City of San José

San José/Santa Clara Water Pollution Control Plant Master Plan

TASK NO. 3
PROJECT MEMORANDUM NO. 3
EXISTING TREATMENT PLANT PERFORMANCE

FINAL DRAFT
July 2009

in association with

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CITY OF SAN JOSÉ

SAN JOSÉ/SANTA CLARA WATER POLLUTION CONTROL PLANT MASTER PLAN

TASK NO. 3
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EXISTING TREATMENT PLANT PERFORMANCE

1.0 INTRODUCTION

This project memorandum (PM) reviews the overall performance of the San José/Santa Clara Water Pollution Control Plant (WPCP) and the performance of its individual treatment processes from 2000 to 2007. The WPCP's compliance with its National Pollution Discharge Elimination System (NPDES) requirements is also documented.

The existing treatment performance will be critical in evaluating the WPCP's ability to meet future capacity needs and regulatory requirements, and is critical in the planning of new facilities. The process performance presented herein will be used in PMs 3.4 and 3.5 to validate and establish sizing criteria for use in planning for future treatment needs.

2.0 BASIS OF EVALUATION OF TREATMENT PLANT PERFORMANCE

The various wastewater flow and load definitions used as the basis for evaluating treatment performance in this PM are listed and defined in Table 1, along with the purpose each will serve in planning for future facilities. The analysis period over which performance has been evaluated is from January 2000 to December 2007. Historical process loadings and criteria presented in this PM are based on reported data provided by the City of San José (City). For some parameters, data was not available for the entire analysis period, and therefore, the data that is available is presented.

The WPCP NPDES discharge permit (Permit CA0037842) was issued in 2003 by the San Francisco Regional Water Quality Control Board (RWQCB). The permit requirements are presented in Table 2. A Draft Permit was issued in August 2008. A comparison between the existing and Draft Permit is presented in PM 4.1.

The WPCP permit compliance for each of the regulated constituents is discussed in the subsequent sections.

3.0 OVERALL TREATMENT PLANT PERFORMANCE

In the following sections, the overall WPCP performance with respect to treatment of Biochemical Oxygen Demand (BOD), TSS, ammonia-nitrogen, oil and grease, pathogens, metals, and monitored organics will be reviewed. Characteristics of other regulated constituents in the treated effluent such as chlorine residual, temperature, and pH are also reviewed.

Table 1	Wastewater Flow and Loading Definitions San José/Santa Clara Water Pollution Control Plant Master Plan City of San José	
Term	**Definition**	**Purpose**
Wastewater Flow Definitions		
ADWIF	<u>Average Dry Weather Influent Flow</u> The average daily flow over any five weekday period between the months of June and October. The maximum of the weekday averages is reported for permit compliance.	To assess future permit compliance.
ADWF[(1)]	<u>Average Dry Weather Flow</u> The average daily influent flow occurring over the three consecutive lowest flow months in the dry weather season (May through October).	To develop base wastewater flow projections and to provide the basis for sizing certain treatment facilities. Also used to evaluate taking various process units out of service.
ADWEF	<u>Average Dry Weather Effluent Flow</u> The average daily effluent flow occurring over the three consecutive lowest flow months in the dry weather season (May through October).	To assess future permit compliance.
ADAF	<u>Average Daily Annual Flow</u> The average daily flow or loading for an annual period.	To evaluate annual power use.
ADMMF	<u>Average Daily Maximum Month Flow</u> The average daily flow occurring during the peak flow month of the year. Peak flow and peak loadings do not necessarily have to occur in the same month. ADMMF typically occurs in the wet season (November through April).	To size wastewater treatment facilities to meet 30-day National Pollutant Discharge Elimination System (NPDES) permit requirements.
PHWWF	<u>Peak Hour Wet Weather Flow</u> The peak hour flow resulting from a rainfall event.	To set plant hydraulic capacity.
MDWWF	<u>Maximum Day Wet Weather Flow</u> The maximum daily flow occurring in the wet season (November through April).	Used to evaluate ability to meet daily max permit limits.
Wastewater Load Definitions		
ADWL	<u>Average Dry Weather Load</u> The average daily loading occurring over the three consecutive lowest flow months in the dry weather season (May through October)	To develop base wastewater load projections and to provide the basis for sizing certain treatment

Table 1 Wastewater Flow and Loading Definitions
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

		facilities.
ADAL	Average Daily Annual Load The average daily loading for an annual period.	To size certain solids facilities (such as lagoons and drying beds) and evaluate annual power use.
ADMML	Average Daily Maximum Month Load The average daily organic or suspended solids loading occurring during the peak loading month of the year. Peak flow and peak loadings do not necessarily have to occur in the same month.	To size wastewater treatment facilities to meet 30-day NPDES permit requirements and sizing for various solids handling facilities including digesters and thickening equipment.
MDDWL	Maximum Day Dry Weather Load The maximum day loading occurring during the dry weather season (May through October).	Together with consideration of diurnal variation, often used to determine aeration demands as well as to check max day requirements.
MDWWL	Maximum Day Wet Weather Load The maximum daily loading occurring in the wet season (November through April).	Together with consideration of diurnal variation, often used to determine aeration demands as well as to check max day requirements.
MWWWL	Maximum Week Wet Weather Load The maximum week loading occurring in the wet season (November through April).	Used in a biological nutrient removal plant to determine the solids retention time for nitrification and denitrification

Note:

(1) This definition for ADWF is equivalent to the Average Dry Weather Effluent Flow (ADWEF) in the WPCP NPDES Permit (No. CA0037842). In this PM, the ADWF averaging period is also used for influent flows (and loads in PM 3.2) for the purpose of developing base wastewater flow and load projections and to size treatment facilities.

Table 2 Current WPCP NPDES Permit Effluent Requirements
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Constituent	Units	Monthly Average	Daily Maximum	Instantaneous Maximum	Total Monthly	Range
Carbonaceous Biochemical Oxygen Demand (CBOD)	mg/L 10		20	NA	NA	NA
Ammonia-Nitrogen mg/L		3	8	NA	NA	NA
Total Suspended Solids (TSS)	mg/L 10		20	NA	NA	NA
Oil and Grease	mg/L	5	10	NA	NA	NA
Settleable Matter	mg/L-hr	0.1	0.2	NA	NA	NA
Turbidity NTU		NA	NA	10	NA	NA
Chlorine Residual	mg/L	NA	NA	0.0[1]	NA NA	
pH	-	NA	NA	NA	NA	6.5 - 8.5
Copper	μg/L	12 18		NA	NA	NA
Mercury[2]	μg/L	0.012 2.1		NA	0.23[3]	NA
Nickel	μg/L	25 34		NA	NA	NA
4,4-DDE[2]	μg/L	NA 0.05		NA	NA	NA
Dieldrin[2]	μg/L	NA 0.01		NA	NA	NA
Heptachlor Epoxide[2]	μg/L	NA 0.01		NA	NA	NA
Benzo(b) Fluoranthene[2]	μg/L	NA 10.0		NA	NA	NA
Indeno(1,2,3-cd)Pyrene[2]	μg/L	NA 0.05		NA	NA	NA
Enterococcus C	olonies/100 mL	35[4] NA		276	NA	NA

Notes:

NA = Not Available.

(1) Requirement defined as below the limit of detection in standard test methods defined in the latest Environmental Protection Agency (EPA) approved edition of Standard Methods for the Examination of Water and Wastewater.

(2) Interim Limits, valid until October 31, 2008, or until the San Francisco Bay Regional Water Quality Control Board (RWQCB) amends the limitations based on additional data, site-specific objective, or the waste load allocation (WLA) in respective total maximum daily loads (TMDLs).

(3) Dry weather months (May through October), the total mercury mass load shall not exceed the mercury mass emission limitation of 0.231 kilogram per month (kg/month).

(4) Geometric mean.

Data was collected, as available from January 1998 to December 2007. However, due to change in the configuration and operation of the secondary process at the WPCP starting in 2000, only performance and loading data from January 2000 to December 2007 was analyzed and presented in this PM.

3.1 Flows

Historical wastewater flows were discussed in PM 3.1. Monthly average influent and effluent flows from January 2000 to December 2007 are presented in Figure 1. As discussed in PM 3.1, the total influent flow represents a calculated value. The effluent flows are generally less than the total influent flows. The difference between the influent and effluent flows is primarily due to treated water that is not discharged to the outfall but is instead diverted for recycled water needs and for process water for the storage lagoons/other in WPCP uses.

The WPCP has a 167 million gallons per day (mgd) trigger on the average dry weather influent flow (ADWIF), determined during any five weekday period during the months of June through October. The WPCP has a permitted discharge trigger of 120 mgd average dry weather effluent flow (ADWEF) measured as the three consecutive lowest effluent flow months between the months of May through October. In the analysis period, the highest ADWIF was 139 mgd in 2000. The highest ADWEF was 117 mgd, also observed in 2000.

3.2 CBOD Treatment

Although the WPCP NPDES permit regulates CBOD, the WPCP monitors its five-day BOD. Since BOD demands are greater than CBOD, meeting effluent limits with the BOD measurement guarantees that the CBOD limit is met. The current maximum daily permit CBOD limit is 20 milligrams per liter (mg/L). The monthly average permit limit is 10 mg/L.

Monthly average BOD variation of the WPCP influent and effluent are presented in Figure 2. Figure 3 presents the WPCP BOD mass loading.

The monthly average BOD observed in the WPCP influent, at the raw sewage wet well, averaged 311 milligrams per liter (mg/L) and ranged from 225 mg/L to 376 mg/L. The highest monthly average BOD was measured in December 2007. The variation of the influent concentration is typical for municipal wastewater treatment plants. The sample taken at the raw sewage wet well includes the impact of sludge lagoon supernatant and recycle flows. These recycle flows and the historical influent BOD are discussed in PM 3.2. There were no discernible trends in the BOD loading observed at the WPCP.

In the 8-year review period, the monthly average BOD removal at the WPCP was 99 percent. The monthly average effluent BOD concentration never exceeded the 10 mg/L monthly NPDES limit. The WPCP also never exceeded the daily maximum BOD permit limit of 20 mg/L.

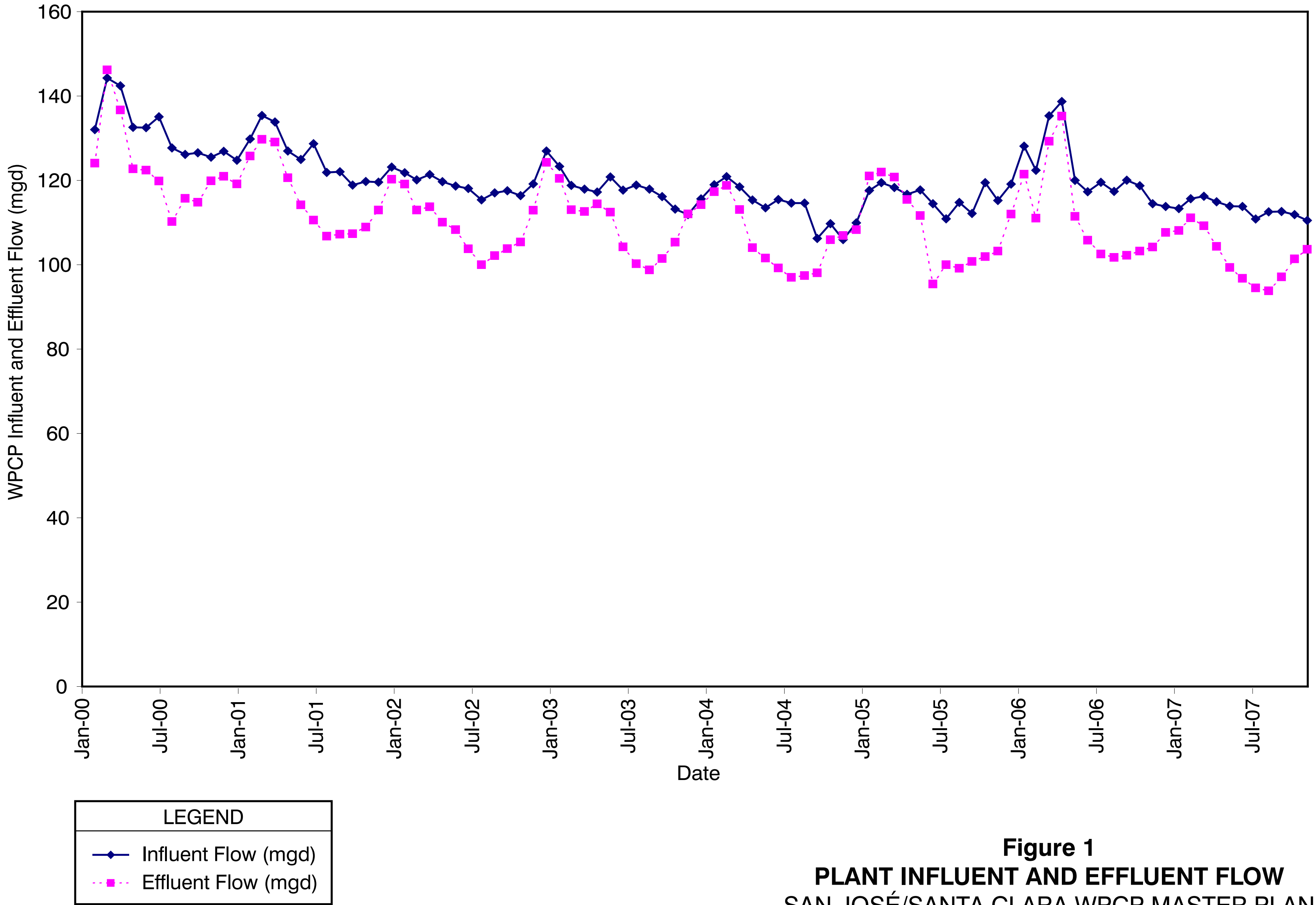

Figure 1
PLANT INFLUENT AND EFFLUENT FLOW
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
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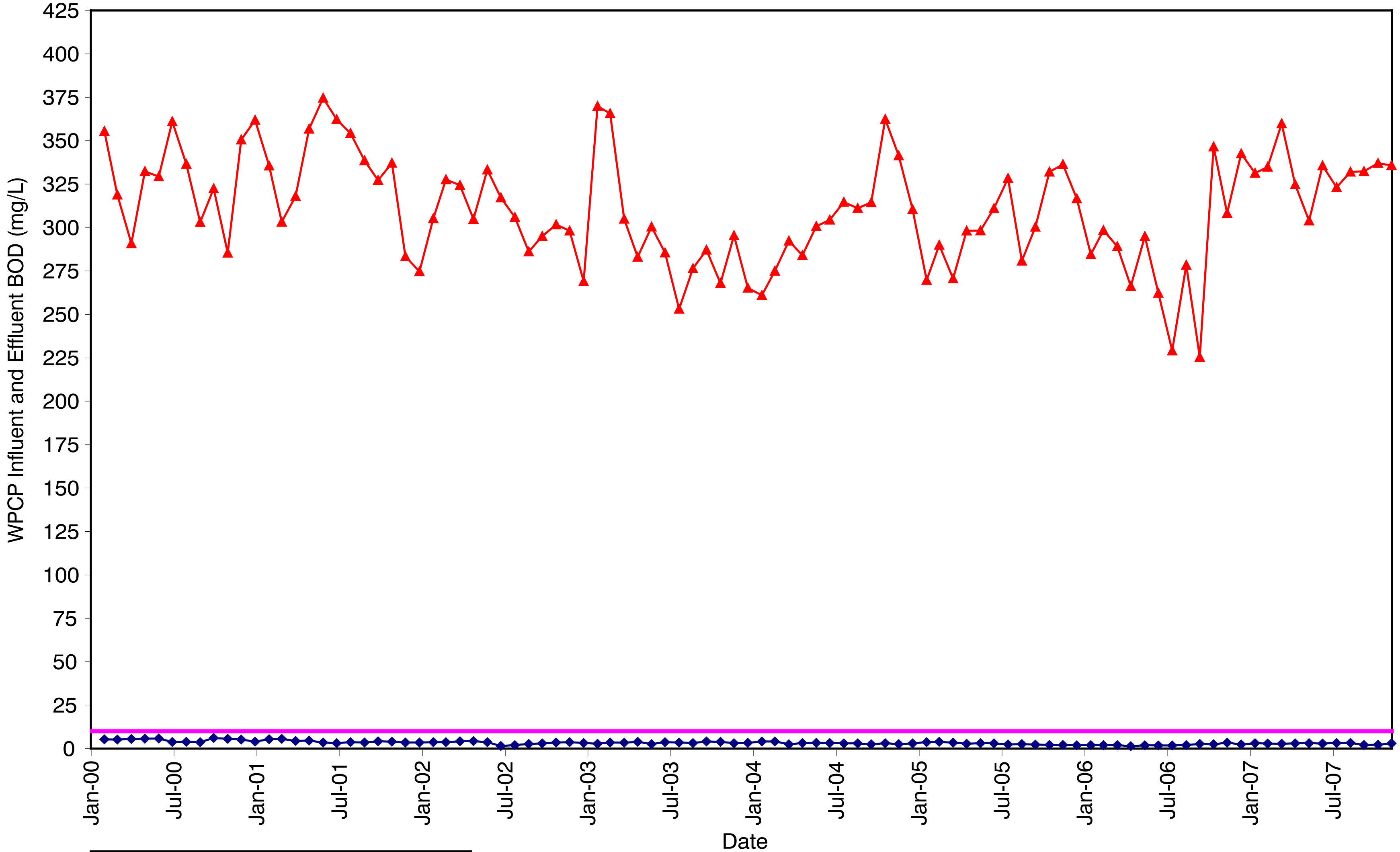

LEGEND

- Effluent BOD
- Maximum Monthly Effluent Limit
- Influent BOD

Figure 2
MONTHLY AVERAGE INFLUENT AND EFFLUENT BOD CONCENTRATION
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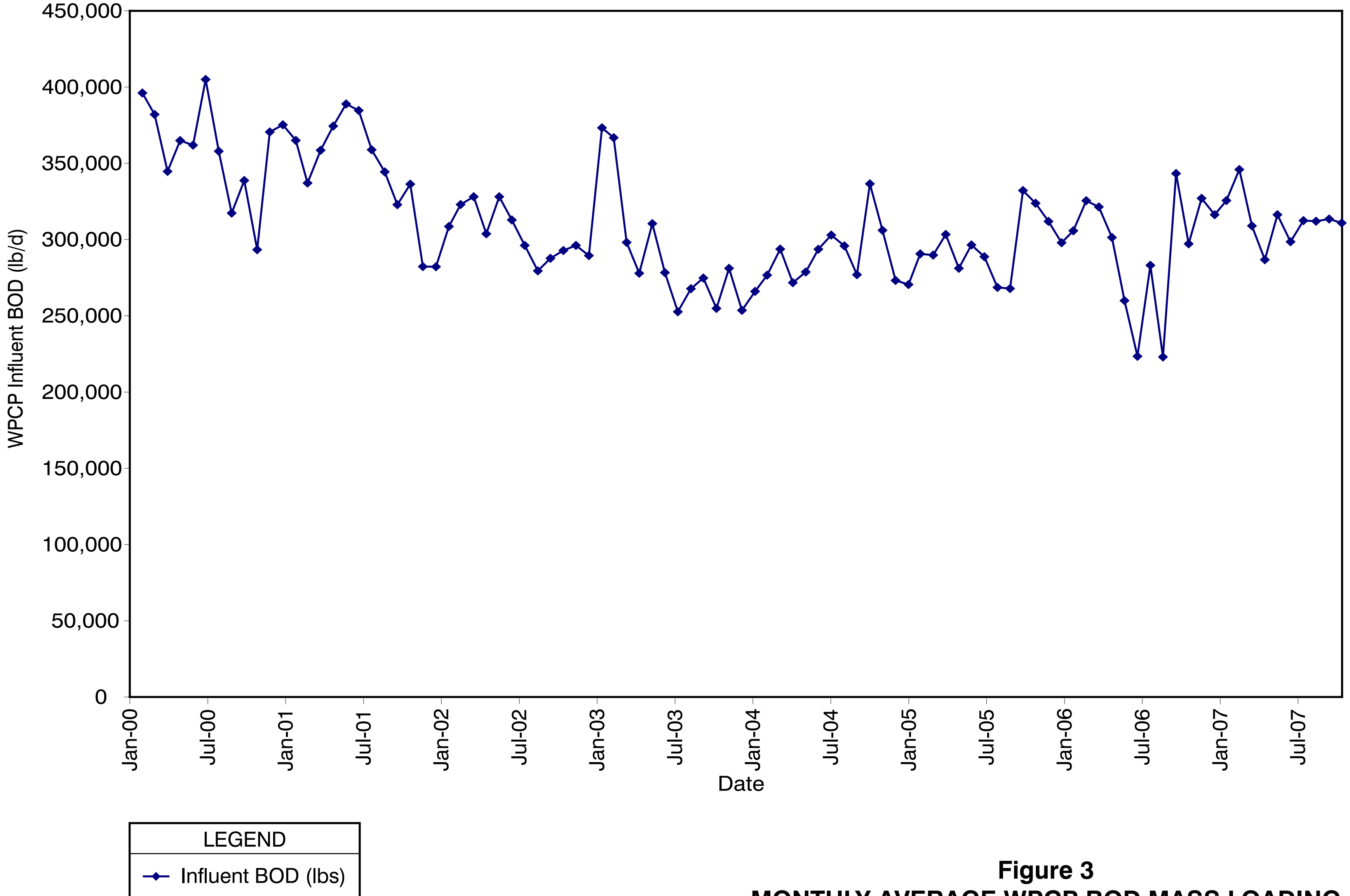

Figure 3
MONTHLY AVERAGE WPCP BOD MASS LOADING
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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3.3 TSS Treatment

Monthly average WPCP influent and effluent TSS concentrations are presented in Figure 4. Figure 5 presents the monthly average TSS mass loadings.

The monthly average TSS concentration and mass loadings have slightly declined in the analysis period. The monthly average influent TSS concentration averaged 300 mg/L and ranged from 201 to 401 mg/L. The maximum monthly TSS average was observed in June 2001. The raw sewage wet well TSS concentration includes the effects of the sludge lagoon supernatant flows. Influent TSS concentration and mass loadings are discussed further in PM 3.2.

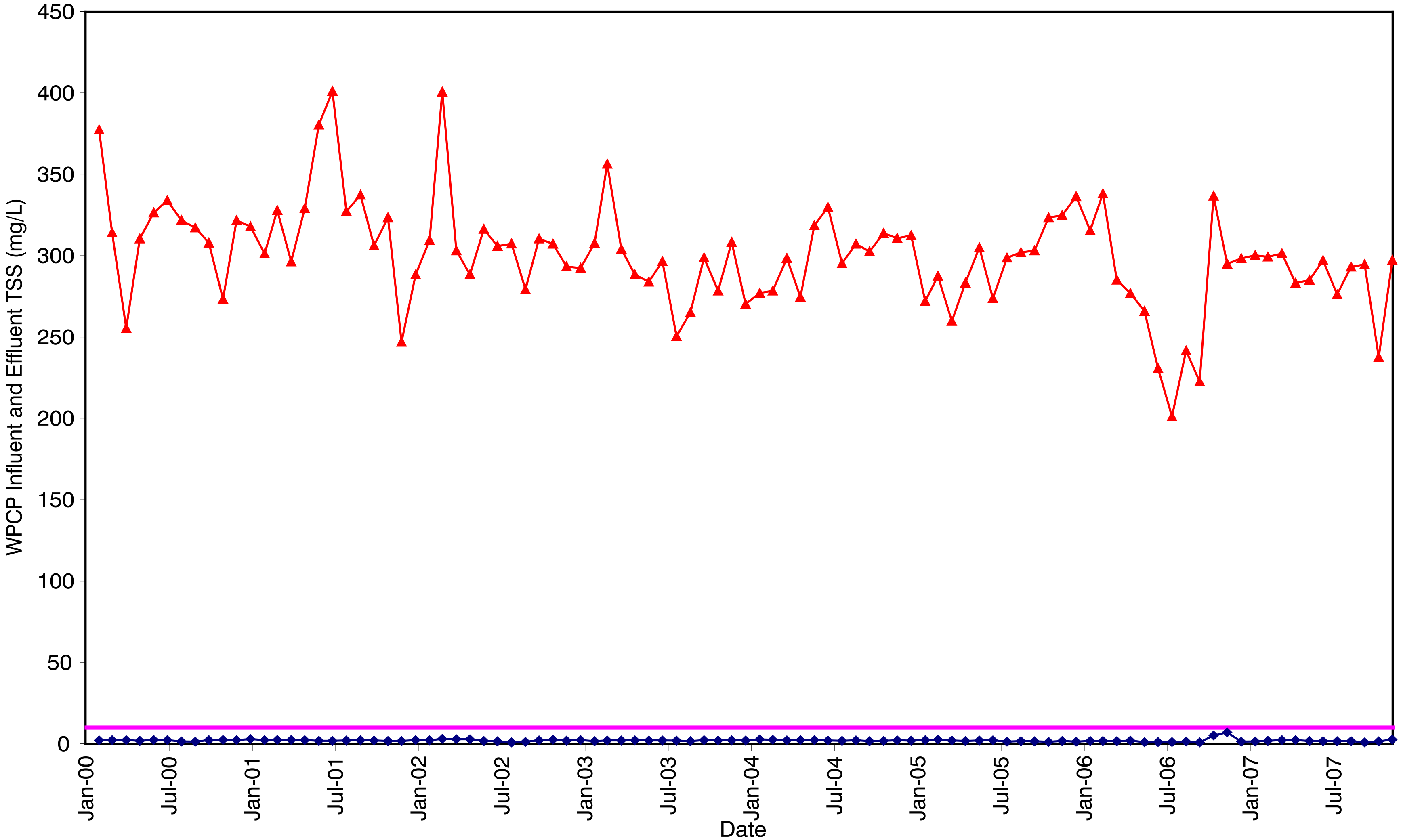
The overall average WPCP TSS removal efficiency is 99 percent. The daily effluent TSS concentration ranged from the detection limit of 1 mg/L to 13 mg/L. These values are well below the daily maximum permit limit of 20 mg/L. The WPCP monthly average effluent TSS concentration averaged 2 mg/L and ranged from the detection limit of 1 mg/L to 7 mg/L. The WPCP has also never exceeded the maximum monthly concentration of 10 mg/L in the analysis period.

3.4 Ammonia Treatment

The WPCP influent and effluent ammonia-nitrogen concentration is presented in Figure 6. Figure 7 presents the ammonia-nitrogen mass loading.

The daily ammonia-nitrogen concentrations averaged 25 mg/L and ranged between 11 mg/L to 60 mg/L. The average monthly influent ammonia-nitrogen concentrations averaged 26 mg/L and ranged between 21 mg/L to 32 mg/L. The maximum average monthly concentration was observed in December 2006. Similar to influent BOD and TSS loading, influent ammonia-nitrogen loading also includes the effects of sludge lagoon supernatant recycle streams as the samples were taken at the raw sewage wet well.

During the analysis period, the daily effluent ammonia-nitrogen concentrations ranged between non-detect to 2.4 mg/L and the daily concentrations never exceed the maximum daily effluent limit of 8 mg/L. The average monthly effluent ammonia-nitrogen concentrations ranged between non-detect and 1.4 mg/L. The average monthly effluent concentration did not exceed the average monthly effluent limit of 3 mg/L. The overall WPCP ammonia-nitrogen removal averages approximately 98 percent.



LEGEND

- Effluent TSS
- Maximum Monthly Effluent Limit
- Influent TSS

Figure 4
MONTHLY AVERAGE INFLUENT AND EFFLUENT TSS CONCENTRATIONS
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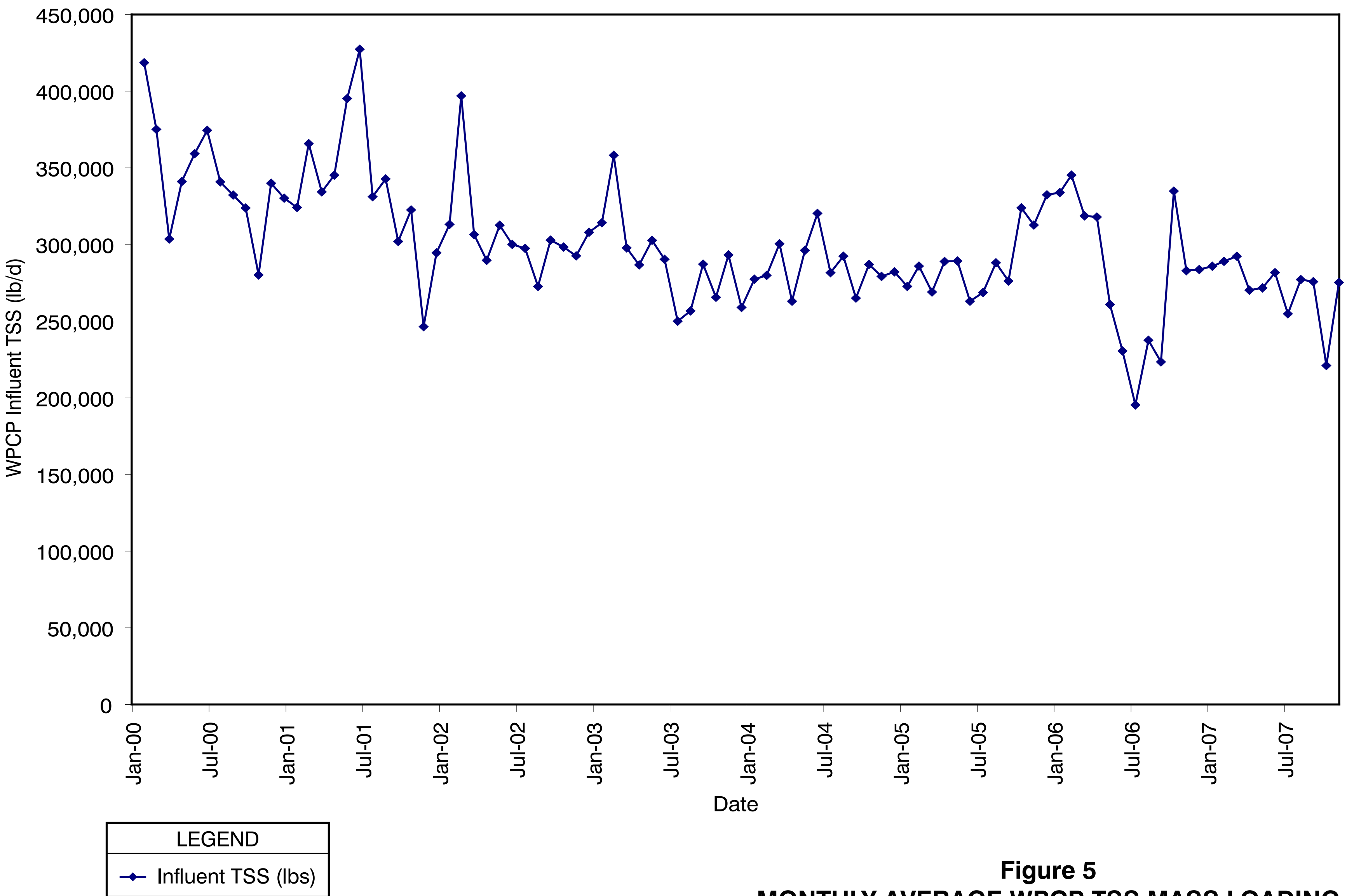

Figure 5
MONTHLY AVERAGE WPCP TSS MASS LOADING
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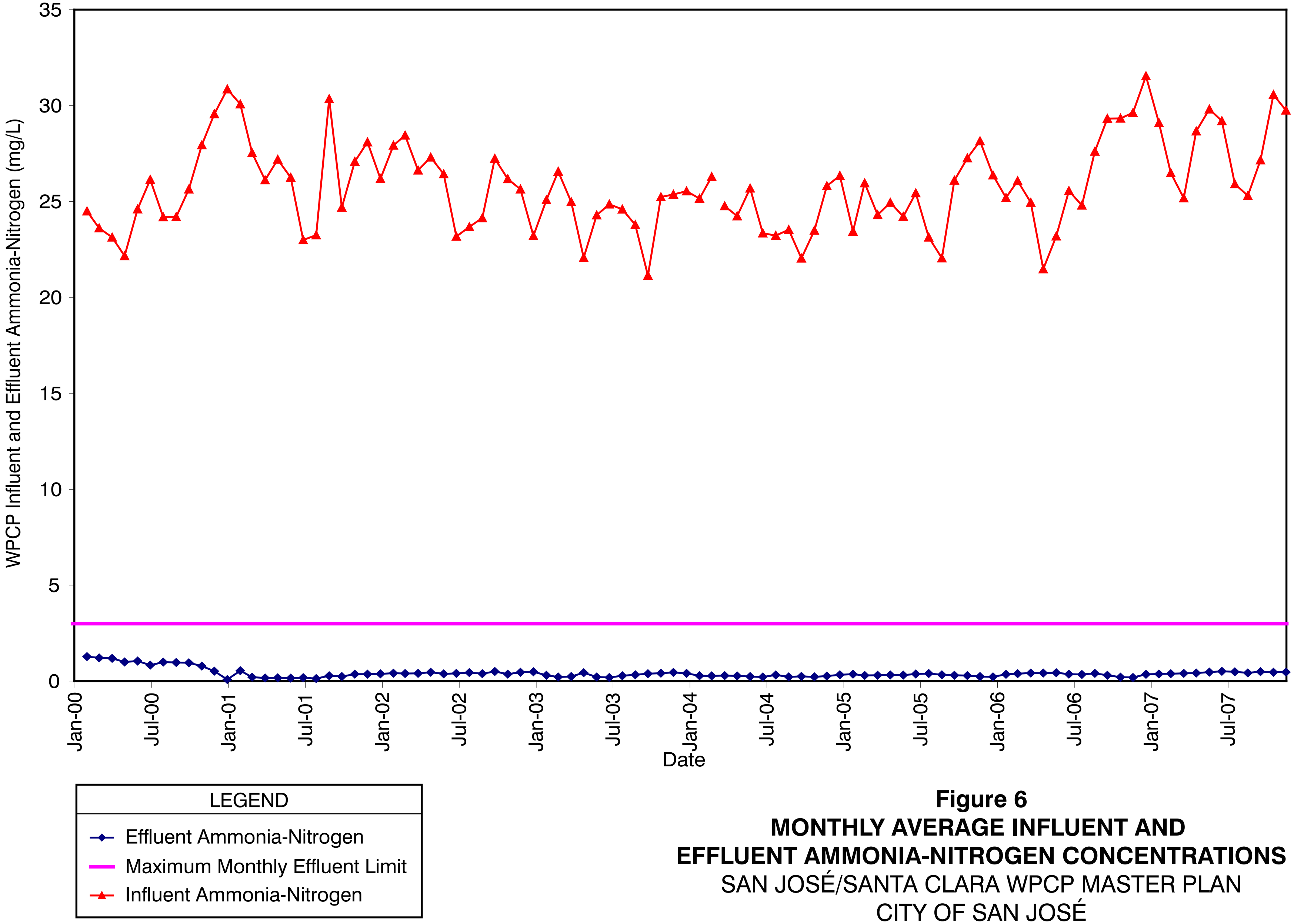

Figure 6
MONTHLY AVERAGE INFLUENT AND EFFLUENT AMMONIA-NITROGEN CONCENTRATIONS
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CITY OF SAN JOSÉ

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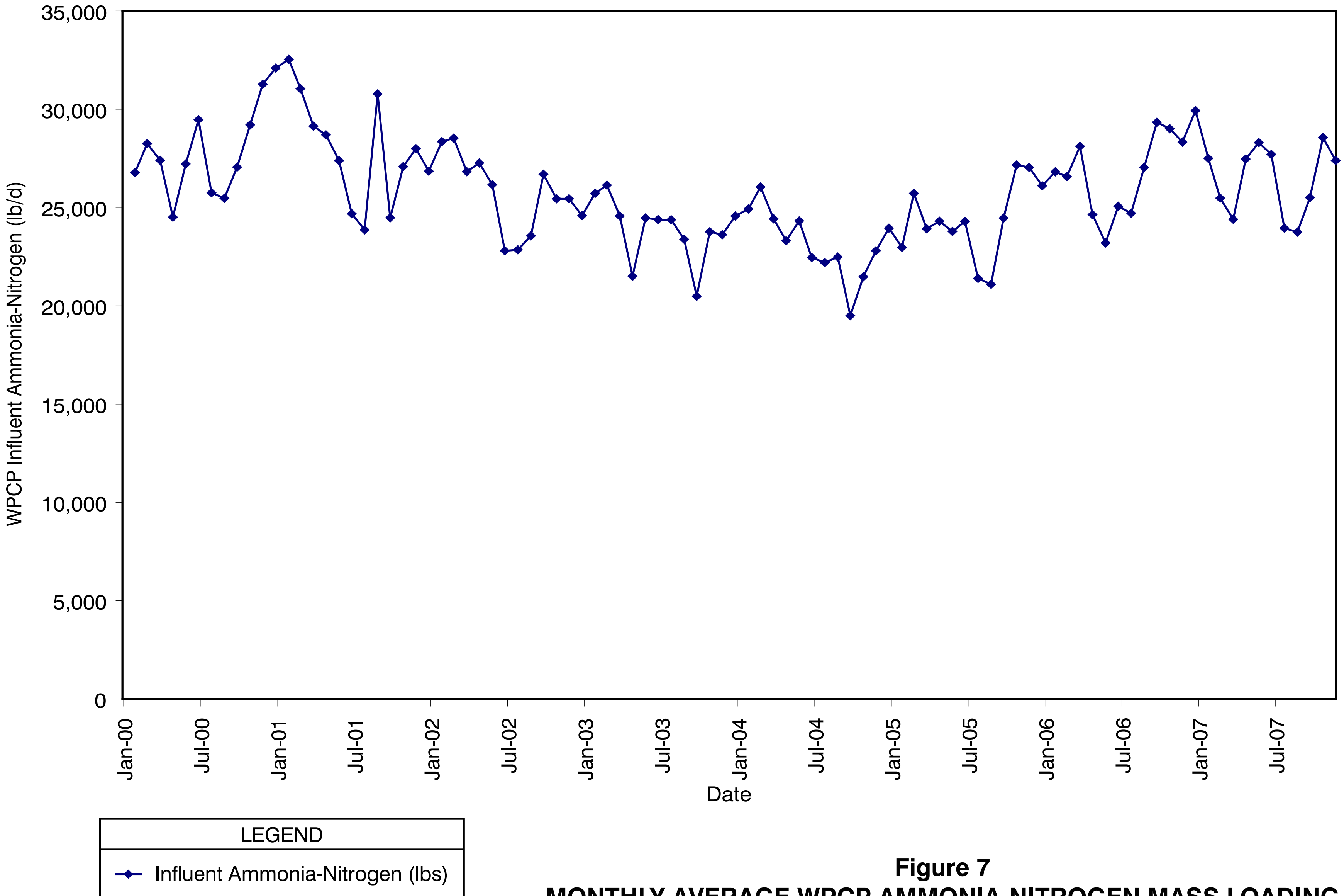

Figure 7
MONTHLY AVERAGE WPCP AMMONIA-NITROGEN MASS LOADING
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3.5 Oil and Grease Treatment

The WPCP influent oil and grease (O&G) is not separately monitored. The WPCP does however track the weight of grease, grit, and screenings hauled from the WPCP.

The WPCP monitors its effluent O&G through grab samples. Figure 8 presents the effluent O&G concentrations. The average daily O&G concentrations range between 1 mg/L to 5 mg/L. In January 2001, a change in reporting is observed. The minimum detectable concentration was no longer reported, instead all data was reported at the analytical RL of 5 mg/L. The daily effluent concentrations are below the effluent daily maximum permit limit of 10 mg/L.

3.6 Chlorine Residual

The WPCP monitors its chlorine residual at several different locations. The current NPDES permit requires that the instantaneous maximum chlorine residual not exceed 0.0 mg/L. The WPCP dechlorination system adds sufficient dechlorination chemical dosage (sulfur dioxide) to ensure no chlorine is discharged in the effluent. The measured final discharge effluent chlorine residual was always observed to be zero for the analysis period.

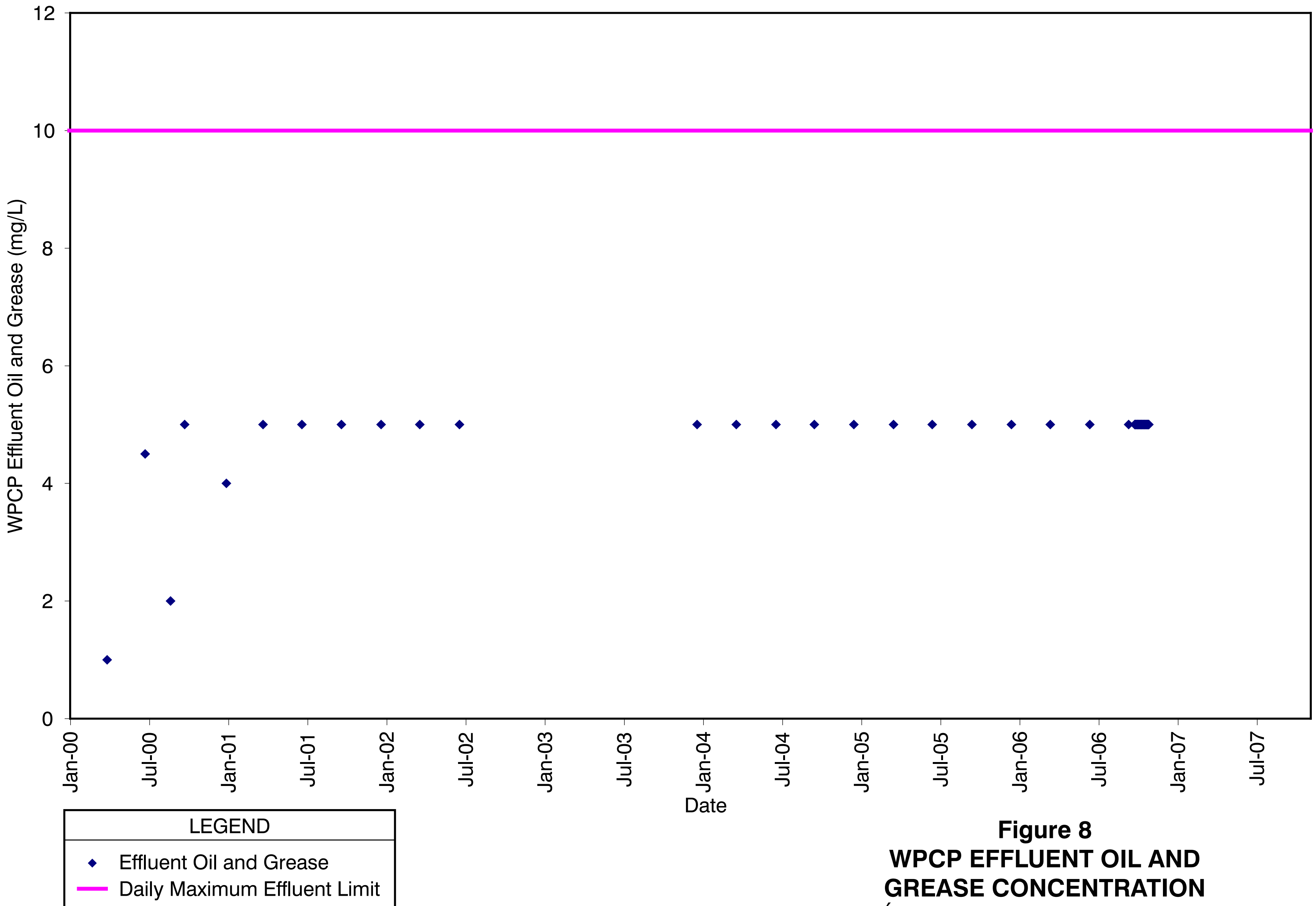
3.7 Pathogen Indicator

The enterococci count is monitored. The WPCP maximum daily enterococcus limit is 276 colony forming unit (cfu) per 100 ml. The enterococcus count for the analysis period ranged between 1 cfu/100 ml and 54 cfu per 100 ml, well below the permitted limit.

3.8 Discharge Temperature

The effluent discharge temperature ranged between 11 degrees Celsius (°C), 27°C. Monthly average effluent temperature averaged 20°C, and ranged from 16 to 24°C. Figure 9 presents the WPCP effluent temperature over the analysis period. The 10-day running average temperature is also presented in Figure 9. The minimum 10-day average temperature was 14.5°C.

As expected, lower effluent temperatures are observed in the winter months. The monthly low temperatures are lower than are typically seen for communities in the San Francisco Bay area. This is likely because the temperature measurements are taken in the Artesian Slough, which allows for more effluent cooling during cold weather periods than had the measurements been taken immediately after the disinfection system. No temperature data was available upstream of the Artesian Slough for review to confirm this.



Notes:
Most of reported data had analysis detection limit of 5 mg/L.

Figure 8
WPCP EFFLUENT OIL AND GREASE CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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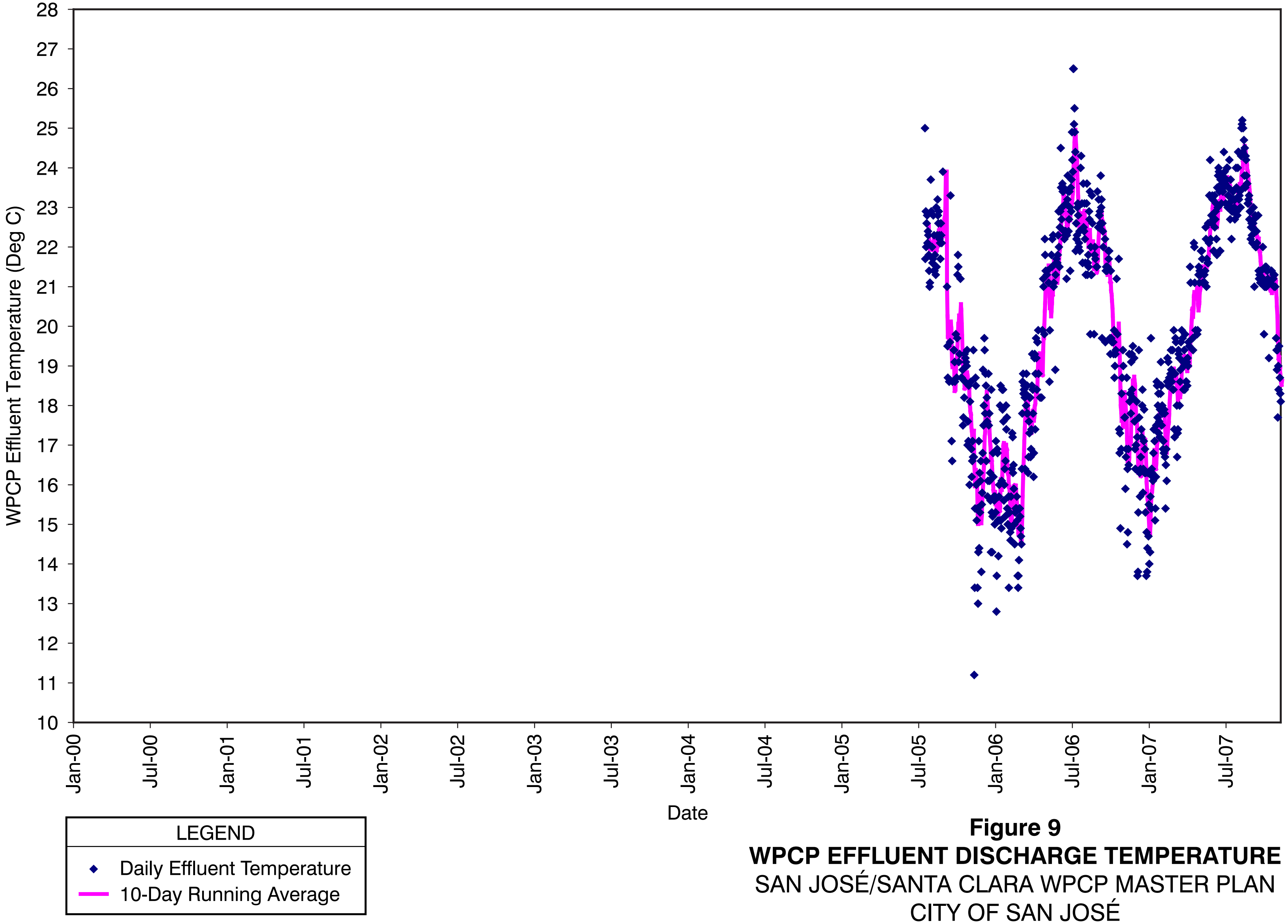

Figure 9

WPCP EFFLUENT DISCHARGE TEMPERATURE

SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN

CITY OF SAN JOSÉ

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3.9 pH

The WPCP effluent pH is presented in Figure 10. The NPDES permit requires that WPCP effluent pH fall within the range of 6.5 to 8.5. Over the analysis period, the WPCP effluent pH consistently falls within this range. The monthly average pH ranged between 7.2 and 7.5.

3.10 Turbidity

The WPCP NPDES permit requires that the instantaneous maximum effluent turbidity be lower than 10 Nephelometric Turbidity Units (NTU). During the analysis period, the daily effluent turbidity has typically been less than 2 NTU with only a few days where it was higher.

3.11 Metals and Cyanide

The WPCP NPDES permit regulates the concentrations of copper, mercury, and nickel. In addition to these metals, cyanide and selenium have been identified as pollutants of concern, as discussed in PM 3.2, 4.1, and 4.2.

Since metals detection limits have changed in the last several years, metals data from the last five years (2003 to 2007) were used for WPCP metals removal analysis. Table 3 summarizes the average influent and effluent metal concentration from 2003 to 2007, as well as the average percent removal.

Influent and effluent metals concentrations are collected using intermittent grab samples, and thus influent and effluent concentrations were not always available for the same day. In addition, the recorded metals concentrations were often below the metals detection limit. If the recorded concentration was below the detection limit, the concentration was assumed to equal the detection limit for calculation of average influent and effluent concentrations. If the influent concentration was below the detection limit, or if both the influent and effluent concentrations were unavailable for the given day, this data was not used in calculating the percent removal.

The average percent removal of copper from 2003 to 2007 was 97 percent, the average percent removal of mercury was 98 percent, and average percent removal of nickel was 51 percent. Average selenium removal over the same period was 77 percent and the average cyanide removal was -3 percent. To calculate removal efficiency, all influent and effluent concentrations below the RL were assumed to equal the RL value, and the removal efficiency was calculated for each paired sample set.

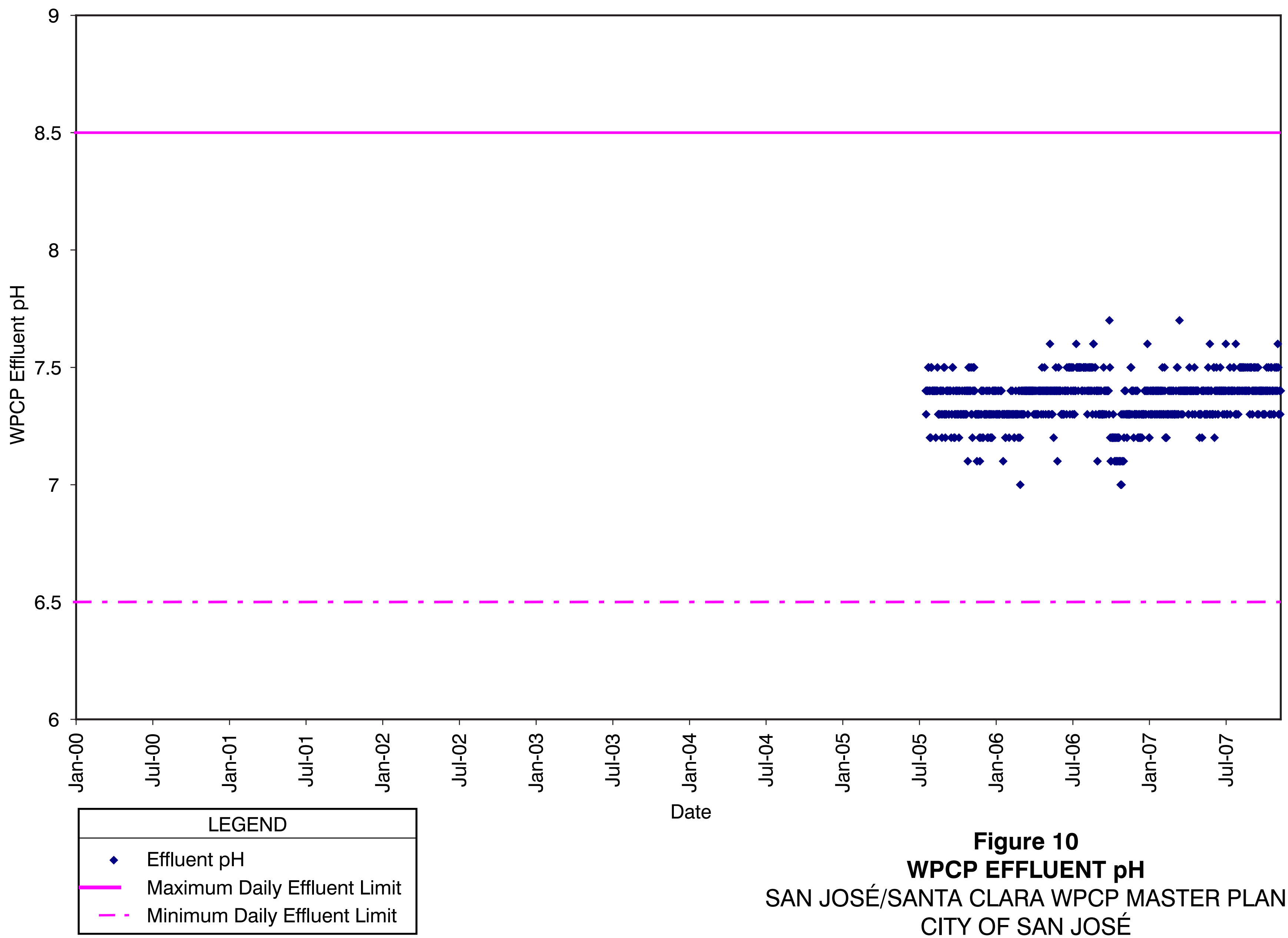

Figure 10
WPCP EFFLUENT pH
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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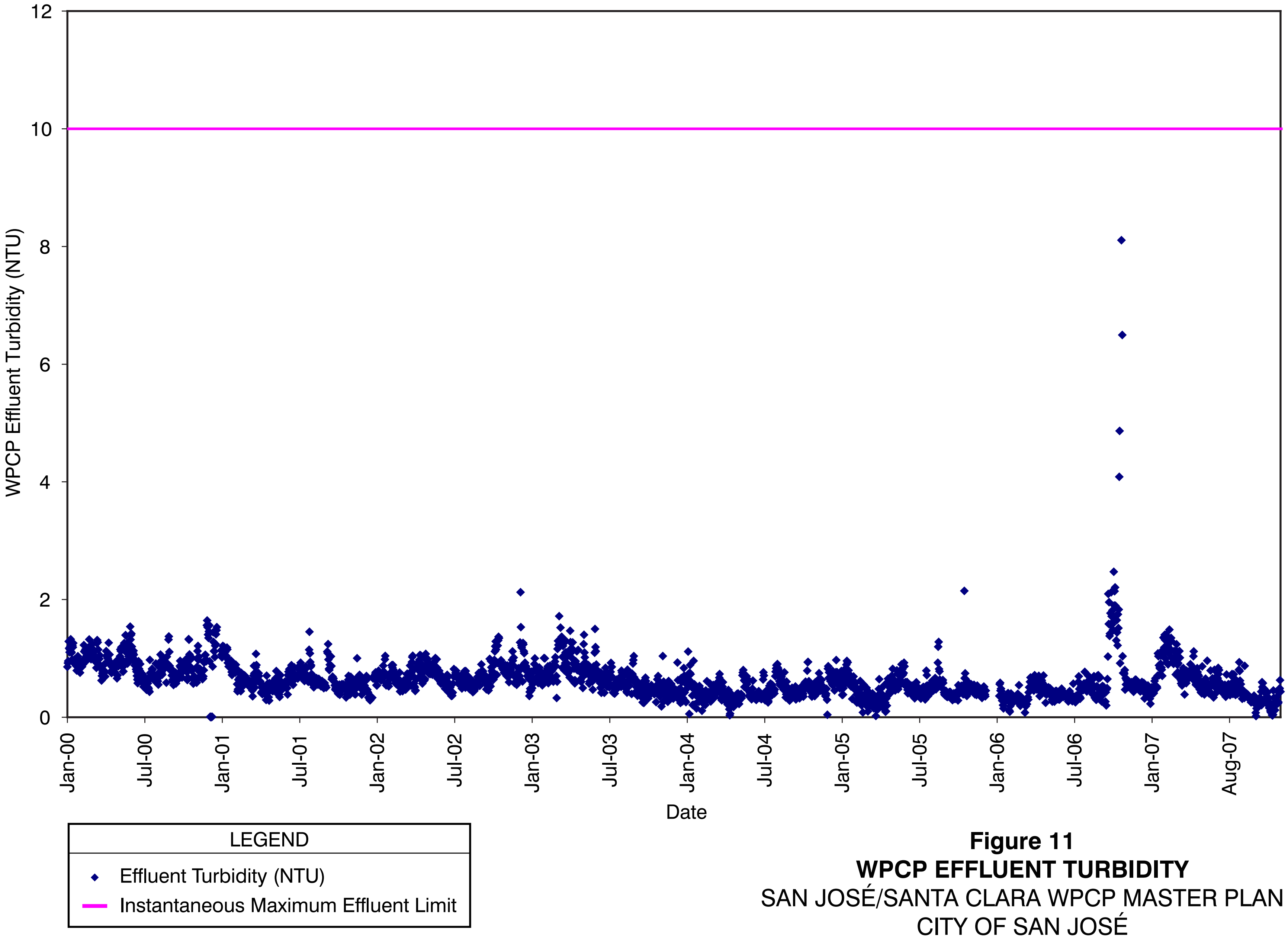

Figure 11
WPCP EFFLUENT TURBIDITY
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CITY OF SAN JOSÉ

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Table 3 Summary of Influent and Effluent Metals and Cyanide Concentrations
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

	Influent			Effluent				
Pollutant	**N**	**No. Less than RL**	**Average Concentration (µg/L)**	**N**	**No. Less than RL**	**Average Concentration (µg/L)**	**NPDES Permit Limit**	**Percent Removal**
Copper	463	0	104	244	5	2.90	18 97%	
Cyanide 357		325	5.0	332	312	5.1	14	-3%(3)
Mercury	418	0	0.260	100	6	0.00368	2.1(1) 98%	
Nickel	446	0	13.3	247	1	6.29	34 51%	
Selenium 59		0	2.05	66	0	0.45	None(2) 77%	

Notes:
N = Number of samples.
RL = Reporting limit.
(1) The current permit sets a maximum monthly mercury concentration of 0.012 µg/L. The Draft Permit has only a maximum month concentration limit of 0.025.
(2) Selenium does not have a WQBEL in the current or Draft Permit. The EPA is currently drafting new criteria that may change how selenium is regulated in the San Francisco Bay area.
(3) The Draft permit sets a cyanide limit of 14 µg/L. Cyanide does not have a water quality based effluent limit in the current permit.

The influent and effluent metals concentrations, and the effluent limit for the regulated metals: copper, mercury, and nickel are presented in Figures 12 through 14, respectively. As seen from the figures, the effluent metal concentrations have been below the permit limits.

3.12 Organics and Pollutants of Concern

The WPCP NPDES permit regulates effluent concentrations of several organics, namely: 4,4-DDE, dieldrin, heptachlor epoxide, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene. The Draft Permit has water quality based effluent limits for dioxin, heptachlor, and tributylin but not for any of the other currently regulated organics.

Table 4 summarizes the influent and effluent data for the currently regulated organics compiled between the years 2000 to 2007. Table 5 presents the available influent and effluent data for the organics regulated in the Draft Permit, with the exception of polychlorinated biphenyls (PCBs). The Draft Permit does not regulate the effluent concentration of PCBs. However, a TMDL is currently under development for PCBs and thus the WPCP performance for these compounds is presented.

The dataset for most of these compounds was limited to two samples per year. To calculate average concentrations, RLs were used for values reported as below the RL. However, for dioxins this approach was not adopted because the WPCP reports a zero concentration if all the individual dioxins are measured to be below the RLs. Therefore, only the detected dioxins concentrations, as reported to the RWQCB, were used to calculate influent and effluent concentrations. Over the analysis period, several detection methods were used for the same constituents. Many of the constituents had different RLs based on the detection method used. In cases where there was a range in RL over the analyzed period, this range is noted.

In some cases, all of the samples were below the RLs. In these cases, the average concentration has limited meaning since it is the average of the RL values. When calculating percent removal of the microconstituent, if the influent concentration was below the detection limit, or if both the influent and effluent concentrations were unavailable for the given day, this data was not used in calculating the percent removal. In cases where a detectable influent concentration was available with a non-detect effluent concentration, the concentration was assumed to equal the detection limit for calculation of percent removal.

In all cases, the WPCP has met its effluent limits for organics.

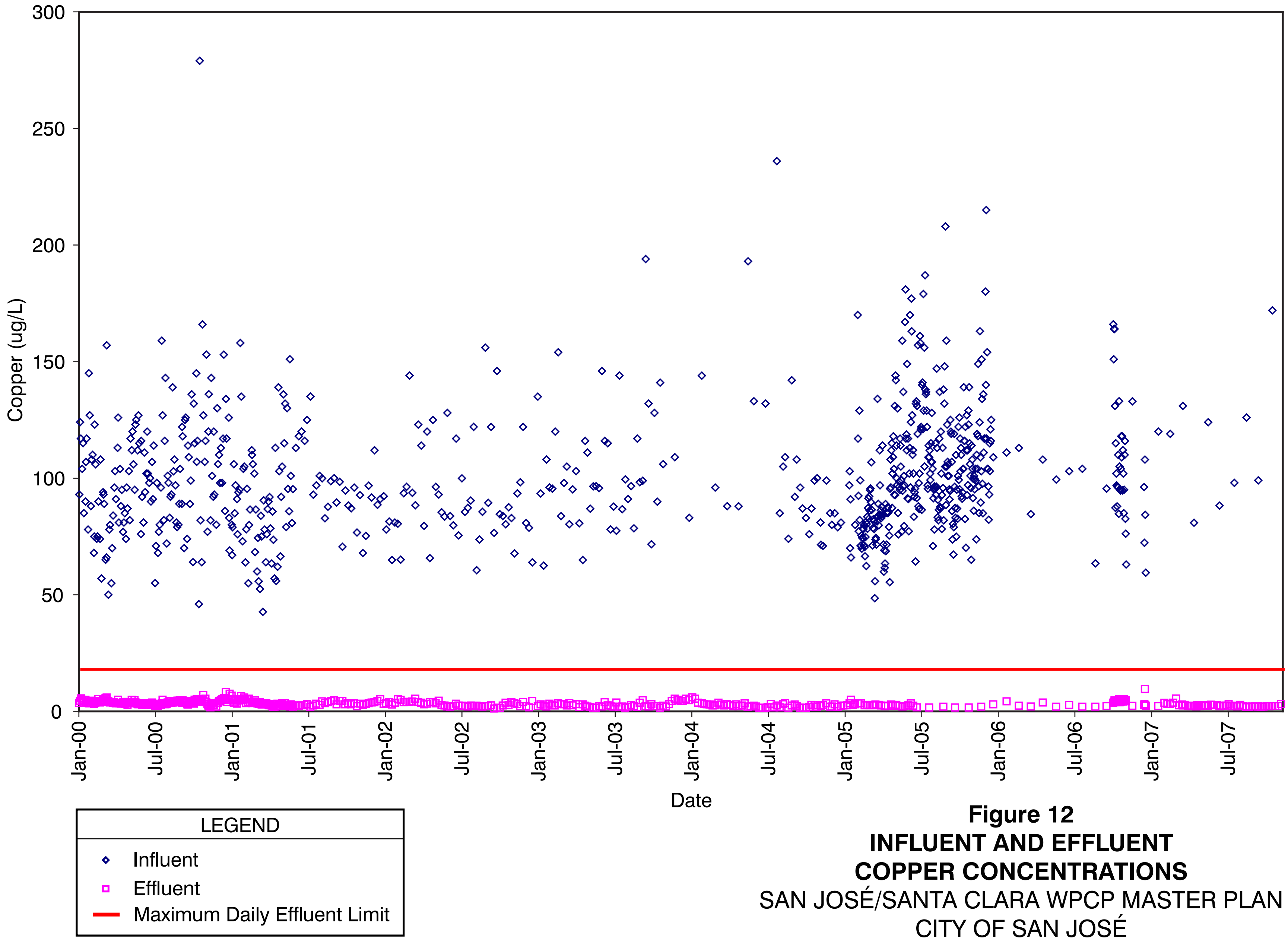

Figure 12
INFLUENT AND EFFLUENT
COPPER CONCENTRATIONS
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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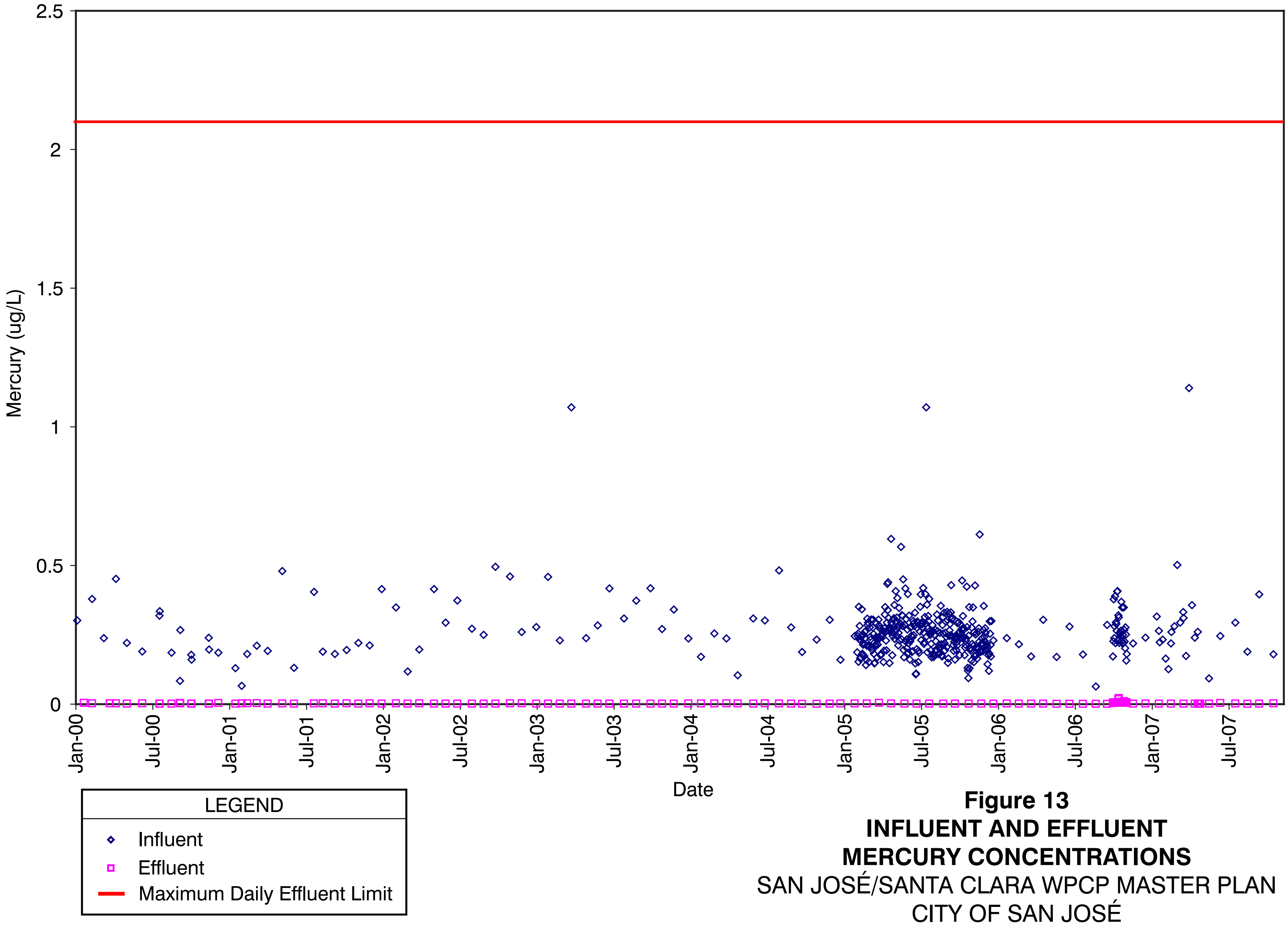

Figure 13
INFLUENT AND EFFLUENT
MERCURY CONCENTRATIONS
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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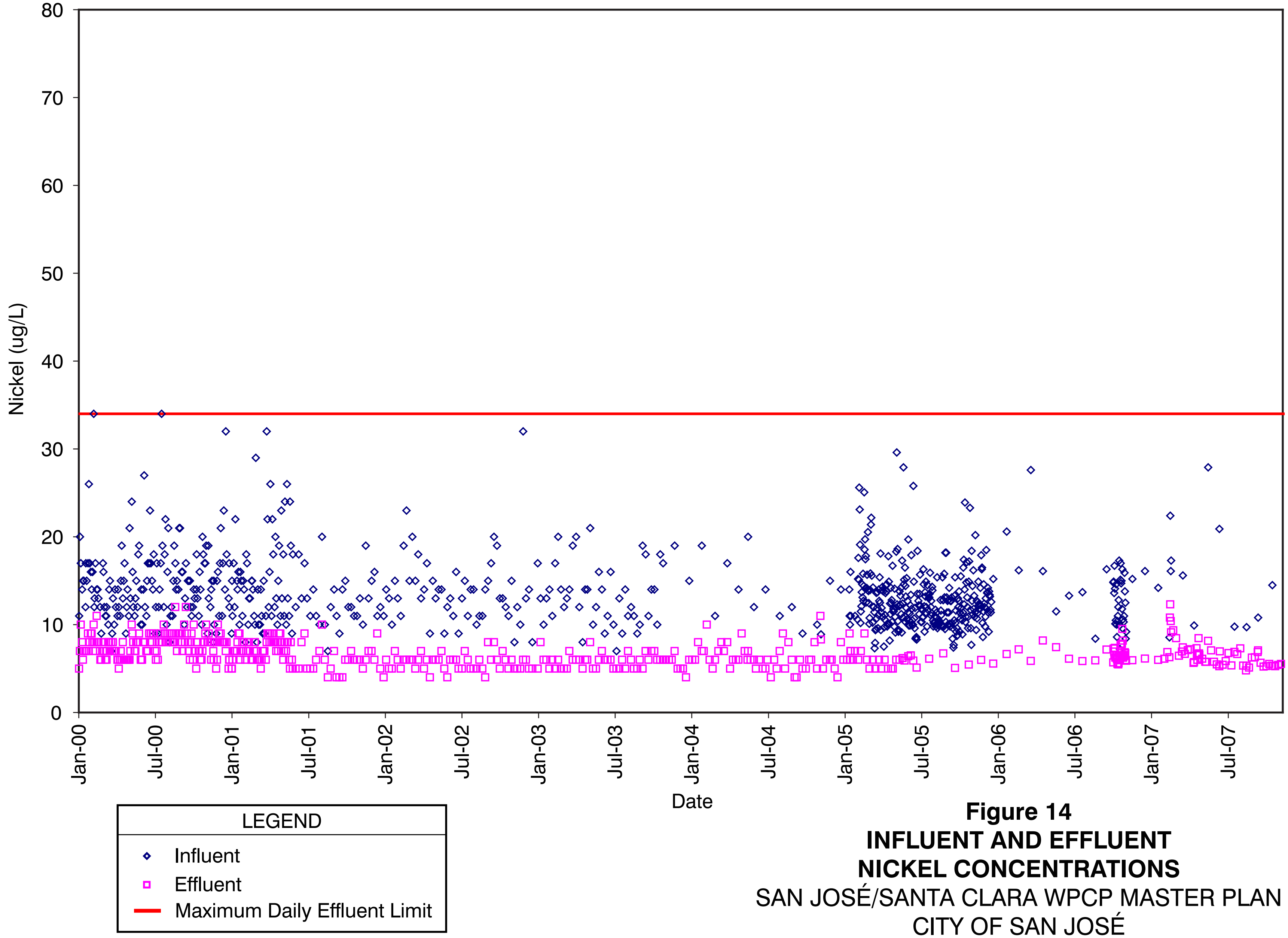

Figure 14
INFLUENT AND EFFLUENT
NICKEL CONCENTRATIONS
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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Table 4 **Influent and Effluent Characteristics of Currently Regulated Organic Compounds, 2000 to 2007**
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

	Number of Influent Samples	Number of Effluent Samples	Values Detected in Influent	Values Detected in Effluent	Reporting Limit (µg/L)	Average Influent Concentration (µg/L)	Average Effluent Concentration (µg/L)	Maximum Observed Effluent Concentration (µg/L)	Percent Removal	Daily Maximum NPDES Permit Limit (µg/L)
4,4'-DDE	0	7	NA	0	[1] NA		0.008[2] --		NA[7] 0.05	[9]
Dieldrin	6 13 0			0	[3] 0.024	[2] 0.013	[2] --		NA[8] 0.01	[9]
Heptachlor Epoxide	6	13	0	0	[4] 0.015	[2] 0.012	[2] --		NA[8] 0.01	[9]
Benzo(b)Fluoran-thene	0	8	NA	1	[5] NA		0.243[2] 0.3		NA[7] 10.0	[9]
Indeno(1,2,3-cd)Pyrene	0	8	NA	1	[6] NA		0.049[2] 0.05		NA[7] 0.05	[9]

Notes:
NA = Not Available.
-- = No measured/observed values above reporting limit (RL).
(1) RLs have ranged from 0.002 to 0.01 µg/L.
(2) The average effluent concentration was calculated assuming that all values reported as below the RL are at the RL.
(3) RLs have ranged from 0.005 to 0.05 µg/L.
(4) RLs have ranged from 0.001 to 0.025 µg/L.
(5) RLs have ranged from 0.03 to 0.3 µg/L.
(6) RLs have ranged from 0.04 to 0.05 µg/L.
(7) Percent removal not calculated because influent data was not available.
(8) Percent removal not calculated because all influent data were below the RL.
(9) 4-4' DDE, dieldrin, heptachlor epoxide, benzo(b)fluoran-thene and indeno(1,2,3-cd)pyrene are not regulated in the Draft Permit.

Table 5 Influent and Effluent Characteristics (2000 to 2007) of Regulated Organic Compounds in Draft Permit
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

	Number of Influent Samples	Number of Effluent Samples	Values Detected in Influent	Values Detected in Effluent	Reporting Limit (µg/L)	Average Influent Concentration (µg/L)	Average Effluent Concentration (µg/L)	Maximum Observed Effluent Concentration [1] (µg/L)	Percent Removal	Daily Maximum Draft Permit Limit (µg/L)
Dioxin (µg/L)	2	10	2	9	[2] 1.04		0.108	0.394	88	2.8×10^{-8}
Heptachlor	6	10	0	3	[3]	0.018[4] 0.014	[4] 0.25		NA[5] 0.0004	2[6]
Tributylin (µg/L)	7	36	6	1	[7]	2.6[4] 0.059	[4] 2		92%	0.012
PCBs (µg/L)	6 6 1			1	[7]	2.71[4] 2.24	[4] 3.5		77%	None[9]

Notes:
NA = Not Available
(1) Value presented is the maximum value observed above the RL.
(2) RLs for the individual dioxin compounds have ranged from 0.10 to 6.27 pg/L.
(3) RLs have ranged from 0.004 to 0.025 µg/L.
(4) The average effluent concentration was calculated assuming that all values reported as below the RL are at the RL.
(5) Percent removal not calculated because all influent data were below the RL.
(6) The current permit daily maximum effluent limit for heptachlor is 0.01µg/L.
(7) RLs have ranged from 0.001 to 2 µg/L.
(8) RLs have ranged from 0.7 to 3.5 µg/L.
(9) A TMDL limit is currently under development for PCBs.

4.0 INDIVIDUAL UNIT PROCESS PERFORMANCE

In the following sections, the major treatment processes, namely preliminary, primary, secondary, tertiary, and solids handling performance are presented. For each process, design parameters are defined, relationships among design parameters discussed, and historical loading and performance data for each individual process is presented.

The loading and performance data is presented based on the actual number of units in service, and is not representative of the performance at maximum capacity since not all units are in service at all times. The performance presented will be used in PM 3.4 to develop planning design criteria.

Figures 15 through 19 present the process schematic for the WPCP and the sampling points at which water quality is monitored. The figures present the headworks schematic, primary treatment schematic, secondary treatment schematic, tertiary treatment schematic, and solids processing schematic, respectively.

4.1 Preliminary Treatment

The WPCP's preliminary treatment consists of Headworks No. 1 and 2 with bar screens and grit removal. The new headworks use vortex grit tanks, while the existing headworks use aerated grit chambers and detritor tanks for grit removal. Headworks No. 2 was not yet fully operational during the review period, and thus performance data presented only reflects operating conditions and performance of Headworks No. 1.

The number of bar screens and grit chambers in service was not available, therefore when developing operational criteria for the grit chambers, it was assumed all units were in service for Headworks No. 1. The WPCP monitors the tons of grit, grease, and screenings hauled from the preliminary treatment units. Table 6 presents the annual grit, grease, and screenings hauled from 2003 to 2007.

The design parameters for aerated grit chambers and detritor tanks typically include overflow rate and hydraulic detention time. Table 7 presents the preliminary treatment loading and performance data for ADWF, ADAF, ADMMF, and PHWWF conditions. The month and flow corresponding to ADMMF and the date and flow corresponding to PHWWF were presented in PM 3.2. The historical average monthly grit chamber overflow rate during the analysis period is presented in Figure 20. In general, the aerated grit chambers and detritor tanks were operating well within original typical design loadings.

4.2 Primary Treatment

Primary treatment at the WPCP includes east and west primary settling tanks. The east primary settling tanks include a set of eighteen tanks operating in parallel. The west primary settling tanks consist of six settling tanks. The west primary settling tanks were not in

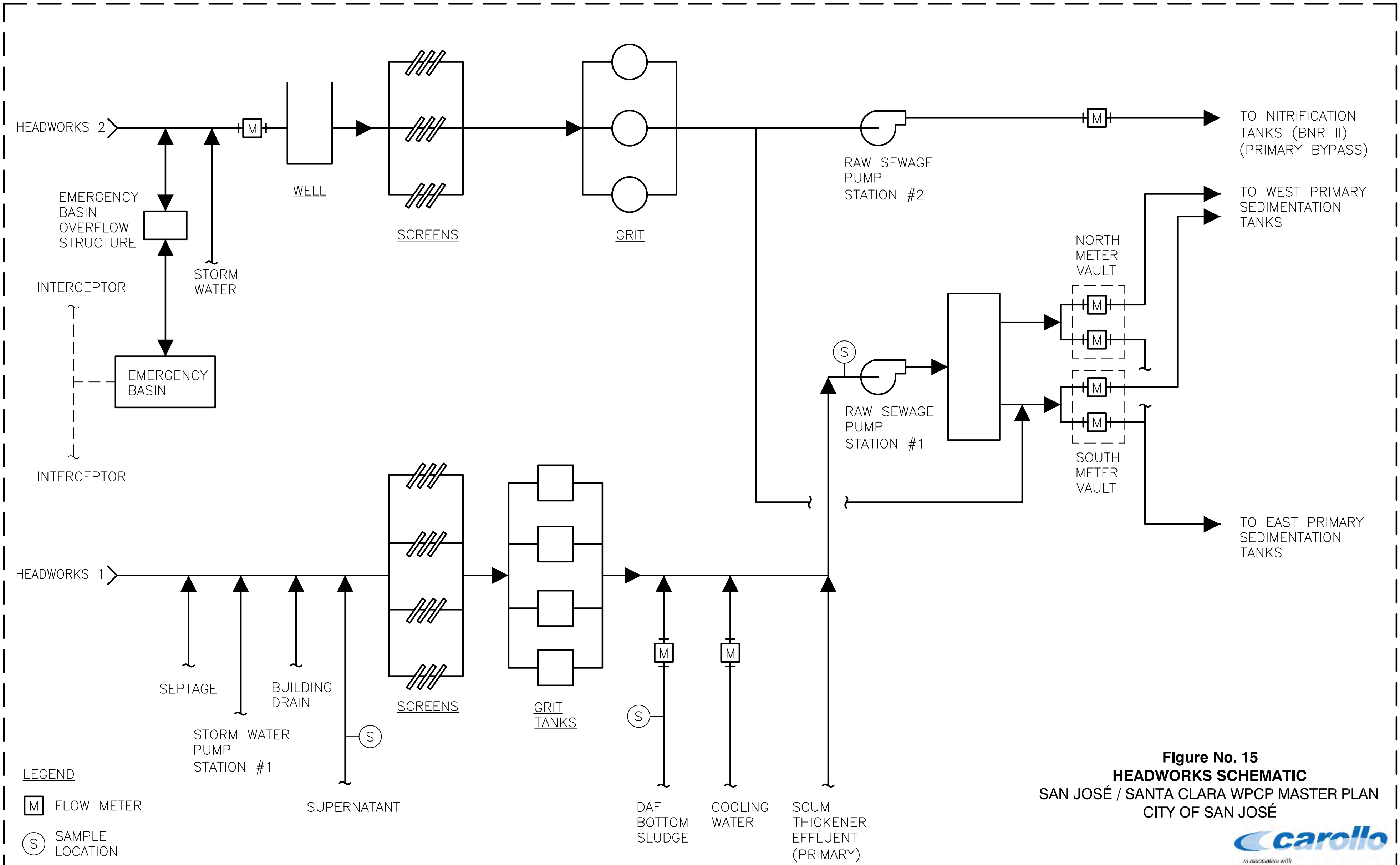

Figure No. 15
HEADWORKS SCHEMATIC
SAN JOSÉ / SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

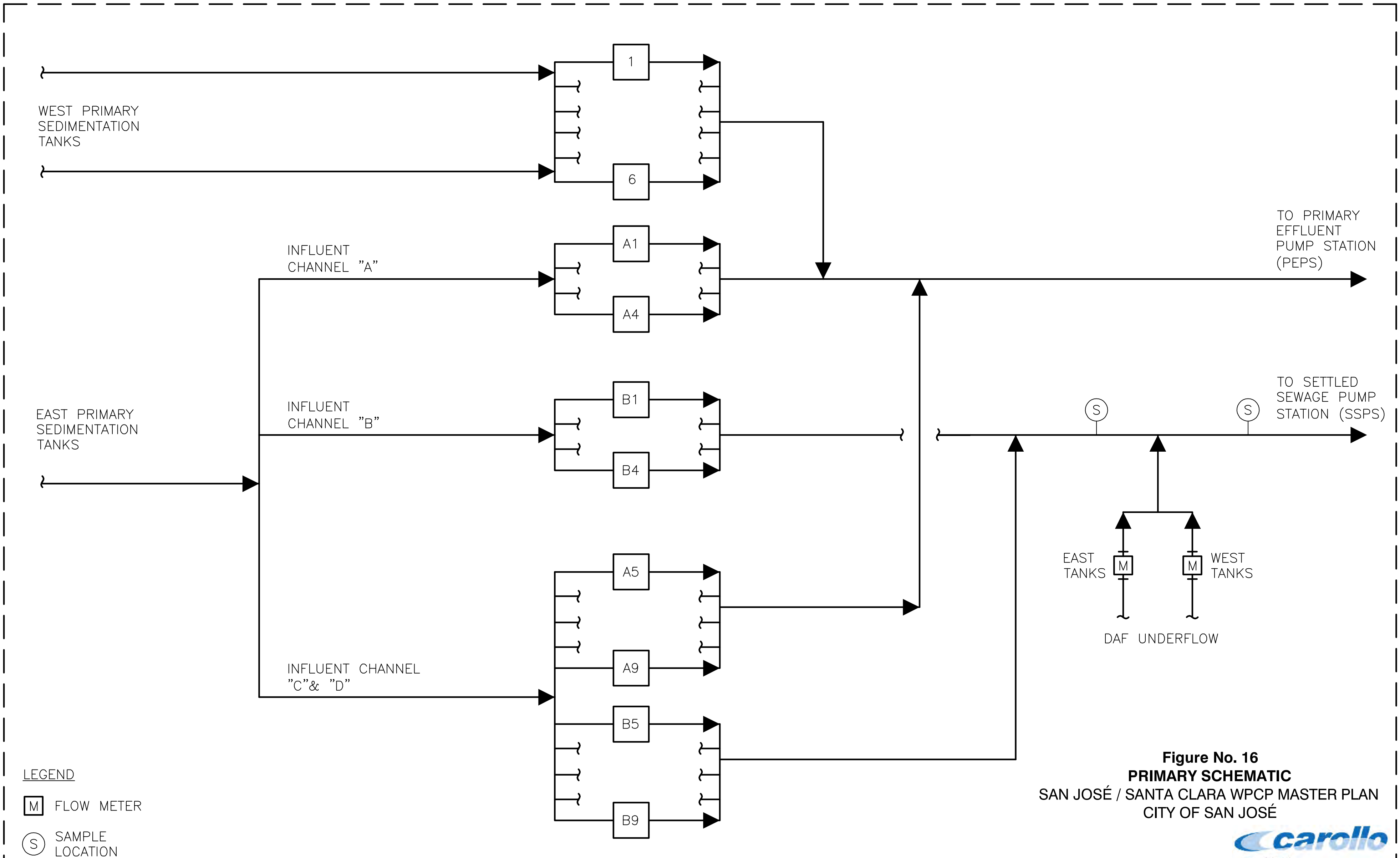

Figure No. 16
PRIMARY SCHEMATIC
SAN JOSÉ / SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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in association with
BROWN AND CALDWELL SOM

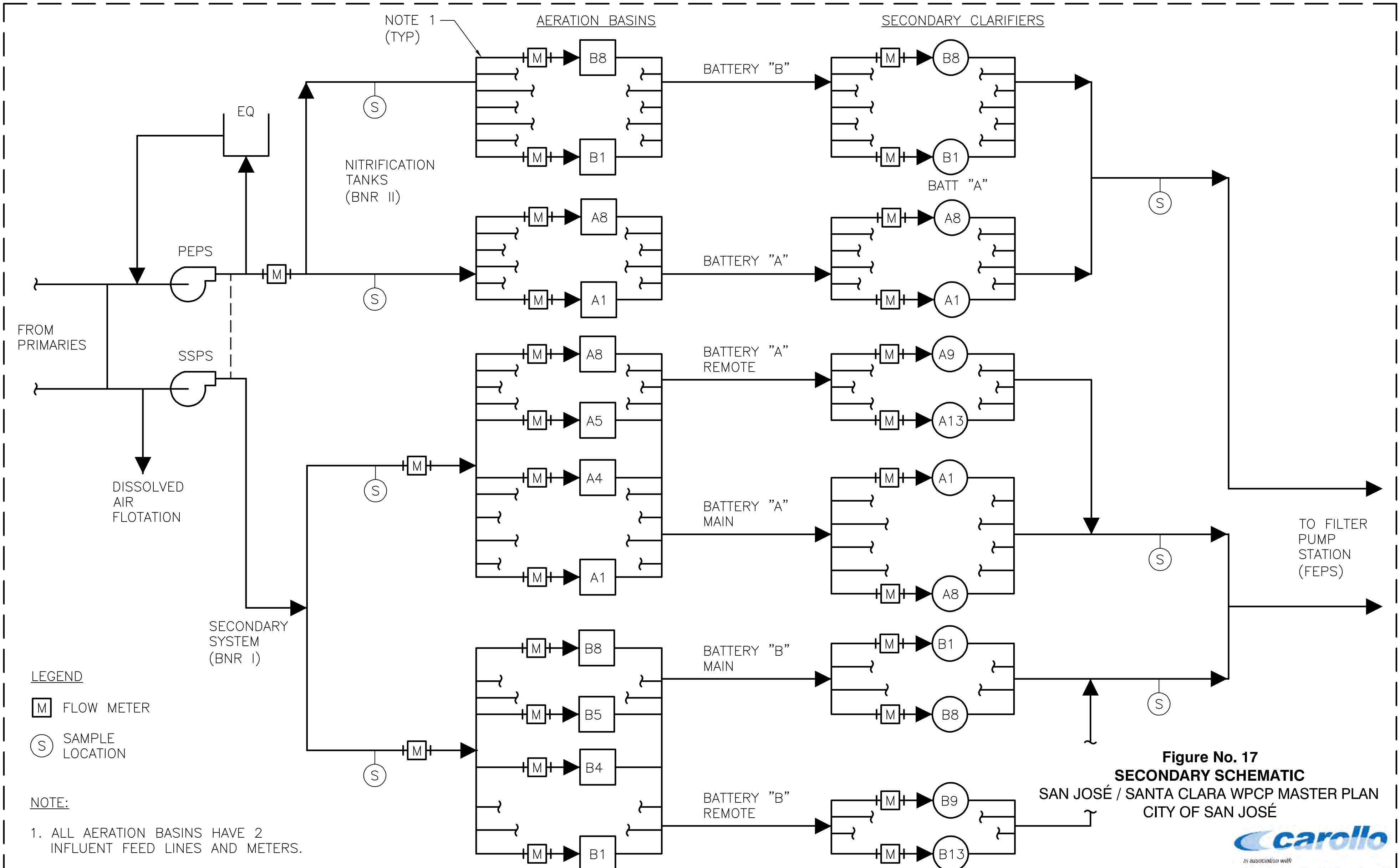

Figure No. 17
SECONDARY SCHEMATIC
SAN JOSÉ / SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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BROWN AND CALDWELL SOM

H:\Client\SanJose_WCO\7897A00\FIGURE\FIGURE 17 7-13-09 02:10pm JRygh XREFS: CarolloBrownCaldwellSomLogo;

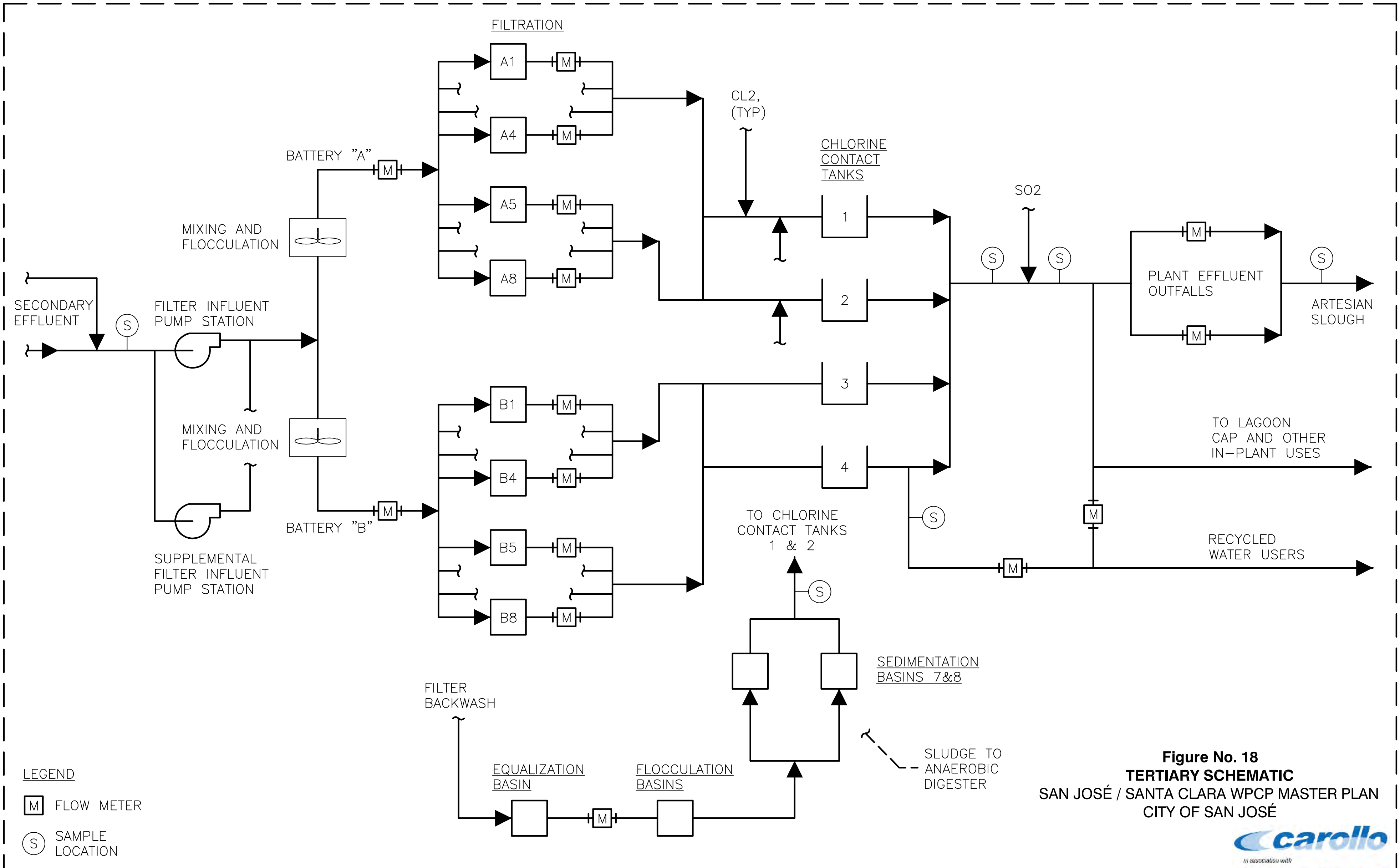

Figure No. 18
TERTIARY SCHEMATIC
SAN JOSÉ / SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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H:\Client\SanJose_WCO\7897A00\FIGURE\FIGURE 18 6-12-09 11:47am JRygh XREFS: CarolloBrownCaldwellSomLogo;

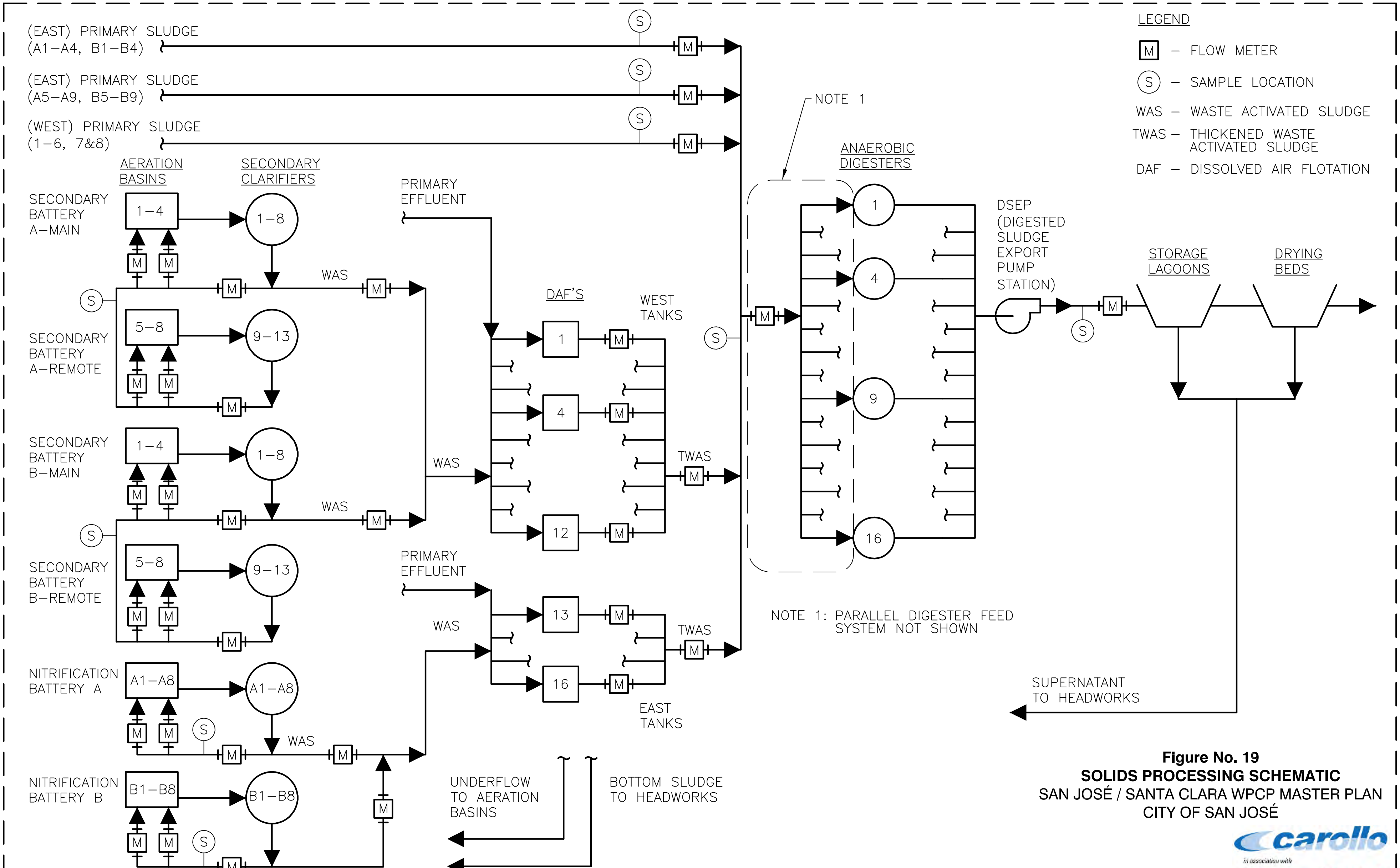

Figure No. 19
SOLIDS PROCESSING SCHEMATIC
SAN JOSÉ / SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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H:\Client\SanJose_WCO\7897A00\FIGURE\FIGURE 19 6-12-09 11:47am JRygh XREFS: CarolloBrownCaldwellSomLogo;

Table 6 Annual Grit, Screenings and Grease Hauling Quantities
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Hauling Category	2003	2004	2005	2006	2007
Grit (tons/yr)(1)	192	301	714	282	326
Average percentage solids(2)	50.8	52.6	56.1	NA	NA
Screenings (tons/yr)(1)	742	594	750	603	627
Average percentage solids(2)	32.4	43.0	38.0	NA	NA
Scum/Grease (tons/yr)(1)	829	725	709	635	640
Average percentage solids(2)	56.5	51.0	48.6	NA	NA

Notes:
NA = Not available.
(1) Quantities obtained from WPCP GGS hauling spreadsheets.
(2) No percent solids data for the years 2006 - 2007.

Table 7 Preliminary Treatment Loading and Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria	Performance/Loading(1,2) (2000 - 2007)	
			Average	Range
Grit Removal(3)				
Overflow Rate (gpd/sf)				
	ADWF	NA	14,690	13,810 - 15,540
	ADAF	NA	15,090	13,960 - 16,180
	ADMMF	NA	16,110	14,370 - 17,770
	PHWWF	33,900	26,060	21,360 - 31,060
Hydraulic Detention Time (min)				
	ADWF	NA	6.1	5.8 - 6.5
	ADAF	NA	6.0	5.6 - 6.5
	ADMMF	NA	5.7	5.1 - 6.3
	PHWWF	2 - 5	4.6	3.8 - 5.5

Notes:
NA = Not Available.
gpd/sf = gallons per day per square foot.
(1) Performance data are monthly averages unless otherwise noted.
(2) Based on actual number of units in service. Not all units are in service at all times.
(3) Grit removal performance estimated based on the assumption that all aerated grit basins and detritor tanks in Headworks No. 1 are in service.

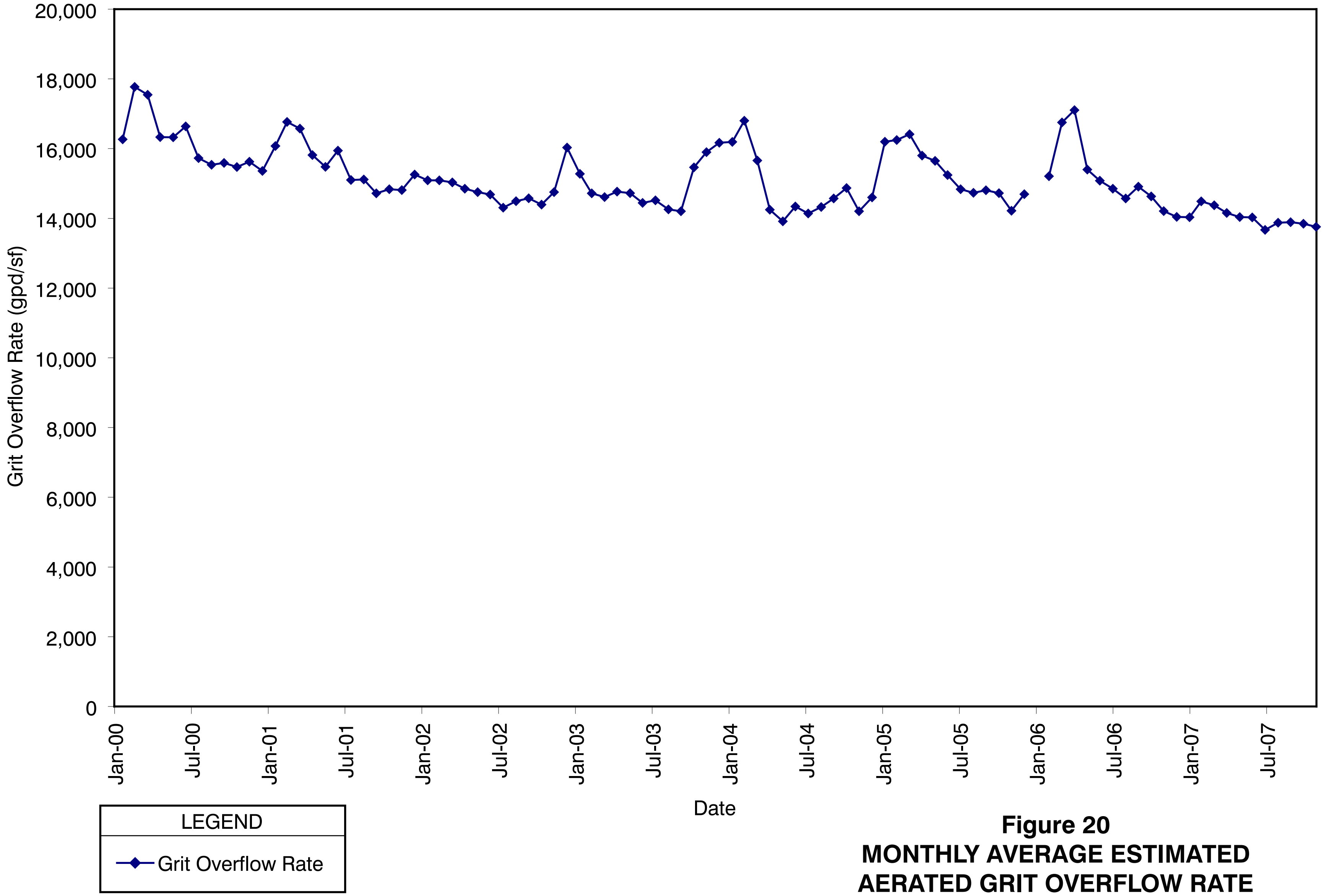

Figure 20
MONTHLY AVERAGE ESTIMATED
AERATED GRIT OVERFLOW RATE
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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service during most of the analysis period, therefore design loadings and performance is provided almost exclusively for the east primary settling tanks.

Table 8 presents the primary treatment loading data and monthly average primary settling tanks overflow rates are presented in Figure 21. Monthly average overflow rates varied between 1,170 and 1,570 gallons per day per square foot (gpd/sf). The monthly average primary settling tank BOD and TSS removal efficiencies are presented in Figure 22. During ADAF conditions, primary settling tank BOD and TSS removal efficiency averages approximately 42 percent and 62 percent, respectively, over the analysis period.

Figures 23 and 24 present the primary settling tank influent and effluent BOD and TSS concentrations, respectively. As shown in these figures, the monthly average ADWF BOD and TSS concentrations in the primary settling tank effluent averaged 177 mg/L and 112 mg/L, respectively. Both the effluent BOD concentrations and TSS concentrations have slightly decreased in the recent years. Primary effluent concentrations for both BOD and TSS were slightly lower for ADMMF flow conditions than they were for ADAF or ADAL. This is likely because influent BOD concentrations are lower during peak flow months than during ADAF conditions. That said, there was not significant difference in BOD or TSS concentration during the various design flow conditions, when expressed on a monthly average basis.

The ADWF hydraulic detention time averaged 1.1 hours, which is lower than the original and typical design criteria for the primary settling tanks. This criterion is not as meaningful for evaluating the process as the overflow rate.

4.3 Secondary Treatment

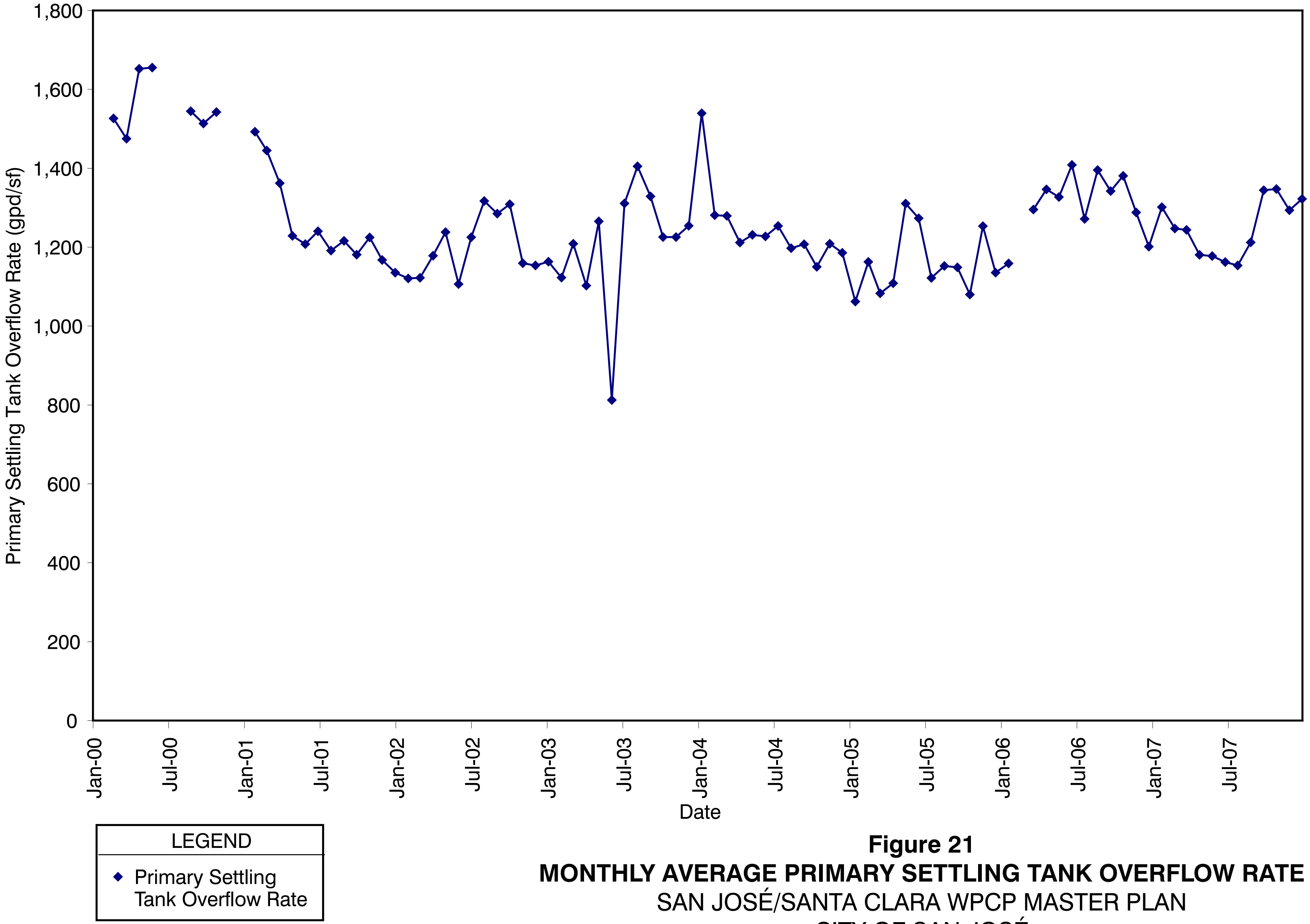
The WPCP secondary treatment consists of the secondary aeration tanks and clarifiers (Biological Nutrient Removal (BNR) I), and the nitrification tanks and clarifiers (BNR II). These systems operate in parallel to provide secondary treatment for the WPCP. The nitrification system was originally designed to operate in series with the secondary system; however, the WPCP has not operated in this mode at least since 2000. The performance data provided in this section reflects the WPCP's practice of parallel operation of BNR I and BNR II.

Both BNR I and BNR II each have two batteries of aeration tanks and clarifiers (A and B batteries). This results in four parallel trains of operation with four separate sludge flows. There are a total of 8 aeration tanks and 42 clarifiers between the BNR I and BNR II process trains. During the analysis period, approximately 65 percent of the total primary effluent flow was treated by BNR I and the remaining 35 percent by BNR II. Although BNR I has more aeration basin volume, BNR I and BNR II have approximately the same clarifier surface area.

Table 8 Primary Treatment Loading and Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria(1)	Performance/Loading(2,3) (2000 - 2007) Average	Range
Primary Settling Tanks(3)				
Overflow Rate (gpd/sf)				
	ADWF	NA	1,274	1,130 - 1,530
	ADAF	NA	1,270	1,170 - 1,570
	ADMMF	1,100 - 1,200	1,287	1,120 - 1,530
	PHWWF	1,930	1,970	1,620- 3,080
Hydraulic Detention Time (hrs)				
	ADWF	NA	1.1	0.9 - 1.2
	ADAF	NA	1.1	0.9 - 1.2
	ADMMF	1.6	1.1	0.7 - 1.3
	PHWWF	NA	0.8	0.5 - 0.9
BOD Removal (%)				
	ADWF	NA	42	34 - 50
	ADAF	NA	42	37 - 50
	ADMMF	NA	45	37 - 52
Primary Effluent BOD, mg/L				
	ADWF	NA	177	152 - 202
	ADAF	NA	179	160 - 200
	ADMMF	NA	168	139 - 186
TSS Removal (%)				
	ADWF	NA	62	52 - 73
	ADAF	NA	62	57 - 70
	ADMMF	NA	63	56 - 70
Primary Effluent TSS, mg/L				
	ADWF	NA	112	90 - 134
	ADAF	NA	111	90 - 124
	ADMMF	NA	107	90 - 129

Notes:
NA = Not Available.
(1) Design criteria based on maximum capacity available (i.e. all units in service).
(2) Based on actual number of units in service. Not all units are in service at all times.
(3) Performance data presented are monthly averages unless otherwise noted.



Note: West primary settling tanks out of service during most of the reporting period. Overflow rate reflects east primary settling tanks in service only.

Figure 21
MONTHLY AVERAGE PRIMARY SETTLING TANK OVERFLOW RATE
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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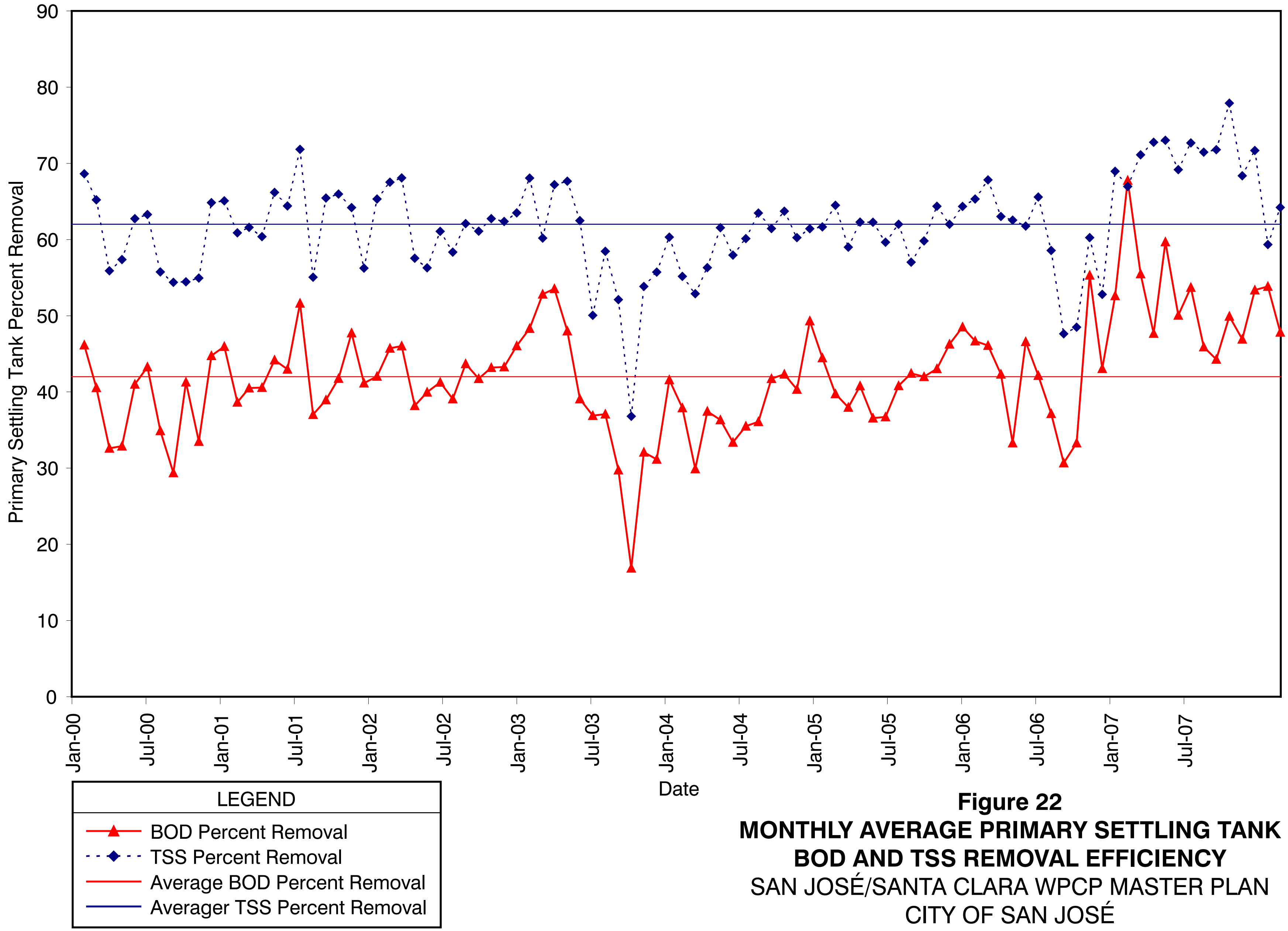

Figure 22
MONTHLY AVERAGE PRIMARY SETTLING TANK BOD AND TSS REMOVAL EFFICIENCY
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CITY OF SAN JOSÉ

Note: West primary settling tanks out of service during most of the reporting period. Overflow rate reflects east primary settling tanks in service only.

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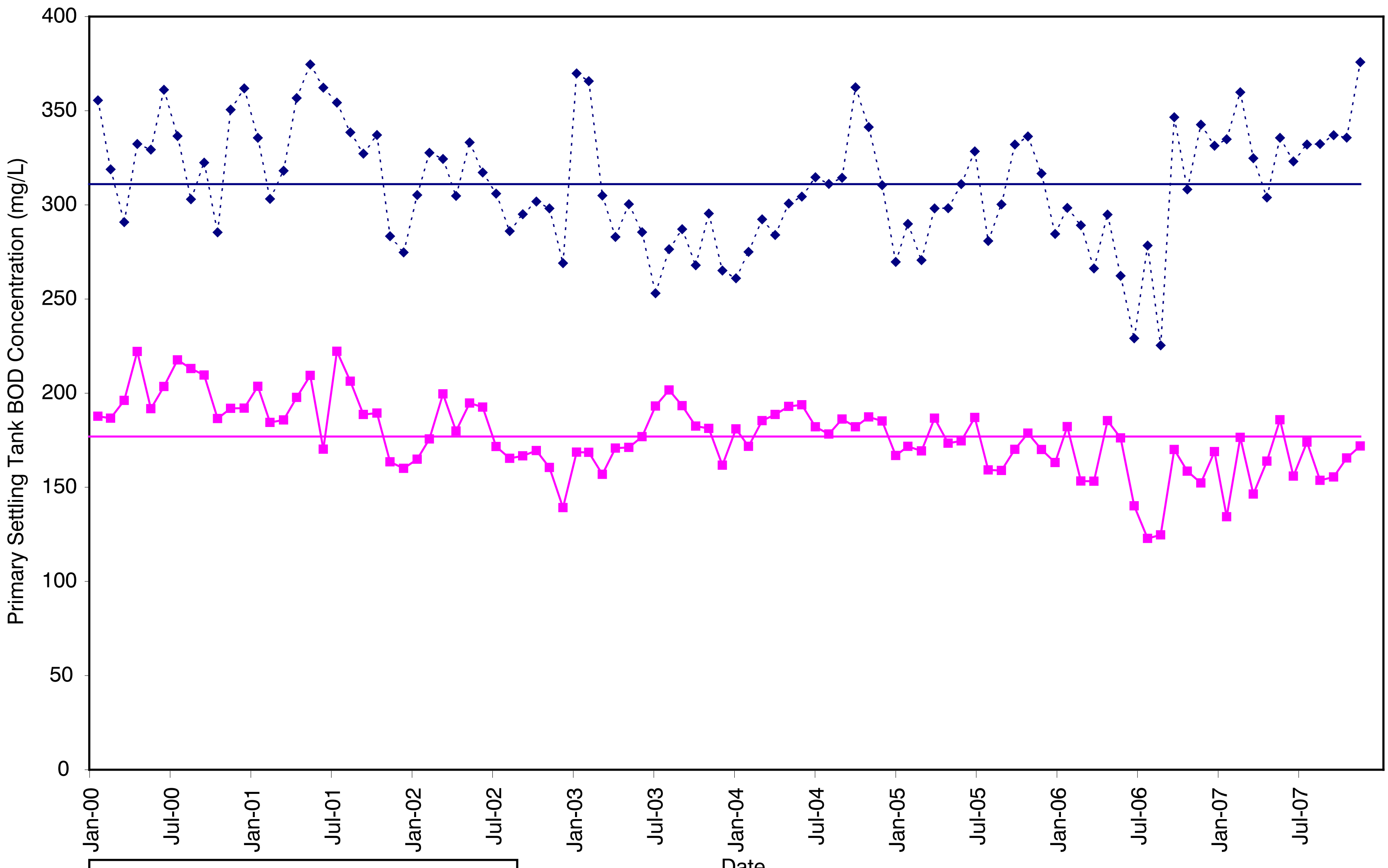

LEGEND

- Influent BOD Concentration (mg/L)
- Effluent BOD Concentration (mg/L)
- Average Influent BOD Concentration
- Average Effluent BOD Concentration

Note: West primary settling tanks out of service during most of the reporting period. Overflow rate reflects east primary settling tanks in service only.

Figure 23

MONTHLY AVERAGE PRIMARY SETTLING TANK BOD INFLUENT AND EFFLUENT CONCENTRATIONS

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CITY OF SAN JOSÉ

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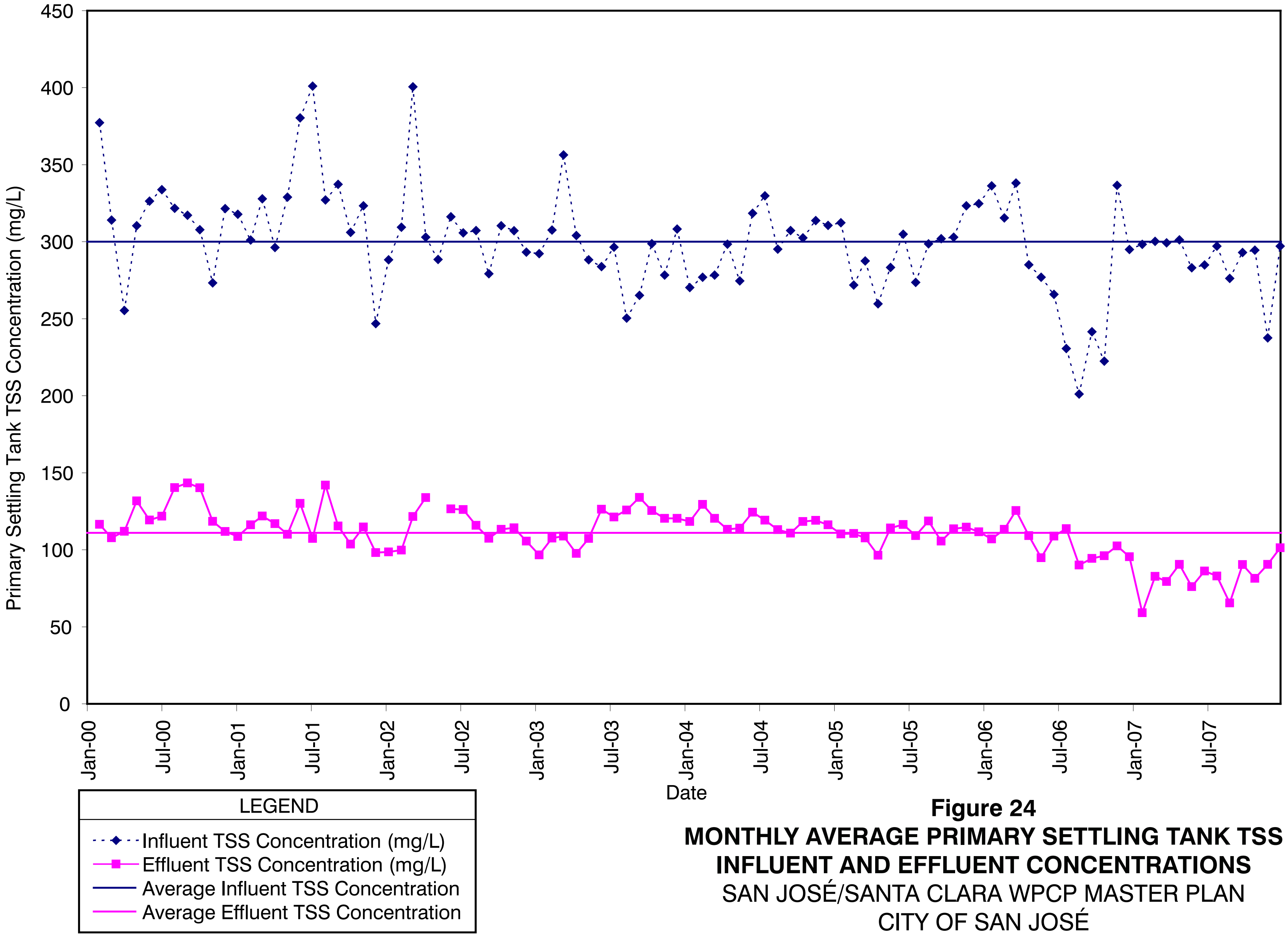

Note: West primary settling tanks out of service during most of the reporting period. Overflow rate reflects east primary settling tanks in service only.

Figure 24

MONTHLY AVERAGE PRIMARY SETTLING TANK TSS INFLUENT AND EFFLUENT CONCENTRATIONS

SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN

CITY OF SAN JOSÉ

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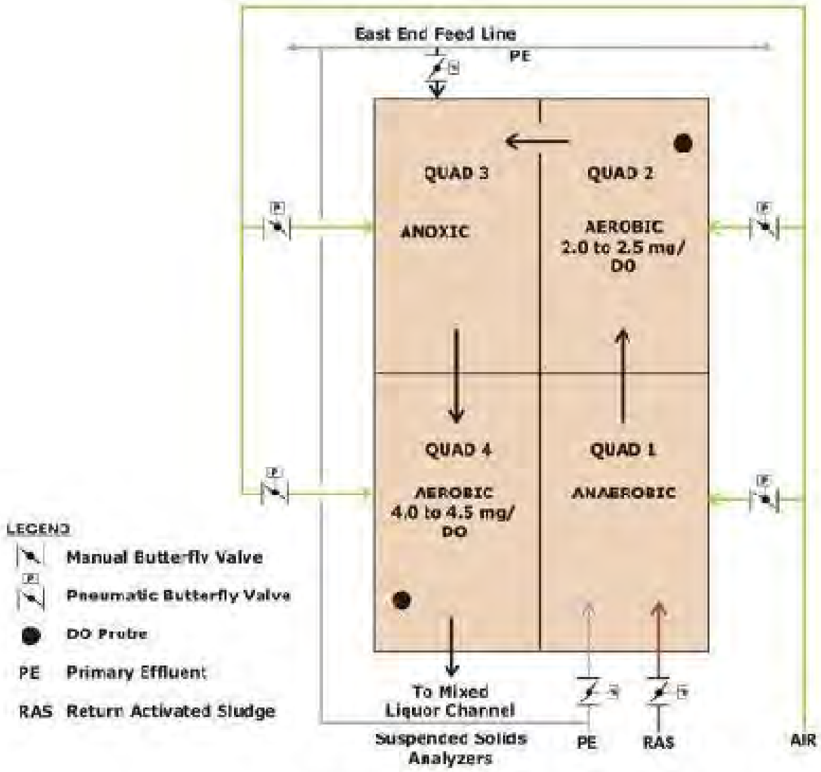
The aeration tanks have the same process configuration in each of the four separate batteries. Each aeration tank consists of four zones operated in anaerobic, aerobic, anoxic, and aerobic conditions, respectively. Figure 25 presents the aeration tank feed pattern for BNR I and BNR II. As shown in the figure, the operating dissolved oxygen (DO) concentrations are slightly different in the two systems. Primary effluent is introduced in the anaerobic (60 percent of total primary effluent feed) and anoxic zones (40 percent of total primary effluent feed) while return activated sludge (RAS) is typically introduced only in the anaerobic zone. Note that although the first and third zones are considered to be anaerobic and anoxic (respectively). These zones are mixed using coarse bubble aeration, which may result in a portion of these zones being aerobic. PMs 2.1 and 3.4 provide more detailed information on the existing system.

Table 9 presents the secondary treatment loading and performance data for the overall BNR system. The appendix presents the loading and performance data for each train. The key design parameters for the aeration tanks include total and aerobic solids retention time (SRT), hydraulic retention time (HRT), and the operating mixed liquor suspended solids (MLSS) concentrations. In addition to these design parameters, Table 9 presents other performance metrics such as sludge yield (pounds of waste activated sludge (WAS) per pound of BOD removed), sludge volume index (SVI), which is a measure of settleability, and volatile suspended solids/total suspended solids (VSS/TSS) ratios for the MLSS and RAS.

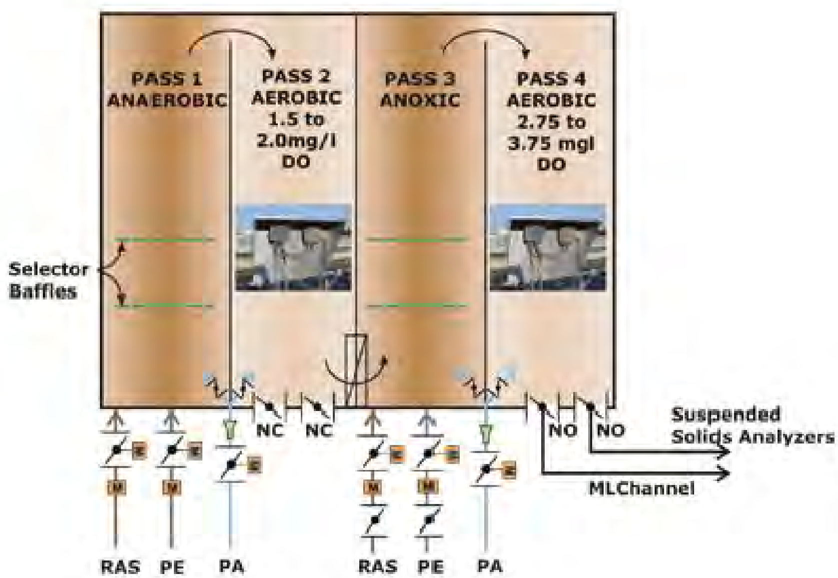
Key design parameters for the clarifiers include the overflow rate, solids loading rate (SLR), and the RAS ratio used. All of these are important process parameters that are used for monitoring and day-to-day control of the process at the WPCP. In addition, these parameters will also be used for evaluating and optimizing the capacity of the existing facilities in other PMs.

The secondary process achieved the required removals for BOD, TSS, and ammonia-nitrogen during the analysis period. In addition, the process has been configured to remove some nitrate and reduce the total nitrogen loadings in the effluent. This mode of operation also typically results in some phosphorus removal. While the NPDES discharge permit does not require removal of nitrates or phosphorus, these types of process changes typically result in reduced aeration demands (due to denitrification and improved oxygen transfer efficiency), and improved settleability.

In addition to performing well, the secondary process is clearly operating well under the actual capacity. During the analysis period, on average about 60 percent of the aeration tank volume and clarifier area was in service.



BNR I Aeration Tank Feed Pattern



BNR II Aeration Tank Feed Pattern

Figure 25
AERATION TANK FEED PATTERN
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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Table 9 Secondary Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria[1]	Performance/Loading[2,3] (2000 - 2007)	
			Average	Range
BNR Aeration Tanks[4]				
HRT (hrs)				
	ADWF	NA	7.6	7.2 - 8.2
	ADAF	NA	7.6	7.2 - 8.2
	ADMMF	NA	7.9	7.3 - 8.7
Total SRT (days)				
	ADWL	NA	8.4	7.0 - 9.4
	ADAL	NA	8.5	7.7 - 9.1
	ADMML	NA	8.4	7.3 - 9.2
Aerobic SRT (days)				
	ADWL	NA	4.2	3.5 - 4.7
	ADAL	NA	4.2	3.8 - 4.5
	ADMML	NA	4.2	3.6 - 4.6
MLSS (mg/L)				
	ADWL	NA	2,890	2,640 - 3,210
	ADAL	NA	3,000	2,780 - 3,330
	ADMML	NA	3,100	2,760 - 3,300
Sludge Yield (lb VSS/lb BOD Removed)				
	ADWL	NA	0.63	0.48 - 0.70
	ADAL	NA	0.56	0.48 - 0.73
ADMML	[5]	NA	0.58	0.45 - 0.91
Sludge Yield (lb TSS/lb BOD Removed)				
	ADWL	NA	0.76	0.63 - 0.95
	ADAL	NA	0.75	0.65 - 0.96
ADMML	[6]	NA	0.76	0.65 - 0.96
SVI (mL/g)				
	ADAL	NA	82	72 - 99
RAS/WAS Concentration (mg/L)				
	ADAL	NA	7,400	6,750 - 7,860

Table 9 Secondary Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria[1]	Performance/Loading[2,3] (2000 - 2007)	
			Average	Range
WAS Flow (mgd)				
	ADWL	NA	2.06	1.9 - 2.4
	ADAL	NA	2.11	2.0 - 2.3
	ADMML	NA	2.12	1.9 - 2.3
WAS TSS (ppd)				
	ADWL	NA	131,320	113,830 - 155,020
	ADAL	NA	131,700	120,520 - 142,270
	ADMML	NA	134,900	113,330 - 154,610
WAS VSS/TSS				
	ADAL	NA	0.74	0.73 - 0.76
Secondary/Nitrification Clarifiers[4]				
Overflow Rate (gpd/sf)				
	ADWF	NA	530	440 - 560
	ADAF	NA	430	420 - 540
	ADMMF	800	491	400 - 590
	PHWWF [7]	930 (BNR I) 810 (BNR II)	680	580 - 770
RAS Ratio, %				
	ADAF	NA	64	54 - 73
SLR (lbs/sf/day)				
	ADWF	NA	23	19 - 25
	ADAF	NA	22	17 - 26
	ADMMF	NA	22	14 - 31
PHWWF	[7]	34.5	24	19 - 28

Notes:

NA = Not Available.

(1) Design criteria based on maximum capacity available (i.e. all units in service).

(2) Based on actual number of units in service. Not all units are in service at all times.

(3) Performance data presented are monthly averages unless otherwise noted.

(4) Performance data presented is for combined performance of BNR I and BNR II.

(5) VSS/BOD sludge yield data unavailable during the maximum load month in 2002 or 2004 for calculation of the ADMML condition.

(6) TSS/BOD sludge yield data unavailable during the maximum load month in 2002 for calculation of the ADMML condition.

(7) Data unavailable for calculation of PHWWF average performance and performance range in 2006 for the secondary/nitrification clarifier overflow rate and SLR.

4.3.1 Secondary Process BOD, TSS, Ammonia-Nitrogen, and Nutrients

Figures 26 through 31 illustrate influent and effluent concentrations of the secondary process for available BOD, TSS, and ammonia-nitrogen data. Note that influent BOD and TSS concentrations to the BNR system show some variability in time and from sample location (Figures 26 and 27). The different sample locations generally provide different results affected by DAF subnatant flows and the primary effluent equalization tank. To account for this, calculations and analysis are based on reported influent concentrations to individual BNR trains as opposed to primary effluent, which is sampled upstream of the equalization tank and where DAF subnatant is returned to the process.

In general, the secondary process achieved very good removal of BOD and TSS, well within typical performance for this type of process. BNR 2 appears to be performing marginally better than BNR 1 for TSS removal, though the difference is small and the cause is not known. The process has also performed very well at removing ammonia-nitrogen, with effluent concentrations around 0.1 mg/L for the last several years. Effluent ammonia concentrations in 2000 and 2001 were at times higher than recent performance. This could be due to the change in the process configuration and associated “start-up” and optimization efforts. Effluent nitrate concentrations typically ranged from 7 to 12 mg/L, with an average value of 8 mg/L. Effluent nitrite concentrations were generally very low (less than about 0.1 mg/L), indicating that the nitrification and denitrification process is working well. Figure 32 presents the effluent nitrite and nitrate concentrations. No influent phosphorus data was available for calculation of phosphorous removal; however, limited total phosphate concentrations measured in the effluent averaged 4.2 mg/L.

4.3.2 Aeration Basin Hydraulic Retention Time

At the time the WPCP was built, aeration basin HRT was often used for sizing of aeration basins. Today this criterion is seen to be of lesser importance for the sizing and evaluation of this type of process. Sizing is based instead on operating parameters linked to loading and mixed liquor solids. The ADAF HRT during the analysis period was 7.6 hours, which is sufficient for the current treatment objectives.

4.3.3 Solids Retention Time

The SRT is calculated as the total inventory of biomass in the aeration tanks divided by the solids wasted from the secondary system, and represents the average residence time of the biomass in the aeration tanks. The SRT can also be calculated as an aerobic SRT, which only considers the inventory in the aerobic zones of the aeration tank. The aerobic SRT impacts the degree of removal that can be expected for constituents such as soluble and particulate BOD and especially ammonia-nitrogen. Because the growth rates for microorganisms that oxidize ammonia-nitrogen are very sensitive to temperature, as temperatures decline, longer aerobic SRT’s are needed for ammonia-nitrogen removal. For the WPCP, approximately half of the total aeration tank volume and SRT is aerobic. The

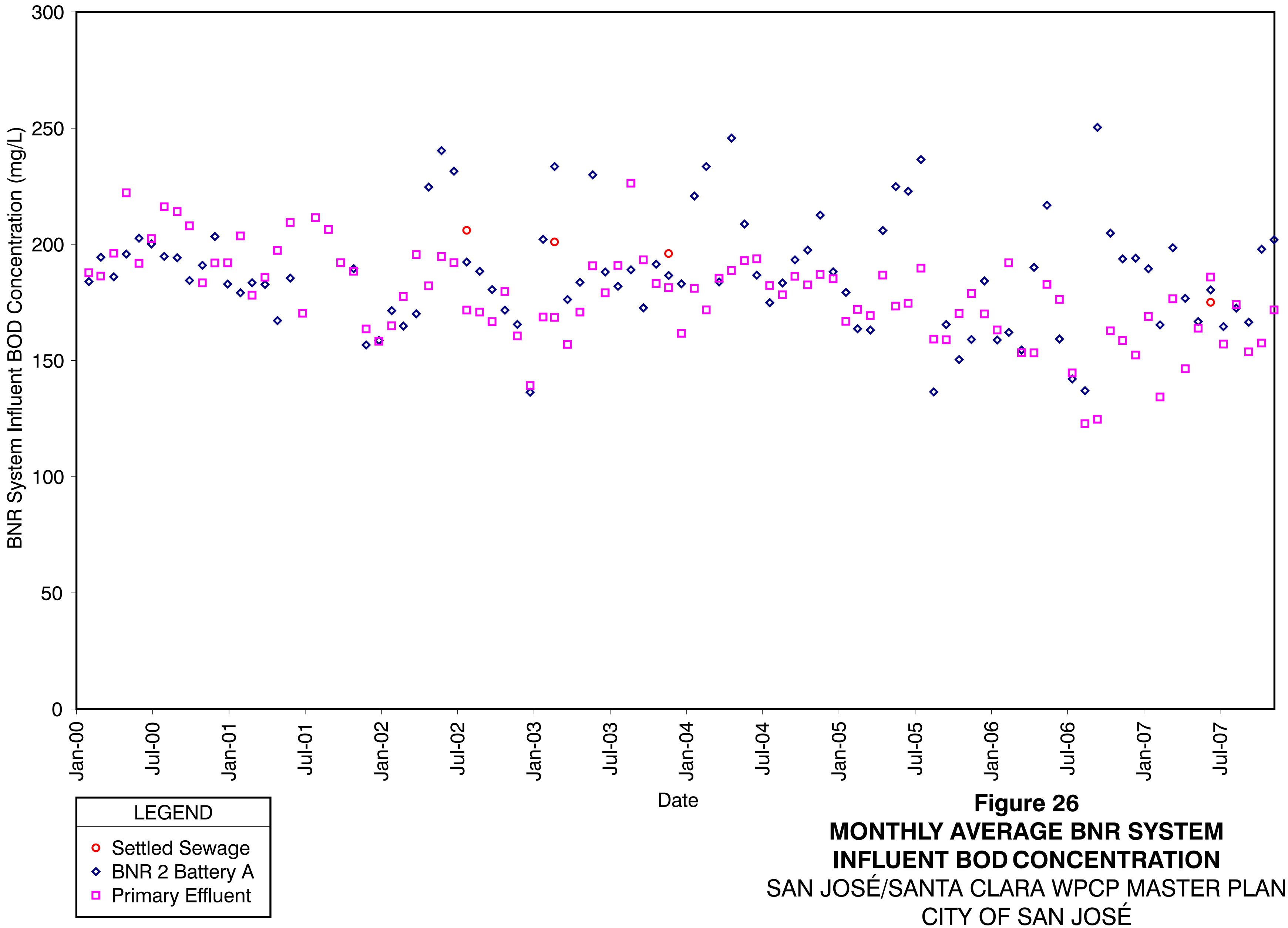

Figure 26
MONTHLY AVERAGE BNR SYSTEM INFLUENT BOD CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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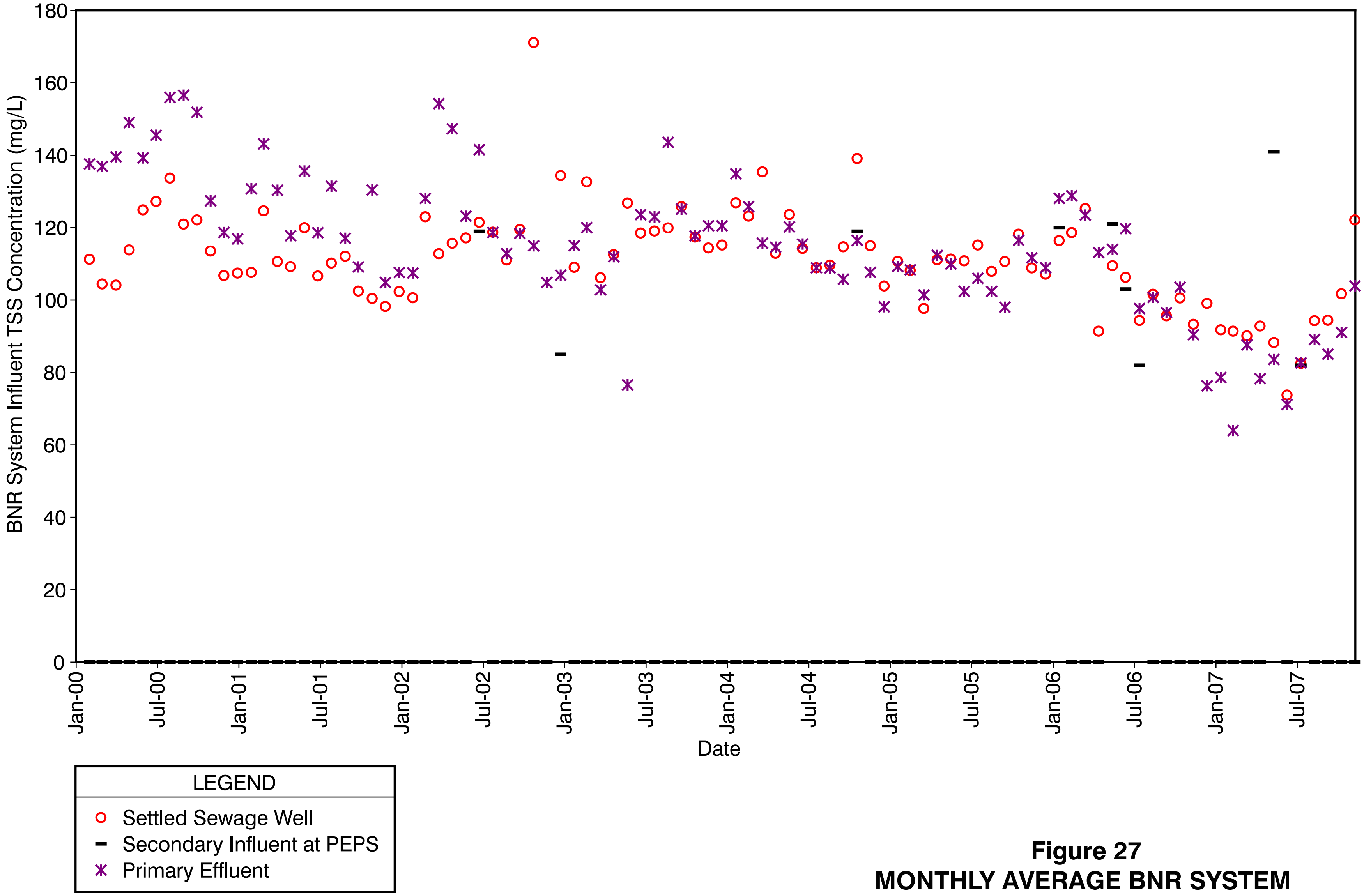

Figure 27
MONTHLY AVERAGE BNR SYSTEM INFLUENT TSS CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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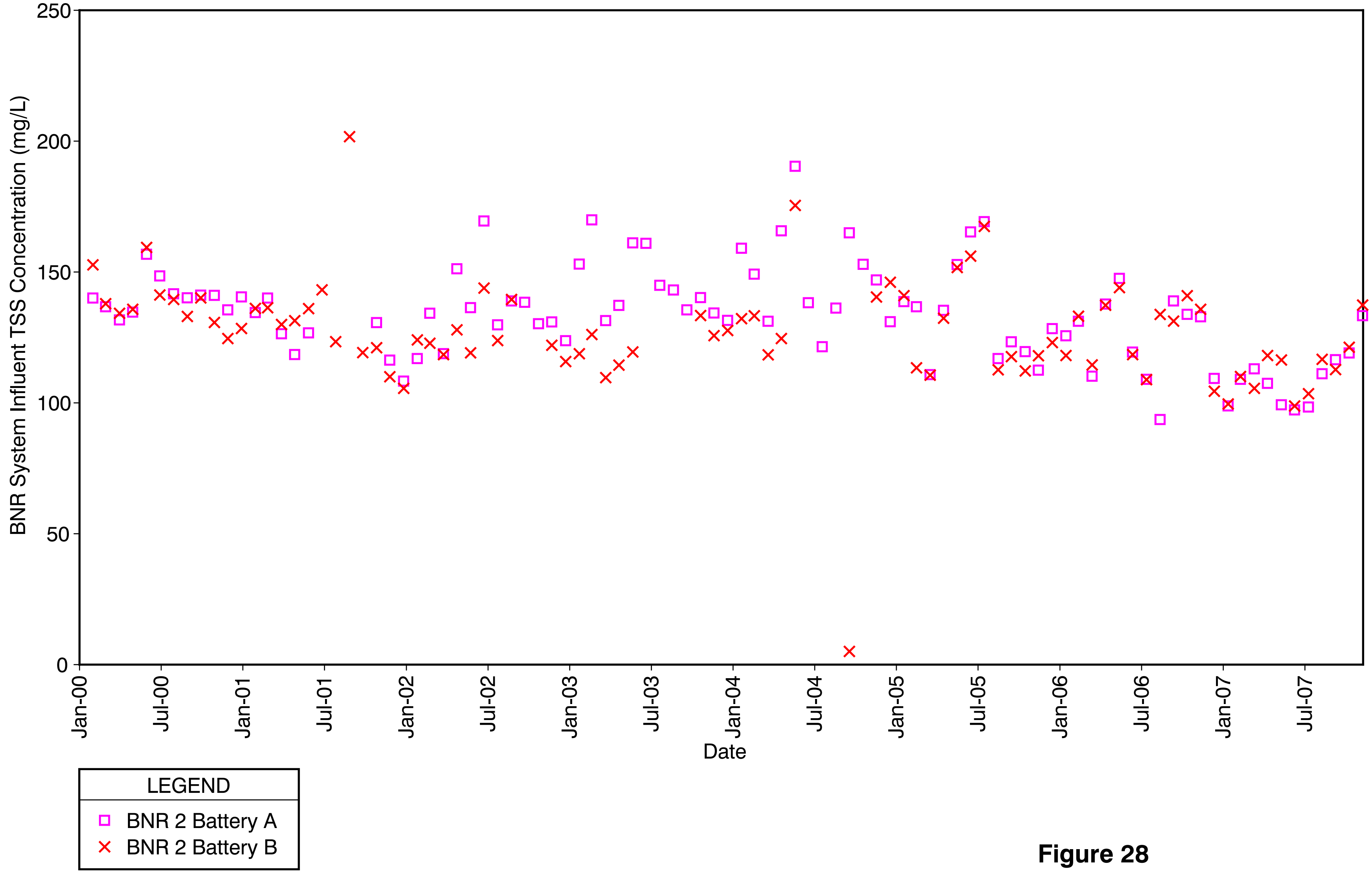

Figure 28
MONTHLY AVERAGE BNR 2 SYSTEM INFLUENT TSS CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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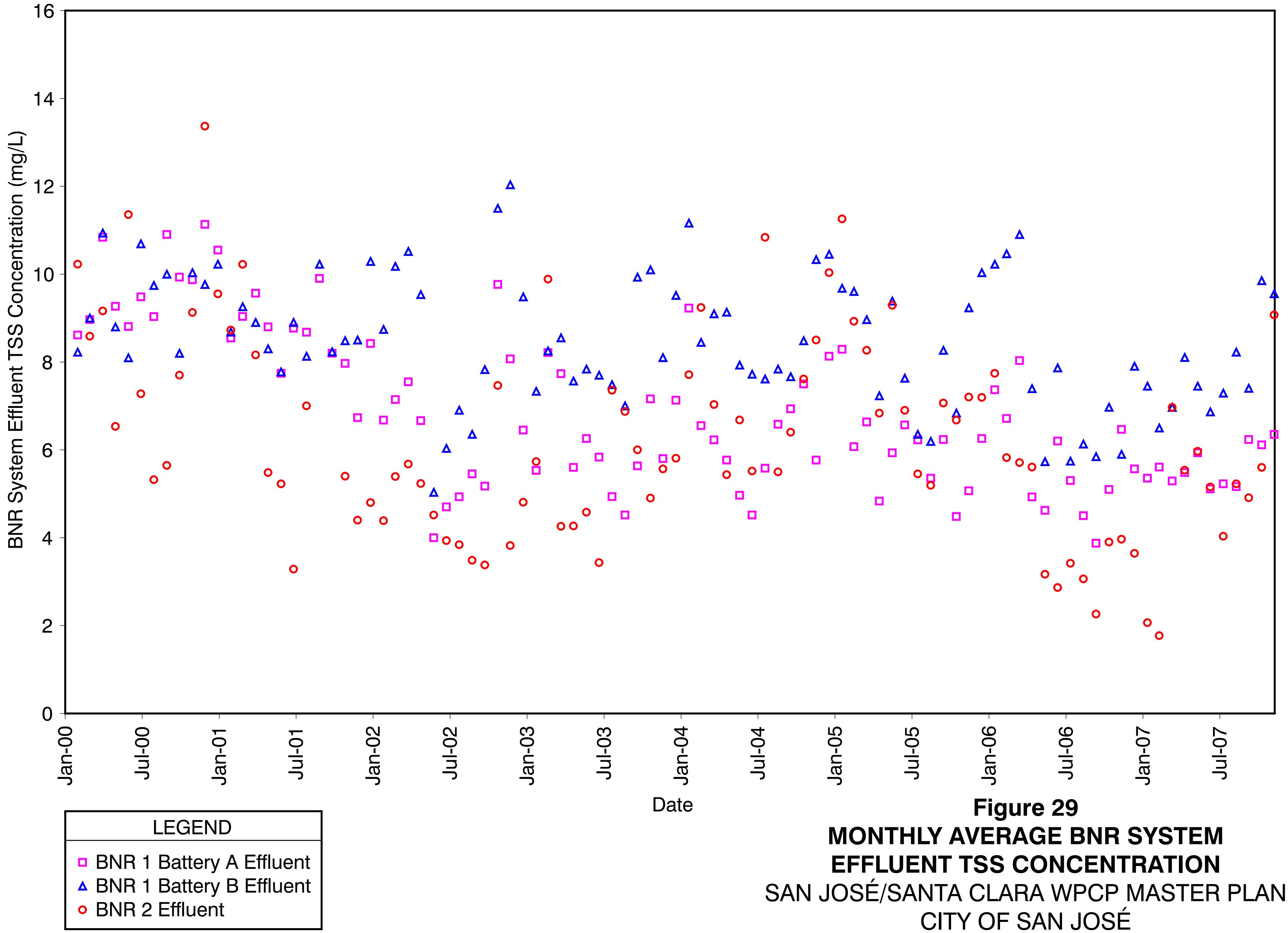

Figure 29
MONTHLY AVERAGE BNR SYSTEM EFFLUENT TSS CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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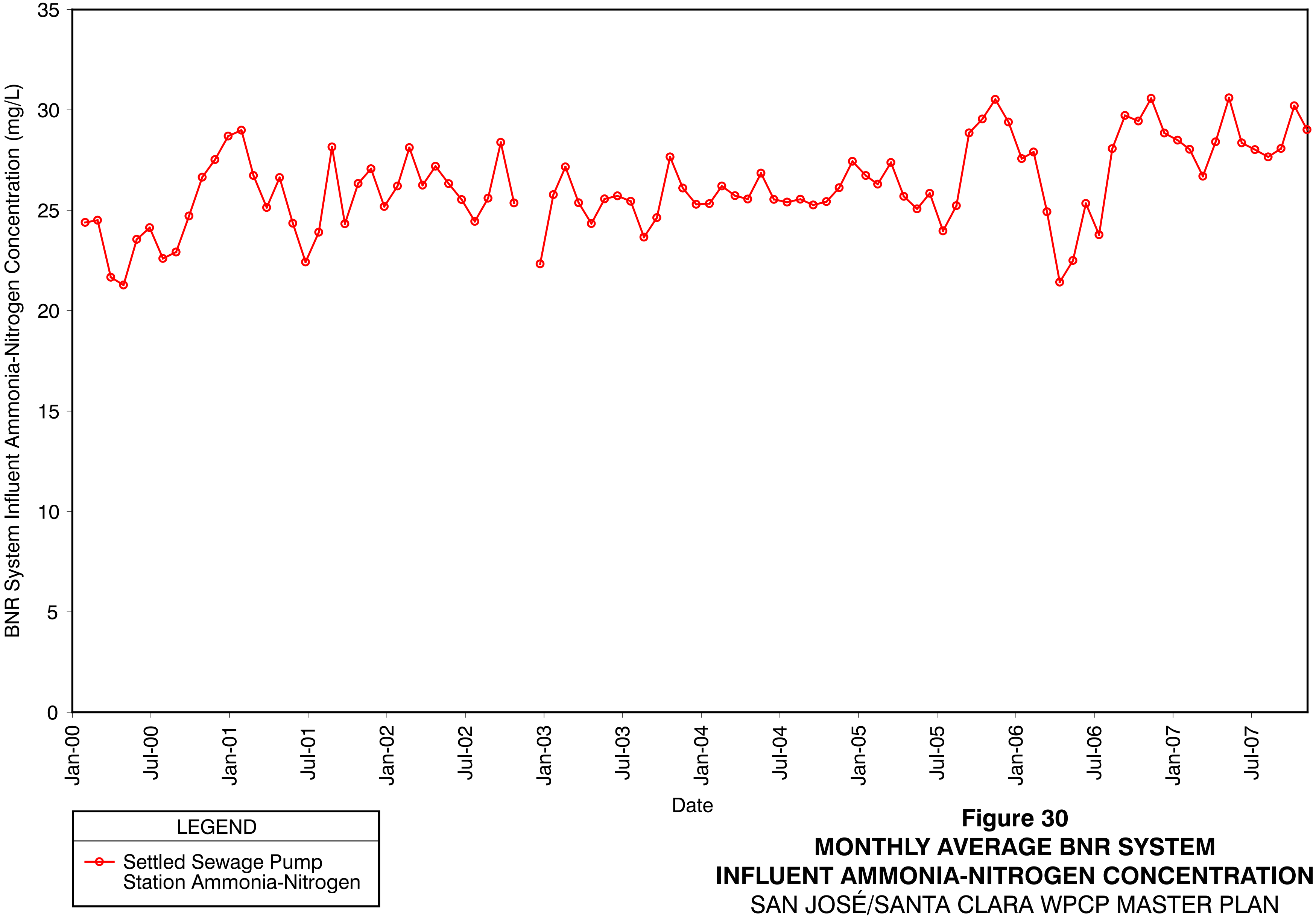

Figure 30
MONTHLY AVERAGE BNR SYSTEM
INFLUENT AMMONIA-NITROGEN CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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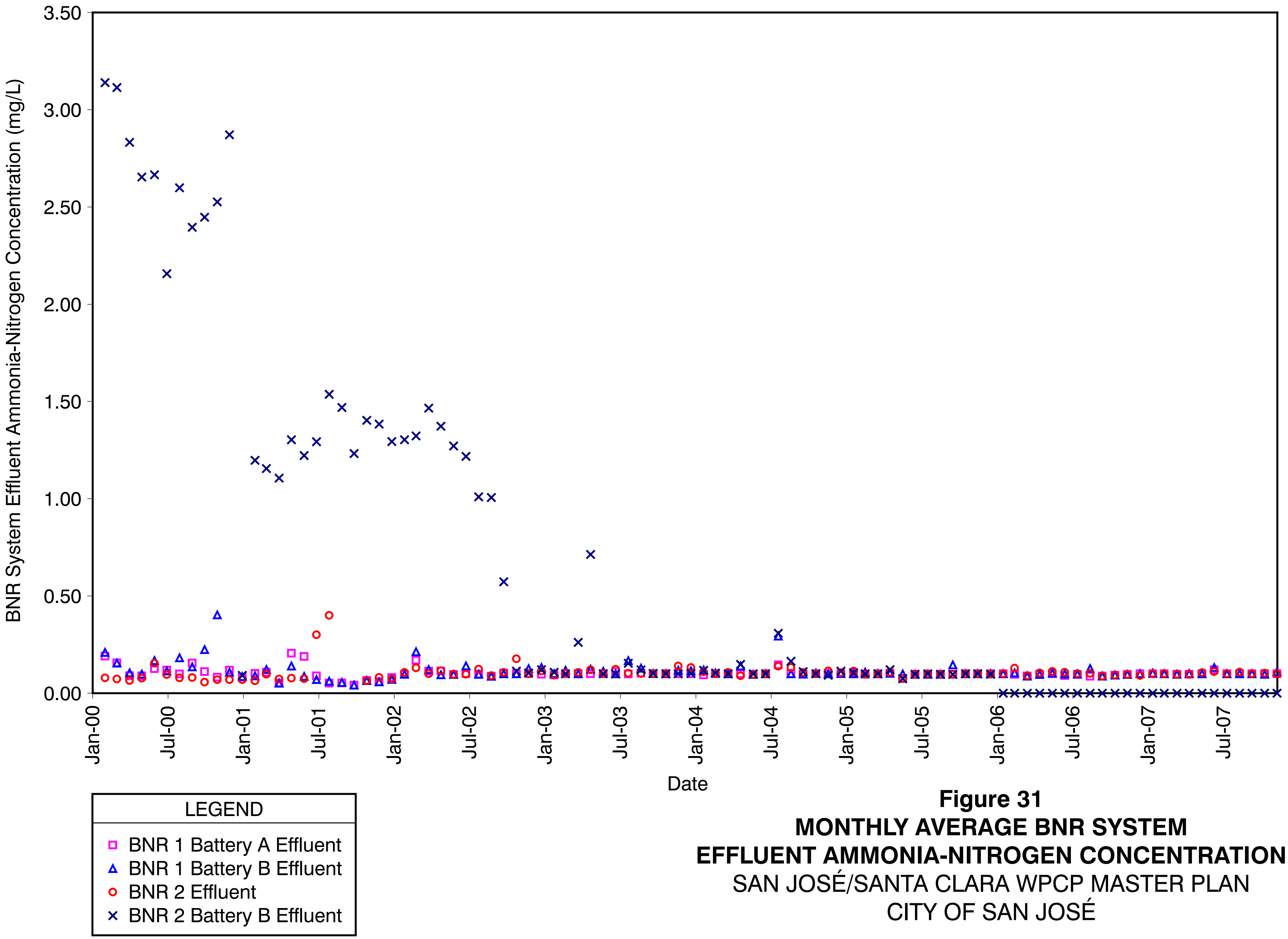

Figure 31
MONTHLY AVERAGE BNR SYSTEM
EFFLUENT AMMONIA-NITROGEN CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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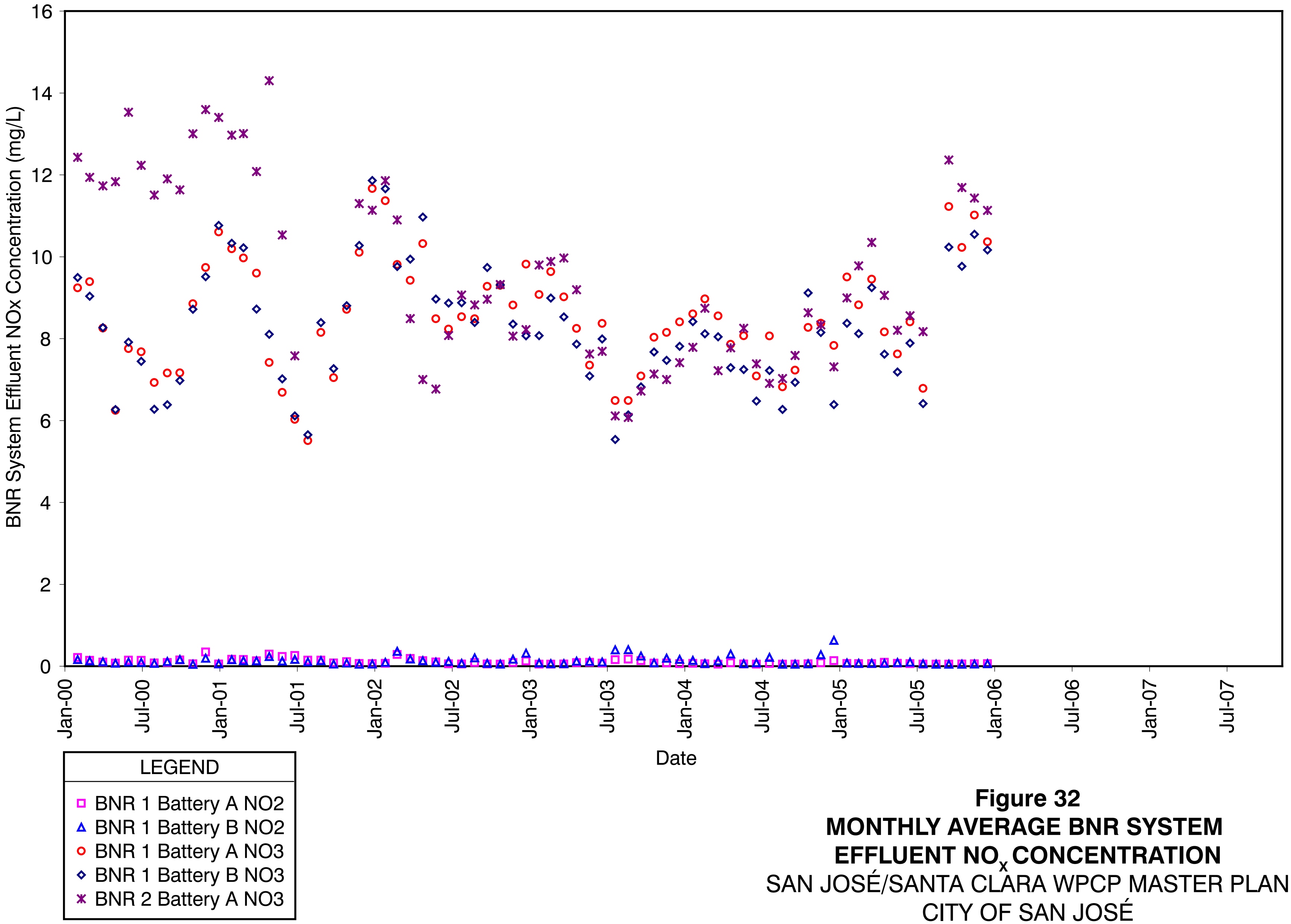

Figure 32
MONTHLY AVERAGE BNR SYSTEM EFFLUENT NO_x CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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WPCP has been successfully operating at an average total SRT of 8.5 days, with an aerobic SRT of 4.2 days, which is on the low end for facilities that must nitrify in this climate. It is possible that the actual aerobic SRT is longer if some of the anaerobic and anoxic zones are partially aerobic resulting from using diffused aeration for mixing. Figure 33 illustrates the SRT for different batteries and the overall secondary process.

4.3.4 MLSS and MLVSS

The MLSS concentration is the total suspended solids concentration in the aeration tanks. The mixed liquor volatile suspended solids (MLVSS) concentration is the total volatile suspended solids concentration in the aeration tanks, which is directly proportional to the quantity of biomass available to perform treatment. The operating MLSS has a direct impact on the operating SRT, solids loading and performance of the clarifiers, and sometimes sludge settleability.

The aeration tanks have been operated with a MLSS and MLVSS concentration of approximately 3,000 and 2,200 mg/L, respectively, for the last 8 years. This concentration is well within typical concentrations of this process and operating at this concentration has resulted in good performance. Figure 34 and 35 illustrate the MLSS and MLVSS concentrations for different batteries and the overall secondary process as measured downstream of the aeration tanks. Note that due to the fact that all of the RAS is fed in the first zone, while primary effluent is split between the first and third zones (60/40 split), the measured MLSS and MLVSS only represents the concentrations in the latter 2 zones after the RAS has been diluted with 100 percent of the total primary effluent. The first two zones will be operating at higher concentrations (approximately 30 percent higher) because the RAS is only diluted at approximately 60 percent of the total primary effluent. The tables provided in the appendix presents the calculated MLSS concentrations for each battery for the BNR I and BNR II systems.

4.3.5 Sludge Yield and Waste Activated Sludge Production

WAS production and sludge yields (pounds of sludge generated per pound of BOD removed) are in the expected range for this type of secondary process. The average yield of biomass during the review period was 0.56 pound of VSS per pound of BOD removed. The average yield of total solids during the review period was 0.75 pound of TSS per pound of BOD removed. Typically, the sludge yields can be expected to decrease if the operating SRT is increased; conversely, one would expect the sludge yields to increase if the operating SRT is reduced. Figure 36 illustrates the sludge yields for the entire secondary process during the review period. The jump in yield after July 2006 may be an anomaly due to measurement error.

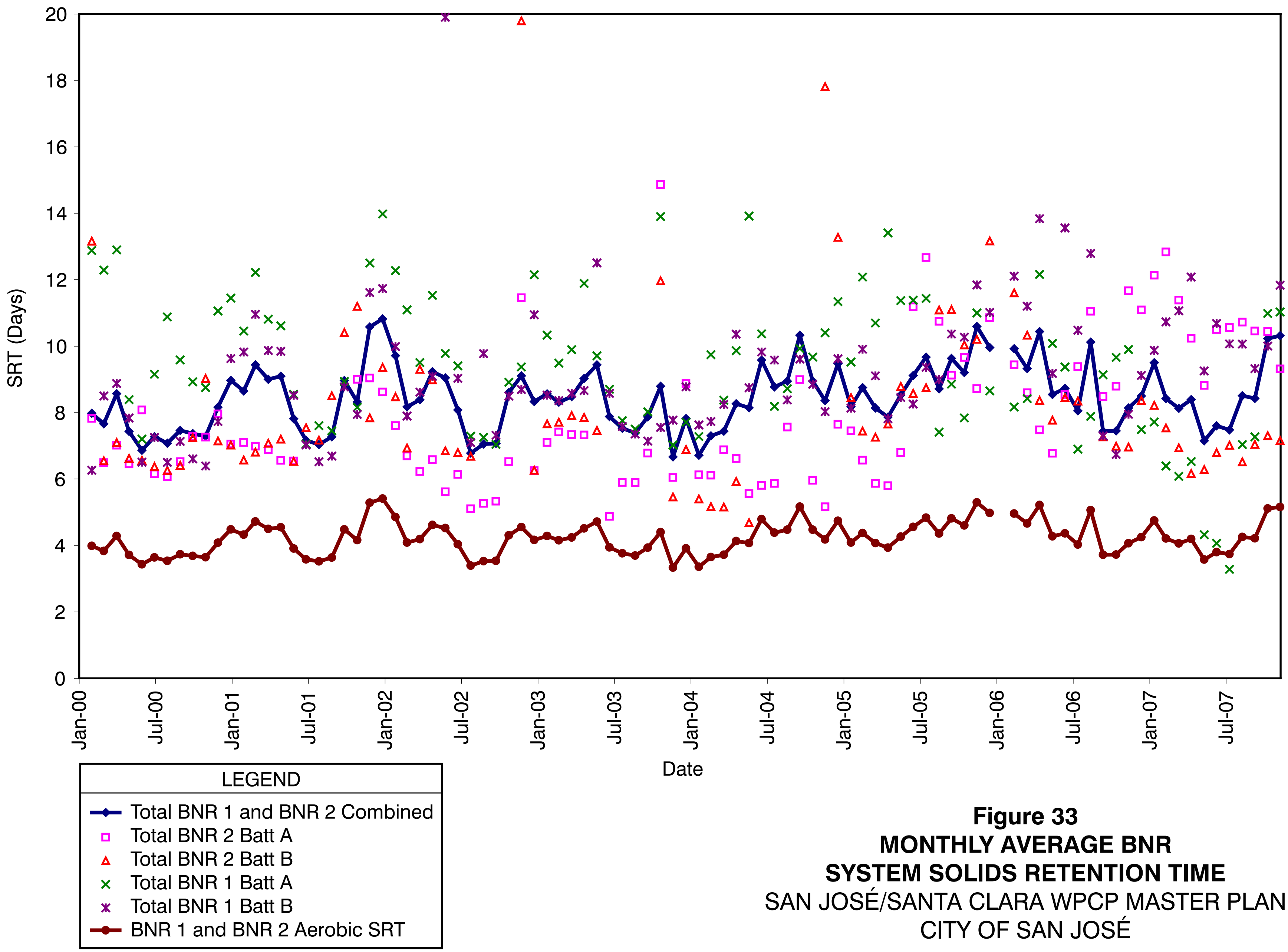

Figure 33
MONTHLY AVERAGE BNR
SYSTEM SOLIDS RETENTION TIME
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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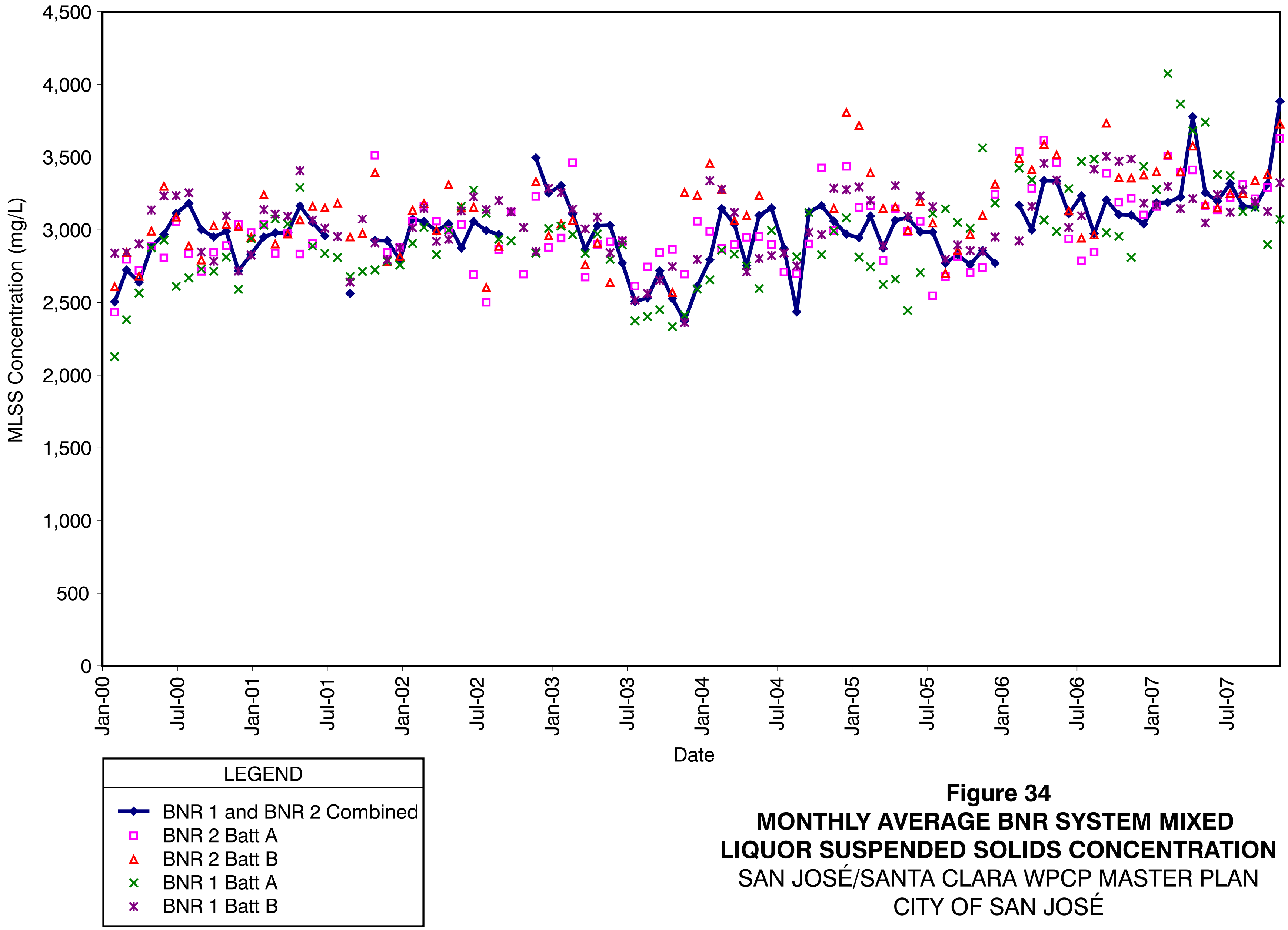

Figure 34
MONTHLY AVERAGE BNR SYSTEM MIXED LIQUOR SUSPENDED SOLIDS CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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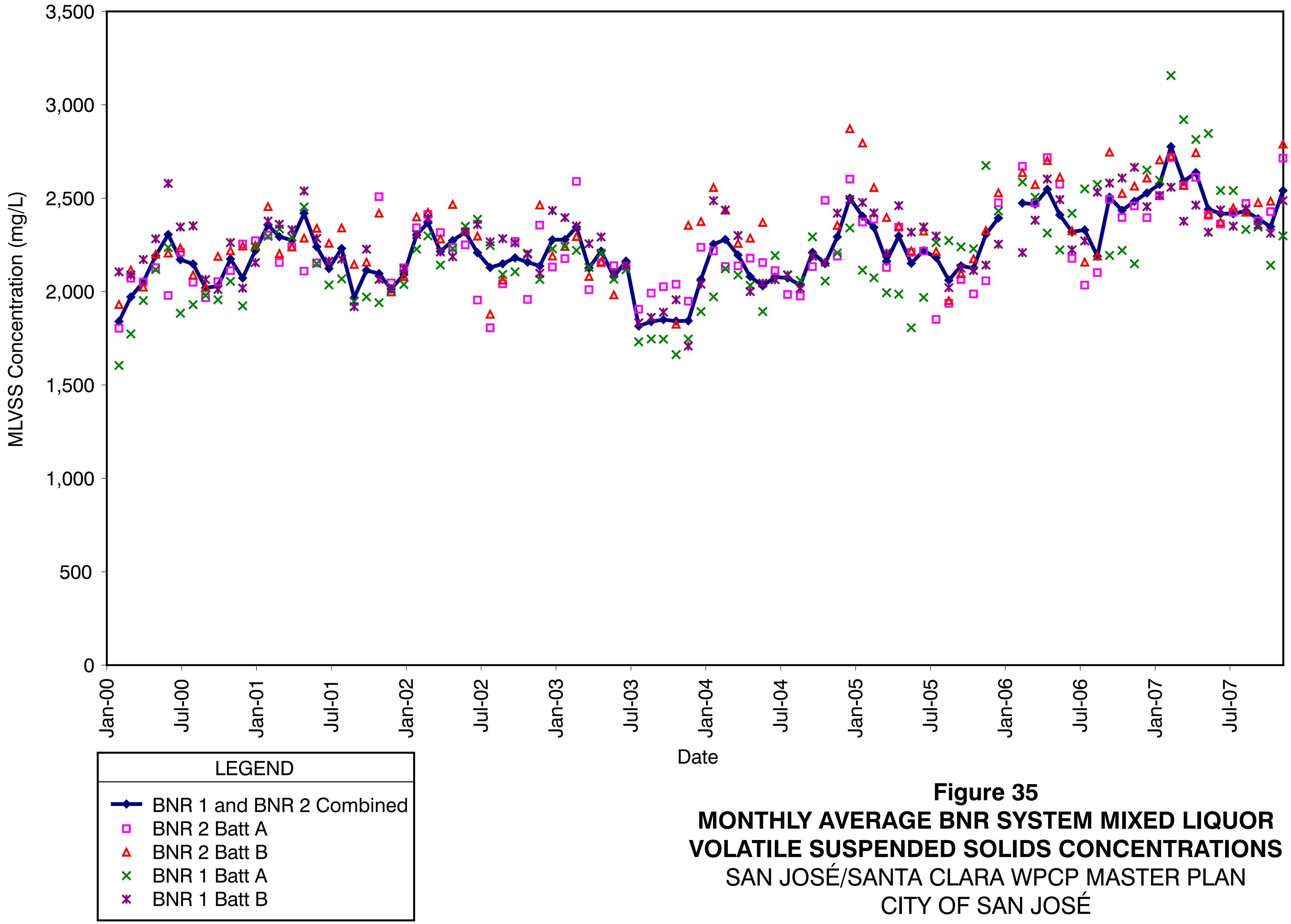

Figure 35

MONTHLY AVERAGE BNR SYSTEM MIXED LIQUOR VOLATILE SUSPENDED SOLIDS CONCENTRATIONS

SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN

CITY OF SAN JOSÉ

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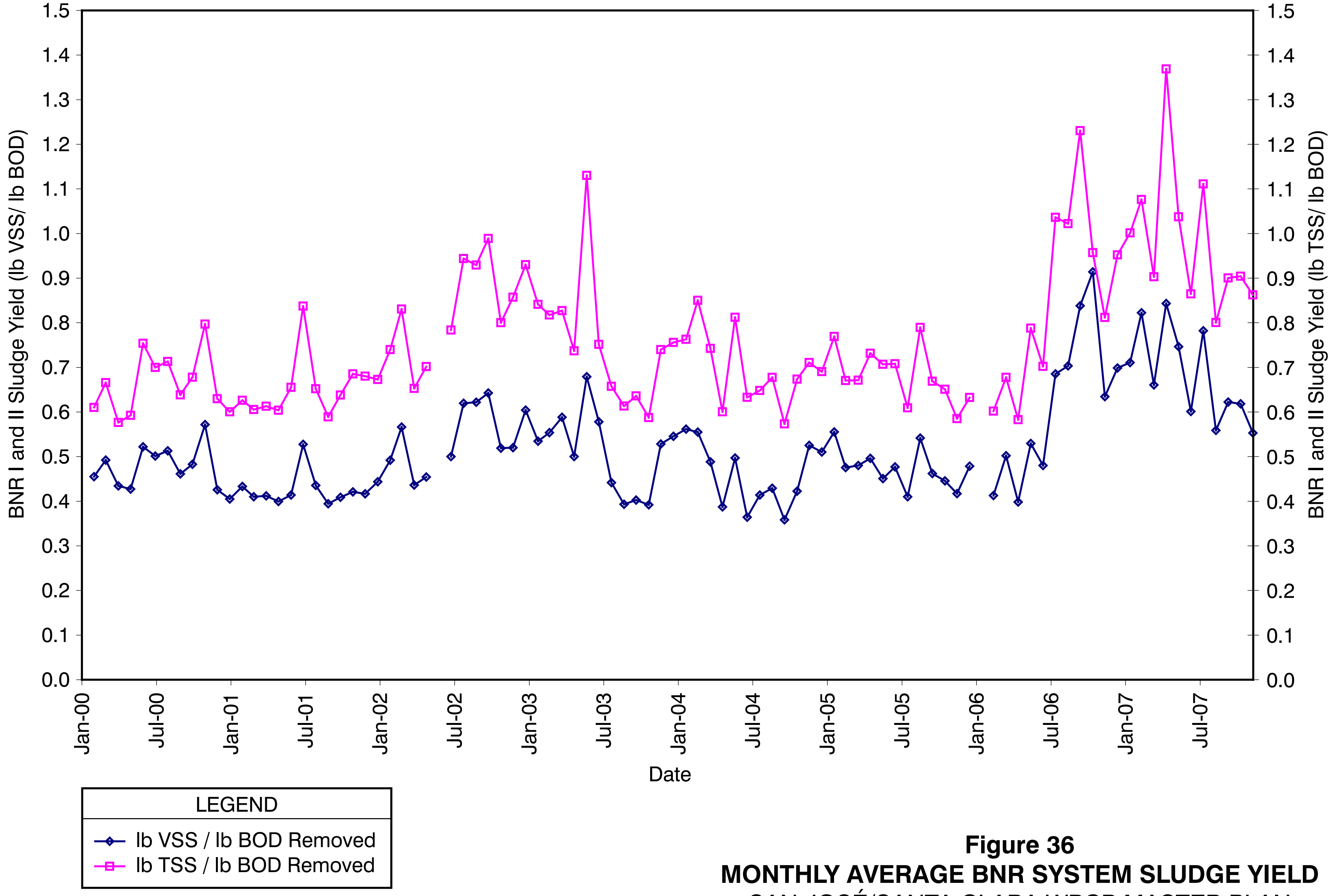

Figure 36
MONTHLY AVERAGE BNR SYSTEM SLUDGE YIELD
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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4.3.6 Sludge Volume Index

The SVI is a measure of settleability. In general, the lower the number, the better the settleability. SVI's below 150 milliliters per gram (mL/g) are generally considered to have good settleability. Plants that have selectors or a nutrient removal process (such as the WPCP) often have good settleability. The average settleability during the review period was 83 mL/g. The frequency distribution of settleability for the 50th, 90th, 95th and 99th percentile were 76 mL/g, 99.6 mL/g, 113.7 mL/g, and 219.6 mL/g, respectively. Figure 37 illustrates the monthly average settleability during the review period. As the figure illustrates, there have been few brief periods with poor settleability where SVI's climbed above 150 mL/g. The cause for these excursions is not known. However, staff has observed that settleability is degraded during wet weather events (City of San José, 1998).

4.3.7 Clarifier Overflow Rates

The clarifier overflow rate has averaged approximately 500 and 680 gallons per day per square foot (gpd/sf) during ADAF and PHWWF conditions reviewed during the analysis period. At the WPCP's typical operating MLSS concentration and SVIs, these overflow rates are an acceptable loading rate for maintaining good clarifier performance. Effluent TSS data (see Figure 29) show the clarifiers are performing well. Figure 38 illustrates the overflow rate for different clarifier batteries and the overall clarifier process. Note that in 2006, BNR 1 was operated at a higher loading rate than previous years to accommodate a temporary shut-down to BNR 2 for the headworks project tie-in.

4.3.8 Clarifier Solids Loading Rates

The clarifier SLR has averaged 17 and 26 pounds per day per square foot (ppd/sf) during ADAF and PHWWF conditions reviewed during the analysis period. At the WPCP's typical operating MLSS concentration and SVI's, these SLR's are an acceptable loading rate for maintaining good clarifier performance. Effluent TSS data (see Figure 29) show the clarifiers are performing well under normal operation conditions. Figure 39 illustrates the SLR for different batteries and the overall clarifier process. Note that in 2006, BNR 1 was operated at a higher loading rate than previous years to accommodate a temporary shut-down to BNR 2 for the headworks project tie-in.

4.4 Tertiary Treatment

The WPCP tertiary treatment consists of media filtration followed by chlorine disinfection. Table 10 presents the performance of tertiary treatment at the WPCP. Note that the WPCP Design Criteria column in Table 10 is based on design drawings and other sources. Further discussion of WPCP design and stand-by criteria is presented in PM 3.4.

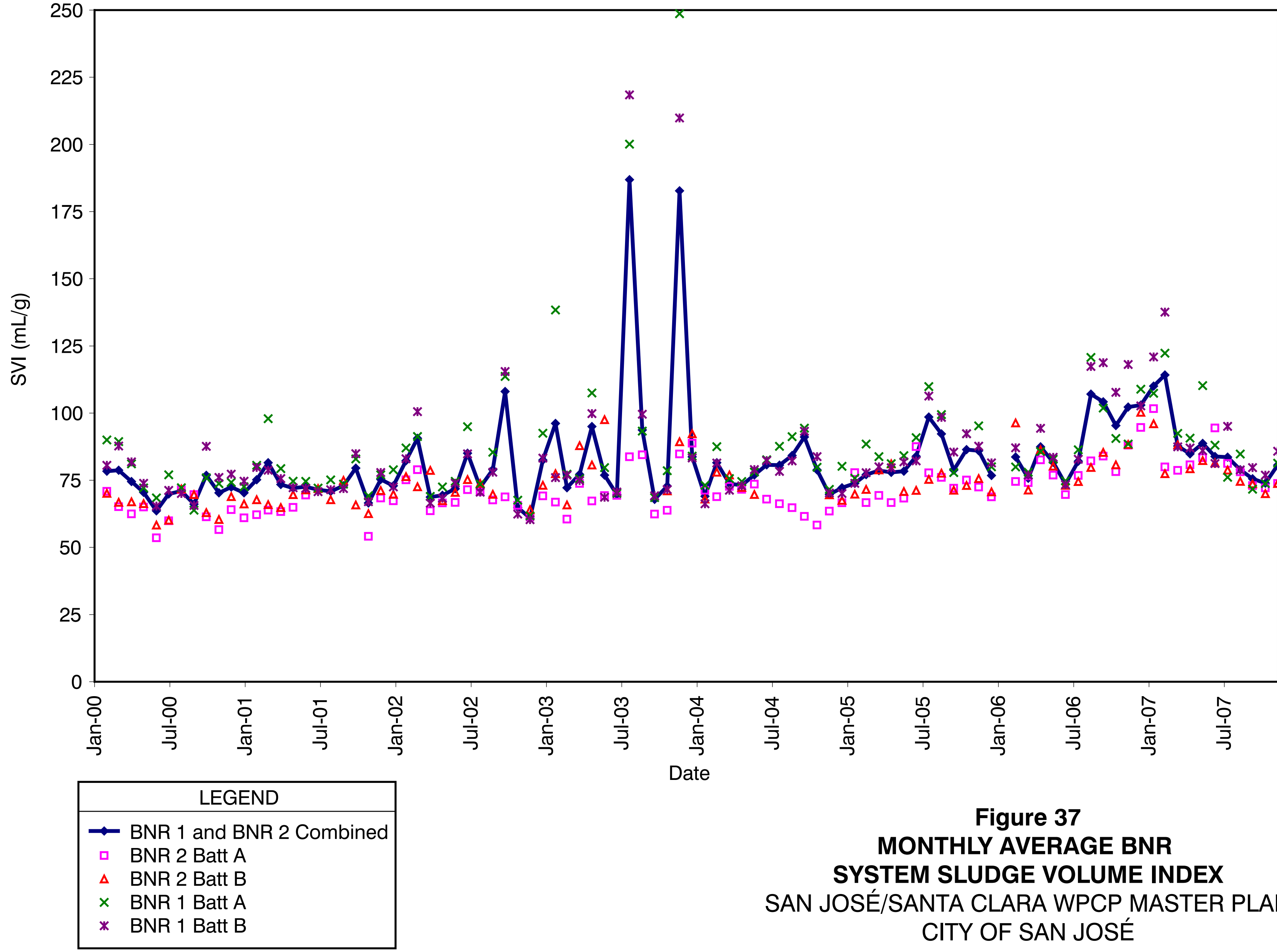

Figure 37
MONTHLY AVERAGE BNR
SYSTEM SLUDGE VOLUME INDEX
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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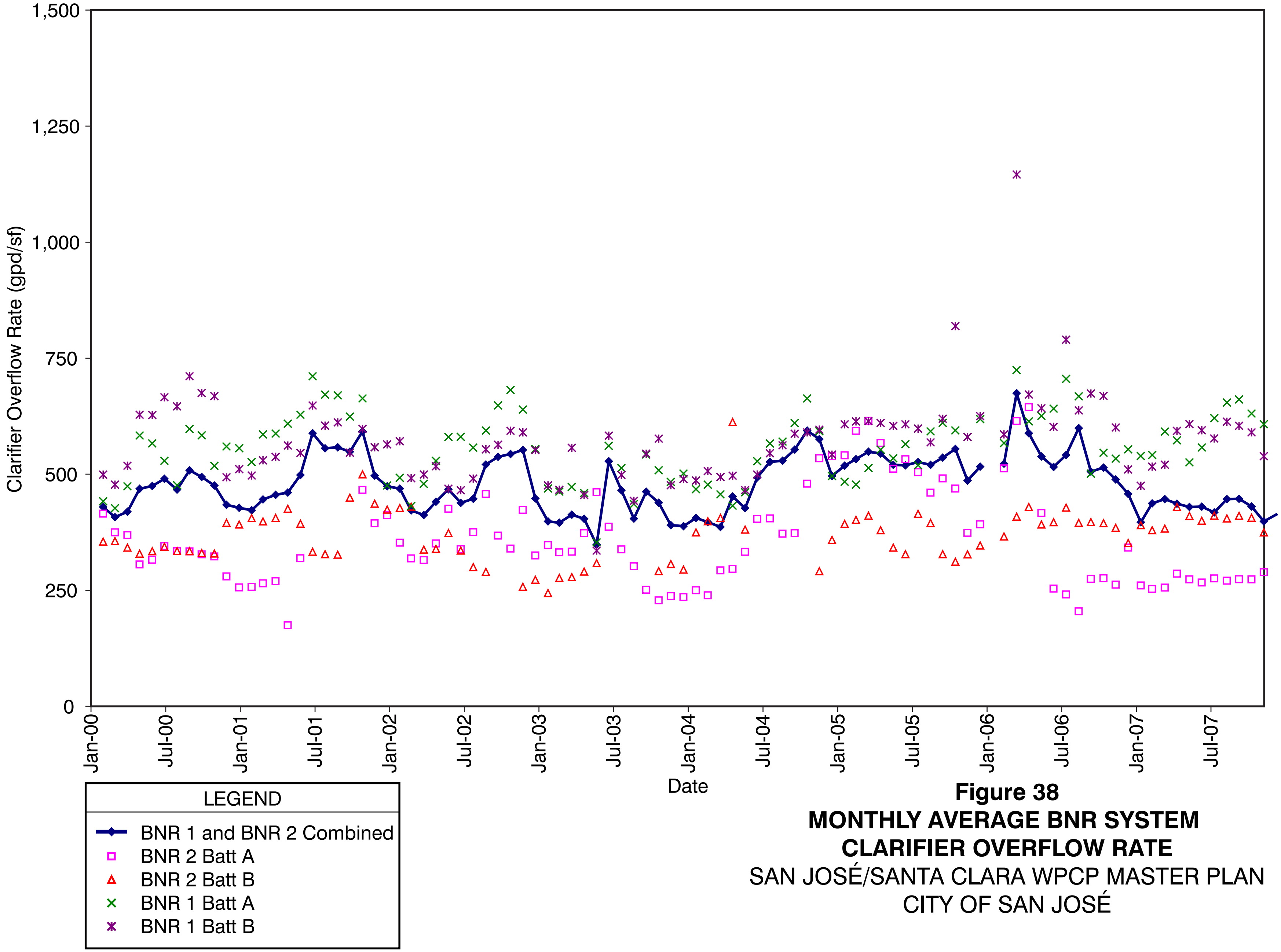

Figure 38

MONTHLY AVERAGE BNR SYSTEM CLARIFIER OVERFLOW RATE

SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN

CITY OF SAN JOSÉ

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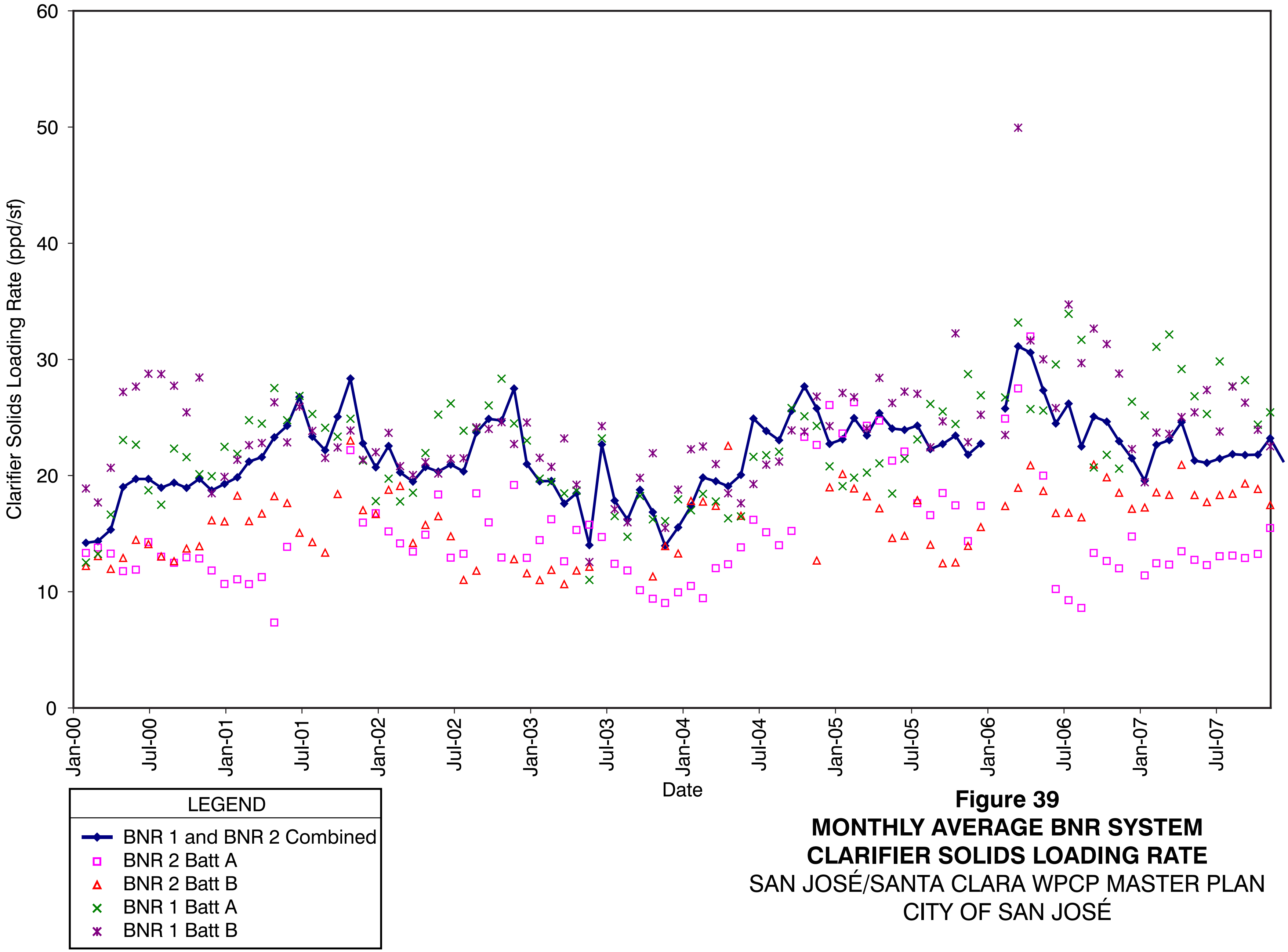

Figure 39
MONTHLY AVERAGE BNR SYSTEM CLARIFIER SOLIDS LOADING RATE
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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Table 10 Tertiary Treatment Loading and Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria(1)	Performance/Loading(2,3) (2000 - 2007)	
			Average	Range
Tertiary Filters				
Filtration Rate (gpm/sf)				
	ADWF	NA	4.8	4.1 - 6.0
	ADAF	5	4.8	4.2 - 5.5
	ADMMF	NA	5.0	4.4 - 6.0
	PHWWF	5.7 or 7	7.2	6.3- 8.6
Backwash, % of Influent Flow				
	ADWF	NA	3	3 - 4
	ADAF	NA	5	3 - 15
ADMMF		NA	4	3 -6
Filtration Efficiency or Percent Removal of Solids				
	ADWF	NA	76	73 - 80
	ADAF	NA	73	57 - 81
	ADMMF	NA	73	66 - 84
Influent Turbidity (NTU)				
	ADWF	NA	1.7	1.2 - 2.2
	ADAF	NA	1.8	1.2 - 2.4
	ADMMF	NA	1.9	0.2 - 3.8
Effluent Turbidity (NTU)				
	ADWF	NA	0.6	0.4 - 0.8
	ADAF	NA	0.7	0.5 - 0.9
	ADMMF	NA	0.7	0.4 - 1.1
Disinfection and Dechlorination				
Chlorine Contact Tank Contact Time (hrs)				
	ADWF	NA	1.2	1.1 - 1.2
	ADAF	NA	1.2	1.0 - 1.2
	ADMMF	NA	1.0	1.0 - 1.2
	PHWWF	0.9	0.7	0.6 - 0.8
Chlorine Dose(4) (mg/L)				
	ADWF	NA	3.5	1.6 - 4.5
	ADAF	NA	3.4	2.6 - 4.2
	ADMMF	NA	3.4	2.4 - 4.1

Table 10	Tertiary Treatment Loading and Performance Data San José/Santa Clara Water Pollution Control Plant Master Plan City of San José			
Process/Design Parameter	**Design Condition (Flow or Load)**	**WPCP Design Criteria(1)**	**Performance/Loading(2,3) (2000 - 2007)**	
			Average	**Range**
Sulphur Dioxide Dose(5) (mg/L)				
	ADWF	NA	2.6	1.5 - 4.4
	ADAF	NA	2.7	1.4 - 5.0
	ADMMF	NA	2.9	1.1 - 6.0
Recycled Water CT Value(2) (mg-min/L)				
	ADWF	NA	2,780	1,530 - 4,070
	ADAF	NA	2,710	1,470 - 4,460
	ADMMF	NA	2,530	1,490 - 4,260

Notes:
NA = Not Available.
(1) Design criteria based on maximum capacity available (i.e. all units in service).
(2) Performance data are monthly averages unless otherwise noted.
(3) Based on actual number of units in service. Not all units are in service at all times.
(4) Chlorine dose average and range based on data from 2000 to 2007. ADMMF average and range determined using data from 2000, and 2002 to 2007.
(5) Sulphur dioxide dose based on data from 2000 to 2007.

4.4.1 Filtration

The key design criteria for multi-media filters are hydraulic loading rates (gpm/sf) at PHWWF and ADWF, solids removal efficiency, backwash volume, and the effluent turbidity. During the analysis period, the filter loading rate was 4.8 gallons per minute per square foot (gpm/sf) during ADAF. The WPCP filters are approximately 76 percent efficient in solids removal. The ADAF turbidity of the filter influent is reduced from approximately 1.8 NTU to 0.7 NTU. Figure 40 presents the filter loading rate.

4.4.2 Disinfection and Dechlorination

The key design criteria of a chlorine disinfection system is the chlorine dose and contact time (CT) for the chlorine contact basins. As part of the disinfection process, the WPCP also uses ammonia-nitrogen. In addition, to meet Title 22 requirements for recycled water, the diverted portion of the WPCP effluent considered to be recycled water must meet requirements for a minimum CT value in mg-min/L (residual chlorine in mg/L multiplied by modal CT in minutes), and modal CT in minutes. Once the flow has been disinfected, it is then dechlorinated with sulfur dioxide.

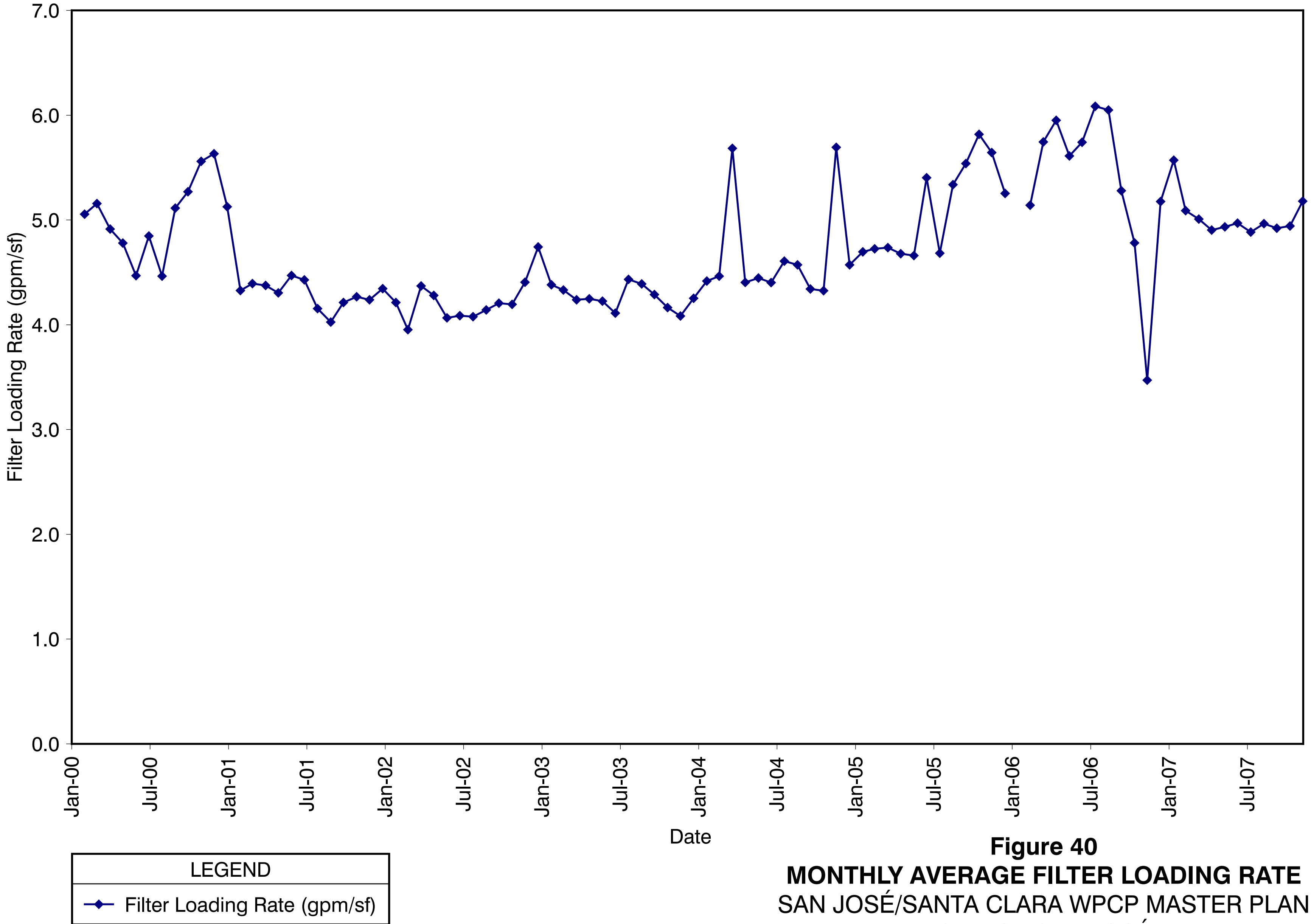

Figure 40
MONTHLY AVERAGE FILTER LOADING RATE
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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Figure 41 presents the chlorine contact tank detention time. The detention time has increased slightly over the analysis period from approximately 0.9 hrs to 1.2 hrs. ADWF chlorine and sulfur dioxide doses averaged approximately 3.5 and 2.6 mg/L, respectively. No ammonia-nitrogen use data was available for review.

4.5 Solids Treatment

Solids in the WPCP are removed from the primary, secondary, and tertiary clarifiers/settling tanks. Primary sludge is thickened within the primary settling tanks, and then pumped to all anaerobic digesters that are in service. Secondary sludge is thickened in the DAFs before digestion. Digested biosolids are sent to the biosolids lagoons. After storage time in the biosolids lagoons, the biosolids are dredged and pumped to the drying beds. The biosolids then dry through the summer and early fall for a total of about six months. Final air-dried biosolids are sampled to confirm Class A pathogen status. Table 11 summarizes the solids handling loading and performance data from 2000 through 2007.

4.5.1 Primary Sludge Thickening

Primary sludge is thickened in the primary settling tanks and removed at approximately 4 percent solids. Historical primary sludge total solids and percent solids data are also presented in Table 11. The monthly averages of primary sludge total solids and percent solids over the past 8 years are shown in Figure 42. Based on the reported primary sludge flow and percent solids, the average annual primary sludge total solids ranges from approximately 107,000 lb/d per day to 134,000 lb/d with a solids percent range of 3.4 percent to 4.3 percent. Average annual primary sludge flows have ranged from 299,000 to 463,000 gpd.

4.5.2 Dissolved Air Flotation Thickening

There are 16 DAF thickeners at the WPCP. The WAS and thickened waste activated sludge (TWAS) total solids are presented in Figure 43. The WAS data show a fairly consistent trend with only one monthly average dipping below 100 thousand pounds per day (klbs/day) and no months exceeding 160 klbs/day. The TWAS data, however, show a decreasing trend until the summer months of 2004 when there is a dramatic jump. Based on discussions with the City, they believe the dramatic change in TWAS solids in 2004 was due to erroneous flow measurements prior to 2004. TWAS measurements after 2004 are believed to be more accurate.

The key design parameters in a DAF thickening system are SLR and hydraulic loading rate. For the secondary waste sludge thickening, only 10 to 12 of the DAF units are typically operated at any given time (Ken Rock, personal communication, 2008). For the 8 years of service data, it was assumed that 11 tanks were annually in operation. The associated SLR is plotted in Figure 44. As seen from Table 11, with 11 units in service, DAF SLRs are low and hydraulic loading rates are extremely low.

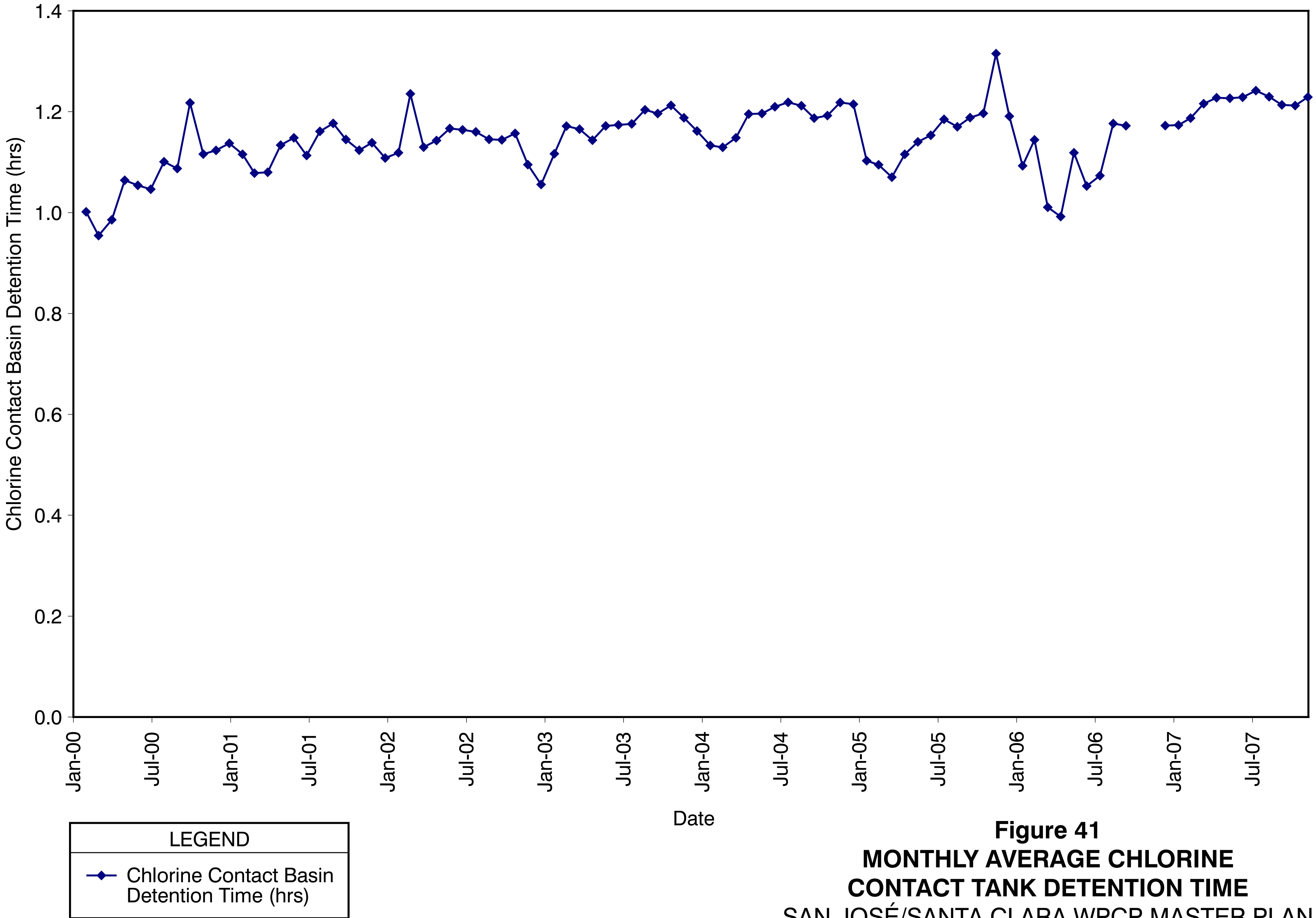

Figure 41
MONTHLY AVERAGE CHLORINE CONTACT TANK DETENTION TIME
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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Table 11 Solids Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Load	WPCP Design Criteria[1]	Performance/Loading[2,3] (2000 - 2007) Average	Range
Primary Sludge Thickening				
Primary Sludge Flow (gpd)				
ADAF		NA	375,800	298,700-463,100
ADWF		NA	363,550	317,500-450,850
ADMMF		NA	410,700	262,700-542,900
Primary Sludge Total Solids (lb/day)				
	ADAL	NA	121,600	106,900 - 133,600
	ADWL	NA	117,400	107,000 - 127,300
	ADMML	NA	123,400	108,000 - 144,000
Primary Sludge % Solids				
	ADAL	NA	3.95	3.44 - 4.31
Primary Sludge VSS/TSS				
	ADAL	NA	0.83	0.80 - 0.85
DAF Thickening				
Solids Loading[4] (lb/sf/day)				
ADAL		NA	5.29	2.94-7.54
	ADWL	NA	5.43	2.66-7.79
	ADMML	NA	5.63	3.12-8.69
Hydraulic Loading[4] (gpm/sf)				
	ADAL	NA	0.083	0.077 - 0.091
	ADWL	NA	0.084	0.074 - 0.096
	ADMML	NA	0.081	0.067 - 0.090
% Solids Capture				
		NA 88.0	[5a]	84.9 - 91.7[5a]
		NA	50.4[5b]	43.4 - 61.4[5b]
Thickened Waste Activated Sludge (TWAS), (lb/day)				
ADAL		NA	95,400	53,050-136,000
	ADWL	NA 97,900		48,050-140,500
	ADMML	NA 101,500		56,350-156,700

Table 11	Solids Treatment Performance Data San José/Santa Clara Water Pollution Control Plant Master Plan City of San José			
Process/Design Parameter	**Design Load**	**WPCP Design Criteria[1]**	**Performance/Loading[2,3] (2000 - 2007)**	
			Average	**Range**
Sludge Digestion				
Volatile Solids Loading[6] (lb VS/cf/day)				
	ADAL	NA	0.052	0.038 - 0.071
	ADWL	NA	0.047	0.033 - 0.063
	ADMML	NA	0.052	0.036 - 0.077
SRT[6] (days)				
	ADAL	NA	40.5	25.4 - 55.4
	ADWL	NA	42.5	28.5 - 61.2
	ADMML	16.4	38.2	20.8 - 58.8
Digester Feed Sludge Concentration (%)				
ADAL		3.73[7]	3.84	3.52 - 4.16
Digester Feed VSS/TSS				
	ADAL	NA	0.79	0.78 - 0.80
VSR[8] (%)				
	ADAL	NA	52.6	48.5 - 58.9
	ADWL	NA	50.6	43.8 - 61.4
	ADMML	NA	51.3	44.9 - 60.6
Digested Sludge Concentration (%)				
	ADAL	NA	1.91	1.66 - 2.15
Digested Sludge VSS/TSS				
	ADAL	NA	0.64	0.62 - 0.67
Digested Sludge Flow Rate to Biosolids Lagoons (1,000 gal/day)				
	ADAF	NA	739	684 - 926
Biosolids Lagoon Solids Loading (lb TSS/day)				
	ADAL	NA	140,420	128,250 - 152,450
% Solids in Biosolids Lagoons				
ADAL		NA	NA	NA
Sludge Drying Beds Influent Flow (gal/yr)				
ADAL		NA	NA[9] NA	[9]

Table 11	Solids Treatment Performance Data San José/Santa Clara Water Pollution Control Plant Master Plan City of San José			
Process/Design Parameter	**Design Load**	**WPCP Design Criteria(1)**	**Performance/Loading(2,3) (2000 - 2007)**	
			Average	**Range**

Notes:

NA = Not Available.

(1) Design criteria based on maximum capacity available (i.e. all units in service).

(2) Performance data are monthly averages unless otherwise noted.

(3) Based on actual number of units in service. Not all units are in service at all times.

(4) WPCP staff operates between 10-12 DAF units so assumed that 11 DAF units were in service at all times.

(5) Due to trends in TWAS data, perhaps due to operational considerations or equipment calibration, capture rate was looked at for two periods of time, 2000-2004 (5b) and 2005-2007 (5a).

(6) Used digester temperature data to determine number of units in service each day. 90 degrees F was used as the cutoff point for determining whether a digester was in service or not.

(7) This design criterion is for TWAS only, not for TWAS and thickened primary sludge combined, as the data presented.

(8) Used Van Kleeck method to calculate VSR.

(9) Limited data on dredging flow rates. Insufficient data for reporting.

To determine the solids capture rate of the DAF thickeners, a mass balance should be conducted using the WAS, TWAS and DAF underflow stream total solids. Using the WAS and TWAS data only, the capture rate averages 50 percent from 2000 to 2004 and 88 percent from 2004 to 2007. Typical DAF capture rates range from 85 to 95 percent. As previously noted, the TWAS data from 2000 to 2004 is believed to be erroneous, and the capture rate estimated from 2004 onward is more representative of the DAFT performance.

No polymer conditioning is used in this DAF thickening system. This typically limits the float concentration to about 4 percent solids on average.

4.5.3 Anaerobic Sludge Digestion

The WPCP has 16 anaerobic digesters. Currently 5 are out of service due to cover and mixing problems. It is desirable to maintain at least a 20-day detention time in the digesters to provide more stable biosolids for biosolids lagoon feeding, thereby keeping odor emissions down at the biosolids lagoons.

Digester temperatures are kept in the range of 95 to 100 degrees F and volatile solids reductions average about 52 percent. There is adequate hot water from the cogeneration system to keep digesters at the proper temperature. Digested biosolids are pumped to the biosolids lagoons at about 2 percent solids.

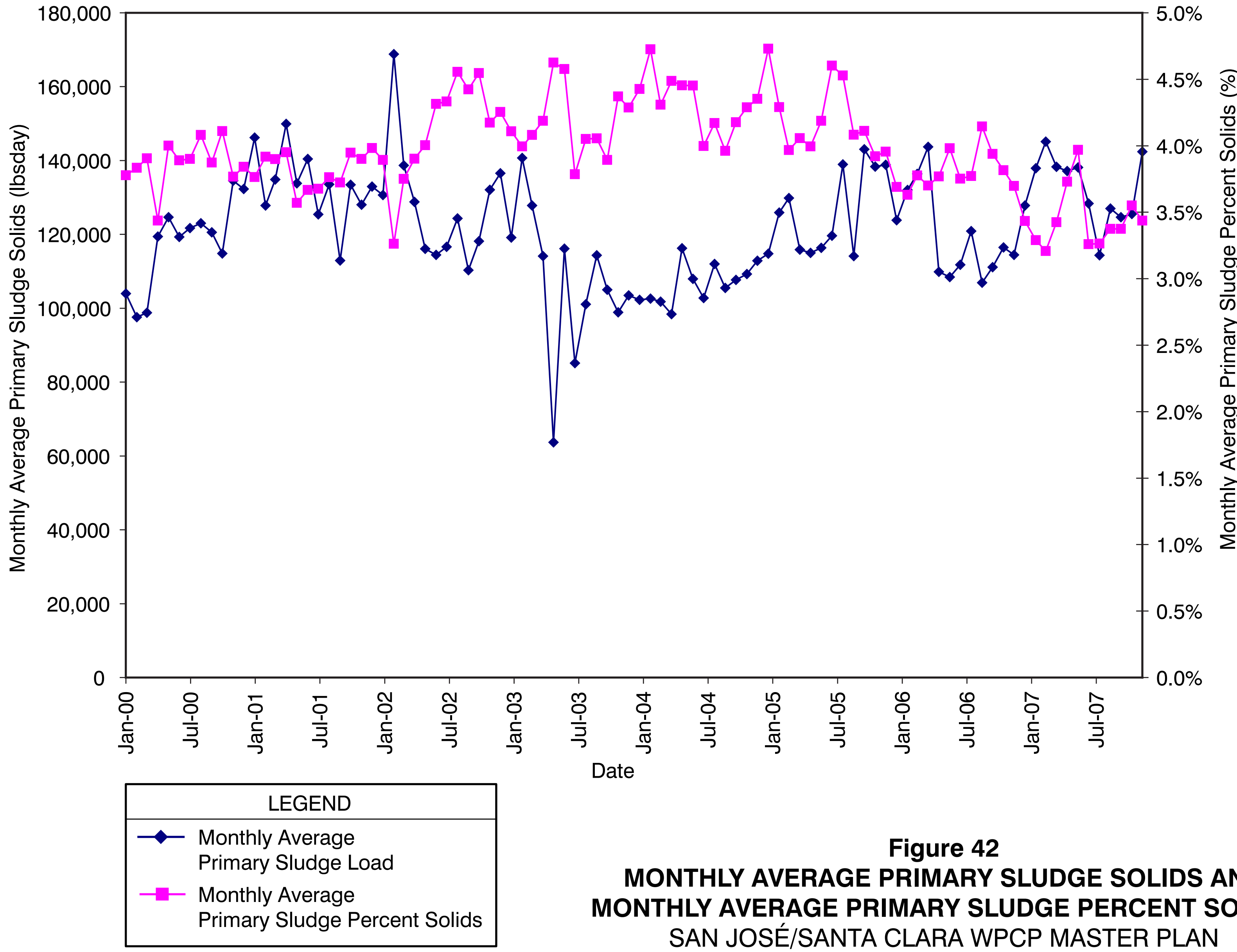

Figure 42
MONTHLY AVERAGE PRIMARY SLUDGE SOLIDS AND
MONTHLY AVERAGE PRIMARY SLUDGE PERCENT SOLIDS
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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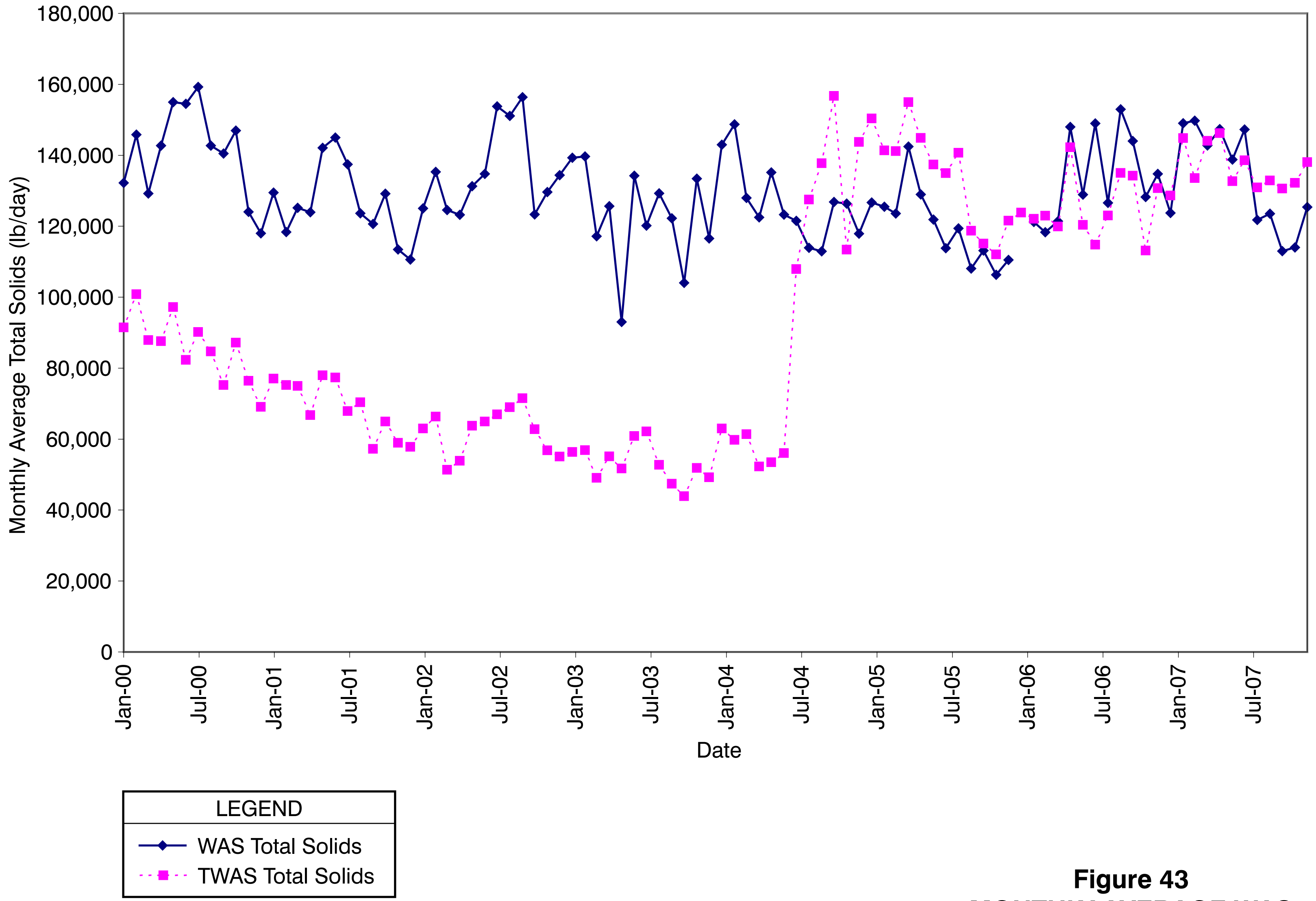

Figure 43
MONTHLY AVERAGE WAS
AND TWAS MASS LOADING
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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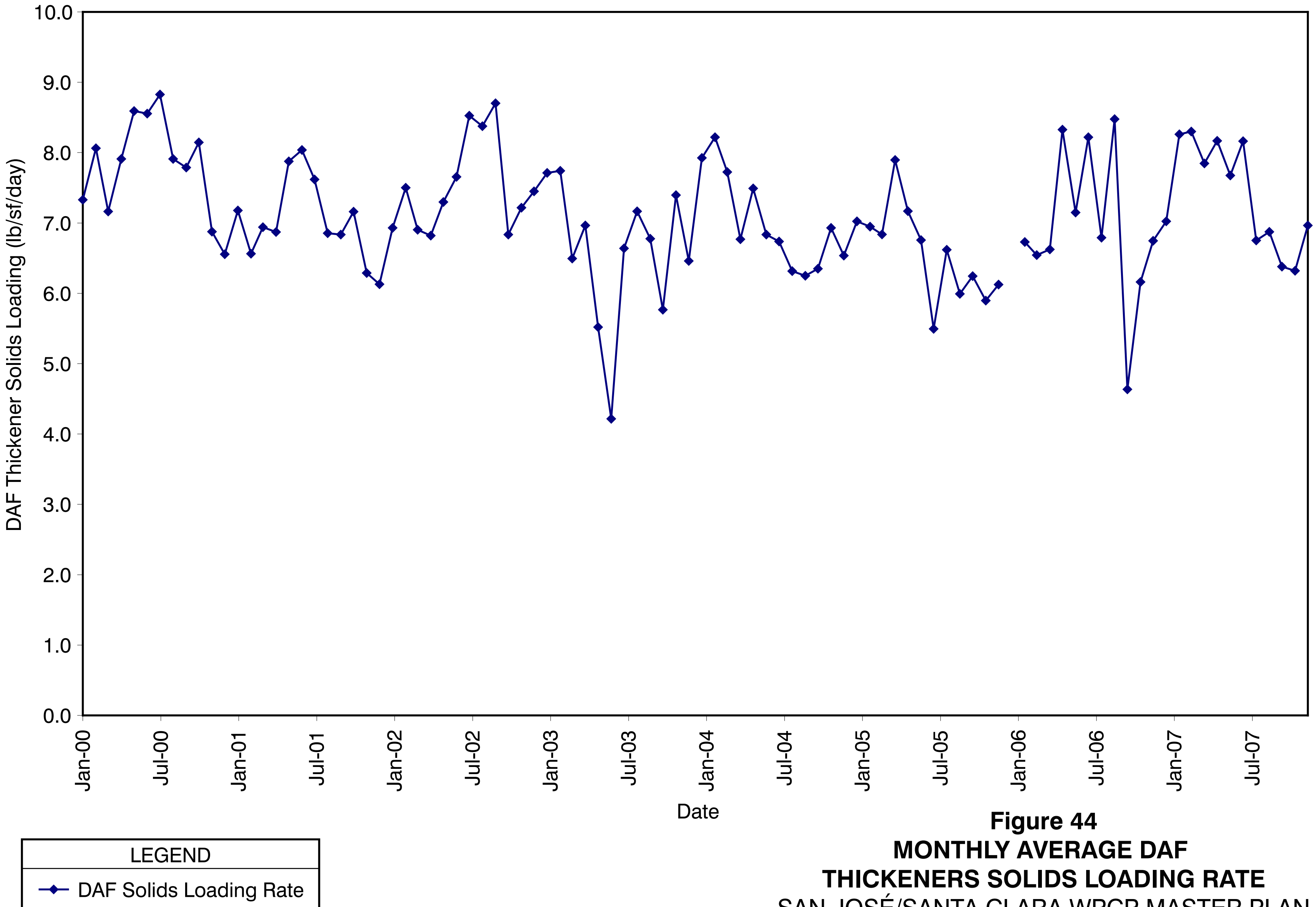

Note: Loading rate assumes 11 DAF units in service at all times.

Figure 44
MONTHLY AVERAGE DAF THICKENERS SOLIDS LOADING RATE
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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The key design parameters for anaerobic digestion are SRT and volatile solids loading rate (VSLR). Other parameters, such as volatile solids reduction (VSR), can provide insight into the digester performance. Digester data is presented in Table 11 and Figures 45 through 48.

Digester SRT values have been calculated from feed sludge flow rate and data on number of digesters in service. The digesters in service from 2000 to 2007 were determined by assuming that all digesters with an average daily temperature above 90 degrees F were in service. The SLR was calculated using the thickened sludge solids data.

Figure 45 presents the VSLR. The monthly average VSR data is shown in Figure 46 and the annual average is presented in Table 11. The average VSR values are around 50 percent and do not vary significantly, indicating a well performing digestion system. As the VSLR decreases, the VSR tends to slightly increase.

As seen from Figure 47, the recorded digester SRT had been quite long through 2003, and in recent years has been declining. The maximum monthly average SRT of 67.6 days was recorded in October 2002. The minimum value of 20.8 days was recorded in January 2007. Increases in flow and loading to the digesters lower the SRT. The solids loading rate has seen a slight increase in recent years. The VSR tends to be higher for longer SRT values. The feed sludge concentration presented in Figure 48 has an annual average percent of 3.8 percent and does not vary significantly. In comparison to other facilities, this is a low percent solids feed.

On average, 739,000 gallons per day of digested biosolids are pumped to the biosolids lagoons. The biosolids lagoons achieve additional VS reduction, additional product stability, reduced odor potential, and, with the 2-year minimum storage time, achieve pathogen reduction to the Class A level. A water cap is maintained on the biosolids lagoons for odor control, and supernatant is drawn off the biosolids lagoons and recycled to the WPCP for treatment. This recycle flow brings additional ammonia-nitrogen loads to the liquid treatment facilities. Thickening of the biosolids is also achieved within the biosolids lagoons. Little in-situ data on thickness exists within the biosolids lagoons, but thickness is likely on the order of 10 percent solids toward the bottom of the biosolids lagoons, and somewhat thinner toward the top.

Dredging of the biosolids (normally January to April each year) is typically conducted at about 4 to 5 percent solids since thicker material is difficult to pump. Drying beds are filled with this dredged biosolids and dried over the summer months to about 75 percent solids using mobile equipment. The Class A dried biosolids are trucked over the ensuing months/year to the Newby Island Landfill to the north of the WPCP site, and used as landfill cover material. Drying to levels of 80 percent solids and higher are normally avoided to reduce dusting potential.

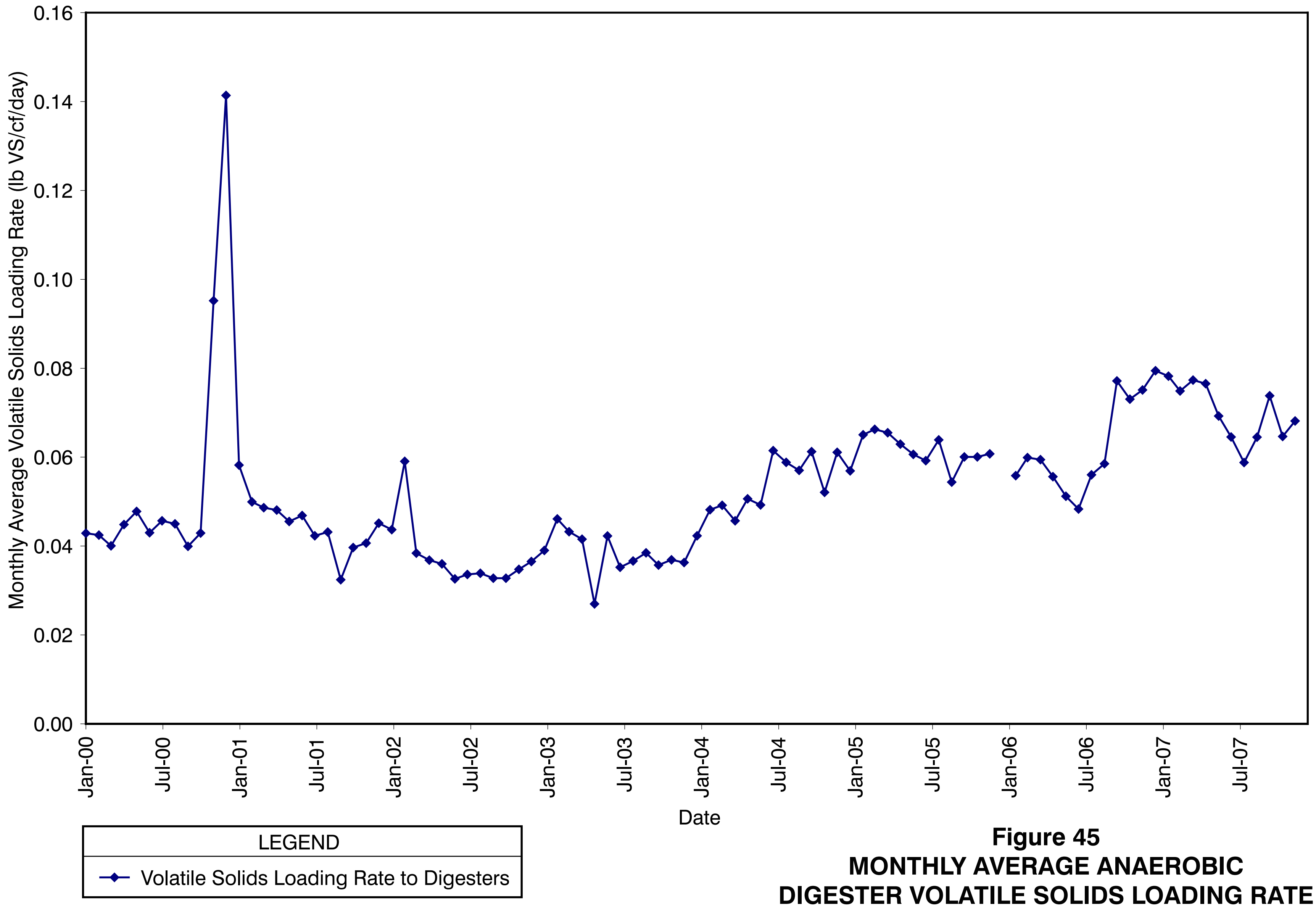

Figure 45
MONTHLY AVERAGE ANAEROBIC
DIGESTER VOLATILE SOLIDS LOADING RATE
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

sj908f80-7897.ai

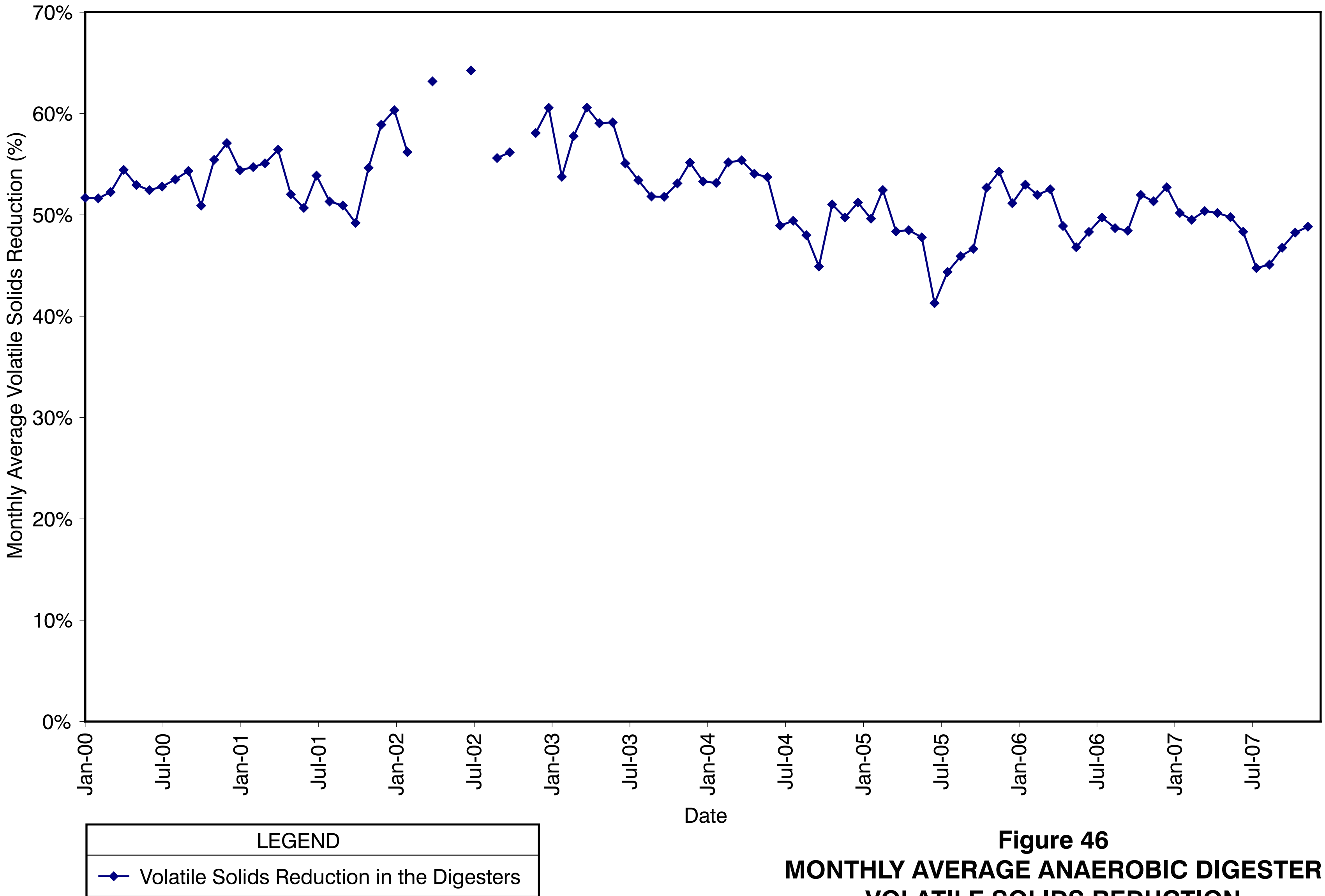

Figure 46
MONTHLY AVERAGE ANAEROBIC DIGESTER VOLATILE SOLIDS REDUCTION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

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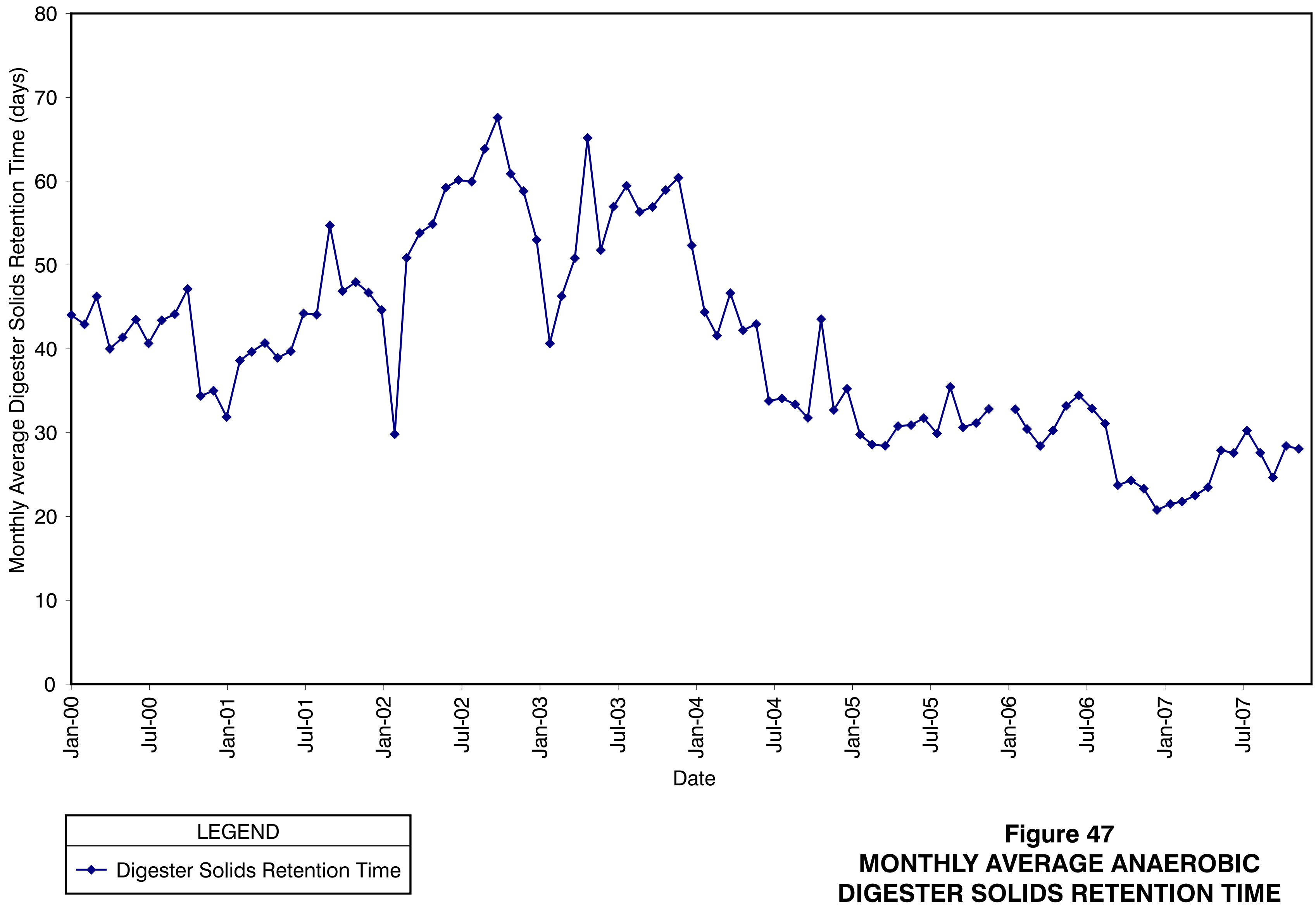
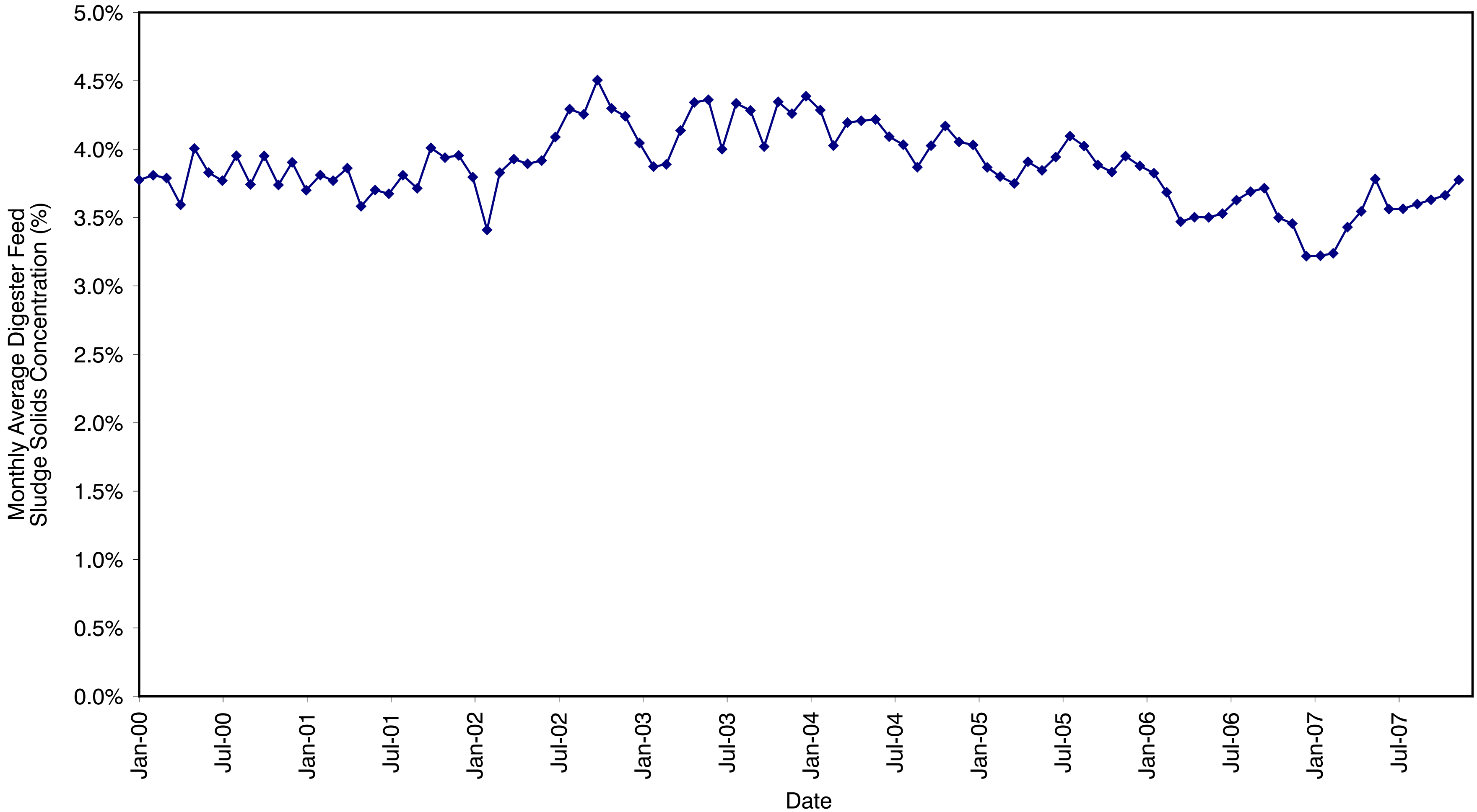


Figure 47
MONTHLY AVERAGE ANAEROBIC
DIGESTER SOLIDS RETENTION TIME
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

sj908f83-7897.ai



LEGEND

Digester Feed Sludge Solids Concentration

Note:
Feed sludge includes primary sludge and thickened waste activated sludge (TWAS).

Figure 48
MONTHLY AVERAGE ANAEROBIC DIGESTER FEED SLUDGE CONCENTRATION
SAN JOSÉ/SANTA CLARA WPCP MASTER PLAN
CITY OF SAN JOSÉ

sj908f85-7897.ai

4.6 WPCP Mass Balance

As part of the plant performance review described in this PM and the process model development described in subsequent PM's, a plant solids mass balance was developed. The mass balance could not be completely resolved, suggesting there were discrepancies or some uncertainty in the reported solids data. These discrepancies were discussed with the City since they impact the capacity assessment and evaluation of future solids handling facilities. Results and decisions from these discussions are documented in this section.

The most significant mass balance issue results from the uncertainty in how much primary sludge is generated at the WPCP. Mass (or pounds) of primary sludge generated is calculated in one of two ways:

- Use reported primary sludge flow and concentration where primary sludge (in pounds) = primary sludge flow (in mgd) x primary sludge concentration (in mg/L) x 8.34. This is a common approach for estimating primary sludge from wastewater treatment plants; and

- Perform a mass balance around the primary clarifiers where the primary sludge (in pounds) = primary influent (in pounds) - primary effluent (in pounds). The City believes the most accurate estimate of primary effluent solids is from a flow weighted average of the influent to the different BNR trains. For this approach, a flow weighted average of BNR influent was used. Although the BNR influent also includes the solids from the DAF subnatant, this is not believed to have a significant impact due to the low solids concentrations routinely measured in the subnatant.

The reported primary sludge in this PM is based on the first approach, however, it results in approximately 35 percent less primary sludge than the second approach. The City conducted additional sampling to determine if this was a result of primary influent or effluent sampling errors. After a month long investigation, the City concluded that the primary influent or effluent sample was not the source of error. The City also believes the primary sludge flow measurements are accurate, therefore, the error is likely related to the sludge density or concentration measurements. Moving forward in preparing the capacity analysis and developing treatment alternatives, it was decided that primary sludge estimates would be based on the second approach, or a mass balance around the primary clarifiers. Using the second approach results in a more conservative estimate of primary sludge than using the first approach.

The other mass balance issue is related to the amount of waste activated sludge (WAS) generated from the secondary process. Recent testing of the WAS flow meters by the City show that they are measuring high, meaning that actual WAS flow (and mass) generated is likely less than has been reported by as much as 25 percent. This finding is consistent with process modeling that has been performed and will be further discussed in PM 3.5.

Note that the data or calculations reported in this PM have not been modified to reflect any of these decisions or findings, and reflect the recorded data. These decisions will be incorporated in the work moving forward with the capacity assessment and alternatives evaluations.

4.7 Existing Treatment Plant Performance Summary

Existing WPCP loading and performance data was analyzed from 2000 to 2007. The NPDES permit compliance, as well as individual treatment process operations data was analyzed for this period. As presented in the preceding sections, the WPCP has consistently performed well and has met its permitted effluent limits for the compounds for which it is currently regulated. In addition to currently regulated compounds, the WPCP performance for compounds in the Draft Permit were also analyzed. Table 12 summarizes the WPCP treatment for each constituent. The percent removals presented were calculated for paired data samples only. Average influent and effluent concentrations were calculated using all available data, therefore percent removal does not correspond directly to observed reduction in average influent and effluent concentrations. These removal efficiencies will be used to project future WPCP performance.

Table 12 Overall WPCP Performance Summary
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Constituent	Unit	Average Influent Concentration	Average Effluent Concentration	Percent Removal	NPDES Permit Limit[1]
BOD mg/L		311	3.4	99	10
TSS mg/L		300	2.0	99	10
Ammonia-Nitrogen	mg/L 25		0.41	98	3
O&G mg/L		NA	4.8	NA	5
Settleable Matter	mg/L–hr	NA	NA	NA	0.1
Turbidity NTU		1.8	0.7	61	10[2]
Chlorine Residual	mg/L	NA	0.0	NA	0.0[2]
pH		NA	7.4	NA	6.5 - 8.5
Enterococcus cfu/100	ml	NA	1.1	NA	35
Metals					
Copper µg/L		104	2.9	97	12[3]
Mercury µg/L		0.260	0.00368	98	0.012[4]
Nickel µg/L		13.3	6.29	51	25[5]
Cyanide µg/L		5	5.1	-3	-- [6]
Selenium µg/L		2.05	0.45	77	None[6]
Organics					
4,4-DDE	µg/L	NA	0.008[8] NA	[9] 0.05	[10]
Dieldrin	µg/L	0.024[8] 0.013	[8] NA	[9] 0.01	[10]
Heptachlor Epoxide	µg/L 0.015	[8] 0.012	[8] NA	[9] 0.01	[10]
Benzo(b) Fluoranthene	µg/L NA		0.243[8] NA	[9] 10.0	[10]
Indeno(1,2,3-cd)Pyrene	µg/L NA		0.049[8] NA	[9] 0.05	[10]
Dioxin pg/L		1.04	0.108	88	2.8×10^{-8}[11]
Heptachlor µg/L		0.018[8] 0.014	[8] NA	[9] 0.01	[11]
Tributylin µg/L		2.6[8] 0.059	[8] 92		0.012[11]
PCBs [13] µg/L		2.71[8] 2.24	[3] 77		None[12]

Table 12	Overall WPCP Performance Summary San José/Santa Clara Water Pollution Control Plant Master Plan City of San José				
Constituent	Unit	Average Influent Concentration	Average Effluent Concentration	Percent Removal	NPDES Permit Limit(1)

Notes:

NA = Not Available.

(1) All presented NPDES permit limits are monthly average limits except when noted.

(2) NPDES permit limit does not exist for a monthly concentration. The presented limit is the instantaneous maximum limit.

(3) The Draft Permit reduces the monthly average copper effluent limit to 11 μg/L.

(4) The current permit sets a maximum month mercury limit of 0.012 μg/L. This limit is increased to 0.025 μg/L in the Draft Permit.

(5) The Draft Permit increases the maximum daily nickel effluent limit to 34 μg/L.

(6) Cyanide is not currently regulated. The Draft Permit has a average monthly concentration limit of 5.7 μg/L.

(7) Selenium does not have a WQBEL. The EPA is drafting new criteria that may change how selenium is regulated in the San Francisco Bay.

(8) Assumes the RL for all values reported as below the RL.

(9) Percent removal not calculated due to lack of influent data and/or all influent data was non-detect.

(10) Not regulated in the Draft Permit.

(11) The NPDES permit does not have a maximum monthly limit. Presented limit is the daily maximum limit.

(12) TMDL limits are currently under development for PCBs.

REFERENCES

REFERENCES

1. Brown and Caldwell, 1996. PFRP Equivalent Test Plan - Final Report.
2. City of San José, 2008. Performance and Loading Data.
3. City of San José, 1998. Plant Optimization Program at the San José/Santa Clara Water Pollution Control Plant.
4. Rock, Ken, 2008. Personal Communication.

APPENDIX – SECONDARY TREATMENT SYSTEM LOADING AND PERFORMANCE FOR EACH BATTERY

Table A-1 BNR I Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria[1]	Performance/Loading[2,3] (2000 - 2007)			
			Battery A		**Battery B**	
			Average	Range	Average	Range
BNR I Aeration Basins						
Hydraulic Retention Time (hrs)						
	ADWF	NA	6.7	5.9 - 7.5	7.2	7.0 - 7.6
	ADAF	NA	7.6	7.1 - 9.3	7.7	7.2 - 9.0
	ADMMF	NA	7.3	6.8 - 7.9	7.3	6.7 - 8.1
Total Solids Retention Time (days)						
	ADWL	NA	8.3	5.8 - 9.4	9.0	6.7 - 12.3
	ADAL	NA	9.4	7.0 - 10.3	9.1	7.4 - 10.5
ADMML		7[1]	9.1	6.1 - 10.6	8.9	6.7 – 11.1
Aerobic Solids Retention Time (days)						
	ADWL	NA	4.2	2.9 - 4.7	4.5	3.4 - 6.2
	ADAL	NA	4.7	3.5 - 5.2	4.6	3.7 - 5.3
	ADMML	NA	4.6	3.0 - 5.3	5.0	3.4 - 5.6

Table A-1 BNR I Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria[1]	Performance/Loading[2,3] (2000 - 2007)			
			Battery A		Battery B	
			Average	Range	Average	Range
MLSS (mg/L)						
	ADWL	NA	3,000	2,700 - 3,410	3,000	2,880 - 3,200
	ADAL	NA	2,950	2,660 - 3,370	3,050	2,820 - 3,270
	ADMML	NA	3,050	2,610 - 3,870	3,160	2,860 - 3,470
Sludge Volume Index (mL/g)						
	ADAL	NA	87.3	75.8 - 111.8	85.2	74.3 - 102.9
RAS/WAS Concentration (mg/L)						
	ADAL	NA	7,280	6,520 - 7,950	7,520	6,590 - 7,990
WAS Flow (mgd)						
	ADWL	NA	0.75	0.5 - 1.0	0.80	0.62 - 1.0
	ADAL	NA	0.67	0.53 - 0.79	0.75	0.63 - 0.88
	ADMML	NA	0.64	0.49 - 0.87	0.77	0.60 - 1.11

Table A-1 BNR I Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria[1]	Performance/Loading[2,3] (2000 - 2007)			
			Battery A		Battery B	
			Average	Range	Average	Range
WAS TSS (ppd)						
	ADWL	NA	46,990	32,580 - 63,560	49,620	41,270 - 67,780
	ADAL	NA	40,450	31,180 - 50,510	47,470	41,650 - 57,730
	ADMML	NA	41,140	27,890 – 59,600	50,600	38,400 - 73,820
WAS VSS/TSS						
	ADAL	NA	0.74	0.73 - 0.76	0.74	0.73 - 0.76
BNR I Secondary Clarifiers						
Overflow Rate (gpd/sf)						
	ADWF	NA	620	570 - 670	600	530 - 690
	ADAF	NA	560	480 - 610	570	490 - 690
	ADMMF	800	540	430 - 610	570	480 - 820
PHWWF	[4]	810	540	480 - 650	600	490 - 690
RAS Ratio, %						
	ADAF	NA	0.46	0.39 - 0.54	0.39	0.34 - 0.46

Table A-1 BNR I Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria[1]	Performance/Loading[2,3] (2000 - 2007)			
			Battery A		Battery B	
			Average	Range	Average	Range
Solids Loading Rate (lbs/sf/day)						
	ADWF	NA	25.0	21.4 - 31.4	24.6	22.2 - 29.8
	ADAF	NA	22.7	17.4 - 27.2	24.0	19.1 - 31.2
	ADMMF	NA	22.7	13.3 - 32.1	24.6	17.7 - 32.2
PHWWF	[4]	34.5	20.9	13.8 - 30.2	24.0	18.3 - 28.0

Notes:
NA = Not Available
(1) Design criteria based on maximum capacity available (i.e. all units in service).
(2) Based on actual number of units in service. Not all units are in service at all times.
(3) Performance data presented are monthly averages unless otherwise noted.
(4) Data unavailable for calculation of PHWWF average performance and performance range in 2006 for the secondary clarifier overflow rate and solids loading rate.

Table A-2 BNR II Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria (1)	Performance/Loading (2,3) (2000 - 2007)			
			Battery A		Battery B	
			Average	Range	Average	Range
BNR II Nitrification Tanks						
Hydraulic Retention Time (hrs)						
	ADWF	NA	8.4	7.2 - 10.3	8.6 (4)	7.2 - 10.4(4)
	ADAF	NA	8.2	7.3 - 9.0	8.2	7.3 - 9.1
	ADMMF	NA	8.2	7.1 - 9.9	7.4	0.0 - 9.9(5)
Total Solids Retention Time (days)						
	ADWL	NA	8.4	5.2 - 10.8	13.9 (4)	6.9 - 25.7(4)
	ADAL	NA	8.0	0.5 - 10.5	8.8	6.9 - 12.3
ADMML		7(1)	7.7	6.0 – 11.4	7.8	6.4 - 10.0(5)
Aerobic Solids Retention Time (days)						
	ADWL	NA	4.2	2.6 - 5.4	7.0 (4)	3.5 - 12.9(4)
	ADAL	NA	4.0	3.3 - 5.5	4.4	3.5 - 6.2
	ADMML	NA	3.8	3.0 - 6.7	3.9	3.2 - 5.0(5)

Table A-2 BNR II Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria (1)	Performance/Loading(2,3) (2000 - 2007)			
			Battery A		Battery B	
			Average	Range	Average	Range
MLSS (mg/L)						
	ADWL	NA	2,990	2,680 - 3,510	2,990 (4)	2,700 - 3,280(4)
	ADAL	NA	3,000	2,830 - 2,330	3,150	2,930 - 3,390
	ADMML	NA	3,080	2,700 - 3,430	3,130	2,970 -3,400(5)
Sludge Volume Index (mL/g)						
	ADAL	NA	71.5	63.4 - 81.0	75.0	65.7 - 83.2
RAS/WAS Concentration (mg/L)						
	ADAL	NA	7,460	6,440 - 7,980	7,330	6,580 - 8,550
WAS Flow (mgd)						
	ADWL	NA	0.26	0.08 - 0.46	0.26 (4)	0.19 - 0.50(4)
	ADAL	NA	0.48	0.37 - 0.43	0.41	0.31 - 0.49
	ADMML	NA	0.33	0.16 - 0.44	0.43	0.26 -0.57(5)

Table A-2 BNR II Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria [1]	Performance/Loading[2,3] (2000 - 2007)			
			Battery A		Battery B	
			Average	Range	Average	Range
WAS TSS (ppd)						
	ADWL	NA	18,000	400 - 30,000	17,000 [4]	9,700 - 35,200[4]
	ADAL	NA	23,240	18,260 - 28,000	25,980	16,830 - 34,020
	ADMML	NA	20,660	8,890 – 30,130	25,800	14,300 - 36,000[5]
WAS VSS/TSS						
	ADAL	NA	0.74	0.73 - 0.76	0.74	0.73 - 0.76
BNR II Nitrification Clarifiers						
Overflow Rate (gpd/sf)						
	ADWF	NA	375	240 - 490	375	300 - 430
	ADAF	NA	360	270 - 500	370	280 - 420
	ADMMF	800	360	230 - 640	350	240 - 430
PHWWF	[6]	930	400	270 - 490	540	480 - 650
RAS Ratio, %						
	ADAF	NA	0.69	0.63 - 0.75	0.66	0.61 - 0.69

Table A-2 BNR II Loading and Treatment Performance Data
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

Process/Design Parameter	Design Condition (Flow or Load)	WPCP Design Criteria (1)	Performance/Loading(2,3) (2000 - 2007)			
			Battery A		Battery B	
			Average	Range	Average	Range
Solids Loading Rate (lbs/sf/day)						
	ADWF	NA	14.8	9.3 - 17.8	15.3	11.3 - 18.7
	ADAF	NA	15.0	12.4 - 20.3	16.1	12.0 - 18.6
	ADMMF	NA	15.4	9.4 - 32.0	15.2	11.0 - 20.9
PHWWF	(6)	34.5	17.3	10.8 - 23.8	20.9	13.8 - 31.0

Notes:
NA = Not Available
(1) Design criteria based on maximum capacity available (i.e. all units in service).
(2) Based on actual number of units in service. Not all units are in service at all times.
(3) Performance data presented are monthly averages unless otherwise noted.
(4) ADWF and ADWL data not available, or was zero in 2003 and 2004. These data points are not included in the average or range.
(5) The flow to Nitrification Battery B during the ADMML month in 2004 was zero and not included in reported data.
(6) Data unavailable for calculation of PHWWF average performance and performance range in 2006 for the nitrification clarifier overflow rate and solids loading rate.