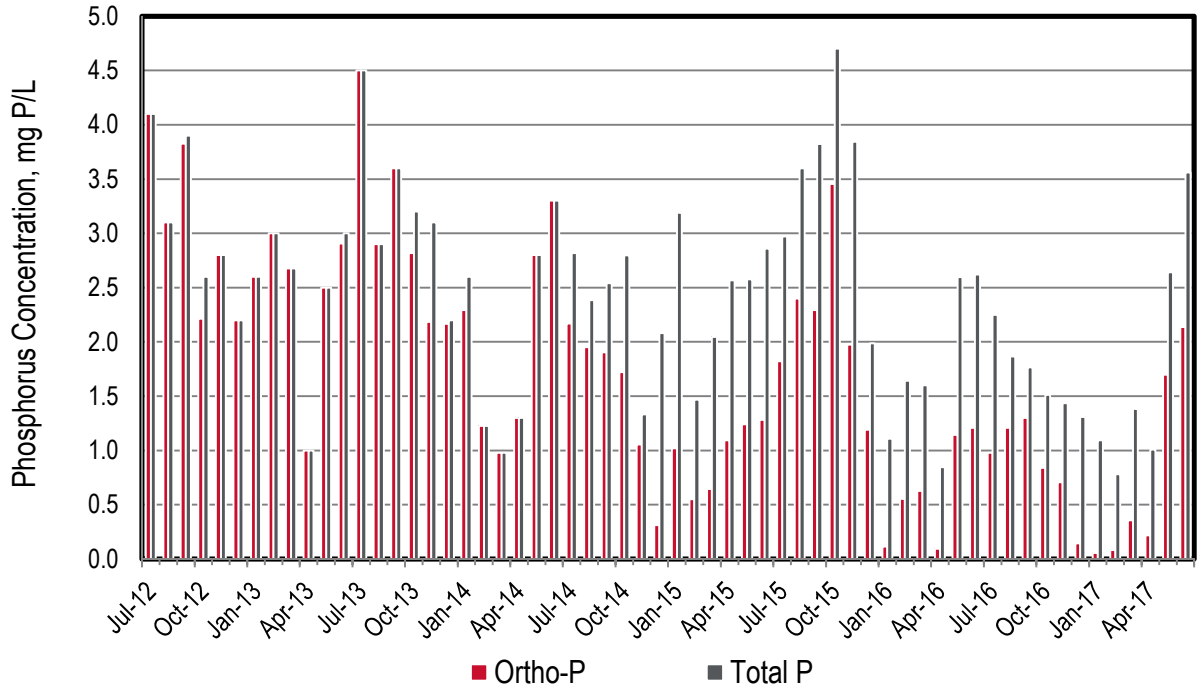


**Figure 12-5. Millbrae Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 12-1. Millbrae Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 1.4 | 220 | 220 | 3 | 223 | 23 | 22 |
| Aug-12 | 1.1 | 147 | 176 | 1 | 176 | 38 | 13 |
| Sep-12 | 1.4 | 256 | 272 | 0 | 273 | 21 | 21 |
| Oct-12 | 1.5 | 185 | 190 | 1 | 192 | 12 | 15 |
| Nov-12 | 1.6 | 253 | 265 | 1 | 266 | 39 | 17 |
| Dec-12 | 2.0 | 273 | 287 | 1 | 288 | 24 | 16 |
| Jan-13 | 1.7 | 283 | 308 | 1 | 309 | 17 | 17 |
| Feb-13 | 1.4 | 236 | 242 | 1 | 242 | 20 | 16 |
| Mar-13 | 1.5 | 253 | 269 | 5 | 275 | 22 | 16 |
| Apr-13 | 1.6 | 152 | 164 | 8 | 173 | 8 | 6 |
| May-13 | 1.6 | 257 | 293 | 4 | 296 | 20 | 15 |
| Jun-13 | 1.3 | 194 | 242 | 2 | 243 | 14 | 15 |
| Jul-13 | 1.6 | 291 | 329 | 6 | 335 | 32 | 28 |
| Aug-13 | 1.5 | 249 | 312 | 1 | 313 | 18 | 17 |
| Sep-13 | 1.6 | 224 | 248 | 9 | 257 | 22 | 22 |
| Oct-13 | 1.4 | 232 | 292 | 2 | 294 | 15 | 17 |
| Nov-13 | 1.5 | 230 | 259 | 1 | 259 | 13 | 18 |
| Dec-13 | 1.4 | 192 | 245 | 1 | 246 | 12 | 12 |
| Jan-14 | 1.5 | 295 | 347 | 0 | 347 | 13 | 15 |
| Feb-14 | 3.0 | 260 | 351 | 3 | 354 | 17 | 14 |
| Mar-14 | 1.7 | 241 | 247 | 1 | 248 | 8 | 6 |
| Apr-14 | 3.0 | 315 | 338 | 2 | 340 | 36 | 15 |
| May-14 | 1.3 | 241 | 211 | 0 | 212 | 18 | 14 |
| Jun-14 | 1.2 | 225 | 253 | 1 | 254 | 16 | 15 |
| Jul-14 | 1.2 | 190 | 225 | 0 | 225 | 10 | 13 |
| Aug-14 | 1.2 | 160 | 164 | 3 | 167 | 9 | 11 |
| Sep-14 | 1.3 | 213 | 234 | 2 | 236 | 9 | 12 |
| Oct-14 | 1.2 | 211 | 254 | 1 | 255 | 8 | 13 |
| Nov-14 | 1.2 | 124 | 146 | 1 | 146 | 5 | 6 |
| Dec-14 | 2.3 | 235 | 300 | 13 | 313 | 3 | 18 |
| Jan-15 | 1.3 | 289 | 336 | 1 | 337 | 5 | 16 |
| Feb-15 | 1.5 | 262 | 309 | 1 | 310 | 3 | 9 |
| Mar-15 | 1.4 | 279 | 311 | 1 | 312 | 3 | 11 |
| Apr-15 | 1.3 | 276 | 300 | 1 | 301 | 5 | 13 |
| May-15 | 1.2 | 231 | 287 | 1 | 288 | 6 | 12 |
| Jun-15 | 1.2 | 230 | 296 | 2 | 298 | 6 | 13 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 1.2 | 231 | 287 | 0 | 287 | 8 | 13 |
| Aug-15 | 1.2 | 250 | 308 | 1 | 309 | 11 | 16 |
| Sep-15 | 1.1 | 231 | 293 | 4 | 297 | 10 | 17 |
| Oct-15 | 1.2 | 250 | 297 | 2 | 299 | 15 | 21 |
| Nov-15 | 1.2 | 274 | 274 | 3 | 277 | 9 | 18 |
| Dec-15 | 1.5 | 197 | 216 | 1 | 216 | 7 | 11 |
| Jan-16 | 2.0 | 245 | 283 | 12 | 296 | 1 | 8 |
| Feb-16 | 1.4 | 203 | 236 | 3 | 239 | 3 | 9 |
| Mar-16 | 2.1 | 259 | 314 | 1 | 315 | 5 | 13 |
| Apr-16 | 1.5 | 290 | 346 | 1 | 347 | 1 | 5 |
| May-16 | 1.4 | 331 | 398 | 1 | 398 | 6 | 14 |
| Jun-16 | 1.4 | 317 | 360 | 1 | 361 | 6 | 14 |
| Jul-16 | 1.4 | 269 | 309 | 0 | 310 | 5 | 12 |
| Aug-16 | 1.4 | 284 | 342 | 1 | 342 | 6 | 10 |
| Sep-16 | 1.4 | 261 | 305 | 1 | 306 | 7 | 9 |
| Oct-16 | 1.6 | 259 | 306 | 1 | 307 | 5 | 9 |
| Nov-16 | 1.5 | 275 | 319 | 1 | 321 | 4 | 8 |
| Dec-16 | 2.1 | 186 | 214 | 4 | 218 | 1 | 10 |
| Jan-17 | 3.1 | 333 | 412 | 10 | 422 | 1 | 13 |
| Feb-17 | 3.1 | 309 | 377 | 6 | 383 | 1 | 9 |
| Mar-17 | 2.1 | 332 | 378 | 0 | 379 | 3 | 11 |
| Apr-17 | 1.8 | 358 | 390 | 1 | 390 | 2 | 7 |
| May-17 | 1.5 | 285 | 285 | 1 | 286 | 9 | 15 |
| Jun-17 | 1.4 | 288 | 310 | 2 | 311 | 11 | 19 |
| | | | | | | | |
| **Dry Season Average** | **1.3** | **243** | **278** | **2** | **280** | **14** | **15** |
| **Dry Season Trend **** | **None** | **Up** | **Up** | **None** | **Up** | **-** | **Down** |
| **Wet Season Average** | **1.8** | **253** | **289** | **3** | **292** | **10** | **12** |
| **Average Annual** | **1.6** | **249** | **285** | **2** | **287** | **11** | **14** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 13 Mt. View Sanitary District

Mt. View discharges to Suisun Bay. The plant has approximately 10,500 service connections; it has a permitted capacity of 3.2 mgd ADWF and a peak wet weather capacity of 8.5 mgd. The current flow is 1.2 mgd ADWF. The plant performs nitrification using a series of trickling filters.

The following observations are made based upon the figures and table in the subsequent pages:

- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- Wet season nitrogen loads are greater and more variable than the dry season loads.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through during the colder months. This increases the ammonia contribution during such months.
- Phosphorus loads do not show a seasonal trend between the wet and dry seasons.
- Ortho-P values are occasionally greater than TP values. For such instances, ortho-P values were set equal to TP for the plots.
- Total phosphorus concentrations range from 0.6 to 6.2 mg P/L, which suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L.

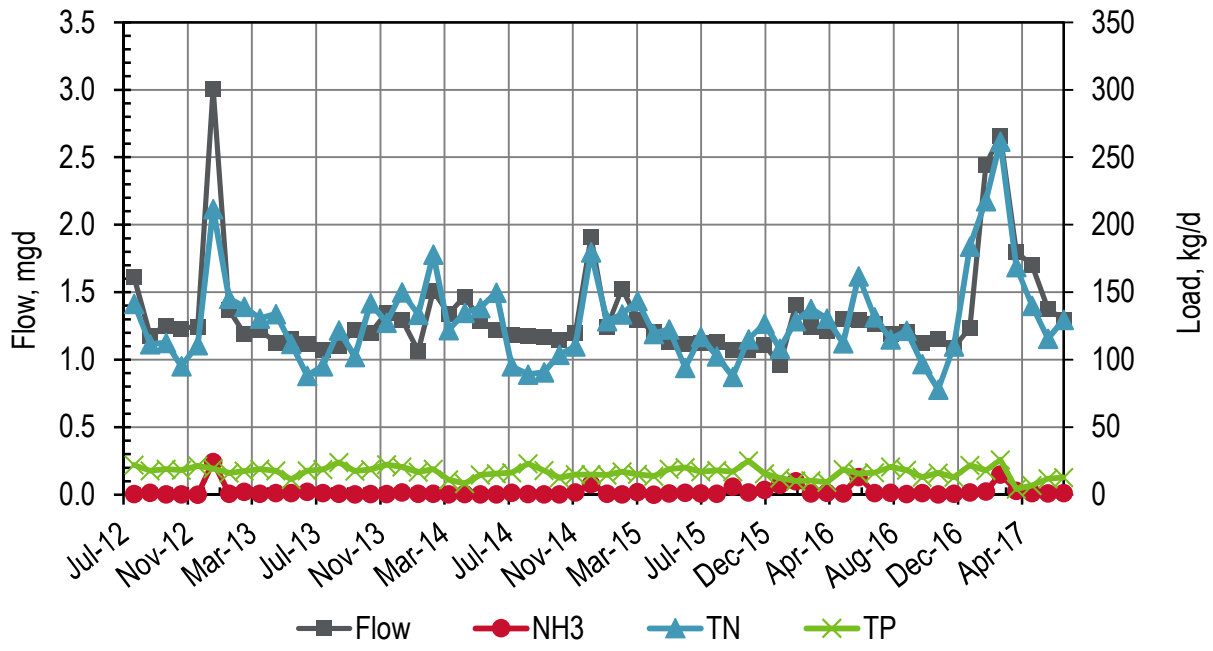


**Figure 13-1. Mt. View Monthly Flows and Loads**

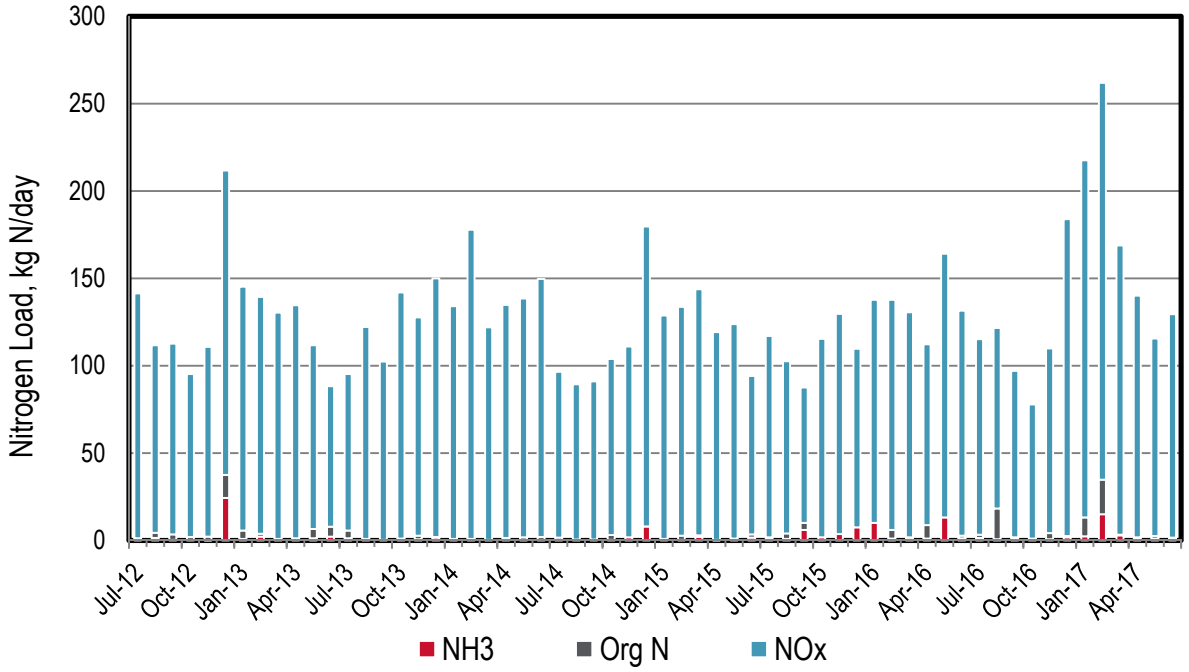


**Figure 13-2. Mt. View Monthly Nitrogen Loads**

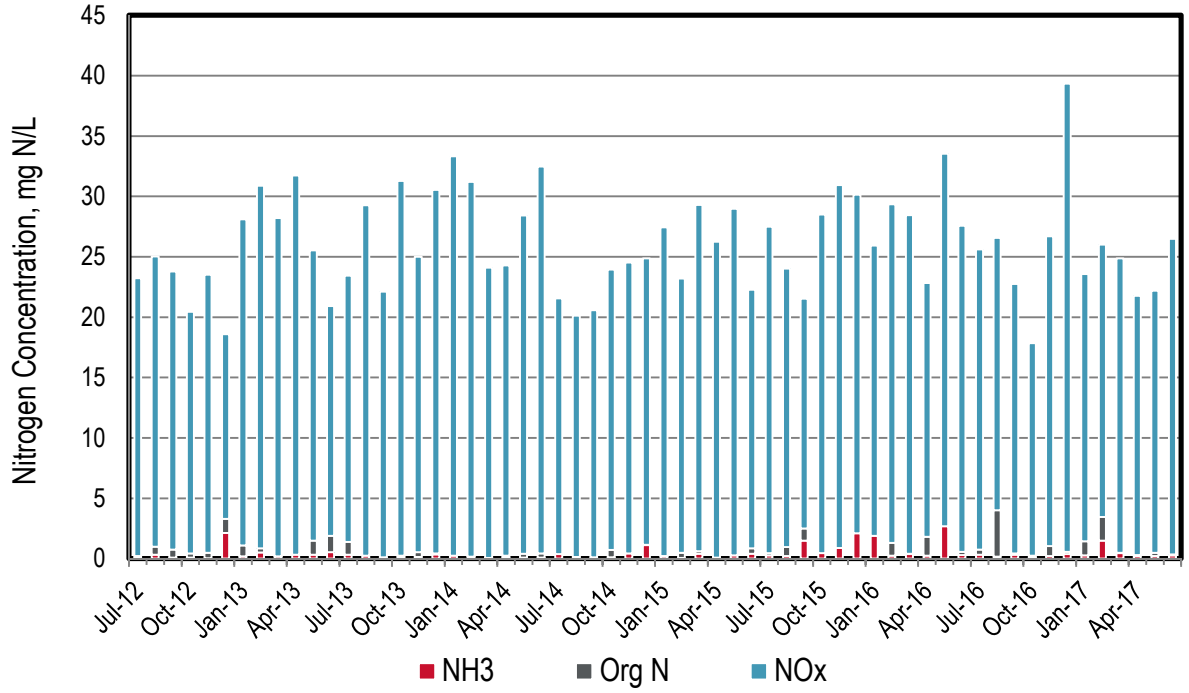


**Figure 13-3. Mt. View Monthly Nitrogen Concentrations**

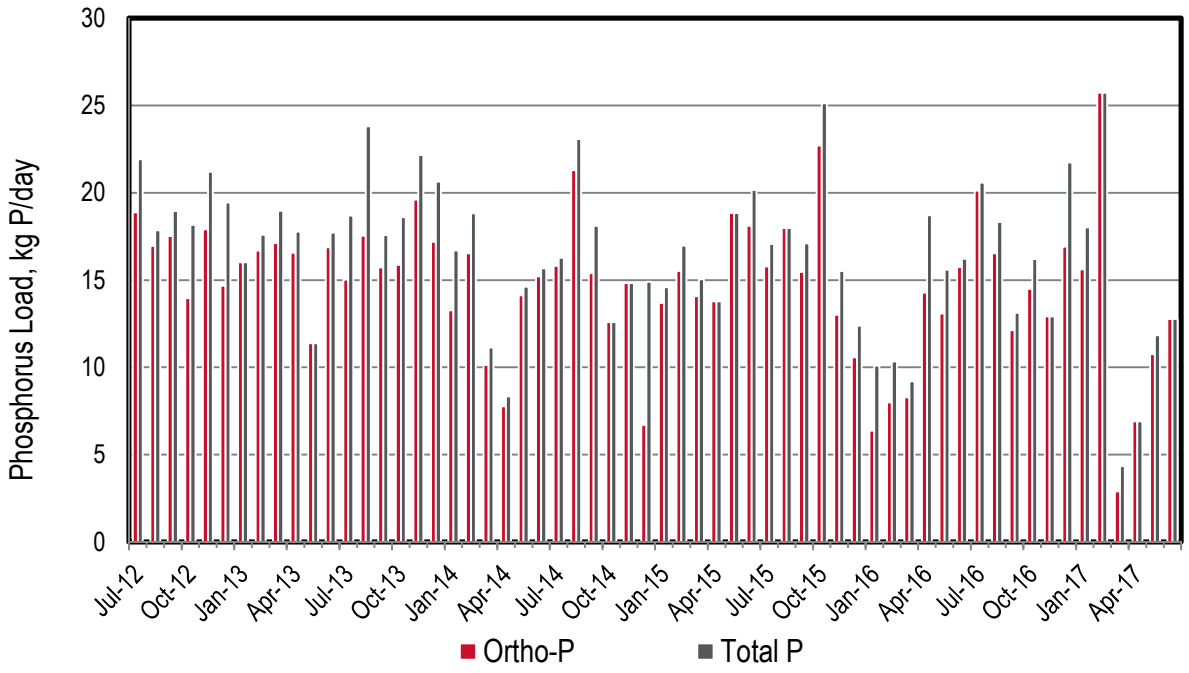


**Figure 13-4. Mt. View Monthly Phosphorus Loads**

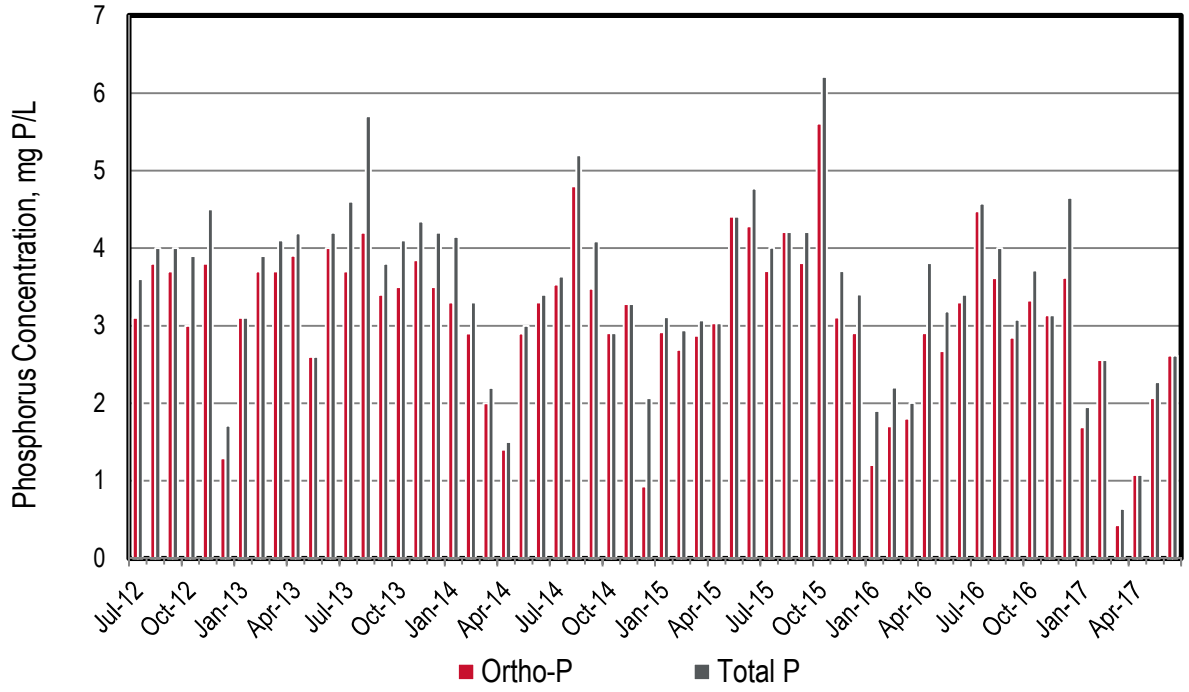


**Figure 13-5. Mt. View Monthly Phosphorus Concentrations**

## Table 13-1. Mt. View Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 1.6 | 1 | 1 | 140 | 141 | 19 | 22 |
| Aug-12 | 1.2 | 2 | 4 | 107 | 112 | 17 | 18 |
| Sep-12 | 1.3 | 0 | 4 | 109 | 113 | 18 | 19 |
| Oct-12 | 1.2 | 0 | 2 | 93 | 95 | 14 | 18 |
| Nov-12 | 1.2 | 0 | 2 | 109 | 111 | 18 | 21 |
| Dec-12 | 3.0 | 24 | 38 | 174 | 212 | 15 | 19 |
| Jan-13 | 1.4 | 1 | 6 | 140 | 145 | 19 | 16 |
| Feb-13 | 1.2 | 2 | 4 | 135 | 139 | 17 | 18 |
| Mar-13 | 1.2 | 1 | 1 | 130 | 131 | 17 | 19 |
| Apr-13 | 1.1 | 1 | 1 | 133 | 134 | 17 | 18 |
| May-13 | 1.2 | 1 | 7 | 105 | 112 | 12 | 11 |
| Jun-13 | 1.1 | 2 | 8 | 80 | 88 | 17 | 18 |
| Jul-13 | 1.1 | 1 | 6 | 90 | 95 | 15 | 19 |
| Aug-13 | 1.1 | 1 | 1 | 121 | 122 | 18 | 24 |
| Sep-13 | 1.2 | 1 | 0 | 102 | 102 | 16 | 18 |
| Oct-13 | 1.2 | 1 | 1 | 141 | 142 | 16 | 19 |
| Nov-13 | 1.4 | 1 | 3 | 125 | 128 | 20 | 22 |
| Dec-13 | 1.3 | 2 | 2 | 148 | 150 | 17 | 21 |
| Jan-14 | 1.1 | 1 | 0 | 133 | 133 | 13 | 17 |
| Feb-14 | 1.5 | 1 | 1 | 177 | 178 | 17 | 19 |
| Mar-14 | 1.3 | 0 | 0 | 122 | 122 | 10 | 11 |
| Apr-14 | 1.5 | 1 | 1 | 133 | 135 | 8 | 8 |
| May-14 | 1.3 | 0 | 2 | 137 | 139 | 14 | 15 |
| Jun-14 | 1.2 | 0 | 2 | 148 | 150 | 15 | 16 |
| Jul-14 | 1.2 | 2 | 0 | 95 | 95 | 16 | 16 |
| Aug-14 | 1.2 | 1 | 0 | 89 | 89 | 21 | 23 |
| Sep-14 | 1.2 | 1 | 0 | 91 | 91 | 15 | 18 |
| Oct-14 | 1.1 | 0 | 3 | 101 | 104 | 13 | 13 |
| Nov-14 | 1.2 | 2 | 1 | 109 | 110 | 17 | 15 |
| Dec-14 | 1.9 | 8 | 8 | 171 | 180 | 7 | 15 |
| Jan-15 | 1.2 | 1 | 1 | 128 | 129 | 14 | 15 |
| Feb-15 | 1.5 | 0 | 3 | 131 | 134 | 16 | 17 |
| Mar-15 | 1.3 | 2 | 3 | 141 | 144 | 14 | 15 |
| Apr-15 | 1.2 | 0 | 0 | 119 | 119 | 14 | 14 |
| May-15 | 1.1 | 1 | 0 | 123 | 123 | 20 | 19 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 1.1 | 2 | 4 | 91 | 94 | 18 | 20 |
| Jul-15 | 1.1 | 1 | 2 | 115 | 117 | 16 | 17 |
| Aug-15 | 1.1 | 1 | 4 | 98 | 103 | 19 | 18 |
| Sep-15 | 1.1 | 6 | 10 | 77 | 88 | 15 | 17 |
| Oct-15 | 1.1 | 2 | 2 | 114 | 115 | 23 | 25 |
| Nov-15 | 1.1 | 4 | 1 | 126 | 127 | 13 | 16 |
| Dec-15 | 1.0 | 8 | 6 | 102 | 108 | 11 | 12 |
| Jan-16 | 1.4 | 10 | 1 | 128 | 129 | 6 | 10 |
| Feb-16 | 1.2 | 1 | 6 | 132 | 138 | 8 | 10 |
| Mar-16 | 1.2 | 2 | 2 | 129 | 131 | 8 | 9 |
| Apr-16 | 1.3 | 1 | 9 | 103 | 112 | 14 | 19 |
| May-16 | 1.3 | 13 | 11 | 151 | 162 | 13 | 16 |
| Jun-16 | 1.3 | 1 | 3 | 129 | 131 | 16 | 16 |
| Jul-16 | 1.2 | 2 | 3 | 112 | 115 | 20 | 21 |
| Aug-16 | 1.2 | 1 | 18 | 103 | 122 | 17 | 18 |
| Sep-16 | 1.1 | 1 | 2 | 95 | 97 | 12 | 13 |
| Oct-16 | 1.2 | 1 | 1 | 77 | 78 | 15 | 16 |
| Nov-16 | 1.1 | 1 | 4 | 106 | 110 | 13 | 13 |
| Dec-16 | 1.2 | 2 | 3 | 181 | 184 | 17 | 22 |
| Jan-17 | 2.4 | 3 | 13 | 204 | 218 | 16 | 18 |
| Feb-17 | 2.7 | 15 | 35 | 227 | 262 | 39 | 26 |
| Mar-17 | 1.8 | 3 | 3 | 166 | 169 | 3 | 4 |
| Apr-17 | 1.7 | 1 | 2 | 138 | 140 | 7 | 7 |
| May-17 | 1.4 | 1 | 3 | 113 | 116 | 11 | 12 |
| Jun-17 | 1.3 | 1 | 2 | 128 | 130 | 13 | 13 |
| | | | | | | | |
| **Dry Season Average** | **1.2** | **2** | **4** | **110** | **114** | **16** | **17** |
| **Dry Season Trend **** | **None** | **None** | **None** | **None** | **None** | **-** | **None** |
| **Wet Season Average** | **1.4** | **3** | **5** | **135** | **140** | **14** | **16** |
| **Average Annual** | **1.3** | **2** | **4** | **125** | **129** | **15** | **17** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 14 Napa Sanitation District

Napa discharges to the Napa River that is connected to San Pablo Bay. The plant has a permitted capacity of 15.4 mgd ADWF. The plant performs nitrogen removal using a step-feed activated sludge process with anoxic zones coupled with oxidation ponds which also serves as equalization during peak flow. Discharge is prohibited July 1 through September 30.

The following observations are made based upon the figures and table in the subsequent pages:

- There are no emerging dry season trends as Napa has not discharged during the dry season for the years of data evaluated.
- Both nitrogen and phosphorus loads generally increase with flow during wet weather events.
- NOx is the majority of the nitrogen discharged as the Activated Sludge system is operated to nitrify. During the wet season months partially nitrified pond effluent may be clarified then comingled with nitrified Activated Sludge effluent prior to discharge which may increase the ammonia levels during such months.
- Based on average monthly values, the plant discharge currently meets Level 2 total nitrogen concentration limits (i.e., 15 mg N/L) developed under the Scoping and Evaluation Plan for all but two months.
- The plant discharge average monthly total phosphorus concentrations ranging from 0.3 to 3.3 mg P/L, This suggests a portion of P is removed as typical influent TP concentrations are 4 to 6 mg P/L. The removal mechanism is most likely from ferric chloride addition.

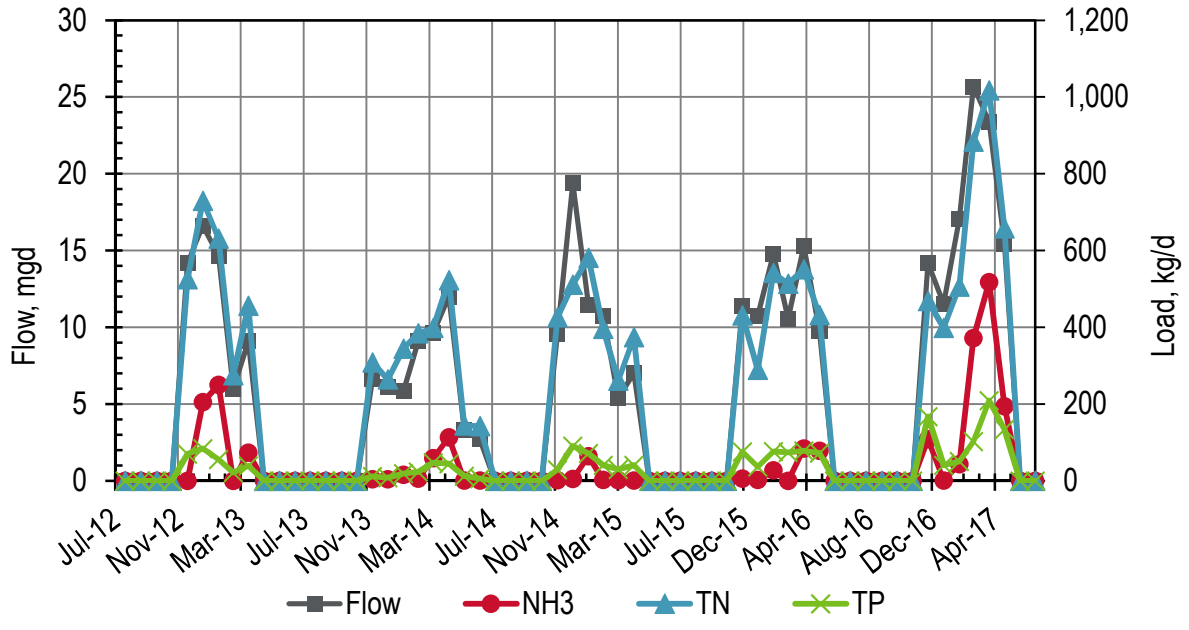


**Figure 14-1. Napa Monthly Flows and Loads**

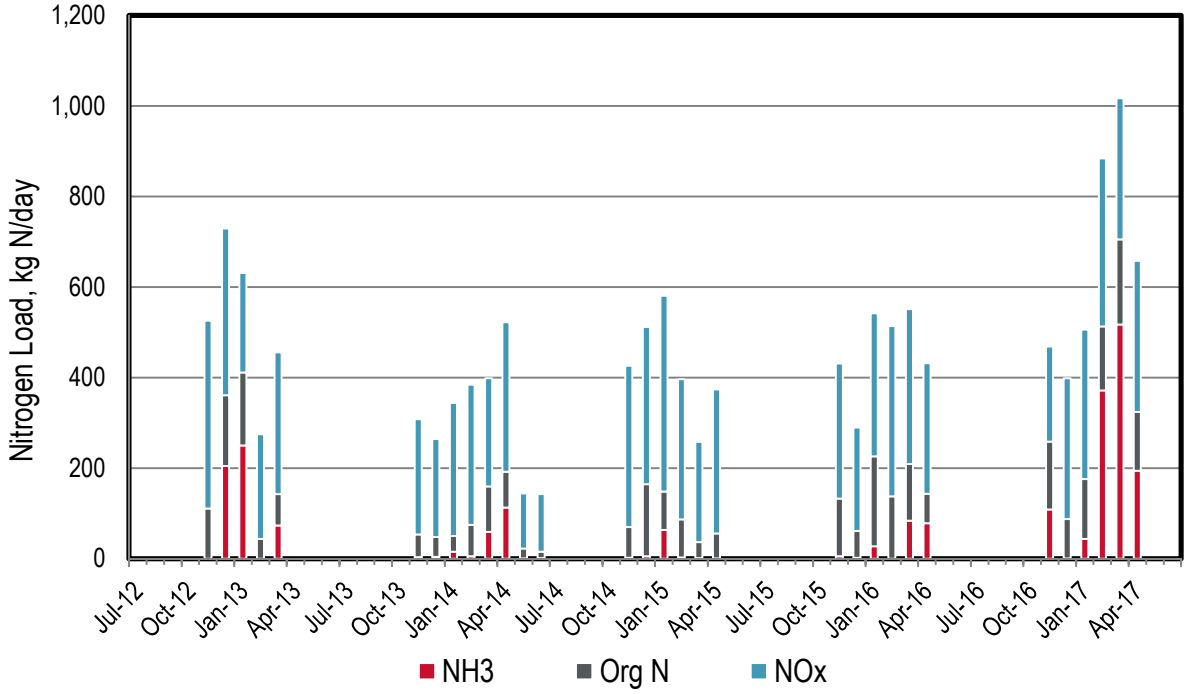


**Figure 14-2. Napa Monthly Nitrogen Loads**

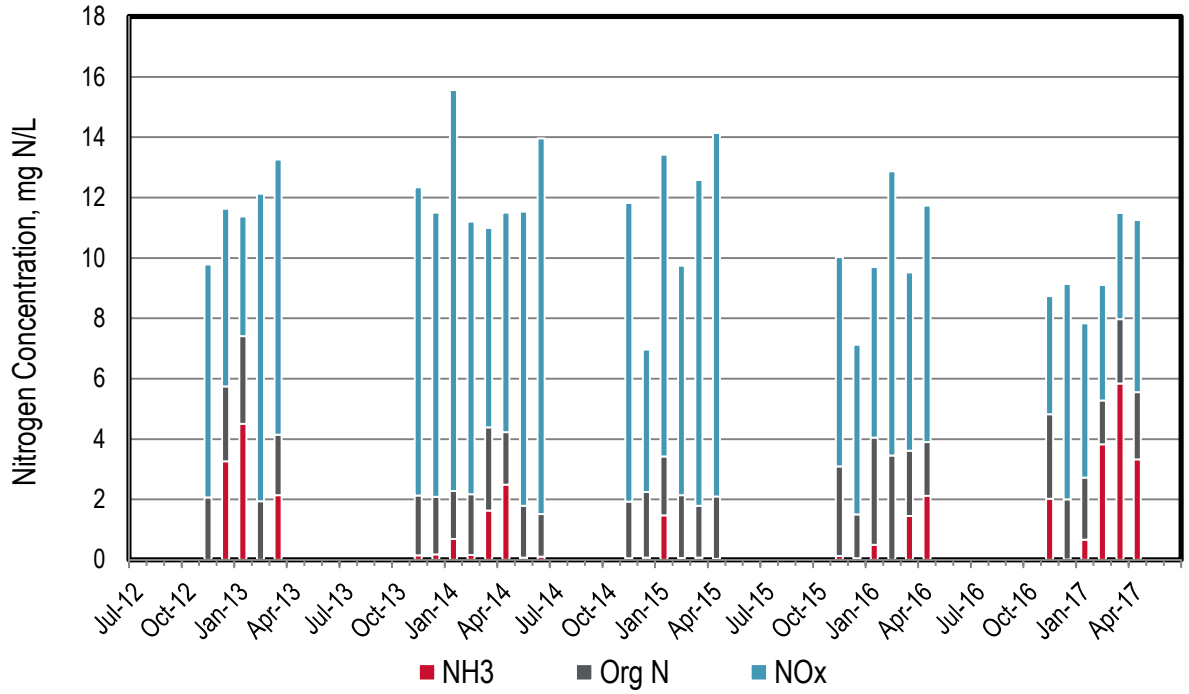


**Figure 14-3. Napa Monthly Nitrogen Concentrations**

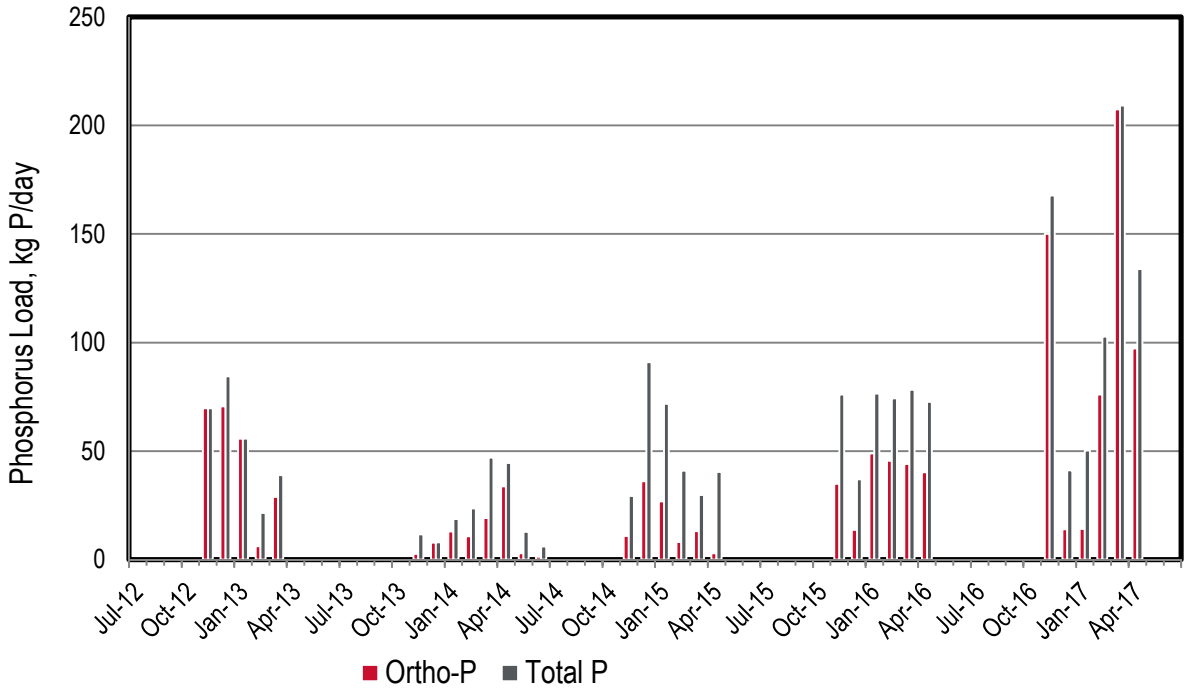


**Figure 14-4. Napa Monthly Phosphorus Loads**

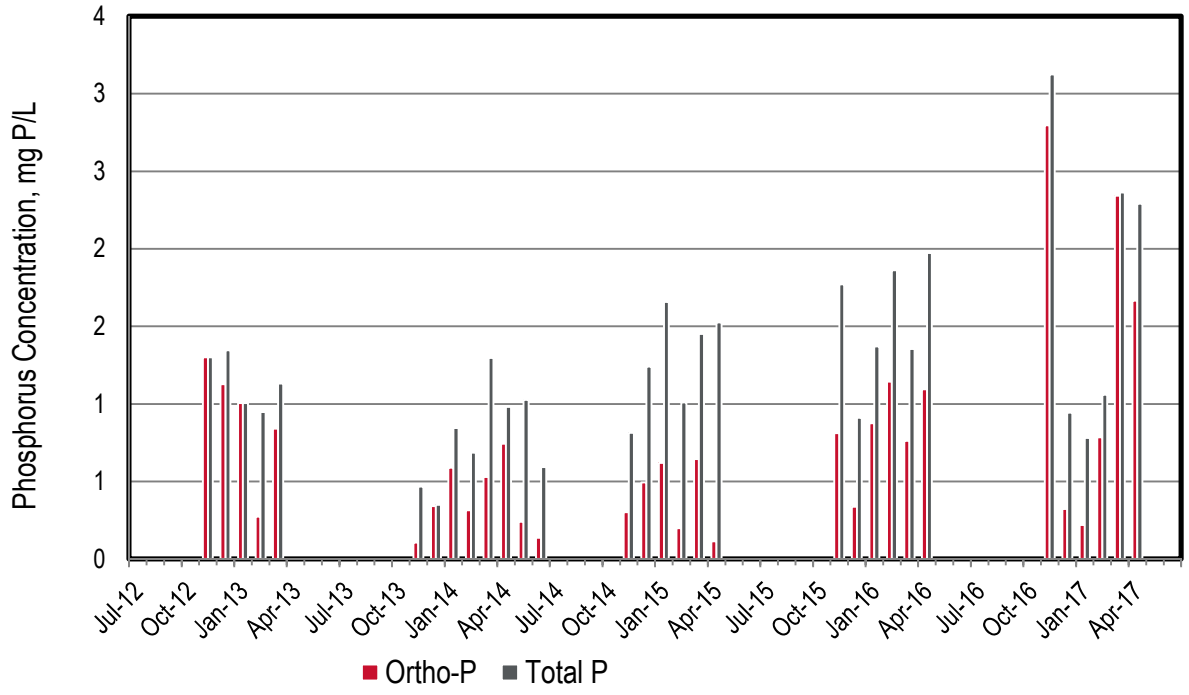


**Figure 14-5. Napa Monthly Phosphorus Concentrations**

## Table 14-1. Napa Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-12 | 14.2 | 0 | 111 | 414 | 525 | 72 | 70 |
| Dec-12 | 16.6 | 205 | 361 | 369 | 729 | 71 | 84 |
| Jan-13 | 14.7 | 250 | 411 | 220 | 631 | 111 | 56 |
| Feb-13 | 6.0 | 0 | 44 | 231 | 275 | 6 | 21 |
| Mar-13 | 9.1 | 74 | 142 | 314 | 456 | 29 | 39 |
| Apr-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-13 | 6.6 | 4 | 53 | 255 | 308 | 3 | 12 |
| Dec-13 | 6.1 | 4 | 48 | 216 | 264 | 8 | 8 |
| Jan-14 | 5.9 | 15 | 50 | 294 | 344 | 13 | 19 |
| Feb-14 | 9.1 | 5 | 75 | 310 | 385 | 11 | 24 |
| Mar-14 | 9.6 | 59 | 159 | 239 | 399 | 19 | 47 |
| Apr-14 | 12.0 | 113 | 192 | 330 | 522 | 34 | 45 |
| May-14 | 3.3 | 1 | 22 | 122 | 144 | 3 | 13 |
| Jun-14 | 2.7 | 1 | 15 | 127 | 142 | 1 | 6 |
| Jul-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-14 | 9.5 | 2 | 70 | 356 | 426 | 11 | 29 |
| Dec-14 | 19.4 | 5 | 165 | 347 | 511 | 36 | 91 |
| Jan-15 | 11.5 | 64 | 148 | 433 | 581 | 27 | 72 |
| Feb-15 | 10.8 | 3 | 87 | 309 | 396 | 8 | 41 |
| Mar-15 | 5.4 | 2 | 37 | 221 | 261 | 13 | 30 |
| Apr-15 | 7.0 | 1 | 56 | 319 | 374 | 3 | 40 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| May-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-15 | 11.4 | 6 | 133 | 298 | 431 | 35 | 76 |
| Dec-15 | 10.7 | 2 | 61 | 228 | 289 | 14 | 37 |
| Jan-16 | 14.8 | 28 | 226 | 315 | 542 | 49 | 77 |
| Feb-16 | 10.6 | 0 | 138 | 376 | 514 | 46 | 74 |
| Mar-16 | 15.3 | 84 | 209 | 342 | 551 | 44 | 78 |
| Apr-16 | 9.7 | 78 | 144 | 288 | 432 | 40 | 73 |
| May-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-16 | 14.2 | 109 | 259 | 210 | 469 | 150 | 168 |
| Dec-16 | 11.5 | 1 | 87 | 311 | 399 | 14 | 41 |
| Jan-17 | 17.1 | 43 | 176 | 330 | 506 | 14 | 50 |
| Feb-17 | 25.7 | 372 | 513 | 371 | 884 | 76 | 103 |
| Mar-17 | 23.4 | 517 | 705 | 311 | 1,017 | 207 | 209 |
| Apr-17 | 15.4 | 194 | 324 | 333 | 657 | 97 | 134 |
| May-17 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-17 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | |
| **Dry Season Average** | **0.2** | **0** | **2** | **10** | **11** | **0** | **1** |
| **Dry Season Trend **** | **None** | **None** | **None** | **None** | **None** | **-** | **None** |
| **Wet Season Average** | **10.1** | **64** | **148** | **254** | **402** | **36** | **53** |
| **Average Annual** | **6.0** | **37** | **87** | **152** | **239** | **21** | **31** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 15 Novato Sanitary District

Novato discharges to San Pablo Bay. The plant has approximately 28,500 service connections; it has a permitted capacity of 7.0 mgd ADWF and a peak wet weather capacity of 47 mgd. The plant performs nitrogen removal using activated sludge. Discharge is prohibited June 1 through August 31, unless (1) facility inflow will exceed the capacity of influent storage (after factoring in anticipated wet weather storage needs), and facility effluent flow will exceed the capacity of the reclamation water distribution and storage system to meet reclaimed water demand (e.g., June 2017); and (2) the discharge meets the advanced treatment limits specified in the permit. The discharge will increase to year-round if Novato begins discharging to a new wetland adjacent to San Pablo Bay as noted in their current permit.

The following observations are made based upon the figures and table in the subsequent pages:

- There are no emerging dry season trends as Novato does not typically discharge during the dry season.
- Wet season trends were analyzed (data not shown) and there are no emerging trends.
- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through during the colder months. This increases the ammonia contribution during such months.
- The plant nearly meets Level 2 total nitrogen concentration limits (i.e., 15 mg N/L) developed under the Scoping and Evaluation Plan with values reliably less than 22 mg N/L.
- Ortho-P values are occasionally greater than TP values for the Section 13267 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value once. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.2 to 3.2 mg P/L, This suggests a portion of P is removed as typical effluent TP concentrations for similar treatment plants are 4 to 6 mg P/L. The removal mechanism might be attributed to a combination of ferric chloride addition to the digester influent and/or biological P removal.

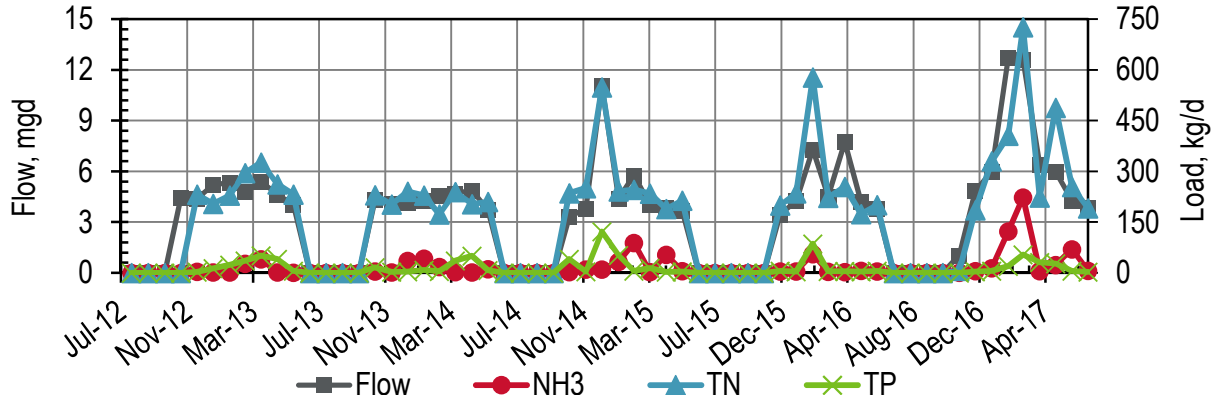


**Figure 15-1. Novato Monthly Flows and Loads**

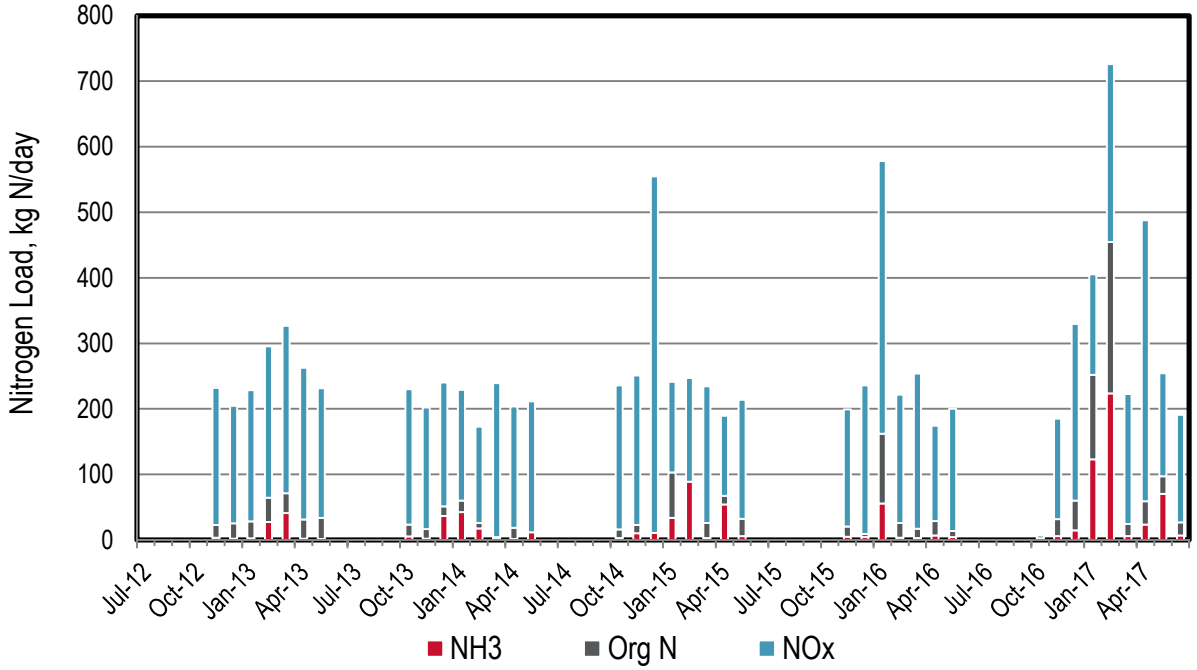


**Figure 15-2. Novato Monthly Nitrogen Loads**

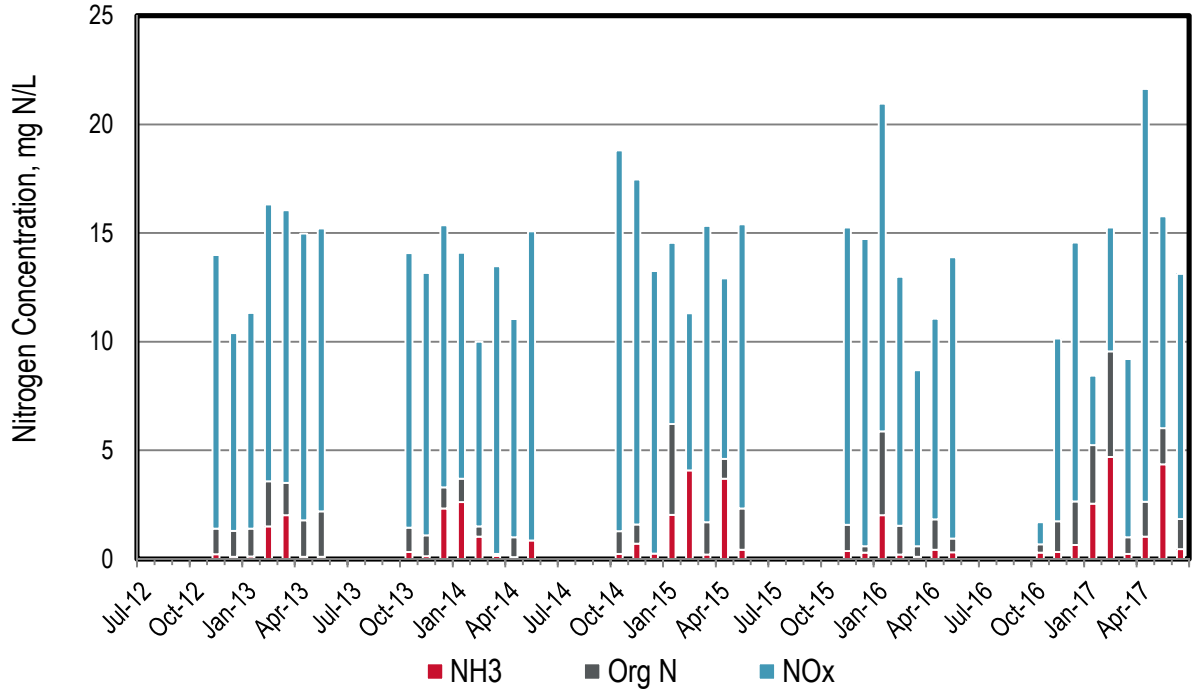


**Figure 15-3. Novato Monthly Nitrogen Concentrations**

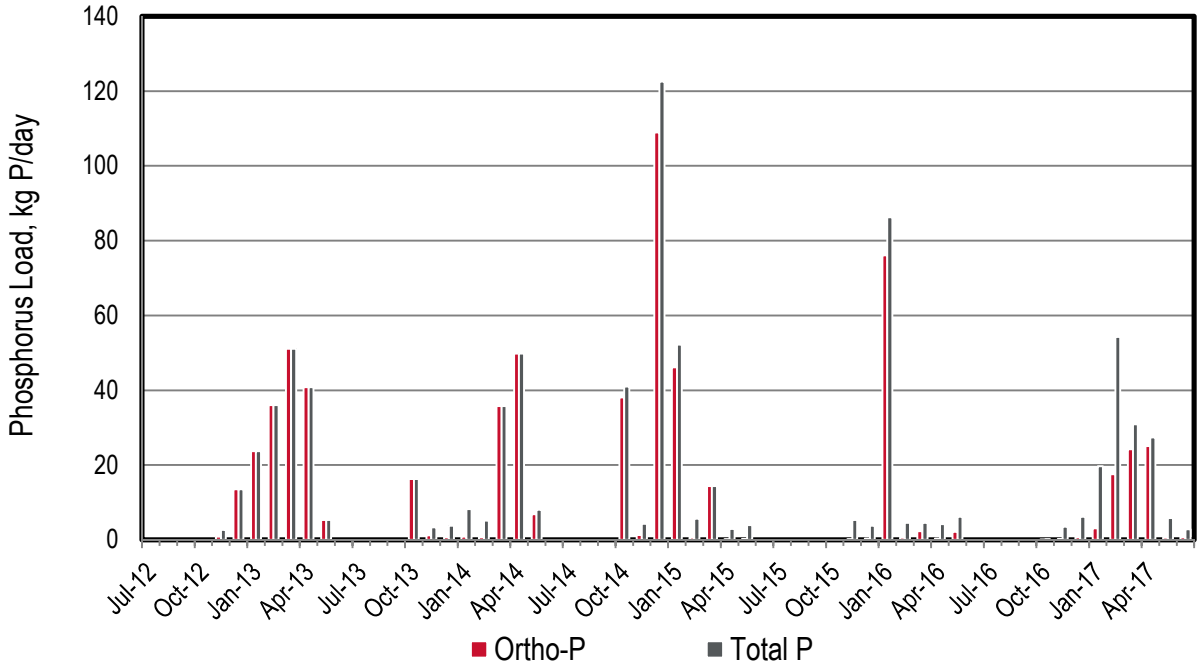


**Figure 15-4. Novato Monthly Phosphorus Loads**

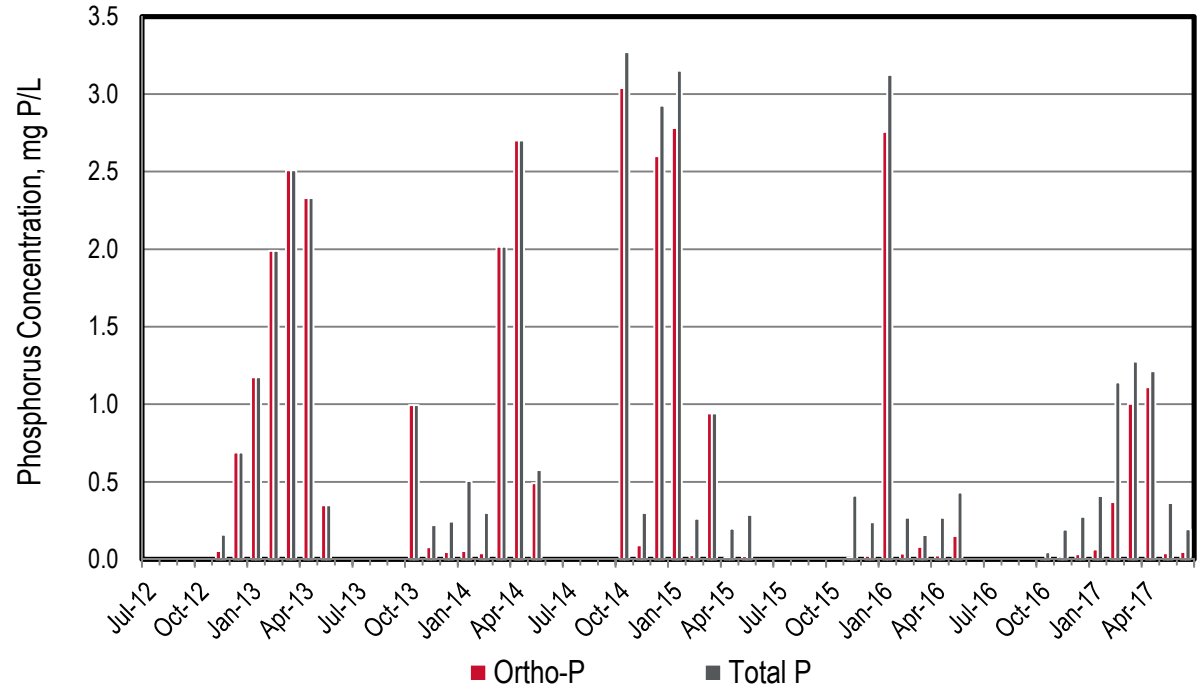


**Figure 15-5. Novato Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 15-1. Novato Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-12 | 4.4 | -- | -- | -- | -- | -- | -- |
| Nov-12 | 4.4 | 4 | 23 | 209 | 232 | 1 | 3 |
| Dec-12 | 5.2 | 2 | 26 | 179 | 205 | 35 | 14 |
| Jan-13 | 5.3 | 2 | 28 | 200 | 229 | 35 | 24 |
| Feb-13 | 4.8 | 27 | 65 | 231 | 295 | 58 | 36 |
| Mar-13 | 5.4 | 41 | 71 | 255 | 327 | 86 | 51 |
| Apr-13 | 4.6 | 2 | 31 | 231 | 263 | 64 | 41 |
| May-13 | 4.0 | 2 | 34 | 198 | 232 | 9 | 5 |
| Jun-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-13 | 4.3 | 5 | 24 | 207 | 230 | 22 | 16 |
| Nov-13 | 4.1 | 2 | 17 | 186 | 202 | 1 | 3 |
| Dec-13 | 4.1 | 36 | 52 | 189 | 240 | 1 | 4 |
| Jan-14 | 4.3 | 43 | 60 | 169 | 229 | 1 | 8 |
| Feb-14 | 4.6 | 18 | 26 | 147 | 173 | 1 | 5 |
| Mar-14 | 4.7 | 3 | 4 | 235 | 239 | 58 | 36 |
| Apr-14 | 4.9 | 2 | 18 | 185 | 204 | 82 | 50 |
| May-14 | 3.7 | 12 | 10 | 200 | 210 | 7 | 8 |
| Jun-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-14 | 3.3 | 3 | 16 | 220 | 236 | 38 | 41 |
| Nov-14 | 3.8 | 10 | 23 | 228 | 251 | 1 | 4 |
| Dec-14 | 11.1 | 11 | 4 | 544 | 548 | 109 | 123 |
| Jan-15 | 4.4 | 34 | 103 | 138 | 241 | 46 | 52 |
| Feb-15 | 5.8 | 89 | 88 | 158 | 246 | 1 | 6 |
| Mar-15 | 4.0 | 3 | 26 | 208 | 234 | 19 | 14 |
| Apr-15 | 3.9 | 54 | 68 | 122 | 189 | 0 | 3 |
| May-15 | 3.7 | 6 | 32 | 182 | 214 | 0 | 4 |
| Jun-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-15 | 3.5 | 5 | 21 | 179 | 199 | 0 | 5 |
| Dec-15 | 4.2 | 5 | 9 | 227 | 236 | 0 | 4 |
| Jan-16 | 7.3 | 56 | 162 | 416 | 578 | 76 | 86 |
| Feb-16 | 4.5 | 3 | 26 | 196 | 222 | 1 | 5 |
| Mar-16 | 7.7 | 3 | 17 | 237 | 254 | 2 | 5 |
| Apr-16 | 4.2 | 7 | 29 | 146 | 175 | 0 | 4 |
| May-16 | 3.8 | 5 | 14 | 187 | 200 | 2 | 6 |
| Jun-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-16 | 1.0 | 1 | 3 | 4 | 7 | 0 | 0 |
| Nov-16 | 4.8 | 6 | 32 | 154 | 185 | 0 | 4 |
| Dec-16 | 6.0 | 15 | 60 | 270 | 330 | 1 | 6 |
| Jan-17 | 12.7 | 123 | 252 | 154 | 405 | 3 | 20 |
| Feb-17 | 12.6 | 223 | 455 | 271 | 726 | 18 | 54 |
| Mar-17 | 6.4 | 6 | 24 | 199 | 223 | 24 | 31 |
| Apr-17 | 6.0 | 23 | 59 | 429 | 488 | 25 | 27 |
| May-17 | 4.3 | 70 | 97 | 157 | 254 | 1 | 6 |
| Jun-17 | 3.9 | 7 | 27 | 164 | 191 | 1 | 3 |
| | | | | | | | |
| **Dry Season Average** | **0.9** | **4** | **9** | **44** | **52** | **1** | **1** |
| **Dry Season Trend **** | **None** | **None** | **None** | **None** | **None** | **-** | **None** |
| **Wet Season Average** | **5.2** | **25** | **55** | **203** | **258** | **23** | **22** |
| **Average Annual** | **3.4** | **16** | **36** | **139** | **175** | **14** | **14** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 16 City of Palo Alto

Palo Alto discharges to the Lower South Bay. The plant serves an estimated population of 217,000 and it has a permitted ADWF capacity of 39 mgd and a peak wet weather capacity of 80 mgd. The current ADWF flow is approximately 21 mgd. The plant performs ammonia and limited nitrogen removal using a combination of trickling filters and activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- There appears to be no emerging dry season trend for flow or nitrogen loads,
- There is a dry season upwards trend in TP loads in the plant influent (data not shown) that might continue as population and economy grows and shifts away from industrial and towards business office growth.
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant reliably nitrifies year round.
- TN loads in general increase with flows.
- TKN and TN have a sudden spike in April 2015, which was validated by contract laboratory. The basis for this is unclear.
- TP discharge concentrations range from 3.1 to 5.9 mg P/L. This is within the range of typical effluent TP concentrations (4 to 6 mg P/L).

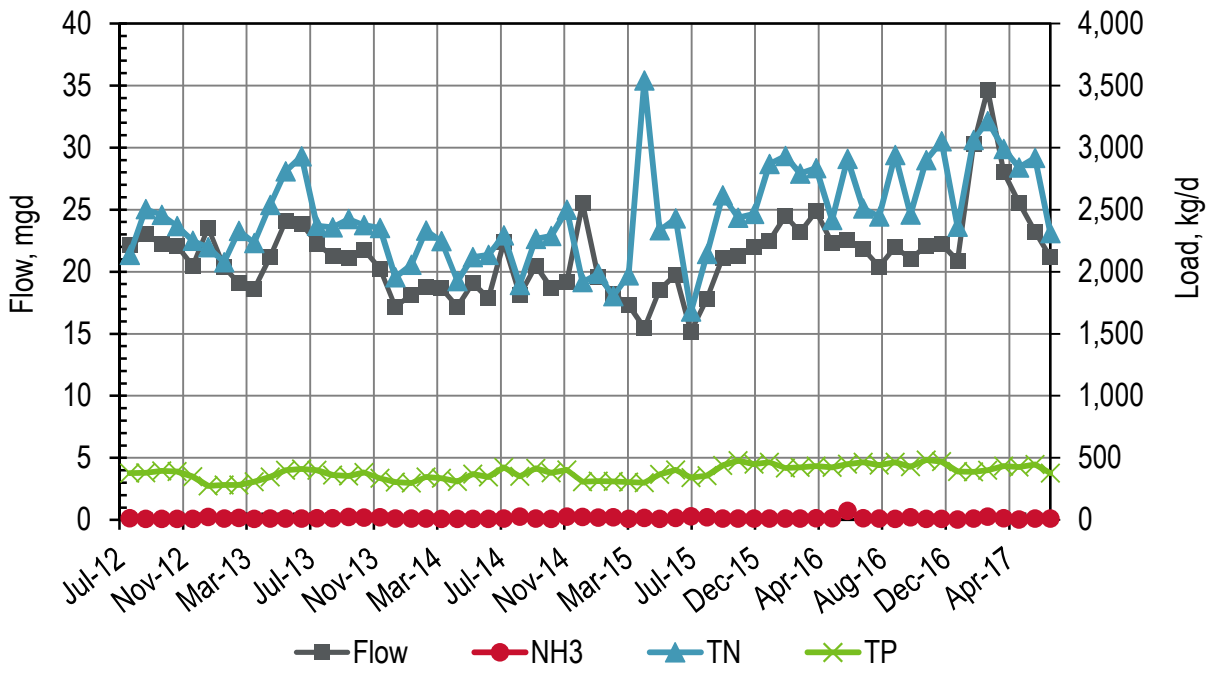


**Figure 16-1. Palo Alto Monthly Flows and Loads**

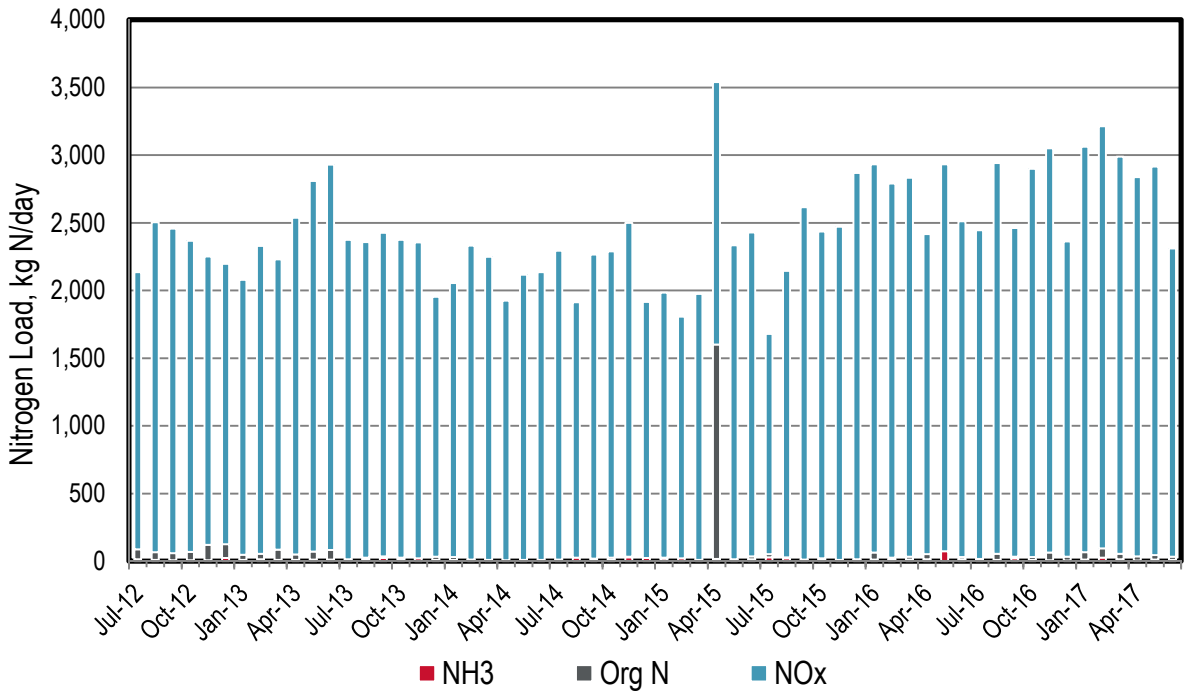


**Figure 16-2. Palo Alto Monthly Nitrogen Loads**

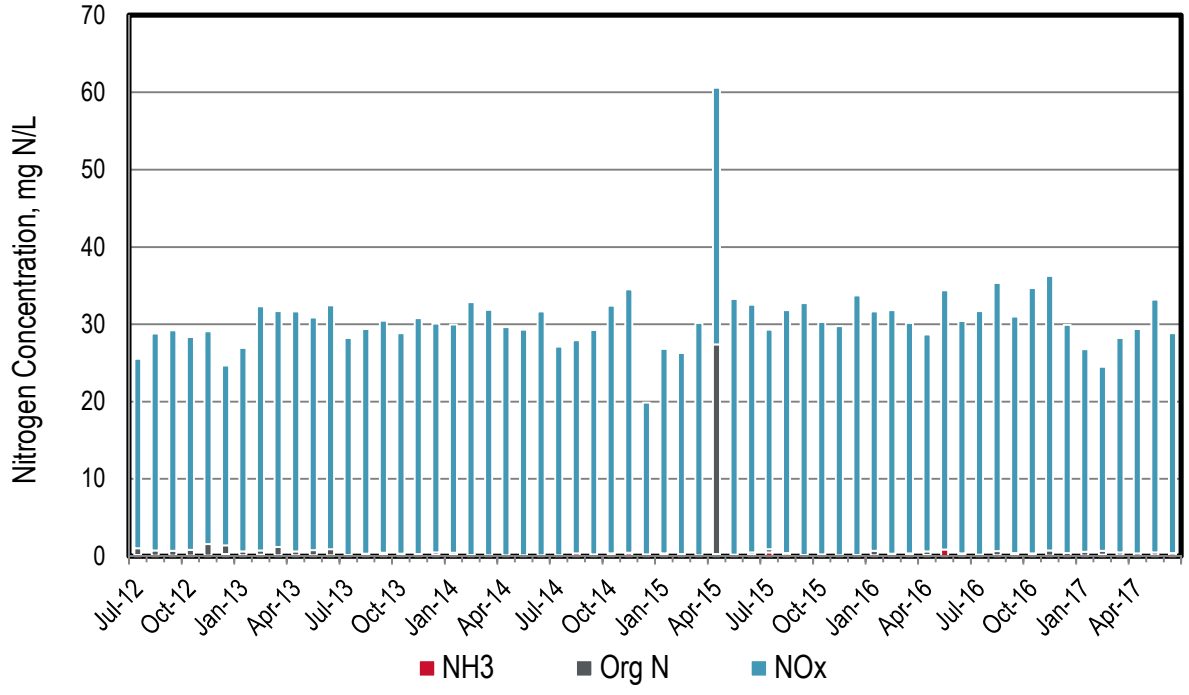


**Figure 16-3. Palo Alto Monthly Nitrogen Concentrations**

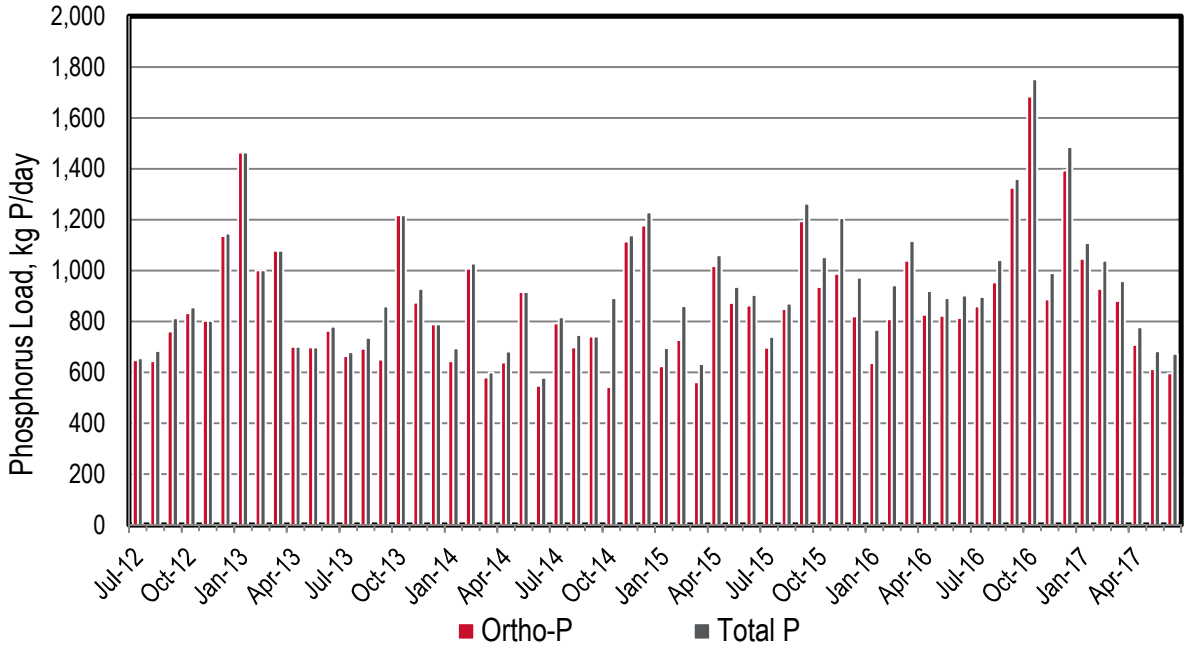


**Figure 16-4. Palo Alto Monthly Phosphorus Loads**

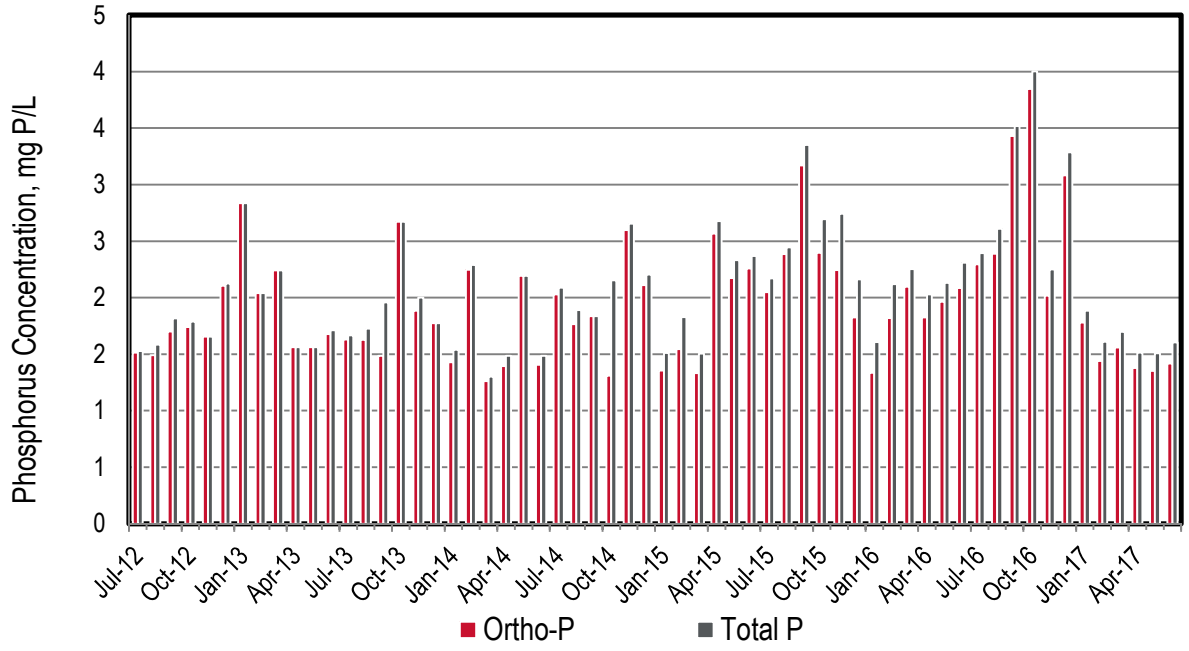


**Figure 16-5. Palo Alto Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 16-1. Palo Alto Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day* | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 22.1 | 14 | 87 | 2,049 | 2,136 | 360 | 377 |
| Aug-12 | 23.0 | 9 | 66 | 2,439 | 2,504 | 370 | 379 |
| Sep-12 | 22.2 | 8 | 60 | 2,398 | 2,457 | 379 | 395 |
| Oct-12 | 22.1 | 8 | 69 | 2,298 | 2,368 | 389 | 389 |
| Nov-12 | 20.5 | 8 | 120 | 2,130 | 2,250 | 333 | 349 |
| Dec-12 | 23.6 | 24 | 125 | 2,072 | 2,197 | 256 | 275 |
| Jan-13 | 20.4 | 10 | 48 | 2,029 | 2,077 | 275 | 283 |
| Feb-13 | 19.1 | 15 | 55 | 2,275 | 2,330 | 298 | 282 |
| Mar-13 | 18.6 | 9 | 84 | 2,146 | 2,230 | 303 | 306 |
| Apr-13 | 21.2 | 10 | 51 | 2,487 | 2,538 | 337 | 345 |
| May-13 | 24.1 | 12 | 71 | 2,737 | 2,808 | 397 | 401 |
| Jun-13 | 23.9 | 12 | 82 | 2,848 | 2,931 | 407 | 411 |
| Jul-13 | 22.3 | 14 | 10 | 2,359 | 2,370 | 362 | 400 |
| Aug-13 | 21.2 | 15 | 27 | 2,330 | 2,357 | 350 | 362 |
| Sep-13 | 21.1 | 23 | 35 | 2,390 | 2,425 | 347 | 355 |
| Oct-13 | 21.8 | 18 | 26 | 2,349 | 2,375 | 375 | 383 |
| Nov-13 | 20.2 | 21 | 18 | 2,333 | 2,352 | 334 | 336 |
| Dec-13 | 17.2 | 10 | 33 | 1,921 | 1,954 | 288 | 304 |
| Jan-14 | 18.1 | 10 | 30 | 2,025 | 2,055 | 287 | 298 |
| Feb-14 | 18.8 | 11 | 12 | 2,319 | 2,331 | 326 | 347 |
| Mar-14 | 18.7 | 9 | 9 | 2,239 | 2,247 | 330 | 337 |
| Apr-14 | 17.2 | 8 | 8 | 1,916 | 1,924 | 304 | 311 |
| May-14 | 19.1 | 9 | 10 | 2,106 | 2,117 | 357 | 370 |
| Jun-14 | 17.8 | 9 | 8 | 2,127 | 2,136 | 335 | 345 |
| Jul-14 | 22.4 | 11 | 11 | 2,282 | 2,292 | 415 | 423 |
| Aug-14 | 18.1 | 26 | 5 | 1,887 | 1,892 | 339 | 351 |
| Sep-14 | 20.5 | 10 | 18 | 2,246 | 2,264 | 406 | 417 |
| Oct-14 | 18.7 | 9 | 27 | 2,261 | 2,288 | 355 | 380 |
| Nov-14 | 19.2 | 28 | 33 | 2,466 | 2,499 | 390 | 403 |
| Dec-14 | 25.5 | 24 | 24 | 1,891 | 1,916 | 283 | 307 |
| Jan-15 | 19.6 | 19 | 27 | 1,956 | 1,983 | 295 | 312 |
| Feb-15 | 18.2 | 20 | 16 | 1,785 | 1,802 | 294 | 311 |
| Mar-15 | 17.3 | 9 | 5 | 1,966 | 1,971 | 306 | 306 |
| Apr-15 | 15.5 | 17 | 1,600 | 1,940 | 3,540 | 293 | 301 |
| May-15 | 18.6 | 9 | 15 | 2,320 | 2,334 | 356 | 367 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day* | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 19.8 | 16 | 37 | 2,392 | 2,429 | 373 | 404 |
| Jul-15 | 15.2 | 30 | 52 | 1,627 | 1,679 | 317 | 341 |
| Aug-15 | 17.8 | 22 | 28 | 2,116 | 2,144 | 360 | 355 |
| Sep-15 | 21.1 | 10 | 12 | 2,602 | 2,614 | 427 | 438 |
| Oct-15 | 21.3 | 10 | 21 | 2,413 | 2,434 | 428 | 477 |
| Nov-15 | 22.0 | 11 | 6 | 2,459 | 2,465 | 406 | 449 |
| Dec-15 | 22.5 | 11 | 15 | 2,852 | 2,867 | 433 | 465 |
| Jan-16 | 24.5 | 12 | 64 | 2,868 | 2,932 | 378 | 419 |
| Feb-16 | 23.2 | 11 | 27 | 2,763 | 2,790 | 401 | 423 |
| Mar-16 | 24.9 | 13 | 33 | 2,801 | 2,834 | 413 | 434 |
| Apr-16 | 22.3 | 14 | 53 | 2,363 | 2,416 | 399 | 425 |
| May-16 | 22.6 | 73 | 49 | 2,859 | 2,908 | 442 | 450 |
| Jun-16 | 21.8 | 14 | 31 | 2,480 | 2,511 | 436 | 465 |
| Jul-16 | 20.4 | 12 | 16 | 2,428 | 2,444 | 432 | 441 |
| Aug-16 | 22.0 | 9 | 55 | 2,885 | 2,941 | 444 | 465 |
| Sep-16 | 21.0 | 21 | 33 | 2,429 | 2,461 | 443 | 429 |
| Oct-16 | 22.1 | 10 | 31 | 2,868 | 2,898 | 444 | 482 |
| Nov-16 | 22.2 | 8 | 63 | 2,987 | 3,050 | 455 | 470 |
| Dec-16 | 20.9 | 4 | 33 | 2,329 | 2,362 | 378 | 390 |
| Jan-17 | 30.2 | 12 | 65 | 2,996 | 3,062 | 337 | 388 |
| Feb-17 | 34.7 | 27 | 94 | 3,118 | 3,212 | 385 | 402 |
| Mar-17 | 28.0 | 14 | 54 | 2,935 | 2,989 | 421 | 435 |
| Apr-17 | 25.6 | 4 | 35 | 2,803 | 2,838 | 416 | 427 |
| May-17 | 23.2 | 11 | 45 | 2,871 | 2,916 | 432 | 447 |
| Jun-17 | 21.2 | 11 | 34 | 2,276 | 2,310 | 359 | 376 |
| | | | | | | | |
| **Dry Season Average** | **20.9** | **16** | **36** | **2,379** | **2,415** | **385** | **399** |
| **Dry Season Trend **** | **None** | **None** | **None** | **None** | **None** | **-** | **Up** |
| **Wet Season Average** | **21.6** | **13** | **86** | **2,382** | **2,468** | **339** | **370** |
| **Average Annual** | **21.3** | **14** | **65** | **2,381** | **2,446** | **366** | **382** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 17 Sanitary District No. 5 of Marin County - Paradise Cove Treatment Plant

The Paradise Cove Treatment Plant discharges to the Central Bay. The service area has approximately 65 service connections. The plant has a permitted ADWF capacity of 0.040 mgd and it has currents flows of approximately 0.013 mgd ADWF. The plant performs secondary treatment using an activated sludge treatment process.

The plant is classified as a minor discharger (<1 mgd permitted capacity) and thus not required to sample as frequently as the major dischargers (>1 mgd permitted capacity). The minor dischargers are required to sample twice per year under the Nutrient Watershed Permit. As a result, there are several months of nutrient data gaps, in particular from July 2013 through July 2017.

The following observations are made based upon the figures and table in the subsequent pages:

- Flow values are provided over the entire study period. The remaining nutrient species only have monthly sampling for the first year of sampling, followed by occasional sampling thereafter.
- The plant occasionally nitrifies as evidenced by ammonia values of less than 0.2 mg N/L.
- During months of nitrification, NOx is the majority of the nitrogen species discharged. During months of no nitrification, ammonia is the majority of the nitrogen species discharged.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations are wide ranging from approximately 2.2 to 8.7 mg P/L. Typical effluent TP concentrations range from 4 to 6 mg P/L.

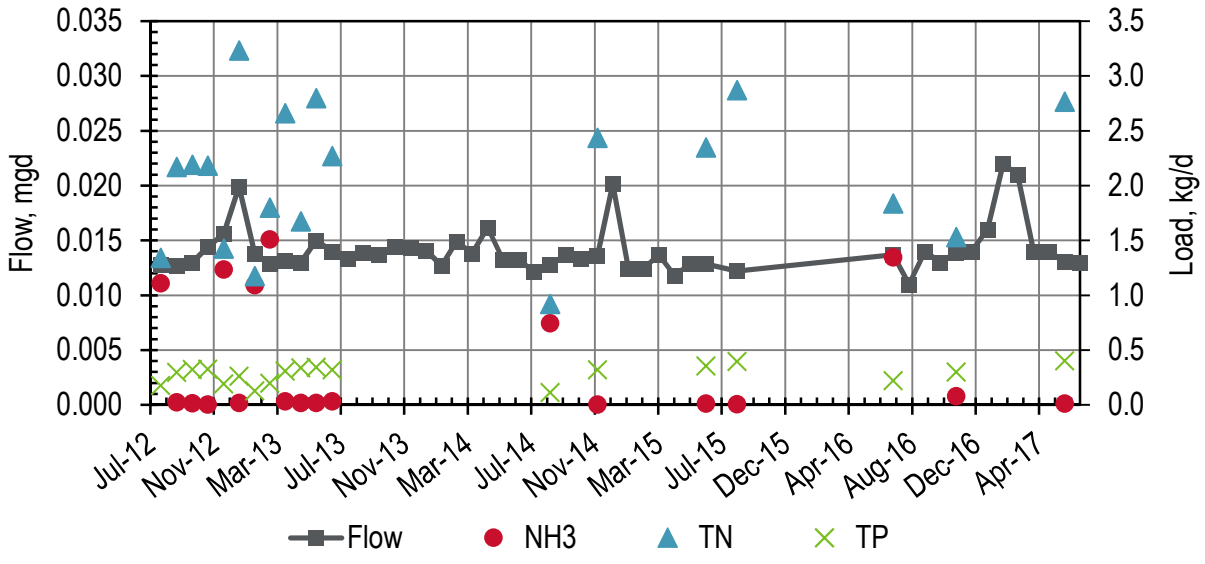


**Figure 17-1. Paradise Cove Monthly Flows and Loads**

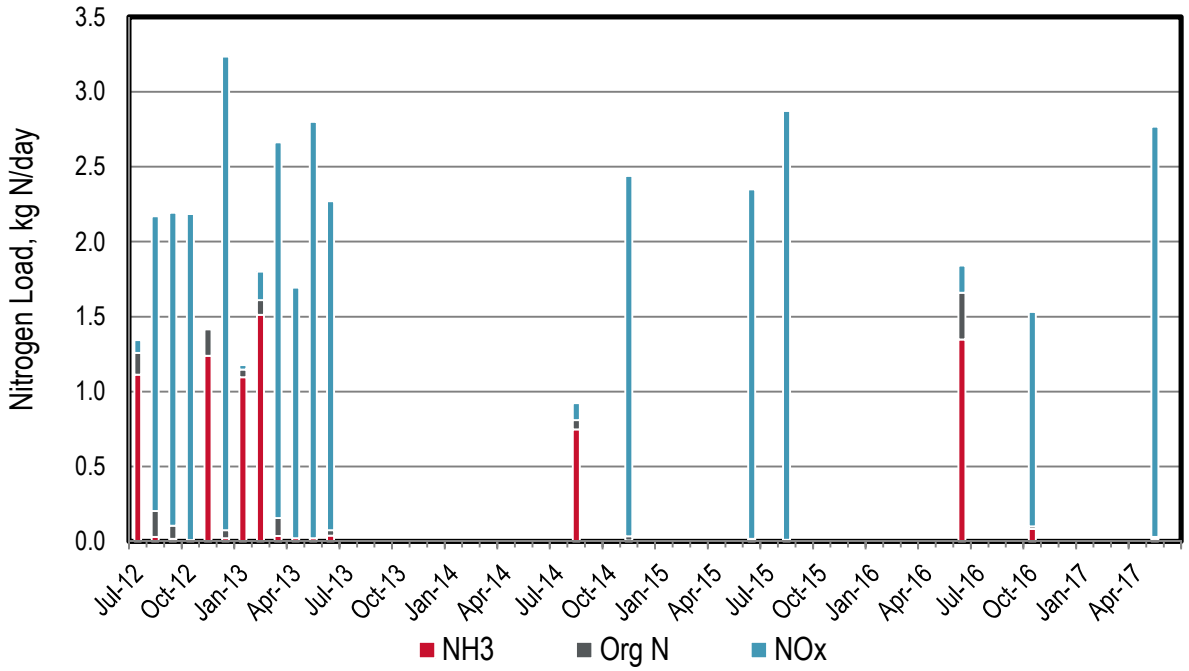


**Figure 17-2. Paradise Cove Monthly Nitrogen Loads**

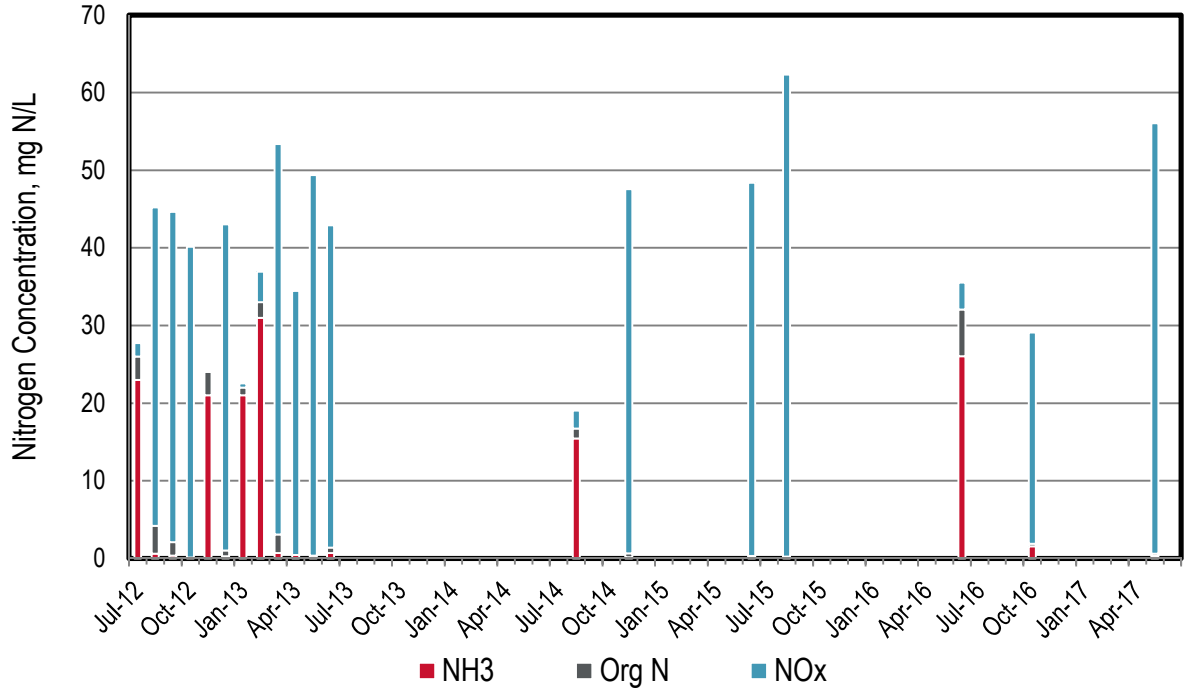


**Figure 17-3. Paradise Cove Monthly Nitrogen Concentrations**

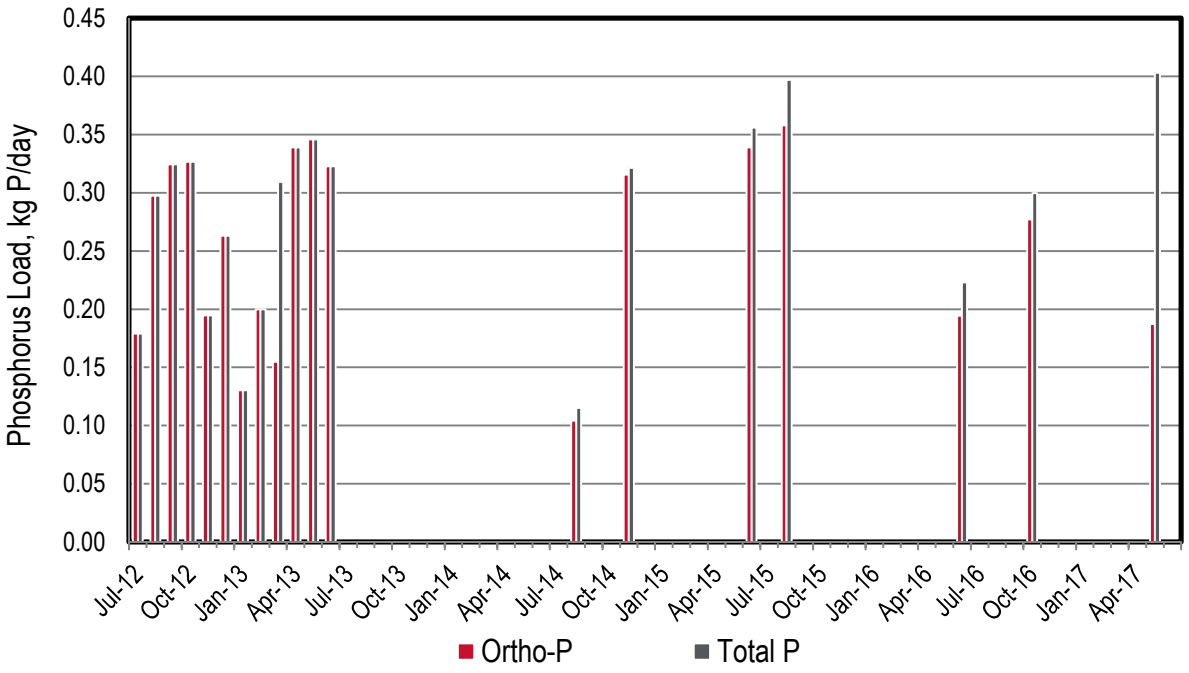


**Figure 17-4. Paradise Cove Monthly Phosphorus Loads**

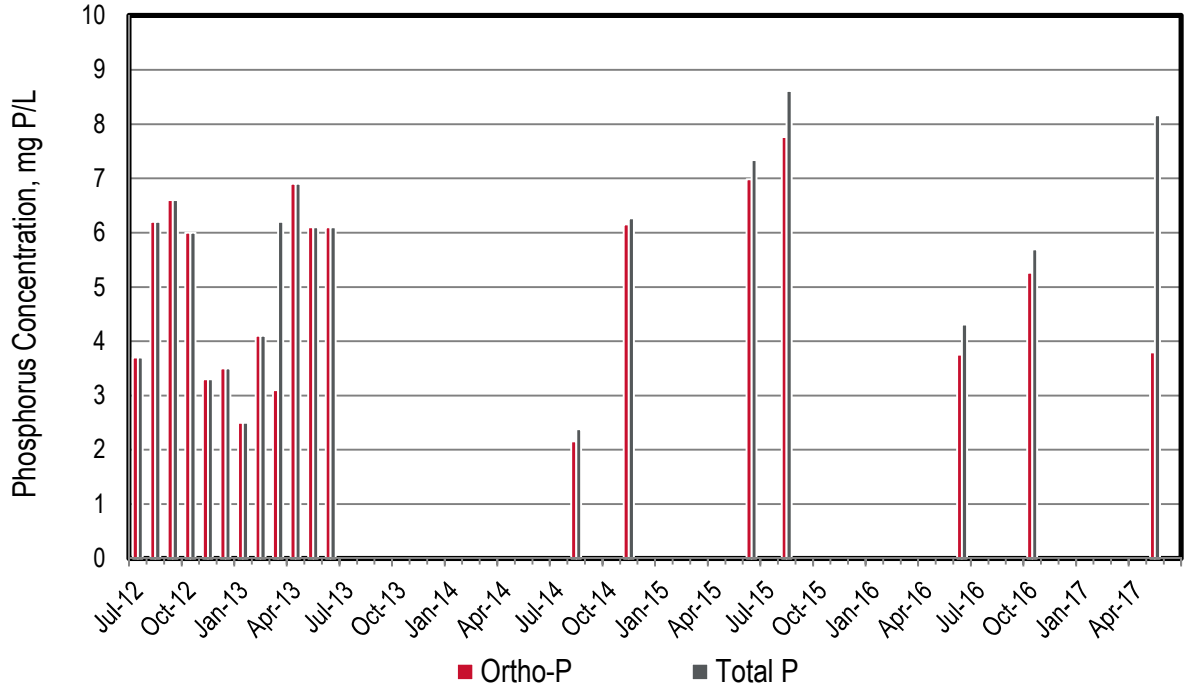


**Figure 17-5. Paradise Cove Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 17-1. Paradise Cove Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.013 | 1.1 | 1.3 | 0.1 | 1.3 | 0.2 | 0.2 |
| Aug-12 | 0.013 | 0.0 | 0.2 | 2.0 | 2.2 | 0.4 | 0.3 |
| Sep-12 | 0.013 | 0.0 | 0.1 | 2.1 | 2.2 | 0.4 | 0.3 |
| Oct-12 | 0.014 | 0.0 | 0.0 | 2.2 | 2.2 | 0.4 | 0.3 |
| Nov-12 | 0.016 | 1.2 | 1.4 | 0.0 | 1.4 | 0.2 | 0.2 |
| Dec-12 | 0.020 | 0.0 | 0.1 | 3.2 | 3.2 | 0.5 | 0.3 |
| Jan-13 | 0.014 | 1.1 | 1.1 | 0.0 | 1.2 | 0.2 | 0.1 |
| Feb-13 | 0.013 | 1.5 | 1.6 | 0.2 | 1.8 | 0.2 | 0.2 |
| Mar-13 | 0.013 | 0.0 | 0.2 | 2.5 | 2.7 | 0.2 | 0.3 |
| Apr-13 | 0.013 | 0.0 | 0.0 | 1.7 | 1.7 | 0.5 | 0.3 |
| May-13 | 0.015 | 0.0 | 0.0 | 2.8 | 2.8 | 0.5 | 0.3 |
| Jun-13 | 0.014 | 0.0 | 0.1 | 2.2 | 2.3 | 0.4 | 0.3 |
| Jul-13 | 0.013 | | | | | | |
| Aug-13 | 0.014 | | | | | | |
| Sep-13 | 0.014 | | | | | | |
| Oct-13 | 0.014 | | | | | | |
| Nov-13 | 0.014 | | | | | | |
| Dec-13 | 0.014 | | | | | | |
| Jan-14 | 0.013 | | | | | | |
| Feb-14 | 0.015 | | | | | | |
| Mar-14 | 0.014 | | | | | | |
| Apr-14 | 0.016 | | | | | | |
| May-14 | 0.013 | | | | | | |
| Jun-14 | 0.013 | | | | | | |
| Jul-14 | 0.012 | | | | | | |
| Aug-14 | 0.013 | 0.7 | 0.8 | 0.1 | 0.9 | 0.1 | 0.1 |
| Sep-14 | 0.014 | | | | | | |
| Oct-14 | 0.013 | | | | | | |
| Nov-14 | 0.014 | 0.0 | 0.0 | 2.4 | 2.4 | 0.3 | 0.3 |
| Dec-14 | 0.020 | | | | | | |
| Jan-15 | 0.012 | | | | | | |
| Feb-15 | 0.012 | | | | | | |
| Mar-15 | 0.014 | | | | | | |
| Apr-15 | 0.012 | | | | | | |
| May-15 | 0.013 | | | | | | |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 0.013 | 0.0 | 0.0 | 2.3 | 2.3 | 0.3 | 0.4 |
| Jul-15 | 0.012 | | | | | | |
| Aug-15 | 0.012 | 0.0 | 0.0 | 2.9 | 2.9 | 0.4 | 0.4 |
| Sep-15 | 0.012 | | | | | | |
| Oct-15 | 0.013 | | | | | | |
| Nov-15 | 0.013 | | | | | | |
| Dec-15 | 0.014 | | | | | | |
| Jan-16 | 0.018 | | | | | | |
| Feb-16 | 0.012 | | | | | | |
| Mar-16 | 0.017 | | | | | | |
| Apr-16 | 0.012 | | | | | | |
| May-16 | 0.012 | | | | | | |
| Jun-16 | 0.012 | 1.3 | 1.7 | 0.2 | 1.8 | 0.2 | 0.2 |
| Jul-16 | 0.011 | | | | | | |
| Aug-16 | 0.014 | | | | | | |
| Sep-16 | 0.013 | | | | | | |
| Oct-16 | 0.014 | 0.1 | 0.1 | 1.4 | 1.5 | 0.3 | 0.3 |
| Nov-16 | 0.014 | | | | | | |
| Dec-16 | 0.016 | | | | | | |
| Jan-17 | 0.022 | | | | | | |
| Feb-17 | 0.021 | | | | | | |
| Mar-17 | 0.014 | | | | | | |
| Apr-17 | 0.014 | | | | | | |
| May-17 | 0.013 | 0.0 | 0.0 | 2.7 | 2.8 | 0.2 | 0.4 |
| Jun-17 | 0.013 | | | | | | |
| | | | | | | | |
| **Dry Season Average** | **0.013** | **0.3** | **0.4** | **1.7** | **2.2** | **0.3** | **0.3** |
| **Dry Season Trend **** | **None** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Wet Season Average** | **0.015** | **0.4** | **0.5** | **1.5** | **2.0** | **0.3** | **0.3** |
| **Average Annual** | **0.014** | **0.4** | **0.5** | **1.6** | **2.1** | **0.3** | **0.3** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 18 City of Petaluma

Petaluma discharges to Petaluma River that is connected to San Pablo Bay. The plant has approximately 25,300 service connections and it has a permitted capacity of 6.7 mgd ADWF. The plant performs nitrogen and phosphorus removal using oxidation ditches coupled with treatment wetlands and oxidation ponds. The oxidation ponds also serve as equalization during peak wet weather flow. Effluent flow that is not discharged to the Petaluma River is diverted to recycled water whenever possible. Discharge to Petaluma River is prohibited May 1 through October 20, except when the Facility inflow exceeds the recycled water distribution and storage system capacity.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table, there are no emerging dry season trends as Petaluma does not discharge during the dry season.
- Wet season trends analyzed (data not shown) and there are no emerging trends.
- Both nitrogen and phosphorus loads typically increase with flow during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through during the colder months. This increases the ammonia contribution during such months.
- The plant meets Level 3 total nitrogen concentration limits (i.e., 6 mg N/L) developed under the Bay Area Clean Water Agencies Scoping and Evaluation Plan for all but two months.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.5 to 3.8 mg P/L, This suggests a portion of P is removed as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is attributed to biological P removal in the oxidation ditch.

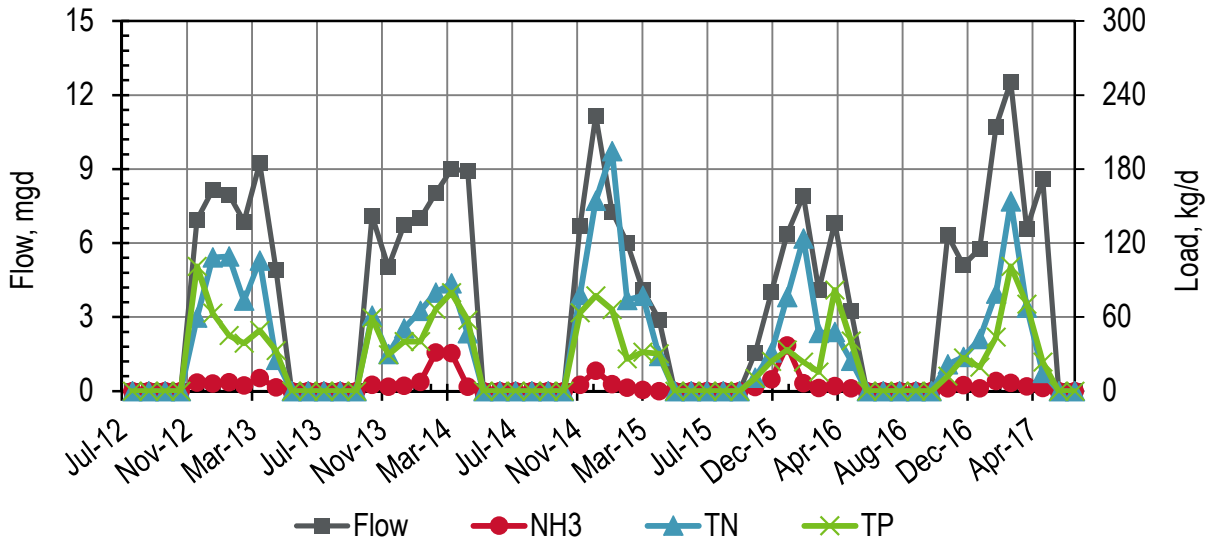


**Figure 18-1. Petaluma Monthly Flows and Loads**

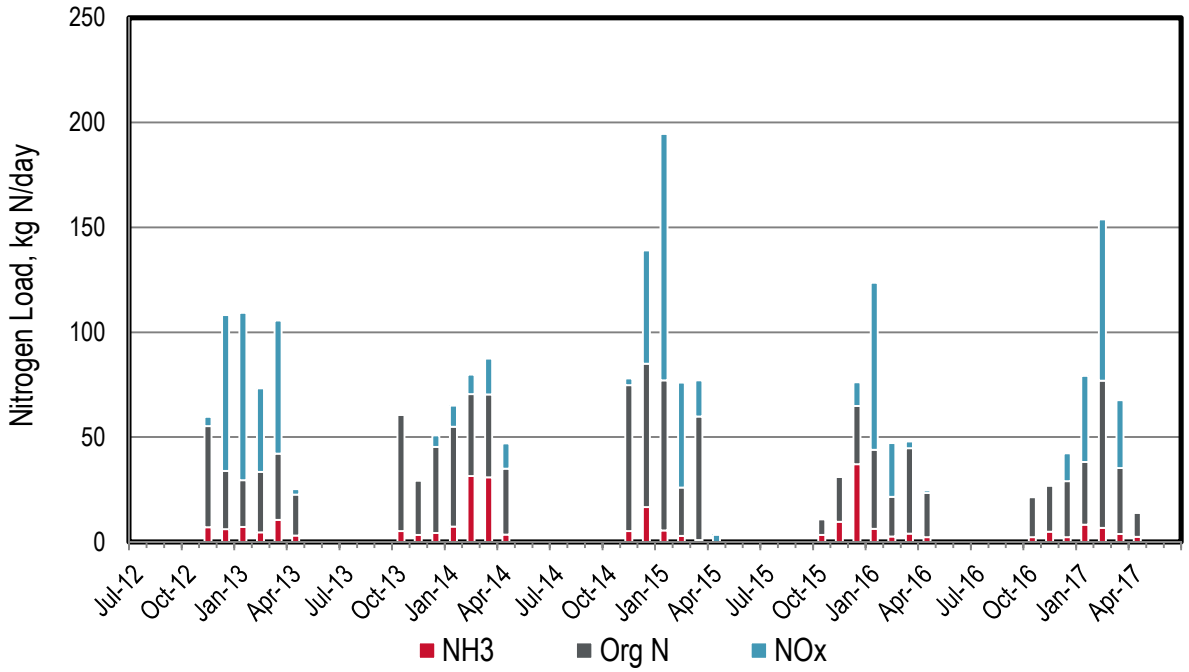


**Figure 18-2. Petaluma Monthly Nitrogen Loads**

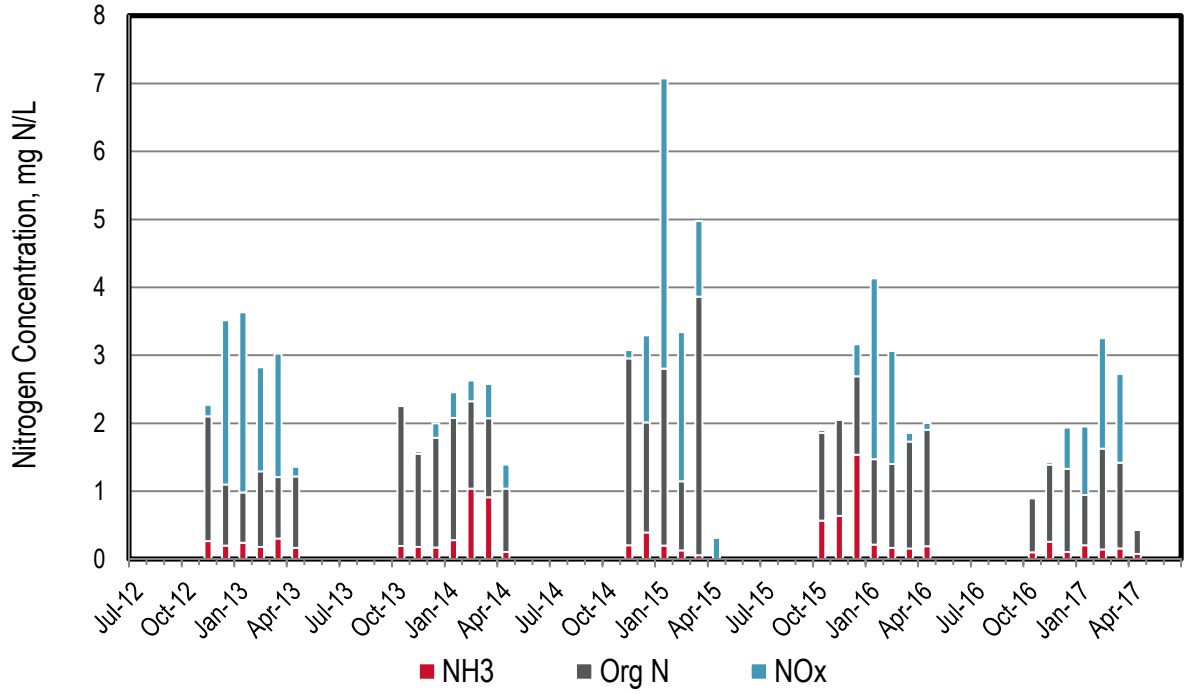


**Figure 18-3. Petaluma Monthly Nitrogen Concentrations**

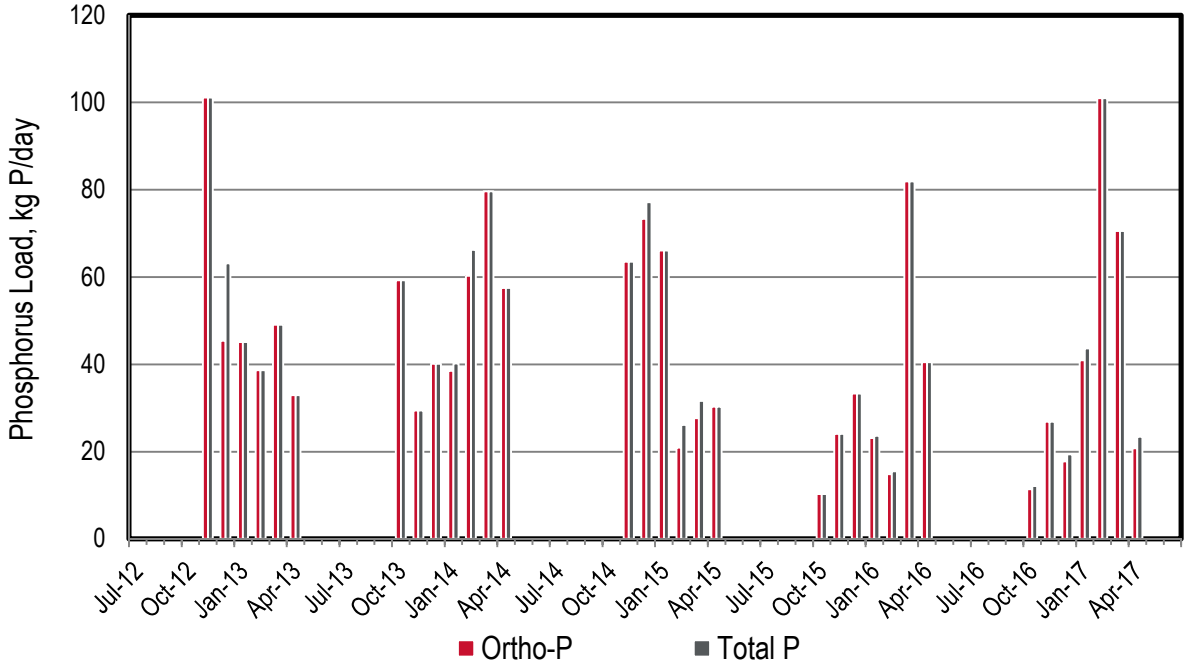


**Figure 18-4. Petaluma Monthly Phosphorus Loads**

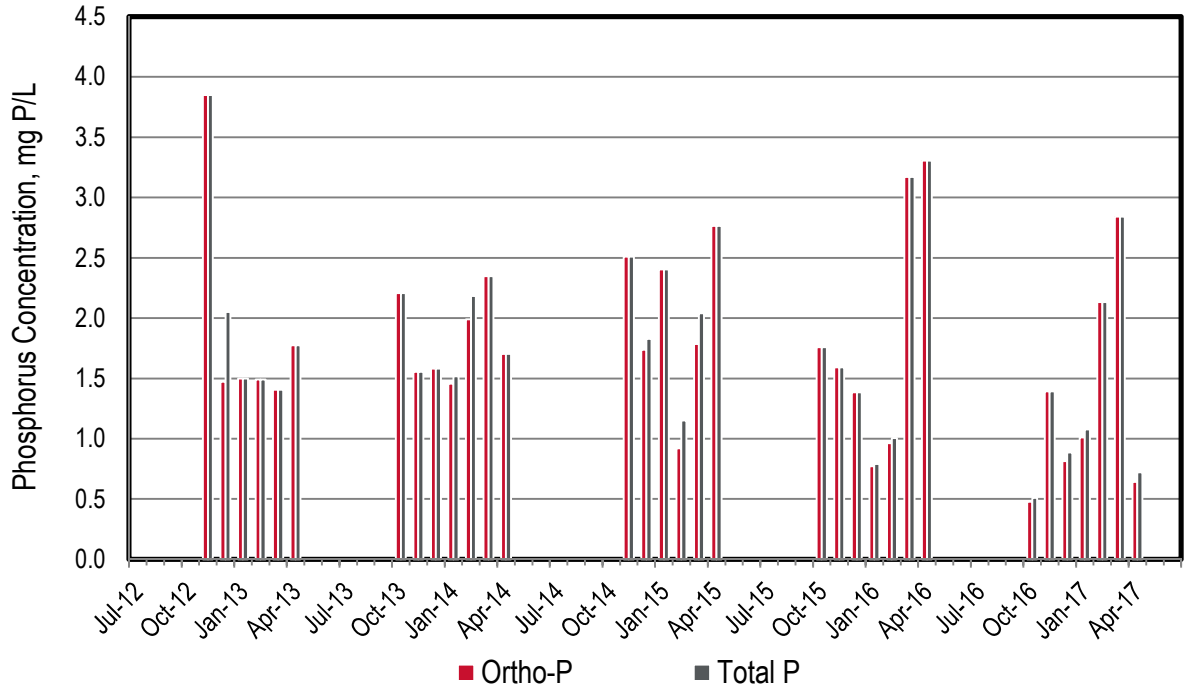


**Figure 18-5. Petaluma Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 18-1. Petaluma Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-12 | 7.0 | 7 | 55 | 4 | 60 | 106 | 101 |
| Dec-12 | 8.2 | 6 | 34 | 74 | 108 | 45 | 63 |
| Jan-13 | 8.0 | 7 | 29 | 80 | 109 | 45 | 45 |
| Feb-13 | 6.9 | 5 | 33 | 40 | 73 | 45 | 39 |
| Mar-13 | 9.2 | 11 | 42 | 63 | 106 | 51 | 49 |
| Apr-13 | 4.9 | 3 | 23 | 3 | 25 | 38 | 33 |
| May-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-13 | 7.1 | 5 | 61 | 1 | 61 | 61 | 59 |
| Nov-13 | 5.0 | 3 | 29 | 1 | 30 | 30 | 29 |
| Dec-13 | 6.7 | 4 | 45 | 5 | 51 | 45 | 40 |
| Jan-14 | 7.0 | 7 | 55 | 10 | 65 | 39 | 40 |
| Feb-14 | 8.0 | 31 | 70 | 9 | 80 | 60 | 66 |
| Mar-14 | 9.0 | 31 | 70 | 17 | 87 | 81 | 80 |
| Apr-14 | 8.9 | 4 | 35 | 12 | 47 | 63 | 57 |
| May-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-14 | 6.7 | 5 | 75 | 3 | 78 | 66 | 64 |
| Dec-14 | 11.2 | 17 | 85 | 54 | 154 | 73 | 77 |
| Jan-15 | 7.3 | 6 | 77 | 117 | 195 | 66 | 66 |
| Feb-15 | 6.0 | 3 | 26 | 50 | 74 | 21 | 26 |
| Mar-15 | 4.1 | 1 | 60 | 17 | 77 | 28 | 32 |
| Apr-15 | 2.9 |  | 25 | 3 | 28 | 30 | 30 |
| May-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-15 | 1.5 | 1 | 2 | 0 | 2 | 1 | 1 |
| Nov-15 | 4.0 | 10 | 31 | 0 | 31 | 24 | 24 |
| Dec-15 | 6.4 | 37 | 65 | 11 | 76 | 33 | 33 |
| Jan-16 | 7.9 | 6 | 44 | 80 | 124 | 23 | 24 |
| Feb-16 | 4.1 | 3 | 22 | 26 | 47 | 15 | 15 |
| Mar-16 | 6.8 | 4 | 45 | 3 | 48 | 87 | 82 |
| Apr-16 | 3.2 | 0 | 2 | 0 | 2 | 0 | 0 |
| May-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-16 | 6.3 | 2 | 21 | 0 | 22 | 11 | 12 |
| Nov-16 | 5.1 | 5 | 27 | 1 | 28 | 30 | 27 |
| Dec-16 | 5.8 | 2 | 29 | 13 | 42 | 18 | 19 |
| Jan-17 | 10.7 | 8 | 38 | 41 | 79 | 41 | 44 |
| Feb-17 | 12.5 | 7 | 77 | 77 | 154 | 101 | 101 |
| Mar-17 | 6.6 | 4 | 35 | 32 | 68 | 82 | 71 |
| Apr-17 | 8.6 | 3 | 14 | 1 | 15 | 21 | 23 |
| May-17 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-17 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | |
| **Dry Season Average** | **0.0** | **0** | **0** | **0** | **0** | **0** | **0** |
| **Dry Season Trend **** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Wet Season Average** | **6.4** | **7** | **40** | **24** | **65** | **44** | **44** |
| **Average Annual** | **3.7** | **4** | **24** | **14** | **38** | **25** | **25** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 19 City of Pinole

The Pinole-Hercules Water Pollution Control Plant discharges to San Pablo Bay. The plant has approximately 11,215 service connections; it has a permitted capacity of 4.06 mgd ADWF and a peak wet weather capacity of 20.0 mgd. The current flow averages about 2.4 mgd ADWF.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging dry season downward trend for flow, NOx, and TP loads.
- Nitrogen and phosphorus loads do not track with the flows as seen at the majority of the other plants.
- With the exception of ammonia, nutrient species were not sampled in July and August 2014.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not fully nitrify. A portion of the ammonia load is partially nitrified to NOx. The ammonia loads increased in the 2016 dry season due to operational changes at the plant (decrease in MCRT and low dissolved oxygen levels to remedy floating solids in the secondary clarifiers).
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations from 0.5 to 5.1 mg P/L.

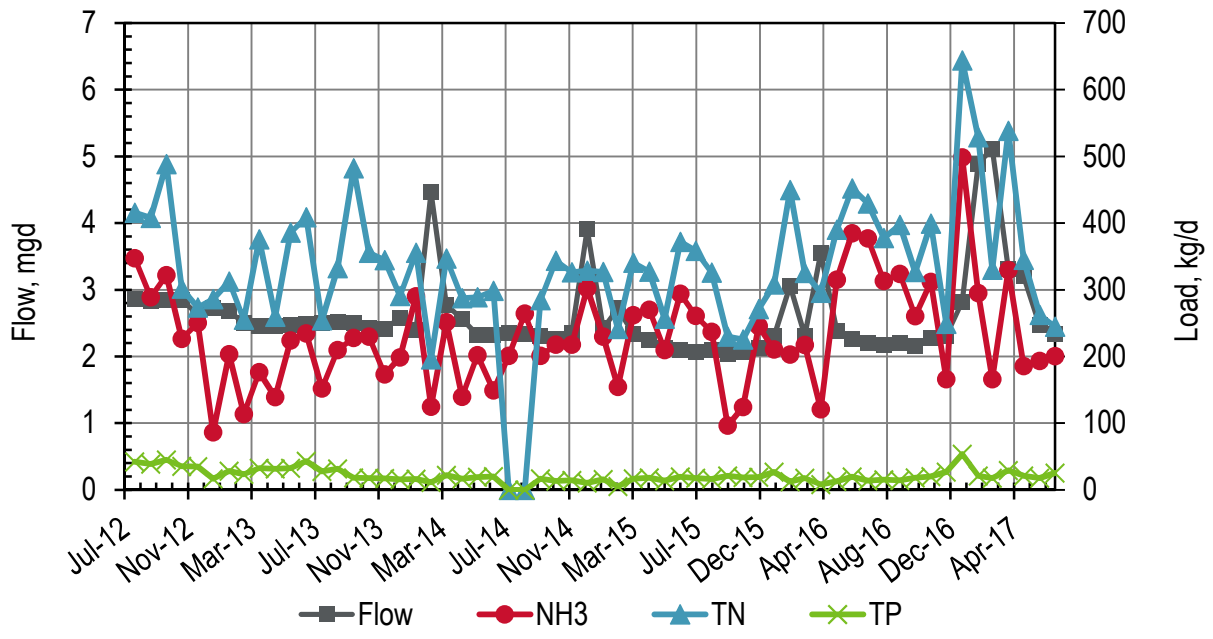


**Figure 19-1. Pinole Monthly Flows and Loads**

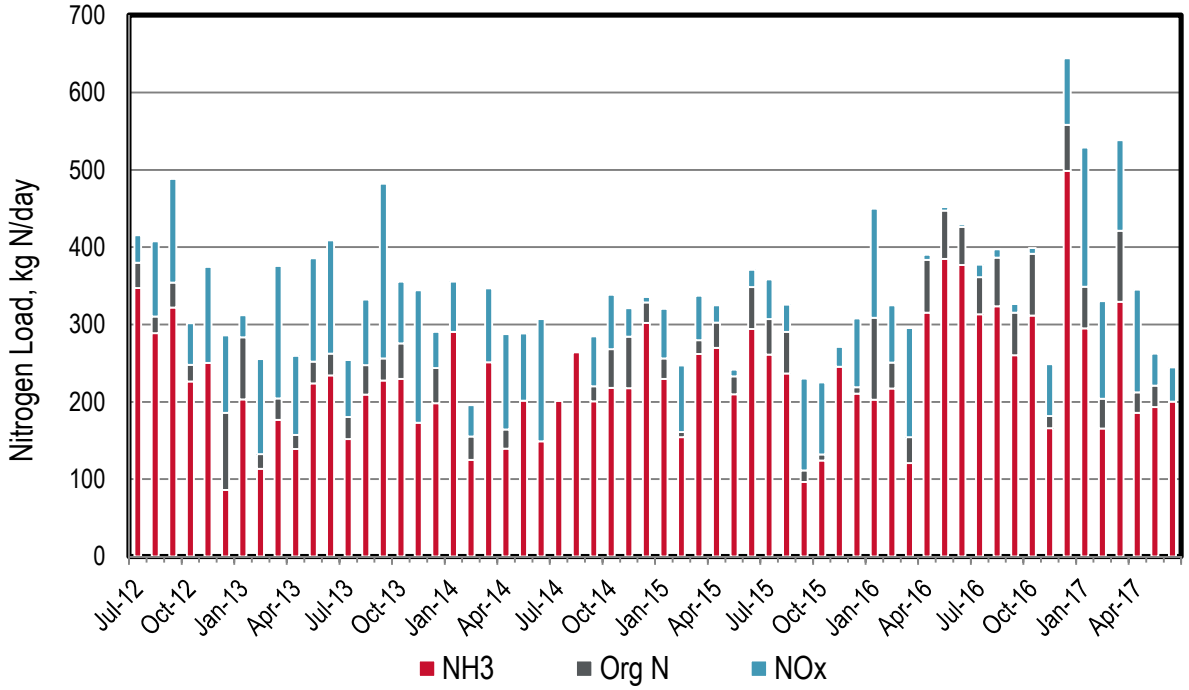


**Figure 19-2. Pinole Monthly Nitrogen Loads**

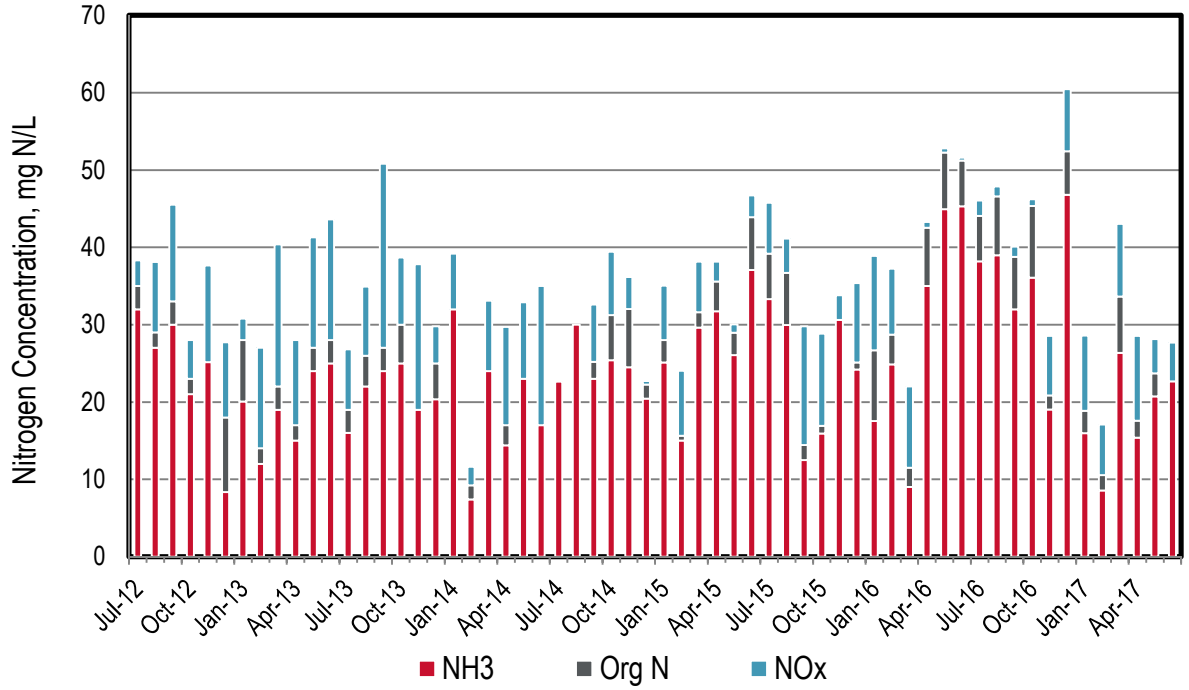


**Figure 19-3. Pinole Monthly Nitrogen Concentrations**

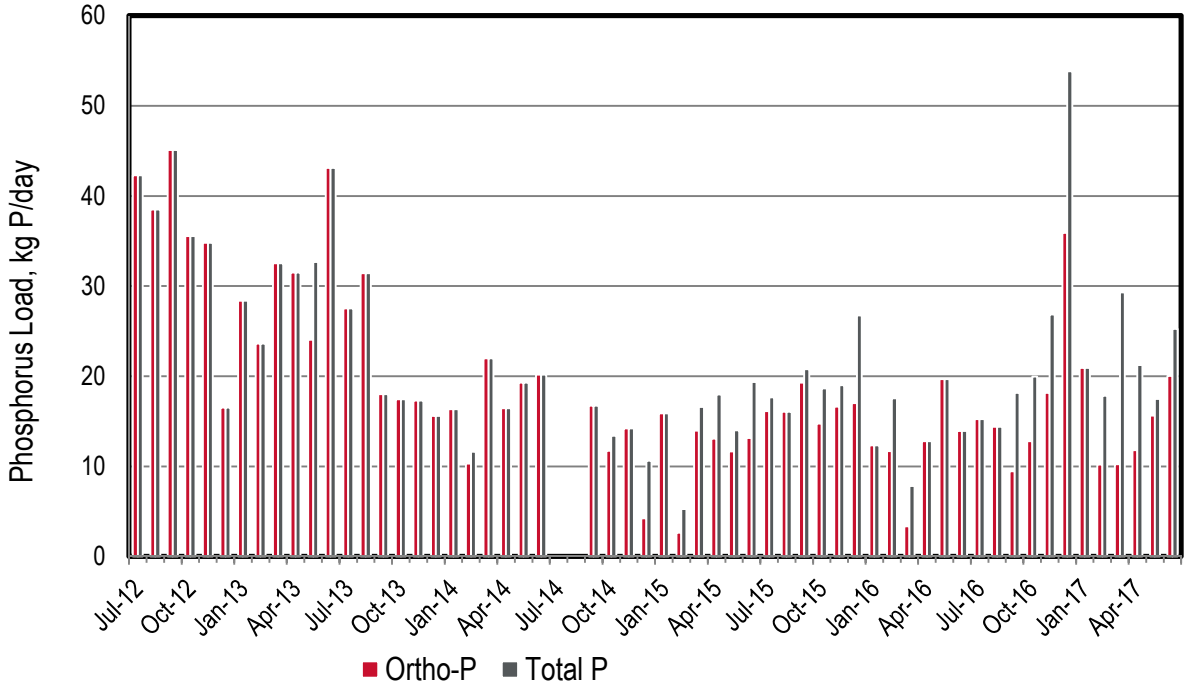


**Figure 19-4. Pinole Monthly Phosphorus Loads**

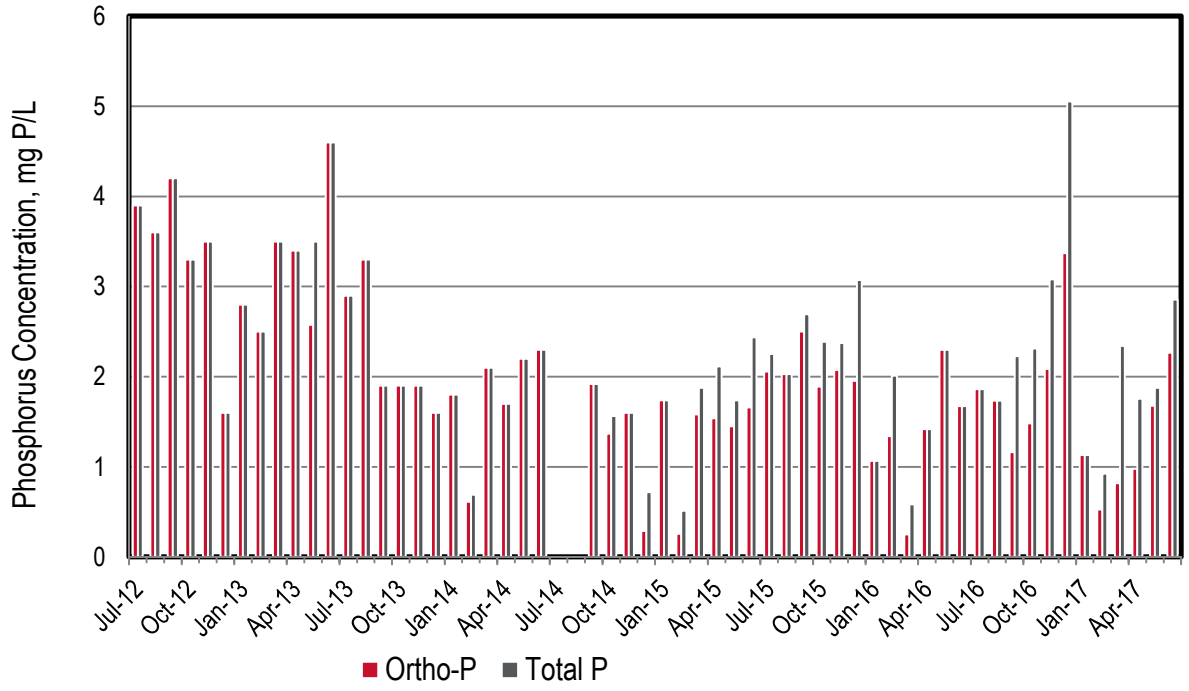


**Figure 19-5. Pinole Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 19-1. Pinole Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 2.9 | 347 | 380 | 36 | 416 | 62 | 42 |
| Aug-12 | 2.8 | 289 | 310 | 97 | 408 | 49 | 39 |
| Sep-12 | 2.8 | 322 | 354 | 134 | 488 | 66 | 45 |
| Oct-12 | 2.9 | 226 | 248 | 54 | 302 | 50 | 36 |
| Nov-12 | 2.6 | 250 | 149 | 124 | 273 | 52 | 35 |
| Dec-12 | 2.7 | 86 | 186 | 100 | 286 | 37 | 17 |
| Jan-13 | 2.7 | 203 | 284 | 28 | 312 | 32 | 28 |
| Feb-13 | 2.5 | 113 | 132 | 123 | 255 | 34 | 24 |
| Mar-13 | 2.5 | 177 | 205 | 171 | 376 | 50 | 33 |
| Apr-13 | 2.5 | 139 | 157 | 102 | 259 | 60 | 31 |
| May-13 | 2.5 | 224 | 252 | 134 | 386 | 24 | 33 |
| Jun-13 | 2.5 | 234 | 262 | 146 | 409 | 59 | 43 |
| Jul-13 | 2.5 | 152 | 180 | 74 | 254 | 40 | 28 |
| Aug-13 | 2.5 | 210 | 248 | 85 | 332 | 45 | 31 |
| Sep-13 | 2.5 | 228 | 256 | 226 | 482 | 40 | 18 |
| Oct-13 | 2.4 | 230 | 276 | 80 | 355 | 29 | 17 |
| Nov-13 | 2.4 | 173 | 173 | 171 | 344 | 32 | 17 |
| Dec-13 | 2.6 | 198 | 244 | 47 | 291 | 25 | 16 |
| Jan-14 | 2.4 | 290 | 290 | 65 | 356 | 25 | 16 |
| Feb-14 | 4.5 | 125 | 155 | 40 | 196 | 10 | 12 |
| Mar-14 | 2.8 | 251 | 251 | 95 | 347 | 31 | 22 |
| Apr-14 | 2.6 | 139 | 165 | 123 | 287 | 21 | 16 |
| May-14 | 2.3 | 202 | 202 | 87 | 289 | 31 | 19 |
| Jun-14 | 2.3 | 149 | 140 | 158 | 298 | 35 | 20 |
| Jul-14 | 2.4 | 201 | -- | -- | -- | -- | -- |
| Aug-14 | 2.3 | 264 | -- | -- | -- | -- | -- |
| Sep-14 | 2.3 | 201 | 220 | 64 | 285 | -- | 17 |
| Oct-14 | 2.3 | 218 | 268 | 70 | 344 | 12 | 13 |
| Nov-14 | 2.4 | 218 | 284 | 37 | 326 | 18 | 14 |
| Dec-14 | 3.9 | 302 | 329 | 7 | 329 | 4 | 11 |
| Jan-15 | 2.4 | 230 | 256 | 64 | 327 | 16 | 16 |
| Feb-15 | 2.7 | 154 | 161 | 86 | 241 | 3 | 5 |
| Mar-15 | 2.3 | 262 | 280 | 58 | 341 | 14 | 17 |
| Apr-15 | 2.3 | 270 | 303 | 22 | 327 | 13 | 18 |
| May-15 | 2.1 | 210 | 233 | 9 | 256 | 12 | 14 |
| Jun-15 | 2.1 | 294 | 348 | 22 | 372 | 13 | 19 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 2.1 | 261 | 307 | 51 | 359 | 16 | 18 |
| Aug-15 | 2.1 | 237 | 290 | 35 | 326 | 16 | 16 |
| Sep-15 | 2.0 | 96 | 111 | 119 | 230 | 19 | 21 |
| Oct-15 | 2.1 | 124 | 132 | 93 | 225 | 15 | 19 |
| Nov-15 | 2.1 | 246 | 246 | 25 | 271 | 17 | 19 |
| Dec-15 | 2.3 | 211 | 219 | 89 | 308 | 17 | 27 |
| Jan-16 | 3.1 | 203 | 309 | 141 | 450 | 13 | 12 |
| Feb-16 | 2.3 | 217 | 251 | 74 | 325 | 12 | 18 |
| Mar-16 | 3.6 | 121 | 154 | 141 | 296 | 3 | 8 |
| Apr-16 | 2.4 | 315 | 383 | 7 | 390 | 14 | 13 |
| May-16 | 2.3 | 385 | 447 | 5 | 452 | 40 | 20 |
| Jun-16 | 2.2 | 377 | 426 | 3 | 429 | 16 | 14 |
| Jul-16 | 2.2 | 313 | 361 | 16 | 377 | 29 | 15 |
| Aug-16 | 2.2 | 324 | 387 | 11 | 397 | 24 | 14 |
| Sep-16 | 2.2 | 260 | 315 | 11 | 326 | 9 | 18 |
| Oct-16 | 2.3 | 312 | 392 | 8 | 399 | 13 | 20 |
| Nov-16 | 2.3 | 166 | 182 | 67 | 249 | 18 | 27 |
| Dec-16 | 2.8 | 498 | 558 | 86 | 644 | 36 | 54 |
| Jan-17 | 4.9 | 295 | 349 | 180 | 529 | 22 | 21 |
| Feb-17 | 5.1 | 166 | 204 | 126 | 330 | 10 | 18 |
| Mar-17 | 3.3 | 330 | 421 | 117 | 538 | 10 | 29 |
| Apr-17 | 3.2 | 186 | 212 | 133 | 345 | 12 | 21 |
| May-17 | 2.5 | 193 | 221 | 41 | 262 | 16 | 17 |
| Jun-17 | 2.3 | 200 | 200 | 44 | 245 | 20 | 25 |
| | | | | | | | |
| **Dry Season Average** | **2.4** | **271** | **258** | **64** | **323** | **27** | **22** |
| **Dry Season Trend **** | **Down** | **None** | **None** | **Down** | **None** | **-** | **Down** |
| **Wet Season Average** | **2.8** | **218** | **252** | **84** | **336** | **22** | **21** |
| **Average Annual** | **2.6** | **240** | **263** | **79** | **342** | **26** | **22** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 20 Rodeo Sanitary District

Rodeo discharges to San Pablo Bay. The plant services approximately 8,900 people and it has a permitted capacity of 1.14 mgd ADWF. The current plant flows are approximately 0.5 mgd. The plant performs nitrification and phosphorus removal using an activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging dry season downward trend for flows.
- Total nitrogen loads increase with flow during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia occasionally bleeds through year round.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.3 to 7.5 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is thought to be the anaerobic selector in the activated sludge process.

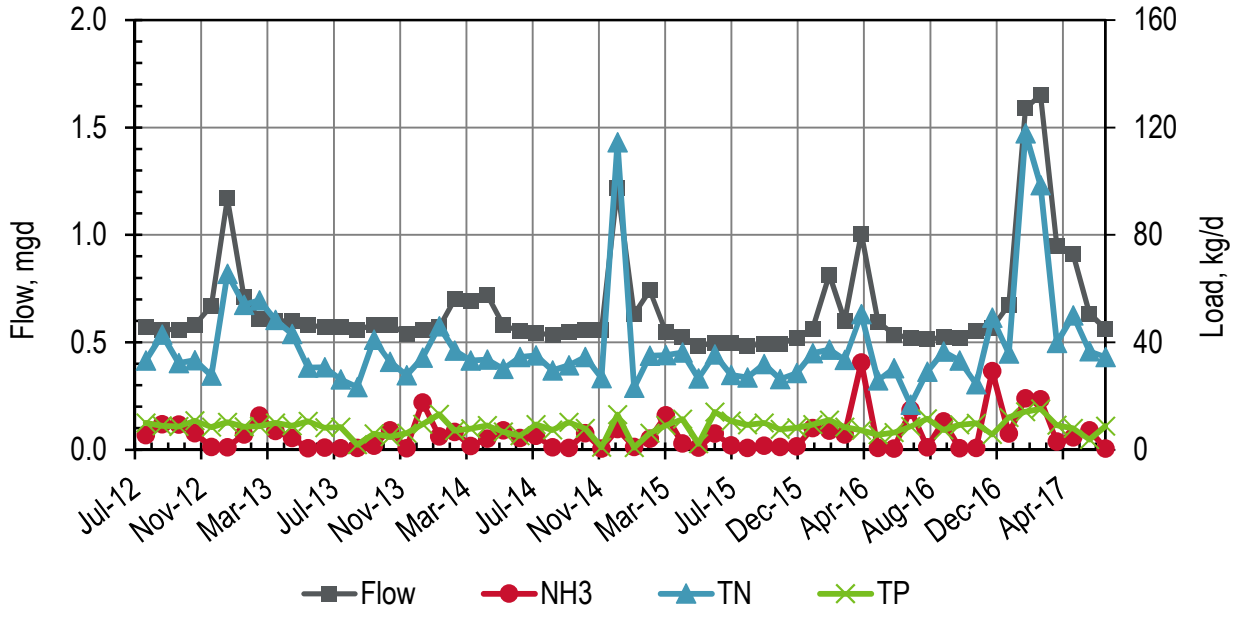


**Figure 20-1. Rodeo Monthly Flows and Loads**

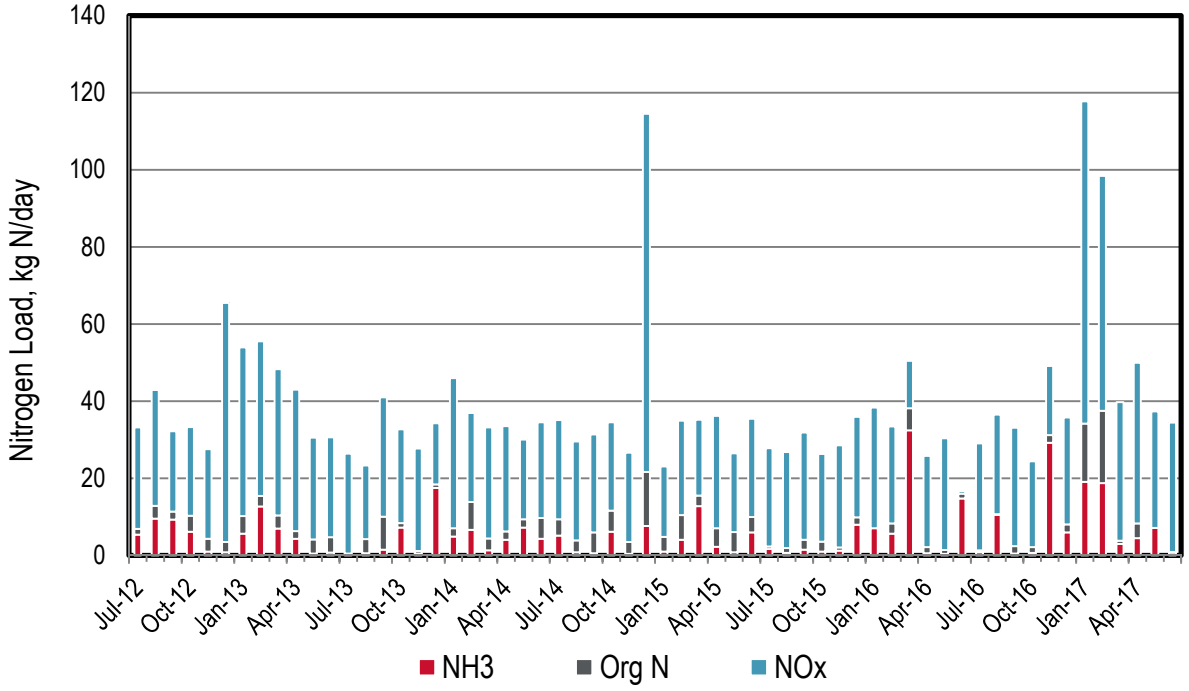


**Figure 20-2. Rodeo Monthly Nitrogen Loads**

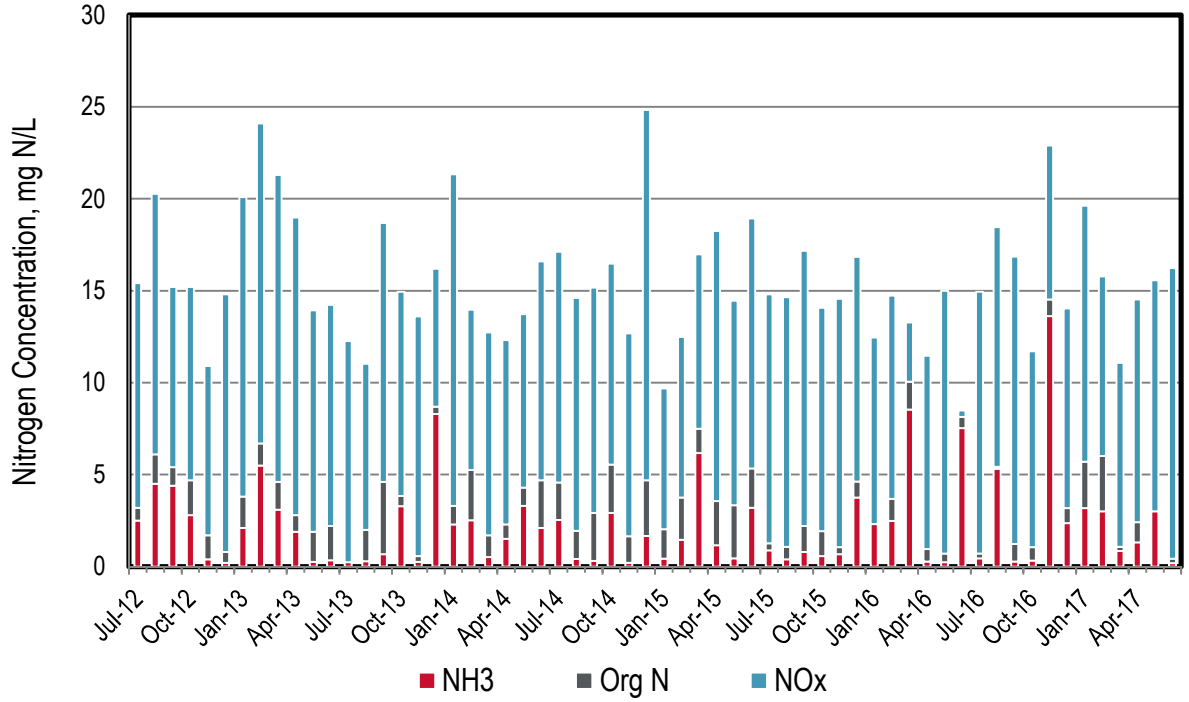


**Figure 20-3. Rodeo Monthly Nitrogen Concentrations**

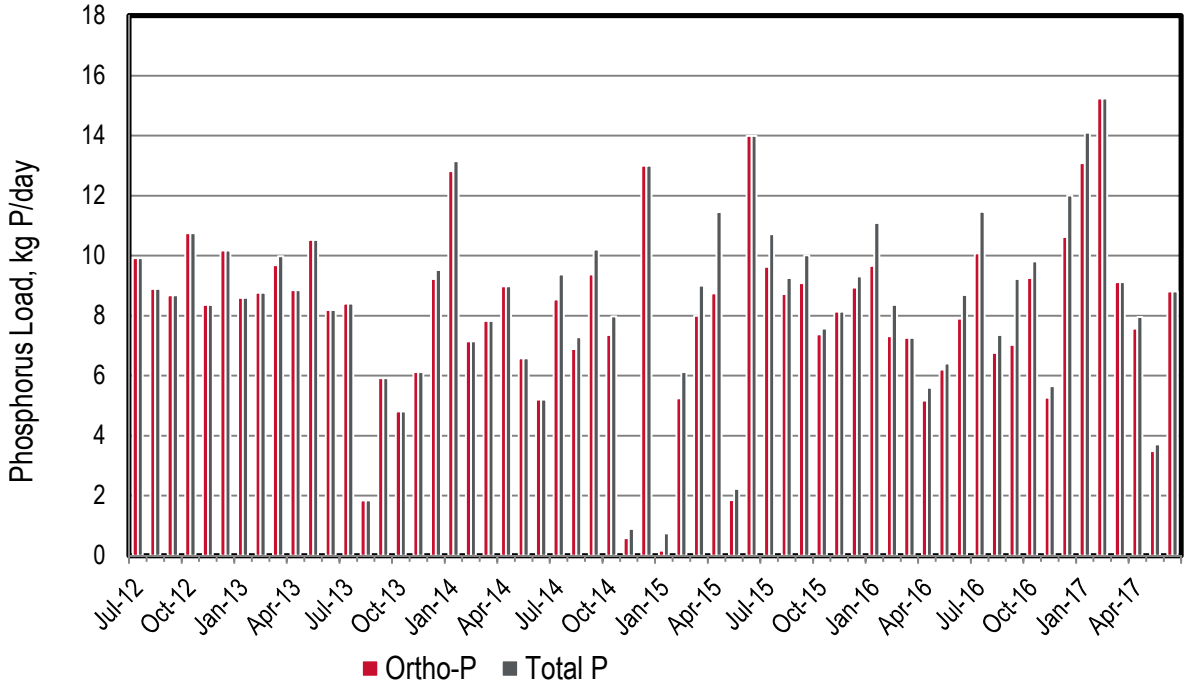


**Figure 20-4. Rodeo Monthly Phosphorus Loads**

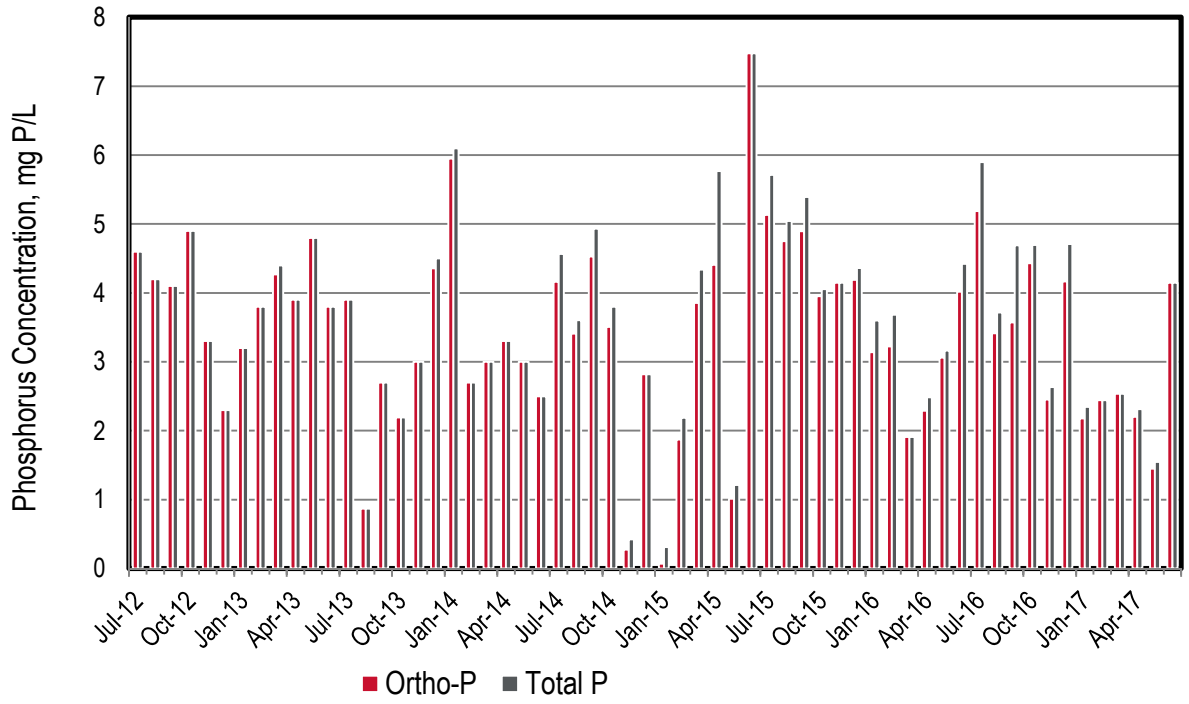


**Figure 20-5. Rodeo Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 20-1. Rodeo Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.6 | 5 | 7 | 26 | 33 | 19 | 10 |
| Aug-12 | 0.6 | 10 | 13 | 30 | 43 | 20 | 9 |
| Sep-12 | 0.6 | 9 | 11 | 21 | 32 | 22 | 9 |
| Oct-12 | 0.6 | 6 | 10 | 23 | 33 | 14 | 11 |
| Nov-12 | 0.7 | 1 | 4 | 23 | 28 | 13 | 8 |
| Dec-12 | 1.2 | 1 | 4 | 62 | 65 | 32 | 10 |
| Jan-13 | 0.7 | 6 | 10 | 44 | 54 | 10 | 9 |
| Feb-13 | 0.6 | 13 | 15 | 40 | 56 | 9 | 9 |
| Mar-13 | 0.6 | 7 | 10 | 38 | 48 | 10 | 10 |
| Apr-13 | 0.6 | 4 | 6 | 37 | 43 | 10 | 9 |
| May-13 | 0.6 | 1 | 4 | 26 | 31 | 13 | 11 |
| Jun-13 | 0.6 | 1 | 5 | 26 | 31 | 9 | 8 |
| Jul-13 | 0.6 | 1 | 0 | 26 | 26 | 10 | 8 |
| Aug-13 | 0.6 | 1 | 4 | 19 | 23 | 2 | 2 |
| Sep-13 | 0.6 | 1 | 10 | 31 | 41 | 8 | 6 |
| Oct-13 | 0.6 | 7 | 8 | 24 | 33 | 5 | 5 |
| Nov-13 | 0.5 | 1 | 1 | 27 | 28 | 7 | 6 |
| Dec-13 | 0.6 | 18 | 18 | 16 | 34 | 9 | 10 |
| Jan-14 | 0.6 | 5 | 7 | 39 | 46 | 13 | 13 |
| Feb-14 | 0.7 | 7 | 14 | 23 | 37 | 16 | 7 |
| Mar-14 | 0.7 | 1 | 4 | 29 | 33 | 14 | 8 |
| Apr-14 | 0.7 | 4 | 6 | 27 | 34 | 18 | 9 |
| May-14 | 0.6 | 7 | 9 | 21 | 30 | 8 | 7 |
| Jun-14 | 0.6 | 4 | 10 | 25 | 35 | 5 | 5 |
| Jul-14 | 0.5 | 5 | 9 | 26 | 35 | 9 | 9 |
| Aug-14 | 0.5 | 1 | 4 | 26 | 30 | 7 | 7 |
| Sep-14 | 0.5 | 1 | 6 | 25 | 31 | 9 | 10 |
| Oct-14 | 0.6 | 6 | 12 | 23 | 35 | 7 | 8 |
| Nov-14 | 0.6 | 0 | 3 | 23 | 27 | 1 | 1 |
| Dec-14 | 1.2 | 8 | 22 | 93 | 115 | 13 | 13 |
| Jan-15 | 0.6 | 1 | 5 | 18 | 23 | 0 | 1 |
| Feb-15 | 0.7 | 4 | 10 | 24 | 35 | 5 | 6 |
| Mar-15 | 0.5 | 13 | 16 | 20 | 35 | 8 | 9 |
| Apr-15 | 0.5 | 2 | 7 | 29 | 36 | 9 | 11 |
| May-15 | 0.5 | 1 | 6 | 20 | 27 | 2 | 2 |
| Jun-15 | 0.5 | 6 | 10 | 25 | 35 | 20 | 14 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 0.5 | 2 | 2 | 25 | 28 | 10 | 11 |
| Aug-15 | 0.5 | 1 | 2 | 25 | 27 | 9 | 9 |
| Sep-15 | 0.5 | 1 | 4 | 28 | 32 | 9 | 10 |
| Oct-15 | 0.5 | 1 | 4 | 23 | 26 | 7 | 8 |
| Nov-15 | 0.5 | 1 | 2 | 26 | 29 | 9 | 8 |
| Dec-15 | 0.6 | 8 | 10 | 26 | 36 | 9 | 9 |
| Jan-16 | 0.8 | 7 | 6 | 31 | 37 | 10 | 11 |
| Feb-16 | 0.6 | 6 | 8 | 25 | 33 | 7 | 8 |
| Mar-16 | 1.0 | 32 | 38 | 12 | 50 | 7 | 7 |
| Apr-16 | 0.6 | 1 | 2 | 24 | 26 | 5 | 6 |
| May-16 | 0.5 | 0 | 1 | 29 | 30 | 6 | 6 |
| Jun-16 | 0.5 | 15 | 16 | 1 | 17 | 8 | 9 |
| Jul-16 | 0.5 | 1 | 1 | 28 | 29 | 10 | 11 |
| Aug-16 | 0.5 | 11 | 11 | 26 | 37 | 7 | 7 |
| Sep-16 | 0.5 | 1 | 2 | 31 | 33 | 7 | 9 |
| Oct-16 | 0.5 | 1 | 2 | 22 | 24 | 9 | 10 |
| Nov-16 | 0.6 | 29 | 31 | 18 | 49 | 5 | 6 |
| Dec-16 | 0.7 | 6 | 8 | 28 | 36 | 11 | 12 |
| Jan-17 | 1.6 | 19 | 34 | 84 | 118 | 13 | 14 |
| Feb-17 | 1.7 | 19 | 38 | 61 | 98 | 33 | 15 |
| Mar-17 | 1.0 | 3 | 4 | 36 | 40 | 11 | 9 |
| Apr-17 | 0.9 | 5 | 8 | 42 | 50 | 8 | 8 |
| May-17 | 0.6 | 7 | 6 | 30 | 37 | 3 | 4 |
| Jun-17 | 0.6 | 0 | 1 | 34 | 34 | 9 | 9 |
| | | | | | | | |
| **Dry Season Average** | **0.5** | **4** | **6** | **25** | **31** | **10** | **8** |
| **Dry Season Trend **** | **None** | **None** | **None** | **None** | **None** | **-** | **None** |
| **Wet Season Average** | **0.7** | **7** | **11** | **33** | **44** | **10** | **9** |
| **Average Annual** | **0.7** | **6** | **9** | **29** | **39** | **10** | **8** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 21 San Jose-Santa Clara Regional Wastewater Facility

The San Jose-Santa Clara Regional Wastewater Facility discharges to the Lower South Bay, and serves an estimated population of 1.4 million with approximately 17,000 commercial and industrial connections. The plant has a permitted ADWF capacity of 167 mgd and a peak wet weather capacity of 261 mgd. The current flows are approximately 78 mgd ADWF. The process includes advanced treatment with a Biological Nutrient Removal (BNR) activated sludge system for N and P removal.

The following observations are made based upon the figures and table in the subsequent pages:

- The flows reduce 10 to 20 mgd from the wet to the dry season due to a combination of recycled water demand and a lack of inflow and infiltration during the dry season.
- Based on the average monthly values table below, there appears to be a downward trend in flows during the dry season for the reasons stated above.
- There appears to be an upward dry season trend for NOx and TP loads. The increase in concentrations over time supports this trend as the dry season flows are relatively flat.
- Both nitrogen (except ammonia) and phosphorus loads typically increase with flow during wet weather events.
- Wet season loads are greater and more variable than the dry season loads.
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since the plant fully nitrifies year-round.
- Ortho-P values are routinely greater than TP values, in particular for the Section 13267 Letter Day (July 2012 through June 2014). For such instances, ortho-P values were set equal to TP for the plots. This has only occurred for three monthly average values since the Regional Watershed Permit nutrient sampling went into effect (July 2014).
- Total phosphorus concentrations are typically below 1 mg P/L during the dry season with occasional excursions between 2 and 3 mg P/L during the wet season.

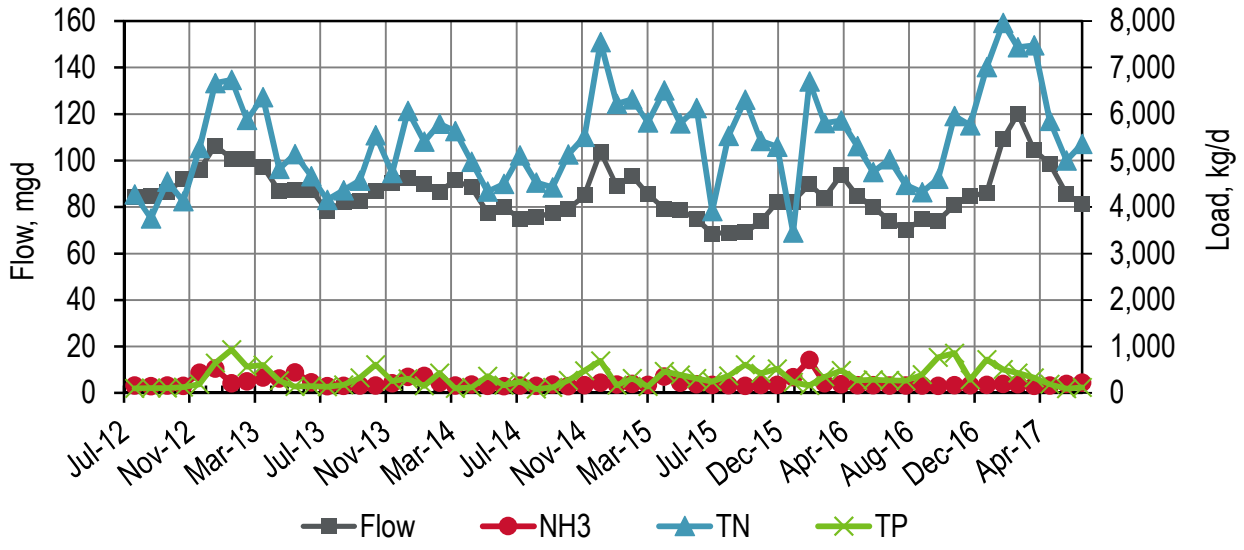


**Figure 21-1. San Jose Monthly Flows and Loads**

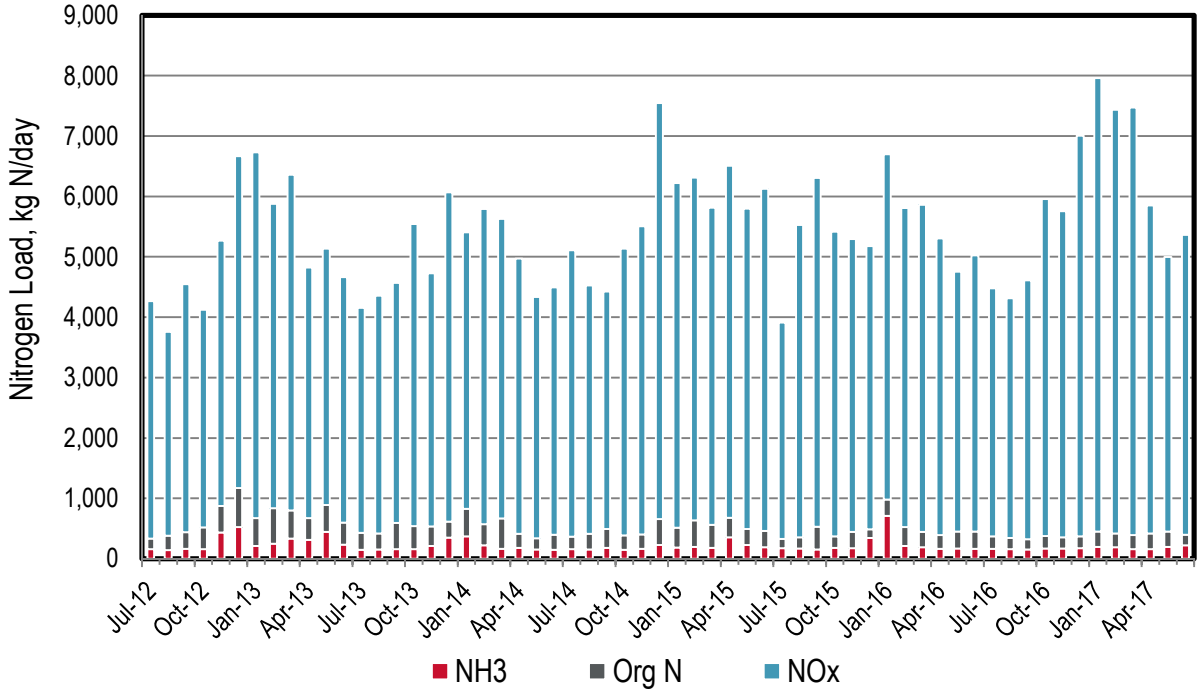


**Figure 21-2. San Jose Monthly Nitrogen Loads**

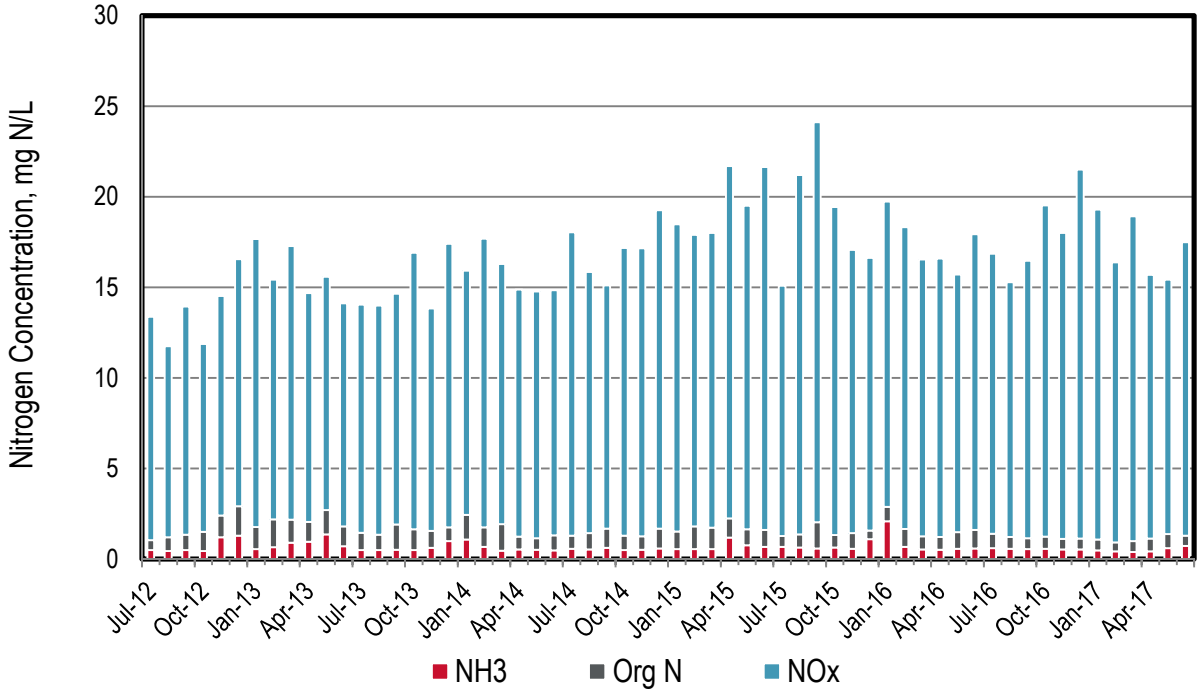


**Figure 21-3. San Jose Monthly Nitrogen Concentrations**

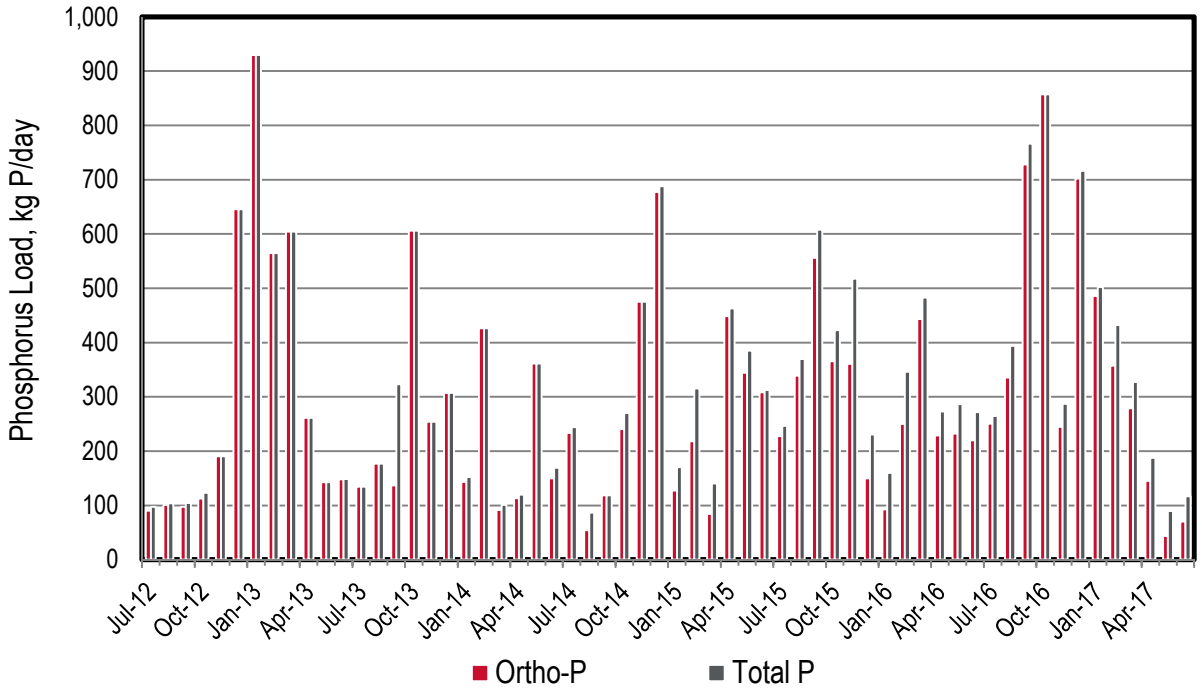


**Figure 21-4. San Jose Monthly Phosphorus Loads**

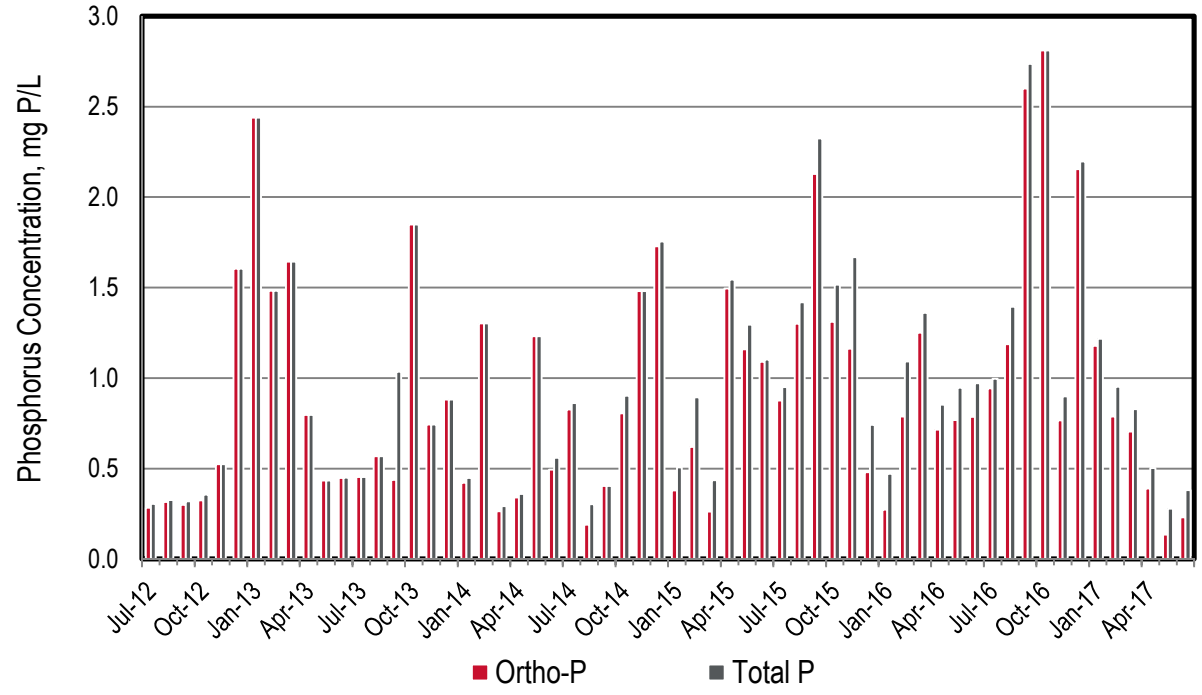


**Figure 21-5. San Jose Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 21-1. San Jose Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 84.5 | 160 | 335 | 3,932 | 4,267 | 90 | 97 |
| Aug-12 | 84.6 | 144 | 384 | 3,372 | 3,755 | 101 | 104 |
| Sep-12 | 86.3 | 163 | 439 | 4,107 | 4,546 | 98 | 104 |
| Oct-12 | 91.9 | 157 | 521 | 3,604 | 4,125 | 113 | 124 |
| Nov-12 | 96.0 | 433 | 874 | 4,393 | 5,267 | 203 | 190 |
| Dec-12 | 106.5 | 523 | 1,171 | 5,494 | 6,665 | 672 | 646 |
| Jan-13 | 100.9 | 211 | 674 | 6,059 | 6,732 | 1,102 | 930 |
| Feb-13 | 100.8 | 247 | 836 | 5,040 | 5,876 | 746 | 565 |
| Mar-13 | 97.3 | 332 | 802 | 5,557 | 6,359 | 746 | 605 |
| Apr-13 | 86.9 | 313 | 674 | 4,148 | 4,822 | 304 | 261 |
| May-13 | 87.2 | 446 | 892 | 4,242 | 5,134 | 167 | 143 |
| Jun-13 | 87.5 | 232 | 596 | 4,068 | 4,665 | 148 | 149 |
| Jul-13 | 78.3 | 148 | 429 | 3,726 | 4,156 | 159 | 134 |
| Aug-13 | 82.4 | 156 | 421 | 3,936 | 4,357 | 217 | 177 |
| Sep-13 | 82.6 | 161 | 594 | 3,975 | 4,569 | 137 | 323 |
| Oct-13 | 86.8 | 161 | 541 | 5,002 | 5,543 | 766 | 606 |
| Nov-13 | 90.4 | 211 | 534 | 4,195 | 4,729 | 254 | 254 |
| Dec-13 | 92.3 | 347 | 612 | 5,455 | 6,067 | 349 | 307 |
| Jan-14 | 89.9 | 370 | 829 | 4,576 | 5,405 | 143 | 152 |
| Feb-14 | 86.7 | 220 | 575 | 5,219 | 5,794 | 521 | 426 |
| Mar-14 | 91.5 | 162 | 667 | 4,963 | 5,630 | 91 | 101 |
| Apr-14 | 88.4 | 180 | 411 | 4,562 | 4,973 | 113 | 120 |
| May-14 | 77.6 | 153 | 338 | 3,997 | 4,334 | 411 | 361 |
| Jun-14 | 80.2 | 146 | 399 | 4,098 | 4,496 | 150 | 169 |
| Jul-14 | 74.9 | 160 | 363 | 4,743 | 5,107 | 234 | 244 |
| Aug-14 | 75.6 | 152 | 412 | 4,115 | 4,526 | 54 | 87 |
| Sep-14 | 77.5 | 181 | 494 | 3,929 | 4,424 | 129 | 118 |
| Oct-14 | 79.1 | 149 | 387 | 4,746 | 5,133 | 241 | 270 |
| Nov-14 | 84.9 | 166 | 401 | 5,108 | 5,508 | 496 | 475 |
| Dec-14 | 103.7 | 226 | 658 | 6,890 | 7,549 | 678 | 688 |
| Jan-15 | 89.0 | 184 | 512 | 5,708 | 6,219 | 127 | 171 |
| Feb-15 | 93.3 | 195 | 636 | 5,675 | 6,312 | 218 | 315 |
| Mar-15 | 85.5 | 178 | 563 | 5,253 | 5,816 | 85 | 141 |
| Apr-15 | 79.4 | 356 | 675 | 5,832 | 6,508 | 448 | 463 |
| May-15 | 78.7 | 227 | 491 | 5,306 | 5,797 | 344 | 385 |
| Jun-15 | 74.9 | 190 | 458 | 5,670 | 6,128 | 309 | 312 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 68.6 | 175 | 328 | 3,584 | 3,913 | 227 | 246 |
| Aug-15 | 69.0 | 167 | 357 | 5,172 | 5,530 | 339 | 370 |
| Sep-15 | 69.2 | 151 | 532 | 5,774 | 6,306 | 556 | 608 |
| Oct-15 | 73.8 | 178 | 371 | 5,046 | 5,417 | 365 | 423 |
| Nov-15 | 82.1 | 177 | 446 | 4,849 | 5,295 | 361 | 518 |
| Dec-15 | 82.4 | 343 | 488 | 4,691 | 3,453 | 150 | 231 |
| Jan-16 | 89.8 | 710 | 978 | 5,721 | 6,698 | 93 | 160 |
| Feb-16 | 83.8 | 212 | 525 | 5,281 | 5,806 | 250 | 346 |
| Mar-16 | 93.8 | 190 | 444 | 5,417 | 5,861 | 443 | 483 |
| Apr-16 | 84.7 | 166 | 392 | 4,915 | 5,307 | 229 | 273 |
| May-16 | 80.1 | 170 | 452 | 4,301 | 4,753 | 232 | 287 |
| Jun-16 | 74.1 | 163 | 450 | 4,574 | 5,024 | 220 | 272 |
| Jul-16 | 70.3 | 161 | 369 | 4,110 | 4,479 | 251 | 265 |
| Aug-16 | 74.7 | 159 | 344 | 3,971 | 4,315 | 335 | 394 |
| Sep-16 | 74.1 | 156 | 321 | 4,289 | 4,610 | 728 | 766 |
| Oct-16 | 80.7 | 171 | 375 | 5,581 | 5,956 | 869 | 857 |
| Nov-16 | 84.6 | 169 | 356 | 5,401 | 5,756 | 245 | 287 |
| Dec-16 | 86.2 | 172 | 371 | 6,635 | 7,007 | 702 | 716 |
| Jan-17 | 109.1 | 196 | 448 | 7,512 | 7,960 | 486 | 502 |
| Feb-17 | 120.1 | 190 | 417 | 7,015 | 7,433 | 357 | 432 |
| Mar-17 | 104.5 | 157 | 392 | 7,083 | 7,475 | 279 | 327 |
| Apr-17 | 98.7 | 159 | 419 | 5,432 | 5,852 | 145 | 187 |
| May-17 | 85.7 | 198 | 450 | 4,549 | 4,999 | 44 | 90 |
| Jun-17 | 81.1 | 222 | 397 | 4,964 | 5,361 | 70 | 117 |
| | | | | | | | |
| **Dry Season Average** | **78.4** | **182** | **442** | **4,340** | **4,782** | **230** | **253** |
| **Dry Season Trend **** | **Down** | **None** | **None** | **Up** | **None** | **-** | **Up** |
| **Wet Season Average** | **91.3** | **243** | **571** | **5,373** | **5,895** | **383** | **387** |
| **Average Annual** | **85.9** | **218** | **517** | **4,943** | **5,431** | **319** | **331** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 22 City of San Mateo

San Mateo discharges to the South Bay and it has approximately 37,823 service connections. The plant has a permitted ADWF capacity of 15.7 mgd and a peak wet weather capacity of 60 mgd, with blending allowable above 40 mgd. The current flows are approximately 9.4 mgd ADWF. The plant performs secondary treatment using activated sludge.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, there appears to be a downward trend for flows in the dry season. This is attributed to a combination of weather (drought) and water conservation.
- There appears to be an emerging upward dry season trend for NOx loads.
- Nitrogen species concentrations are typically highest during the dry season.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 1.5 to 4.6 mg P/L, This suggests a portion of P is removed as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is most likely from ferrous chloride addition to solids thickening.

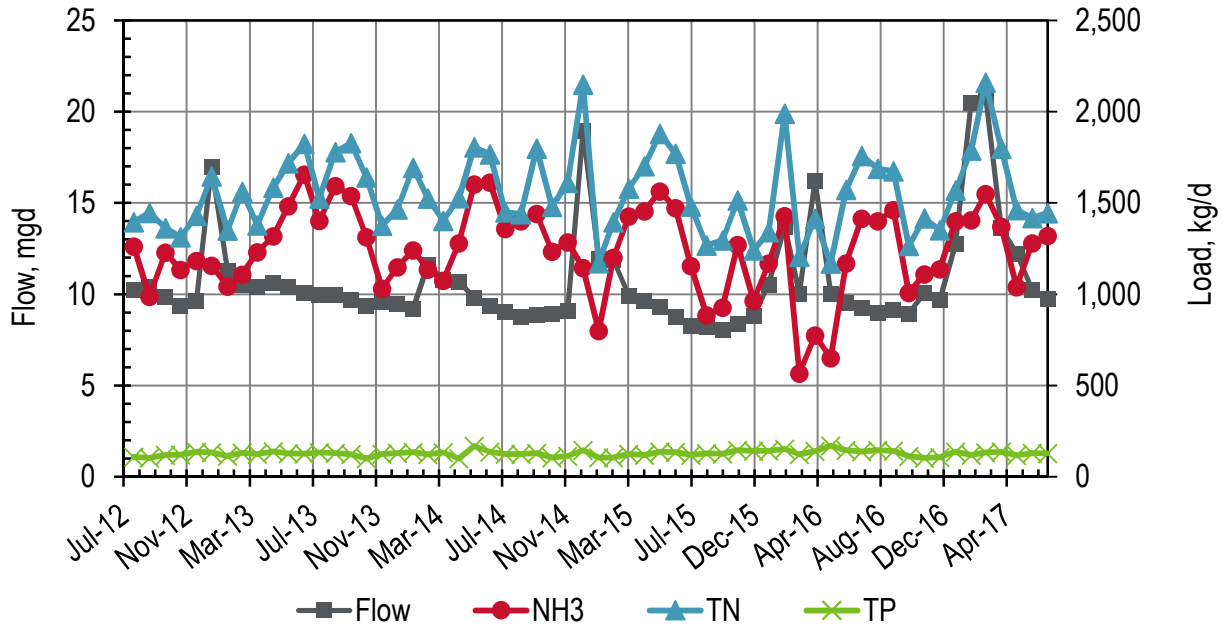


**Figure 22-1. San Mateo Monthly Flows and Loads**

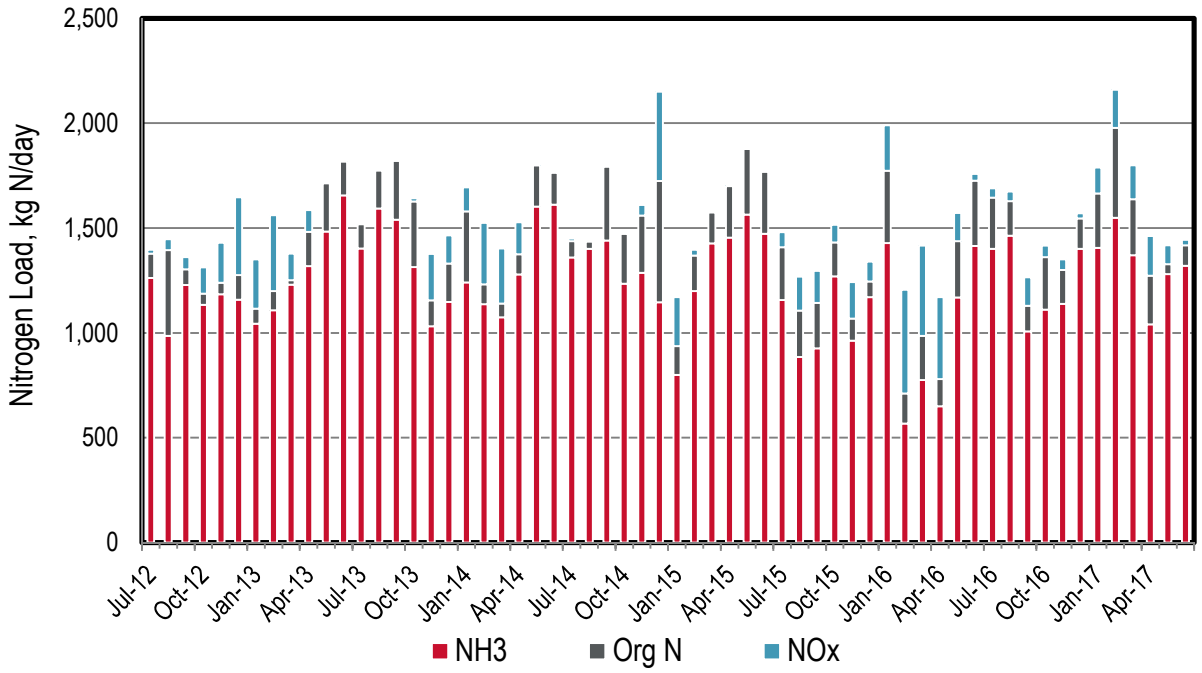


**Figure 22-2. San Mateo Monthly Nitrogen Loads**

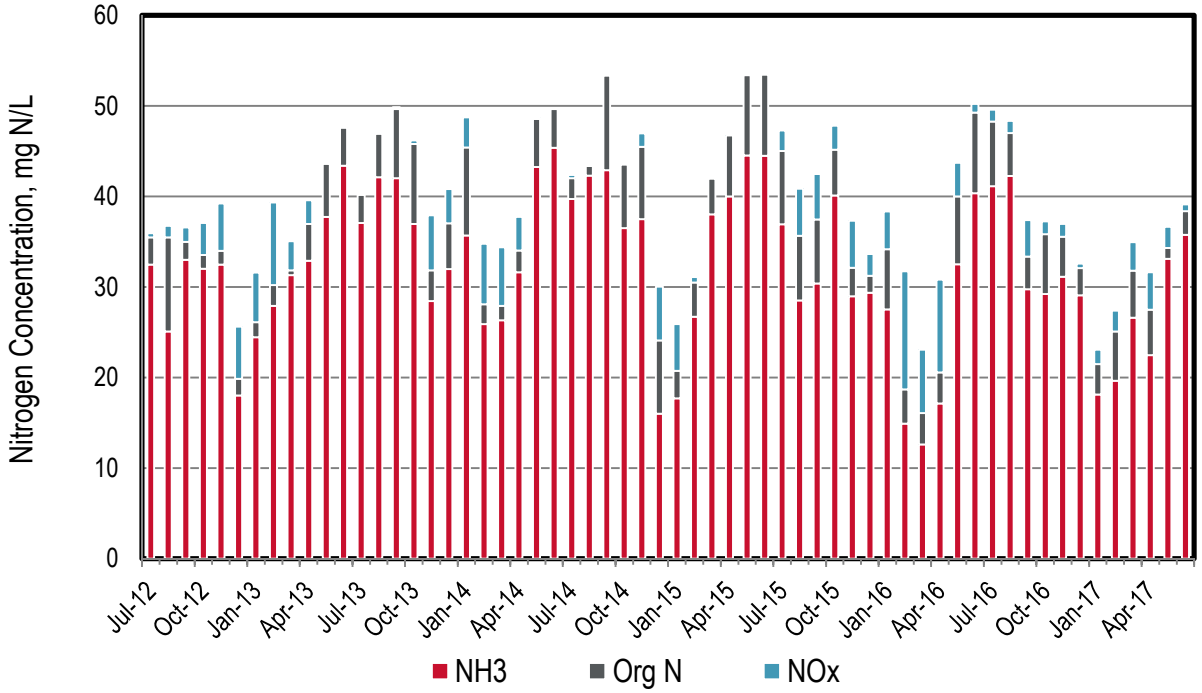


**Figure 22-3. San Mateo Monthly Nitrogen Concentrations**

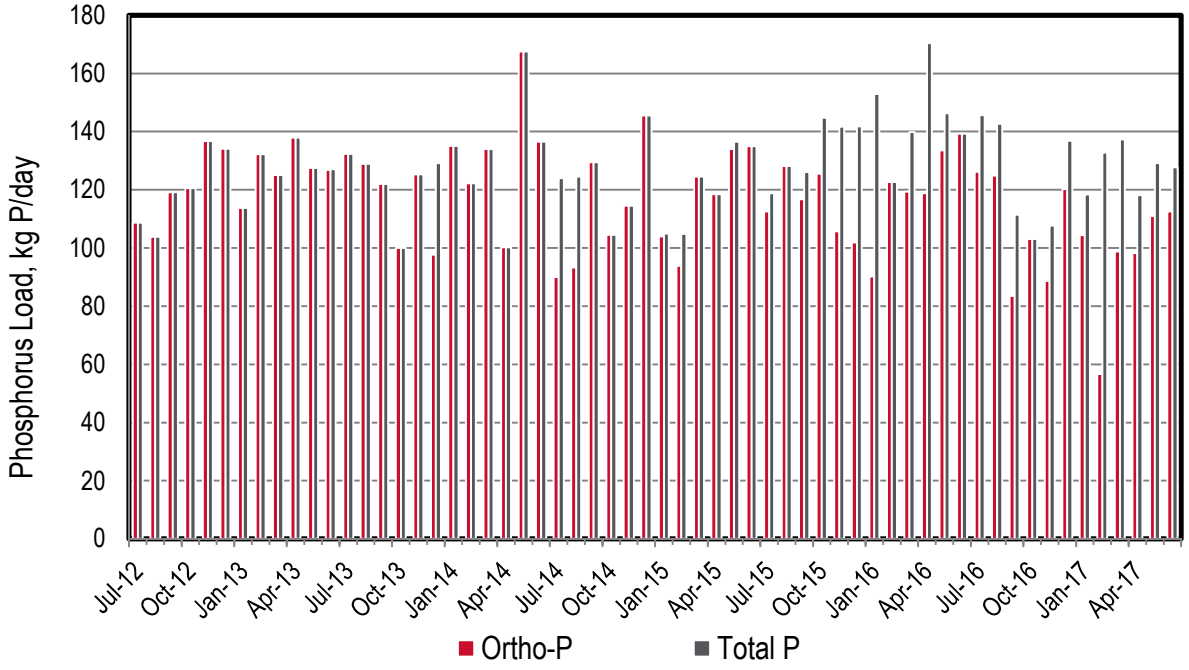


**Figure 22-4. San Mateo Monthly Phosphorus Loads**

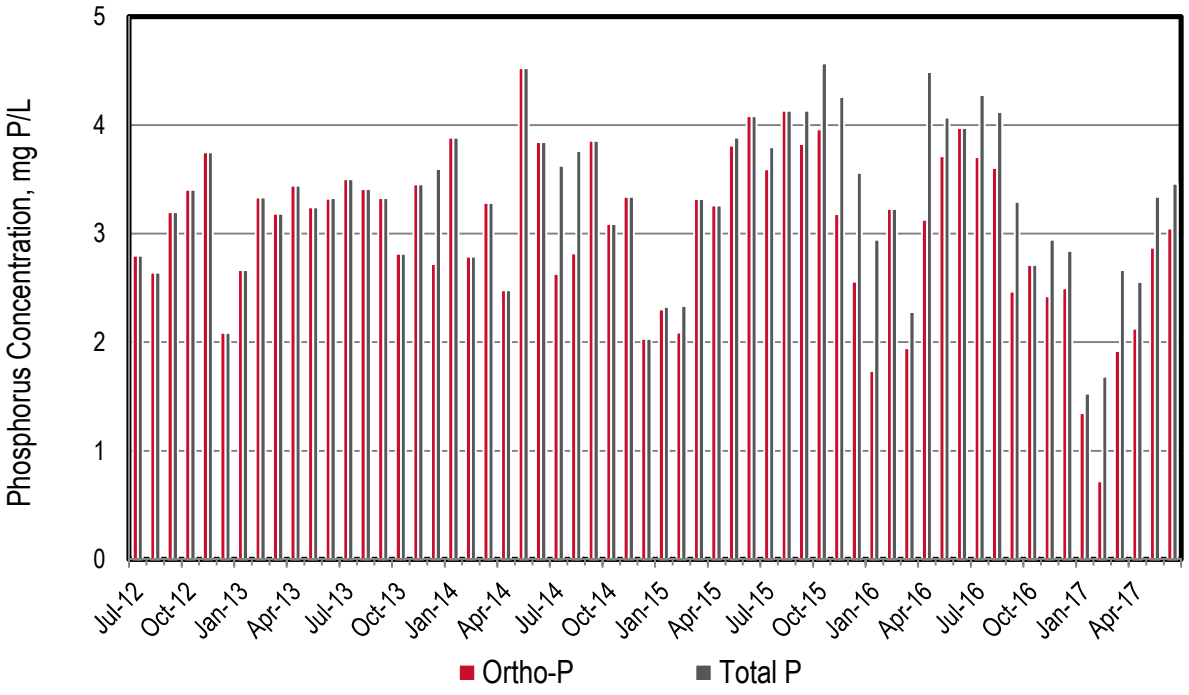


**Figure 22-5. San Mateo Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 22-1. San Mateo Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 10.3 | 1,262 | 1,378 | 18 | 1,396 | 113 | 109 |
| Aug-12 | 10.4 | 986 | 1,395 | 51 | 1,446 | 127 | 104 |
| Sep-12 | 9.8 | 1,228 | 1,303 | 59 | 1,362 | 140 | 119 |
| Oct-12 | 9.4 | 1,134 | 1,187 | 126 | 1,313 | 207 | 121 |
| Nov-12 | 9.6 | 1,184 | 1,239 | 192 | 1,430 | 158 | 137 |
| Dec-12 | 17.0 | 1,158 | 1,276 | 371 | 1,646 | 141 | 134 |
| Jan-13 | 11.3 | 1,044 | 1,115 | 235 | 1,350 | 149 | 114 |
| Feb-13 | 10.5 | 1,107 | 1,199 | 362 | 1,561 | 220 | 132 |
| Mar-13 | 10.4 | 1,230 | 1,251 | 127 | 1,378 | 245 | 125 |
| Apr-13 | 10.6 | 1,318 | 1,481 | 104 | 1,585 | 140 | 138 |
| May-13 | 10.4 | 1,484 | 1,714 | 4 | 1,718 | 142 | 128 |
| Jun-13 | 10.1 | 1,656 | 1,818 | 7 | 1,824 | 127 | 127 |
| Jul-13 | 10.0 | 1,402 | 1,518 | 6 | 1,525 | 221 | 132 |
| Aug-13 | 10.0 | 1,593 | 1,774 | 6 | 1,780 | 193 | 129 |
| Sep-13 | 9.7 | 1,540 | 1,820 | 8 | 1,828 | 205 | 122 |
| Oct-13 | 9.4 | 1,313 | 1,627 | 14 | 1,641 | 219 | 100 |
| Nov-13 | 9.6 | 1,032 | 1,155 | 221 | 1,376 | 250 | 125 |
| Dec-13 | 9.5 | 1,148 | 1,330 | 135 | 1,465 | 98 | 129 |
| Jan-14 | 9.2 | 1,241 | 1,579 | 115 | 1,694 | 263 | 135 |
| Feb-14 | 11.6 | 1,136 | 1,231 | 294 | 1,525 | 131 | 122 |
| Mar-14 | 10.8 | 1,074 | 1,140 | 263 | 1,403 | 203 | 134 |
| Apr-14 | 10.7 | 1,279 | 1,376 | 151 | 1,527 | 319 | 100 |
| May-14 | 9.8 | 1,602 | 1,799 | 6 | 1,805 | 273 | 168 |
| Jun-14 | 9.4 | 1,612 | 1,764 | 4 | 1,767 | 257 | 137 |
| Jul-14 | 9.1 | 1,359 | 1,437 | 12 | 1,449 | 90 | 124 |
| Aug-14 | 8.8 | 1,401 | 1,436 | 3 | 1,439 | 93 | 125 |
| Sep-14 | 8.9 | 1,441 | 1,793 | 5 | 1,798 | 150 | 130 |
| Oct-14 | 8.9 | 1,235 | 1,473 | 7 | 1,480 | 177 | 105 |
| Nov-14 | 9.1 | 1,286 | 1,560 | 51 | 1,611 | 143 | 115 |
| Dec-14 | 18.9 | 1,145 | 1,725 | 425 | 2,150 | 156 | 146 |
| Jan-15 | 12.0 | 983 | 938 | 233 | 1,171 | 104 | 105 |
| Feb-15 | 11.9 | 1,370 | 1,369 | 27 | 1,396 | 94 | 105 |
| Mar-15 | 9.9 | 1,426 | 1,575 | 4 | 1,579 | 136 | 125 |
| Apr-15 | 9.6 | 1,455 | 1,700 | 2 | 1,702 | 183 | 119 |
| May-15 | 9.3 | 1,564 | 1,877 | 2 | 1,879 | 134 | 137 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 8.8 | 1,472 | 1,768 | 3 | 1,771 | 146 | 135 |
| Jul-15 | 8.3 | 1,156 | 1,409 | 71 | 1,480 | 113 | 119 |
| Aug-15 | 8.2 | 885 | 1,107 | 161 | 1,267 | 135 | 128 |
| Sep-15 | 8.1 | 927 | 1,143 | 153 | 1,296 | 117 | 126 |
| Oct-15 | 8.4 | 1,270 | 1,431 | 84 | 1,515 | 126 | 145 |
| Nov-15 | 8.8 | 963 | 1,068 | 173 | 1,242 | 106 | 142 |
| Dec-15 | 10.5 | 1,170 | 1,244 | 96 | 1,340 | 102 | 142 |
| Jan-16 | 13.7 | 1,428 | 1,773 | 217 | 1,990 | 90 | 153 |
| Feb-16 | 10.1 | 567 | 711 | 495 | 1,205 | 129 | 123 |
| Mar-16 | 16.2 | 775 | 986 | 430 | 1,415 | 119 | 140 |
| Apr-16 | 10.0 | 651 | 780 | 389 | 1,170 | 119 | 170 |
| May-16 | 9.5 | 1,169 | 1,438 | 134 | 1,572 | 134 | 146 |
| Jun-16 | 9.3 | 1,414 | 1,725 | 33 | 1,759 | 145 | 139 |
| Jul-16 | 9.0 | 1,401 | 1,644 | 44 | 1,689 | 126 | 146 |
| Aug-16 | 9.2 | 1,463 | 1,628 | 47 | 1,674 | 125 | 143 |
| Sep-16 | 9.0 | 1,008 | 1,129 | 136 | 1,265 | 83 | 111 |
| Oct-16 | 10.1 | 1,110 | 1,362 | 54 | 1,416 | 103 | 103 |
| Nov-16 | 9.7 | 1,138 | 1,299 | 52 | 1,351 | 89 | 108 |
| Dec-16 | 12.7 | 1,401 | 1,545 | 24 | 1,570 | 120 | 137 |
| Jan-17 | 20.5 | 1,405 | 1,664 | 124 | 1,788 | 104 | 118 |
| Feb-17 | 20.9 | 1,549 | 1,978 | 182 | 2,159 | 57 | 133 |
| Mar-17 | 13.6 | 1,370 | 1,638 | 162 | 1,799 | 99 | 137 |
| Apr-17 | 12.2 | 1,040 | 1,272 | 190 | 1,462 | 98 | 118 |
| May-17 | 10.2 | 1,280 | 1,328 | 90 | 1,418 | 111 | 129 |
| Jun-17 | 9.8 | 1,320 | 1,417 | 27 | 1,444 | 113 | 128 |
| | | | | | | | |
| **Dry Season Average** | **9.4** | **1,345** | **1,542** | **44** | **1,586** | **144** | **130** |
| **Dry Season Trend **** | **Down** | **None** | **None** | **Up** | **None** | **-** | **None** |
| **Wet Season Average** | **11.6** | **1,165** | **1,351** | **175** | **1,526** | **148** | **127** |
| **Average Annual** | **10.7** | **1,240** | **1,431** | **120** | **1,551** | **147** | **128** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 23 Sewerage Agency of Southern Marin (SASM)

SASM discharges to the Central Bay. The plant has approximately 14,800 service connections and it has a permitted capacity of 3.6 mgd ADWF. The current plant flow is approximately 1.9 mgd ADWF. The plant currently performs nitrification using under-loaded trickling filters.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging dry season downward trend for flows.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. However, a portion of ammonia occasionally bleeds through year round. The ammonia bleed through is attributed to cold weather and over loading the trickling filters for nitrification.
- Ortho-P values are occasionally greater than TP values for the Section 13257 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value once. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 1.1 to 11 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is thought to be metal salt addition in the collection system.

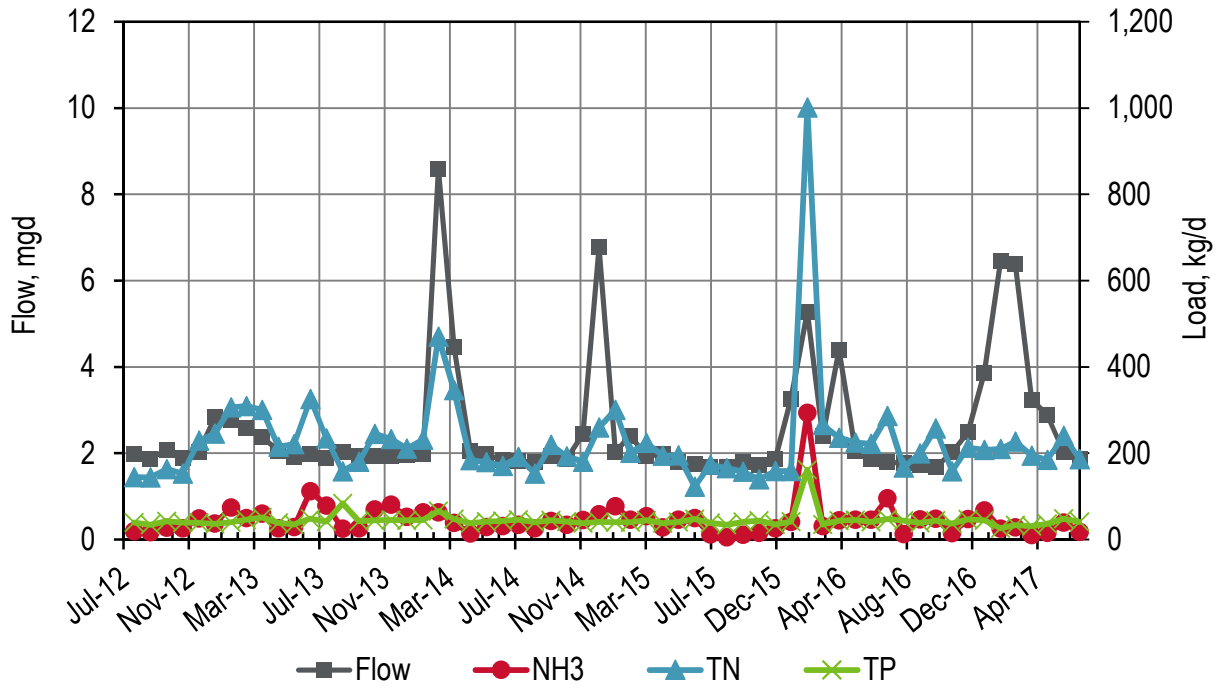


**Figure 23-1. SASM Monthly Flows and Loads**

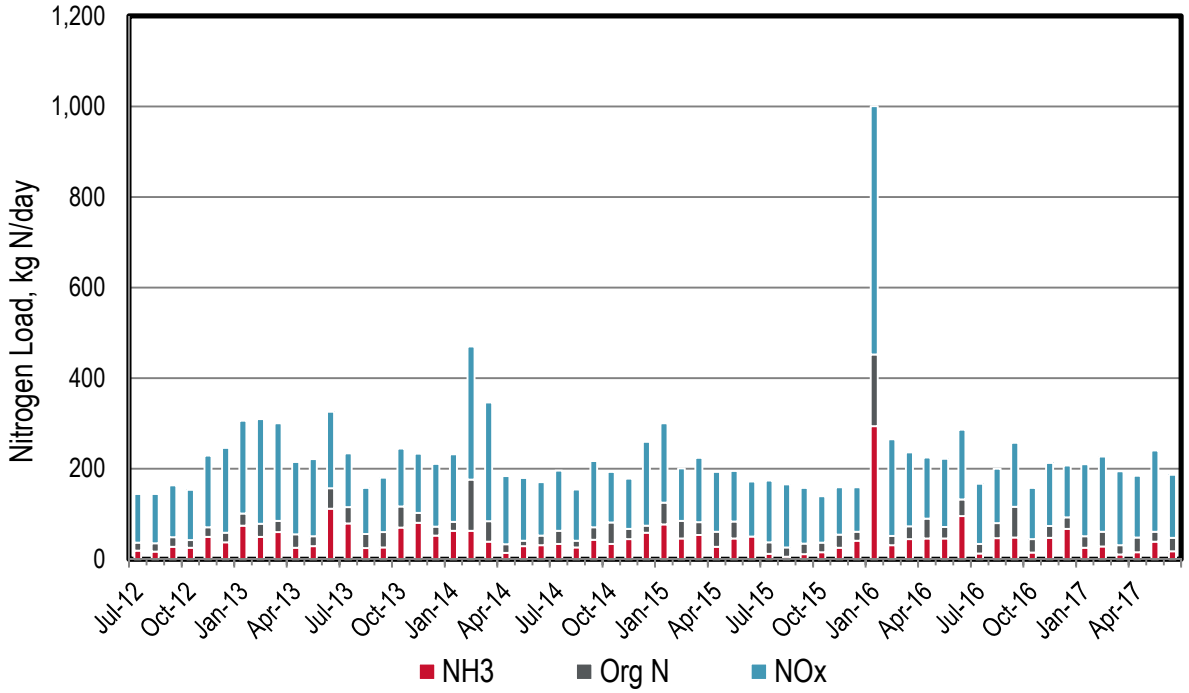


**Figure 23-2. SASM Monthly Nitrogen Loads**

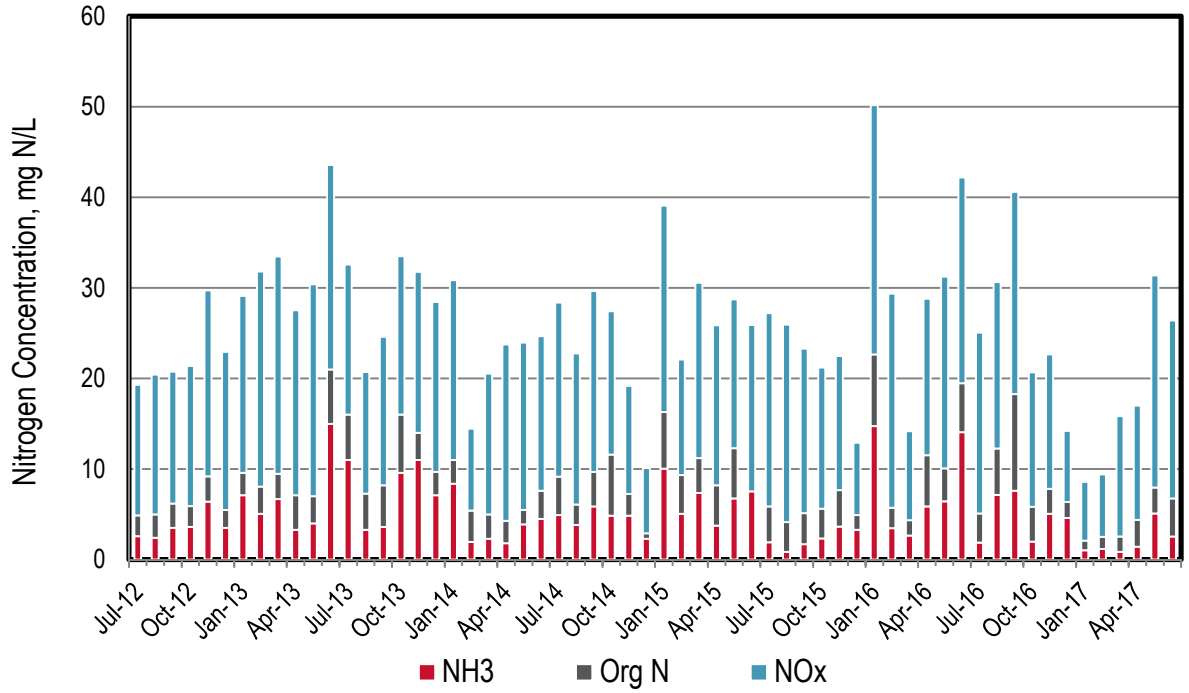


**Figure 23-3. SASM Monthly Nitrogen Concentrations**

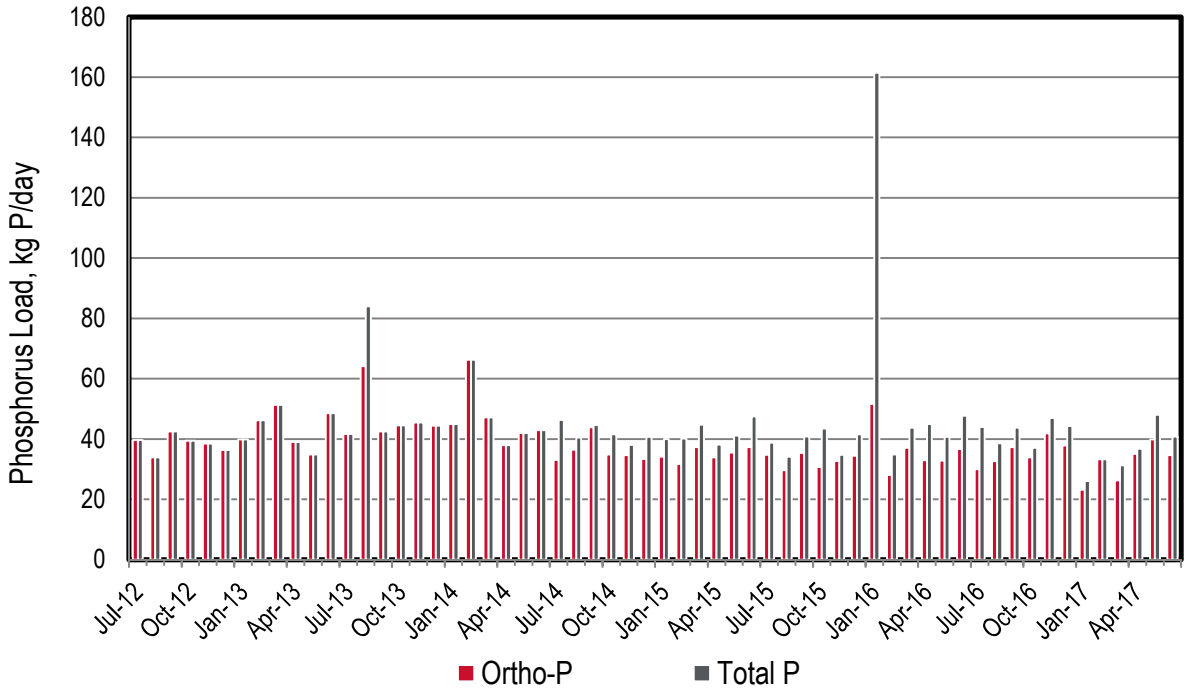


**Figure 23-4. SASM Monthly Phosphorus Loads**

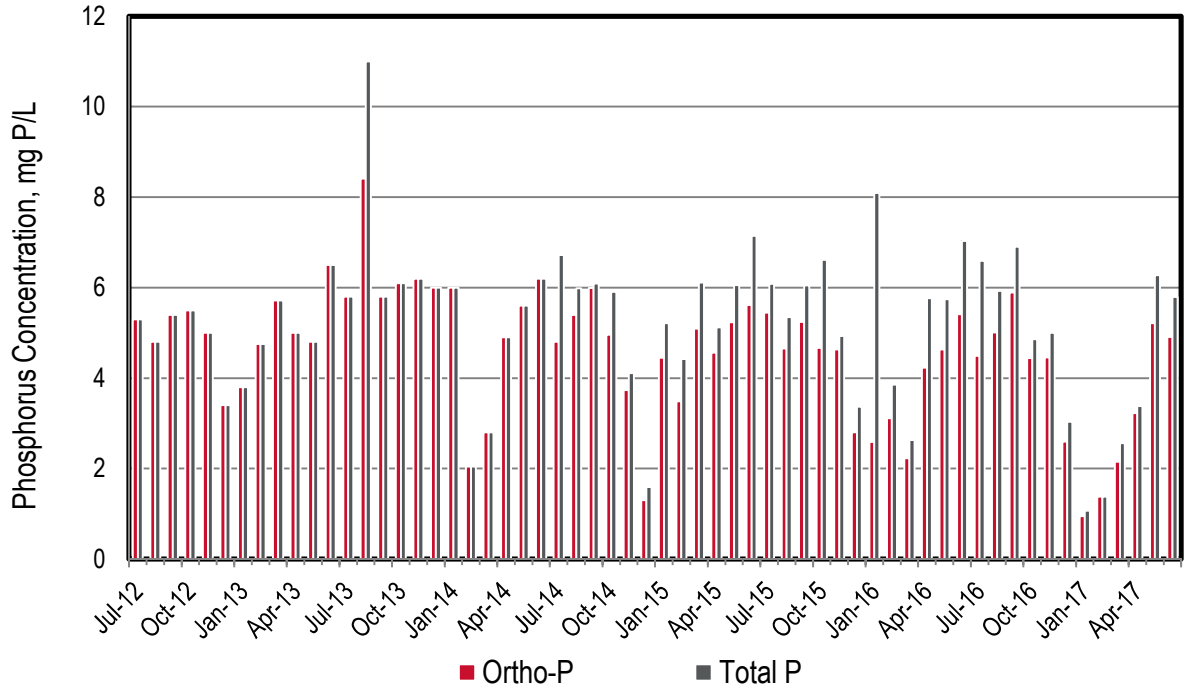


**Figure 23-5. SASM Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 23-1. SASM Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 2.0 | 19 | 37 | 108 | 145 | 56 | 40 |
| Aug-12 | 1.9 | 17 | 35 | 109 | 144 | 69 | 34 |
| Sep-12 | 2.1 | 28 | 49 | 115 | 164 | 70 | 43 |
| Oct-12 | 1.9 | 26 | 42 | 111 | 153 | 80 | 39 |
| Nov-12 | 2.0 | 49 | 71 | 158 | 229 | 67 | 39 |
| Dec-12 | 2.8 | 37 | 59 | 187 | 246 | 55 | 36 |
| Jan-13 | 2.8 | 75 | 101 | 205 | 306 | 58 | 40 |
| Feb-13 | 2.6 | 49 | 79 | 231 | 310 | 91 | 46 |
| Mar-13 | 2.4 | 60 | 85 | 216 | 301 | 78 | 51 |
| Apr-13 | 2.1 | 26 | 55 | 159 | 215 | 71 | 39 |
| May-13 | 1.9 | 29 | 51 | 170 | 221 | 80 | 35 |
| Jun-13 | 2.0 | 112 | 157 | 169 | 326 | 90 | 49 |
| Jul-13 | 1.9 | 79 | 115 | 119 | 234 | 66 | 42 |
| Aug-13 | 2.0 | 25 | 56 | 102 | 158 | 64 | 84 |
| Sep-13 | 1.9 | 26 | 60 | 120 | 181 | 74 | 43 |
| Oct-13 | 1.9 | 70 | 117 | 128 | 245 | 78 | 45 |
| Nov-13 | 1.9 | 81 | 103 | 130 | 233 | 79 | 45 |
| Dec-13 | 2.0 | 53 | 72 | 139 | 211 | 79 | 44 |
| Jan-14 | 2.0 | 63 | 83 | 149 | 232 | 98 | 45 |
| Feb-14 | 8.6 | 63 | 176 | 294 | 470 | 128 | 66 |
| Mar-14 | 4.5 | 39 | 84 | 262 | 346 | 120 | 47 |
| Apr-14 | 2.1 | 14 | 33 | 151 | 184 | 72 | 38 |
| May-14 | 2.0 | 29 | 41 | 138 | 179 | 78 | 42 |
| Jun-14 | 1.8 | 31 | 53 | 118 | 171 | 164 | 43 |
| Jul-14 | 1.8 | 34 | 63 | 132 | 191 | 33 | 46 |
| Aug-14 | 1.8 | 26 | 41 | 113 | 153 | 36 | 40 |
| Sep-14 | 1.9 | 43 | 71 | 146 | 219 | 44 | 45 |
| Oct-14 | 1.9 | 34 | 82 | 111 | 193 | 35 | 42 |
| Nov-14 | 2.5 | 45 | 67 | 111 | 180 | 35 | 38 |
| Dec-14 | 6.8 | 59 | 74 | 185 | 260 | 33 | 41 |
| Jan-15 | 2.0 | 77 | 125 | 175 | 300 | 34 | 40 |
| Feb-15 | 2.4 | 46 | 85 | 116 | 201 | 32 | 40 |
| Mar-15 | 1.9 | 54 | 82 | 142 | 224 | 37 | 45 |
| Apr-15 | 2.0 | 28 | 61 | 132 | 194 | 34 | 38 |
| May-15 | 1.8 | 46 | 84 | 112 | 195 | 36 | 41 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 1.8 | 50 | 0 | 122 | 122 | 37 | 48 |
| Jul-15 | 1.7 | 12 | 37 | 136 | 174 | 35 | 39 |
| Aug-15 | 1.7 | 5 | 27 | 139 | 166 | 30 | 34 |
| Sep-15 | 1.8 | 12 | 35 | 123 | 157 | 35 | 41 |
| Oct-15 | 1.7 | 15 | 37 | 102 | 139 | 31 | 44 |
| Nov-15 | 1.9 | 26 | 54 | 104 | 159 | 33 | 35 |
| Dec-15 | 3.3 | 41 | 61 | 99 | 159 | 35 | 42 |
| Jan-16 | 5.3 | 294 | 452 | 549 | 1,001 | 52 | 161 |
| Feb-16 | 2.4 | 31 | 52 | 214 | 265 | 28 | 35 |
| Mar-16 | 4.4 | 45 | 73 | 163 | 236 | 37 | 44 |
| Apr-16 | 2.1 | 46 | 90 | 135 | 225 | 33 | 45 |
| May-16 | 1.9 | 46 | 72 | 150 | 222 | 33 | 41 |
| Jun-16 | 1.8 | 95 | 132 | 154 | 286 | 37 | 48 |
| Jul-16 | 1.8 | 13 | 34 | 133 | 167 | 30 | 44 |
| Aug-16 | 1.7 | 47 | 80 | 120 | 200 | 33 | 39 |
| Sep-16 | 1.7 | 48 | 116 | 142 | 257 | 37 | 44 |
| Oct-16 | 2.0 | 15 | 45 | 113 | 158 | 34 | 37 |
| Nov-16 | 2.5 | 48 | 73 | 140 | 213 | 42 | 47 |
| Dec-16 | 3.9 | 67 | 93 | 114 | 207 | 38 | 44 |
| Jan-17 | 6.5 | 26 | 51 | 159 | 210 | 23 | 26 |
| Feb-17 | 6.4 | 29 | 61 | 166 | 227 | 37 | 33 |
| Mar-17 | 3.2 | 11 | 31 | 163 | 194 | 26 | 31 |
| Apr-17 | 2.9 | 15 | 48 | 137 | 185 | 35 | 37 |
| May-17 | 2.0 | 39 | 61 | 179 | 240 | 40 | 48 |
| Jun-17 | 1.9 | 18 | 48 | 139 | 186 | 35 | 41 |
| | | | | | | | |
| **Dry Season Average** | **1.9** | **37** | **62** | **132** | **194** | **54** | **44** |
| **Dry Season Trend **** | **Down** | **None** | **None** | **None** | **None** | **-** | **None** |
| **Wet Season Average** | **3.1** | **50** | **84** | **167** | **252** | **54** | **45** |
| **Average Annual** | **2.6** | **45** | **75** | **153** | **228** | **54** | **44** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 24 San Francisco International Airport – MLTP (SFO)

SFO discharges to the South Bay. The plant has a permitted capacity of 3.4 mgd ADWF. The current flow is approximately 1.1 mgd ADWF. The process includes two separate treatment processes. Domestic water from the airport facilities are collected through the sanitary sewer collection system and treated with a sequential batch reactor (SBR). Industrial wastewater and storm run-off is treated in the Industrial plant, which includes a trickling filter.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, there appears to be an emerging dry season downward trend for TKN, TN, and TP loads.
- Phosphorus loads generally increase with flow during wet weather events.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- Total nitrogen concentrations occasionally reach upwards of 100 mg N/L, which is higher than most of the other plants. The plant receives concentrated waste from landed planes which most likely increases the concentrations.
- Ortho-P values are occasionally greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from <1 to 9.2 mg P/L. This wide range is attributed to a combination of highly variable industrial waste and/or occasional P removal (typical municipal discharge TP concentrations are 4 to 6 mg P/L).
- Total phosphorus concentrations occasionally exceed 9 mg P/L, which is higher than most of the other plants.

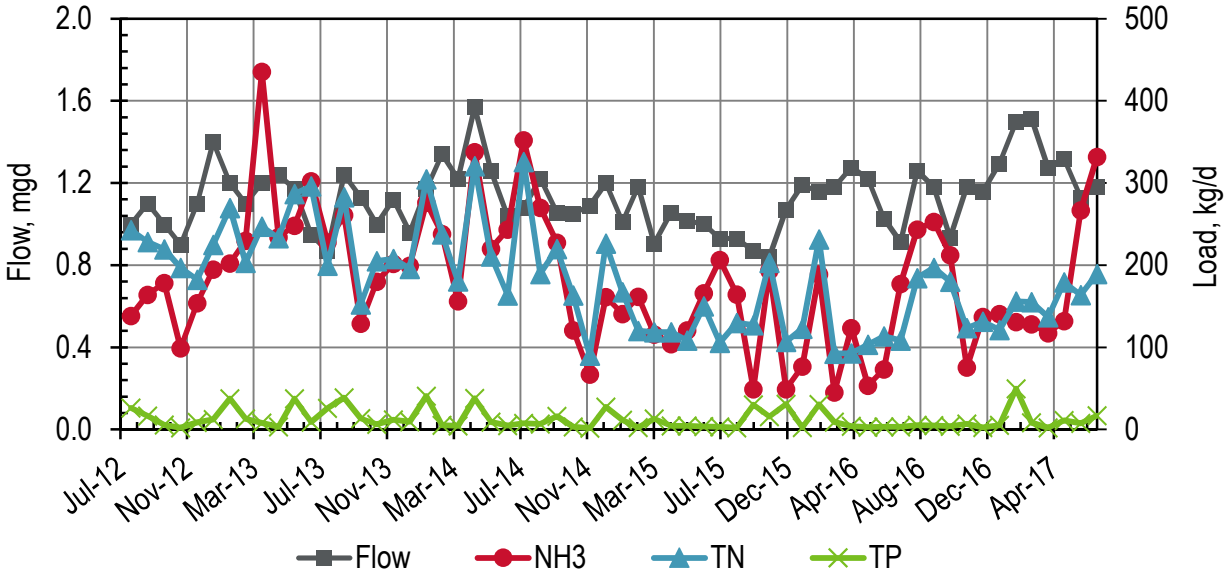


**Figure 24-1. SFO Airport Monthly Flows and Loads**

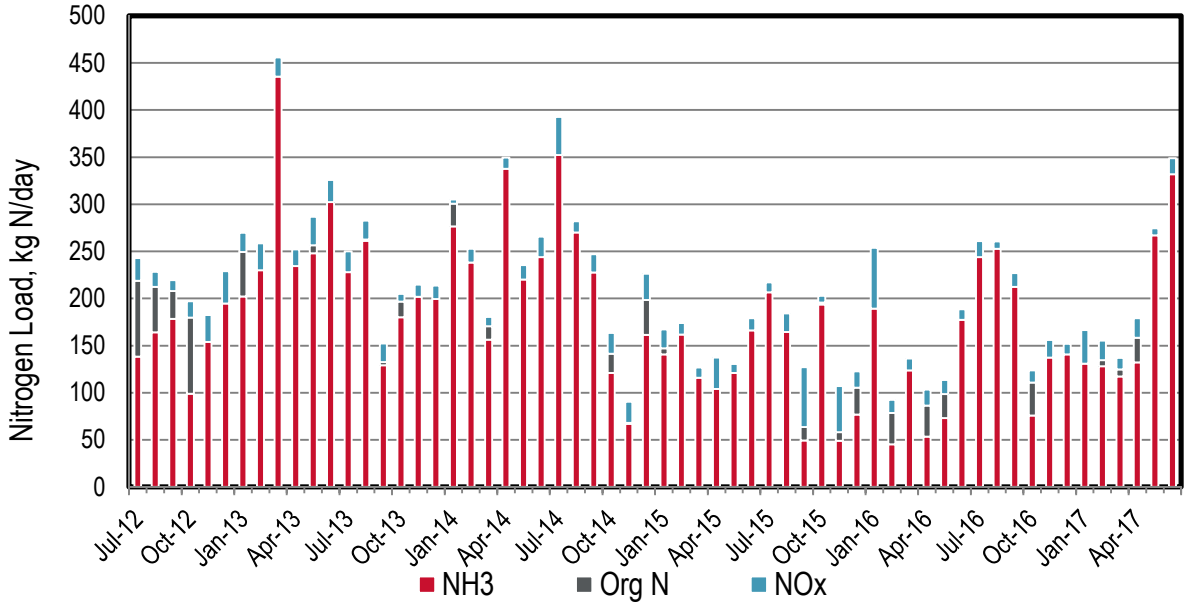


**Figure 24-2. SFO Airport Monthly Nitrogen Loads**

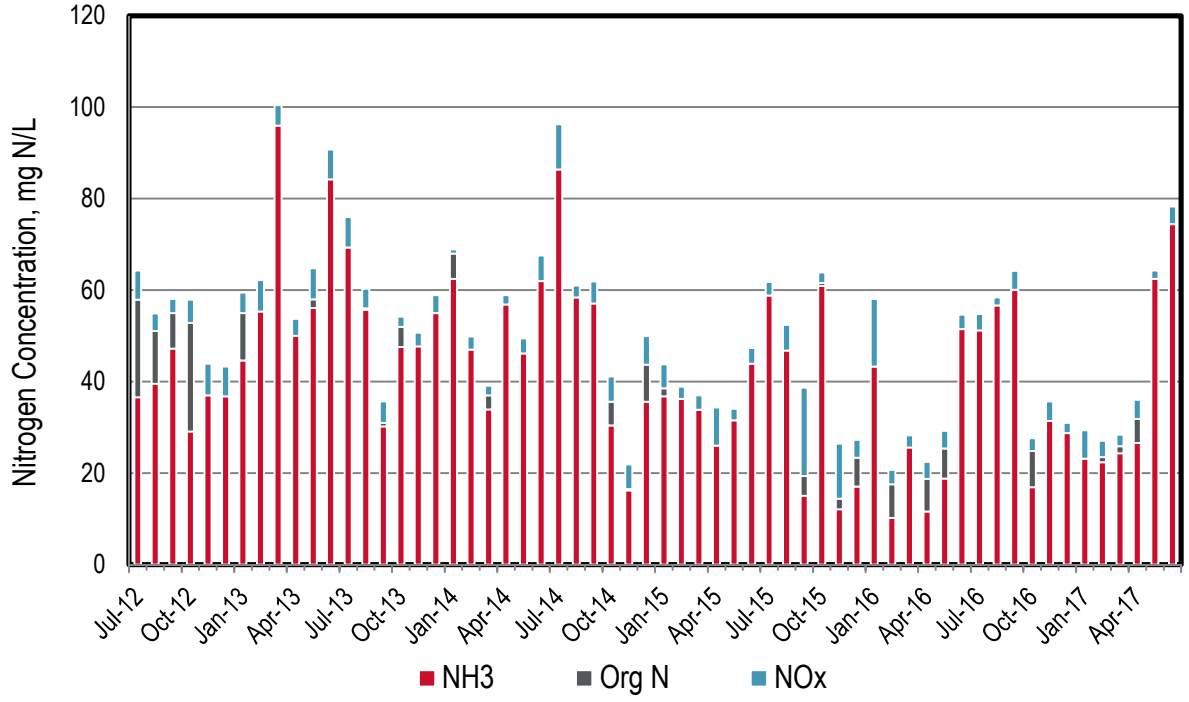


**Figure 24-3. SFO Airport Monthly Nitrogen Concentrations**

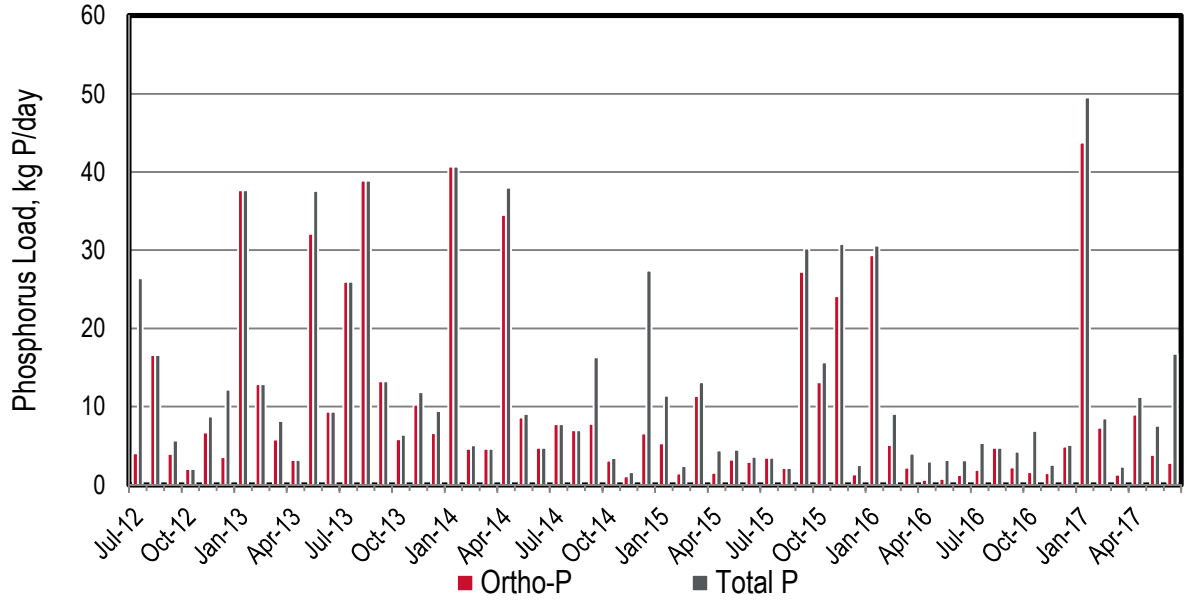


**Figure 24-4. SFO Airport Monthly Phosphorus Loads**

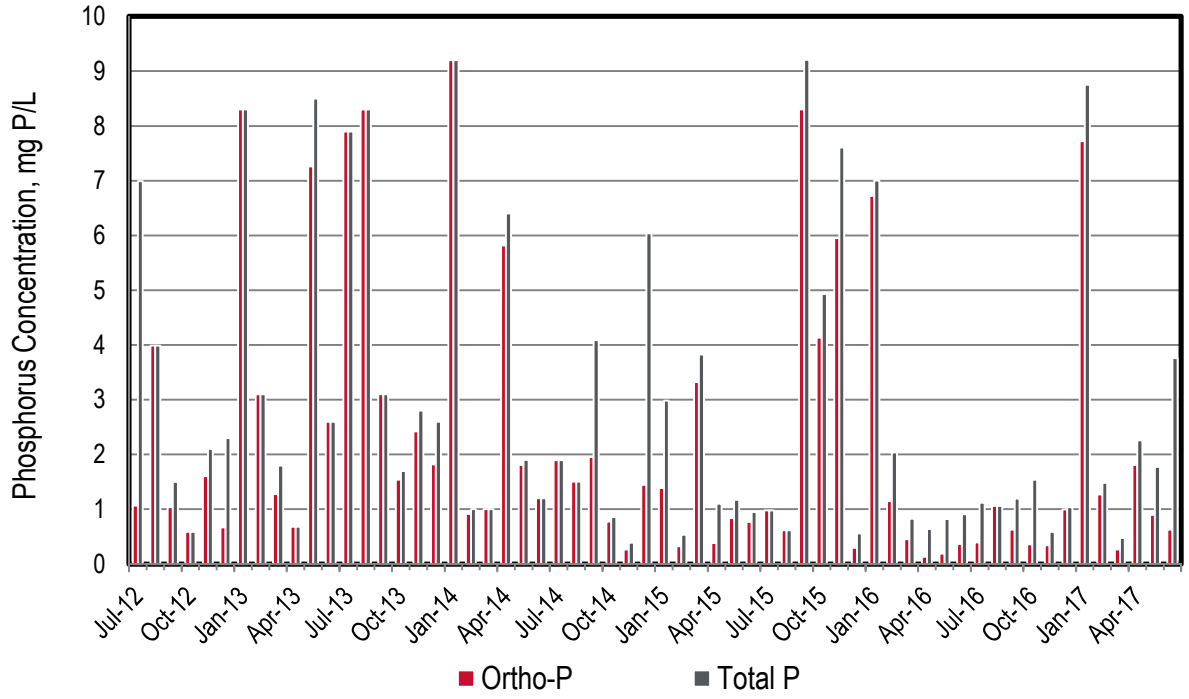


**Figure 24-5. SFO Airport Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 24-1. SFO Airport Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 1.0 | 138 | 219 | 24 | 243 | 4 | 26 |
| Aug-12 | 1.1 | 164 | 212 | 16 | 228 | 25 | 17 |
| Sep-12 | 1.0 | 178 | 208 | 12 | 219 | 4 | 6 |
| Oct-12 | 0.9 | 99 | 180 | 17 | 197 | 8 | 2 |
| Nov-12 | 1.1 | 154 | 154 | 29 | 183 | 7 | 9 |
| Dec-12 | 1.4 | 195 | 191 | 34 | 225 | 4 | 12 |
| Jan-13 | 1.2 | 202 | 249 | 20 | 270 | 43 | 38 |
| Feb-13 | 1.1 | 230 | 175 | 29 | 203 | 25 | 13 |
| Mar-13 | 1.2 | 435 | 227 | 20 | 247 | 6 | 8 |
| Apr-13 | 1.2 | 234 | 216 | 18 | 233 | 4 | 3 |
| May-13 | 1.2 | 248 | 257 | 30 | 287 | 32 | 38 |
| Jun-13 | 1.0 | 302 | 273 | 23 | 296 | 12 | 9 |
| Jul-13 | 0.9 | 228 | 178 | 22 | 200 | 48 | 26 |
| Aug-13 | 1.2 | 261 | 262 | 20 | 283 | 57 | 39 |
| Sep-13 | 1.1 | 129 | 132 | 20 | 152 | 17 | 13 |
| Oct-13 | 1.0 | 180 | 197 | 8 | 205 | 6 | 6 |
| Nov-13 | 1.1 | 202 | 195 | 13 | 208 | 10 | 12 |
| Dec-13 | 1.0 | 200 | 181 | 14 | 196 | 7 | 9 |
| Jan-14 | 1.2 | 276 | 301 | 4 | 305 | 41 | 41 |
| Feb-14 | 1.3 | 238 | 223 | 15 | 238 | 5 | 5 |
| Mar-14 | 1.2 | 156 | 171 | 10 | 180 | 6 | 5 |
| Apr-14 | 1.6 | 338 | 309 | 12 | 321 | 35 | 38 |
| May-14 | 1.3 | 220 | 195 | 16 | 211 | 9 | 9 |
| Jun-14 | 1.0 | 244 | 142 | 22 | 163 | 6 | 5 |
| Jul-14 | 1.1 | 352 | 285 | 40 | 326 | 13 | 8 |
| Aug-14 | 1.2 | 270 | 177 | 12 | 189 | 11 | 7 |
| Sep-14 | 1.1 | 228 | 200 | 19 | 220 | 8 | 16 |
| Oct-14 | 1.1 | 121 | 141 | 22 | 163 | 3 | 3 |
| Nov-14 | 1.1 | 67 | 68 | 22 | 90 | 1 | 2 |
| Dec-14 | 1.2 | 162 | 198 | 28 | 226 | 7 | 27 |
| Jan-15 | 1.0 | 141 | 147 | 20 | 167 | 5 | 11 |
| Feb-15 | 1.2 | 162 | 108 | 12 | 120 | 1 | 2 |
| Mar-15 | 0.9 | 116 | 108 | 11 | 119 | 11 | 13 |
| Apr-15 | 1.1 | 104 | 85 | 33 | 119 | 2 | 4 |
| May-15 | 1.0 | 121 | 99 | 10 | 108 | 3 | 5 |
| Jun-15 | 1.0 | 166 | 137 | 13 | 150 | 3 | 4 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 0.9 | 207 | 95 | 10 | 106 | 3 | 3 |
| Aug-15 | 0.9 | 165 | 110 | 20 | 130 | 3 | 2 |
| Sep-15 | 0.9 | 49 | 64 | 63 | 127 | 27 | 30 |
| Oct-15 | 0.8 | 194 | 196 | 7 | 203 | 13 | 16 |
| Nov-15 | 1.1 | 49 | 58 | 49 | 107 | 24 | 31 |
| Dec-15 | 1.2 | 77 | 105 | 18 | 123 | 1 | 3 |
| Jan-16 | 1.2 | 189 | 167 | 65 | 232 | 29 | 31 |
| Feb-16 | 1.2 | 45 | 78 | 14 | 92 | 5 | 9 |
| Mar-16 | 1.3 | 124 | 80 | 13 | 93 | 2 | 4 |
| Apr-16 | 1.2 | 53 | 86 | 17 | 103 | 1 | 3 |
| May-16 | 1.0 | 73 | 99 | 15 | 114 | 1 | 3 |
| Jun-16 | 0.9 | 178 | 97 | 11 | 108 | 1 | 3 |
| Jul-16 | 1.3 | 244 | 167 | 17 | 184 | 2 | 5 |
| Aug-16 | 1.2 | 253 | 189 | 8 | 197 | 7 | 5 |
| Sep-16 | 0.9 | 212 | 165 | 15 | 180 | 2 | 4 |
| Oct-16 | 1.2 | 76 | 111 | 13 | 124 | 2 | 7 |
| Nov-16 | 1.2 | 137 | 113 | 19 | 131 | 1 | 3 |
| Dec-16 | 1.3 | 141 | 110 | 11 | 121 | 5 | 5 |
| Jan-17 | 1.5 | 131 | 120 | 35 | 156 | 44 | 50 |
| Feb-17 | 1.5 | 128 | 134 | 21 | 155 | 7 | 8 |
| Mar-17 | 1.3 | 117 | 125 | 12 | 137 | 1 | 2 |
| Apr-17 | 1.3 | 132 | 158 | 21 | 179 | 9 | 11 |
| May-17 | 1.1 | 267 | 156 | 8 | 164 | 4 | 8 |
| Jun-17 | 1.2 | 332 | 172 | 17 | 189 | 3 | 17 |
| | | | | | | | |
| **Dry Season Average** | **1.1** | **209** | **172** | **19** | **191** | **12** | **12** |
| **Dry Season Trend **** | **None** | **None** | **Down** | **None** | **Down** | **-** | **Down** |
| **Wet Season Average** | **1.2** | **160** | **156** | **20** | **176** | **11** | **13** |
| **Average Annual** | **1.1** | **181** | **163** | **20** | **182** | **11** | **14** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 25 SFPUC Southeast Plant

SFPUC has a combined collection system, discharges to the South Bay, and serves approximately 450,000 service connections. The plant has a permitted ADWF capacity of 85.4 mgd and a peak wet weather capacity of 250 mgd (150 mgd secondary, 100 mgd primary). The plant currently flows at approximately 54 mgd ADWF and performs secondary treatment using a high purity oxygen system.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly loads since 2012, there appears to be a dry season upward trend for nitrogen species (except NOx).
- Ammonia and Total Nitrogen loads do not always increase with elevated flows typically associated with rain events during the wet season.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This is expected because this plant does not nitrify.
- Reported Ortho-P values were frequently greater than TP values prior to January 2015. This is attributed to a combination of the sampling methodology as discussed in the main report body and SFPUC began using Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) for TP detection. For such instances in Figure 25-4 and Figure 25-5, ortho-P values were set equal to TP. In Table 25-1, the reported ortho-P values were used for the data table.

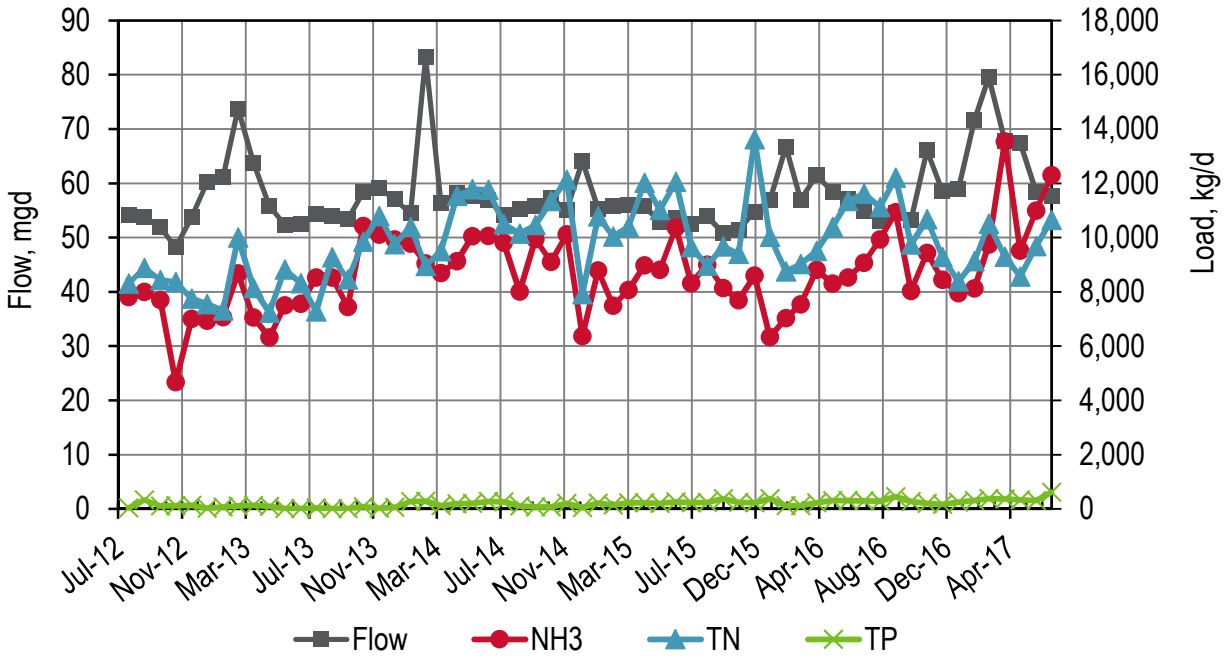


**Figure 25-1. SFPUC Southeast Monthly Flows and Loads**

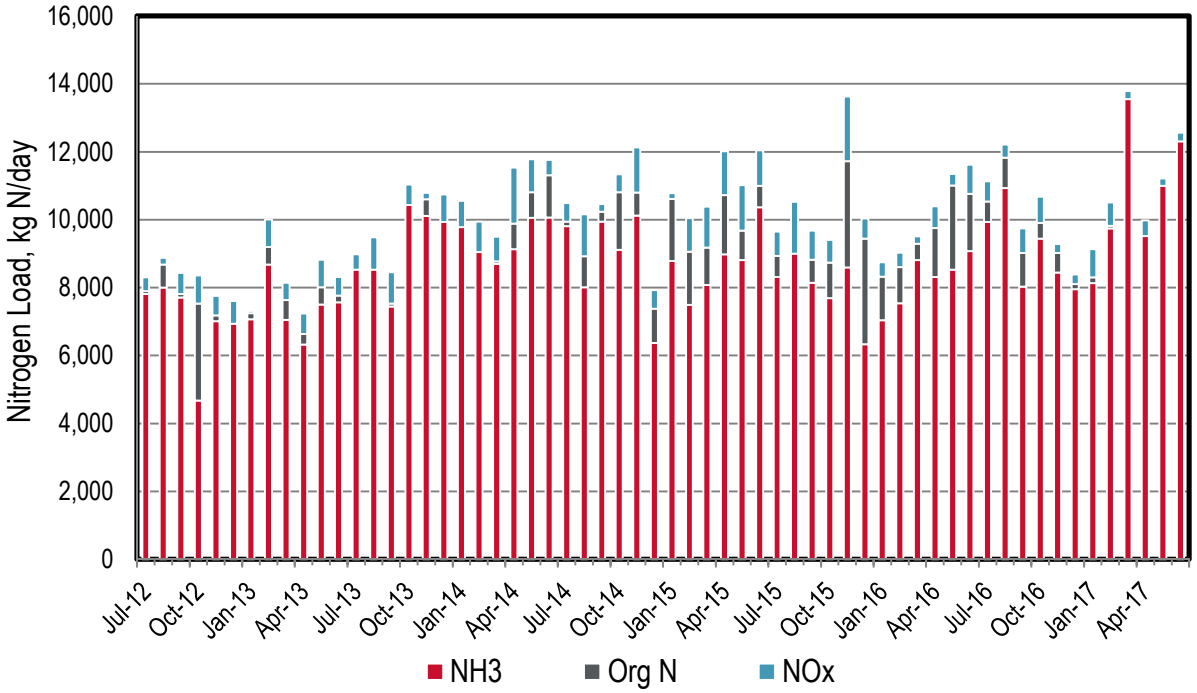


**Figure 25-2. SFPUC Southeast Monthly Nitrogen Loads**

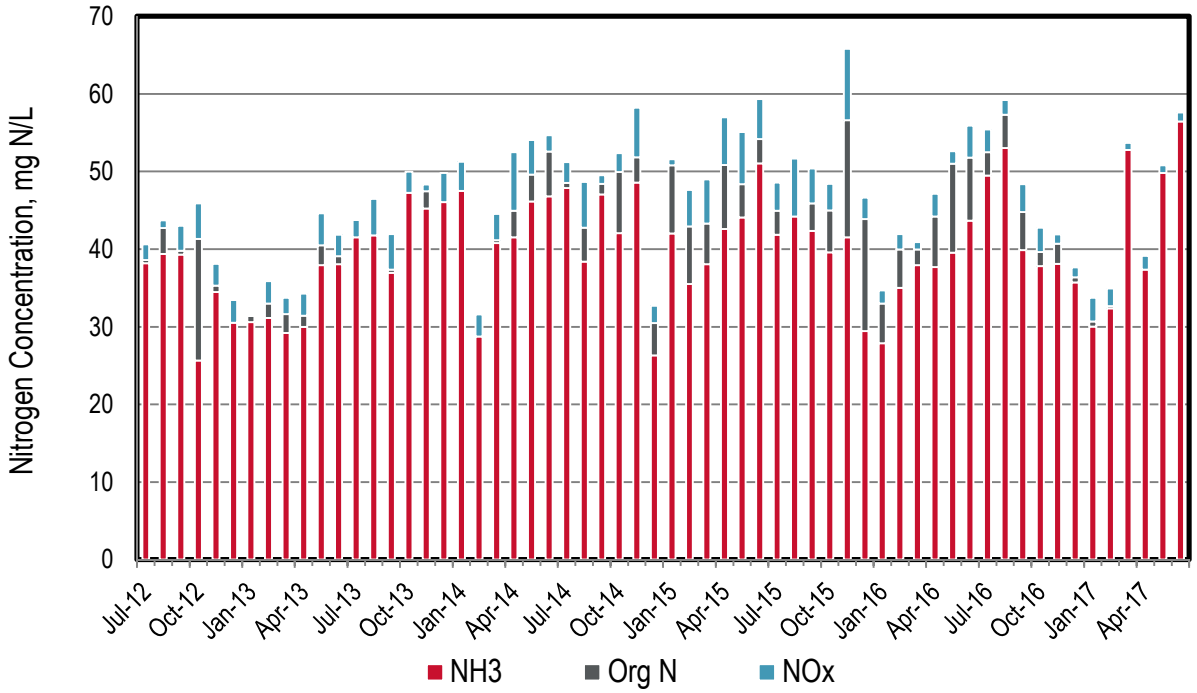


**Figure 25-3. SFPUC Southeast Monthly Nitrogen Concentrations**

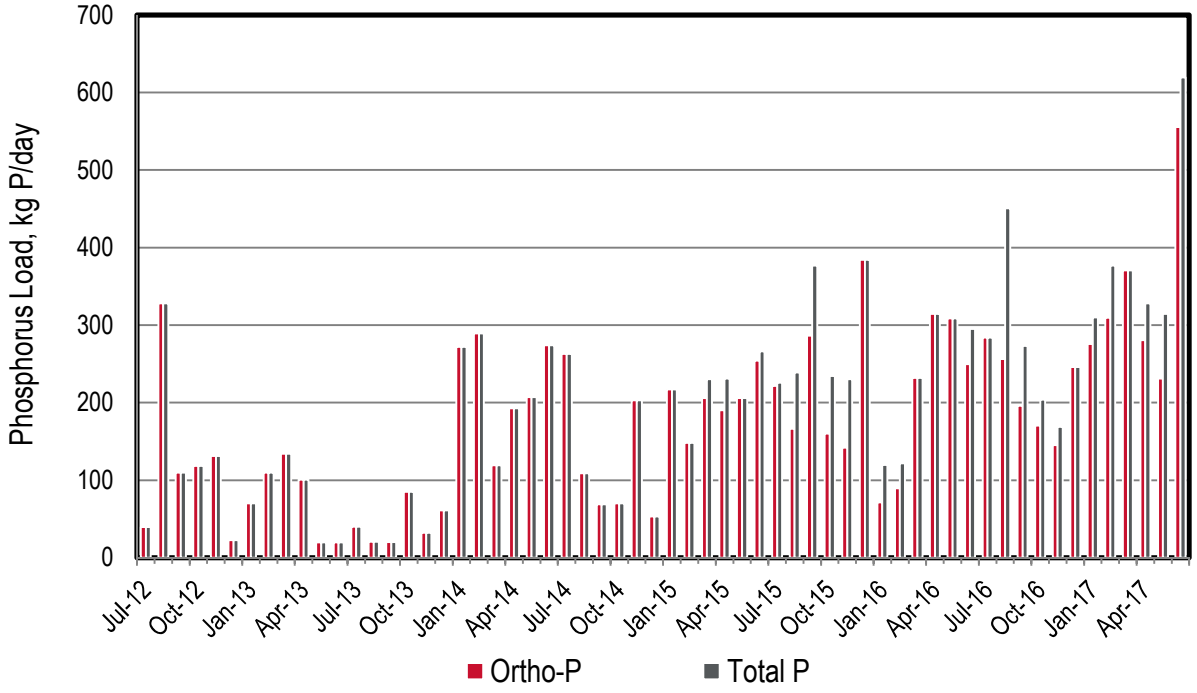


**Figure 25-4. SFPUC Southeast Monthly Phosphorus Loads**

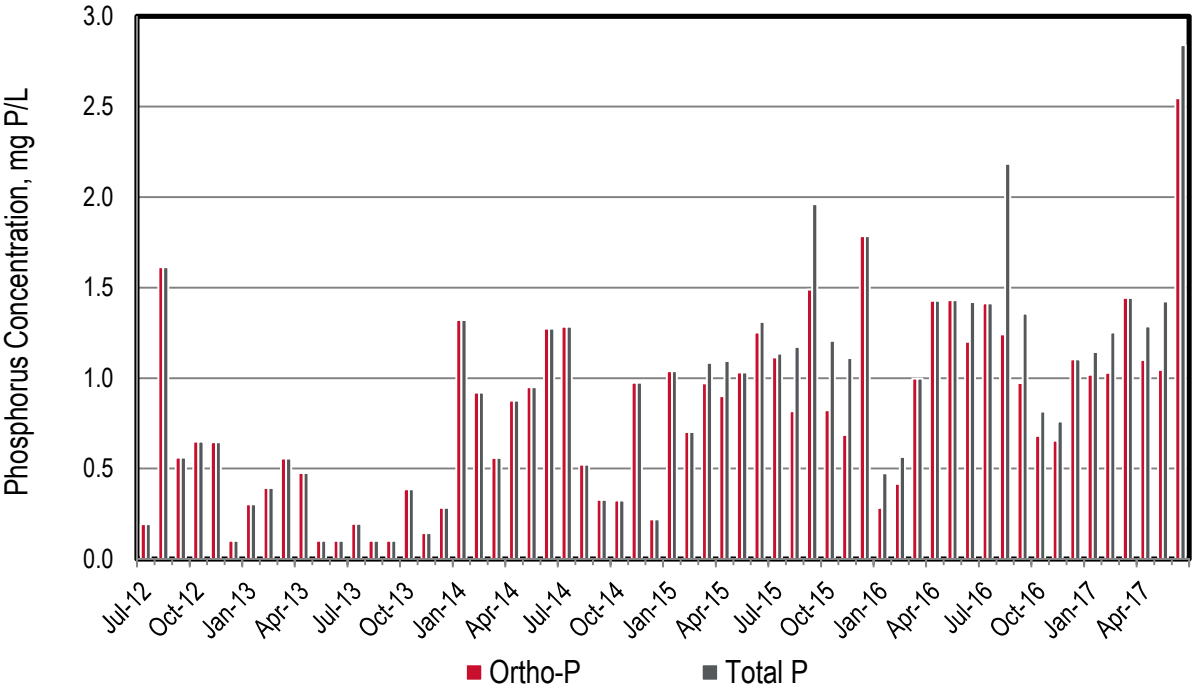


**Figure 25-5. SFPUC Southeast Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 25-1. SFPUC Southeast Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 54.1 | 7,812 | 7,897 | 406 | 8,302 | 231 | 40 |
| Aug-12 | 53.8 | 7,999 | 8,677 | 201 | 8,878 | 831 | 328 |
| Sep-12 | 51.9 | 7,707 | 7,808 | 627 | 8,436 | 304 | 110 |
| Oct-12 | 48.2 | 4,674 | 7,529 | 832 | 8,362 | 295 | 118 |
| Nov-12 | 53.8 | 7,009 | 7,182 | 570 | 7,752 | 560 | 131 |
| Dec-12 | 60.2 | 6,939 | 6,882 | 663 | 7,545 | 173 | 23 |
| Jan-13 | 61.1 | 7,070 | 7,244 | 65 | 7,309 | 244 | 70 |
| Feb-13 | 73.8 | 8,683 | 9,196 | 810 | 10,006 | 324 | 110 |
| Mar-13 | 63.8 | 7,050 | 7,633 | 506 | 8,139 | 308 | 134 |
| Apr-13 | 55.9 | 6,327 | 6,635 | 600 | 7,235 | 234 | 100 |
| May-13 | 52.3 | 7,498 | 8,008 | 813 | 8,820 | 356 | 20 |
| Jun-13 | 52.6 | 7,563 | 7,764 | 550 | 8,314 | 215 | 20 |
| Jul-13 | 54.3 | 8,526 | 6,828 | 451 | 7,279 | 688 | 40 |
| Aug-13 | 54.0 | 8,528 | 8,321 | 956 | 9,277 | 288 | 20 |
| Sep-13 | 53.4 | 7,449 | 7,534 | 920 | 8,453 | 200 | 20 |
| Oct-13 | 58.4 | 10,433 | 9,255 | 600 | 9,855 | 131 | 85 |
| Nov-13 | 59.1 | 10,107 | 10,598 | 194 | 10,793 | 132 | 32 |
| Dec-13 | 57.1 | 9,935 | 8,947 | 804 | 9,752 | 147 | 61 |
| Jan-14 | 54.5 | 9,785 | 9,622 | 769 | 10,391 | 359 | 272 |
| Feb-14 | 83.2 | 9,043 | 8,064 | 895 | 8,959 | 446 | 289 |
| Mar-14 | 56.4 | 8,698 | 8,769 | 726 | 9,494 | 228 | 119 |
| Apr-14 | 58.2 | 9,129 | 9,882 | 1,653 | 11,535 | 307 | 192 |
| May-14 | 57.7 | 10,053 | 10,806 | 973 | 11,779 | 349 | 207 |
| Jun-14 | 56.9 | 10,067 | 11,306 | 452 | 11,758 | 478 | 274 |
| Jul-14 | 54.2 | 9,809 | 9,943 | 549 | 10,496 | 287 | 263 |
| Aug-14 | 55.2 | 8,006 | 8,926 | 1,230 | 10,149 | 161 | 109 |
| Sep-14 | 55.9 | 9,944 | 10,229 | 235 | 10,462 | 152 | 69 |
| Oct-14 | 57.3 | 9,109 | 10,811 | 528 | 11,343 | 159 | 70 |
| Nov-14 | 55.1 | 10,118 | 10,796 | 1,328 | 12,121 | 203 | 203 |
| Dec-14 | 64.1 | 6,373 | 7,381 | 544 | 7,915 | 119 | 53 |
| Jan-15 | 55.3 | 8,784 | 10,614 | 168 | 10,782 | 222 | 217 |
| Feb-15 | 55.8 | 7,491 | 9,052 | 997 | 10,044 | 205 | 148 |
| Mar-15 | 56.1 | 8,073 | 9,177 | 1,207 | 10,388 | 206 | 230 |
| Apr-15 | 55.8 | 8,980 | 10,723 | 1,295 | 12,022 | 190 | 231 |
| May-15 | 52.9 | 8,814 | 9,675 | 1,339 | 11,017 | 206 | 206 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 53.7 | 10,365 | 10,995 | 1,052 | 12,052 | 254 | 266 |
| Jul-15 | 52.6 | 8,313 | 8,933 | 714 | 9,647 | 221 | 226 |
| Aug-15 | 53.9 | 9,002 | 7,437 | 1,525 | 8,961 | 166 | 239 |
| Sep-15 | 50.8 | 8,138 | 8,821 | 856 | 9,678 | 286 | 377 |
| Oct-15 | 51.4 | 7,687 | 8,738 | 668 | 9,406 | 160 | 234 |
| Nov-15 | 54.8 | 8,599 | 11,727 | 1,900 | 13,627 | 142 | 230 |
| Dec-15 | 56.9 | 6,337 | 9,441 | 591 | 10,031 | 405 | 384 |
| Jan-16 | 66.7 | 7,036 | 8,323 | 425 | 8,748 | 71 | 120 |
| Feb-16 | 57.0 | 7,542 | 8,602 | 427 | 9,029 | 90 | 122 |
| Mar-16 | 61.5 | 8,815 | 9,290 | 217 | 9,507 | 271 | 232 |
| Apr-16 | 58.3 | 8,309 | 9,750 | 643 | 10,393 | 401 | 315 |
| May-16 | 57.1 | 8,529 | 11,004 | 344 | 11,348 | 327 | 309 |
| Jun-16 | 55.0 | 9,070 | 10,760 | 856 | 11,616 | 250 | 295 |
| Jul-16 | 53.1 | 9,934 | 10,534 | 591 | 11,126 | 339 | 284 |
| Aug-16 | 54.6 | 10,935 | 11,824 | 388 | 12,212 | 256 | 450 |
| Sep-16 | 53.3 | 8,029 | 9,017 | 723 | 9,740 | 196 | 273 |
| Oct-16 | 66.1 | 9,442 | 9,902 | 777 | 10,679 | 170 | 204 |
| Nov-16 | 58.6 | 8,443 | 9,022 | 263 | 9,285 | 145 | 169 |
| Dec-16 | 58.9 | 7,952 | 8,101 | 287 | 8,388 | 400 | 246 |
| Jan-17 | 71.6 | 8,129 | 8,304 | 828 | 9,132 | 276 | 310 |
| Feb-17 | 79.6 | 9,740 | 9,819 | 686 | 10,505 | 310 | 377 |
| Mar-17 | 67.9 | 13,545 | 9,063 | 236 | 9,299 | 435 | 370 |
| Apr-17 | 67.5 | 9,522 | 8,105 | 458 | 8,564 | 280 | 328 |
| May-17 | 58.4 | 10,997 | 9,471 | 213 | 9,684 | 231 | 314 |
| Jun-17 | 57.7 | 12,308 | 10,395 | 253 | 10,648 | 555 | 619 |
| | | | | | | | |
| **Dry Season Average** | **54.4** | **9,016** | **9,317** | **689** | **10,005** | **313** | **215** |
| **Dry Season Trend **** | **None** | **Up** | **Up** | **None** | **Up** | **-** | **- **** |
| **Wet Season Average** | **60.6** | **8,426** | **8,977** | **690** | **9,667** | **250** | **187** |
| **Average Annual** | **58.0** | **8,672** | **9,118** | **690** | **9,808** | **276** | **198** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue. Statistical trending was not performed on TP due to the analytical methodology issue discussed in with the bullet points.

# 26 Sausalito-Marin City Sanitary District (SMCSD)

SMCSD discharges to the Central Bay. The plant has approximately 6,500 service connections and permitted capacity of 1.8 mgd ADWF. The current flows are approximately 1.1 mgd ADWF. The plant performs partial nitrification using a trickling filter.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there appears to be an emerging downward trend for flows.
- The plant has been under construction since May 2017 with upgrades to improve treatment capacity and performance. During this period, the plant has been using one of two sedimentation tanks and fixed film reactors which has compromised the overall treatment performance. As a result, no statistical trending analysis on discharge loads was performed as the May and June 2017 data is not reflective of plant treatment capacity and performance.
- Nitrogen and phosphorus loads do not appear to track with flows during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant nitrifies. A portion of ammonia bleeds through year round due to the trickling filters inability to reliably remove all the ammonia.
- Ortho-P values are routinely greater than TP values due to the different nature of samples (grab vs. composite as discussed in the main report body). For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 0.8 to 6.1 mg P/L, This suggests occasional P removal as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is most likely from metal salt addition at the front of the plant with removal in the primary clarifiers.

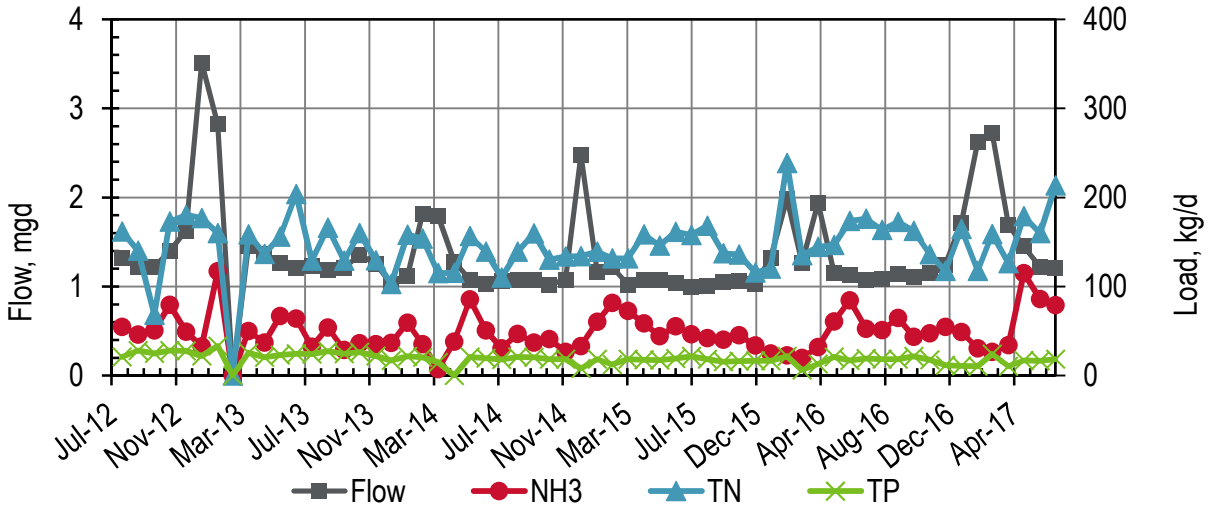


**Figure 26-1. SMCSD Monthly Flows and Loads**

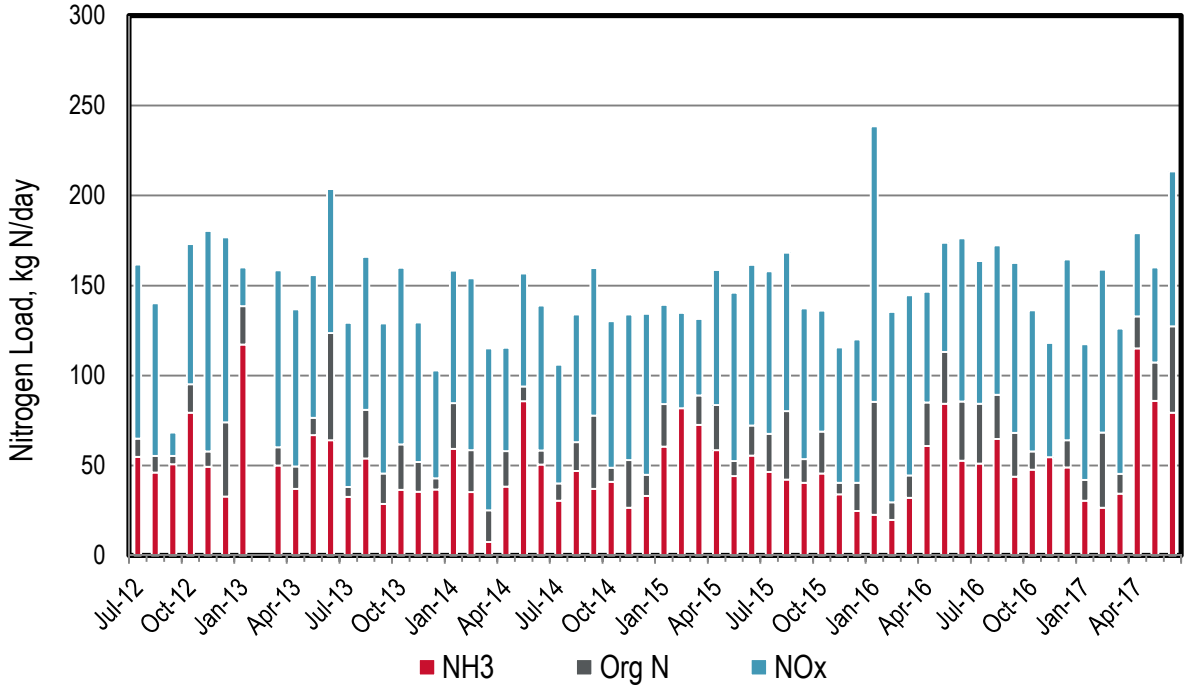


**Figure 26-2. SMCSD Monthly Nitrogen Loads**

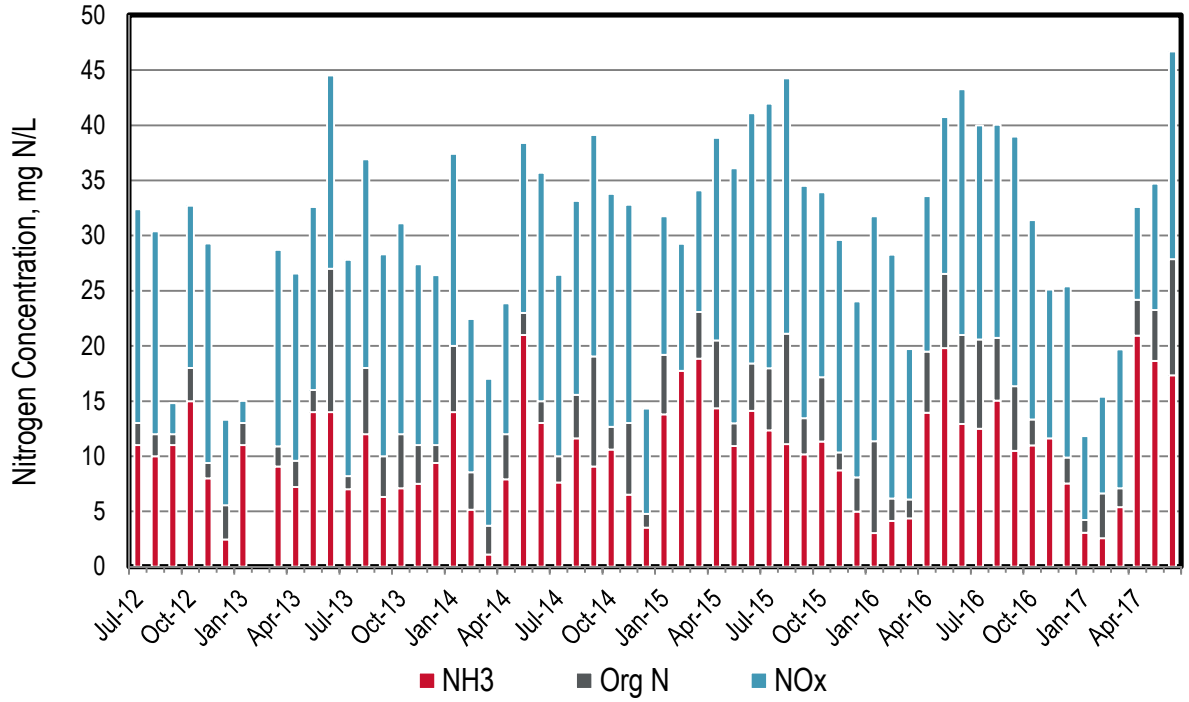


**Figure 26-3. SMCSD Monthly Nitrogen Concentrations**

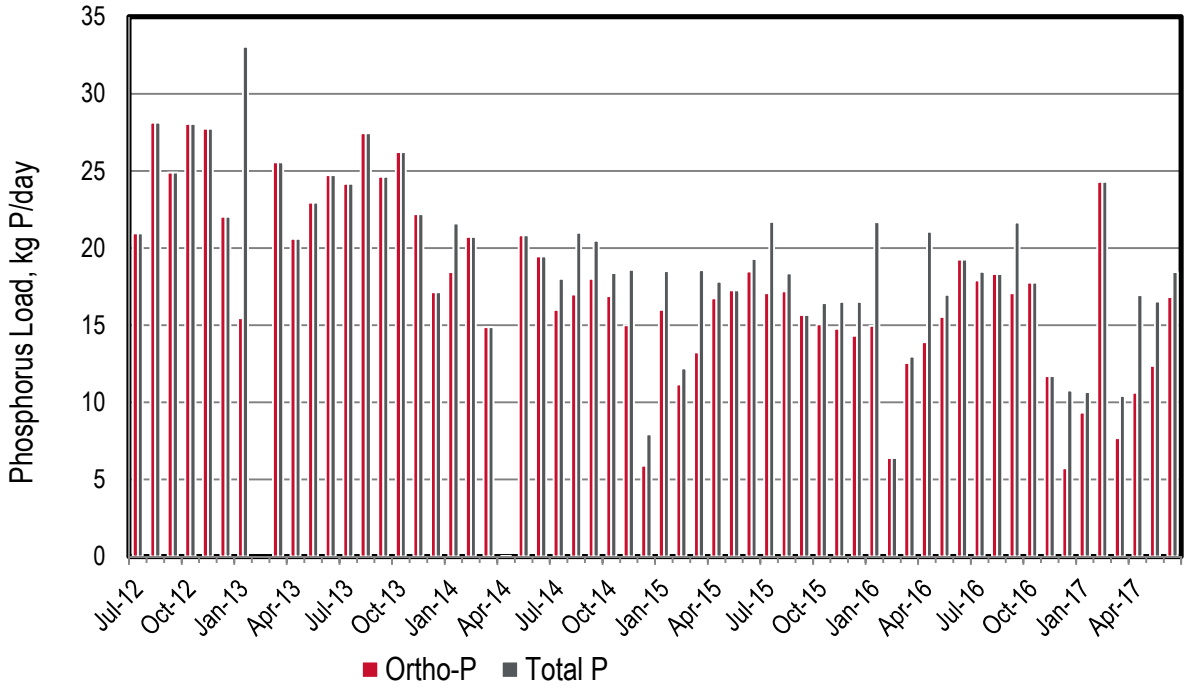


**Figure 26-4. SMCSD Monthly Phosphorus Loads**

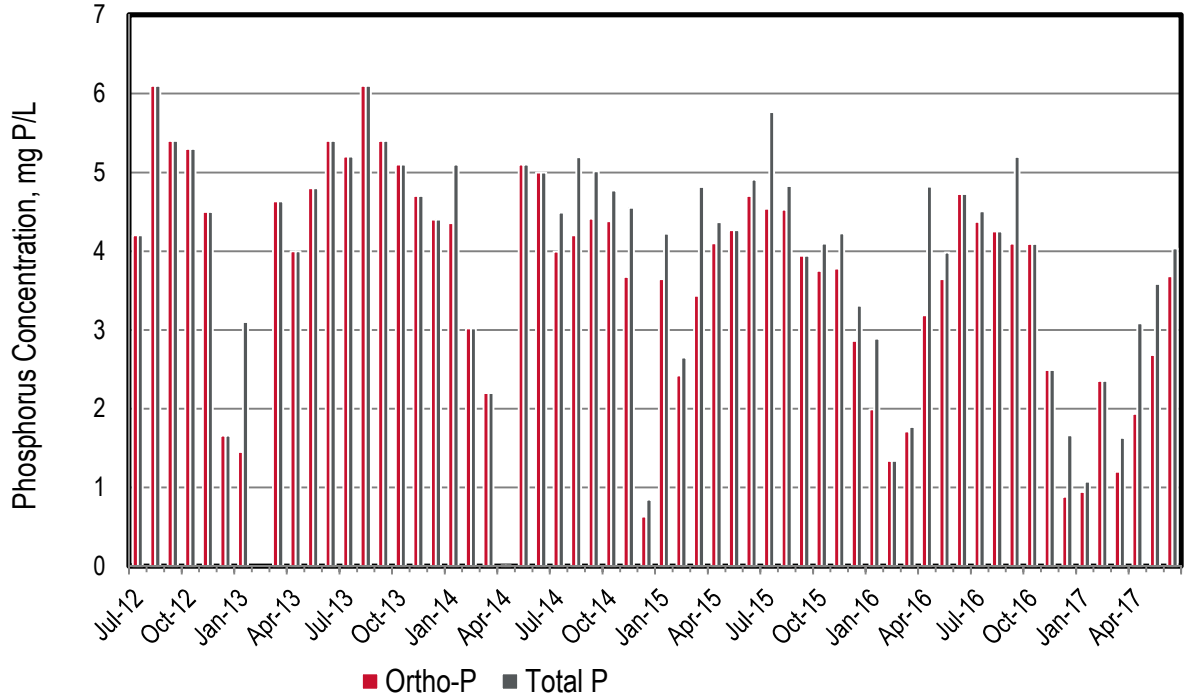


**Figure 26-5. SMCSD Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 26-1. SMCSD Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 1.3 | 55 | 65 | 97 | 162 | 36 | 21 |
| Aug-12 | 1.2 | 46 | 55 | 85 | 140 | 63 | 28 |
| Sep-12 | 1.2 | 51 | 55 | 13 | 68 | 40 | 25 |
| Oct-12 | 1.4 | 79 | 95 | 78 | 173 | 42 | 28 |
| Nov-12 | 1.6 | 49 | 58 | 122 | 180 | 63 | 28 |
| Dec-12 | 3.5 | 33 | 74 | 103 | 177 | 30 | 22 |
| Jan-13 | 2.8 | 117 | 139 | 22 | 160 | 15 | 33 |
| Feb-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mar-13 | 1.5 | 50 | 60 | 98 | 158 | 39 | 26 |
| Apr-13 | 1.4 | 37 | 49 | 87 | 137 | 29 | 21 |
| May-13 | 1.3 | 67 | 77 | 79 | 156 | 36 | 23 |
| Jun-13 | 1.2 | 64 | 124 | 80 | 204 | 67 | 25 |
| Jul-13 | 1.2 | 33 | 38 | 91 | 129 | 55 | 24 |
| Aug-13 | 1.2 | 54 | 81 | 85 | 166 | 56 | 27 |
| Sep-13 | 1.2 | 29 | 46 | 83 | 129 | 69 | 25 |
| Oct-13 | 1.4 | 36 | 62 | 98 | 160 | 35 | 26 |
| Nov-13 | 1.3 | 35 | 52 | 77 | 129 | 35 | 22 |
| Dec-13 | 1.0 | 37 | 43 | 60 | 103 | 32 | 17 |
| Jan-14 | 1.1 | 59 | 85 | 74 | 158 | 18 | 22 |
| Feb-14 | 1.8 | 35 | 59 | 95 | 154 | 29 | 21 |
| Mar-14 | 1.8 | 7 | 25 | 90 | 115 | 16 | 15 |
| Apr-14 | 1.3 | 38 | 58 | 57 | 115 | 25 | 0 |
| May-14 | 1.1 | 86 | 94 | 63 | 157 | 37 | 21 |
| Jun-14 | 1.0 | 51 | 58 | 81 | 139 | 33 | 19 |
| Jul-14 | 1.1 | 31 | 40 | 66 | 110 | 16 | 18 |
| Aug-14 | 1.1 | 47 | 63 | 71 | 139 | 17 | 21 |
| Sep-14 | 1.1 | 37 | 78 | 82 | 160 | 18 | 20 |
| Oct-14 | 1.0 | 41 | 49 | 81 | 130 | 17 | 18 |
| Nov-14 | 1.1 | 27 | 53 | 81 | 134 | 15 | 19 |
| Dec-14 | 2.5 | 33 | 45 | 89 | 134 | 6 | 8 |
| Jan-15 | 1.2 | 60 | 84 | 55 | 139 | 16 | 19 |
| Feb-15 | 1.2 | 82 | 78 | 53 | 132 | 11 | 12 |
| Mar-15 | 1.0 | 73 | 89 | 43 | 131 | 13 | 19 |
| Apr-15 | 1.1 | 59 | 84 | 75 | 159 | 17 | 18 |
| May-15 | 1.1 | 44 | 53 | 93 | 146 | 19 | 17 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 1.0 | 55 | 72 | 89 | 162 | 18 | 19 |
| Jul-15 | 1.0 | 46 | 68 | 90 | 158 | 17 | 22 |
| Aug-15 | 1.0 | 42 | 80 | 88 | 168 | 17 | 18 |
| Sep-15 | 1.1 | 40 | 54 | 84 | 137 | 17 | 16 |
| Oct-15 | 1.1 | 45 | 69 | 67 | 136 | 15 | 16 |
| Nov-15 | 1.0 | 34 | 40 | 75 | 116 | 15 | 17 |
| Dec-15 | 1.3 | 25 | 40 | 80 | 120 | 14 | 17 |
| Jan-16 | 2.0 | 23 | 85 | 153 | 239 | 15 | 22 |
| Feb-16 | 1.3 | 20 | 30 | 106 | 135 | 7 | 6 |
| Mar-16 | 1.9 | 32 | 45 | 100 | 145 | 13 | 13 |
| Apr-16 | 1.2 | 61 | 85 | 62 | 147 | 14 | 21 |
| May-16 | 1.1 | 84 | 113 | 61 | 174 | 16 | 17 |
| Jun-16 | 1.1 | 53 | 86 | 91 | 176 | 19 | 19 |
| Jul-16 | 1.1 | 51 | 84 | 79 | 164 | 18 | 18 |
| Aug-16 | 1.1 | 65 | 89 | 83 | 172 | 18 | 18 |
| Sep-16 | 1.1 | 44 | 68 | 94 | 163 | 17 | 22 |
| Oct-16 | 1.1 | 48 | 58 | 78 | 136 | 19 | 18 |
| Nov-16 | 1.2 | 55 | 54 | 64 | 118 | 14 | 12 |
| Dec-16 | 1.7 | 49 | 64 | 101 | 165 | 6 | 11 |
| Jan-17 | 2.6 | 31 | 42 | 75 | 117 | 9 | 11 |
| Feb-17 | 2.7 | 27 | 68 | 90 | 159 | 40 | 24 |
| Mar-17 | 1.7 | 34 | 45 | 81 | 126 | 8 | 10 |
| Apr-17 | 1.5 | 115 | 133 | 46 | 179 | 11 | 17 |
| May-17 *** | 1.2 *** | 86 *** | 107 *** | 53 *** | 160 *** | 12 *** | 17 *** |
| Jun-17 *** | 1.2 *** | 79 *** | 127 *** | 86 *** | 213 *** | 17*** | 18 *** |
| | | | | | | | |
| **Dry Season Average** | **1.1** | **54** | **75** | **79** | **154** | **30** | **21** |
| **Dry Season Trend **** | **Down** | **--*** | **--*** | **--*** | **--*** | **--*** | **--*** |
| **Wet Season Average** | **1.5** | **45** | **63** | **78** | **140** | **20** | **17** |
| **Average Annual** | **1.4** | **49** | **68** | **78** | **146** | **24** | **19** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

*** The plant has been under construction since May 2017 with upgrades to improve treatment capacity and performance. During this period, the plant has been using one of two sedimentation tanks and fixed film reactors which has compromised the overall treatment performance. As a result, no statistical trending analysis on discharge loads was performed as the May and June 2017 data is not reflective of plant treatment capacity and performance.

# 27 Sonoma Valley County Sanitation District

Sonoma Valley discharges to Schell Slough which is connected to San Pablo Bay. The plant has approximately 17,200 service connections and a permitted capacity of 3.0 mgd ADWF. The plant has a wet weather discharge to Schell Slough at a capacity of 11 mgd. Discharge to Schell Slough is prohibited May 1 through October 31. The plant performs nitrogen removal using an activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- There are no emerging dry season trends as Sonoma Valley is prohibited from discharging to Schell Slough during the dry season. There is one exception in May 2017, where discharge was for 3 days due to the relatively wet month. Sonoma Valley is only allowed to discharge if flows entering the plant exceed 6 mgd and storage is 50 % or more full.
- Wet season trends analyzed (data not shown) and there are no emerging trends.
- There are only 17 out of 60 months in which they discharged to Schell Slough. The water was all recycled during the other months.
- Both nitrogen and phosphorus loads increase with flow during wet weather events.
- NOx is the majority of the nitrogen species discharged as would be expected since this plant fully nitrifies. The highest average monthly effluent ammonia concentration was 0.6 mg N/L.
- The plant meets Level 2 total nitrogen concentration limits (i.e., 15 mg N/L) developed under the Scoping and Evaluation Plan for all but four months. Three of these months are in the most recent year of reported data (2016-2017) due to the relatively high levels of precipitation during this most recent wet season.
- Ortho-P values are occasionally greater than TP values for the Section 13257 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value once. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations range from 1.3 to 4.5 mg P/L, which suggests a portion of P is removed as typical effluent TP concentrations are 4 to 6 mg P/L. The removal mechanism is unclear at this stage.

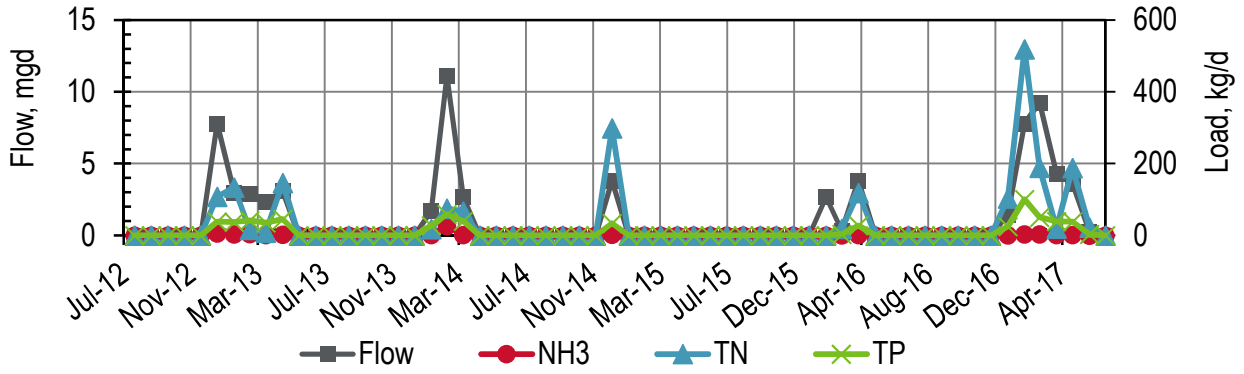


**Figure 27-1. Sonoma Valley Monthly Flows and Loads**

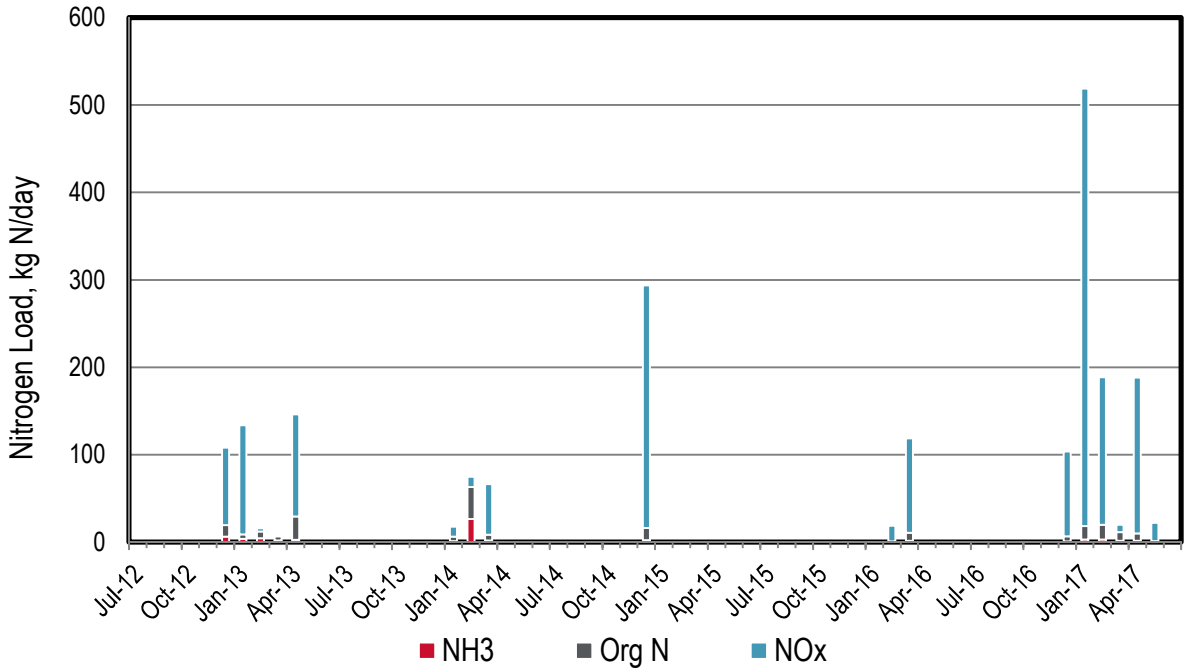


**Figure 27-2. Sonoma Valley Monthly Nitrogen Loads**

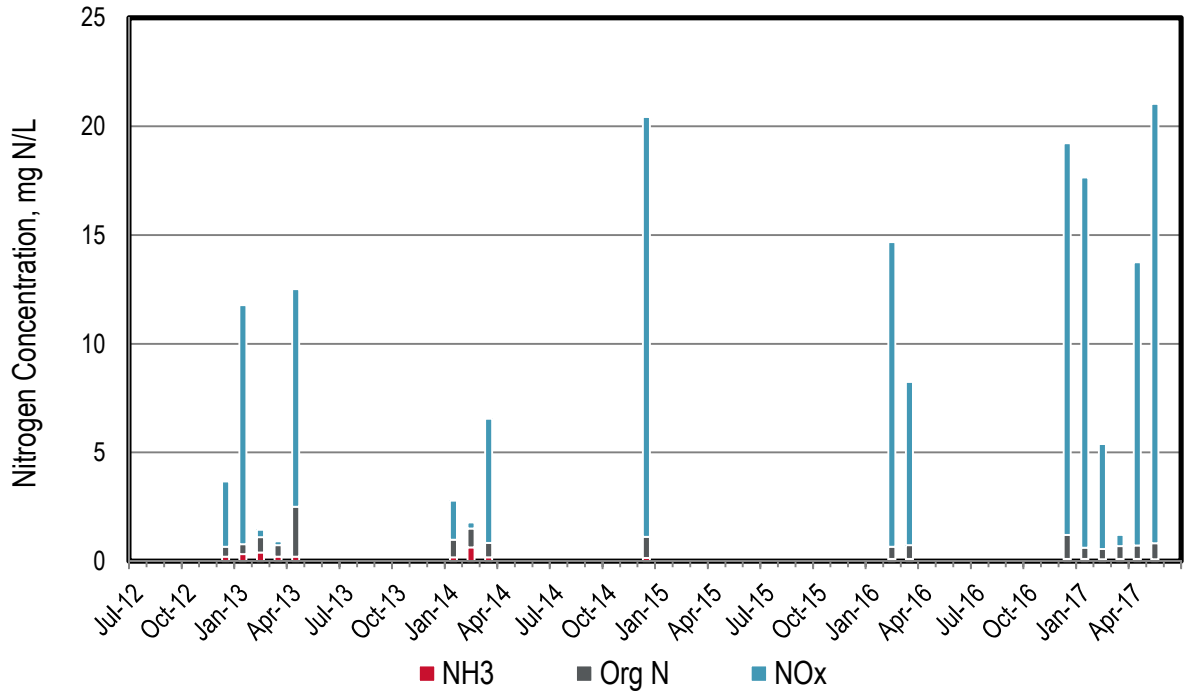


**Figure 27-3. Sonoma Valley Monthly Nitrogen Concentrations**

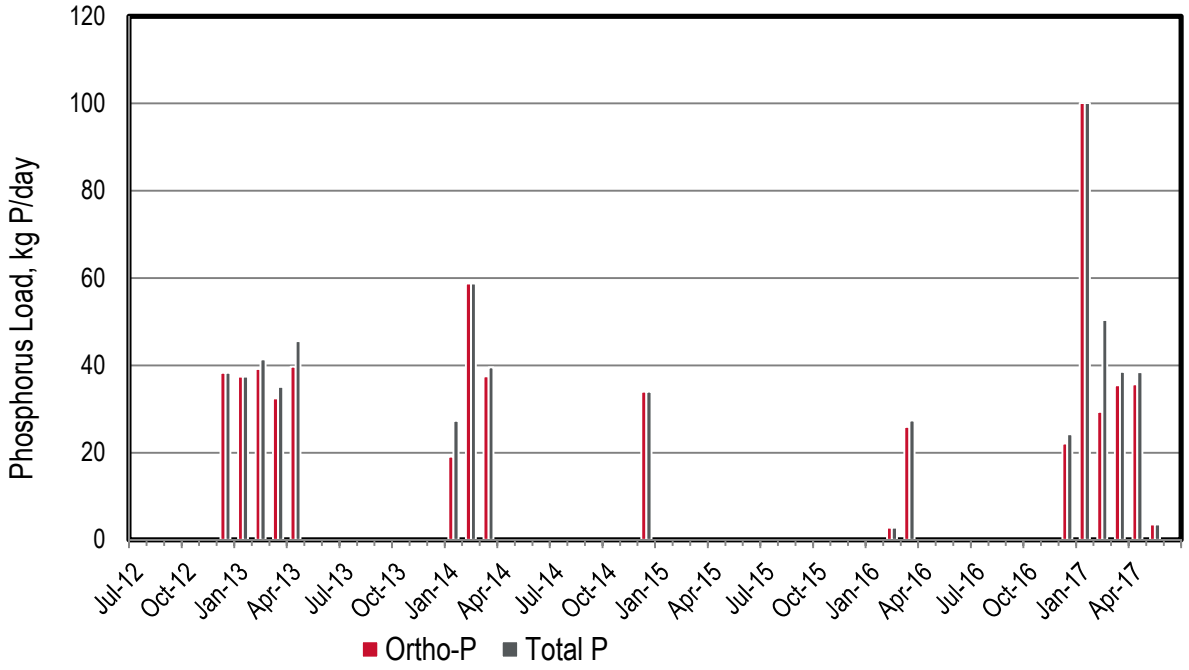


**Figure 27-4. Sonoma Valley Monthly Phosphorus Loads**

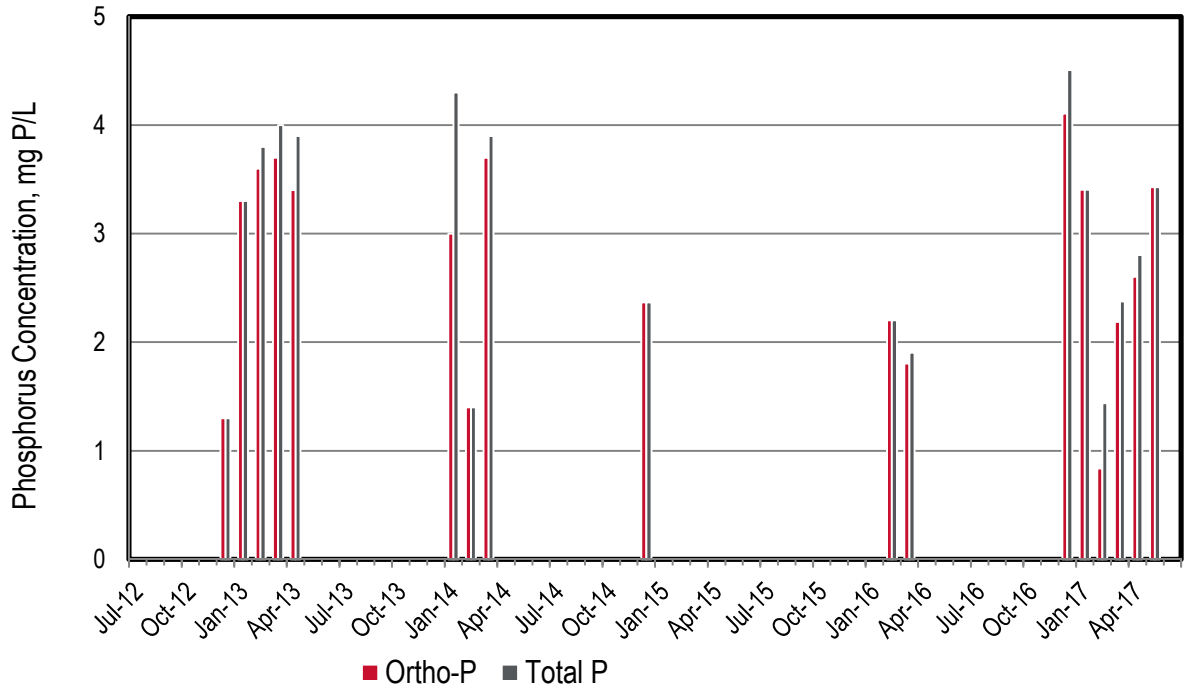


**Figure 27-5. Sonoma Valley Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 27-1. Sonoma Valley Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-12 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec-12 | 7.8 | 6 | 19 | 88 | 108 | 41 | 38 |
| Jan-13 | 3.0 | 4 | 9 | 125 | 133 | 39 | 37 |
| Feb-13 | 2.9 | 4 | 12 | 4 | 16 | 39 | 41 |
| Mar-13 | 2.3 | 2 | 6 | 2 | 8 | 32 | 35 |
| Apr-13 | 3.1 | 2 | 29 | 117 | 146 | 40 | 46 |
| May-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec-13 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jan-14 | 1.7 | 1 | 6 | 11 | 18 | 19 | 27 |
| Feb-14 | 11.1 | 26 | 63 | 12 | 75 | 63 | 59 |
| Mar-14 | 2.7 | 2 | 9 | 58 | 66 | 37 | 40 |
| Apr-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-14 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec-14 | 3.8 | 2 | 16 | 278 | 299 | 36 | 34 |
| Jan-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Feb-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mar-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Apr-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec-15 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jan-16 | 2.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| Feb-16 | 0.3 | 0 | 1 | 18 | 19 | 3 | 3 |
| Mar-16 | 3.8 | 1 | 11 | 108 | 118 | 26 | 27 |
| Apr-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| May-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jun-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jul-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Aug-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sep-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Oct-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nov-16 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Dec-16 | 1.4 | 1 | 6 | 97 | 103 | 22 | 24 |
| Jan-17 | 7.8 | 3 | 18 | 500 | 519 | 100 | 100 |
| Feb-17 | 9.3 | 3 | 20 | 169 | 189 | 29 | 50 |
| Mar-17 | 4.3 | 2 | 11 | 8 | 20 | 35 | 39 |
| Apr-17 | 3.6 | 1 | 10 | 178 | 188 | 36 | 38 |
| May-17 | 0.3 | 0 | 1 | 21 | 22 | 4 | 4 |
| Jun-17 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | |
| **Dry Season Average** | **0.0** | **0** | **0** | **1** | **1** | **0** | **0** |
| **Dry Season Trend **** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Wet Season Average** | **2.0** | **2** | **7** | **51** | **58** | **17** | **18** |
| **Average Annual** | **1.2** | **1** | **4** | **30** | **34** | **10** | **11** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 28 South San Francisco-San Bruno

South SF-San Bruno discharges to Lower San Francisco Bay (referred to as South Bay in the Group Annual Report). The plant has a permitted capacity of 13 mgd ADWF and a peak wet weather capacity of 30 mgd, with blending above 30 mgd allowable. The current flow is approximately 7.9 mgd ADWF. The process includes a conventional activated sludge system.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, there appears to be a downward dry season trend for flows. The decrease in flows is attributed to a combination of recycled water and water conservation.
- Nitrogen loads generally increases with flow during wet weather events.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since they do not nitrify.
- Ammonia loads are occasionally greater than TN loads. This is attributed to sampling frequency, whereby ammonia is sampled daily and other nitrogen species bimonthly. During nitrogen species sampling days, ammonia values are always less than TKN and TN values.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table. This is not an issue in the most recent three reporting years.
- Total phosphorus concentrations range from 1.3 to 9 mg P/L, which suggests a portion of P might be removed as typical effluent TP concentrations are 4 to 6 mg P/L. The majority of the samples fall within the typical effluent TP concentrations though so the occasional lower concentrations might be sampling artifacts.

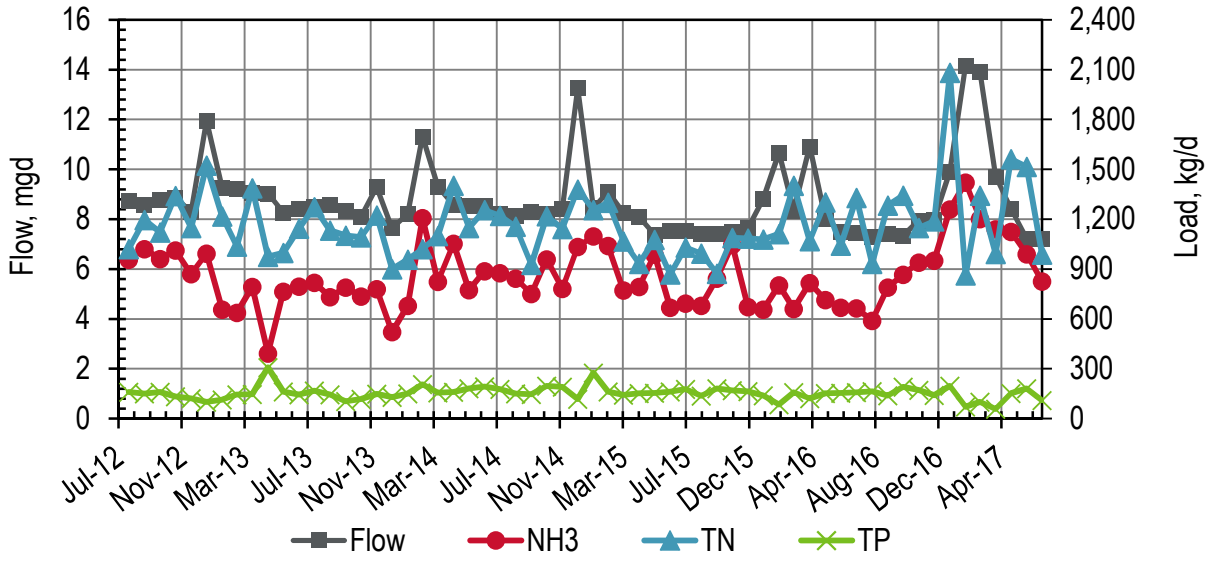


**Figure 28-1. South SF-San Bruno Monthly Flows and Loads**

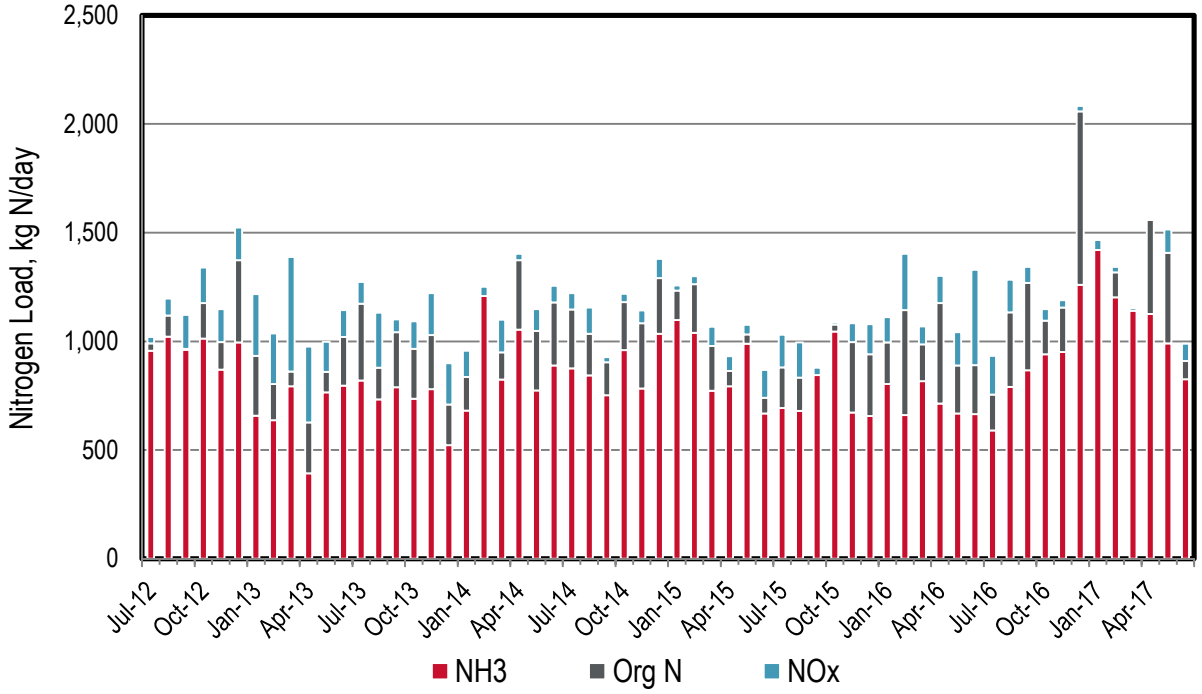


**Figure 28-2. South SF-San Bruno Monthly Nitrogen Loads**

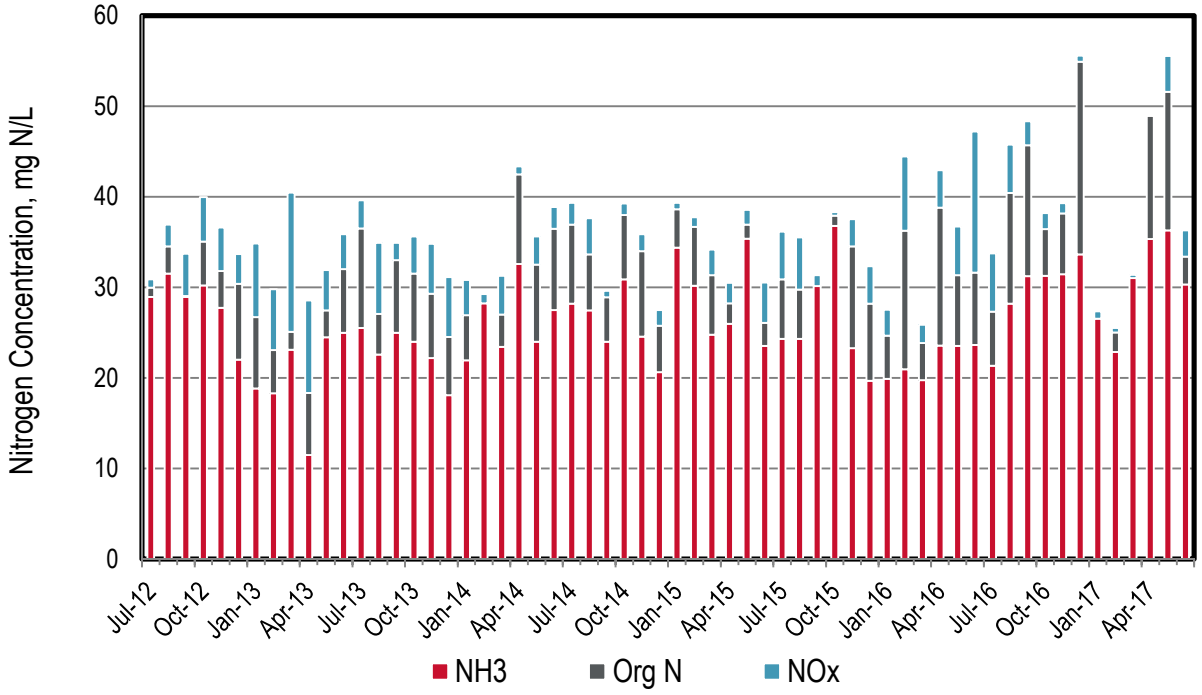


**Figure 28-3. South SF-San Bruno Monthly Nitrogen Concentrations**

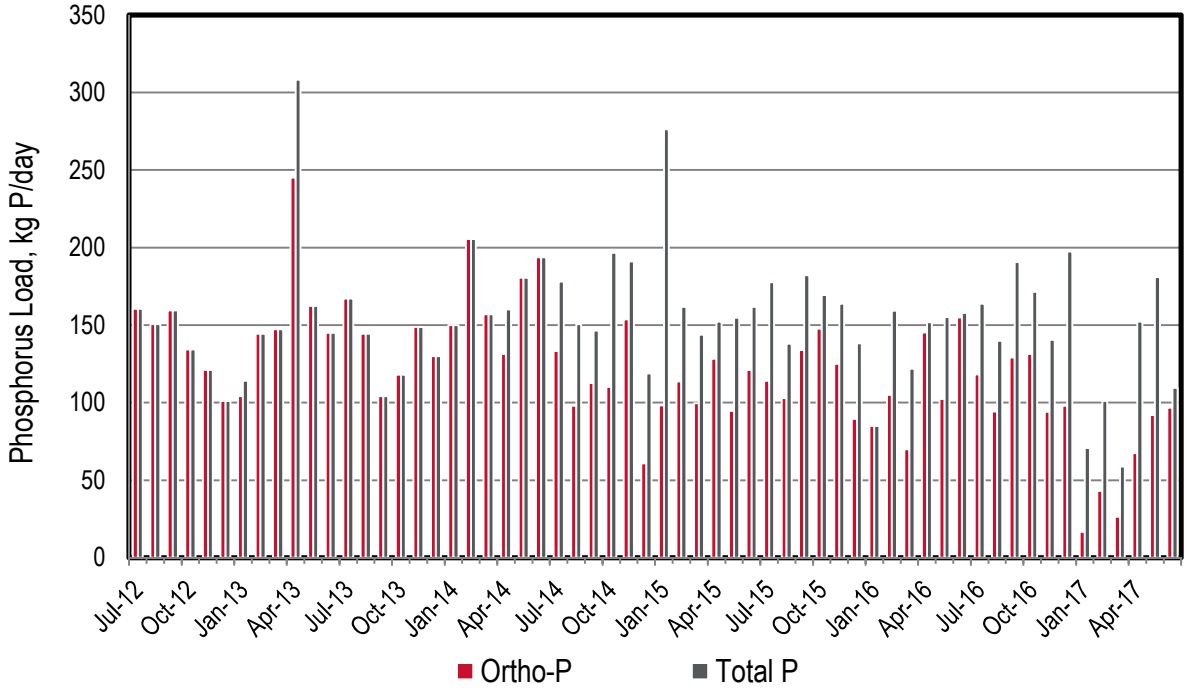


**Figure 28-4. South SF-San Bruno Monthly Phosphorus Loads**

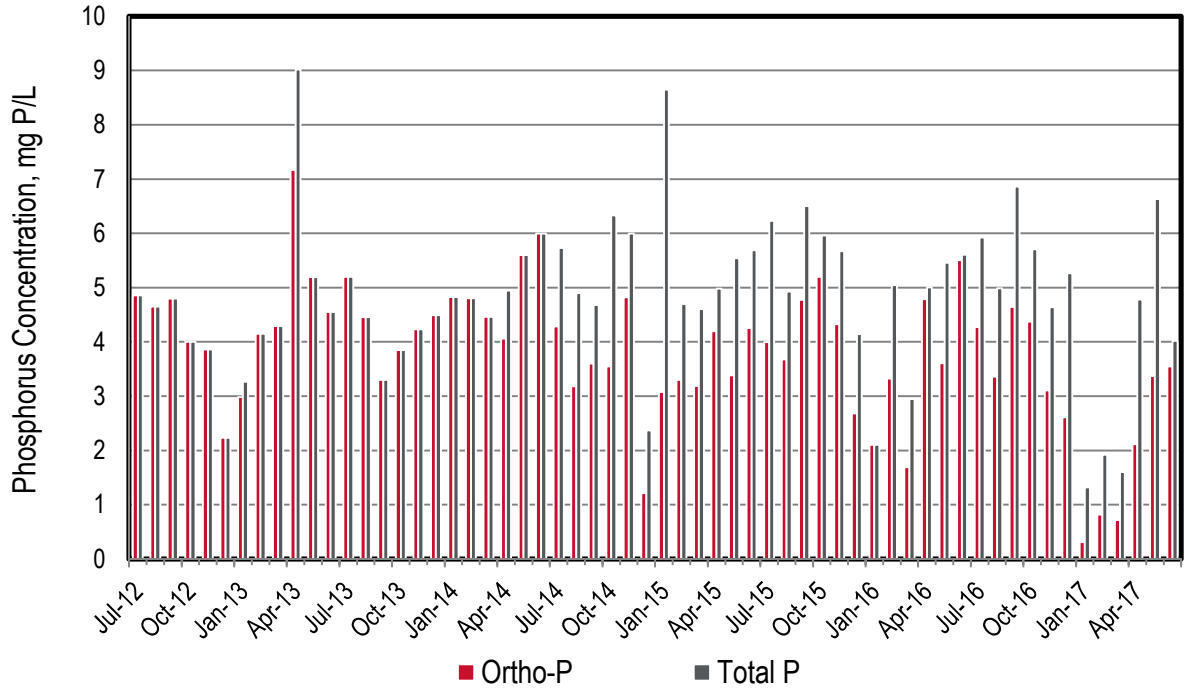


**Figure 28-5. South SF-San Bruno Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 28-1. South SF-San Bruno Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 8.7 | 957 | 990 | 30 | 1,020 | 182 | 161 |
| Aug-12 | 8.6 | 1,021 | 1,118 | 78 | 1,196 | 161 | 151 |
| Sep-12 | 8.8 | 962 | 965 | 156 | 1,121 | 264 | 159 |
| Oct-12 | 8.9 | 1,013 | 1,176 | 164 | 1,340 | 148 | 134 |
| Nov-12 | 8.3 | 870 | 997 | 151 | 1,148 | 161 | 121 |
| Dec-12 | 12.0 | 995 | 1,373 | 149 | 1,523 | 128 | 101 |
| Jan-13 | 9.2 | 658 | 933 | 284 | 1,217 | 104 | 114 |
| Feb-13 | 9.2 | 637 | 804 | 233 | 1,037 | 205 | 144 |
| Mar-13 | 9.1 | 793 | 860 | 527 | 1,387 | 183 | 147 |
| Apr-13 | 9.0 | 393 | 626 | 349 | 975 | 245 | 308 |
| May-13 | 8.3 | 766 | 859 | 139 | 998 | 297 | 162 |
| Jun-13 | 8.4 | 797 | 1,020 | 124 | 1,143 | 188 | 145 |
| Jul-13 | 8.5 | 820 | 1,173 | 100 | 1,273 | 194 | 167 |
| Aug-13 | 8.6 | 733 | 878 | 254 | 1,132 | 163 | 144 |
| Sep-13 | 8.4 | 789 | 1,042 | 60 | 1,101 | 150 | 104 |
| Oct-13 | 8.1 | 736 | 966 | 127 | 1,092 | 196 | 118 |
| Nov-13 | 9.3 | 779 | 1,030 | 193 | 1,223 | 255 | 149 |
| Dec-13 | 7.6 | 523 | 709 | 191 | 900 | 211 | 130 |
| Jan-14 | 8.2 | 681 | 836 | 121 | 957 | 226 | 150 |
| Feb-14 | 11.3 | 1,209 | 978 | 43 | 1,021 | 273 | 206 |
| Mar-14 | 9.3 | 824 | 950 | 150 | 1,100 | 254 | 157 |
| Apr-14 | 8.6 | 1,054 | 1,374 | 29 | 1,403 | 131 | 160 |
| May-14 | 8.5 | 774 | 1,048 | 100 | 1,148 | 275 | 181 |
| Jun-14 | 8.6 | 889 | 1,179 | 77 | 1,256 | 304 | 194 |
| Jul-14 | 8.2 | 876 | 1,147 | 74 | 1,222 | 133 | 178 |
| Aug-14 | 8.1 | 844 | 1,034 | 122 | 1,156 | 98 | 151 |
| Sep-14 | 8.3 | 752 | 904 | 23 | 927 | 113 | 147 |
| Oct-14 | 8.2 | 960 | 1,180 | 39 | 1,220 | 110 | 197 |
| Nov-14 | 8.4 | 783 | 1,083 | 60 | 1,143 | 154 | 191 |
| Dec-14 | 13.3 | 1,036 | 1,291 | 88 | 1,379 | 61 | 119 |
| Jan-15 | 8.5 | 1,098 | 1,233 | 23 | 1,257 | 98 | 276 |
| Feb-15 | 9.1 | 1,040 | 1,263 | 37 | 1,300 | 114 | 162 |
| Mar-15 | 8.3 | 774 | 979 | 88 | 1,067 | 100 | 144 |
| Apr-15 | 8.1 | 794 | 863 | 69 | 932 | 128 | 152 |
| May-15 | 7.4 | 989 | 1,031 | 45 | 1,077 | 95 | 155 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 7.5 | 669 | 741 | 127 | 868 | 121 | 162 |
| Jul-15 | 7.5 | 693 | 881 | 150 | 1,031 | 114 | 178 |
| Aug-15 | 7.4 | 680 | 834 | 161 | 995 | 103 | 138 |
| Sep-15 | 7.4 | 845 | 839 | 34 | 874 | 134 | 182 |
| Oct-15 | 7.5 | 1,045 | 1,077 | 11 | 1,088 | 148 | 169 |
| Nov-15 | 7.6 | 673 | 997 | 87 | 1,084 | 125 | 164 |
| Dec-15 | 8.8 | 657 | 941 | 137 | 1,078 | 89 | 138 |
| Jan-16 | 10.7 | 803 | 996 | 115 | 1,111 | 91 | 85 |
| Feb-16 | 8.3 | 661 | 1,144 | 258 | 1,402 | 105 | 159 |
| Mar-16 | 10.9 | 817 | 986 | 83 | 1,068 | 70 | 122 |
| Apr-16 | 8.0 | 714 | 1,176 | 125 | 1,301 | 145 | 152 |
| May-16 | 7.5 | 668 | 890 | 153 | 1,043 | 102 | 155 |
| Jun-16 | 7.4 | 665 | 890 | 438 | 1,329 | 155 | 158 |
| Jul-16 | 7.3 | 590 | 755 | 178 | 933 | 118 | 164 |
| Aug-16 | 7.4 | 791 | 1,134 | 149 | 1,283 | 94 | 140 |
| Sep-16 | 7.3 | 868 | 1,269 | 73 | 1,342 | 129 | 191 |
| Oct-16 | 7.9 | 940 | 1,095 | 53 | 1,148 | 131 | 171 |
| Nov-16 | 8.0 | 951 | 1,155 | 34 | 1,189 | 94 | 140 |
| Dec-16 | 9.9 | 1,260 | 2,058 | 26 | 2,083 | 98 | 197 |
| Jan-17 | 14.2 | 1,421 | 818 | 45 | 863 | 17 | 71 |
| Feb-17 | 13.9 | 1,203 | 1,318 | 25 | 1,342 | 43 | 101 |
| Mar-17 | 9.7 | 1,141 | 981 | 12 | 993 | 26 | 59 |
| Apr-17 | 8.4 | 1,126 | 1,559 | 3 | 1,562 | 67 | 152 |
| May-17 | 7.2 | 990 | 1,407 | 108 | 1,515 | 92 | 181 |
| Jun-17 | 7.2 | 826 | 910 | 79 | 989 | 97 | 110 |
| | | | | | | | |
| **Dry Season Average** | **7.9** | **810** | **998** | **121** | **1,119** | **155** | **158** |
| **Dry Season Trend **** | **Down** | **None** | **None** | **None** | **None** | **-** | **None** |
| **Wet Season Average** | **9.3** | **887** | **1,080** | **118** | **1,198** | **135** | **150** |
| **Average Annual** | **8.7** | **855** | **1,046** | **119** | **1,165** | **144** | **154** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 29 City of Sunnyvale

Sunnyvale discharges to a tributary of the Lower South Bay. It has approximately 28,300 service connections with a permitted ADWF capacity of 29.5 mgd and a peak wet weather flow capacity of 40 mgd. The permitted ADWF capacity will be reduced to 19.5 mgd for the upcoming design. The current flows are approximately 8.5 mgd ADWF. This value excludes effluent that is diverted to Sunnyvale's recycling water network. The plant currently nitrifies using oxidation ponds followed by nitrifying trickling filters and has filtration.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, there do not appear to be any emerging dry season trends for any of the parameters considered. Seasonal flow variation is attributed to rainfall and evaporation from the oxidation ponds and recycled water in the summer.
- Nitrogen and phosphorus loads typically increase with flow during wet weather events.
- The trickling filters struggle to reliably nitrify during colder months as evidenced by occasional ammonia spikes. This is a common phenomenon for nitrifying trickling filters exacerbated by occasionally very cold temperatures from the oxidation ponds.
- In 2012, the City began a dredging project in the Oxidation Ponds to remove accumulated sediment and restore treatment capacity. Disturbance of the sediment resulted in the release of bound ammonia and the increase in loading rates during that period.
- Nitrogen wet season loads are typically greater and more variable than the dry season loads (with the exception of a TN spike in September 2013).
- The plant has seasonal denitrification as evidenced by ADWF TN values that range from 10 to 20 mg N/L. The denitrification occurs in the oxidation ponds during the summer months.
- NOx is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant nitrifies year round (except for colder months, when only partial nitrification occurs).
- Total phosphorus concentrations are wide ranging from approximately 2.3 to 8.4 mg P/L. Typical effluent TP concentrations range from 4 to 6 mg P/L.

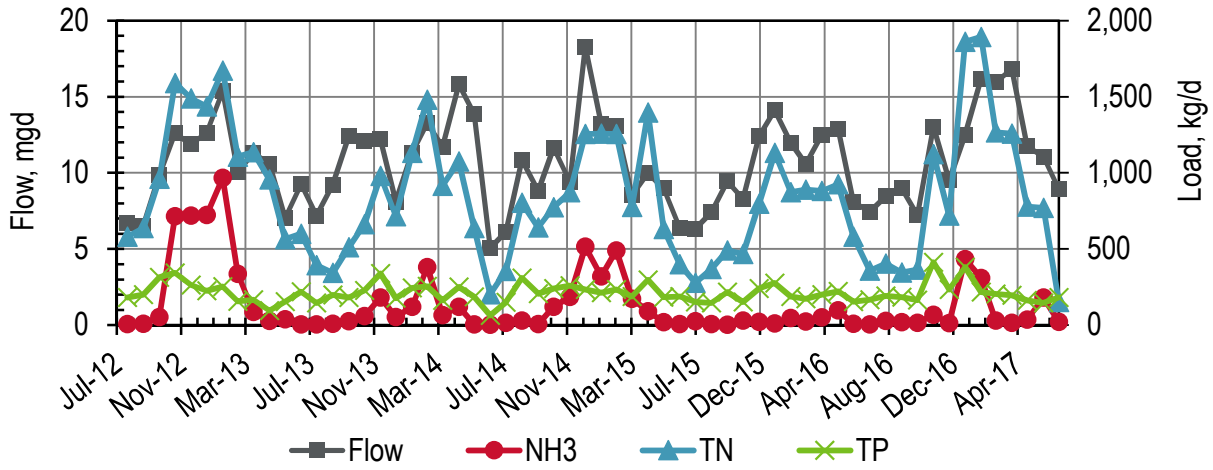


**Figure 29-1. Sunnyvale Monthly Flows and Loads**

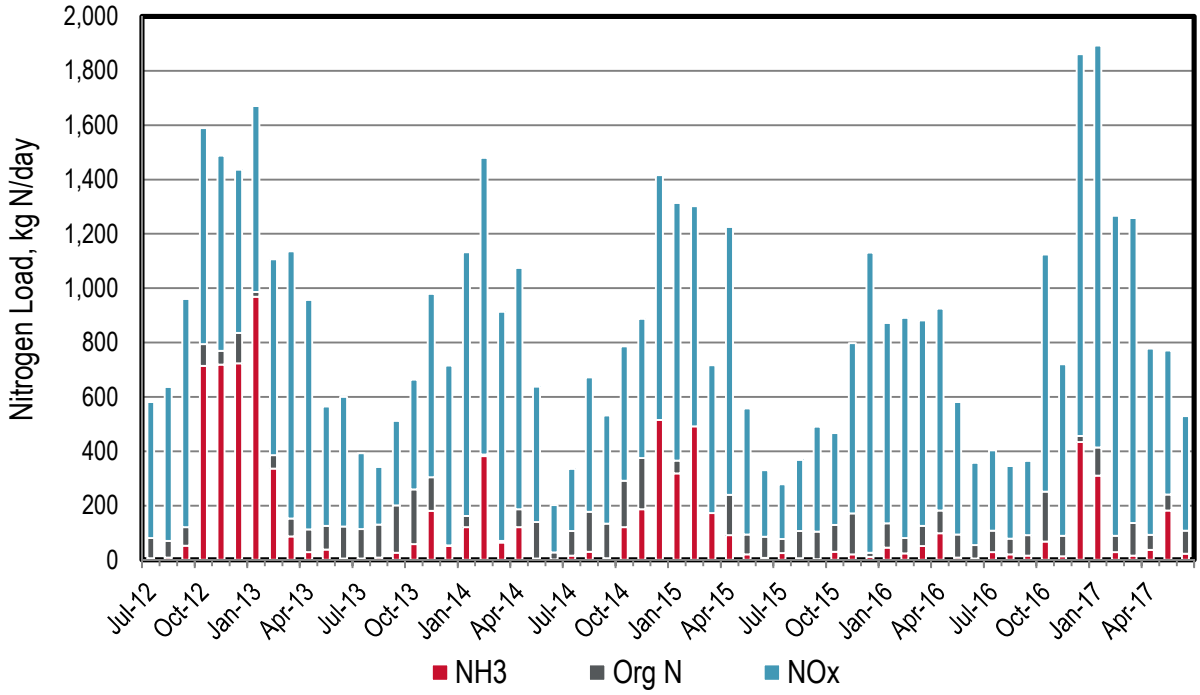


**Figure 29-2. Sunnyvale Monthly Nitrogen Loads**

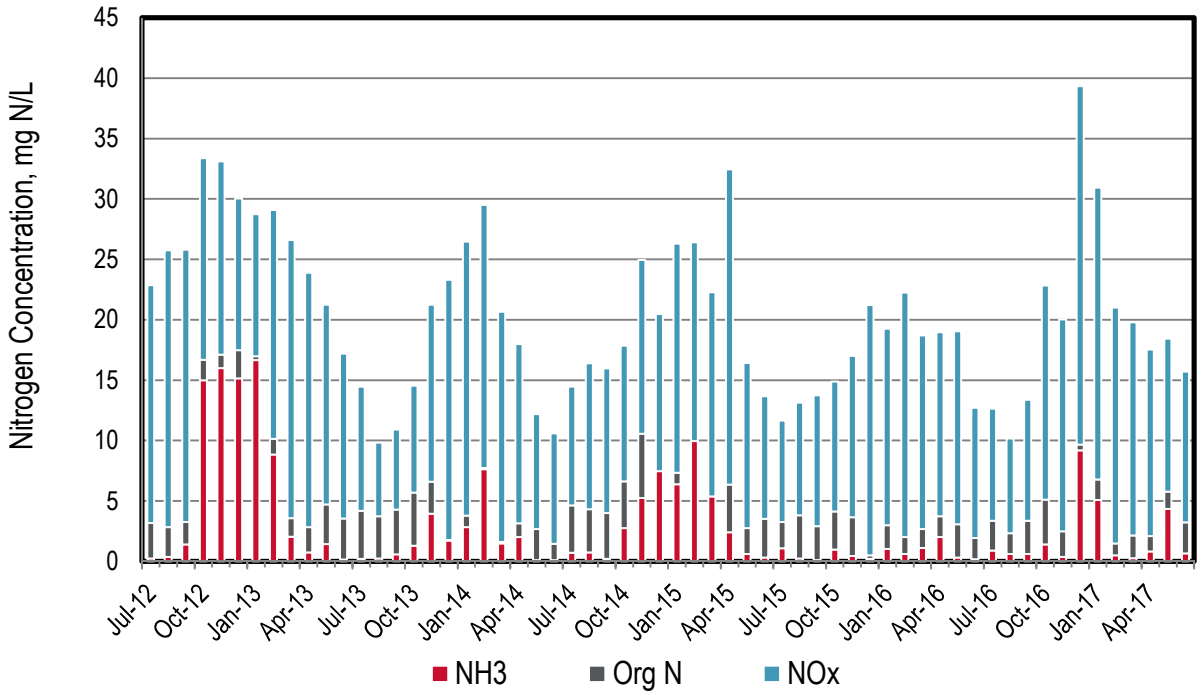


**Figure 29-3. Sunnyvale Monthly Nitrogen Concentrations**

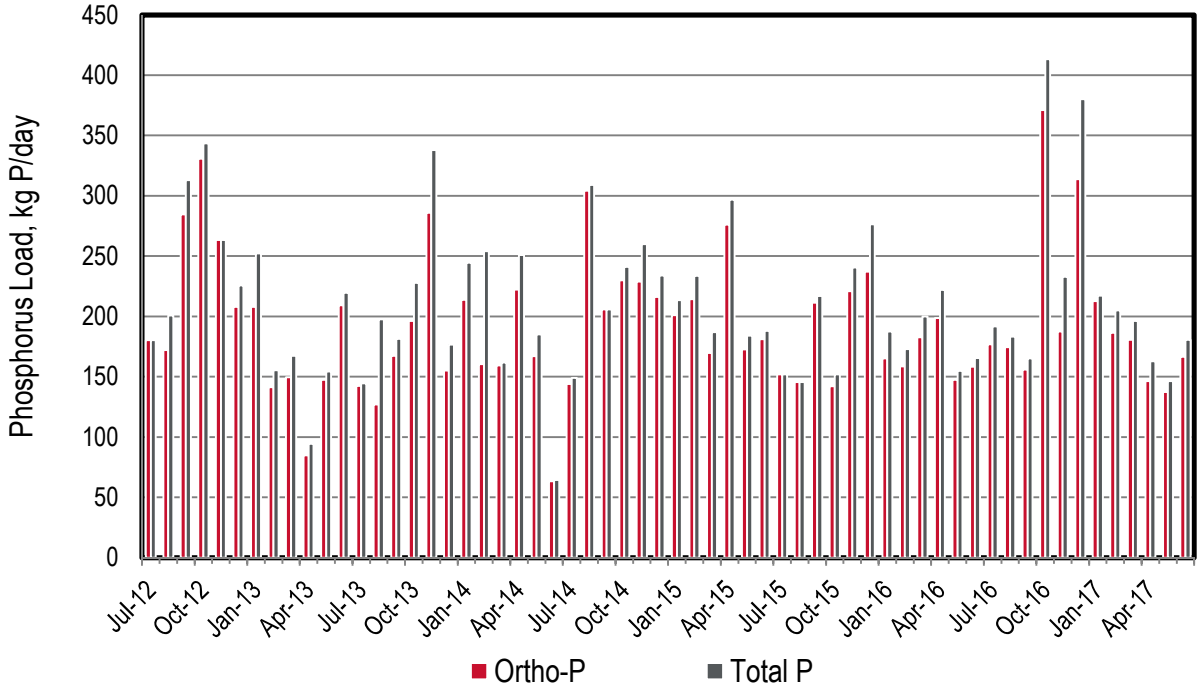


**Figure 29-4. Sunnyvale Monthly Phosphorus Loads**

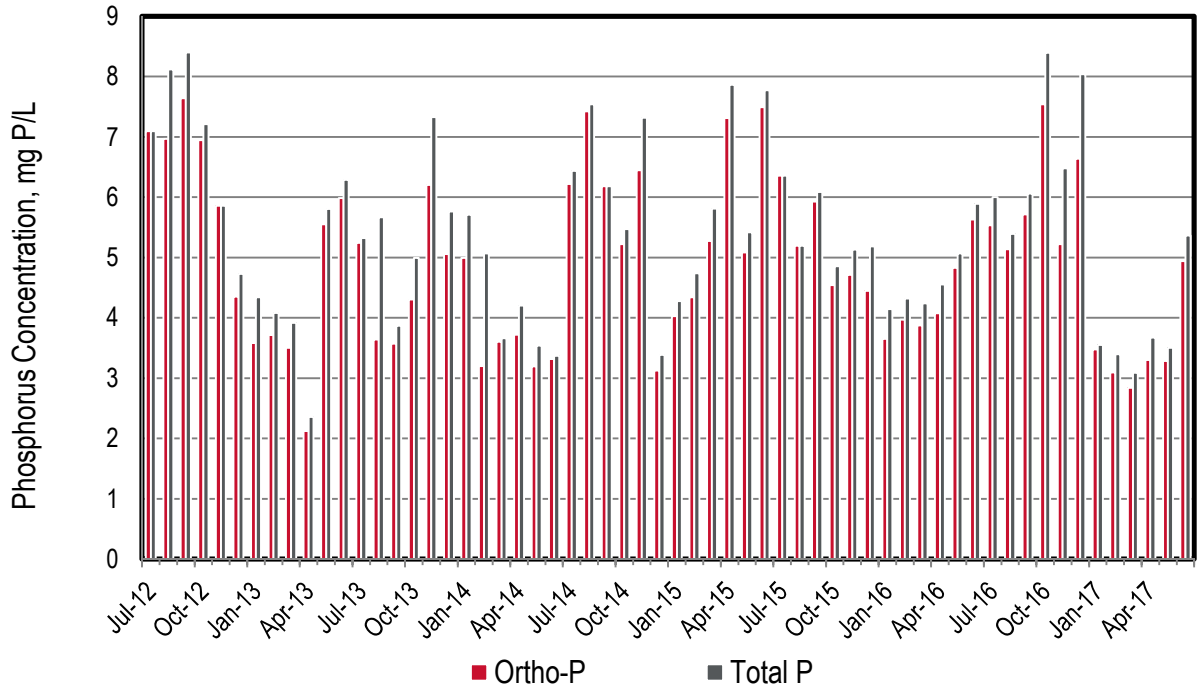


**Figure 29-5. Sunnyvale Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 29-1. Sunnyvale Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 6.7 | 6 | 81 | 500 | 581 | 197 | 180 |
| Aug-12 | 6.5 | 9 | 70 | 567 | 637 | 172 | 201 |
| Sep-12 | 9.9 | 52 | 121 | 840 | 961 | 285 | 313 |
| Oct-12 | 12.6 | 714 | 795 | 795 | 1,590 | 331 | 343 |
| Nov-12 | 11.9 | 719 | 769 | 718 | 1,488 | 269 | 263 |
| Dec-12 | 12.6 | 724 | 835 | 600 | 1,436 | 208 | 226 |
| Jan-13 | 15.4 | 968 | 986 | 685 | 1,671 | 208 | 252 |
| Feb-13 | 10.1 | 336 | 386 | 720 | 1,106 | 141 | 155 |
| Mar-13 | 11.3 | 86 | 153 | 983 | 1,136 | 149 | 167 |
| Apr-13 | 10.6 | 29 | 113 | 844 | 956 | 85 | 94 |
| May-13 | 7.0 | 38 | 125 | 439 | 565 | 148 | 154 |
| Jun-13 | 9.2 | 6 | 123 | 477 | 600 | 209 | 220 |
| Jul-13 | 7.2 | 6 | 113 | 279 | 393 | 142 | 145 |
| Aug-13 | 9.2 | 8 | 130 | 212 | 342 | 127 | 198 |
| Sep-13 | 12.4 | 27 | 201 | 310 | 511 | 167 | 181 |
| Oct-13 | 12.1 | 58 | 259 | 404 | 663 | 196 | 228 |
| Nov-13 | 12.2 | 181 | 304 | 675 | 979 | 286 | 338 |
| Dec-13 | 8.1 | 52 | 54 | 661 | 715 | 155 | 177 |
| Jan-14 | 11.3 | 121 | 161 | 971 | 1,132 | 214 | 244 |
| Feb-14 | 13.3 | 382 | 388 | 1,092 | 1,479 | 160 | 254 |
| Mar-14 | 11.7 | 65 | 71 | 843 | 914 | 159 | 162 |
| Apr-14 | 15.8 | 120 | 187 | 887 | 1,074 | 222 | 251 |
| May-14 | 13.9 | 5 | 139 | 498 | 638 | 167 | 185 |
| Jun-14 | 5.1 | 2 | 28 | 175 | 202 | 63 | 64 |
| Jul-14 | 6.1 | 16 | 107 | 228 | 356 | 144 | 149 |
| Aug-14 | 10.8 | 29 | 177 | 495 | 803 | 304 | 309 |
| Sep-14 | 8.8 | 6 | 133 | 399 | 641 | 239 | 206 |
| Oct-14 | 11.7 | 120 | 291 | 495 | 774 | 230 | 241 |
| Nov-14 | 9.4 | 186 | 375 | 512 | 873 | 229 | 260 |
| Dec-14 | 18.3 | 515 | 477 | 901 | 1,255 | 216 | 234 |
| Jan-15 | 13.2 | 319 | 366 | 948 | 1,257 | 201 | 214 |
| Feb-15 | 13.1 | 491 | 481 | 811 | 1,255 | 214 | 234 |
| Mar-15 | 8.5 | 173 | 127 | 544 | 776 | 170 | 187 |
| Apr-15 | 10.0 | 91 | 240 | 985 | 1,397 | 276 | 297 |
| May-15 | 9.0 | 20 | 93 | 465 | 632 | 173 | 184 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 6.4 | 8 | 85 | 246 | 399 | 181 | 188 |
| Jul-15 | 6.3 | 26 | 77 | 201 | 279 | 153 | 152 |
| Aug-15 | 7.4 | 6 | 106 | 262 | 368 | 150 | 145 |
| Sep-15 | 9.4 | 3 | 104 | 386 | 490 | 211 | 217 |
| Oct-15 | 8.3 | 30 | 129 | 338 | 467 | 142 | 152 |
| Nov-15 | 12.4 | 21 | 171 | 627 | 798 | 221 | 241 |
| Dec-15 | 14.1 | 11 | 26 | 1,105 | 1,132 | 237 | 276 |
| Jan-16 | 12.0 | 46 | 135 | 737 | 872 | 165 | 188 |
| Feb-16 | 10.6 | 24 | 80 | 810 | 890 | 159 | 173 |
| Mar-16 | 12.5 | 51 | 126 | 756 | 882 | 183 | 200 |
| Apr-16 | 12.9 | 98 | 182 | 744 | 925 | 199 | 222 |
| May-16 | 8.1 | 9 | 94 | 488 | 582 | 147 | 155 |
| Jun-16 | 7.4 | 5 | 54 | 303 | 357 | 158 | 166 |
| Jul-16 | 8.5 | 28 | 107 | 296 | 403 | 177 | 192 |
| Aug-16 | 9.0 | 20 | 79 | 267 | 345 | 174 | 183 |
| Sep-16 | 7.2 | 16 | 91 | 273 | 365 | 156 | 165 |
| Oct-16 | 13.0 | 68 | 252 | 872 | 1,124 | 371 | 413 |
| Nov-16 | 9.5 | 13 | 89 | 631 | 720 | 188 | 233 |
| Dec-16 | 12.5 | 434 | 456 | 1,404 | 1,861 | 314 | 380 |
| Jan-17 | 16.2 | 310 | 414 | 1,479 | 1,893 | 213 | 217 |
| Feb-17 | 16.0 | 29 | 89 | 1,178 | 1,267 | 187 | 205 |
| Mar-17 | 16.8 | 16 | 136 | 1,123 | 1,258 | 181 | 196 |
| Apr-17 | 11.7 | 36 | 93 | 685 | 778 | 146 | 163 |
| May-17 | 11.1 | 182 | 241 | 530 | 770 | 137 | 146 |
| Jun-17 | 8.9 | 22 | 108 | 421 | 151 | 166 | 181 |
| | | | | | | | |
| **Dry Season Average** | **8.5** | **22** | **112** | **382** | **495** | **174** | **183** |
| **Dry Season Trend **** | **None** | **None** | **None** | **None** | **None** | **-** | **None** |
| **Wet Season Average** | **12.3** | **218** | **291** | **816** | **1,108** | **206** | **231** |
| **Average Annual** | **10.7** | **137** | **216** | **635** | **853** | **193** | **211** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 30 Silicon Valley Clean Water (SVCW)

SVCW discharges to the South Bay. The plant services a population of approximately 200,000 and has a permitted ADWF capacity of 29 mgd. The current flows are approximately 12.1 mgd ADWF. The plant performs tertiary treatment using a trickling filter complemented with an activated sludge system followed by mono-media or dual-media filtration.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the table with the average monthly values, there is an emerging slight upward dry season trend for ammonia, TKN, TN, and TP loads.
- Nitrogen loads typically increases with flow during wet weather events.
- Nitrogen wet season loads are typically greater and more variable than the dry season loads. The plant is subjected to lower loads in the dry season and the warmer temperature lends itself to nitrifying a portion of the ammonia load.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- There was an analytical sampling issue for the July 2015 phosphorus species samples (data not shown)
- Ortho-P values are routinely greater than TP values for the sampling issues discussed in the main report body. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations are wide ranging, from approximately 1.7 to 5.7 mg P/L. Typical effluent TP concentrations range from 4 to 6 mg P/L.

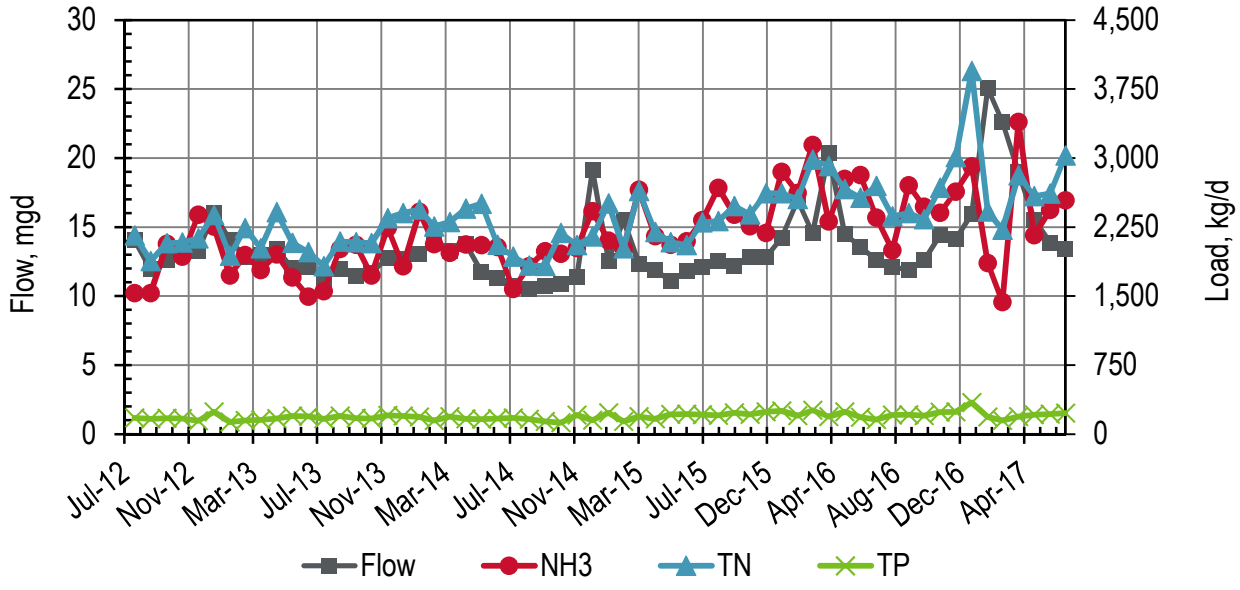


**Figure 30-1. SVCW Monthly Flows and Loads**

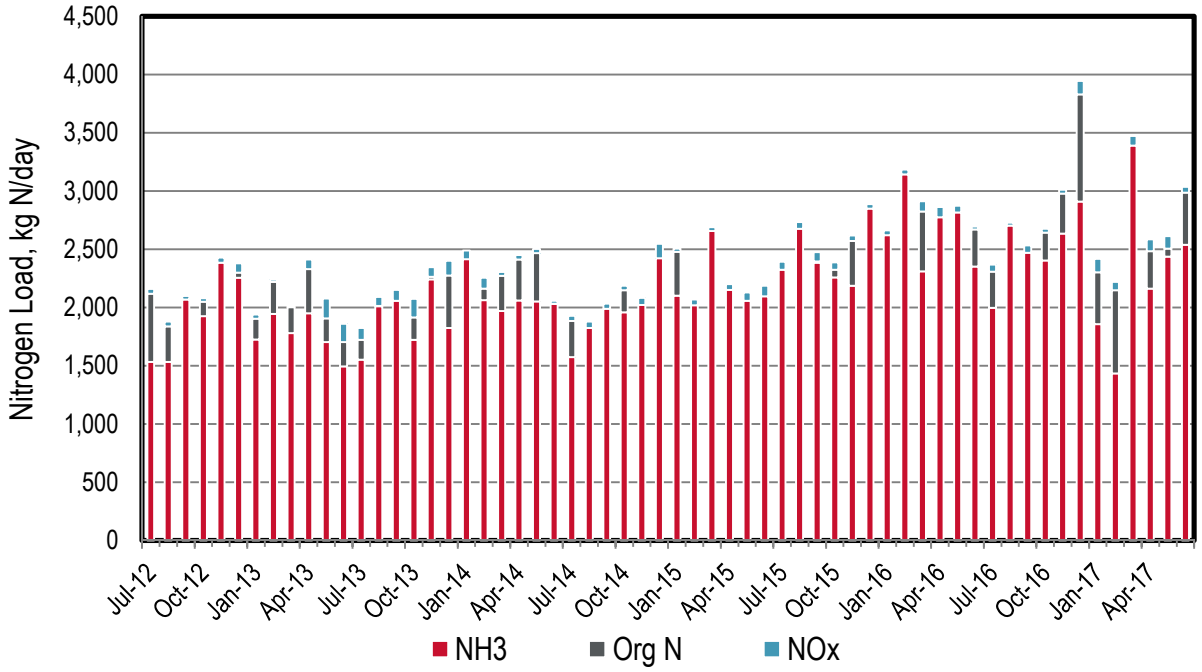


**Figure 30-2. SVCW Monthly Nitrogen Loads**

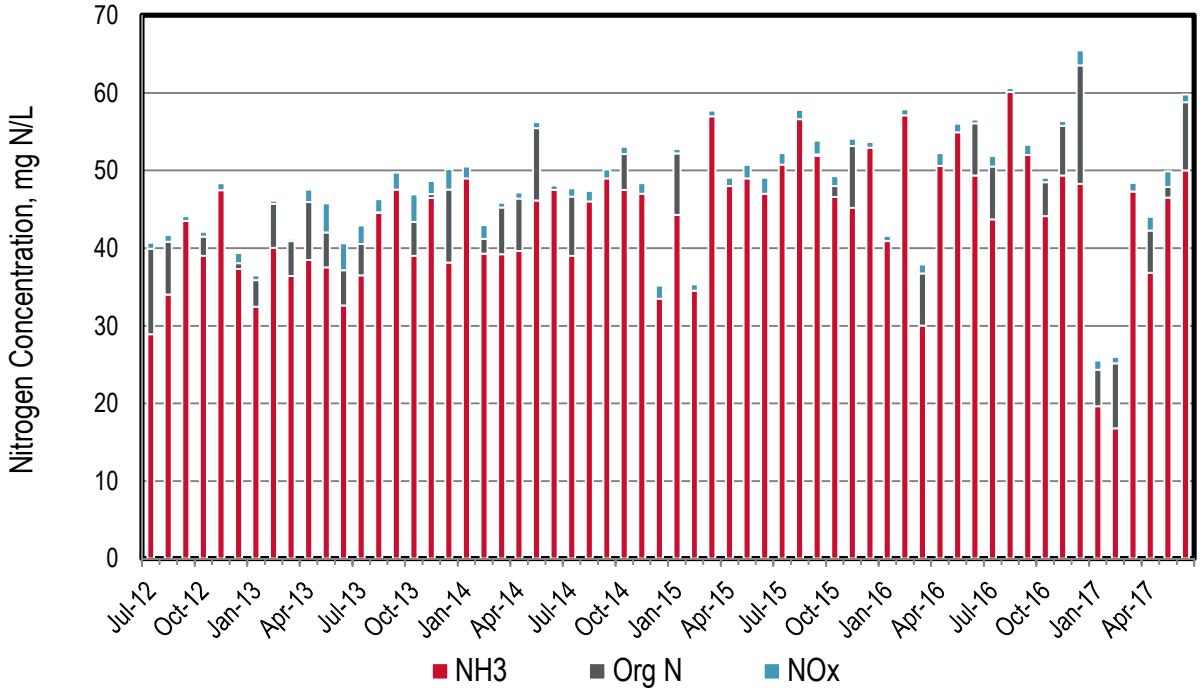


**Figure 30-3. SVCW Monthly Nitrogen Concentrations**

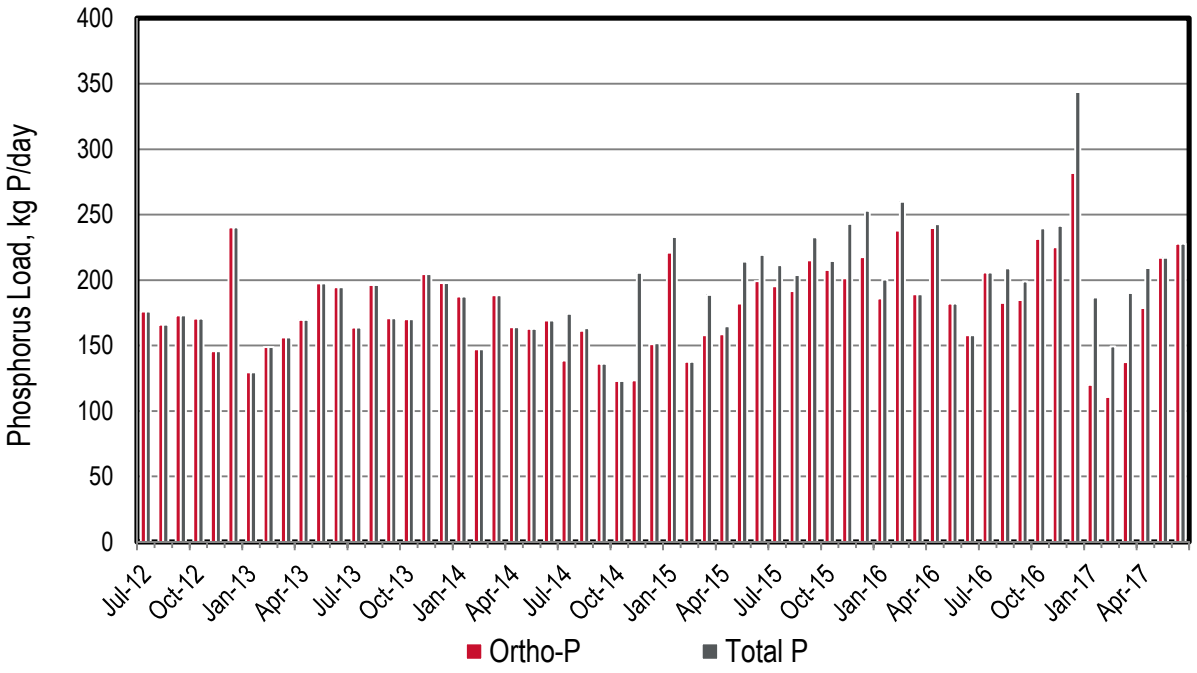


**Figure 30-4. SVCW Monthly Phosphorus Loads**

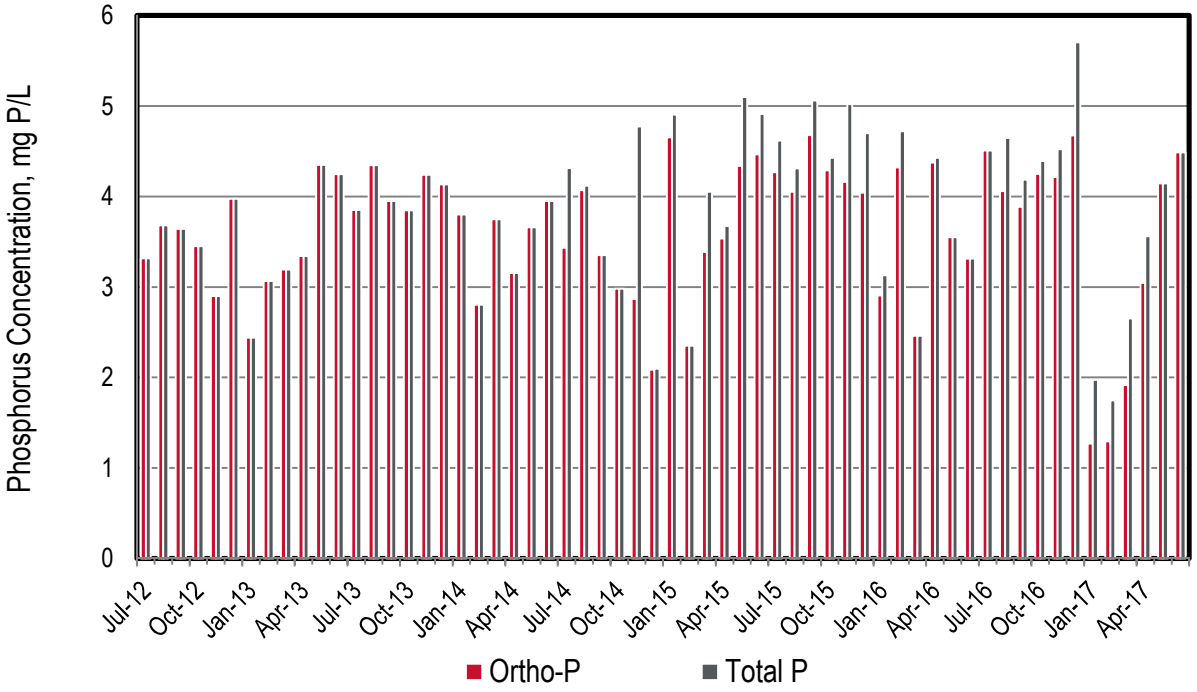


**Figure 30-5. SVCW Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 30-1. SVCW Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 14.0 | c1,533 | 2,118 | 41 | 2,159 | 233 | 176 |
| Aug-12 | 11.9 | 1,533 | 1,839 | 39 | 1,878 | 305 | 166 |
| Sep-12 | 12.6 | 2,068 | 2,045 | 31 | 2,076 | 564 | 173 |
| Oct-12 | 13.1 | 1,927 | 2,051 | 30 | 2,081 | 288 | 171 |
| Nov-12 | 13.3 | 2,384 | 2,083 | 44 | 2,128 | 193 | 146 |
| Dec-12 | 16.0 | 2,256 | 2,299 | 80 | 2,379 | 257 | 240 |
| Jan-13 | 14.1 | 1,724 | 1,905 | 33 | 1,939 | 161 | 130 |
| Feb-13 | 12.9 | 1,945 | 2,219 | 19 | 2,238 | 181 | 149 |
| Mar-13 | 13.0 | 1,782 | 2,003 | 15 | 2,017 | 181 | 156 |
| Apr-13 | 13.4 | 1,952 | 2,330 | 81 | 2,411 | 233 | 170 |
| May-13 | 12.0 | 1,703 | 1,907 | 171 | 2,078 | 263 | 197 |
| Jun-13 | 12.1 | 1,494 | 1,702 | 159 | 1,976 | 250 | 195 |
| Jul-13 | 11.3 | 1,553 | 1,723 | 103 | 1,826 | 541 | 164 |
| Aug-13 | 12.0 | 2,012 | 2,014 | 78 | 2,092 | 709 | 196 |
| Sep-13 | 11.5 | 2,057 | 1,991 | 95 | 2,086 | 212 | 171 |
| Oct-13 | 11.7 | 1,723 | 1,916 | 157 | 2,073 | 286 | 170 |
| Nov-13 | 12.8 | 2,241 | 2,264 | 82 | 2,346 | 312 | 204 |
| Dec-13 | 12.7 | 1,825 | 2,274 | 127 | 2,401 | 256 | 198 |
| Jan-14 | 13.0 | 2,415 | 2,366 | 74 | 2,440 | 280 | 187 |
| Feb-14 | 13.9 | 2,063 | 2,162 | 94 | 2,256 | 261 | 147 |
| Mar-14 | 13.3 | 1,971 | 2,273 | 32 | 2,305 | 274 | 188 |
| Apr-14 | 13.8 | 2,060 | 2,412 | 39 | 2,451 | 212 | 164 |
| May-14 | 11.8 | 2,053 | 2,468 | 35 | 2,504 | 248 | 163 |
| Jun-14 | 11.3 | 2,034 | 2,034 | 24 | 2,059 | 196 | 169 |
| Jul-14 | 10.7 | 1,576 | 1,884 | 43 | 1,928 | 139 | 174 |
| Aug-14 | 10.5 | 1,824 | 1,778 | 54 | 1,833 | 161 | 163 |
| Sep-14 | 10.7 | 1,989 | 1,783 | 45 | 1,829 | 161 | 136 |
| Oct-14 | 10.9 | 1,959 | 2,149 | 39 | 2,188 | 168 | 123 |
| Nov-14 | 11.4 | 2,024 | 1,994 | 59 | 2,053 | 124 | 206 |
| Dec-14 | 19.1 | 2,424 | 2,026 | 122 | 2,148 | 151 | 152 |
| Jan-15 | 12.6 | 2,103 | 2,478 | 28 | 2,506 | 221 | 233 |
| Feb-15 | 15.5 | 2,020 | 1,969 | 49 | 2,018 | 144 | 138 |
| Mar-15 | 12.3 | 2,657 | 2,608 | 33 | 2,641 | 158 | 189 |
| Apr-15 | 11.9 | 2,152 | 2,148 | 48 | 2,196 | 159 | 165 |
| May-15 | 11.1 | 2,058 | 2,014 | 72 | 2,086 | 182 | 214 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 11.8 | 2,096 | 1,962 | 92 | 2,054 | 199 | 219 |
| Jul-15 | 12.1 | 2,324 | 2,231 | 68 | 2,299 | 195 | 211 |
| Aug-15 | 12.5 | 2,676 | 2,258 | 57 | 2,316 | 191 | 204 |
| Sep-15 | 12.2 | 2,385 | 2,395 | 82 | 2,477 | 215 | 233 |
| Oct-15 | 12.8 | 2,257 | 2,325 | 63 | 2,387 | 208 | 215 |
| Nov-15 | 12.8 | 2,187 | 2,571 | 47 | 2,618 | 201 | 243 |
| Dec-15 | 14.2 | 2,849 | 2,576 | 40 | 2,616 | 217 | 253 |
| Jan-16 | 16.9 | 2,621 | 2,513 | 40 | 2,553 | 186 | 200 |
| Feb-16 | 14.6 | 3,143 | 2,939 | 43 | 2,982 | 238 | 260 |
| Mar-16 | 20.3 | 2,310 | 2,825 | 88 | 2,913 | 199 | 189 |
| Apr-16 | 14.5 | 2,774 | 2,572 | 89 | 2,661 | 240 | 243 |
| May-16 | 13.6 | 2,816 | 2,512 | 58 | 2,570 | 191 | 182 |
| Jun-16 | 12.6 | 2,351 | 2,672 | 24 | 2,695 | 167 | 158 |
| Jul-16 | 12.1 | 1,996 | 2,307 | 61 | 2,368 | 248 | 206 |
| Aug-16 | 11.9 | 2,705 | 2,377 | 23 | 2,400 | 183 | 209 |
| Sep-16 | 12.6 | 2,471 | 2,274 | 61 | 2,335 | 185 | 199 |
| Oct-16 | 14.4 | 2,404 | 2,642 | 33 | 2,675 | 232 | 239 |
| Nov-16 | 14.1 | 2,635 | 2,978 | 32 | 3,010 | 225 | 242 |
| Dec-16 | 15.9 | 2,909 | 3,829 | 115 | 3,944 | 282 | 344 |
| Jan-17 | 25.1 | 1,858 | 2,303 | 115 | 2,417 | 120 | 187 |
| Feb-17 | 22.6 | 1,434 | 2,148 | 72 | 2,221 | 111 | 149 |
| Mar-17 | 19.0 | 3,391 | 2,757 | 81 | 2,833 | 137 | 190 |
| Apr-17 | 15.5 | 2,162 | 2,484 | 103 | 2,586 | 179 | 209 |
| May-17 | 13.9 | 2,436 | 2,506 | 106 | 2,612 | 248 | 217 |
| Jun-17 | 13.4 | 2,540 | 2,986 | 50 | 3,027 | 256 | 228 |
| | | | | | | | |
| **Dry Season Average** | **12.1** | **2,091** | **2,151** | **67** | **2,222** | **258** | **189** |
| **Dry Season Trend **** | **None** | **Up** | **Up** | **None** | **Up** | **-** | **Up** |
| **Wet Season Average** | **14.7** | **2,244** | **2,383** | **64** | **2,447** | **208** | **194** |
| **Average Annual** | **13.6** | **2,180** | **2,286** | **65** | **2,353** | **229** | **192** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 31 Sanitary District No. 5 of Marin County – Tiburon Treatment Plant

The Tiburon Treatment Plant discharges to the Central Bay. The service area has a population of approximately 8,400. The plant has a permitted ADWF capacity of 0.98 mgd and a peak wet weather capacity of 2.3 mgd. It has currents flows of approximately 0.54 mgd ADWF. The plant performs secondary treatment using an activated sludge treatment process.

The plant is classified as a minor discharger (<1 mgd permitted capacity) and thus not required to sample as frequently as the major dischargers (>1 mgd permitted capacity). The minor dischargers are required to sample twice per year under the Nutrient Watershed Permit. As a result, there are several months of nutrient data gaps, in particular from July 2013 through July 2014.

The following observations are made based upon the figures and table in the subsequent pages:

- Flow values are provided over the entire study period. The remaining nutrient species only have monthly sampling for the first year of sampling, followed by occasional sampling thereafter.
- Based on the table with the average monthly values, there appears to be an emerging upward trend for flows in the dry season. There is insufficient data to evaluate nutrient species trending.
- With the exception of January 2013, ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since this plant does not nitrify.
- Ortho-P values are routinely greater than TP values. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations are wide ranging from approximately 1.4 to 6.5 mg P/L. Typical effluent TP concentrations range from 4 to 6 mg P/L.

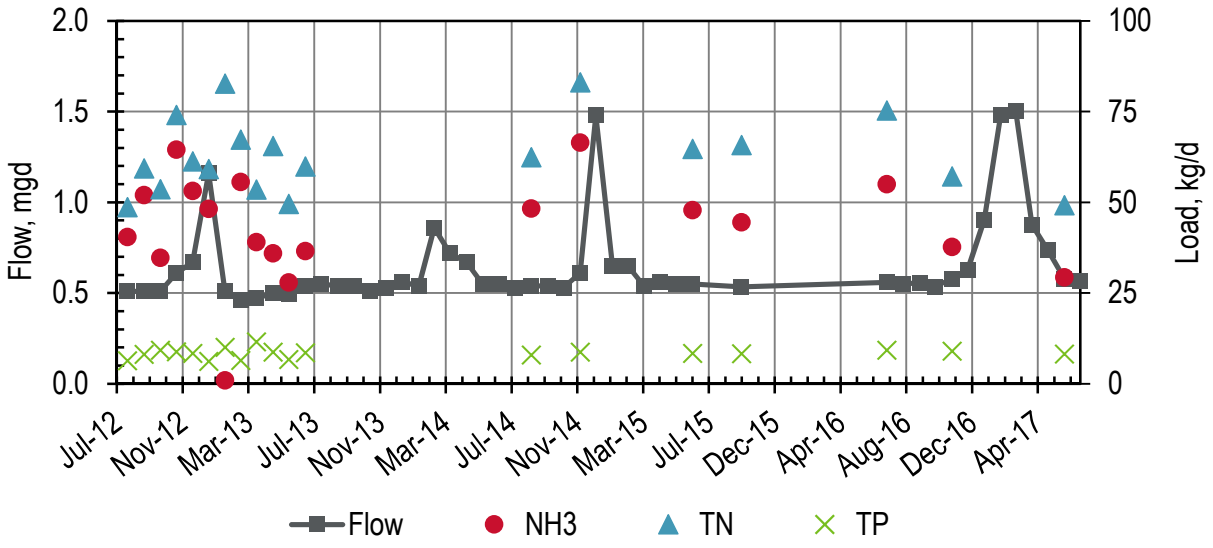


**Figure 31-1. Tiburon Monthly Flows and Loads**

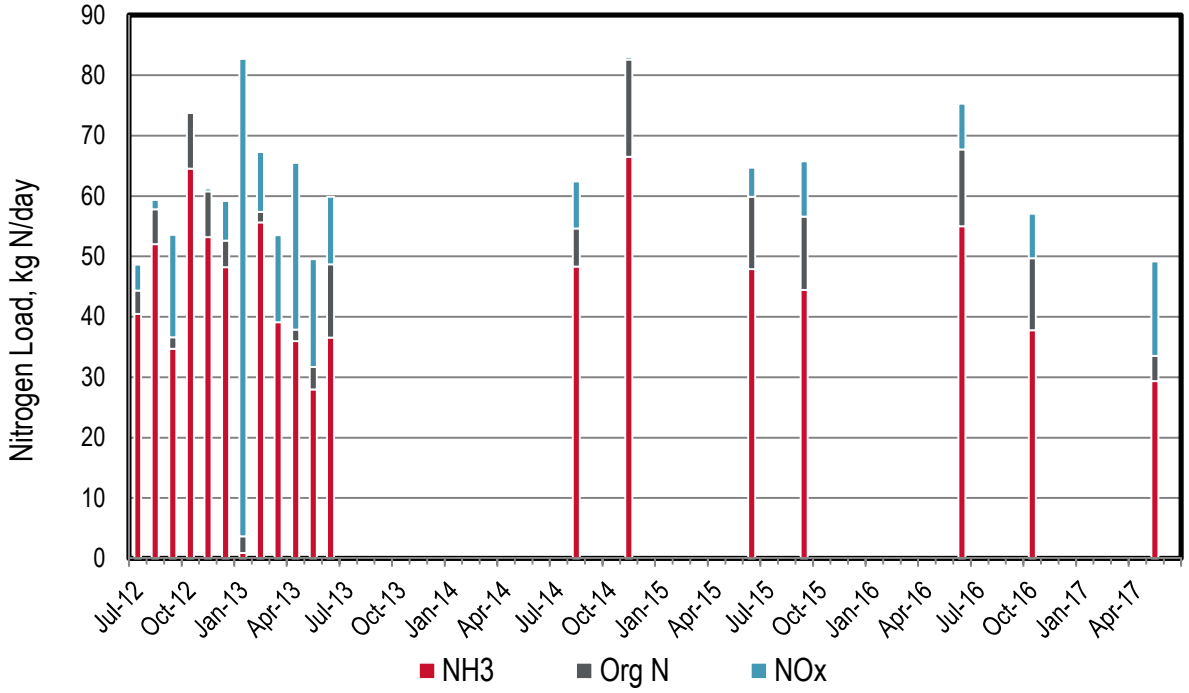


**Figure 31-2. Tiburon Monthly Nitrogen Loads**

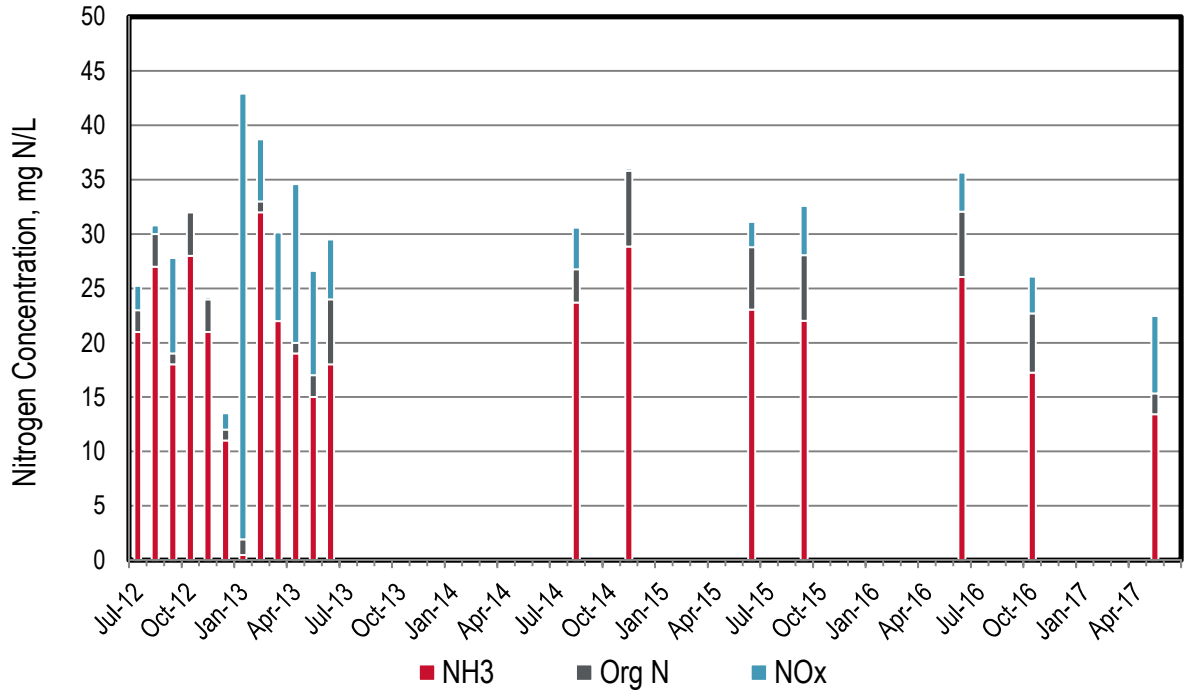


**Figure 31-3. Tiburon Monthly Nitrogen Concentrations**

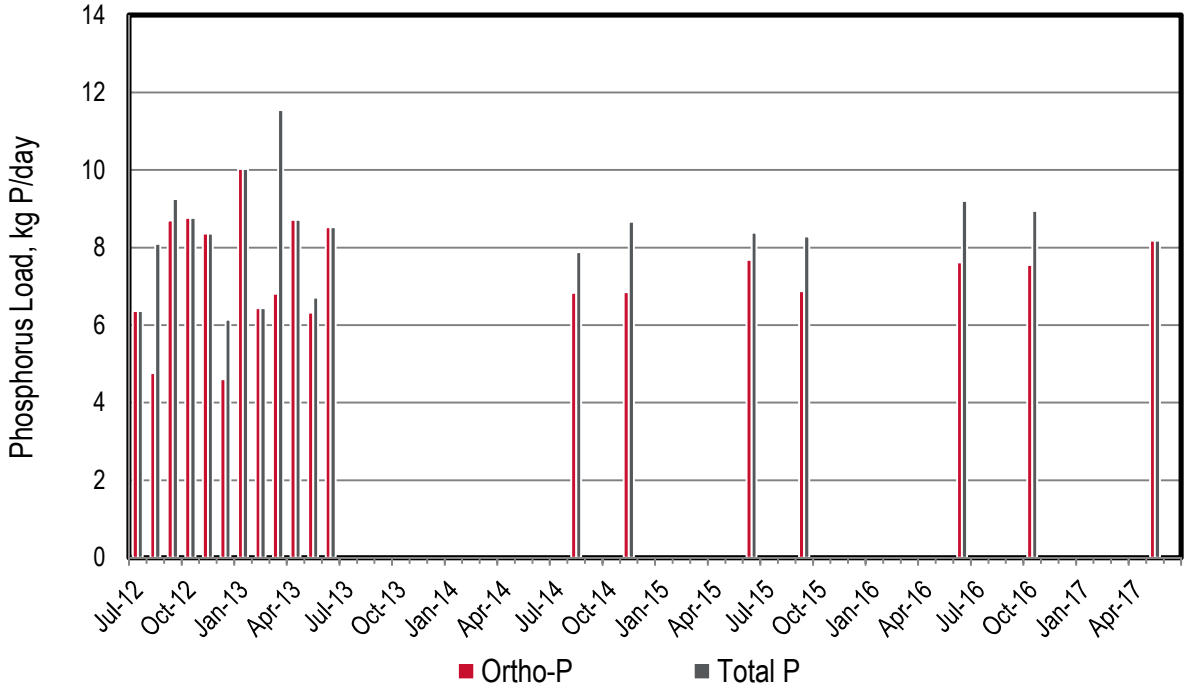


**Figure 31-4. Tiburon Monthly Phosphorus Loads**

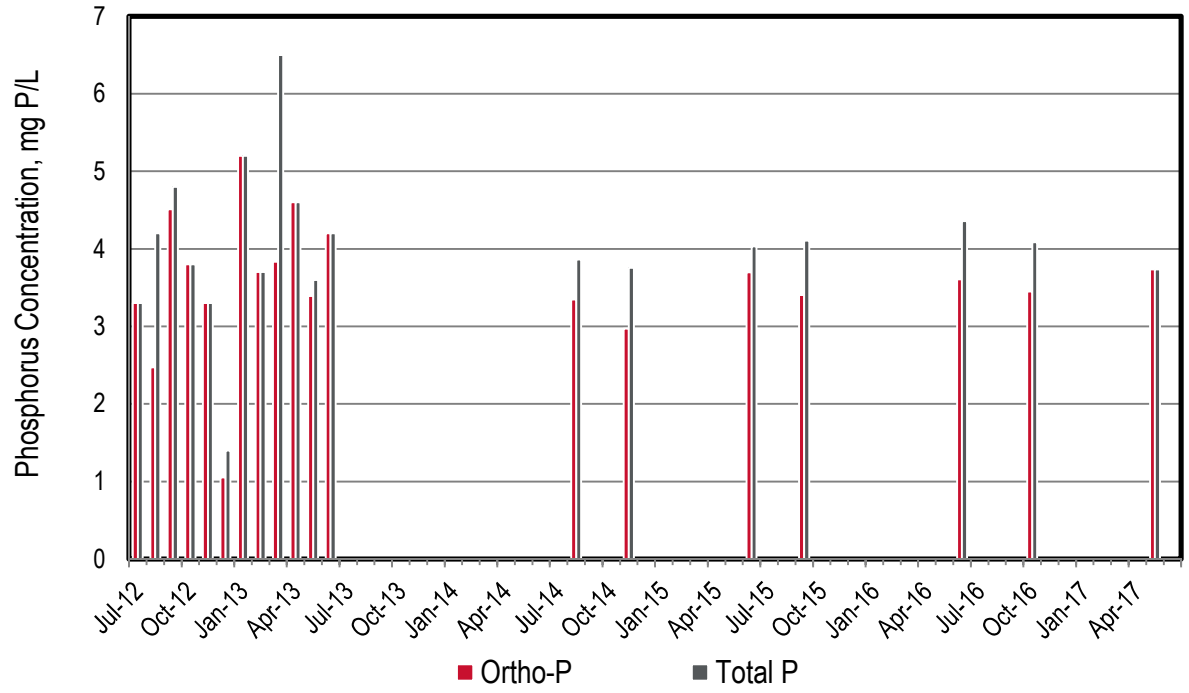


**Figure 31-5. Tiburon Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 31-1. Tiburon Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.5 | 40 | 44 | 4 | 49 | 7 | 6 |
| Aug-12 | 0.5 | 52 | 58 | 2 | 59 | 5 | 8 |
| Sep-12 | 0.5 | 35 | 37 | 17 | 54 | 9 | 9 |
| Oct-12 | 0.6 | 65 | 74 | 0 | 74 | 14 | 9 |
| Nov-12 | 0.7 | 53 | 61 | 0 | 61 | 11 | 8 |
| Dec-12 | 1.2 | 48 | 53 | 7 | 59 | 5 | 6 |
| Jan-13 | 0.5 | 1 | 4 | 79 | 83 | 13 | 10 |
| Feb-13 | 0.5 | 56 | 57 | 10 | 67 | 8 | 6 |
| Mar-13 | 0.5 | 39 | 39 | 14 | 54 | 7 | 12 |
| Apr-13 | 0.5 | 36 | 38 | 28 | 66 | 12 | 9 |
| May-13 | 0.5 | 28 | 32 | 18 | 50 | 6 | 7 |
| Jun-13 | 0.5 | 37 | 49 | 11 | 60 | 10 | 9 |
| Jul-13 | 0.6 | | | | | | |
| Aug-13 | 0.5 | | | | | | |
| Sep-13 | 0.5 | | | | | | |
| Oct-13 | 0.5 | | | | | | |
| Nov-13 | 0.5 | | | | | | |
| Dec-13 | 0.6 | | | | | | |
| Jan-14 | 0.5 | | | | | | |
| Feb-14 | 0.9 | | | | | | |
| Mar-14 | 0.7 | | | | | | |
| Apr-14 | 0.7 | | | | | | |
| May-14 | 0.6 | | | | | | |
| Jun-14 | 0.6 | | | | | | |
| Jul-14 | 0.5 | | | | | | |
| Aug-14 | 0.5 | 48 | 55 | 8 | 62 | 7 | 8 |
| Sep-14 | 0.5 | | | | | | |
| Oct-14 | 0.5 | | | | | | |
| Nov-14 | 0.6 | 66 | 83 | 0 | 83 | 7 | 9 |
| Dec-14 | 1.5 | | | | | | |
| Jan-15 | 0.7 | | | | | | |
| Feb-15 | 0.7 | | | | | | |
| Mar-15 | 0.5 | | | | | | |
| Apr-15 | 0.6 | | | | | | |
| May-15 | 0.6 | | | | | | |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 0.6 | 48 | 60 | 5 | 65 | 8 | 8 |
| Jul-15 | 0.5 | | | | | | |
| Aug-15 | 0.5 | | | | | | |
| Sep-15 | 0.5 | 44 | 57 | 9 | 66 | 7 | 8 |
| Oct-15 | 0.6 | | | | | | |
| Nov-15 | 0.5 | | | | | | |
| Dec-15 | 0.8 | | | | | | |
| Jan-16 | 1.2 | | | | | | |
| Feb-16 | 0.6 | | | | | | |
| Mar-16 | 1.0 | | | | | | |
| Apr-16 | 0.6 | | | | | | |
| May-16 | 0.6 | | | | | | |
| Jun-16 | 0.6 | 55 | 68 | 8 | 75 | 8 | 9 |
| Jul-16 | 0.6 | | | | | | |
| Aug-16 | 0.6 | | | | | | |
| Sep-16 | 0.5 | | | | | | |
| Oct-16 | 0.6 | 38 | 50 | 7 | 57 | 8 | 9 |
| Nov-16 | 0.6 | | | | | | |
| Dec-16 | 0.9 | | | | | | |
| Jan-17 | 1.5 | | | | | | |
| Feb-17 | 1.5 | | | | | | |
| Mar-17 | 0.9 | | | | | | |
| Apr-17 | 0.7 | | | | | | |
| May-17 | 0.6 | 29 | 34 | 16 | 49 | 13 | 8 |
| Jun-17 | 0.6 | | | | | | |
| | | | | | | | |
| **Dry Season Average** | **0.5** | **42** | **49** | **10** | **59** | **8** | **8** |
| **Dry Season Trend **** | **Up** | **None** | **None** | **None** | **None** | **None** | **None** |
| **Wet Season Average** | **0.7** | **45** | **51** | **16** | **67** | **9** | **9** |
| **Average Annual** | **0.6** | **43** | **50** | **13** | **63** | **9** | **8** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 32 Treasure Island

Treasure Island discharges to the Central Bay. The plant has a permitted capacity of 2.0 mgd ADWF and a peak wet weather capacity of 4.4 mgd. The current plant flow is approximately 0.3 mgd ADWF. The plant currently nitrifies using trickling filters.

The following observations are made based upon the figures and table in the subsequent pages:

- Based on the average monthly values table below, there appears to be an upward dry season trend for all nitrogen species loads (except NOx).
- The plant fully nitrified through April 2014 at which time one of the plant's two trickling arm filters became inoperable, resulting in increased effluent ammonia concentrations.
- Prior to April 2014, NOx was the majority of the nitrogen species discharged as would be expected since this plant nitrifies. Since then, the proportion of ammonia relative to NOx has increased.
- Reported ortho-P values were frequently greater than TP values prior to January 2015. This is attributed to a combination of the sampling methodology as discussed in the main report body and SFPUC began using Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) for TP detection. For such instances in Figure 32-4 and Figure 32-5, ortho-P values were set equal to TP. In Table 32-1, the reported ortho-P values were used for the data table.

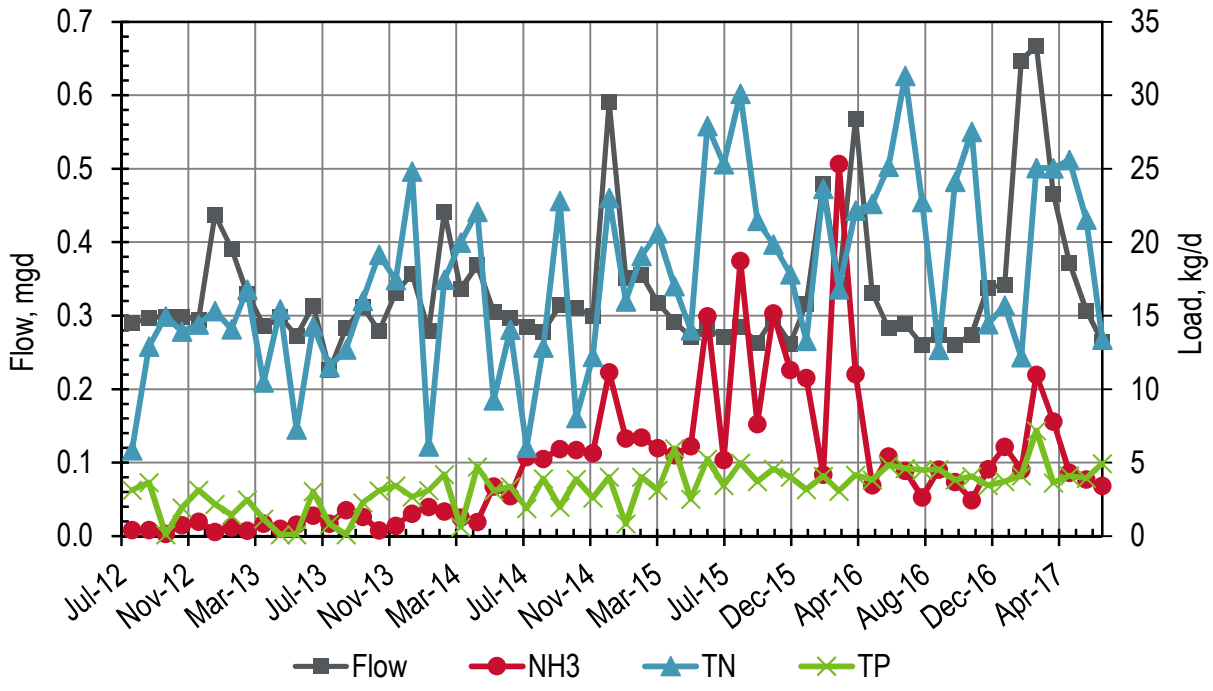


**Figure 32-1. Treasure Island Monthly Flows and Loads**

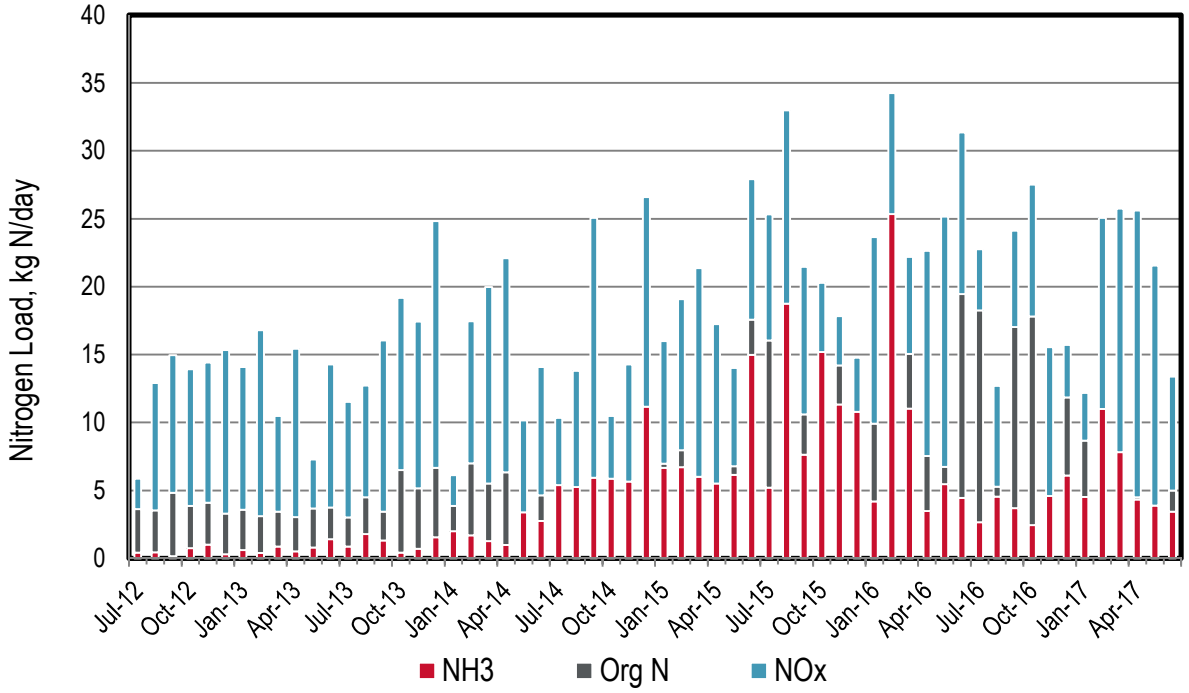


**Figure 32-2. Treasure Island Monthly Nitrogen Loads**

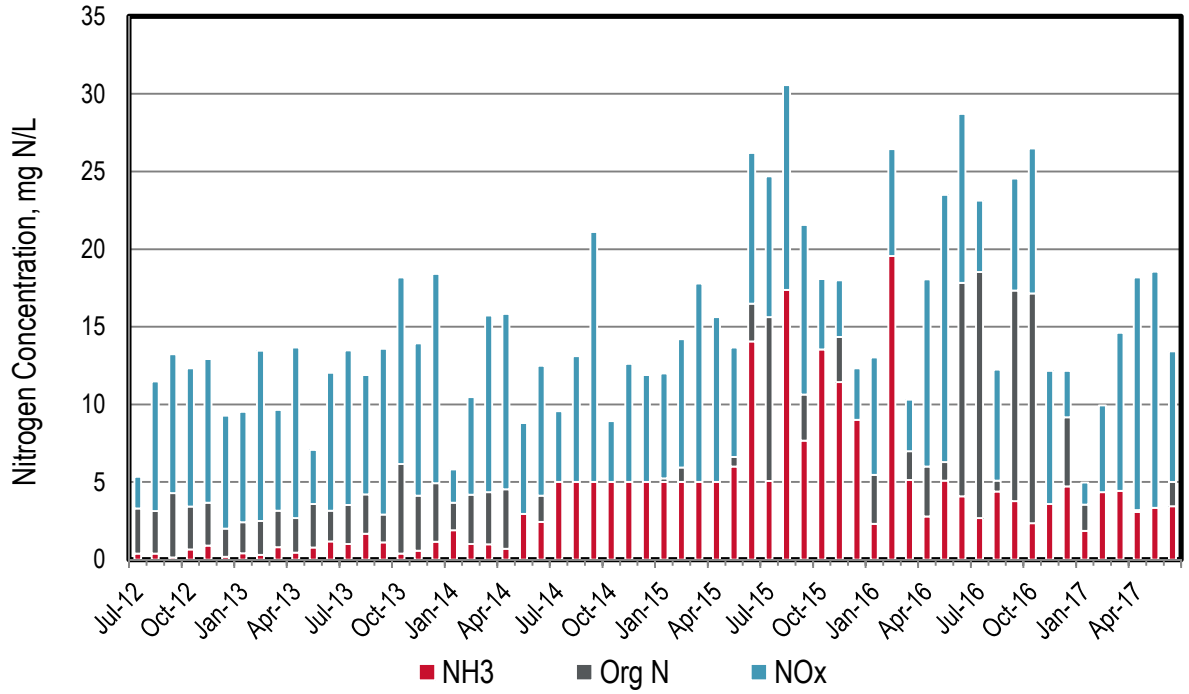


**Figure 32-3. Treasure Island Monthly Nitrogen Concentrations**

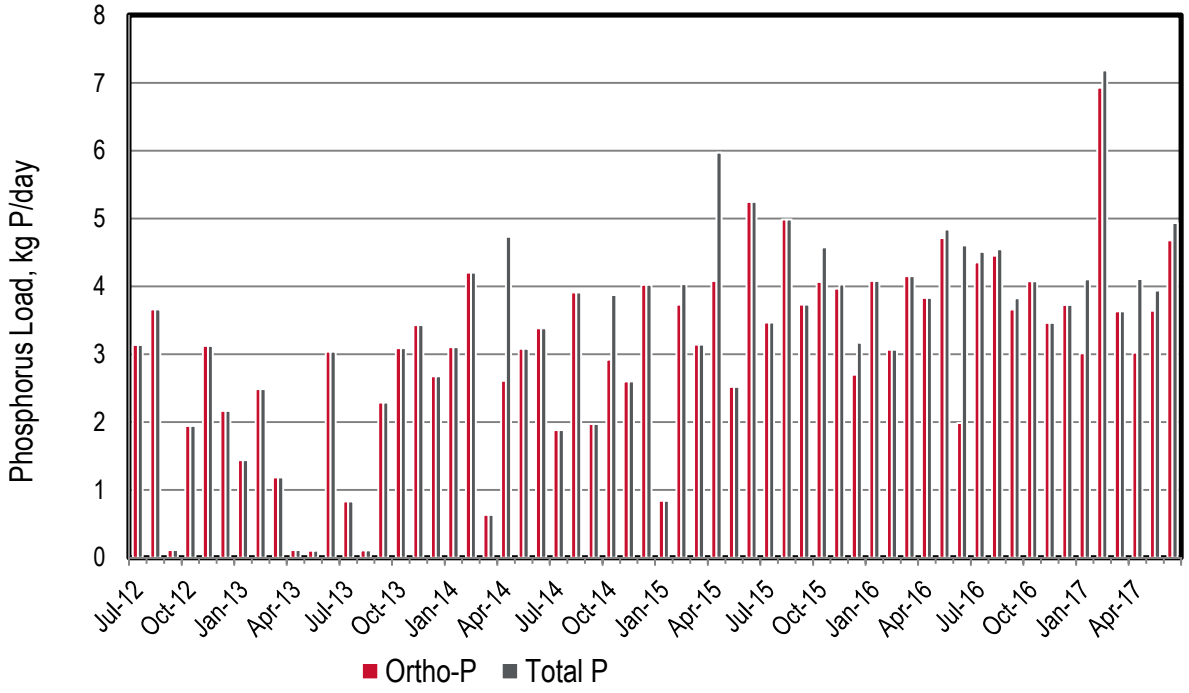


**Figure 32-4. Treasure Island Monthly Phosphorus Loads**

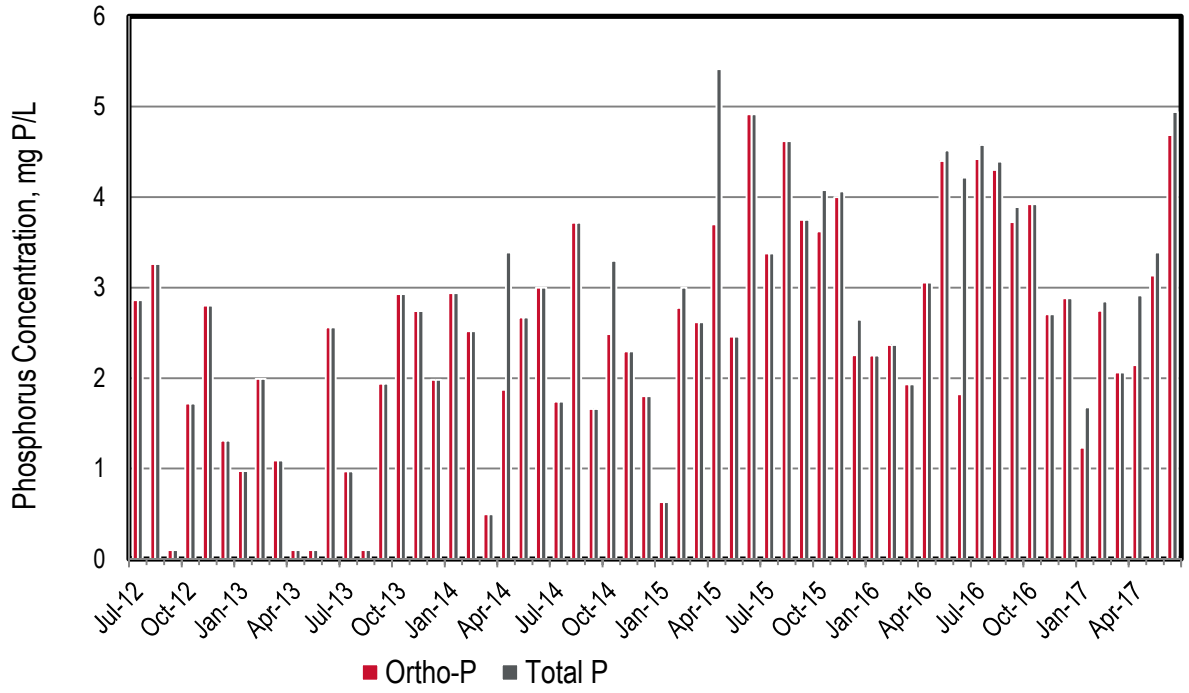


**Figure 32-5. Treasure Island Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 32-1. Treasure Island Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 0.3 | 0 | 4 | 2 | 6 | 4 | 3 |
| Aug-12 | 0.3 | 0 | 4 | 9 | 13 | 4 | 4 |
| Sep-12 | 0.3 | 0 | 5 | 10 | 15 | 3 | 0 |
| Oct-12 | 0.3 | 1 | 4 | 10 | 14 | 4 | 2 |
| Nov-12 | 0.3 | 1 | 4 | 10 | 14 | 4 | 3 |
| Dec-12 | 0.4 | 0 | 3 | 12 | 15 | 3 | 2 |
| Jan-13 | 0.4 | 1 | 4 | 11 | 14 | 3 | 1 |
| Feb-13 | 0.3 | 0 | 3 | 14 | 17 | 4 | 3 |
| Mar-13 | 0.3 | 1 | 3 | 7 | 10 | 3 | 1 |
| Apr-13 | 0.3 | 1 | 3 | 12 | 15 | 4 | 0 |
| May-13 | 0.3 | 1 | 4 | 4 | 7 | 4 | 0 |
| Jun-13 | 0.3 | 1 | 4 | 11 | 14 | 4 | 3 |
| Jul-13 | 0.2 | 1 | 3 | 8 | 12 | 1 | 1 |
| Aug-13 | 0.3 | 2 | 5 | 8 | 13 | 4 | 0 |
| Sep-13 | 0.3 | 1 | 3 | 13 | 16 | 5 | 2 |
| Oct-13 | 0.3 | 0 | 7 | 13 | 19 | 4 | 3 |
| Nov-13 | 0.3 | 1 | 5 | 12 | 17 | 4 | 3 |
| Dec-13 | 0.4 | 2 | 7 | 18 | 25 | 4 | 3 |
| Jan-14 | 0.3 | 2 | 4 | 2 | 6 | 3 | 3 |
| Feb-14 | 0.4 | 2 | 7 | 10 | 17 | 5 | 4 |
| Mar-14 | 0.3 | 1 | 6 | 14 | 20 | 4 | 1 |
| Apr-14 | 0.4 | 1 | 6 | 16 | 22 | 3 | 5 |
| May-14 | 0.3 | 3 | 3 | 7 | 9 | 4 | 3 |
| Jun-14 | 0.3 | 3 | 5 | 9 | 14 | 4 | 3 |
| Jul-14 | 0.3 | 5 | 1 | 5 | 6 | 4 | 2 |
| Aug-14 | 0.3 | 5 | 4 | 9 | 13 | 4 | 4 |
| Sep-14 | 0.3 | 6 | 4 | 19 | 23 | 5 | 2 |
| Oct-14 | 0.3 | 6 | 4 | 5 | 8 | 3 | 4 |
| Nov-14 | 0.3 | 6 | 4 | 9 | 12 | 4 | 3 |
| Dec-14 | 0.6 | 11 | 8 | 15 | 23 | 6 | 4 |
| Jan-15 | 0.4 | 7 | 7 | 9 | 16 | 3 | 1 |
| Feb-15 | 0.4 | 7 | 8 | 11 | 19 | 4 | 4 |
| Mar-15 | 0.3 | 6 | 5 | 15 | 21 | 4 | 3 |
| Apr-15 | 0.3 | 6 | 5 | 12 | 17 | 4 | 6 |
| May-15 | 0.3 | 6 | 7 | 7 | 14 | 4 | 3 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 0.3 | 15 | 18 | 10 | 28 | 6 | 5 |
| Jul-15 | 0.3 | 5 | 16 | 9 | 25 | 5 | 4 |
| Aug-15 | 0.3 | 19 | 16 | 14 | 30 | 5 | 5 |
| Sep-15 | 0.3 | 8 | 11 | 11 | 21 | 4 | 4 |
| Oct-15 | 0.3 | 15 | 15 | 5 | 20 | 4 | 5 |
| Nov-15 | 0.3 | 11 | 14 | 4 | 18 | 4 | 4 |
| Dec-15 | 0.3 | 11 | 9 | 4 | 13 | 3 | 3 |
| Jan-16 | 0.5 | 4 | 10 | 14 | 24 | 4 | 4 |
| Feb-16 | 0.3 | 25 | 8 | 9 | 17 | 3 | 3 |
| Mar-16 | 0.6 | 11 | 15 | 7 | 22 | 6 | 4 |
| Apr-16 | 0.3 | 4 | 8 | 15 | 23 | 4 | 4 |
| May-16 | 0.3 | 6 | 7 | 18 | 25 | 5 | 5 |
| Jun-16 | 0.3 | 5 | 20 | 12 | 31 | 2 | 5 |
| Jul-16 | 0.3 | 3 | 18 | 5 | 23 | 4 | 5 |
| Aug-16 | 0.3 | 5 | 5 | 7 | 13 | 4 | 5 |
| Sep-16 | 0.3 | 4 | 17 | 7 | 24 | 4 | 4 |
| Oct-16 | 0.3 | 2 | 18 | 10 | 28 | 5 | 4 |
| Nov-16 | 0.3 | 5 | 3 | 11 | 14 | 4 | 3 |
| Dec-16 | 0.3 | 6 | 12 | 4 | 16 | 4 | 4 |
| Jan-17 | 0.6 | 5 | 9 | 4 | 12 | 3 | 4 |
| Feb-17 | 0.7 | 11 | 11 | 14 | 25 | 7 | 7 |
| Mar-17 | 0.5 | 8 | 7 | 18 | 25 | 4 | 4 |
| Apr-17 | 0.4 | 4 | 4 | 21 | 26 | 3 | 4 |
| May-17 | 0.3 | 4 | 4 | 18 | 22 | 4 | 4 |
| Jun-17 | 0.3 | 3 | 5 | 8 | 13 | 5 | 5 |
| | | | | | | | |
| **Dry Season Average** | **0.3** | **4** | **8** | **10** | **17** | **4** | **3** |
| **Dry Season Trend ** **** | **None** | **Up** | **Up** | **None** | **Up** | **-** | **-** |
| **Wet Season Average** | **0.4** | **5** | **7** | **11** | **18** | **4** | **3** |
| **Average Annual** | **0.3** | **5** | **7** | **10** | **18** | **4** | **3** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue. Statistical trending was not performed on TP due to the analytical methodology issue discussed in with the bullet points.

# 33 Vallejo Flood and Wastewater District

Vallejo discharges to San Pablo Bay and it has approximately 37,845 service connections. The plant has a permitted ADWF capacity of 15.5 mgd and a peak wet weather capacity of 60 mgd. The current flows are approximately 8.6 mgd ADWF. The plant performs secondary treatment using a trickling filter/solids contact process.

The following observations are made based upon the figures and table in the subsequent pages:

- Previous average monthly trends suggested a downward trend for flows in the dry season attributed to a combination of water conservation and the drought. With the inclusion of last year's data no significant trend is visible, which reflects increased water usage likely due to higher rainfall during the wet season.
- There appears to be an upward dry season trend for all nitrogen species except for NOx, which is downward trending
- Ammonia and NOx had approximately a 50:50 split in TN species during the first couple years of data. Over the last three years, ammonia makes up the majority of the nitrogen species. It appears that the plant performed partial nitrification up until the influent loads exceeded any nitrification capacity over the last year.
- Phosphorus loads had remained relatively flat over the years, but last year's data seems to indicate more variation.
- The distribution of phosphorus species is predominantly ortho-P.
- The phosphorus concentrations range from 1.3 to 5.3 mg P/L, which is lower than typical effluent TP concentrations of 4 to 6 mg P/L.

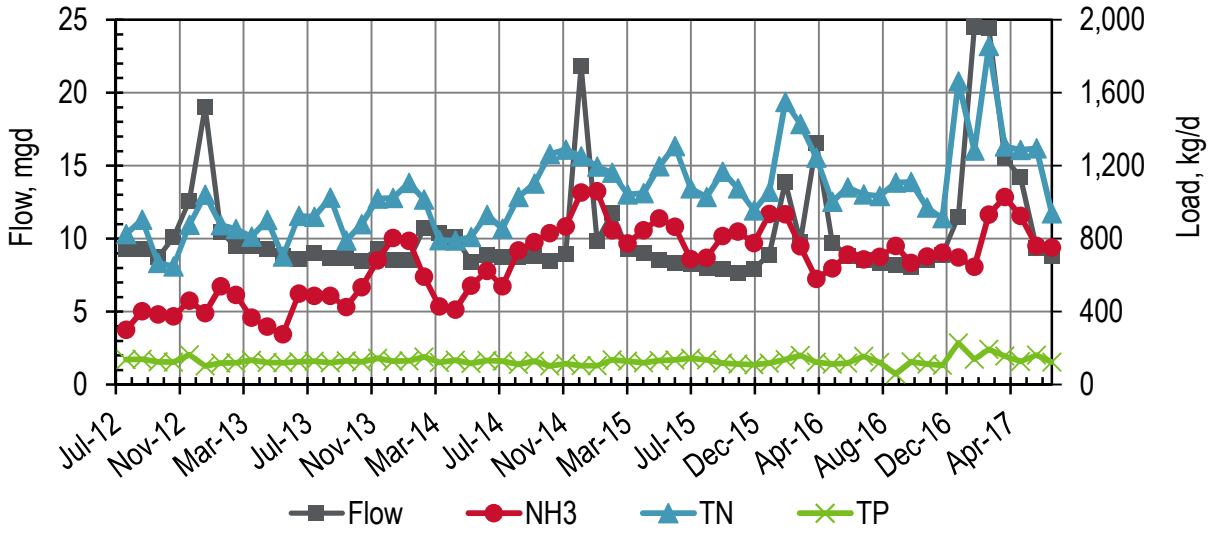


**Figure 33-1. Vallejo Monthly Flows and Loads**

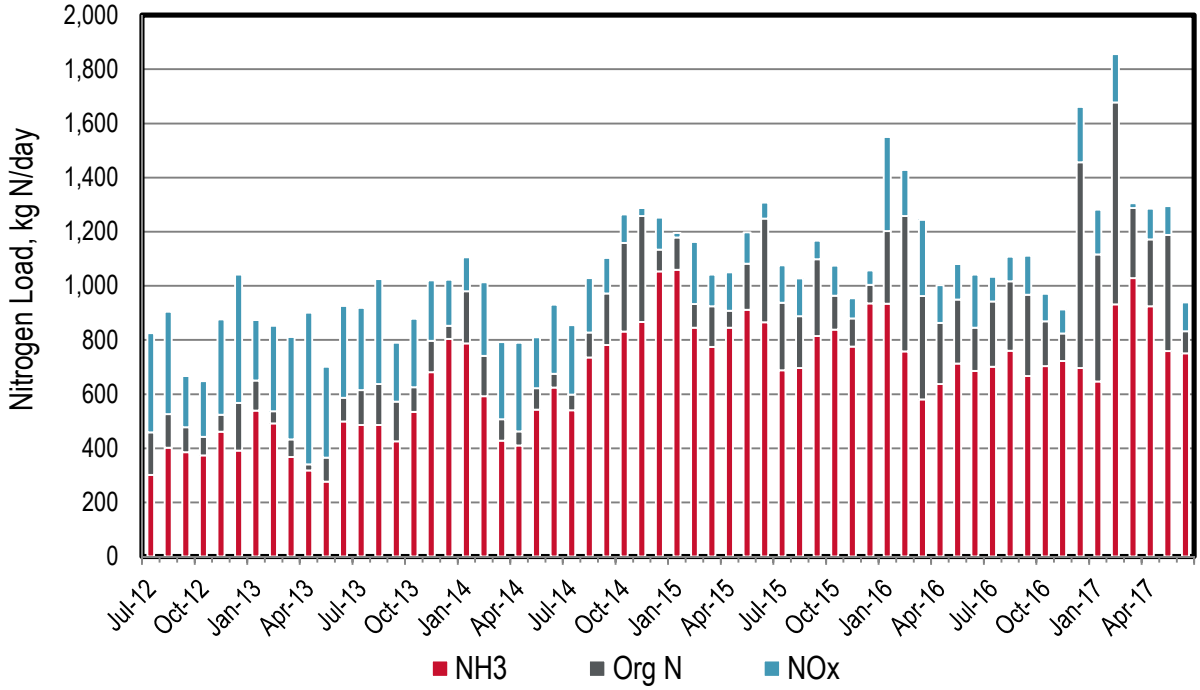


**Figure 33-2. Vallejo Monthly Nitrogen Loads**

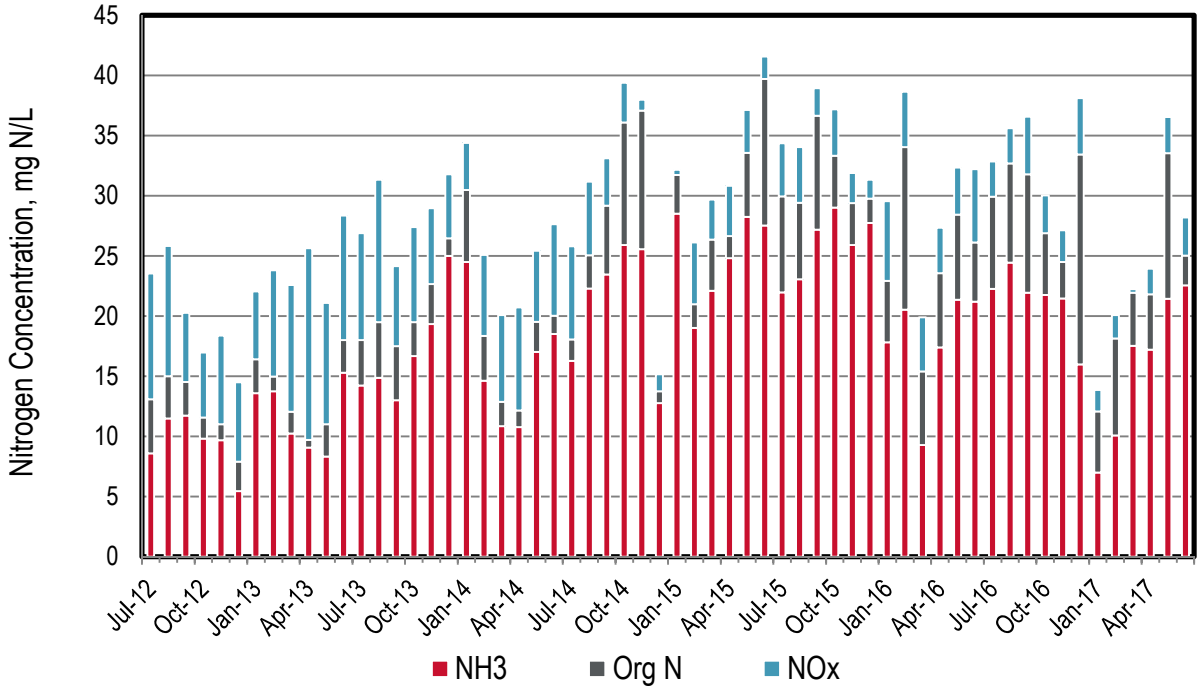


**Figure 33-3. Vallejo Monthly Nitrogen Concentrations**

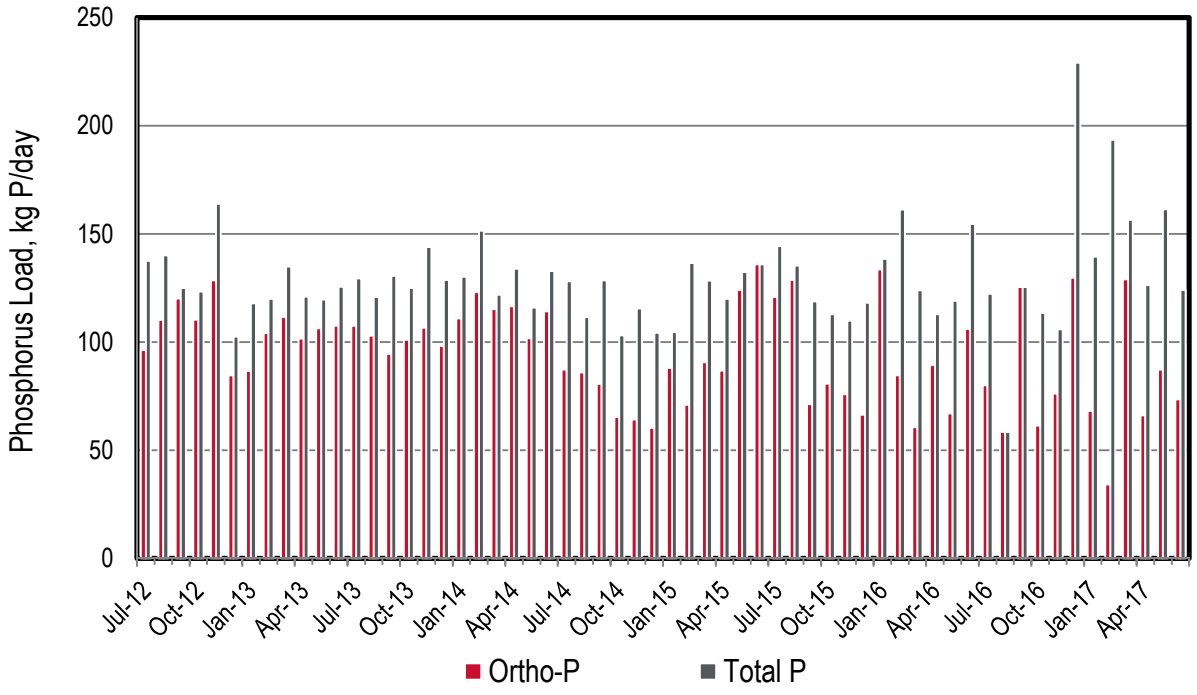


**Figure 33-4. Vallejo Monthly Phosphorus Loads**

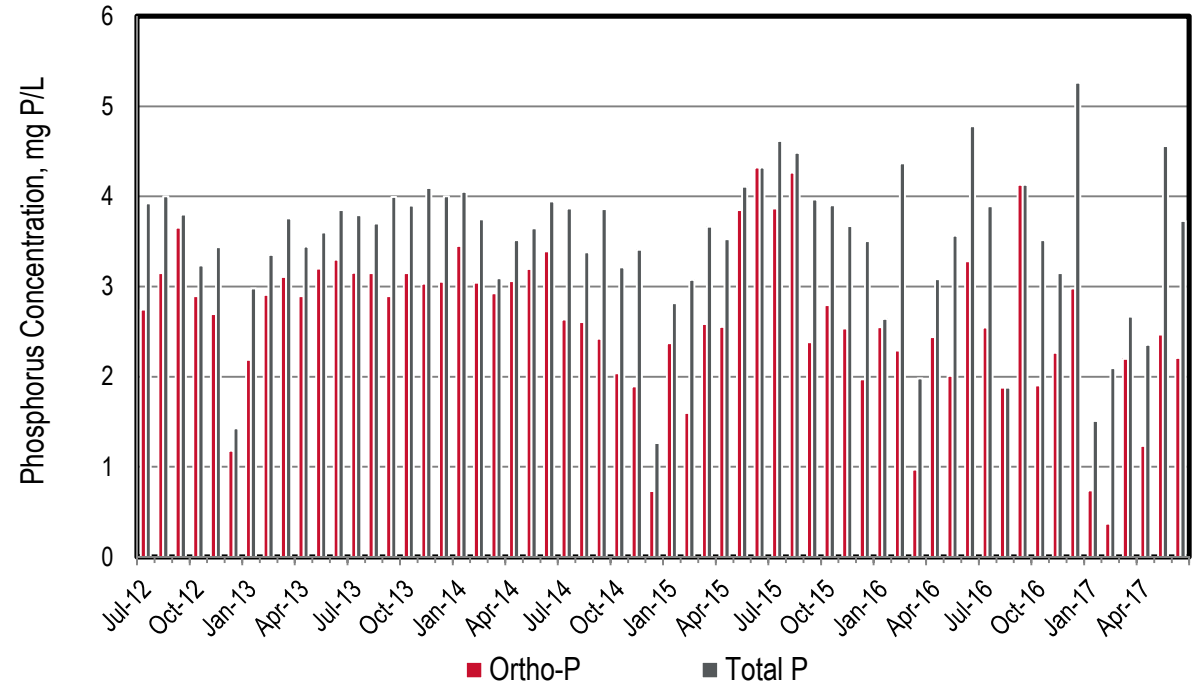


**Figure 33-5. Vallejo Monthly Phosphorus Concentrations**

## Table 33-1. Vallejo Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 9.3 | 302 | 459 | 367 | 826 | 96 | 138 |
| Aug-12 | 9.3 | 402 | 526 | 379 | 905 | 110 | 140 |
| Sep-12 | 8.7 | 386 | 477 | 190 | 667 | 120 | 125 |
| Oct-12 | 10.1 | 374 | 442 | 206 | 648 | 110 | 123 |
| Nov-12 | 12.6 | 461 | 524 | 352 | 876 | 129 | 164 |
| Dec-12 | 19.0 | 391 | 567 | 474 | 1,041 | 85 | 103 |
| Jan-13 | 10.5 | 539 | 651 | 224 | 874 | 87 | 118 |
| Feb-13 | 9.5 | 492 | 536 | 317 | 853 | 104 | 120 |
| Mar-13 | 9.5 | 368 | 432 | 379 | 812 | 112 | 135 |
| Apr-13 | 9.3 | 318 | 341 | 561 | 901 | 102 | 121 |
| May-13 | 8.8 | 276 | 366 | 336 | 701 | 106 | 120 |
| Jun-13 | 8.6 | 499 | 587 | 338 | 925 | 108 | 126 |
| Jul-13 | 9.0 | 486 | 615 | 304 | 919 | 108 | 130 |
| Aug-13 | 8.7 | 486 | 638 | 387 | 1,025 | 103 | 121 |
| Sep-13 | 8.7 | 426 | 573 | 218 | 790 | 95 | 131 |
| Oct-13 | 8.5 | 535 | 625 | 253 | 879 | 101 | 125 |
| Nov-13 | 9.3 | 681 | 797 | 222 | 1,020 | 107 | 144 |
| Dec-13 | 8.5 | 804 | 852 | 171 | 1,023 | 98 | 129 |
| Jan-14 | 8.5 | 788 | 980 | 126 | 1,106 | 111 | 130 |
| Feb-14 | 10.7 | 592 | 742 | 272 | 1,014 | 123 | 152 |
| Mar-14 | 10.4 | 428 | 507 | 285 | 792 | 115 | 122 |
| Apr-14 | 10.1 | 410 | 463 | 327 | 790 | 117 | 134 |
| May-14 | 8.4 | 542 | 621 | 188 | 810 | 102 | 116 |
| Jun-14 | 8.9 | 624 | 675 | 256 | 931 | 114 | 133 |
| Jul-14 | 8.8 | 540 | 599 | 256 | 855 | 87 | 128 |
| Aug-14 | 8.7 | 736 | 827 | 201 | 1,028 | 86 | 112 |
| Sep-14 | 8.8 | 781 | 972 | 131 | 1,103 | 81 | 129 |
| Oct-14 | 8.5 | 831 | 1,159 | 105 | 1,264 | 65 | 103 |
| Nov-14 | 9.0 | 867 | 1,258 | 30 | 1,288 | 64 | 116 |
| Dec-14 | 21.8 | 1,053 | 1,134 | 118 | 1,252 | 60 | 104 |
| Jan-15 | 9.8 | 1,059 | 1,179 | 16 | 1,195 | 88 | 105 |
| Feb-15 | 11.8 | 846 | 933 | 229 | 1,162 | 71 | 137 |
| Mar-15 | 9.3 | 775 | 925 | 117 | 1,042 | 91 | 129 |
| Apr-15 | 9.0 | 846 | 908 | 142 | 1,050 | 87 | 120 |
| May-15 | 8.5 | 911 | 1,082 | 115 | 1,198 | 124 | 132 |
| Jun-15 | 8.3 | 865 | 1,249 | 59 | 1,307 | 143 | 136 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-15 | 8.3 | 688 | 937 | 138 | 1,075 | 121 | 144 |
| Aug-15 | 8.0 | 696 | 888 | 140 | 1,028 | 129 | 135 |
| Sep-15 | 7.9 | 815 | 1,099 | 68 | 1,167 | 71 | 119 |
| Oct-15 | 7.6 | 839 | 964 | 111 | 1,075 | 81 | 113 |
| Nov-15 | 7.9 | 776 | 880 | 74 | 954 | 76 | 110 |
| Dec-15 | 8.9 | 935 | 1,004 | 53 | 1,057 | 66 | 118 |
| Jan-16 | 13.9 | 934 | 1,202 | 348 | 1,550 | 134 | 138 |
| Feb-16 | 9.8 | 758 | 1,258 | 170 | 1,428 | 85 | 161 |
| Mar-16 | 16.6 | 580 | 963 | 281 | 1,244 | 61 | 124 |
| Apr-16 | 9.7 | 637 | 863 | 139 | 1,002 | 89 | 113 |
| May-16 | 8.8 | 713 | 949 | 131 | 1,081 | 67 | 119 |
| Jun-16 | 8.6 | 686 | 845 | 197 | 1,042 | 106 | 155 |
| Jul-16 | 8.3 | 701 | 942 | 92 | 1,034 | 80 | 122 |
| Aug-16 | 8.2 | 760 | 1,017 | 91 | 1,108 | 68 | 58 |
| Sep-16 | 8.0 | 667 | 967 | 145 | 1,112 | 129 | 126 |
| Oct-16 | 8.5 | 703 | 869 | 102 | 971 | 61 | 114 |
| Nov-16 | 8.9 | 722 | 825 | 88 | 913 | 76 | 106 |
| Dec-16 | 11.5 | 696 | 1,457 | 205 | 1,661 | 130 | 229 |
| Jan-17 | 24.5 | 646 | 1,116 | 166 | 1,282 | 68 | 140 |
| Feb-17 | 24.4 | 931 | 1,677 | 178 | 1,856 | 34 | 193 |
| Mar-17 | 15.5 | 1,028 | 1,288 | 17 | 1,305 | 129 | 157 |
| Apr-17 | 14.2 | 924 | 1,171 | 114 | 1,286 | 66 | 126 |
| May-17 | 9.4 | 760 | 1,188 | 107 | 1,295 | 87 | 161 |
| Jun-17 | 8.8 | 751 | 833 | 106 | 939 | 74 | 124 |
| | | | | | | | |
| **Dry Season Average** | **8.6** | **620** | **797** | **198** | **995** | **101** | **127** |
| **Dry Season Trend **** | **None** | **Up** | **Up** | **Down** | **Up** | **-** | **None** |
| **Wet Season Average** | **11.6** | **702** | **900** | **199** | **1,099** | **91** | **131** |
| **Average Annual** | **10.4** | **668** | **857** | **199** | **1,056** | **95** | **129** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.

# 34 West County Agency Outfall

West County is a common outfall and discharge permit between West County and the City of Richmond which discharges to the Central Bay. They have a combined permitted capacity of 28.5 mgd ADWF (12.5 mgd ADWF for West County and 16.0 mgd ADWF for the City of Richmond) and a combined wet weather capacity of 41 mgd (21.5 mgd for West County and 20.0 mgd for the City of Richmond). The Richmond plant has wet weather capacity greater than 20 mgd though only 20 mgd for full secondary treatment. The current discharge flows are approximately 7.0 mgd ADWF. The Richmond plant performs secondary treatment using activated sludge, whereas the West County plant nitrifies using a roughing filter, followed by an activated sludge process.

The following observations are made based upon the figures and table in the subsequent pages:

- The Richmond Plant represents the majority of the discharge flow and load (data not shown). The West County Plant recycles a majority of their flows year-round.
- Based on the table with the average monthly values, there appears to be an emerging dry season upward trend for all data where trend analysis was performed: flow, nitrogen species and total phosphorus.
- Wet season nitrogen and phosphorus loads are typically greater and more variable than the dry season loads.
- Ammonia is the majority of the nitrogen species discharged, regardless of season. This would be expected since the Richmond Plant represents the majority of the discharge load and they do not nitrify. Additionally, West County sends landfill leachate rich in ammonia from their plant to the City of Richmond plant which contributes to the discharge loading.
- Ortho-P values are occasionally greater than TP values for the Section 13257 Letter based on the composite sampling issue discussed in the main report body. Since the Regional Watershed Permit sampling began (July, 2014), the ortho-P values has only exceeded the TP value twice. For such instances, ortho-P values were set equal to TP for the plots. The reported ortho-P values were, however, used for the data table.
- Total phosphorus concentrations vary between 0.6 to 3.7 mg P/L. Such values suggest P removal as typical effluent TP concentrations range from 4 to 6 mg P/L. There are no P removal facilities at the Richmond Plant so additional sampling is recommended to confirm where P removal is occurring.

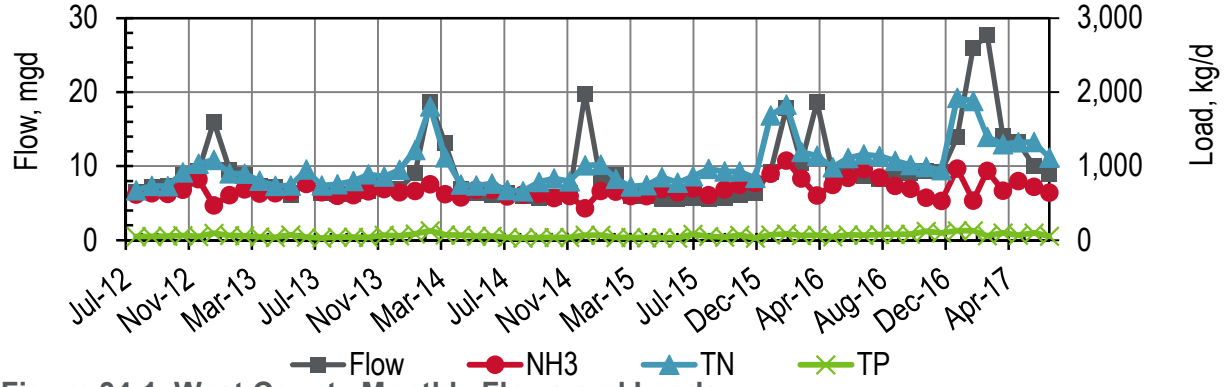


**Figure 34-1. West County Monthly Flows and Loads**

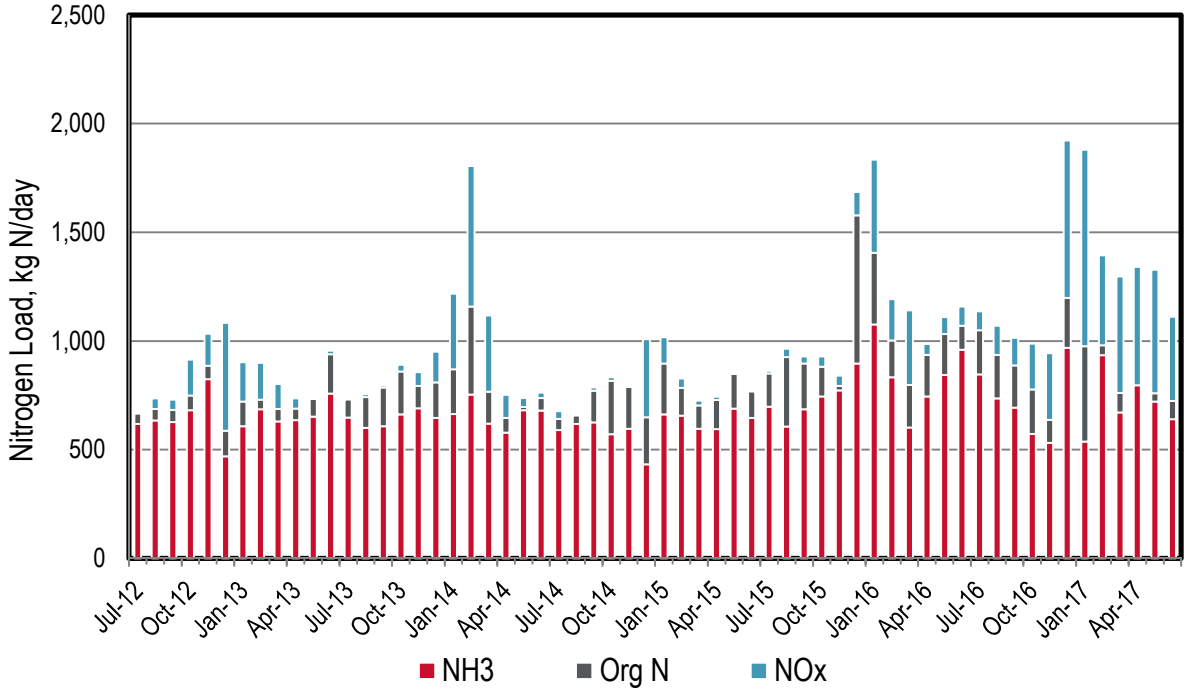


**Figure 34-2. West County Monthly Nitrogen Loads**

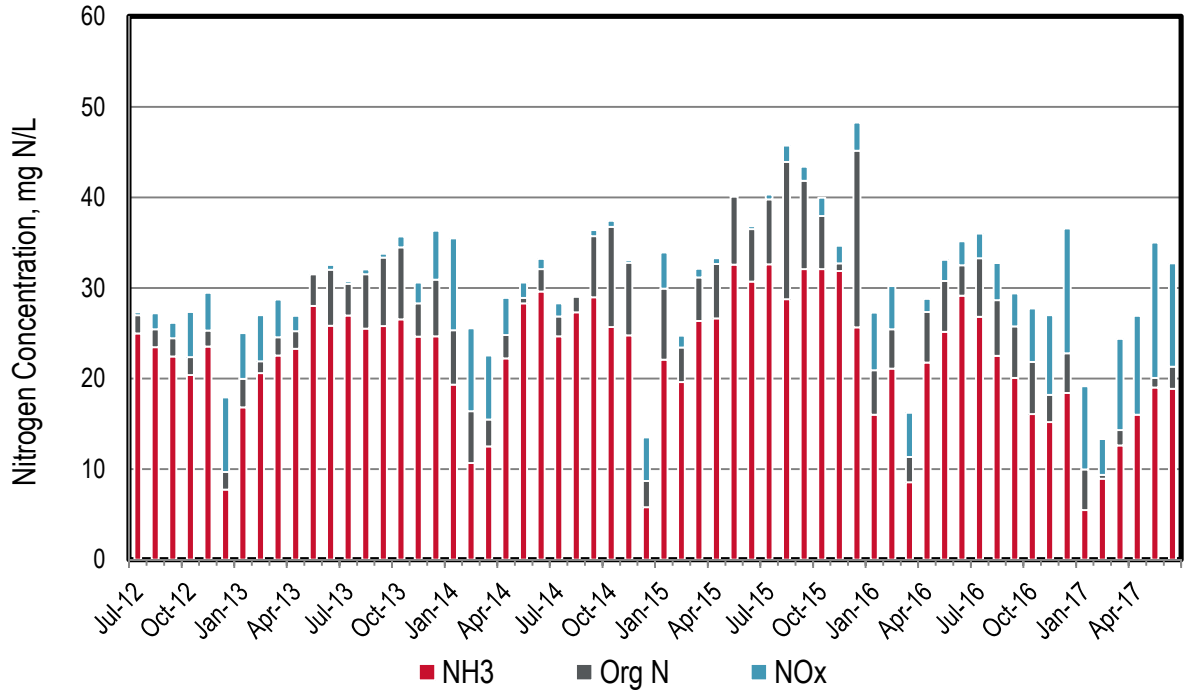


**Figure 34-3. West County Monthly Nitrogen Concentrations**

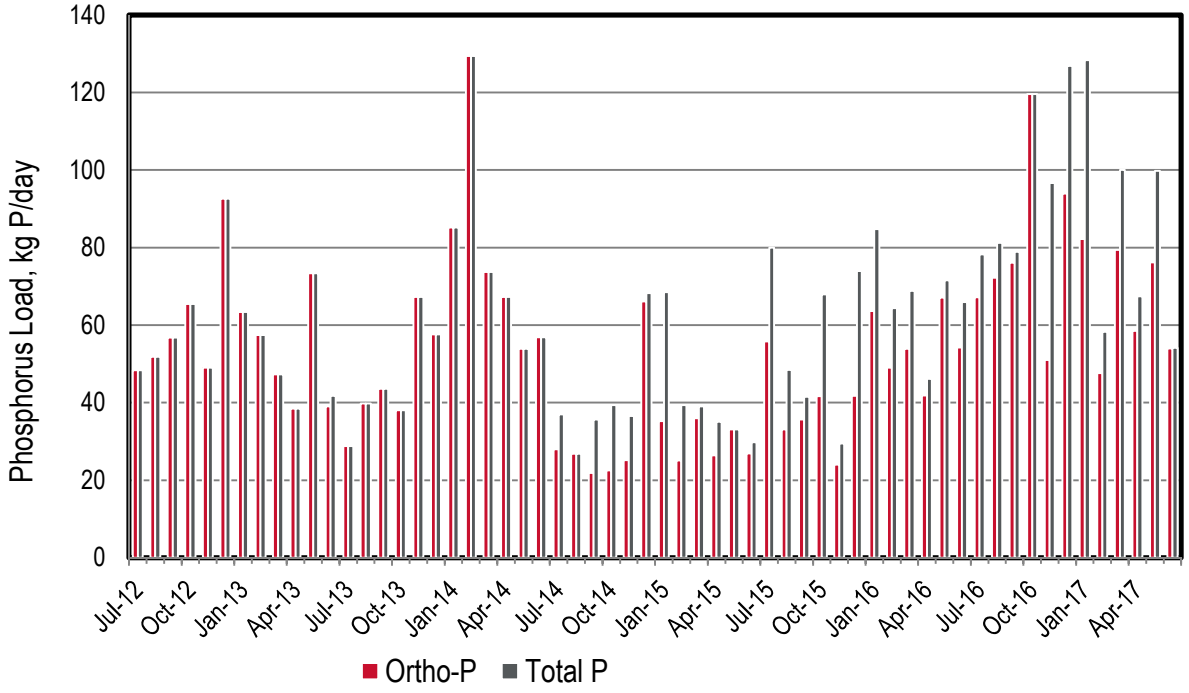


**Figure 34-4. West County Monthly Phosphorus Loads**

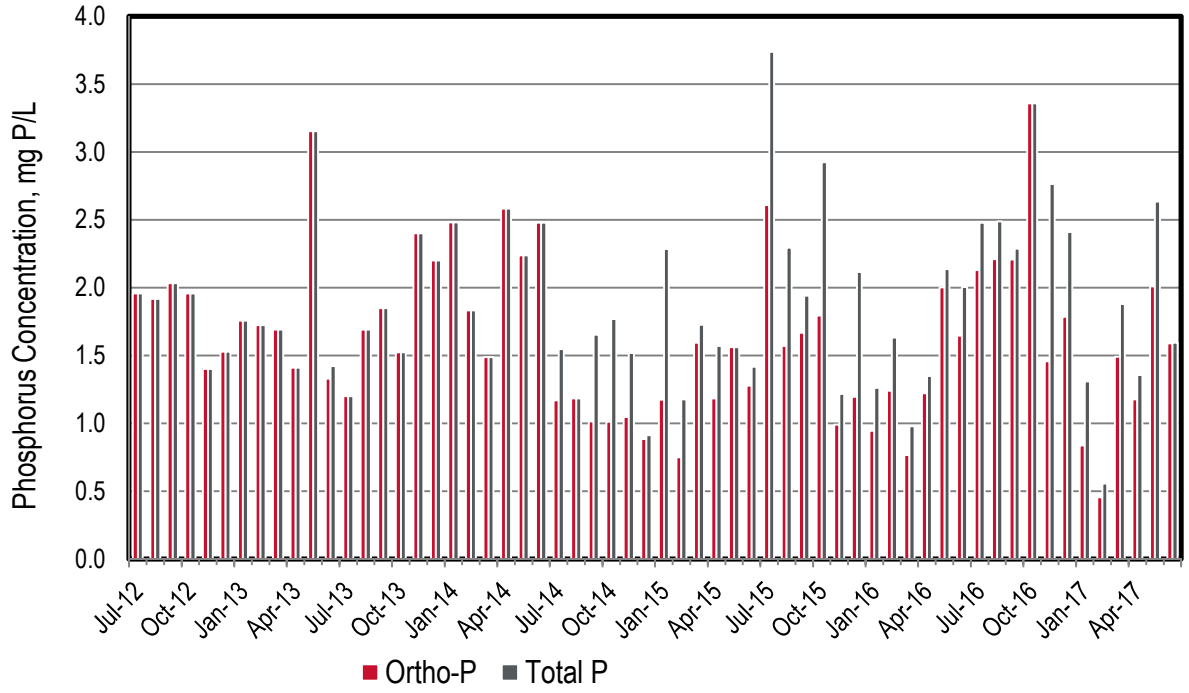


**Figure 34-5. West County Monthly Phosphorus Concentrations**

In the graphs above, where ortho-P exceeded the TP, ortho-P has been set equal to the TP.

## Table 34-1. West County Monthly Flows and Loads

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jul-12 | 6.5 | 618 | 667 | 8 | 675 | 88 | 48 |
| Aug-12 | 7.2 | 634 | 688 | 48 | 736 | 85 | 52 |
| Sep-12 | 7.4 | 627 | 683 | 47 | 730 | 99 | 57 |
| Oct-12 | 8.9 | 682 | 749 | 166 | 914 | 96 | 65 |
| Nov-12 | 9.3 | 824 | 887 | 147 | 1,033 | 76 | 49 |
| Dec-12 | 16.0 | 470 | 587 | 497 | 1,084 | 121 | 93 |
| Jan-13 | 9.5 | 607 | 721 | 182 | 903 | 68 | 63 |
| Feb-13 | 8.8 | 686 | 730 | 169 | 899 | 96 | 57 |
| Mar-13 | 7.4 | 631 | 687 | 116 | 803 | 62 | 47 |
| Apr-13 | 7.2 | 635 | 688 | 47 | 735 | 54 | 38 |
| May-13 | 6.2 | 652 | 733 | 3 | 736 | 103 | 73 |
| Jun-13 | 7.8 | 758 | 940 | 15 | 955 | 39 | 42 |
| Jul-13 | 6.4 | 648 | 732 | 6 | 738 | 29 | 29 |
| Aug-13 | 6.2 | 601 | 742 | 13 | 754 | 61 | 40 |
| Sep-13 | 6.2 | 608 | 786 | 10 | 796 | 48 | 44 |
| Oct-13 | 6.6 | 662 | 860 | 30 | 890 | 59 | 38 |
| Nov-13 | 7.4 | 690 | 794 | 64 | 857 | 92 | 67 |
| Dec-13 | 6.9 | 646 | 809 | 141 | 950 | 82 | 58 |
| Jan-14 | 9.1 | 664 | 870 | 348 | 1,218 | 108 | 85 |
| Feb-14 | 18.7 | 753 | 1,158 | 647 | 1,805 | 166 | 129 |
| Mar-14 | 13.1 | 620 | 767 | 349 | 1,117 | 92 | 74 |
| Apr-14 | 6.9 | 579 | 646 | 106 | 753 | 127 | 67 |
| May-14 | 6.4 | 681 | 696 | 40 | 737 | 73 | 54 |
| Jun-14 | 6.1 | 680 | 737 | 26 | 763 | 91 | 57 |
| Jul-14 | 6.3 | 590 | 642 | 35 | 677 | 28 | 37 |
| Aug-14 | 6.0 | 618 | 657 | 4 | 661 | 27 | 27 |
| Sep-14 | 5.7 | 626 | 771 | 15 | 786 | 22 | 36 |
| Oct-14 | 5.9 | 571 | 817 | 15 | 832 | 23 | 39 |
| Nov-14 | 6.4 | 596 | 789 | 7 | 796 | 25 | 37 |
| Dec-14 | 19.8 | 433 | 650 | 358 | 1,008 | 66 | 68 |
| Jan-15 | 7.9 | 662 | 897 | 121 | 1,018 | 35 | 68 |
| Feb-15 | 8.8 | 656 | 784 | 43 | 827 | 25 | 39 |
| Mar-15 | 6.0 | 596 | 704 | 22 | 726 | 36 | 39 |
| Apr-15 | 5.9 | 595 | 729 | 15 | 744 | 26 | 35 |
| May-15 | 5.6 | 689 | 849 | 2 | 849 | 40 | 33 |

| Month, Year | Flow mgd | Ammonia kg N/day | TKN kg N/day | NOx kg N/day | Total N kg N/day * | Ortho-P kg P/day | Total P kg P/day |
|---|---|---|---|---|---|---|---|
| Jun-15 | 5.6 | 646 | 768 | 7 | 775 | 27 | 30 |
| Jul-15 | 5.7 | 697 | 851 | 12 | 862 | 56 | 80 |
| Aug-15 | 5.6 | 606 | 926 | 38 | 965 | 33 | 48 |
| Sep-15 | 5.7 | 686 | 896 | 33 | 929 | 36 | 42 |
| Oct-15 | 6.1 | 745 | 882 | 46 | 928 | 42 | 68 |
| Nov-15 | 6.4 | 772 | 793 | 47 | 840 | 24 | 29 |
| Dec-15 | 9.2 | 896 | 1,578 | 108 | 1,686 | 42 | 74 |
| Jan-16 | 17.8 | 1,076 | 1,406 | 427 | 1,833 | 64 | 85 |
| Feb-16 | 10.4 | 833 | 1,003 | 189 | 1,192 | 49 | 64 |
| Mar-16 | 18.6 | 602 | 797 | 344 | 1,141 | 54 | 69 |
| Apr-16 | 9.1 | 745 | 936 | 50 | 986 | 42 | 46 |
| May-16 | 8.9 | 843 | 1,032 | 77 | 1,109 | 67 | 72 |
| Jun-16 | 8.7 | 960 | 1,070 | 88 | 1,158 | 54 | 66 |
| Jul-16 | 8.3 | 846 | 1,050 | 86 | 1,136 | 67 | 78 |
| Aug-16 | 8.6 | 736 | 936 | 134 | 1,070 | 72 | 81 |
| Sep-16 | 9.1 | 693 | 888 | 126 | 1,014 | 76 | 79 |
| Oct-16 | 9.4 | 572 | 777 | 210 | 988 | 161 | 120 |
| Nov-16 | 9.3 | 531 | 637 | 308 | 944 | 51 | 97 |
| Dec-16 | 13.9 | 968 | 1,198 | 725 | 1,923 | 94 | 127 |
| Jan-17 | 25.9 | 536 | 977 | 903 | 1,879 | 82 | 128 |
| Feb-17 | 27.7 | 935 | 981 | 414 | 1,395 | 48 | 58 |
| Mar-17 | 14.1 | 671 | 761 | 536 | 1,297 | 79 | 100 |
| Apr-17 | 13.2 | 796 | 776 | 544 | 1,320 | 59 | 67 |
| May-17 | 10.0 | 721 | 760 | 567 | 1,328 | 76 | 100 |
| Jun-17 | 9.0 | 641 | 724 | 388 | 1,112 | 54 | 54 |
| | | | | | | | |
| **Dry Season Average** | **7.0** | **684** | **809** | **73** | **882** | **58** | **54** |
| **Dry Season Trend **** | **Up** | **Up** | **Up** | **Up** | **Up** | **-** | **Up** |
| **Wet Season Average** | **11.1** | **684** | **852** | **241** | **1,093** | **69** | **68** |
| **Average Annual** | **9.4** | **684** | **834** | **171** | **1,005** | **65** | **62** |

* The Total Nitrogen value is calculated by adding the TKN and the NOx values.

** Refer to the Section 3.5 in the main body for a description on the statistical analysis. Statistical trending was not performed on ortho-P due to differences in sampling requirements between the Section 13267 Letter data and the Nutrient Watershed Permit. Refer to Section 3.2 in the main report for a detailed discussion on this issue.