City of Riverside

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

VOLUME 4: WASTEWATER TREATMENT SYSTEM
CHAPTER 3: PROCESS DESIGN AND RELIABILITY CRITERIA

FINAL
February 2008

carollo
Engineers...Working Wonders With Water™

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City of Riverside

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PROCESS DESIGN AND RELIABILITY CRITERIA

3.1 PURPOSE

The purpose of this chapter is to summarize the existing plant capacity, the basis of design, and the design criteria for future facilities at the Regional Water Quality Control Plant (RWQCP). This chapter includes a summary of the wastewater quality and flow data, which was used to calibrate computer models, and the design criteria for future facilities. In subsequent chapters, the calibrated computer models will be used for the evaluation of options for increasing plant capacity. This chapter does not include a detailed description of the existing facilities, which is included in Volume 4, Chapter 1 - Description of Existing Facilities.

3.2 CONCLUSIONS

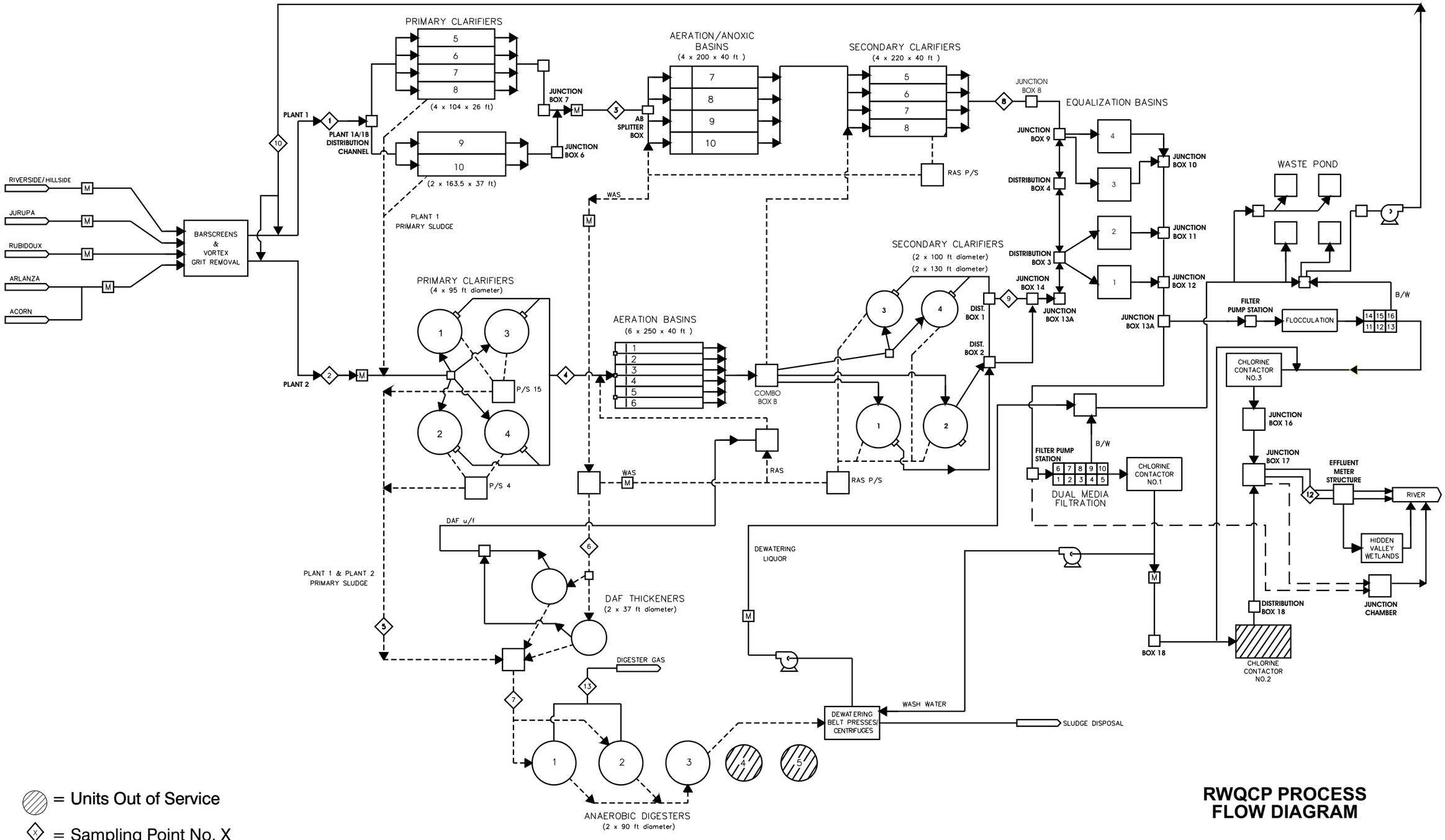
- Based on the Biotran and BioWin™ models, the capacity of the existing facilities is 40 mgd annual average flow rate.
- The design criteria for expansion of the wastewater facilities at the RWQCP are listed in Tables 3.6 and 3.7.

3.3 DESCRIPTION OF EXISTING TREATMENT

The existing RWQCP consists of preliminary, primary, secondary, tertiary, and solids treatment. Figure 3.1 shows the flow schematic of the existing facilities. Wastewater that enters the RWQCP is screened and de-gritted before it is split into two treatment trains (Plant 1 and Plant 2) for further treatment. The flow is split between Plant 1 and Plant 2 in roughly a 40:60 ratio.

In both Plant 1 and Plant 2, wastewater flows by gravity into the primary clarifiers and then to the secondary treatment process. Plant 1 has a total of six rectangular primary clarifiers, four rectangular aeration basins, and four rectangular secondary clarifiers. Plant 2 has four circular primary clarifiers, six rectangular aeration basins, and four circular secondary clarifiers. The secondary effluent from each plant combines and flows into four equalization basins.

Equalized secondary effluent is pumped into the tertiary filters. The filtered effluent then goes through chlorine contact basins for disinfection and final effluent is discharged either to the Santa Ana River directly or to the Hidden Valley Wetlands for further nitrogen removal before discharge to the Santa Ana River.



= Units Out of Service

= Sampling Point No. X

RWQCP PROCESS FLOW DIAGRAM

FIGURE 3.1

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For a detailed description of the existing facilities, refer to Volume 4, Chapter 1 - Description of Existing Facilities. The description of facilities for handling waste solids generated during the wastewater treatment process is discussed separately in Volume 8, Chapter 1 - Existing Facilities. The design criteria for the solids handling facilities is discussed in Volume 8, Chapter 3 - Biosolids Management: Design Criteria Development.

3.3.1 Review of Recent Operating Data

Table 3.1 presents the influent wastewater characteristics for the period of January 2000 to July 2006. The data was split into three separate periods as shown, due to influent or process changes during the time period. The influent Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) concentrations appear to have increased in the past few years. Until March 2006, the recycle streams, including filter backwash water and filtrate from belt-filter presses and centrifuge, were returned to the Plant 1 primary clarifiers. Since March 2006, all the recycle flows are split between the two plants, with approximately 20 percent flowing to Plant 1 and 80 percent flowing to Plant 2.

Table 3.1 Summary of the Process Operating Parameters Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside

Parameter	Units	Jan 2000 - Dec 2003	Jan 2004 - Mar 2006	March 2006 - July 2006
Flow[(1)]				
Daily Average Flow	mgd	30.6	31.9	32.3
Maximum Flow	mgd	39.9	46.5	34.8
Max-Month Peak Factor		1.3	1.45	1.1
Average Influent Quality				
BOD	mg/L	221.5	249.5	252.5
TSS	mg/L	221.9	249.3	234.6
TKN as N	mg/L	34.8	35.2	36.3
Ammonia-N	mg/L	20.5	22.8	29.0
BOD/TKN Ratio		6.4	7.1	7.0
Influent Loads				
Average BOD Load	lb/day	61,600	76,000	79,000
30-day Moving Average Maximum BOD Load	lb/day	84,900	86,900	84,000
Average TSS Load	lb/day	61,800	76,000	73,300
30-day Moving Average Maximum TSS Load	lb/day	73,800	88,100	77,000
Average Ammonia-N Load	lb/day	6,900	8,300	8,100
30-day Moving Average Maximum Ammonia Load	lb/day	10,200	10,800	11,100

Table 3.1	Summary of the Process Operating Parameters Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside			
Parameter	**Units**	**Jan 2000 - Dec 2003**	**Jan 2004 - Mar 2006**	**March 2006 - July 2006**
Average Secondary Effluent Quality				
BOD	mg/L	2.0	3.0	2.8
TSS	mg/L	1.8	1.9	2.9
TKN as N	mg/L	1.7	N/A	N/A
Ammonia as N	mg/L	0.5	0.9	0.2
Nitrate as N	mg/L	12.1	10.4	9.0

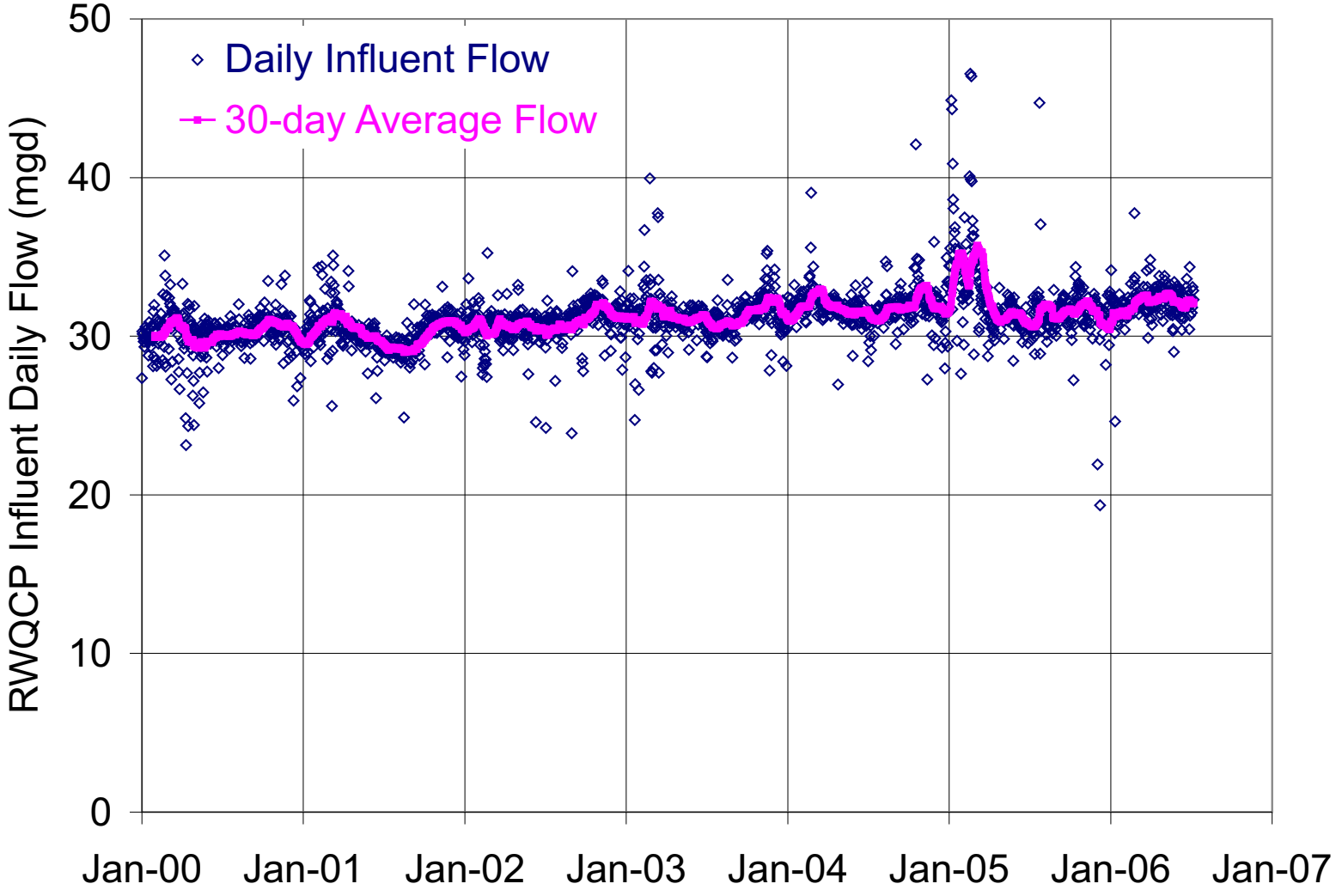
Notes:
(1) The influent flow data presented is based on a calculation provided by the City of Riverside.

Figure 3.2 shows the influent flow data for the period January 2000 to July 2006. The mid-2006 30-day moving average influent flow is about 32.0 mgd. Figures 3.3, 3.4, 3.5, and 3.6 show the influent BOD, TSS, Total Kjeldahl Nitrogen (TKN), and ammonia data for the period January 2000 to July 2006, respectively. Vertical lines in the figures are shown at January 1, 2004 and March 17, 2006. Since March 17, 2006 the ability to divert part of the recycles stream to Plant 2 was added.

The data suggests that the influent wastewater characteristics have changed over the past few years. As seen in Figure 3.3, the influent BOD has increased from an average of about 210 mg/L, for the period January 2000 to December 2003, to an average of about 250 mg/L, for the period 2004 to mid-2006. This implies that the influent average influent BOD has increased by as much as 20 percent. The average influent TSS shows a similar trend. The average TSS increased from about 215 mg/L to about 240 mg/L, which is about a 12 percent increase.

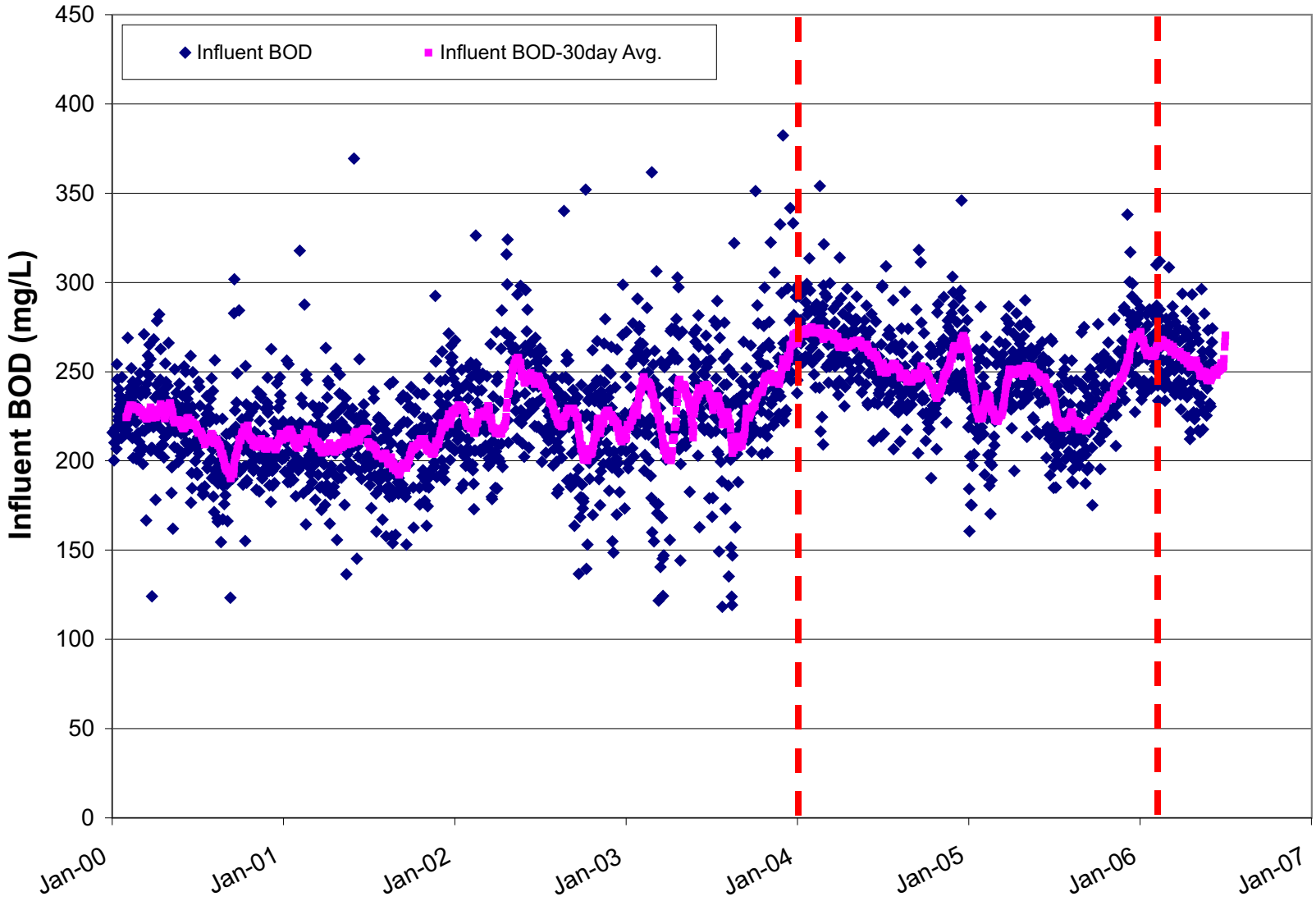
Although the ammonia and TKN data is limited, the current average influent ammonia and TKN values are higher than what they were a few years back. The average ammonia used for design in 2002 was 20.8 mg/L as N, whereas the average for the period 2000 to 2006 is 27.7 mg/L as N, which is approximately 33 percent higher. The average TKN used for design in 2002 was 28.1 mg/L as N, whereas the average for 2000 to 2006 is 35.2 mg/L as N, which is approximately 25 percent higher.

As the average values for wastewater parameters have increased in the past few years, it is suggested that the most recent data (for the period of January 2004 to March 2006) be used for the design of future facilities.



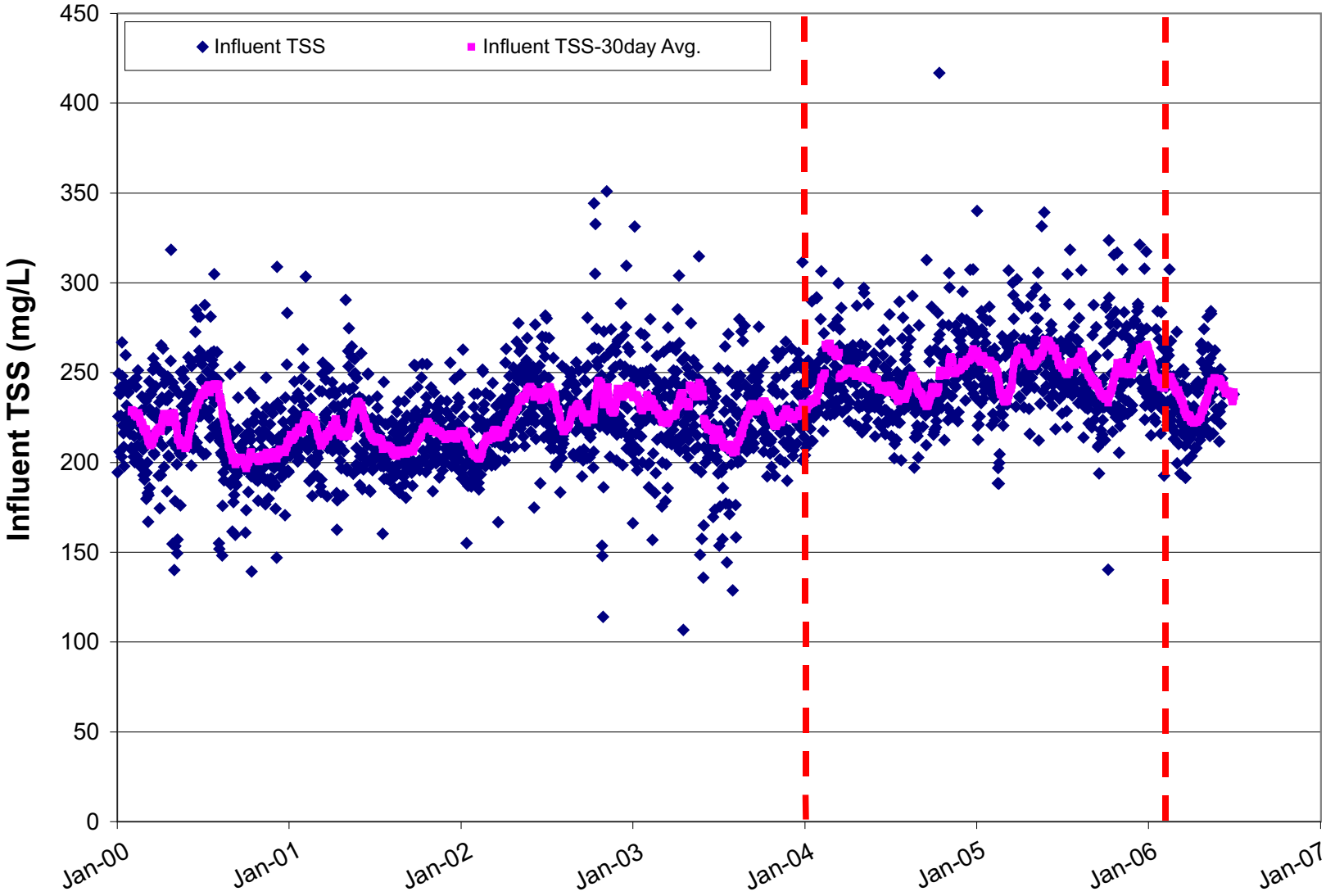
DAILY INFLUENT FLOW AND 30-DAY RUNNING AVERAGE FLOW AT RWQCP

FIGURE 3.2



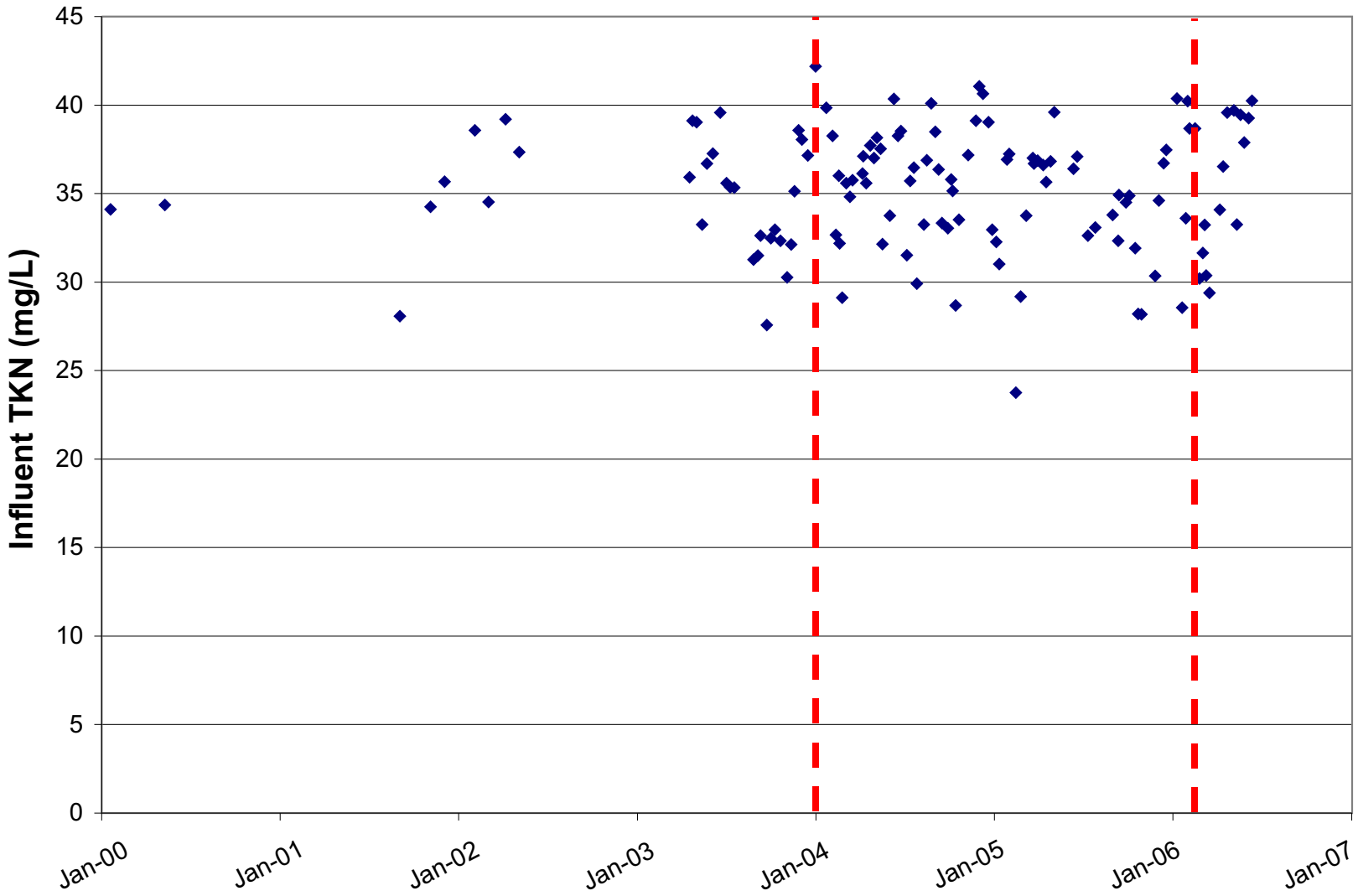
INFLUENT BOD

FIGURE 3.3



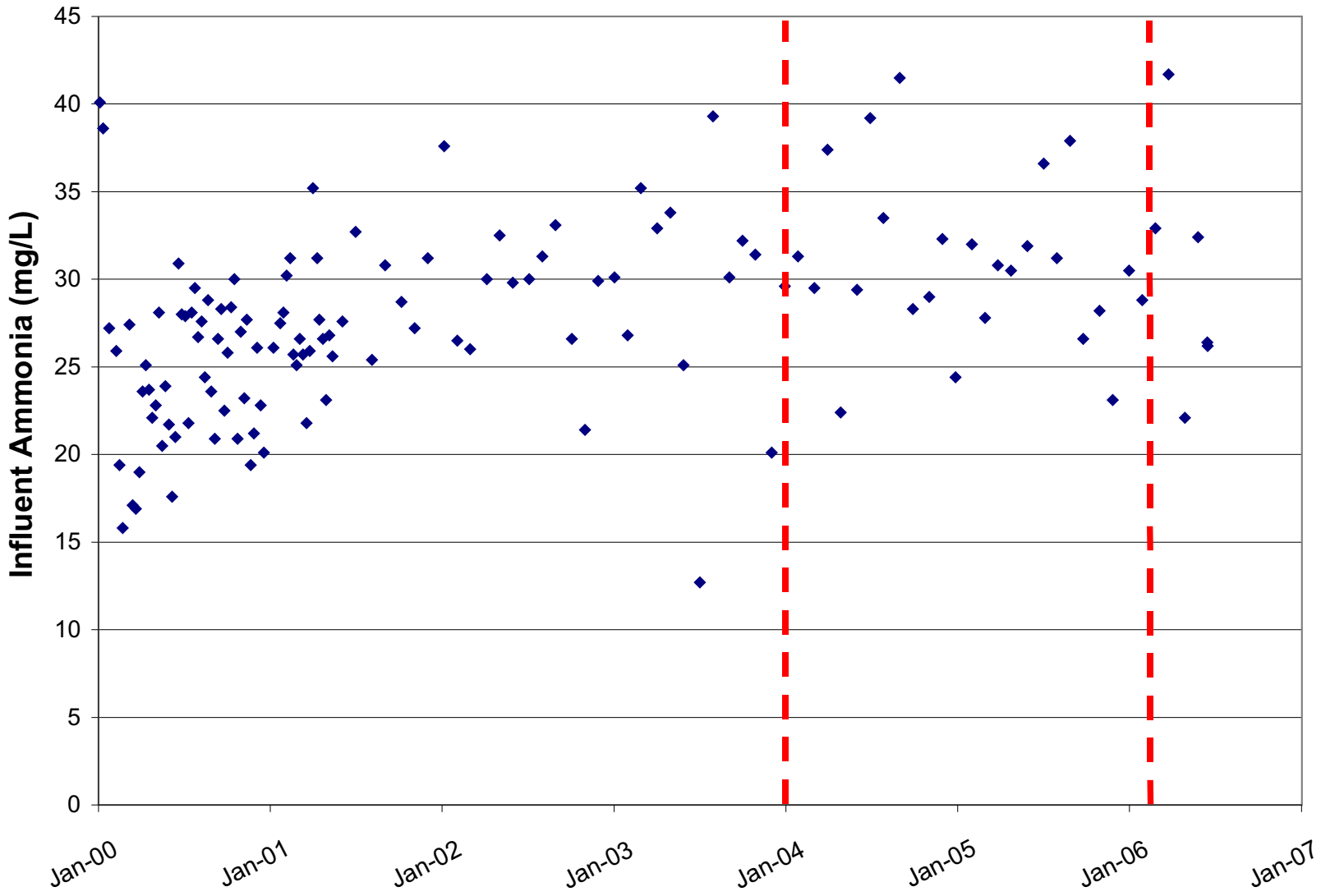
INFLUENT TSS

FIGURE 3.4



INFLUENT TKN

FIGURE 3.5



INFLUENT AMMONIA

FIGURE 3.6

Wastewater treatment facilities are designed to handle both hydraulic and pollutant load peaks. Figures 3.7 and 3.8 show the influent BOD and TSS loads, respectively. As shown, a peaking factor of 1.25 covers most load peaks and hence was chosen for model calibration and for design of future expansion. The peaking factors for wastewater flow and BOD and TSS loads are summarized in Table 3.1. The discussion on peaking factors for wastewater flow is presented in Volume 2, Chapter 3 - Population and Flow Projections. These peaking factors would be confirmed during design.

Table 3.2 Peaking Factors
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

Parameter	Peaking Factor
Wastewater Flows	
Peak Wet Weather Flow	2.2
Peak Dry Weather Flow	1.8
Tertiary Peak	1.5(1)
Wastewater Characteristics	
BOD Load	1.25
TSS Load	1.25
TKN Load(2)	1.25

Notes:
(1) Based on the assumption that secondary effluent is equalized prior to tertiary filtration.
(2) Due to limited availability of influent nitrogen data, the TKN peak factor was based on the BOD and TSS peak factors.

In order to properly size the future expansion project it is necessary to project the future flow conditions. Anticipated wastewater influent flow to the RWQCP is presented in Volume 2, Chapter 3 - Population and Flow Projections.

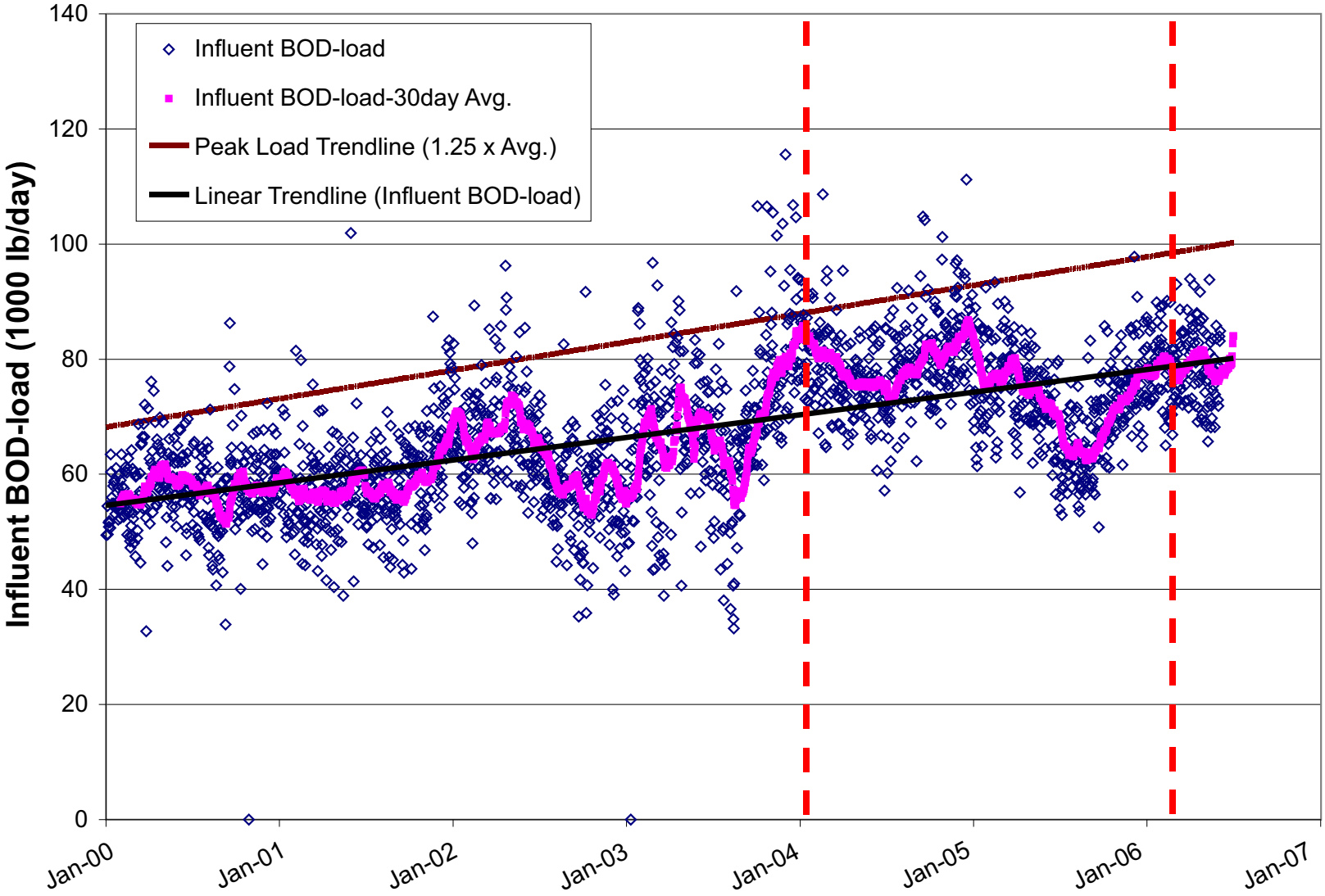
3.3.2 Effluent Wastewater Quality Criteria

The RWQCP has to meet the effluent discharge requirements summarized in Table 3.3.

Table 3.3 Criteria for Effluent
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

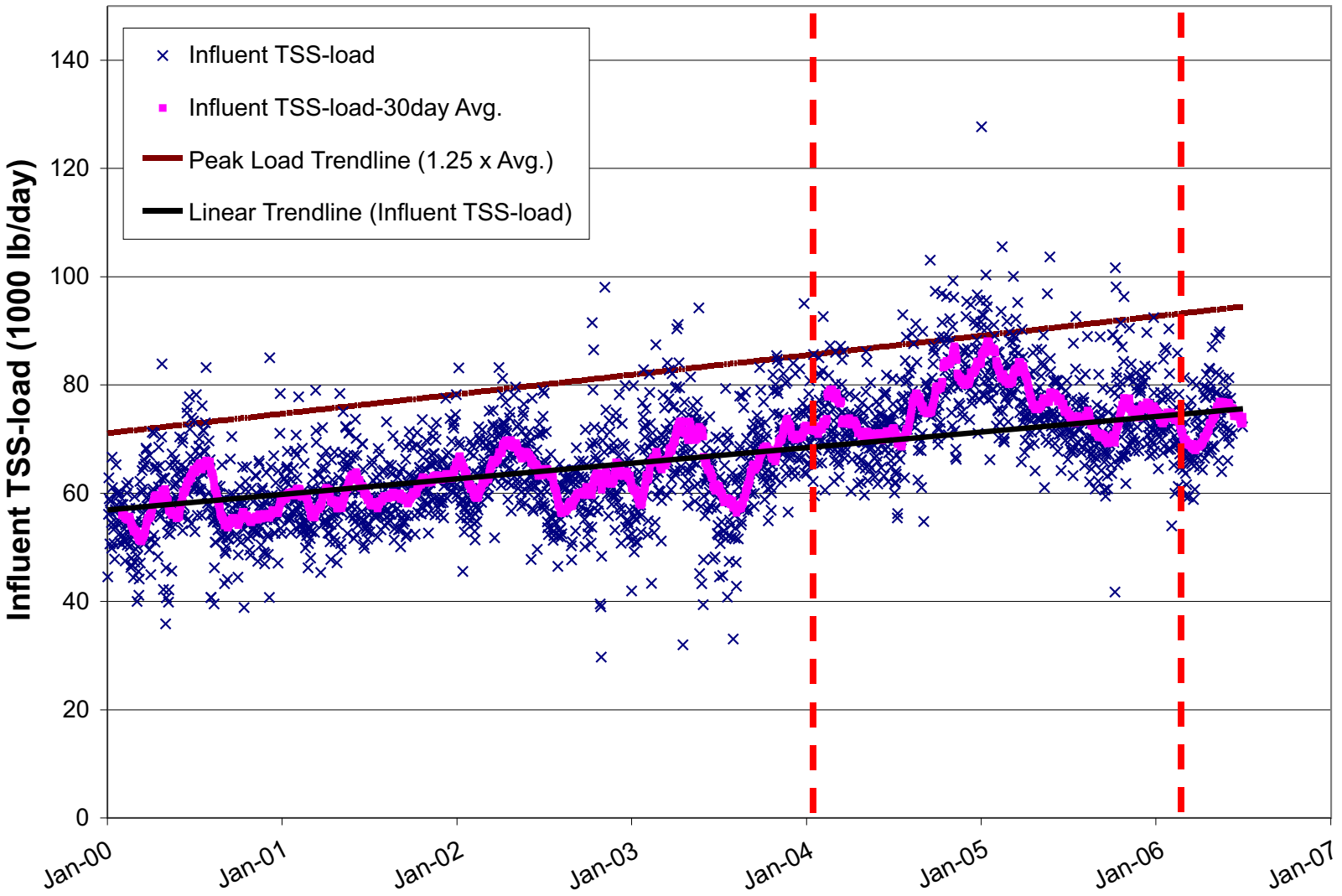
Parameter	30-day Average (mg/L)	7-day Average (mg/L)
BOD	20	30
TSS	20	30
Total Inorganic Nitrogen (as N)	10(1)	N/A

Notes:
(1) Permit requirement is 13 mg/L for flows less than 35 mgd and 10 mg/L for flows above that. A design value of 8 mg/L is used to provide a safety factor.



INFLUENT BOD LOAD

FIGURE 3.7



INFLUENT TSS LOAD

FIGURE 3.8

In addition to the water quality criteria listed above, total coliform, toxic pollutants, and other Basin Plan constituents of concern are addressed in the discharge permit and Title 22.

3.4 MODELING OF EXISTING TREATMENT FACILITIES

3.4.1 Biotran and BioWin™ Process Models

Carollo Engineers (Carollo) employs a customizable spreadsheet based process model, Biotran, to perform mass balances and evaluate operating criteria over an entire treatment plant. A Biotran process model was set up for the RWQCP. A copy of the Biotran model is included in Appendix A.

In addition to the Biotran spreadsheet model, Carollo uses the commercially available process model BioWin™ to simulate and design the activated sludge system. A BioWin™ model was set up for the RWQCP to simulate the performance of the activated sludge process for both Plant 1 and Plant 2.

3.4.2 Calibration

As a first step in applying Biotran for evaluating plant operations, a historical time period is selected, over which operations are reasonably steady to calibrate and check the model predictions against actual operations. Operating data for the RWQCP were examined to select an appropriate period for calibration, and average values of wastewater parameters for the period from January 2004 to March 2006 were used for the calibration of the model.

3.4.3 Calibration Modeling Results

Calibration modeling results are summarized in Table 3.4.

Table 3.4 Comparison of Plant Data and Model Calibration Results Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside

Effluent Parameter	Plant Data	Biotran Model Result	BioWin™ Model Result
Plant 1			
NH_4-N, mg/L	0.6	0.1	0.3
NO3-N, mg/L	20.4	17.7	16.8
TIN, mg/L	21.0	17.8	17.1
WAS Production, lb/day	8,450	7,850	7,763
Plant 2			
NH_4-N, mg/L	0.9	0.1	0.3
NO3-N, mg/L	4.9	5.6	5.1
TIN, mg/L	5.8	5.7	5.4
WAS Production, lb/day	21,950	22,570	21,712

The calibrated Biotran and BioWin™ models show a reasonable agreement with the actual data as far as solids production is concerned. In terms of effluent quality, there is reasonable agreement for effluent ammonia-nitrogen. The effluent nitrate-nitrogen (and thus the effluent total inorganic nitrogen) shows some difference. The difference may be due to operational changes during the calibration period or due to dewatering centrate effects that will be discussed in Volume 4, Chapter 10 - Recycle Stream Management.

Both the Biotran and BioWin™ models show reasonable agreement with the plant data and would be applicable in evaluating future options. The calibrated Biotran (refer to Appendix A) model was used to assess the treatment capacity of the existing facilities. The Biotran model estimates the existing treatment capacity to be 40 mgd (annual average flow rate). This capacity estimate is based on the assumption that the influent flow split between Plant 1 and Plant 2 will be in a 50:50 ratio. Previously, during the secondary system upgrades project, done by Carollo in 2002, the Biotran showed that the plant capacity was approximately 36 mgd. The increase from 36 to 40 mgd is due to the results of the *Clariflux*™ modeling that was done for the master plan. These results will be described in Volume 4, Chapter 7 - Secondary Treatment.

3.5 BASIS OF RWQCP EXPANSION

3.5.1 Reliability and Units Out of Service

The following reliability criteria were established for the maximum number of operating units for each unit out of service. Table 3.5 shows the summary of the reliability and units out-of-service criteria.

Table 3.5 Reliability and Units Out-of-Service Criteria
Wastewater Collection and Treatment Facilities Integrated Master Plan
City of Riverside

Parameter	Number of Units in Service (Up To)	Units Considered Out of Service
Process Tankage(1)	9	1
Tertiary Filters	6	1
Rotating Mechanical Equipment	4	1

Notes:
(1) Applies to aeration basins, secondary clarifiers, and digesters only.

3.5.2 Process Design Criteria and Unit Sizing

The following information (Table 3.6) was used to develop the process design and unit sizing for all various unit processes.

Table 3.6 Unit Process Design Criteria and Sizing Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside		
Parameter	**Value**	**Notes**
Headworks - Screens		
Bar Spacing	3/8”	
Operation Mode	One standby unit and one bypass channel	
Primary Clarifiers	1,200 gpd/ft^2	Annual Average Flow.
	2,250 gpd/ft^2	Peak Hourly Wet Weather Flow.
Primary Clarifier Covers	Low Profile Aluminum Covers	
Odor Control - Biofilters		
Application Rate	3.0 to 5.0 cfm/ft^2	
Typical Depth	3 to 4 ft	
Aeration Basins		
SRT	5 to 8	Days at Max Month Loading Conditions.
Membrane Bioreactor		
SRT	5 to 8	
Operating MLSS	8,000 - 10,000 mg/L	
IFAS Process		
SRT	5 to 8 days	
Equivalent MLSS Increase	40 lbs. per 1,000 ft^2 of media	
Secondary Clarifiers		
Surface Overflow Rate	1,500 gpd/ft^2	At Max Month Conditions
Tertiary Facilities		
Tertiary Facilities Design Flow to Annual Average Flow	1.5:1	Flow equalized prior to tertiary facilities.
Dual Media	4.0	gpm/sq. ft. with one cell out of service and one in backwash.
Cloth Disk Filter	4.5	gpm/sq. ft. (rated with one unit out of service for every seven installed).

Table 3.6	Unit Process Design Criteria and Sizing Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside	
Parameter	**Value**	**Notes**
Disinfection - Chlorination		
Chlorine Contact Basins Ct-value	450 mg/L-min	
Modal Contact Time	90 min	
(Modal Contact Time/ Detention Time) Ratio	85%	
Disinfection - UV		
UV Transmittance (UVT)	55% (to be confirmed)	Typical range 50% to 70%. The UVT value for design would be established by conducting laboratory tests during the preliminary design stage.
Disinfection - Ozone		
Ozone Dose	15 mg/L	Typical range 5 to 40 mg/L. Dose varies with the initial coliform count.
HRT	15 min	

All unit processes shall be capable of treating or hydraulically conveying all flow as identified in the influent characteristics with the largest unit out of service.

Table 3.7 presents a summary of the parameters (flow and wastewater quality) that were used as a basis for evaluating and selecting the various unit processes/operations for expansion of the RWQCP.

Table 3.7	Design Criteria for Expansion of RWQCP Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside
Effluent Parameter	**Value**
Design Flows	
Average Dry Weather Flow (ADWF), mgd	52.2
Peak Wet Weather Flow (PWWF), mgd	115(1)
Approximate Recycle Flow to Headworks, mgd	5.5
Average Influent Wastewater Characteristics(2)	
BOD, mg/L	250
TSS, mg/L	250
TKN, mg/L as N	35.5

Table 3.7	**Design Criteria for Expansion of RWQCP Wastewater Collection and Treatment Facilities Integrated Master Plan City of Riverside**
Effluent Parameter	**Value**
Effluent Quality Requirements	
BOD, mg/L	<10
TSS, mg/L	<10
Total Inorganic Nitrogen, mg/L	<8
Ammonia-Nitrogen, mg/L	<1 (3)

Notes:
(1) Based on an instantaneous peak flow factor of 2.2.
(2) Does not include impact of recycle streams from dewatering, thickening and tertiary filter backwash.
(3) To ensure stable nitrification performance.

APPENDIX A
BIOTRAN MODEL

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
PROJECT: REGIONAL WATER QUALITY CONTROL PLANT -
SUBJECT: PROCESS ANALYSIS AND MASS BALANCE

Calc by	Date	Time	Chk by/Date	FileName:
CFP,NV	10/12/2006	9:03 AM		Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity			Setup	Basis
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	info	
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		

NOTES regarding this application:

					With Default Sludge Settleability 35:65 Recycle Split			With Better Sludge Settleability 40:60 Recycle Split Based on aeration capacity			With Better Sludge Settleability 40:60 Recycle Split Based on aeration capacity Centrifuge, not BP				
SUMMARY:															
FLOW RATES, mgd:															
- Raw WW Flow		11.0	20.1		17.8	22.2		22.2	22.2		22.2	22.2			
- Flow to Primaries		14.5	20.9		19.4	26.5		24.3	26.8		24.1	26.5			
- Flow to Activated Sludge		13.7	21.2		18.2	27.3		22.9	27.3		22.8	26.9			
SECONDARY EFFLUENT QUALITY, mg/L:															
- BOD (est.), mg/L		2	2		3	3		3	3		3	3			
- TSS (nominal), mg/L		5	4		5	4		5	4		5	4			
- NH3-N, mg/L	[Note]	0.07	0.05		0.26	0.46		0.31	0.44		0.27	0.35			
- NO3/NO2-N, mg/L		17.7	5.6		8.5	8.5		7.8	8.0		8.1	8.5			
- T.I.N., mg/L		17.8	5.6		8.8	8.9		8.1	8.5		8.4	8.9			
PRIMARY CLARIFIERS															
- # of Clarifiers		6	4		6	4		6	4		6	4			
- # in Service		6	4		6	4		6	4		6	4			
- Surface Overflow Rate, gpd/sf		631	736		848	935		1,061	946		1,052	934			
AERATION BASINS															
- # of Basins		4	6		4	6		4	6		4	6			
- # in Service		4	6		4	6		4	6		4	6			
- Hydraulic Deten. Time, hr		7.1	8.9		5.3	6.9		4.2	6.9		4.3	7.0			
- Operating Last-Pass MLSS, mg/L		2,860	3,170		2,780	2,330		3,500	2,500		3,500	2,500			
- Design Temperature, deg C		24.9	24.9		20.0	20.0		20.0	20.0		20.0	20.0			
- Unaerated Volume Fraction		0.25	0.19		0.25	0.19		0.25	0.19		0.25	0.19			Selected
- Aerobic SRT, days		8.84	7.78		3.63	2.75		3.22	2.80		3.33	2.94			
-- Min. Aerobic SRT for Nitrification		3.05	3.14		4.17	4.19		4.15	4.23		4.15	4.23			
- Total SRT, days		11.79	9.56		4.83	3.38		4.29	3.44		4.44	3.61			
-- Recommended Min. Total SRT for Nitrification		4.07	3.86		5.56	5.14		5.53	5.19		5.53	5.19			
- F/M, lb BOD Appl./lb MLSS-day		0.16	0.17		0.32	0.35		0.34	0.34		0.34	0.34			
- Aer. BOD Loading, lb BOD/1000 cf-day		28	33		56	51		74	53		74	52			
- ML Recirculation Ratio		2.9	2.1		2.2	1.6		1.7	1.6		1.8	1.6			Selected
- Process Air (est.), scfm		6,110	10,200		10,390	17,560		14,040	17,580		13,940	17,380			
SECONDARY CLARIFIERS															
- # of Basins		4	4		4	4		4	4		4	4			
- # in Service		4	4		4	4		4	4		4	4			
- Sec. Clarifier SOR, gpd/sf		386	494		509	627		645	631		641	623			
- Sec. Clar. Solids Loading, lb/day-sf		15	23		19	18		25	18		25	17			
- Clarifier Safety Factor (CSF)		2.6	1.8		2.0	2.0		2.8	2.8		2.8	2.9			
-- CSF Target		2.3	2.2		2.0	2.0		2.0	2.0		2.0	2.0			

* Input Data

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
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Biotran05 v.1106

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Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		

DETAILED CALCULATIONS:

RAW WASTEWATER (excluding Recycles)															
o Plant Flow Rate, mgd		11.0	20.1		17.8	22.2		22.2	22.2		22.2	22.2			
o Flow Characteristic Ratios															
- Max Month/Annual Avg	*	1	1		1.11	1.11		1.11	1.11		1.11	1.11			Default
- Peak 4-hr Wet-W Flow/Annual Avg	*	2.0	1.9		2.0	1.9		1.9	1.9		1.9	1.9			Default
- Typical 4-hr Diurnal Peak/Daily Avg	*	1.3	1.3		1.3	1.3		1.3	1.3		1.3	1.3			Default
o Wastewater Characteristics															
- BOD, mg/L, Annual Average	*	**233**	**233**		**250**	**250**		**250**	**250**		**250**	**250**			Default
-- Mass Load (lb/d) Peaking Factor	*	1	1		1.25	1.25		1.25	1.25		1.25	1.25			
-- Effective BOD, mg/L		233	233		282	282		282	282		282	282			
"Effective" concentrations correspond to Peak Mass Loads with the flow rate used in the calculation															
- TSS, mg/L, Annual Average	*	**232**	**232**		**250**	**250**		**250**	**250**		**250**	**250**			Default
-- Mass Load (lb/d) Peaking Factor	*	1	1		1.25	1.25		1.25	1.25		1.25	1.25			
-- Effective TSS, mg/L		232	232		282	282		282	282		282	282			
- Fpv, VSS fraction	*	0.83	0.83		0.83	0.83		0.83	0.83		0.83	0.83			Default
-- Effective VSS, mg/L		192	192		234	234		234	234		234	234			
- NH3-N, mg/L, Annual Average	*	21.0	21.0		21.0	21.0		21.0	21.0		21.0	21.0			Default
-- Mass Load (lb/d) Peaking Factor	*	1	1		1.25	1.25		1.25	1.25		1.25	1.25			
-- Effective NH3-N, mg/L		21.0	21.0		23.6	23.6		23.6	23.6		23.6	23.6			
Organic-N, mg/L, Annual Average	*	14.5	14.5		14.5	14.5		14.5	14.5		14.5	14.5			Default
-- Mass Load (lb/d) Peaking Factor	*	1	1		1.25	1.25		1.25	1.25		1.25	1.25			
-- Effective Org-N, mg/L		14.5	14.5		16.3	16.3		16.3	16.3		16.3	16.3			
- NO3-N, mg/L, Annual Average	*	0	0		0	0		0	0		0	0			Default
- Alkalinity, mg/L, Annual Average	*	250	250		250	250		250	250		250	250			Default
- Filterable ("soluble") BOD															
-- fraction, Fbf	*	0.25	0.25		0.25	0.25		0.25	0.25		0.25	0.25			Default
-- mg/L		58	58		70	70		70	70		70	70			
- Fvu, Fraction VSS that is Unbiodeg	*	0.600	0.600		0.600	0.600		0.600	0.600		0.600	0.600			Estimated
- Total Phosphorus, mg/L, Annual Average	*	10.5	10.5		11.0	11.0		11.0	11.0		11.0	11.0			Default
-- Mass Load (lb/d) Peaking Factor	*	1	1		1.25	1.25		1.25	1.25		1.25	1.25			
-- Effective Total-P, mg/L		10.5	10.5		12.4	12.4		12.4	12.4		12.4	12.4			
-- Fraction filterable ("soluble")	*	0.33	0.33		0.32	0.32		0.32	0.32		0.32	0.32			Default
-- Filterable P, mg/L		3.50	3.50		3.94	3.94		3.94	3.94		3.94	3.94			
o Design Temperature, deg. C															
- Minimum (Winter)	*	20	20		20	20		20	20		20	20			Default
- Maximum (Summer)	*	29	29		29	29		29	29		29	29			Default
- Design	*	24.9	24.9		20	20		20	20		20	20			Winter
RECYCLE TO HEADWORKS/PRIM CLAR.S															
o Flow Rate, mgd															
- Filter Backwash	*	3.102	0.000	3.102	1.399	2.598	3.997	1.777	2.665	4.441	1.759	2.639	4.399		
- Dewatering Filterate + Washwater/Centrate	*	0.361	0.000	0.361	0.265	0.493	0.758	0.337	0.505	0.842	0.157	0.236	0.393		
- Primary Sludge From Plant 1	*	0.000	0.766		0.000	1.232		0.000	1.441		0.000	1.397			
- Total		3.462	0.766		1.664	4.323		2.114	4.612		1.917	4.273			
o Wastewater Characteristics, mg/L															
- Total Recycle															
-- BOD		43	1,702		65	589		64	636		55	675			
-- TSS		176	3,000		224	1,015		226	1,093		136	1,073			
-- VSS		127	2,387		168	813		170	877		104	869			
-- NH3-N		51	28		62	52		62	51		69	55			
-- Organic-N		11	141		14	48		15	52		10	50			
-- NO3/NO2-N		10	2		8	6		7	5		8	5			
-- Alkalinity		313	265		347	321		346	318		369	333			
-- Filterable ("soluble") BOD		4.2	45.2		6.3	23.0		6.3	24.6		5.2	24.8			
-- Total soluble Organic N		2.3	0.0		2.5	1.8		2.5	1.7		2.5	1.7			
-- Fpv, VSS fraction		0.72	0.80		0.75	0.80		0.75	0.80		0.77	0.81			
- Fvu, Fraction VSS that is Unbiodeg	*	0.700	0.700		0.700	0.700		0.700	0.700		0.700	0.700			Default

* Input Data

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
PROJECT: REGIONAL WATER QUALITY CONTROL PLANT -
SUBJECT: PROCESS ANALYSIS AND MASS BALANCE

Calc by: CFP,NV | Date: 10/12/2006 | Time: 9:03 AM | Chk by/Date | FileName: Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity				
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Setup info	Basis
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
PRIMARY TREATMENT		In Service	In Service		In Service	In Service		In Service	In Service		In Service	In Service			
o Flow Rate, mgd															
- Raw Wastewater		11.0	20.1		17.8	22.2		22.2	22.2		22.2	22.2			
- Recycle stream		3.46	0.77		1.66	4.32		2.11	4.61		1.92	4.27			
- Total Influent		14.5	20.9		19.4	26.5		24.3	26.8		24.1	26.5			
o Wastewater Characteristics, mg/L															
- BOD		187	287		263	332		263	343		264	345			
- TSS		218	333		277	401		277	421		270	409			
- VSS		177	273		228	328		228	344		223	336			
- NH3-N		28	21		27	28		27	28		27	29			
- Organic-N		14	19		16	21		16	22		16	22			
- NO3-N		2	0		1	1		1	1		1	1			
- Alkalinity		265	251		258	262		258	262		259	263			
- Filterable ("soluble") BOD		45	58		65	63		65	63		65	63			
- Fpv, VSS fraction		0.81	0.82		0.82	0.82		0.82	0.82		0.83	0.82			
o Basin dimensions (inside)															
- Basins Set - 1,2,3,4															
- Number of Basins	*	4	4		4	4		4	4		4	4			
- Number of Units in Service	*	4	4		4	4		4	4		4	4			
- Diameter, ft	*	0	95		0	95		0	95		0	95			
- Side Water Depth, ft	*	9	9		9	9		9	9		9	9			
- Surface Area per Basin, sf		2,704	7,088		2,704	7,088		2,704	7,088		2,704	7,088			
- Surface Area in Service, sf		10,816	28,353		10,816	28,353		10,816	28,353		10,816	28,353			
- Basins Set - 5,6															
- Number of Basins	*	2	0		2	0		2	0		2	0			
- Number of Units in Service	*	2	0		2	0		2	0		2	0			
- Diameter, ft	*	0	0		0	0		0	0		0	0			
- Side Water Depth, ft	*	9	0		9	0		9	0		9	0			
- Surface Area per Basin, sf		6,050	0		6,050	0		6,050	0		6,050	0			
- Surface Area in Service, sf		12,099	0		12,099	0		12,099	0		12,099	0			
- Total Surface Area in Service, sf		22,915	28,353		22,915	28,353		22,915	28,353		22,915	28,353			
o Surface Overflow Rate, gpd/sf															
- At Design Flow		631	736		848	935		1,061	946		1,052	934			
- At Diurnal Peak Flow		820	957		993	1,096		1,243	1,108		1,233	1,094			
- At Peak WW Flow		1,278	1,409		1,493	1,614		1,830	1,631		1,816	1,611			
o Detention Time, hr		1.2	2.2		0.9	1.7		0.7	1.7		0.7	1.7			
o Chemically Enhanced Primary Treatment															
- CEPT applied? [Y=1; N=0]	*	0	0		0	0		0	0		0	0			Default
- Ferric Chloride dosage, mg/L as FeCl3	*	10	10		10	10		10	10		10	10			Default
-- FeCl3 used, lb/d		0	0		0	0		0	0		0	0			
- Polymer dosage, mg/L	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			Default
-- Polymer used, lb/d		0	0		0	0		0	0		0	0			
- Chem Sludge Generated, lb/d															
-- Total, lb/d		0	0		0	0		0	0		0	0			
- Alkalinity Reduction, mg/L		0	0		0	0		0	0		0	0			
o Removal Efficiency, %															
- BOD Removal, %		**45.3**	**43.2**		**42.3**	**40.5**		**39.2**	**40.5**		**39.4**	**40.9**			
- TSS Removal, %		**71.3**	**67.0**		**66.7**	**62.7**		**62.0**	**62.5**		**62.2**	**62.8**			
- Non-volatile SS %, Rpn		76.5	72.5		71.8	68.1		66.8	67.9		67.0	68.1			
- Organic-N Removal, %		52.2	52.3		48.8	49.9		45.6	50.3		45.2	50.1			
o Primary Sludge															
- Solids removed, lb/d															
-- Non-chemical primary solids		19,173	38,971		30,833	55,911		36,066	59,153		34,964	56,967			
-- Chemical solids from CEPT		0	0		0	0		0	0		0	0			
-- Total solids removed		19,173	38,971	58,144	30,833	55,911	86,744	36,066	59,153	95,219	34,964	56,967	91,932		
- Concentration, %	*	0.3	3.5		0.3	3.5		0.3	3.5		0.3	3.5			Default
- Flow Rate, mgd		0.766	0.134		1.232	0.192		1.441	0.203		1.397	0.195			
- Organic N removed, lb/d		901	1,754		1,362	2,388		1,601	2,539		1,539	2,423			
o Primary Effluent Flow, mgd		13.7	20.7		18.2	26.3		22.9	26.6		22.7	26.3			
o Primary Effluent, mg/L															
- BOD		102	163		152	197		160	204		160	204			

* Input Data

CAROLLO ENGINEERS, PC

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Calc by CFP,NV | Date 10/12/2006 | Time 9:03 AM | Chk by/Date | FileName: Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration Plant 1	Calibration Plant 2	Calibration Combined	Design Capacity Plant 1	Design Capacity Plant 2	Design Capacity Combined	Design Capacity Plant 1	Design Capacity Plant 2	Design Capacity Combined	Design Capacity Plant 1	Design Capacity Plant 2	Design Capacity Combined	Setup info		Basis
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0			
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4			
- TSS		63	110		92	149		105	158		102	152				
- VSS		53	94		78	126		89	133		87	129				
- NH3-N		28.2	21.3		27.0	28.3		26.9	28.3		27.2	28.7				
- Organic-N		6.54	9.13		8.28	10.78		8.81	11.13		8.68	10.86				
- NO3-N		2.4	0.1		0.7	1.0		0.6	0.9		0.6	0.9				
- Alkalinity		265	251		258	262		258	262		259	263				
- Filterable ("soluble") BOD		45	58		65	63		65	63		65	63				
RECYCLE TO ACTIVATED SLUDGE																
o Flow Rate, mgd																
- DAF Underflow	*	0.000	0.431	0.431	0.000	0.920	0.920	0.000	0.611	0.611	0.000	0.583	0.583			
- Stream 2	*	0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000				
- Stream 3	*	0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000				
- Spray Water to Basins	*	0.033	0.060		0.048	0.060		0.060	0.060		0.060	0.060				Default
- Total		0.033	0.491		0.048	0.980		0.060	0.671		0.060	0.643				
o Wastewater Characteristics, mg/L																
- Total Recycle																
-- BOD		0	83		0	136		0	228		0	227				
-- TSS		0	371		0	407		0	693		0	693				
-- VSS		0	309		0	346		0	587		0	589				
-- NH3-N		0	0		0	0		0	0		0	0				
-- Organic-N		0	24		0	28		0	47		0	47				
-- NO3-N		0	9		0	8		0	7		0	8				
-- Alkalinity		0	120		0	126		0	124		0	122				
-- Filterable ("soluble") BOD		0.0	0.7		0.0	1.1		0.0	1.1		0.0	1.1				
-- Total soluble Organic N		0.0	1.9		0.0	2.2		0.0	2.1		0.0	2.1				
-- Fpv, VSS fraction		0.00	0.83		0.00	0.85		0.00	0.85		0.00	0.85				
- Fvu, Fraction VSS that is Unbiodeg	*	0.700	0.700		0.700	0.700		0.700	0.700		0.700	0.700				Default
ACTIVATED SLUDGE PROCESS																
o Flow Rate, mgd																
- Main-Stream Influent		13.70	20.73		18.19	26.33		22.87	26.61		22.72	26.28				
- Recycle directly to AS		0.03	0.49		0.05	0.98		0.06	0.67		0.06	0.64				
- Total to Activated Sludge		13.73	21.22		18.24	27.31		22.93	27.28		22.78	26.92				
o Influent Characteristics, mg/L																
- Total BOD		102	161		151	195		159	204		159	205				
- TSS		62	116		92	159		105	171		102	165				
- VSS		53	99		78	134		89	144		86	140				
- NH3-N		28	21		27	27		27	28		27	28				
- Organic-N		7	9		8	11		9	12		9	12				
- NO3-N		2	0		1	1		1	1		1	1				
- Alkalinity		264	248		258	257		258	258		259	260				
- Filterable ("soluble") BOD		45	56		65	60		65	61		65	62				
- Fpv, VSS fraction		0.84	0.85		0.85	0.84		0.85	0.84		0.85	0.85				
- AB Influent D.O. Concentration, mg/L		0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0				
o Basin dimensions																
- Main Basins															**For MBR,**	MBR
-- No. of Basins	*	4	6		4	6		4	6		4	6			enter	0
-- Number of Units in Service	*	4	6		4	6		4	6		4	6			Basin	0
-- Length, ft (inside)	*	200	250		200	250		200	250		200	250			dimen.s	0
-- Width, ft (inside)	*	40	40		40	40		40	40		40	40			in the	0
-- Side Water Depth, ft	*	16.9	17.5		16.9	17.5		16.9	17.5		16.9	17.5			MBR	0
.. Recomm inside Wall height, incl. Freeboard, ft		19.9	20.5		19.9	20.5		19.9	20.5		19.9	20.5			section	3
-- Liquid Volume per Basin, mil gal		1.01	1.31		1.01	1.31		1.01	1.31		1.01	1.31			(not HERE)	0.00
- Supplemental Basins or Sections																
-- Identification	*														calcs	Membrn Zn
-- No. of Basins	*	0	0		0	0		0	0		0	0				0
-- Number of Units in Service	*	0	0		0	0		0	0		0	0			into	0
-- Length, ft (inside)	*	200	200		200	200		200	200		200	200			< - - these	0
-- Width, ft (inside)	*	100	100		100	100		100	100		100	100			columns	0
-- Side Water Depth, ft	*	17	17		17	17		17	17		17	17				0

* Input Data

CAROLLO ENGINEERS, PC

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Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity					
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined		Setup info	Basis
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0			
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4			
-- Volume per Basin, mil gal		2.54	2.54		2.54	2.54		2.54	2.54		2.54	2.54			0.00	
o Total Volume of Basins, mil gal																
- Total Basin volume in service		4.05	7.85		4.05	7.85		4.05	7.85		4.05	7.85				
-- Reduction for MBR cassettes		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00				
- Biological Reaction Volume		4.05	7.85		4.05	7.85		4.05	7.85		4.05	7.85				
o Aerated Zone BOD Loading, lb/1,000 cf-day		28.5	32.9		56.0	50.7		74.3	52.9		73.8	52.3				
o Hydraulic Detention Time, hr		7.07	8.88		5.32	6.90		4.23	6.91		4.26	7.00				
o Selected Operating L-P MLSS, mg/L		2,858	3,173		2,782	2,327		3,500	2,500		3,500	2,500				
PROCESS LAYOUT																
o Zone Sizes (Fraction of Total Volume)																Selected
- Zone 1	*	0.125	0.186		0.125	0.186		0.125	0.186		0.125	0.186		**For MBR,**	0.000	
- Zone 2	*	0.125	0.214		0.125	0.214		0.125	0.214		0.125	0.214		*Copy*	0.000	
- Zone 3	*	0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		*& Paste*	0.000	
- Zone 4	*	0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		these - - >	0.000	
- Zone 5	*	0.000	0.200		0.250	0.200		0.250	0.200		0.250	0.200		calcs into	0.000	
- Zone 6	*	0.330	0.200		0.250	0.200		0.250	0.200		0.250	0.200		< - - these	0.000	
- Zone 7 (by difference)		0.420	0.200		0.250	0.200		0.250	0.200		0.250	0.200		columns	0.000	
-- Total		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000			0.000	
o DO in each Zone (Unaerated, Set = 0), mg/L																
- Zone 1	*	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0		**For MBR,**	0.0	
- Zone 2	*	0.0	2.0		0.0	**2.5**		0.0	2.0		0.0	2.0		Adjust	2.0	
- Zone 3	*	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0		D.O. as	2.0	
- Zone 4	*	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0		needed,	2.0	
- Zone 5	*	2.0	2.0		2.0	**2.3**		2.5	2.0		2.5	2.0		**except** for	2.0	
- Zone 6	*	2.5	2.0		2.5	**2.0**		2.5	2.0		2.5	2.0		Zone 7	2.0	
- Zone 7	*	2.5	2.0		2.5	**2.0**		2.5	2.0		2.5	2.0		< - - copy	***0.0***	
o Aerated/Unaerated Fractions																
- Total Unaerated Volume Fraction		0.25	0.19		0.25	0.19		0.25	0.19		0.25	0.19				
-- Total Unaerated Volume, mil gal		1.01	1.46		1.01	1.46		1.01	1.46		1.01	1.46				
- Total Aerated Volume Fraction		0.75	0.81		0.75	0.81		0.75	0.81		0.75	0.81				
-- Total Aerated Volume, mil gal		3.03	6.39		3.03	6.39		3.03	6.39		3.03	6.39				
- Total Aerated Mass Fraction		0.75	0.81		0.75	0.81		0.75	0.81		0.75	0.81				
o Plant Influent Flow Routing																
- Fraction to Zone 1	*	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00				Default
- Fraction to Zone 2	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00				Default
- Fraction to Zone 3	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00				Default
- Fraction to Zone 4	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00				Default
- Fraction to Zone 5	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00				Default
- Remainder to Zone 6		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00				
o Return Sludge Routing																
- Fraction to Zone 1	*	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00				Default
- Fraction to Zone 2	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00				Default
- Remainder to Zone 3		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00				
o Mixed-Liquor Recirculation Routing																
- MLR Taken from Zone (3, 4, 5, 6, 7)	*	7	7		7	7		7	7		7	7				Default
- MLR Returned to Zone (1, 2, 3, 4, 5)	*	1	1		1	1		1	1		1	1				Default
- MLR Flow, mgd		40.00	44.00		40.00	44.00		40.00	44.00		40.00	44.00				
- MLR Ratio		2.91	2.07		2.19	1.61		1.74	1.61		1.76	1.63				
o Sludge Wasting Method														**For MBR,**		
- Wasting from RAS (1) or ML (0)	*	1	1		1	1		1	1		1	1		< - - copy	***0***	Default
-- If ML, Waste taken from Zone # (1, 2, - - 7)	*	(RAS)	(RAS)		(RAS)	(RAS)		(RAS)	(RAS)		(RAS)	(RAS)		< - - copy	***7***	Default
LOADING CRITERIA																
o BOD Applied, lb/d																
- Total Influent		11,692	28,475		23,025	44,442		30,479	46,492		30,273	45,946				
- (-) WAS Recycled		139	341		293	1,113		339	1,277		339	1,220				
- Net BOD Load		11,553	28,134		22,732	43,330		30,140	45,215		29,933	44,726				
o MLSS under aeration, lb		72,332	169,267		70,375	123,943		88,531	133,144		88,535	133,162				
- F/M, lb BOD Appl./lb MLSS-day		0.16	0.17		0.32	0.35		0.34	0.34		0.34	0.34				
o Organic Loading, Based on Aerated Zone																
- Aerated Volume in Service, 1,000 cf		406	855		406	855		406	855		406	855				

* Input Data

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
PROJECT: REGIONAL WATER QUALITY CONTROL PLANT -
SUBJECT: PROCESS ANALYSIS AND MASS BALANCE

Calc by: CFP,NV | Date Time: 10/12/2006 9:03 AM | Chk by/Date | FileName: Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity			Setup	Basis
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	info	
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
- Aer. BOD Loading, lb BOD/1000 cf-day		28.5	32.9		56.0	50.7		74.3	52.9		73.8	52.3			
o Unaerated Zone															
- Actual HRT (Throughflow), hr		0.39	0.44		0.35	0.42		0.34	0.44		0.35	0.44			
- Mixing Power, total															
-- Total BHP, all Unaerated Zones	*	35.4	51.1		35.4	51.1		35.4	51.1		35.4	51.1			
-- Mixing, hp/mil gal		35	35		35	35		35	35		35	35			
ACTIVATED SLUDGE - ZONE 1		Un-Aer	Un-Aer		Un-Aer	Un-Aer		Un-Aer	Un-Aer		Un-Aer	Un-Aer			
o Zone Volume, mil gal	1	0.506	1.461		0.506	1.461		0.506	1.461		0.506	1.461			
o Flows Entering, mgd	1														
- Plant Influent Flow	1	13.73	21.22		18.24	27.31		22.93	27.28		22.78	26.92			
- RAS Stream	1	8.59	15.05		10.97	12.48		7.62	8.62		7.57	8.51			
- ML Recirculation	1	40.00	44.00		40.00	44.00		40.00	44.00		40.00	44.00			
- Total Flow to this Zone	1	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o ML Flow removed from this Zone, mgd	1														
- ML Recirculated to Other Zones	1	n/a	n/a		n/a	n/a		n/a	n/a		n/a	n/a			
- ML Wasted from this Zone	1	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Other ML Flow removed from this Zone	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Net ML Flow to Next Zone, mgd	1	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o HRT in this Zone	1														
- Hydraulic Detention time, Actual, hr	1	0.19	0.44		0.18	0.42		0.17	0.44		0.17	0.44			
o Effluent from this Zone	1														
-- MLSS, mg/L	1	2,859	3,174		2,779	2,318		3,495	2,490		3,496	2,491			
-- NH3-N, mg/L	1	6.04	5.55		7.04	9.07		8.69	9.60		8.73	9.62			
-- NO3-N, mg/L	1	12.83	0.75		3.92	1.89		2.11	1.15		2.27	1.43			
-- D.O., mg/L	1	0.01	0.00		0.01	0.00		0.01	0.00		0.01	0.00			
o Biological Growth Summary	1														
- Increase in VSS, lb/d	1	1,427	2,313		2,919	3,946		3,703	3,851		3,710	3,871			
- Increase in ISS, lb/d	1	131	230		259	382		327	378		327	377			
ACTIVATED SLUDGE - ZONE 2		Un-Aer	Aerated		Un-Aer	Aerated		Un-Aer	Aerated		Un-Aer	Aerated			
o Zone Volume, mil gal	2	0.506	1.681		0.506	1.681		0.506	1.681		0.506	1.681			
o Flows Entering, mgd	2														
- Throughflow	2	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
- Plant Influent to this Zone	2	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- RAS Stream	2	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- ML Recirculation	2	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Total Flow to this Zone	2	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o ML Flow removed from this Zone, mgd	2														
- ML Recirculated to Other Zones	2	n/a	n/a		n/a	n/a		n/a	n/a		n/a	n/a			
- ML Wasted from this Zone	2	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Other ML Flow removed from this Zone	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Net ML Flow to Next Zone, mgd	2	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o HRT in this Zone	2														
- Hydraulic Detention time, Actual, hr	2	0.19	0.50		0.18	0.48		0.17	0.50		0.17	0.51			
o Effluent from this Zone	2														
-- MLSS, mg/L	2	2,859	3,175		2,779	2,322		3,496	2,494		3,496	2,494			
-- NH3-N, mg/L	2	6.22	1.86		7.22	6.09		8.91	6.44		8.94	6.33			
-- NO3-N, mg/L	2	11.92	3.93		2.57	4.12		0.60	3.46		0.74	3.89			
-- D.O., mg/L	2	0.00	2.00		0.00	2.50		0.00	2.00		0.00	2.00			
o Biological Growth Summary	2														
- Increase in VSS, lb/d	2	-72	574		284	2,033		199	2,067		209	1,976			
- Increase in ISS, lb/d	2	1	252		36	463		35	486		35	469			
ACTIVATED SLUDGE - ZONE 3		N.I.S.	N.I.S.		N.I.S.	N.I.S.		N.I.S.	N.I.S.		N.I.S.	N.I.S.			
o Zone Volume, mil gal	3	0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000			
o Flows Entering, mgd	3														
- Throughflow	3	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
- Plant Influent to this Zone	3	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- RAS Stream	3	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- ML Recirculation	3	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			

* Input Data

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
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Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity				
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Setup info	Basis
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
- Total Flow to this Zone	3	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o ML Flow removed from this Zone, mgd	3														
- ML Recirculated to Other Zones	3	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- ML Wasted from this Zone	3	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Other ML Flow removed from this Zone	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Net ML Flow to Next Zone, mgd	3	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o HRT in this Zone	3														
- Hydraulic Detention time, Actual, hr	3	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
o Effluent from this Zone	3														
-- MLSS, mg/L	3	2,859	3,175		2,779	2,322		3,496	2,494		3,496	2,494			
-- NH3-N, mg/L	3	6.22	1.86		7.22	6.09		8.91	6.44		8.94	6.33			
-- NO3-N, mg/L	3	11.92	3.93		2.57	4.12		0.60	3.46		0.74	3.89			
-- D.O., mg/L	3	0.00	2.00		0.00	2.50		0.00	2.00		0.00	2.00			
o Biological Growth Summary	3														
- Increase in VSS, lb/d	3	0	0		0	0		0	0		0	0			
- Increase in ISS, lb/d	3	0	0		0	0		0	0		0	0			
ACTIVATED SLUDGE - ZONE 4		N.I.S.	N.I.S.		N.I.S.	N.I.S.		N.I.S.	N.I.S.		N.I.S.	N.I.S.			
o Zone Volume, mil gal	4	0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000			
o Flows Entering, mgd	4														
- Throughflow	4	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
- Plant Influent to this Zone	4	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- ML Recirculation	4	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Total Flow to this Zone	4	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o ML Flow removed from this Zone, mgd	4														
- ML Recirculated to Other Zones	4	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- ML Wasted from this Zone	4	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Other ML Flow removed from this Zone	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Net ML Flow to Next Zone, mgd	4	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o HRT in this Zone	4														
- Hydraulic Detention time, Actual, hr	4	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
o Effluent from this Zone	4														
-- MLSS, mg/L	4	2,859	3,175		2,779	2,322		3,496	2,494		3,496	2,494			
-- NH3-N, mg/L	4	6.22	1.86		7.22	6.09		8.91	6.44		8.94	6.33			
-- NO3-N, mg/L	4	11.92	3.93		2.57	4.12		0.60	3.46		0.74	3.89			
-- D.O., mg/L	4	0.00	2.00		0.00	2.50		0.00	2.00		0.00	2.00			
o Biological Growth Summary	4														
- Increase in VSS, lb/d	4	0	0		0	0		0	0		0	0			
- Increase in ISS, lb/d	4	0	0		0	0		0	0		0	0			
ACTIVATED SLUDGE - ZONE 5		N.I.S.	Aerated		Aerated	Aerated		Aerated	Aerated		Aerated	Aerated			
o Zone Volume, mil ga	5	0.000	1.571		1.011	1.571		1.011	1.571		1.011	1.571			
o Flows Entering, mgc	5														
- Throughflow	5	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
- Plant Influent to this Zone	5	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- ML Recirculation	5	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Total Flow to this Zone	5	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o ML Flow removed from this Zone, mgd	5														
- ML Recirculated to Other Zones	5	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- ML Wasted from this Zone	5	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Other ML Flow removed from this Zone	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Net ML Flow to Next Zone, mgd	5	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o HRT in this Zone	5														
- Hydraulic Detention time, Actual, h	5	0.00	0.47		0.35	0.45		0.34	0.47		0.35	0.47			
o Effluent from this Zone	5														
-- MLSS, mg/L	5	2,859	3,175		2,781	2,324		3,498	2,496		3,498	2,497			
-- NH3-N, mg/L	5	6.22	0.34		3.92	3.61		4.92	3.79		4.84	3.59			
-- NO3-N, mg/L	5	11.92	5.23		5.41	6.06		3.97	5.49		4.24	6.03			
-- D.O., mg/L	5	0.00	2.00		2.00	2.25		2.50	2.00		2.50	2.00			
o Biological Growth Summary	5														
- Increase in VSS, lb/d	5	0	-187		501	1,322		839	1,395		786	1,292			
- Increase in ISS, lb/d	5	0	162		202	370		288	393		278	375			

* Input Data

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Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity			Setup	Basis
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	info	
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
ACTIVATED SLUDGE - ZONE 6		Aerated	Aerated		Aerated	Aerated		Aerated	Aerated		Aerated	Aerated			
o Zone Volume, mil ga	6	1.335	1.571		1.011	1.571		1.011	1.571		1.011	1.571			
o Flows Entering, mgc	6														
- Throughflow	6	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
- Plant Influent to this Zone	6	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Total Flow to this Zone	6	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o ML Flow removed from this Zone, mgd	6														
- ML Recirculated to Other Zones	6	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- ML Wasted from this Zone	6	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Other ML Flow removed from this Zone	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Net ML Flow to Next Zone, mgd	6	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o HRT in this Zone	6														
- Hydraulic Detention time, Actual, h	6	0.51	0.47		0.35	0.45		0.34	0.47		0.35	0.47			
o Effluent from this Zone	6														
-- MLSS, mg/L	6	2,860	3,175		2,782	2,326		3,499	2,499		3,499	2,499			
-- NH3-N, mg/L	6	0.90	0.07		1.34	1.61		1.72	1.63		1.61	1.43			
-- NO3-N, mg/L	6	16.90	5.45		7.67	7.63		6.70	7.17		7.02	7.75			
-- D.O., mg/L	6	2.50	2.00		2.50	2.00		2.50	2.00		2.50	2.00			
o Biological Growth Summary	6														
- Increase in VSS, lb/d	6	-24	-696		346	994		664	1,058		600	935			
- Increase in ISS, lb/d	6	107	100		181	327		262	348		252	328			
ACTIVATED SLUDGE - ZONE 7		Aerated	Aerated		Aerated	Aerated		Aerated	Aerated		Aerated	Aerated			
o Zone Volume, mil gal	7	1.699	1.571		1.011	1.571		1.011	1.571		1.011	1.571			
o Flows Entering, mgd	7														
- Throughflow	7	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
- (-) Removed as MBR Filtrate [Note]	7	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Total Flow to this Zone	7	62.31	80.28		69.21	83.80		70.55	79.91		70.35	79.43			
o ML Flow removed from this Zone (excl.MBR Filtr)	7														
- ML Recirculated to Other Zones	7	40.00	44.00		40.00	44.00		40.00	44.00		40.00	44.00			
- ML Wasted from this Zone	7	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Other ML Flow removed from this Zone	*	0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
- Net Flow to Next Zone, mgd	7	22.31	36.28		29.21	39.80		30.55	35.91		30.35	35.43			
o HRT in this Zone	7														
- Hydraulic Detention time, Actual, hr	7	0.65	0.47		0.35	0.45		0.34	0.47		0.35	0.47			
o Effluent from this Zone	7														
-- MLSS, mg/L	7	2,858	3,173		2,782	2,327		3,500	2,500		3,500	2,500			
-- NH3-N, mg/L	7	0.07	0.05		0.26	0.46		0.31	0.44		0.27	0.35			
-- NO3-N, mg/L	7	17.70	5.55		8.55	8.48		7.81	8.05		8.08	8.53			
-- D.O., mg/L	7	2.50	2.00		2.50	2.00		2.50	2.00		2.50	2.00			
o Biological Growth Summary	7														
- Increase in VSS, lb/d	7	-851	-1,070		30	632		285	664		208	517			
- Increase in ISS, lb/d	7	70	43		151	284		227	300		216	279			
WAS SOLIDS PRODUCTION															
o P-Removal															
- Include P-Removal in Calc? (Y=1, N=0)	*	0	0		0	0		0	0		0	0			
o Solids Production, TSS, lb/d															
- TSS Entering in Feed, lb/d		7,647	21,546		14,874	37,659		21,182	40,467		20,451	38,627			
- VSS Change in A.B. Zones		480	933		4,080	8,928		5,690	9,035		5,515	8,591			
- ISS Change in A.B. Zones		308	788		829	1,826		1,138	1,905		1,107	1,829			
- ISS due to Bio-P (Est.), lb/d		0	0		0	0		0	0		0	0			
- Unbiodeg VSS due to Bio-P (Est.), lb/d		0	0		0	0		0	0		0	0			
- Total Solids Production, lb/d		**8,435**	**23,267**		**19,784**	**48,413**		**28,009**	**51,407**		**27,073**	**49,046**			
MLSS CHARACTERISTICS															
o Mixed Liquor Components, mg TSS/L															
- Solids, mg TSS/L															
-- Slowly Biodegradable		14	14		29	31		40	32		39	31			
-- Active Biomass		832	939		1,217	992		1,513	1,049		1,515	1,049			
-- Endogenous Biomass		485	435		252	140		277	149		287	156			
-- Nitrifiers		63	33		51	27		58	28		60	29			
-- Unbiodegradable VSS (Influent + Bio-P)		991	1,239		832	803		1,094	881		1,089	881			

* Input Data

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
PROJECT: REGIONAL WATER QUALITY CONTROL PLANT -
SUBJECT: PROCESS ANALYSIS AND MASS BALANCE

Calc by: CFP,NV | Date: 10/12/2006 | Time: 9:03 AM | Chk by/Date | FileName: Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity			Setup	Basis
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	info	
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
-- Inorganic SS (influent + Biogrowth)		482	534		409	358		526	388		519	382			
-- Inorganic SS due to Bio-P (est.)		0	0		0	0		0	0		0	0			
-- Total Last-Pass MLSS		2,867	3,194		2,790	2,351		3,509	2,527		3,509	2,527			
-- Total Soluble Organic N (SolOrgN)		2.2	2.0		2.3	2.4		2.3	2.4		2.3	2.3			
-- Alkalinity, mg/L as CaCO3		109.3	154.7		134.3	134.9		137.1	136.3		136.0	134.2			
o Org N fraction of MLVSS (NinVSS)		0.080	0.079		0.082	0.082		0.081	0.082		0.081	0.081			
o MLVSS Fraction		0.83	0.83		0.85	0.85		0.85	0.85		0.85	0.85			
o BOD of AS Solids															
- BOD/TSS ratio		0.23	0.22		0.34	0.33		0.34	0.32		0.34	0.32			
SOLIDS RETENTION TIME, SRT															
o Total Solids Wasted, lb/d		8,435	23,267		19,784	48,413		28,009	51,407		27,073	49,046			
- Recycled WAS Solids, lb/d		254	1,522		379	3,328		481	3,879		474	3,715			
- Net lb Solids Yield/day		8,182	21,745		19,404	45,085		27,529	47,528		26,599	45,331			
o Total BOD Load, lb/d		11,553	28,134		22,732	43,330		30,140	45,215		29,933	44,726			
- Recycled BOD, lb/d		139	341		293	1,113		339	1,277		339	1,220			
- Net BOD Load, lb/d		11,414	27,793		22,439	42,217		29,801	43,938		29,594	43,506			
o Solids Production															
- lb Dry SS/lb BOD Applied		0.717	0.782		0.865	1.068		0.924	1.082		0.899	1.042			
o Total Mass TSS in System, lb		96,448	207,940		93,814	152,184		118,013	163,480		118,019	163,507			
- **Total SRT (Rs), days**		**11.79**	**9.56**		**4.83**	**3.38**		**4.29**	**3.44**		**4.44**	**3.61**			
o Total Mass TSS in Aerated Zones, lb		72,332	169,267		70,375	123,943		88,531	133,144		88,535	133,162			
- Nominal Aerated Mass Fraction		0.750	0.814		0.750	0.814		0.750	0.814		0.750	0.814			
- **Nominal Aerobic SRT, days**		**8.84**	**7.78**		**3.63**	**2.75**		**3.22**	**2.80**		**3.33**	**2.94**			
o Mass Fraction in Each Zone															
- Zone 1		0.125	0.186		0.125	0.186		0.125	0.186		0.125	0.186			
- Zone 2		0.125	0.214		0.125	0.214		0.125	0.214		0.125	0.214			
- Zone 3		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000			
- Zone 4		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000			
- Zone 5		0.000	0.200		0.250	0.200		0.250	0.200		0.250	0.200			
- Zone 6		0.330	0.200		0.250	0.200		0.250	0.200		0.250	0.200			
- Zone 7		0.420	0.200		0.250	0.200		0.250	0.200		0.250	0.200			
		1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000			
o Min. Aer. SRT recommended for nitrification, days		3.1	3.1		4.2	4.2		4.1	4.2		4.1	4.2			
- Washout SRT(total)															
-- Rwashout = 1/(Ua*DOsw - ba)		1.48	1.38		2.26	2.04		2.24	2.07		2.24	2.07			
- Recommended Aerobic SRT															
-- Max slope criterion, dNH3/dSRT, mg/L-d	*	0.20	0.20		0.20	0.20		0.20	0.20		0.20	0.20			
-- Recomm. Min. Operating SRT(total)		4.1	3.9		5.6	5.1		5.5	5.2		5.5	5.2			
-- Recomm. Min. Operating SRT(Nominal aerobic)		3.1	3.1		4.2	4.2		4.1	4.2		4.1	4.2			
-- Nitrification Safety Factor		2.74	2.79		2.46	2.52		2.47	2.51		2.47	2.51			
AERATION REQUIREMENTS															
o Oxygen Required, lb/d															
- Net Oxygen Demand in Zone 1		0	0		0	0		0	0		0	0			
- Net Oxygen Demand in Zone 2		0	19,045		0	18,275		0	18,313		0	18,539			
- Net Oxygen Demand in Zone 3		0	0		0	0		0	0		0	0			
- Net Oxygen Demand in Zone 4		0	0		0	0		0	0		0	0			
- Net Oxygen Demand in Zone 5		0	11,055		14,265	14,291		17,842	15,001		18,050	15,133			
- Net Oxygen Demand in Zone 6		17,838	7,599		11,744	12,862		14,534	13,613		14,557	13,498			
- Net Oxygen Demand in Zone 7		8,219	6,792		7,815	10,508		10,159	10,907		9,923	10,465			
- (-) Oxygen provided by MBR Scouring		0	0		0	0		0	0		0	0			
- Total Oxygen required lb/d		**26,058**	**44,490**		**33,824**	**55,936**		**42,535**	**57,834**		**42,530**	**57,635**			
o Diffuser Analysis		**26,058**	**44,490**		**33,964**	**56,243**		**42,715**	**58,144**						
Note:															
All values of air and blower requirements given below are preliminary estimates, to be refined during detailed design															
o Oxygen Transfer Efficiency		[EDI]	[EDI]		[EDI]	[EDI]		[EDI]	[EDI]		[EDI]	[EDI]			
- Diffuser Type		Mini-Panel	Mini-Panel		Mini-Panel	Mini-Panel		Mini-Panel	Mini-Panel		Mini-Panel	Mini-Panel			

* Input Data

CAROLLO ENGINEERS, PC

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Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity				
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Setup info	Basis
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
- Aeration Basin D.O. (Avg), mg/L		2.5	2.0		2.3	2.2		2.5	2.0		2.5	2.0			
- Design Water Temperature, C		29	29		29	29		29	29		29	29			Summer
- Diffuser submergence, ft		15.9	16.5		15.9	16.5		15.9	16.5		15.9	16.5			
- Air loading, scfm/unit [Note]		1.00	1.00		1.25	1.25		1.25	1.25		1.25	1.25			
		scfm/sf	scfm/sf		scfm/sf	scfm/sf		scfm/sf	scfm/sf		scfm/sf	scfm/sf			
- Floor Coverage		25.5	20.9		34.6	28.8		46.8	28.8		46.5	28.5			
		%Actv A	%Actv A		%Actv A	%Actv A		%Actv A	%Actv A		%Actv A	%Actv A			
- Clean Water SOTE	*	37.0	37.9		36.2	37.1		36.2	37.1		36.2	37.1			Mfr. lit.
- Site Conditions Adjustment Factor															
F = Actual / Standard OTE															
-- Alpha factor, including fouling		0.63	0.59		0.48	0.45		0.46	0.45		0.46	0.45			Estimate
-- Theta factor	*	1.024	1.024		1.024	1.024		1.024	1.024		1.024	1.024			Default
-- Temp. correction, Tau		0.85	0.85		0.85	0.85		0.85	0.85		0.85	0.85			
-- Elevation above MSL, ft	*	695	695		695	695		695	695		695	695			Site
-- ..Pressure correction, Omega		0.97	0.97		0.97	0.97		0.97	0.97		0.97	0.97			
-- Beta factor	*	0.99	0.99		0.99	0.99		0.99	0.99		0.99	0.99			Default
-- Equilibrium C*20		10.64	10.70		10.64	10.70		10.64	10.70		10.64	10.70			
..Depth Adjustment Factor	*	0.37	0.37		0.37	0.37		0.37	0.37		0.37	0.37			Default
- F = Alpha x [Theta ^(T-20)]		0.46	0.46		0.36	0.34		0.33	0.35		0.33	0.35			
x (Tau Beta Omega C*20 - C)/C*20															
- Oxygen Transfer Efficiency		16.87	17.26		12.88	12.61		11.99	13.02		12.07	13.13			
OTE = F x SOTE		Percent	Percent		Percent	Percent		Percent	Percent		Percent	Percent			
Preliminary Estimate															
o Surface Aerators		#N/A	#N/A		#N/A	#N/A		#N/A	#N/A		#N/A	#N/A			
- Oxygen to be transferred, lb/hr															
- Aerator hp required															
[Ox. Requ.d/Eff.]															
- Peaking factor	*														
- Aerator hp Installed															
o SOTR Required															
- Average Day @ Design flow															
-- Actual Ox Tr Requd, AOTR, lb/d		26,058	44,490		33,824	55,936		42,535	57,834		42,530	57,635			
-- Site Conditions Adjustment, F		0.46	0.46		0.36	0.34		0.33	0.35		0.33	0.35			
-- Standard Ox Tr Rate, SOTR, lb/d		57,121	97,615		95,143	164,624		128,551	164,819		127,639	162,921			
SOTR = AOTR / F															
o Air Supply Required															
- Average Day @ Design flow															
-- Ox Transfer Rate, AOTR, lb/d		26,058	44,490		33,824	55,936		42,535	57,834		42,530	57,635			
-- Oxygen Supplied, lb/min		107.2	179.0		182.4	308.1		246.4	308.4		244.6	304.9			
-- cf Air/lb Oxygen		57.0	57.0		57.0	57.0		57.0	57.0		57.0	57.0			
[23.3 lb O2/100 lb Air]															
[0.0753 lb Air/scf]															
-- Process Air, scfm		6,110	10,200		10,390	17,560		14,040	17,580		13,940	17,380			
..scfm per lb/d Oxygen		0.234	0.229		0.307	0.314		0.330	0.304		0.328	0.302			
..scf/lb BOD Applied		762	522		658	584		671	560		671	560			
-- Other Uses, e.g. Channel Air	*	800	1,100		1,100	1,200		1,200	1,200		1,200	1,200			Default
-- Total Blower Air, scfm		6,910	11,300		11,490	18,760		15,240	18,780		15,140	18,580			
- Peak Day @ Design Flow															
-- Peaking factor	*	1.3	1.3		1.3	1.3		1.3	1.3		1.3	1.3			Default
-- Process Air, scfm		7,900	13,300		13,500	22,800		18,300	22,900		18,100	22,600			
-- Total Blower Air, scfm		8,700	14,400		14,600	24,000		19,500	24,100		19,300	23,800			
o Diffusers															
- Expressed as active sq ft or # diffusers		sq ft	sq ft		sq ft	sq ft		sq ft	sq ft		sq ft	sq ft			
- Recommended															
-- Air Loading, scfm/(sf or dfr)		1.00	1.00		1.25	1.25		1.25	1.25		1.25	1.25			
-- Number recommended per Basin		1,528	1,701		2,079	2,341		2,809	2,344		2,789	2,317			
- Actual Installed, per basin															
-- Main Basin	*	1,528	1,701		2,079	2,341		2,809	2,344		2,789	2,317			
-- Additional Basin	*	0	0		0	0		0	0		0	0			
- Total Installed, sf or dfr		6,112	10,203		8,315	14,047		11,235	14,063		11,155	13,902			
- Air Loading, scfm/sf or dfr															
-- Daily Average		1.00	1.00		1.25	1.25		1.25	1.25		1.25	1.25			

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		Calibration			Design Capacity			Design Capacity			Design Capacity				
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Setup info	Basis
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
- Floor Coverage															
-- Total Basin Floor Area in Service, sf		32,000	60,000		32,000	60,000		32,000	60,000		32,000	60,000			
-- Total Aerated Floor Area in service		24,000	48,840		24,000	48,840		24,000	48,840		24,000	48,840			
-- Coverage		25.5	20.9		34.6	28.8		46.8	28.8		46.5	28.5			
.. Expressed as		%Actv A	%Actv A		%Actv A	%Actv A		%Actv A	%Actv A		%Actv A	%Actv A			
- Active sf/diffuser, or 1		2.54	2.54		2.54	2.54		2.54	2.54		2.54	2.54			
- Number of diffuser units		2,406	4,017		3,274	5,530		4,423	5,537		4,392	5,473			
o Blower Discharge pressure															
- Head, ft water															
-- Submergence		15.9	16.5		15.9	16.5		15.9	16.5		15.9	16.5			
-- Freeboard above normal op level		0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0			
-- Diffuser head loss		1.5	1.5		1.5	1.5		1.5	1.5		1.5	1.5			
-- Pipe & Valve friction		2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5			
-- Total Head, ft		19.9	20.5		19.9	20.5		19.9	20.5		19.9	20.5			
- Discharge pressure, psig		8.6	8.9		8.6	8.9		8.6	8.9		8.6	8.9			
o Delivered Horsepower															
- Max Operating Air Temp, C	*	34	34		34	34		34	34		34	34			Default
- Barometric Pressure, psia		14.3	14.3		14.3	14.3		14.3	14.3		14.3	14.3			
- Blower Suction Pressure, psia		14.0	14.0		14.0	14.0		14.0	14.0		14.0	14.0			
- Daily Average Total Air, scfm		6,910	11,300		11,490	18,760		15,240	18,780		15,140	18,580			
- Avg Delivered Horsepower, hp		245	411		408	682		541	683		537	676			
- Peak Day Delivered hp		309	524		518	873		692	876		685	865			
o Wire power required															
- Energy Efficiency, %	*	61.0	61.0		61.0	61.0		61.0	61.0		61.0	61.0			Default
- Wire power required, hp															
-- Daily Average		400	670		670	1,120		890	1,120		880	1,110			
-- Firm Installed		510	860		850	1,430		1,130	1,440		1,120	1,420			
SECONDARY SEDIMENTATION BASINS															
o Flow Rates, mgd															
- AS Influent, Q		13.73	21.22		18.24	27.31		22.93	27.28		22.78	26.92			
- Net Sed. Basin Inflow (excl. RAS), Qci		13.73	21.22		18.24	27.31		22.93	27.28		22.78	26.92			
- Return Sludge Flow, Qr		8.59	15.05		10.97	12.48		7.62	8.62		7.57	8.51			
(not including waste sludge flow)															
- Total Sed Basin Inflow		22.31	36.28		29.21	39.80		30.55	35.91		30.35	35.43			
- Total Sed. Basin Underflow		8.71	15.42		11.29	13.30		7.86	9.25		7.80	9.11			
- Net Sec. Effluent, Qe		13.60	20.86		17.92	26.49		22.69	26.66		22.55	26.33			
o Basin dimensions															
- Group 1	*														
-- No. of Basins	*	4	2		4	2		4	2		4	2			
-- Number of Units in Service	*	4	2		4	2		4	2		4	2			
-- Diameter, ft (inside)	*	0	130		0	130		0	130		0	130			
-- Side Water Depth, ft	*	11.9	14.0		11.9	14.0		11.9	14.0		11.9	14.0			
-- Surface Area per Basin, sf		8,800	13,273		8,800	13,273		8,800	13,273		8,800	13,273			
-- Volume per Basin, cf		104,720	185,825		104,720	185,825		104,720	185,825		104,720	185,825			
- Group 2	*														
-- No. of Basins	*	0	2		0	2		0	2		0	2			
-- Number of Units in Service	*	0	2		0	2		0	2		0	2			
-- Diameter, ft (inside)	*	120	100		120	100		120	100		120	100			
-- Side Water Depth, ft	*	14.0	10.3		14.0	10.3		14.0	10.3		14.0	10.3			
-- Surface Area per Basin, sf		11,310	7,854		11,310	7,854		11,310	7,854		11,310	7,854			
-- Volume per Basin, cf		158,336	80,503		158,336	80,503		158,336	80,503		158,336	80,503			
o Flow Split															
- Fraction of ML Flow to Group 1:															
-- Fraction based on Surface Area		1.00	0.63		1.00	0.63		1.00	0.63		1.00	0.63			
-- Fraction selected	*	1.00	0.63		1.00	0.63		1.00	0.63		1.00	0.63			
- Effective (Flow-weighted) SWD, ft		11.90	12.61		11.90	12.61		11.90	12.61		11.90	12.61			
o Surface Overflow Rate															
- Group 1															
-- Surface Area in service, sf		35,200	26,546		35,200	26,546		35,200	26,546		35,200	26,546			
-- Surface Overflow Rate, gpd/sf		386	494		509	627		645	631		641	623			
- Group 2															

* Input Data

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
PROJECT: REGIONAL WATER QUALITY CONTROL PLANT -
SUBJECT: PROCESS ANALYSIS AND MASS BALANCE

Calc by: CFP,NV | Date: 10/12/2006 | Time: 9:03 AM | Chk by/Date | FileName: Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity				
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Setup info	Basis
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
-- Surface Area in service, sf		0	15,708		0	15,708		0	15,708		0	15,708			
-- Surface Overflow Rate, gpd/sf		0	494		0	627		0	631		0	623			
o Solids Loading Rate, lb/day-sf															
- Group 1		15	23		19	18		25	18		25	17			
- Group 2		0	23		0	18		0	18		0	17			
o Volume in service, mil gal															
- Group 1		3.13	2.78		3.13	2.78		3.13	2.78		3.13	2.78			
- Group 2		0.00	1.20		0.00	1.20		0.00	1.20		0.00	1.20			
o Hydraulic Detention Time, hr (based on Q)															
- Group 1		5.5	5.0		4.1	3.9		3.3	3.9		3.3	3.9			
- Group 2		N.A.	3.7		N.A.	2.8		N.A.	2.9		N.A.	2.9			
o Weir Loading															
- Group 1															
-- Actual weir length per unit, ft	*	425	745		560	745		709	745		705	745			Default
-- Weir loading, gpd/ft		8,000	8,801		8,000	11,177		8,000	11,246		8,000	11,107			
- Group 2															
-- Actual weir length per unit, ft	*	0	556		0	556		0	556		0	556			Default
-- Weir loading, gpd/ft		0	6,973		0	8,856		0	8,910		0	8,800			
o Sludge Settling Characteristics															
- Design Max. SVI, ml/g	*	150	150		150	150		150	150		150	150			Default
ISV = a x exp(-b MLSS), ft/h															
- "a" Value, ft/hr	*	19.0	19.0		19.0	19.0		21.3	21.3		21.3	21.3			
- "b" Value [x 1,000,000]	*	430	430		430	430		218	218		218	218			
o Target Settling Values															
- Effluent rise rate (SOR), ft/hr															
-- Group 1		2.15	2.75		2.84	3.49		3.59	3.51		3.57	3.47			
-- Group 2		N.A.	2.75		N.A.	3.49		N.A.	3.51		N.A.	3.47			
-- Average		2.15	2.75		2.84	3.49		3.59	3.51		3.57	3.47			
- Clarifier Safety Factor, CSF	*	2.3	2.2		2.0	2.0		2.0	2.0		2.0	2.0			Default
- Initial Settling Velocity, ISV, ft/hr		5.0	6.1		5.7	7.0		7.2	7.0		7.1	6.9			
- Preferred Max. Last-Pass MLSS, mg/L		3,100	2,660		2,782	2,327		4,987	5,086		5,016	5,143			
o Selected Settling Values															
- Operating L-P MLSS conc, mg/L		2,858	3,173		2,782	2,327		3,500	2,500		3,500	2,500			
- Operating ISV, ft/h		5.6	4.9		5.7	7.0		9.9	12.4		9.9	12.4			
- Operating CSF															
-- Group 1		2.6	1.8		2.0	2.0		2.8	2.8		2.8	2.9			
-- Group 2		N.A.	1.8		N.A.	2.0		N.A.	2.8		N.A.	2.9			
SLUDGE RETURN AND WASTAGE															
o Wasting Method (see Process Layout)															
- Waste Flow from RAS, Qw		0.129	0.363		0.317	0.820		0.239	0.625		0.230	0.594			
- Waste Flow from MLSS, Zone 7, Qmw		0.00	0.00		0.00	0.00		0.00	0.00		0.00	0.00			
o Return Sludge															
- Qr/Q, fraction	*	0.63	0.71		0.60	0.46		0.33	0.32		0.33	0.32			
- RAS flow to Aer Basin, Qr, mgd Average		8.59	15.05		10.97	12.48		7.62	8.62		7.57	8.51			
- RAS concentration, mg/L		7,310	7,462		7,190	6,954		13,590	9,693		13,602	9,717			
o Sludge Wastage															
- Total Solids Wasted, lb/d		8,435	23,267		19,784	48,413		28,009	51,407		27,073	49,046			
- Adjustment for ESS:															
-- Solids in Effluent, lb/d		567	696		747	884		946	889		940	878			
-- Solids in WAS, lb/d		7,868	22,571	30,439	19,036	47,529	66,566	27,063	50,518	77,581	26,132	48,167	74,300		
- Concentration, mg/L		7,310	7,462		7,190	6,954		13,590	9,693		13,602	9,717			
- Organic N, lb/d		524	1,493		1,332	3,313		1,866	3,505		1,805	3,344			
- Flow Rate, mgd Average		0.129	0.363	0.492	0.317	0.820	1.137	0.239	0.625	0.864	0.230	0.594	0.825		
o WAS Characteristics, mg/L															
- Wasting from -		RAS	RAS		RAS	RAS		RAS	RAS		RAS	RAS			
- BOD		1,658	1,646		2,427	2,291		4,558	3,137		4,560	3,132			
- TSS		7,310	7,462		7,190	6,954		13,590	9,693		13,602	9,717			
- VSS		6,082	6,214		6,136	5,896		11,551	8,205		11,589	8,249			
- NH3-N		0.1	0.1		0.3	0.5		0.3	0.4		0.3	0.3			
- Organic-N		486.7	493.5		503.1	484.6		937.0	672.6		939.6	674.5			
- NO3-N		17.7	5.6		8.5	8.5		7.8	8.0		8.1	8.5			

* Input Data

CAROLLO ENGINEERS, PC

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SUBJECT: PROCESS ANALYSIS AND MASS BALANCE

Calc by: CFP,NV | Date: 10/12/2006 | Time: 9:03 AM | Chk by/Date | FileName: Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity				
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Setup info	Basis
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
- Alkalinity		109	155		134	135		137	136		136	134			
- Filterable ("soluble") BOD		0.9	0.8		1.1	1.3		1.2	1.3		1.1	1.2			
- Total soluble Organic N		2.2	2.0		2.3	2.4		2.3	2.4		2.3	2.3			
o Recommended Installed Capacity															
- Return Sludge Pumps, gpm		9,530	15,250		12,660	18,950		15,910	18,930		15,810	18,680			
- WAS Pumps															
-- Wasting operation, hr/day	*	24	24	24	24	24	24	24	24	24	24	24	24		
-- Pump Capacity (2 x Qwas), gpm		180	510	690	450	1,140	1,580	340	870	1,200	320	830	1,150		
-- WAS Solids Peak Handling Capacity, lb/hr		660	1,890	2,540	1,590	3,970	5,550	2,260	4,210	6,470	2,180	4,020	6,200		
SECONDARY EFFLUENT															
o Flow Rate															
- Net Secondary Effluent, mgd		13.60	20.86	34.46	17.92	26.49	44.41	22.69	26.66	49.35	22.55	26.33	48.87		
o Secondary Effluent Quality															
- BOD, mg/L		2	2	2.0	3	3	3.0	3	3	3.0	3	3	3.0		Estimate
- TSS (nominal), mg/L	*	5	4	4.4	5	4	4.4	5	4	4.4	5	4	4.4		Default
- VSS, mg/L		4.2	3.3	3.7	4.3	3.4	3.7	4.2	3.4	3.7	4.3	3.4	3.7		
- NH3-N, mg/L		0.1	0.1	0.1	0.3	0.5	0.4	0.3	0.4	0.4	0.3	0.3	0.3		
- Total Organic N, mg/L		2.6	2.3	2.4	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6		
- NO3/NO2-N, mg/L		17.7	5.6	10.3	8.5	8.5	8.5	7.8	8.0	8.0	8.1	8.5	8.4		
- Alkalinity, mg/L		109	155	137	134	135	135	137	136	137	136	134	135		
- Soluble Organic N, mg/L		2.2	2.0	2.1	2.3	2.4	2.3	2.3	2.4	2.3	2.3	2.3	2.3		
- T.I.N., mg/L		17.8	5.6	10.4	8.8	8.9	8.9	8.1	8.5	8.3	8.4	8.9	8.7		
- Total N, mg/L		20.3	7.9	12.8	11.4	11.6	11.5	10.8	11.1	11.0	11.0	11.5	11.3		
TERTIARY FILTRATION				In Service			In Service			In Service			In Service		
o Tertiary Filtration in Service? (Y=1, N=0)	*			1			1			1			1		
o Influent															
- Flow, mgd															
-- Total				34.5			44.4			49.3			48.9		
- BOD, total, mg/L				2.0			3.0			3.0			3.0		
- SS, total, mg/L				4.4			4.4			4.4			4.4		
o Filter Area															
- Surface Area per Filter, sf	*			200			200			200			200		
- Backwash - Continuous (0) or Intermittent (1)?	*			0			0			0			0		
- Standby Units Provided	*			2			2			2			2		
- Number of Filters															
-- Existing	*			10			10			10			10		
-- New	*			0			0			0			0		
-- Total				10			10			10			10		
- Number of Units in Service				8			8			8			8		
o Filter Loading															
- Equalization provided? (Y=1, N=0)	*			1			1			1			1		
- Peaking factor	*			1.10			1.10			1.10			1.10		Default
- Surface Area in Service, sf				1,600			1,600			1,600			1,600		
- Loading rate, gpm/sf				16.4			21.2			23.5			23.3		
o Removal															
- SS Removal, %	*			70			70			70			70		Default
- SS removed, lb/d				884			1,140			1,266			1,254		
- BOD removed, lb/d				233			468			511			516		
o Backwash Flow															
- Percent of Flow, %	*			9			9			9			9		Cont BW
- Backwash Flow, mgd				3.10			4.00			4.44			4.40		
o Backwash Characteristics, mg/L															
- BOD				10			15			15			15		
- TSS				34			34			34			34		
- VSS				28			29			29			29		
- NH3-N				0.1			0.4			0.4			0.3		
- Organic-N				4			5			5			5		
- NO3-N				10.3			8.5			8.0			8.4		
- Alkalinity				137			135			137			135		
o Net Flow to Disinfection, mgd															

* Input Data

CAROLLO ENGINEERS, PC

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		Calibration			Design Capacity			Design Capacity			Design Capacity			Setup	Basis
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	info	
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
- Undisinfected Plant Water Used	*			0.00			0.00			0.00			0.00		
- To Disinfection				31.36			40.42			44.91			44.48		
o Tertiary Effluent Quality, mg/L															
- BOD				1.2			1.7			1.8			1.7		
- SS				1.3			1.3			1.3			1.3		
- VSS, mg/L				1.1			1.1			1.1			1.1		
- NH3-N, mg/L				0.1			0.4			0.4			0.3		
- Total Organic N, mg/L				2.2			2.4			2.4			2.4		
- NO3/NO2-N, mg/L				10.3			8.5			8.0			8.4		
- Alkalinity, mg/L				137			135			137			135		
- Filterable ("soluble") BOD				0.8			1.2			1.2			1.2		
- Soluble Organic N, mg/L				2.1			2.3			2.3			2.3		
- T.I.N., mg/L				10.4			8.9			8.3			8.7		
- Total N, mg/L				12.6			11.3			10.8			11.1		
CHLORINE CONTACT TANKS				In Service			In Service			In Service			In Service		
o Flow Rate, mgd				31.36			40.42			44.91			44.48		
- Peaking factor	*			1.1			1.1			1.1			1.1		
o Number of Tanks	*			2			2			2			2		
o Volume per Tank, mil gal	*			1.436			1.851			2.057			2.037		
o Detention Time @ peak, min.				120			120			120			120		
FINAL EFFLUENT															
o Flow Rate, mgd															
- Plant Water used	*			0.19			0.41			0.46			0.00		
- Final Effluent Flow				31.17			40.01			44.45			44.48		
RESIDUALS MANAGEMENT															
SOLIDS GENERATED															
o Total Primary Sludge															
- Flow, mgd			0.134	0.134		0.192	0.192		0.203	0.203		0.195	0.195		
- Solids, lb/d			38,971	38,971		55,911	55,911		59,153	59,153		56,967	56,967		
- Concentration, %			3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5		
- VSS, %			80	80		80	80		80	80		81	81		
- Organic N, lb/d			1,754	1,754		2,388	2,388		2,539	2,539		2,423	2,423		
o Total Waste Activated Sludge															
- Flow, mgd		0.129	0.363	0.492	0.317	0.820	1.137	0.239	0.625	0.864	0.230	0.594	0.825		
-- Recomm Installed Capacity, gpm		180	510	690	450	1,140	1,580	340	870	1,200	320	830	1,150		
- Solids, lb/d		7,868	22,571	30,439	19,036	47,529	66,566	27,063	50,518	77,581	26,132	48,167	74,300		
-- Recomm Installed Capacity, lb/hr		660	1,890	2,540	1,590	3,970	5,550	2,260	4,210	6,470	2,180	4,020	6,200		
- Concentration, mg/L		7,310	7,462	7,422	7,190	6,954	7,020	13,590	9,693	10,770	13,602	9,717	10,802		
- VSS, %		83	83	83	85	85	85	85	85	85	85	85	85		
- Organic N, lb/d		524	1,493	2,017	1,332	3,313	4,645	1,866	3,505	5,371	1,805	3,344	5,149		
- BOD/TSS ratio		0.23	0.22	0.22	0.34	0.33	0.33	0.34	0.32	0.33	0.34	0.32	0.33		
WAS THICKENING				In Service			In Service			In Service			In Service		
o Sludge Feed															
- Flow, mgd				0.492			1.137			0.864			0.825		
- Solids, lb/d				30,439			66,566			77,581			74,300		
- Concentration, mg/L				7,422			7,020			10,770			10,802		
- VSS, %				83			85			85			85		
- Organic N, lb/d				2,017			4,645			5,371			5,149		
- Solids BOD, lb/d				6,760			22,072			25,418			24,277		
- NH3-N, mg/L				0.1			0.4			0.4			0.3		
- NO3-N, mg/L				10.3			8.5			8.0			8.4		
- Alkalinity				137			135			137			135		
- Filterable ("soluble") BOD, mg/L				0.8			1.2			1.2			1.2		
- Soluble OrgN, mg/L				2.1			2.3			2.3			2.3		
-- N/VSS ratio for solids				0.080			0.082			0.082			0.082		
o Number of Units	*			2			2			2			2		
- Number of Units in Service	*			2			2			2			2		
- Diameter, ft	*			37			37			37			37		

* Input Data

CAROLLO ENGINEERS, PC

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		Calibration			Design Capacity			Design Capacity			Design Capacity			Setup	Basis
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	info	
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
- Effective Area in Service, sf				1,980			1,980			1,980			1,980		
- Operating cycle, hr/week	*			168			168			168			168		Default
o Hydraulic loading, gpm/sf				0.31			0.70			0.66			0.63		
o Solids Loading, lb/d-sf				15.4			33.6			39.2			37.5		
o Thickened Sludge															
- Solids Capture, %	*			95			95			95			95		
- Solids, lb/d				28,917			63,237			73,702			70,585		
- Percent Solids, %	*			5.7			3.5			3.5			3.5		
- Volume, mgd				0.061			0.217			0.252			0.242		
- Volatile Solids, lb/d				24,076			53,716			62,477			60,001		
- Organic N, lb/d				1,917			4,417			5,107			4,896		
o Underflow															
- Underflow solids, lb/d				1,522			3,328			3,879			3,715		
- Flow, mgd				0.431			0.920			0.611			0.583		
- Characteristics, mg/L															
-- BOD				95			145			251			251		
-- TSS				423			434			761			764		
-- VSS				353			368			645			650		
-- NH3-N				0.1			0.4			0.4			0.3		
-- Organic-N				28			30			52			52		
-- NO3-N				10.3			8.5			8.0			8.4		
-- Alkalinity				137			135			137			135		
ANAEROBIC DIGESTION				In Service			In Service			In Service			In Service		
o Digester Feed															
- Flow, total, mgd				0.194			0.408			0.455			0.437		
- Solids, total, lb/d				67,889			119,148			132,855			127,552		
- Volatile Solids, total, lb/d				55,396			98,595			109,922			105,937		
- Organic N, total, lb/d				3,671			6,805			7,647			7,319		
o Digester Size															
- Smaller Size Units															
-- Number	*			2			2			2			2		
-- Diameter, ft	*			90			90			90			90		
-- SWD, ft	*			32			32			32			32		
-- Volume per Digester, kcf				203.6			203.6			203.6			203.6		
- Larger Size Units															
-- Number	*			0			0			0			0		
-- Diameter, ft	*			70			70			70			70		
-- SWD, ft	*			25.5			25.5			25.5			25.5		
-- Volume per Digester, kcf				98.1			98.1			98.1			98.1		
- Gross Volume, kcf															
-- All Units in Service				407			407			407			407		
-- One Unit OOS				204			204			204			204		
- Allowance for grit, percent	*			5			5			5			5		
- Effective Volume, kcf															
-- All Units in Service				387			387			387			387		
-- One Unit OOS				193			193			193			193		
o Loading															
- VSS Loading, lb VSS/cf-d															
-- All Units in Service				0.143			0.255			0.284			0.274		
-- One Unit OOS				0.286			0.510			0.568			0.548		
- Detention Time, days															
-- All Units in Service				14.9			7.1			6.4			6.6		
-- One Unit OOS				7.4			3.5			3.2			3.3		
o Digested Sludge															
- VSS destruction, %	*			47			42			42			42		Default
- VSS destroyed, lb/d				26,054			41,771			45,736			44,193		
- Discharge Total Solids, lb/d				41,835			77,377			87,119			83,359		
-- TSS, %				2.58			2.27			2.30			2.29		
-- VSS, %				70.1			73.4			73.7			74.1		
o Gas Production															
- cf/lb VSS destroyed	*			15			15			15			15		Default

* Input Data

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
PROJECT: REGIONAL WATER QUALITY CONTROL PLANT -
SUBJECT: PROCESS ANALYSIS AND MASS BALANCE

Calc by: CFP,NV | Date: 10/12/2006 | Time: 9:03 AM | Chk by/Date | FileName: Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity			Setup	Basis
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	info	
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
- Gas Production, kcf/d				391			627			686			663		
o Nitrogen in Dig Sludge Filtrate															
- Assumed Sol OrgN in Digester effl, mg/L	*			5			5			5			5		
- Org N/VSS in Digester Solids				0.066			0.069			0.069			0.069		
- VSS destroyed, lb/d				26,054			41,771			45,736			44,193		
- Ammonia generated, lb/d				1,723			2,876			3,174			3,045		
- NH3 Concentration, mg/L				1,063			845			836			836		
- Alkalinity, mg/L				3,796			3,017			2,986			2,985		calc
DEWATERING (Belt Presses)				In Service			In Service			In Service			N.I.S.		
o Sludge Feed															
- Flow rate, mgd	*			0.194			0.408			0.455			0.437		
- Total Solids, lb/d	*			41,835			77,377			87,119			83,359		
- Total VSS, lb/d	*			29,342			56,824			64,186			61,743		
o Number of Belt Presses (2m)	*			3			3			3			0		
- Number of Units in Service	*			3			3			3			0		
- Feed Rate, gpm per unit	*			110			110			110			110		Default
- Operating cycle															
-- days/week	*			6			6			6			6		
-- hours/day (calc)				11.4			24.0			26.8			0.0		
o Sludge Cake															
- Capture, %	*			90			90			90			90		Default
- Concentration, %	*			16.15			14.23			13.86			13.87		Default
- Cake Solids, lb/d															
-- Dry Solids, lb/d				37,651			69,640			78,407			83,359		
-- Wet Cake, tons/d				116.6			244.6			282.8			N.I.S.		
- Flow, mgd				0.028			0.059			0.068			0.437		
o Filtrate															
- Filtrate Flow, mgd				0.166			0.350			0.387			0.000		
- Characteristics, mg/L															
-- BOD	*			700			700			700			700		Default
-- TSS	*			250			250			250			250		Default
-- VSS				175			184			184			185		
-- NH3-N				1,063			845			836			836		
-- Organic-N				17			18			18			18		
-- NO3-N				0			0			0			0		
-- Alkalinity				3,796			3,017			2,986			2,985		
o Wash Water															
- Wash water, mgd/mgd feed	*			1.00			1.00			1.00			1.00		Default
-- Wash Water flow, mgd				0.194			0.408			0.455			0.000		
- Solids in Wash Water															
-- Unrecovered Solids, lb/d				4,183			7,738			8,712			0		
-- Solids in Filtrate				347			729			808			0		
-- Solids in Wash Water, lb/d				3,837			7,009			7,904			0		
-- TSS in Wash Water, mg/L				2,367			2,059			2,082			0		
- Characteristics, mg/L															
-- BOD				2			3			3			3		

* Input Data

CAROLLO ENGINEERS, PC

W.O./CLIENT: 7472A.00 / CITY OF RIVERSIDE
PROJECT: REGIONAL WATER QUALITY CONTROL PLANT -
SUBJECT: PROCESS ANALYSIS AND MASS BALANCE

Calc by: CFP,NV | Date Time: 10/12/2006 9:03 AM | Chk by/Date | FileName: Recycle Mass Balance.xls

Biotran05 v.1106

		Calibration			Design Capacity			Design Capacity			Design Capacity			Setup	Basis
		Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	Plant 1	Plant 2	Combined	info	
Annual Average Plant Flow, mgd	*	11.0	20.1	31.1	16.0	20.0	36.0	20.0	20.0	40.0	20.0	20.0	40.0		
Design (Max-Month) Flow, mgd		11.0	20.1	31.1	17.8	22.2	40.0	22.2	22.2	44.4	22.2	22.2	44.4		
-- TSS				2,367			2,059			2,082			0		
-- VSS				1,660			1,512			1,534			0		
-- NH3-N				0.0			0.0			0.0			0.0		
-- Organic-N				112			106			109			2		
-- NO3-N				10.3			8.5			8.0			8.4		
-- Alkalinity				137			135			137			135		
-- Filterable ("soluble") BOD				0.8			1.2			1.2			1.2		
-- Total soluble Organic N				2.1			2.3			2.3			2.3		
o Combined Filtrate & Wash Water															
- Flow, mgd															
-- Filtrate				0.166			0.350			0.387			0.000		
-- Wash Water				0.194			0.408			0.455			0.000		
-- Total				0.361			0.758			0.842			0.000		
- Characteristics, mg/L															
-- BOD				324			325			323			0		
-- TSS				1,391			1,224			1,240			0		
-- VSS				975			899			914			0		
-- NH3-N				490			390			384			0		
-- Organic-N				68			65			67			0		
-- NO3-N				6			5			4			0		
-- Alkalinity				1,824			1,464			1,447			0		
-- Filterable ("soluble") BOD				33			33			33			0		
-- Total soluble Organic N				3.4			3.6			3.6			0.0		
CENTRIFUGE DEWATERING/THICKENING				N.I.S.			N.I.S.			N.I.S.			In Service		
o Application				Anaerobic Dig Dewat			Anaerobic Dig Dewat			Anaerobic Dig Dewat			Anaerobic Dig Dewat		
o Sludge Feed															
- Flow Rate, mgd				0.194			0.408			0.455			0.437		
- TSS, %				2.58			2.27			2.30			2.29		
- Solids, lb/d				41,835			77,377			87,119			83,359		
-- VSS fraction				0.70			0.73			0.74			0.74		
o Number of Centrifuges	*			0			0			0			3		
- Number of Units in Service				0			0			0			2		
- Feed Rate, gpm per unit	*			125			125			125			250		
- Operating cycle															
-- days/week	*			6			6			6			6		
-- hours/day (calc)				0.0			0.0			0.0			17.0		
o Chemical Dose															
- Ferric chloride, lb/ton	*			0			0			0			0		
- Ferric chloride, lb/day				0			0			0			0		
- Polymer, lb/ton	*			16			16			16			16		
- Polymer, lb/day				324			600			675			646		
- Chemical Sludge generated, lb/d				0			0			0			0		
o Sludge Cake															
- Capture, %	*			0			0			0			95		Default
- Cake Solids, lb/d				41,835			77,377			87,119			79,191		
- Concentration, %	*			2.6			2.3			2.3			21.7		Default
- Flow, mgd				0.1943			0.4082			0.4551			0.0438		
o Filtrate															
- Filtrate Flow, mgd				0.000			0.000			0.000			0.393		
- Characteristics, mg/L															
-- BOD	*			500			500			500			500		Default
-- TSS				0			0			0			1,271		
-- VSS				0			0			0			941		
-- NH3-N	*			1,063			845			836			836		
-- Organic-N	*			5			5			5			70		
-- NO3-N	*			0			0			0			0		
-- Alkalinity	*			3,796			3,017			2,986			2,985		

* Input Data