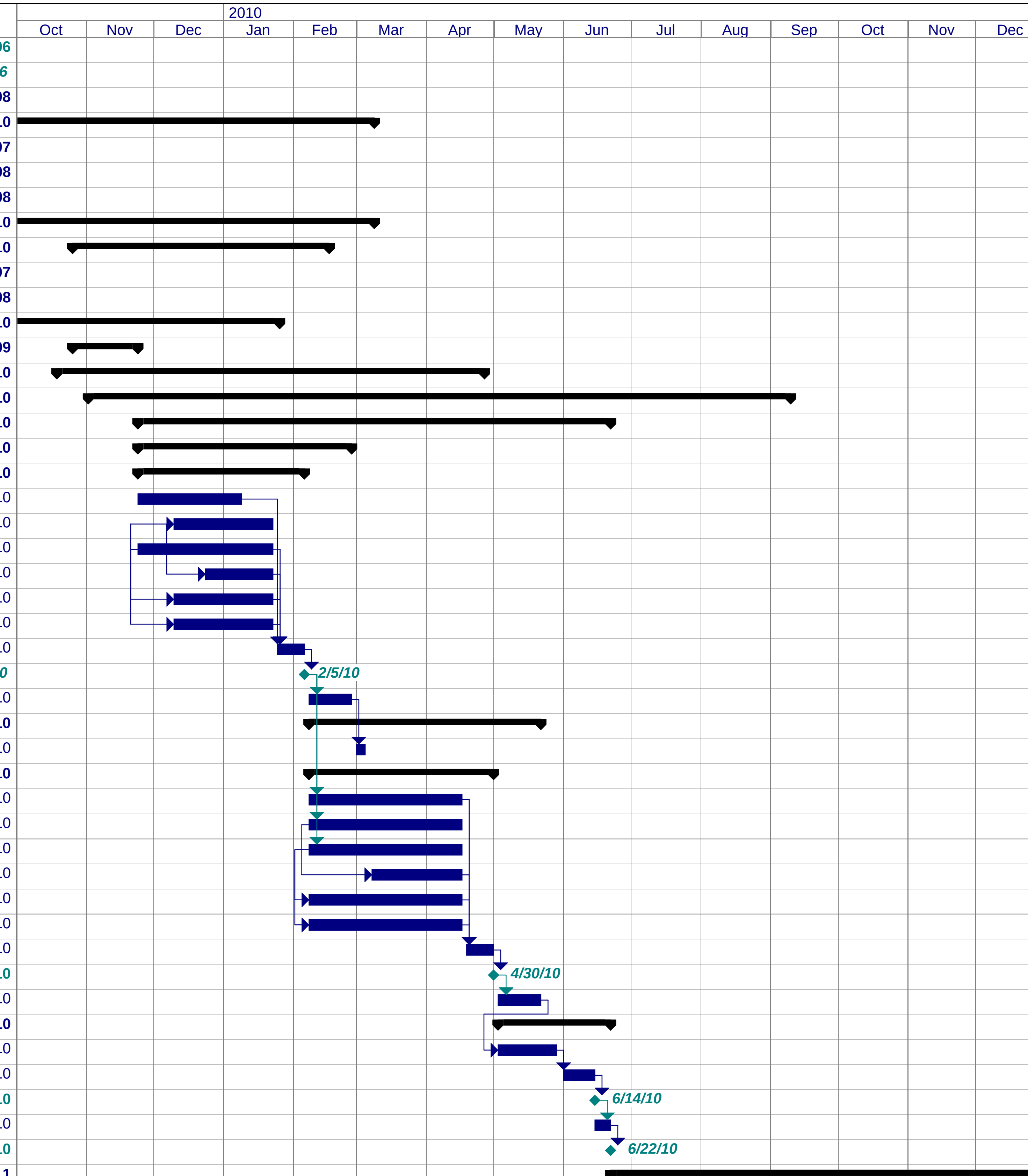
Appendix A
Project Schedule

Updated October 29, 2009

Design Phase Summary
Santa Clara Valley Water District/City of San Jose
South Bay Advanced Recycled Water Treatment Facility
PROJECT SCHEDULE

ID	Indicators	Task Name	Duration	Start	Finish
1	✓	*Notice To Proceed*	0 d	Fri 10/13/06	Fri 10/13/06
2	✓	*Project Team Kickoff Meeting*	*0 d*	*Fri 10/13/06*	*Fri 10/13/06*
3	✓	**Task 1 - Project Management**	**515 d**	**Fri 11/17/06**	**Fri 11/14/08**
30		**Task 2 - Preliminary Design Service / Engineer's Report**	**876 d**	**Fri 10/13/06**	**Mon 3/8/10**
31	✓	**Task 2.1 - Refine Project Description**	**102 d**	**Fri 10/13/06**	**Fri 3/9/07**
35	✓	**Task 2.2 - Preliminary Investigations and Engineer's Report**	**404 d**	**Fri 10/20/06**	**Thu 5/15/08**
61	✓	**Task 2.3 - Development of 30% Design**	**90 d**	**Fri 5/16/08**	**Thu 9/18/08**
68		**Task 2.4 - Membrane Filtration System RFP**	**842 d**	**Mon 12/4/06**	**Mon 3/8/10**
91		**UV System RFP**	**78 d**	**Mon 10/26/09**	**Tue 2/16/10**
107	✓	**Task 2.5 - Site Survey**	**49 d**	**Mon 6/11/07**	**Fri 8/17/07**
110	✓	**Task 2.6 - Geotechnical Study**	**67 d**	**Mon 4/14/08**	**Tue 7/15/08**
114		**Task 2.7 - CEQA Documents**	**590 d**	**Tue 10/16/07**	**Tue 1/26/10**
124		**30% Design Update**	**21 d**	**Mon 10/26/09**	**Mon 11/23/09**
128		**Toxicity Testing**	**132 d**	**Mon 10/19/09**	**Mon 4/26/10**
141		**Early Earthwork Construction Contract**	**217 d**	**Mon 11/2/09**	**Thu 9/9/10**
148		**Task 3 - Project Design**	**145 d**	**Tue 11/24/09**	**Tue 6/22/10**
149		**Task 3.1 - 60% Design Submittal**	**65 d**	**Tue 11/24/09**	**Fri 2/26/10**
150		**Prepare 60% Design Documents**	**50 d**	**Tue 11/24/09**	**Fri 2/5/10**
151		Prepare 60% Design Documents- Civil	6 w	Tue 11/24/09	Fri 1/8/10
152		Prepare 60% Design Documents- Arch/Struct	6 w	Thu 12/10/09	Fri 1/22/10
153		Prepare 60% Design Documents- Mech Process	8 w	Tue 11/24/09	Fri 1/22/10
154		Prepare 60% Design Documents- Mech Bldg	4 w	Thu 12/24/09	Fri 1/22/10
155		Prepare 60% Design Documents- Electrical	6 w	Thu 12/10/09	Fri 1/22/10
156		Prepare 60% Design Documents- Instrumentation	6 w	Thu 12/10/09	Fri 1/22/10
157		B&V QC & Edit QC Comments	2 w	Mon 1/25/10	Fri 2/5/10
158		***Deliverable due District - 60% Design Submittal***	***0 d***	***Fri 2/5/10***	***Fri 2/5/10***
159		District Review and Workshop	3 w	Mon 2/8/10	Fri 2/26/10
160		**Task 3.2 - 90% Design Submittal**	**75 d**	**Mon 2/8/10**	**Fri 5/21/10**
161		Address Client Comments	4 d	Mon 3/1/10	Thu 3/4/10
162		**Prepare 90% Design Documents**	**60 d**	**Mon 2/8/10**	**Fri 4/30/10**
163		Prepare 90% Design Documents- Civil	10 w	Mon 2/8/10	Fri 4/16/10
164		Prepare 90% Design Documents- Arch/Struct	10 w	Mon 2/8/10	Fri 4/16/10
165		Prepare 90% Design Documents- Mech Process	10 w	Mon 2/8/10	Fri 4/16/10
166		Prepare 90% Design Documents- Mech Bldg	6 w	Mon 3/8/10	Fri 4/16/10
167		Prepare 90% Design Documents- Instrumentation	10 w	Mon 2/8/10	Fri 4/16/10
168		Prepare 90% Design Documents- Electrical	10 w	Mon 2/8/10	Fri 4/16/10
169		B&V QC & Edit QC Comments	2 w	Mon 4/19/10	Fri 4/30/10
170		***Deliverable due District - 90% Design Submittal***	**0 d**	**Fri 4/30/10**	**Fri 4/30/10**
171		District review	3 w	Mon 5/3/10	Fri 5/21/10
172		**Task 3.3 - 100% Design Submittal**	**35 d**	**Mon 5/3/10**	**Tue 6/22/10**
173		Prepare 100% Design Documents	4 w	Mon 5/3/10	Fri 5/28/10
174		B&V QC & Edit QC Comments	2 w	Tue 6/1/10	Mon 6/14/10
175		***Deliverable due District - 100% Design Submittal***	**0 d**	**Mon 6/14/10**	**Mon 6/14/10**
176		District review	5 d	Tue 6/15/10	Mon 6/21/10
177		**Board Approval to Advertise**	**0 d**	**Tue 6/22/10**	**Tue 6/22/10**
178		**Task 5 - Construction Services Submittal Review**	**387 d**	**Tue 6/22/10**	**Thu 12/29/11**



Appendix B
Impact of RO Concentrate Stream on WPCP Effluent Quality

Eisenberg, Olivieri & Associates
Environmental and Public Health Engineering

TECHNICAL MEMORANDUM

TO: Sanjay Reddy,
Black & Veatch

FROM: Ray Goebel & Tom Hall

DATE: March 28, 2008

SUBJECT: **South Bay Advanced Recycled Water Treatment Facility – Impact of RO Concentrate Stream on WPCP Effluent Quality**

Introduction

The Santa Clara Valley Water District (SCVWD) and San Jose/Santa Clara Water Pollution Plant (WPCP) are planning to construct a facility to reduce salinity levels in recycled water (RW) produced at the WPCP. The facility will utilize microfiltration (MF) and reverse osmosis (RO) to meet Title 22 filtration requirements for disinfected tertiary RW and to reduce salinity levels in the recycled water (RW) product. RW from these systems will be disinfected and delivered to the South Bay Water Recycling distribution system. The MF waste stream will be returned to the plant for processing, while the RO waste stream will be recombined with the WPCP effluent stream for discharge to the Bay.

Under subcontract to Separation Processes, Inc (SPI), EOA examined the likely impact of the RO concentrate stream on final effluent quality from the WPCP. The analysis considers conventional pollutants (CBOD, TSS and ammonia) and toxic pollutants which are regulated (or potentially regulated) under the WPCP's NPDES Permit. The analysis uses a mass balance model to determine pollutant concentrations in the RO concentrate (reject) and combined final plant effluent discharge streams. The projections are based on historic WPCP effluent quality and flow data, plus projected flows and performance data for the MF/RO system.

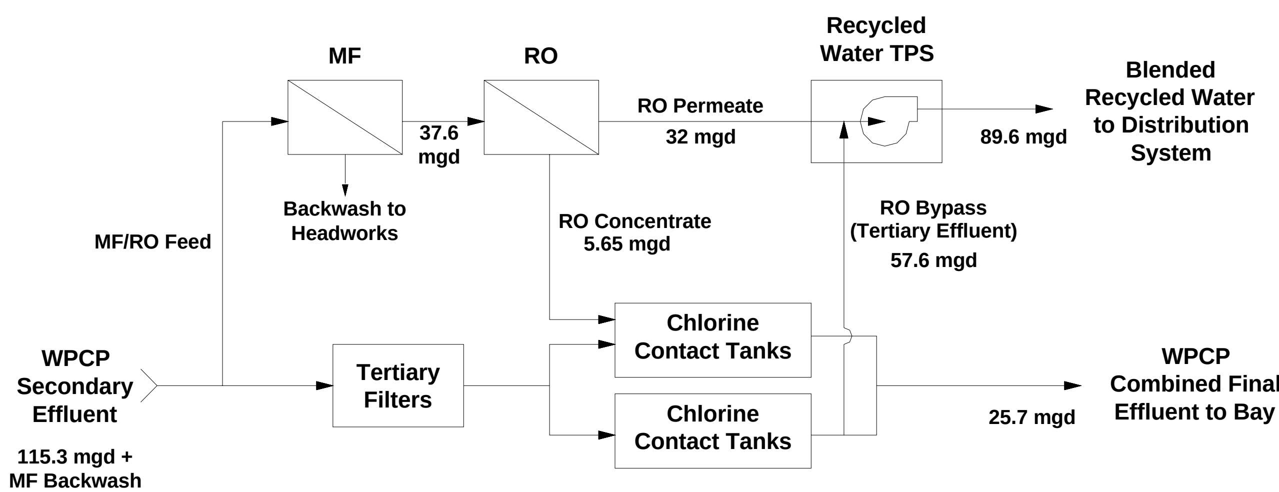
An analysis was conducted in Spring 2007 for a project that would blend 8 mgd RO product (permeate) with a slightly greater amount of tertiary effluent, to produce a total of 16.8 mgd blended recycled water. A similar analysis was conducted for a 12 mgd RO product scenario. These projects would have only a minor impact on pollutant concentrations in final effluent discharged to the Bay, raising those concentrations by about 8% and 13%, respectively, from current levels.

In January 2008, EOA was asked to evaluate the impacts of a much larger project, consisting of up to 40 mgd of RO permeate, with the final recycled water blend consisting of 1.8 part tertiary effluent to 1 part RO permeate. The 1:1.8 "blend ratio" is designed to produce a total dissolved solids (TDS) concentration of approximately 500 mg/L in the recycled water. This memo addresses the impacts of the larger project.

Process Description

Figure 1 is a schematic of the proposed system, showing only those elements essential to the mass balance analysis. Flows to the MF/RO system will be diverted from the WPCP's secondary effluent stream. MF backwash will be returned to the plant headworks, while the RO concentrate stream will be rerouted to the chlorine contact tanks and blended back into the WPCP effluent for discharge to the Bay. The RO permeate will be combined with the "RO Bypass" stream (filtered tertiary effluent). These streams will be disinfected to meet Title 22 requirements and pumped into the recycled water (RW) distribution system. For purposes of illustration, the flows associated with a 32 mgd RO permeate project are indicated in Figure 1.

Figure 1. Process Flow Schematic
For 115.3 mgd Effluent + Recycled Water, 32 mgd RO Permeate



Mass Balance Model

The spreadsheet model used for this evaluation of RO concentrate impacts on final effluent quality performed a mass balance to determine the mass and concentration of pollutants in the RO feed, permeate and concentrate streams. Inputs to the model include:

- Flows: WPCP secondary effluent, RO system feed, RO "bypass"
- Water Quality Data: Historic WPCP final effluent data is used to characterize pollutant concentrations in both the MF/RO feed and in the plant effluent prior to recombining of the RO concentrate.
- RO System Performance: hydraulic recovery and pollutant rejection rates
- NPDES effluent limits or water quality objectives at the point of discharge

The RO concentrate stream is mathematically combined with the remaining final effluent stream to determine combined final effluent flow and concentrations.[1] These concentrations are then compared to the NPDES effluent limits or the applicable water quality to determine if operation under the specified conditions will impact current or future compliance.

Model Input Data

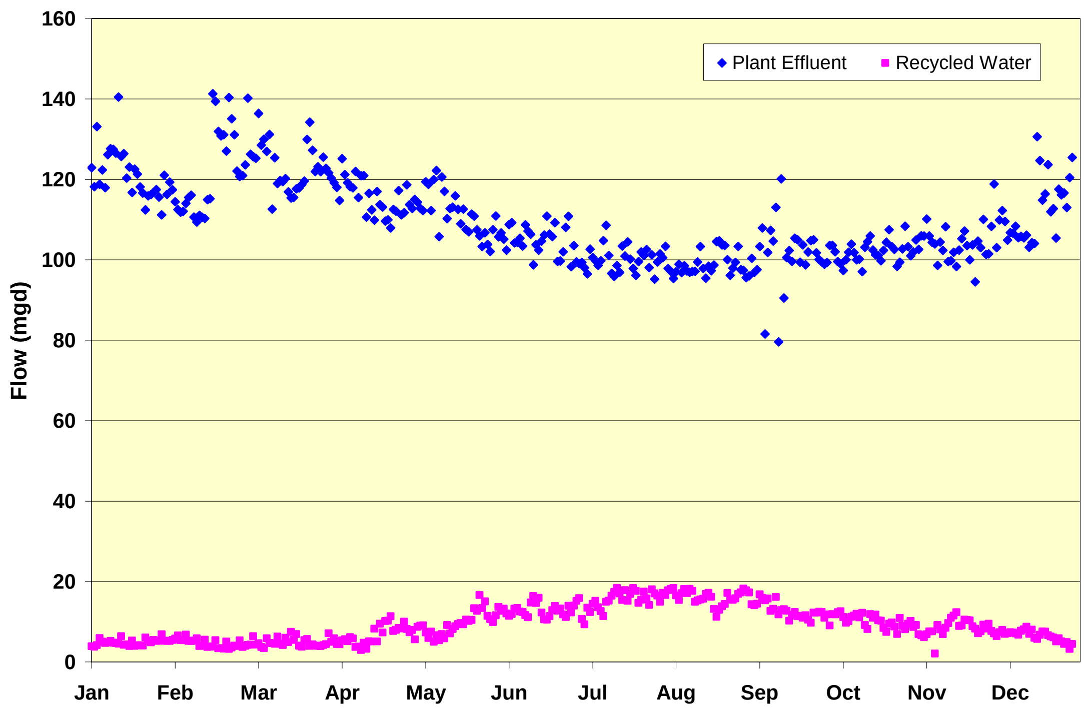
Flows

RO permeate flows up to 40 mgd were specified, with a fixed blend ratio of 1.8 parts tertiary effluent to 1 part RO permeate. Under the minimum summertime flow conditions described below, the final effluent consists of 100% RO concentrate (i.e. no tertiary effluent remains for blending with the reject) at a RO permeate flow of 38.7 mgd, effectively capping the maximum possible size of a single stage RO project for this minimum flow condition.

EOA examined historic WPCP effluent and RW flow data to identify a reasonable worst case minimum flow condition for use in the mass balance. Historic (2001-2005) flow data provided by the WPCP staff was supplemented by additional (2006) data derived from the electronic reporting system (ERS) database used to report self-monitoring data to the RWQCB. As expected, the minimum flow (sum of historic plant discharge flow plus RW flow) occurs during the summer. In 2005 and 2006, the minimum plant effluent flows occurred in August, when the monthly average flows (excluding RW) were 99.1 mgd and 101.7 mgd, respectively. The average monthly RW flow also peaked in August 2005 at 16.2 mgd (2006 RW flow data were not available). Within these months, daily flows for the both the plant effluent and recycled water were very consistent, indicating that the use of monthly average values is sufficiently conservative. On this basis, the August 2005 flow of 115.3 mgd was selected as a typical worst case condition for use in the mass balance. Figure 2 shows the pattern of plant effluent and RW (Transmission Pump Station) flows during 2005.

[1] The mass balance does not explicitly account for the waste stream produced from the MF system. However, because historic (filtered) effluent data are being used to characterize secondary effluent concentrations, the mass balance in essence assumes that pollutants currently removed by the sand filters will continue to be removed by the MF system.

Figure 2. WPCP Flows - 2005



RO System Performance

SPI provided typical performance data for the MF/RO system. The MF/RO flow recovery is assumed to be 85% (i.e. 85% of the feed passes through as RO product, 15% to concentrate). The rejection rate for pollutants was estimated to be 99% for metals and 95% for cyanide. EOA assumed 99% removal for CBOD, and TSS, and 90% for ammonia. As a result of these assumption, pollutant levels in the RO concentrate are approximate five times those of RO feed stream. For reasons described below, organics were not evaluated using the mass balance approach.

In specifying the 1.8:1 blend ratio, the designers have assumed a secondary effluent TDS of 750 mg/L, and an RO permeate TDS of 50 mg/L (will initially be lower, but increasing to that level over time).

Pollutant Concentrations

Historic plant final effluent data was used to characterize both the MF/RO feed stream and the plant effluent stream prior to recombining with the RO concentrate. EOA extracted priority pollutant data from the ERS database. For metals and conventional pollutants, a four-year (2004-2007) data set was used, except as noted in table footnotes. For organics, a larger six year data set was used because of the fewer number of available values per year. The later data included all CTR priority pollutants plus tributyltin, diazonon, and chlorpyrifos. The only data censoring that was performed was to exclude certain high-detection limit non-detect (ND) results, in cases where inclusion of these values (particularly where mixed DLs are present) would significantly skew the resulting statistical measures. Values listed as ND were conservatively evaluated at the detection limit. Estimated ("DNQ") values were evaluated at the estimated value.

Table 1 summarizes data for metals and cyanide. A more complete statistical summary is provided in Appendix A. For copper and nickel, statistical summaries were developed for both individual (daily) and monthly average values. For other constituents, the summaries reflect individual values only. The number of non-detect and DNQ values in the data set were very low. As a result, the data are highly amenable to a mass balance approach for predicting the impacts of the MF/RO project. The large number of data points allow the "worst case" percentile concentrations to be estimated with a relatively high level of confidence.[2]

Table 2 summarizes the data for the conventional pollutants cBOD, TSS, ammonia, and oil & grease. A more complete statistical summary is provided in Appendix A. For cBOD and TSS, both daily and monthly average values were evaluated. The datasets of daily CBOD and TSS values are quite large, allowing accurate characterization even at high (e.g. 99^{th}) percentile concentrations. For ammonia and oil & grease, only monthly averages are evaluated, since samples are normally collected on a monthly (ammonia) or quarterly (oil & grease) basis.

Table 3 summarizes the data for organics, showing only those pollutants for which at least one value was detectable. A complete summary for organics is included in Attachment A. In the case of organics, the data set consists almost entirely of non-detect results, so that a mass balance approach is largely meaningless. A better approach is to examine pollutants with detectable values, and to qualitatively assess the impact of the project on those pollutants. The column headed "Max. with 32 mgd RO Project is included to aid in that discussion. (See "Model Results – Organics" section).

For TDS, a constant value of 750 mg/L was used for all percentiles, as data for calculating actual percentiles was not readily available. The TDS of the final blended effluent discharge is of interest relative to salt marsh conversion and mitigation issues.

[2] The percentile values used for this analysis were determined by ranking the actual data, as opposed to statistical estimates based on an assumed distribution.

Table 1. Metals Data Summary, 2004 - 2007

	Number of Results	WPCP Effluent Concentration, ug/L				Effluent Limit or WQO
		Average	90%ile	95%ile	99%ile	
Arsenic	56	1.1	1.5	1.7	2.1	36
Cadmium	42	0.05	0.08	0.15	0.21	7
Chromium VI	8	0.53	0.67	0.68	0.70	200
Copper - daily max.	180	2.9	4.4	4.8	5.7	18
Copper - monthly avg	50	2.7	4.1	4.2	4.8	12
Lead	43	0.5	0.8	1.0	1.4	8.5
Mercury	47	0.0017	0.0024	0.0027	0.0040	0.025[1]
Nickel - daily max	200	6.4	8.0	9.0	10.8	34
Nickel - monthly avg		6.3	7.2	7.5	8.7	25
Selenium	57	0.43	0.60	0.66	0.93	5
Silver	45	0.04	0.07	0.11	0.17	2
Zinc	65	38	60	68	82	170
Cyanide	28	2.2	3.0	3.2	3.4	7[2]

1. Limit from mercury Watershed Permit. Trigger value is 0.011 ug/L.
2. Expected permit limit using cyanide site-specific objective

Table 2. Conventional Pollutant Data Summary, 2004 - 2007

		WPCP Effluent Concentration, mg/L				Effluent Limit
		Average	90%ile	95%ile	99%ile	
CBOD - daily max	461	2.8	4.0	4.0	5.0	20
CBOD - monthly avg	48	2.8	3.4	4.0	4.1	10
TSS - daily max	645	2.0	3.0	6.2	8.9	20
TSS - monthly avg	48	1.8	2.3	2.6	6.2	10
Ammonia-N	48	0.4	0.6	0.6	0.8	3.0

Table 3. Summary of WPCP Effluent Organics Data, 2002 - 2007, Detected Values Only

All values are ug/L except dioxins and furans, which are pg/L

CTR	Pollutant	Total # Values	# of Qual. Values[1]	Average[2]	Maximum[3]	Max. w/ 32 mgd RO Project[4]	W.Q. Objective[5]
20	Bromoform (Tribromomethane)	7	2	< 0.37	0.69	1.54	380
23	Chlorodibromomethane	8	0	1.93	3.5	7.8	34
26	Chloroform	12	0	4.87	10	22.3	-
27	Dichlorobromomethane	8	0	3.49	5.9	13.2	46
35	Chloromethane (Methyl Chloride)	5	4	< 0.33	0.04	0.089	-
36	Methylene Chloride[6]	7	2	< 0.34	0.8	1.8	1600
39	Toluene	7	2	< 0.54	0.9	2.0	200,000
68	Bis(2-ethylhexyl)phthalate	8	5	< 0.81	2	4.5	5.9
102	Aldrin	13	12	< 0.01	**0.032**[7]	**0.0729**	0.00014
103	A-BHC	7	6	< 0.00	0.0046	0.010	0.013
114	Endosulfan Sulfate	7	6	< 0.01	0.016	0.036	240
117	Heptachlor	11	10	< 0.01	**0.038**	**0.085**	0.00021
16f	1,2,3,4,6,7,8-HpCDD	9	8	< 1.54	6.77	15.1	-
16g	OCDD	10	4	< 7.74	51.6	115.1	-
16h	2,3,7,8-TCDF	10	8	< 1.23	6.25	13.9	-
16q	OCDF	9	6	< 1.85	7.34	16.4	-
16-TEQ	TCDD-TEQ[8]	9	2	< 0.083	**0.394**	**0.879**	0.014[9]
A	Trybutyltin[10]	63	61	< 0.002	0.005	0.010	-

Notes:

1. Qualified values include values flagged as "ND", "<", or "DNQ".
2. Averages computed with NDs, <s and DNQs evaluated at the detection limit.
3. Where dataset consists of both detected and non-detected values, the highest detected value is listed.
4. Estimated values based on 2.23 concentration factor. See "Model Results" discussion.
5. CTR objective for human health, consumption of organisms only
6. One non-detect value with very high DL excluded
7. Aldrin value was from March 2002.
8. TEQ value calculated by EOA. Listed value (<0.603 pg/L) may have been incorrectly calculated.
9. CTR objective is for 2,3,7,8-TCDD, but has been applied to TCDD-TEQ in recent Region 2 NPDES permits.
10. Tributyltin average includes eignt values at <0.01.

Rationale for Selecting Pollutant Concentration Percentiles

EOA evaluated impacts of the RO system on final effluent quality over the range of flows based on average, 95th percentile and 99th percentile pollutant concentrations. Bearing in mind that the analysis was done for worst-case minimum flow conditions, a 95th percentile concentration was selected as a reasonable "worst-case" concentration for comparison to average monthly effluent limitations (or criterion continuous concentration water quality objectives), while the 99th percentile was selected for comparison to daily maximum effluent limitations for copper, nickel, BOD and TSS. These are the same criteria used by the Water Board for assessing feasibility of compliance with water quality based effluent limitations. An argument could made that more conservative (higher) percentiles should be used to represent worst-case conditions, however, EOA believes that the use of a minimum flow condition (which occurs less than 10% of the time) provides a sufficient addition factor of safety for the selected percentiles. In the final analysis, as the project size increases above 32 mgd RO permeate flow, final effluent discharge concentrations are much more sensitive to project size than to the percentile used to characterize pollutant concentrations.

Effluent Limits or Water Quality Objectives

NPDES Permit effluent limits or applicable water quality objectives are also indicated on Tables 1-3. For the compliance evaluation, effluent limits from the current NPDES Permit (Order R2-2003-0085) were used for copper and nickel, and the evaluation is performed relative to both average monthly and daily maximum limits. For mercury, the concentration limit from the recently adopted mercury watershed permit was used. For the remaining metals, the more stringent of the CTR freshwater or saltwater objectives (criterion continuous concentration) is listed.[3] The comparison of model results to average monthly limits (or CCC objectives) is conservative in cases where multiple samples are collected each month. A review of the data indicate that except for copper and nickel, one sample per month is generally the norm for metals.

For cyanide, the next Permit's expected monthly average concentration limit, based on the recently adopted Basin Plan Amendments for Cyanide, was used. The expected value is 7 ug/L. The mass balance approach may not be completely valid for cyanide, as some portion of the cyanide in final effluent is generated during disinfection, and thus levels in the RO concentrate (and the blended final effluent) would be lower than predicted by the mass balance.

For CBOD and TSS, model results were evaluated against both the daily maximum and monthly average effluent limits. For organics, the applicable CTR human health objective (for consumption of organisms only) is listed. The Permit has interim daily maximum effluent limits for dieldrin, 4,4'-DDE, heptachlor epoxide, benzo(b)flouoranthene, and indeno(1,2,3-cd)pyrene which are numerically equal to the Permit-specified minimum detection level (ML) for these compounds. However, none of these pollutants were present at detectable levels in the 2002-2007 data set.

[3] Exceeding a water quality criterion would trigger a determination of "reasonable potential" in the subsequent NPDES Permit renewal process, which would result in the new Permit having an effluent limit for that pollutant. For shallow water dischargers such as the SJ/SC WPCP, the effluent limit would be numerically close to the criterion, except in the case of metals, where the application of site-specific translators could result in effluent limits that are higher than the objective.

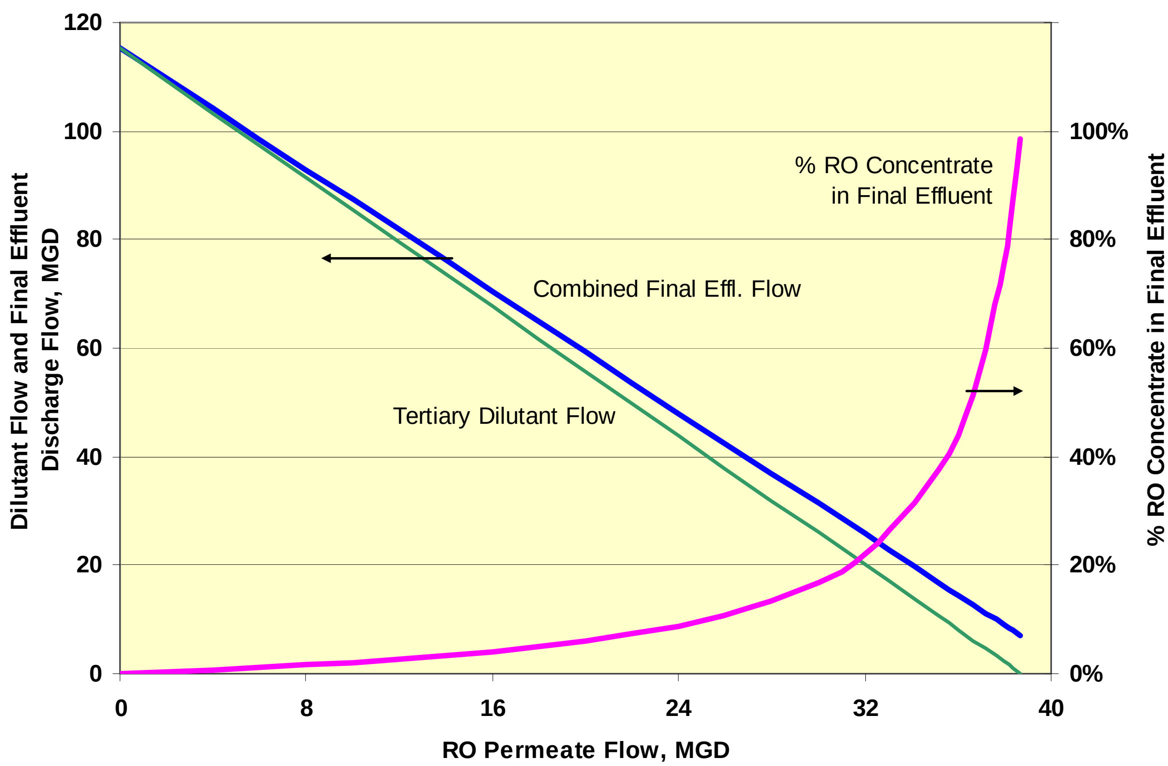
Model Results

The concentrating effect of the RO process on pollutants is determined primarily by the RO rejection rate, which describes the relative amounts of RO permeate and RO concentrate. For a rejection rate of 85% (85% permeate and 15% concentrate), the RO concentrate pollutant concentrations are approximately five time higher than in the feed stream. In the final plant effluent discharged to the Bay, these pollutant concentrations are reduced (diluted) by mixing with the tertiary effluent that remains after the "RO bypass" stream is diverted for blending with the RO product water. The final effluent discharge concentrations depend strongly on the amount of tertiary effluent available for dilution, and the overall impact of the RO system can, to a large extent, be understood by examining changes in the volume of this flow stream as the project size increases.

Figure 2 illustrates that both the tertiary effluent dilutant and final effluent discharge flows decrease linearly as project size (RO permeate flow) increases. Also shown in Figure 2 is the percentage of RO concentrate in the final effluent stream, which increases sharply at RO permeate flows above 32 mgd, to 100% RO concentrate at an RO permeate flow of 38.7 mgd. Note that Figure 2 is for the minimum plant flow condition of 115.3 mgd. The curves in Figure 2 all shift to the right as the plant flow value increases.

Figure 3. Impact of Project Size on Tertiary Effluent Dilutant Flow and Bay Discharge Flow

WPCP Plant Flow = 115.3 mgd; Blend Ratio = 1.8:1



Metals and Cyanide

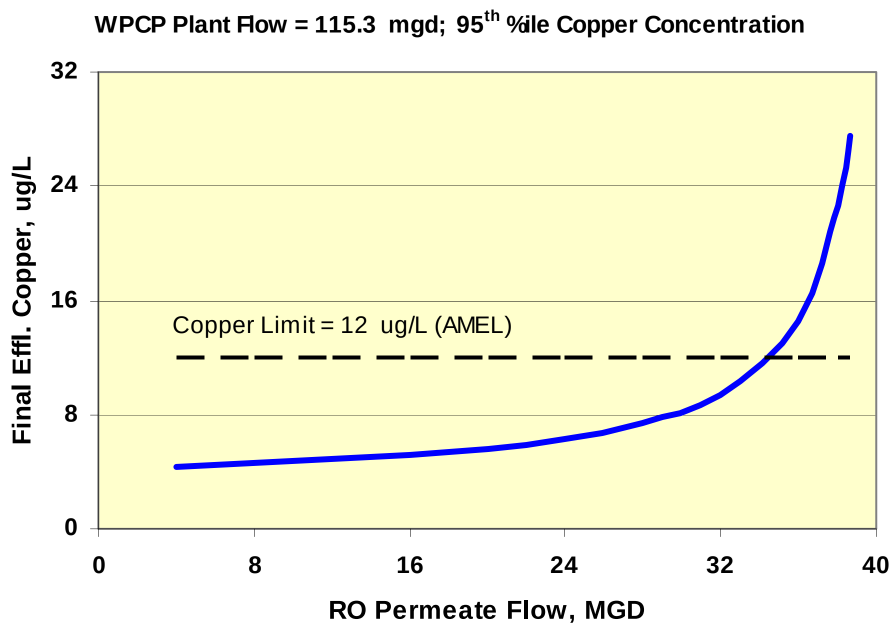
Table B-1 in Appendix B is a typical model result printout for a 32 mgd RO Permeate project, based on a plant flow of 115.3 mgd (minimum plant flow condition) and 95th percentile concentrations. Tables B-2 through B-5 list the blended final effluent concentrations for the 8, 16, 32 mgd projects at all percentile concentration evaluated..

For the specified minimum flow value of 115.3 mgd, the results based on average (mean) concentrations indicate no compliance problems until the RP permeate flow is above 35 mgd. Cyanide is the first to exceed the expected permit limit at about 35 mgd, followed by nickel, which exceeds the average monthly limit at 36.9 mgd.[4] As indicated previously, actual effluent cyanide concentrations may be lower than those calculated by the model.

For 95th percentile concentrations, compliance problems emerge at lower RO permeate flows. Cyanide exceeds the expected limit at 31.8 mgd. Zinc exceeds the water quality objective at 33.3 mgd, while copper exceeds the average monthly effluent limit at 34.6 mgd. For 99th percentile concentrations, cyanide and zinc exceed the effluent limit or WQO at 31.1 mgd, while copper and nickel exceed their respective daily maximum effluent limits at 35.5 mgd.

Figure 4 shows the projected increase blended final effluent copper as project size increases. As expected, the curve closely resembles the"% RO Concentrate in Final Effluent" curve in Figure 3.

Figure 4. Projected Copper Concentration in Blended Final Effluent

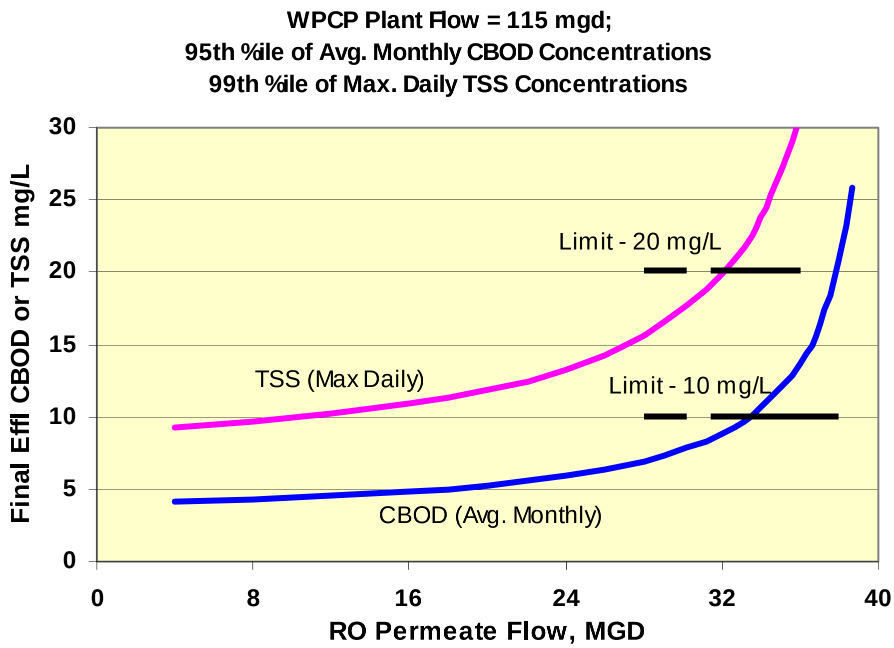


[4] Results for average concentration values are presented only to illustrate the earlier point regarding sensitivity to dilutant flow, and not to suggest that average concentrations should be used to gauge compliance.

Conventional Pollutants

Results for conventional pollutants are also listed on Tables B-2 through B-5. Results are similar to those for metals, with compliance problems starting at around the 32 mgd project size. At just above 32 mgd, the 99th percentile TSS concentration exceeds the maximum daily TSS limit.[5] The next compliance obstacle is the 95th percentile CBOD value, which exceeds the average monthly CBOD limit at 33.4 mgd. Figure 5 shows the projected blended final effluent concentrations over the range of project sizes for these parameters. Compliance problems for ammonia do not emerge until RO permeate flows exceed 37 mgd.

Figure 5. Projected TSS and CBOD Concentrations in Blended Final Effluent

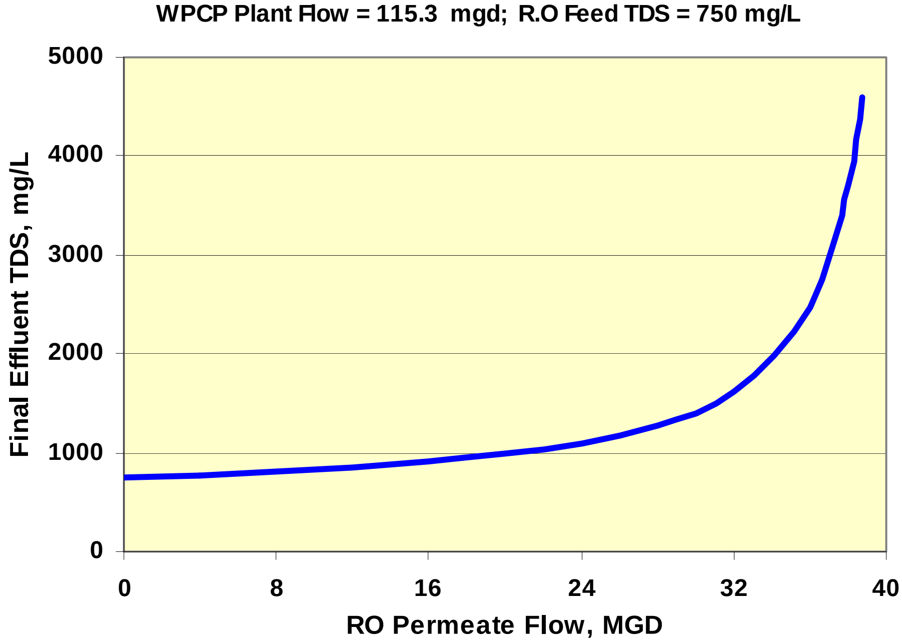


TDS

Figure 6 shows the projected blended final effluent TDS concentrations over the range of project sizes. For a 32 mgd RO permeate project, the projected TDS concentration is 1610 mg/L.

[5] Note that if the 99th percentile TSS concentrations are compared to the <u>monthly average</u> TSS limit, rather than the maximum daily limit as suggested, TSS would exceed the limit at project size of 26.5 mgd RO Permeate. For reasons previously stated, EOA believes this comparison is overly conservative.

Figure 6. Projected TDS Concentration in Blended Final Effluent



Organics

As indicated above, the data set for organics consists almost entirely of non-detect values, and is not really amenable to a mass balance evaluation. However, the summary data in Table 3 can be reviewed to identify pollutants for which an increase in final effluent concentration corresponding to a 32 mgd RO project (a factor of 2.3) might be problematic.[6] (Such a comparison should be considered approximate given the uncertainty is the underlying data). That review indicates that, except for most pollutants, the maximum historic effluent concentrations are far below the applicable objectives, so that the project would have no impact on compliance for these pollutants. A possible exception to this assessment could occur if a compound which has historically never been detected and which has a WQO below the detection limit was rendered detectable by the project. This scenario can only be assessed by analyzing effluent samples that have been concentrated through sample preparation methods or pilot RO studies.

For two pollutants (bis(2-ethylhexyl) phthalate and A-BHC), the projected concentrations for a 32 mgd RO project are within 25% of the WQO. (Note that for A-BHC, this observation is based on a single detected value, and thus subject to much uncertainty. Bis(2-ethylhexyl) phthalate is detected more frequently in effluent samples, and thus a more likely to pose an actual compliance issue). For three pollutants (aldrin, heptachlor, and TCDD-TEQ), the maximum historic values already exceeded the applicable water objective. In each case, the exceeding values are so far above the objective that doubling in concentration would have no bearing on compliance or reasonable potential. Note that for aldrin and heptachlor, the single exceeding values for each are

[6] To the extent that removal of organics by the RO system might be less than 99%, the percent increase of the pollutant concentration in the final effluent could be less than these amounts.

the only detected values in the respective data sets, and may not be representative of actual effluent concentrations. For TCDD-TEQ, the variability in the historic data is so great (many orders of magnitude) that the increased concentration resulting from an RO project unlikely to have any impact on compliance from a practical perspective.

Summary and Conclusions

EOA evaluated the probable impacts on WPCP final effluent discharge quality from blending of RO concentrate generated by the proposed South Bay Advanced Recycled Water Treatment Facility into the WPCP's final effluent stream. The evaluation covered a range of possible project sizes up to 40 mgd of RO Permeate. The project plan calls for blending RO permeate with tertiary plant effluent in at a ratio of 1 to 1.8, in order to reduce TSD levels in the recycled water to 500 mg/L. Based on historic flow data, EOA identified a typical minimum flow condition of 115.3 mgd for use in the evaluation. For this plant flow and the specified RO performance and blend ratio, the percentage of RO concentrate in the final effluent increases gradually to about 20% at a project size of 32 mgd RO permeate (nearly 90 mgd of blended recycled water), and increases rapidly to 100% RO concentrate at 38.7 mgd RO Permeate.

A spreadsheet model was used top perform a mass balance, wherein final effluent concentrations were calculated based on the concentration and flow of RO concentrate and the remaining tertiary effluent after diversions to the recycled water system. EOA examined historic WPCP effluent data to characterize expected pollutant concentrations in the RO feed and tertiary effluent dilutant streams. In order to evaluate plausible worst-case scenarios, percentile concentrations were determined for metals, cyanide, and conventional pollutants. In conjunction with the minimum flow condition, EOA recommends use of the 95th percentile concentration to evaluate compliance relative to average monthly effluent limits, and 99th percentiles for maximum daily effluent limits. For constituents with no effluent limits, EOA compared the blended final effluent concentrations to the applicable water quality objectives (WQOs). (Unless special conditions were applied to the project by the Water Board, concentrations that exceeded WQOs would trigger "reasonable potential" and would result in effluent limits in the subsequent permit). The mass balance approach was not used for organics, which were dominated by non-detect values. Organics were instead evaluated qualitatively.

Neither acute nor chronic toxicity are amenable to analysis by the mass balance approach or by qualitative assessment. EOA recommends that whole effluent toxicity impacts be assessed through screening studies using RO concentrate/tertiary effluent blends generated from benchtop or pilot-scale RO units.

The mass balance analysis indicated likely compliance problems (or exceeding water quality objective) starting at around 32 mgd RO permeate flow. Between 32 and 35 mgd, cyanide, copper, nickel, zinc, TSS and CBOD exceed the applicable effluent limitations, and zinc exceeds the water quality objective. 32 mgd RO permeate (90 mgd total recycled water) would represent a quite large project.

The analysis of historic effluent data for trace organics revealed no likely compliance issues for 109 of the 114 compounds examined. Of the remaining five, the concentrations of two compounds (bis(2-ethylhexyl) phthalate and A-BHC) could increase to levels that might be of concern. (Of these two, bis(2-ethylhexyl) phthalate is more likely to pose an actual compliance issue). For the remaining three pollutants (aldrin, heptachlor, and TCDD-TEQ), one or more maximum historic values exceeded the applicable water objectives. However, for these three, the existing data indicate that a 2.3-fold increase in historic effluent concentrations (which occurs at a project size of 32 mgd RO product) would have no bearing on (i.e. would not change) compliance or reasonable potential.

Overall, the analysis indicates that a project up to about 32 mgd RO permeate should not pose compliance problems with respect to the discharge of RO concentrated blended into the remaining WPCP tertiary effluent plant stream. This conclusion applies to individual conventional or toxic pollutants. Potential Impacts on whole effluent toxicity need to be evaluated separately. A phased approach to project implementation, wherein MF/RO capacity is added in increments, will provide the opportunity to verify the findings from this analysis and more accurately identify the factors that limit the maximum feasible project size based on discharge considerations.

Attachments:

A. Statistical summaries of WPCP effluent data
B. Example spreadsheet model printouts and summary of model results

Attachment A

Statistical Summaries of WPCP Effluent Data

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Table A-1. Summary of WPCP Final Effluent Concentration Data for Metals and Cyanide, 2004-2007[1]

All results are ug/L

	Arsenic	Cadmium	Cr VI	Copper-Daily	Copper-Mo. Avg.	Lead	Mercury[2]	Nickel Daily	Nickel Mo. Avg.	Selenium	Silver	Zinc	Cyanide
# of samples	56	42	8	184	50	43	47	200	48	57	45	65	28
# ND's	0	5	0	0	0	0	0	1	0	0	6	0	1
# DNQ's	0	39	3	0	0	4	0	0	0	0	38	0	23
Minimum	0.40	0.01	0.33	1.50	1.65	0.15	0.0002	4.0	5.0	0.19	0.010	21.3	1
Maximum	2.27	0.23	0.70	9.54	4.98	1.36	0.0049	12.3	9.2	1.18	0.170	85.0	3.4
Median	1.12	0.03	0.51	2.60	2.50	0.43	0.0016	6.0	6.2	0.39	0.027	31.3	2.1
Geo. Mean	1.08	0.03	0.51	2.87	2.58	0.40	0.0016	6.2	6.2	0.41	0.029	35.5	2.10
Average	1.13	0.05	0.53	2.91	2.68	0.46	0.0017	6.4	6.3	0.43	0.038	38.2	2.17
Std. Dev.	0.34	0.05	0.12	1.07	0.80	0.28	0.0024	1.3	0.8	0.15	0.035	15.6	0.56
C.V.	0.30	0.98	0.23	0.37	0.30	0.60	1.3627	0.20	0.13	0.35	0.916	0.41	0.26
90th %ile	1.50	0.08	0.67	4.41	4.07	0.80	0.0024	8.0	7.2	0.60	0.066	60.4	3
95th %ile	1.70	0.15	0.68	4.74	4.23	1.03	0.0027	9.0	7.5	0.66	0.112	68.5	3.20
99th %ile	2.07	0.21	0.70	5.65	4.76	1.36	0.0040	10.8	8.7	0.93	0.166	81.8	3.37

1. Results for cyanide are Nov 2005-December 2007 only, all at low detection limit.
2. "13267" monitoring dataset, one sample/month.
3. Non-detect values with high detection limits were excluced.

Table A-2
San Jose/Santa Clara WPCP Organics Data, 2002 - 2007

All values are ug/L except dioxins and furans, which are pg/L
Shaded values are those withat least one detected or DNQ value.

CTR	Pollutant	Total # Values	# of Qual. Values[1]	Average[2]	Maximum[3]
17	Acrolein	5	5	< 1.73	< 5
18	Acrylonitrile	5	5	< 1.09	< 2
19	Benzene	5	5	< 0.26	< 0.7
20	Bromoform (Tribromomethane)	7	2	< 0.37	0.69
21	Carbon tetrachloride	5	5	< 0.28	< 0.75
22	Chlorobenzene	5	5	< 0.25	< 0.63
23	Chlorodibromomethane	8	0	1.93	3.5
24	Chloroethane (Ethyl Chloride)	5	5	< 0.31	< 0.92
25	2-Chloroethylvinylether	5	5	< 0.32	< 1
26	Chloroform	12	0	4.87	10
27	Dichlorobromomethane	8	0	3.49	5.9
28	1,1-dichloroethane (ethylidene chloride)	5	5	< 0.27	< 0.73
29	1,2-Dichloroethane	5	5	< 0.28	< 0.75
30	1,1-Dichloroethylene	5	5	< 0.29	< 0.74
31	1,2-Dichloropropane	5	5	< 2.16	< 10
33	Ethylbenzene	5	5	< 0.26	< 0.65
34	Bromomethane (Methyl Bromide)	4	4	< 0.37	< 0.84
35	Chloromethane (Methyl Chloride)	5	4	< 0.33	0.04
36	Methylene Chloride	7	2	< 0.34	0.8
37	1,1,2,2-Tetrachloroethane	5	5	< 0.29	< 0.79
38	Tetrachloroethylene	5	5	< 0.29	< 0.82
39	Toluene	7	2	< 0.54	0.9
40	TRANS-1,2-dichloroethylene	5	5	< 0.29	< 0.77
41	1,1,1-Trichloroethane (Methyl Chloroform)	5	5	< 0.27	< 0.75
42	1,1,2-Trichloroethane (Vinyl Trichloride)	5	5	< 0.28	< 0.73
43	Trichloroethene	5	5	< 0.27	< 0.69
44	Vinyl chloride	5	5	< 0.33	< 1
45	2-Chlorophenol	7	7	< 0.80	< 2
46	2,4-Dichlorophenol	7	7	< 0.78	< 1
47	2,4-Dimethylphenol (Xylenol Isomer)	7	7	< 0.93	< 2
48	4,6,-Dinitro-2-methylphenol	7	7	< 1.56	< 5
49	2,4,- Dinitrophenol	6	6	< 1.05	< 1.2
50	2-Nitrophenol	7	7	< 1.85	< 5
51	4-Nitrophenol	7	7	< 1.36	< 5
52	4-chloro-3-methylphenol	7	7	< 0.79	< 1
53	Pentachlorophenol	7	7	< 1.00	< 1.7
54	Phenol	7	7	< 0.63	< 1
55	2,4,6-Trichlorophenol	7	7	< 1.44	< 5
56	Acenaphthene	9	9	< 0.09	< 0.3
57	acenaphtylene	19	19	< 0.11	< 0.27
58	anthracene	19	19	< 0.27	< 3
59	Benzidine	7	7	< 3.06	< 10
60	1,2,-benzo(a)Anthracene	19	19	< 0.14	< 0.3
61	benzo[a]pyrene	19	19	< 0.16	< 0.3
62	3,4-benzo(b)fluoranthene	24	24	< 0.15	< 0.3
63	1,12-benzo(g,h,i)perylene	19	19	< 0.11	< 0.31
64	benzo[k]fluoranthene	19	19	< 0.13	< 0.3
65	Bis(2-chloroethoxy)methane	7	7	< 1.21	< 5
66	Bis(2-chloroethyl)ether	7	7	< 1.26	< 5

CTR	Pollutant	Total # Values	# of Qual. Values[1]	Average[2]	Maximum[3]
67	Bis(2-chlorisopropyl)ether	7	7	< 1.18	< 5
68	Bis(2-ethylhexyl)phthalate	8	5	< 0.81	2
69	4-Bromophenyl-Phenylether	7	7	< 1.27	< 5
70	Butylbenzyl Phthalate (BBP)	7	7	< 1.61	< 5
71	2-Chloronaphthalene	7	7	< 1.27	< 5
72	4-Chlorophenyl-Phenylether	7	7	< 1.21	< 5
73	chrysene	19	19	< 0.14	< 0.401
74	dibenzo[ah]Anthracene	19	19	< 0.11	< 0.282
75	1,2-Dichlorobenzene	5	5	< 0.28	< 0.77
76	1,3-Dichlorobenzene	5	5	< 2.15	< 10
77	1,4-Dichlorobenzene	6	3	< 2.00	10
78	3,3-Dichlorobenzidine	7	7	< 1.60	< 5
79	Diethyl phthalate	7	7	< 0.90	< 2
80	Dimethyl phthalate	7	7	< 0.77	< 2
81	Di-n-butyl Phthalate	7	7	< 1.23	< 5
82	2,4-Dinitrotoluene	7	7	< 1.32	< 5
83	2,6-Dinitrotoluene	7	7	< 1.22	< 5
84	DI-N-Octyl Phthalate (Dioctyl Phthalate)	7	7	< 1.63	< 5
85	1,2-Diphenylhydrazine	7	7	< 0.66	< 1
86	Fluoranthene	9	9	< 0.04	< 0.05
87	fluorene	19	19	< 0.08	< 0.146
88	Hexachlorobenzene	11	11	< 0.89	< 2.5
89	Hexachlorobutadiene	7	7	< 0.67	< 1
90	Hexachlorocyclopentadiene	7	7	< 1.95	< 5
91	Hexachloroethane	7	7	< 0.86	< 1.33
92	indeno[1,2,3-cd]pyrene	24	24	< 0.06	< 0.24
93	Isophorone	7	7	< 0.60	< 1
94	Naphthalene (Tar Camphor)	9	9	< 0.08	< 0.2
95	Nitrobenzene (Oil of Mirbane)	7	7	< 0.69	< 1
96	N-nitrosodimethylamine	7	7	< 1.39	< 5
97	N-Nitrosodi-N-Propylamine	7	7	< 0.73	< 1
98	N-nitrosodiphenylamine	7	7	< 0.58	< 1
99	phenanthrene	19	19	< 0.06	< 0.171
100	pyrene	19	19	< 0.06	< 0.205
101	1,2,4-Trichlorobenzene	7	7	< 1.36	< 5
102	Aldrin	13	12	< 0.01	0.032
103	A-BHC	7	6	< 0.00	0.0046
104	B-BHC	6	6	< 0.00	< 0.005
105	G-BHC (Lindane)	6	6	< 0.00	< 0.01
106	Delta-BHC (C-BHC)	6	6	< 0.00	< 0.005
107	Chlordane	10	10	< 0.02	< 0.1
108	4,4'-DDT	6	6	< 0.00	< 0.01
109	4,4'-DDE	10	10	< 0.01	< 0.01
110	4,4'-DDD	6	6	< 0.00	< 0.01
111	Dieldrin	14	14	< 0.01	< 0.01
112	Endosulfan (alpha)	6	6	< 0.00	< 0.01
113	Endosulfan (beta)	6	6	< 0.00	< 0.01
114	Endosulfan Sulfate	7	6	< 0.01	0.016
115	Endrin	10	10	< 0.01	< 0.02
116	Endrin Aldehyde	6	6	< 0.00	< 0.01
117	Heptachlor	11	10	< 0.01	0.038
118	Heptachlor Epoxide	14	14	< 0.01	< 0.1
119	PCB-1016 (Aroclor)	10	10	< 0.09	< 0.2
120	PCB-1221 (Aroclor)	10	10	< 0.11	< 0.2

CTR	Pollutant	Total # Values	# of Qual. Values[1]	Average[2]	Maximum[3]
121	PCB-1232 (Aroclor)	6	6	< 0.04	< 0.06
122	PCB-1242 (Aroclor)	10	10	< 0.10	< 0.2
123	PCB-1248 (Aroclor)	10	10	< 0.10	< 0.2
124	PCB-1254 (Aroclor)	10	10	< 0.09	< 0.2
125	PCB-1260 (Aroclor)	10	10	< 0.09	< 0.2
126	Toxaphene	10	10	< 0.36	< 2
16a	2,3,7,8-TCDD	11	11	< 0.42	< 1.25
16b	1,2,3,7,8-PeCDD	9	9	< 0.80	< 2.81
16c	1,2,3,4,7,8-HxCDD	9	9	< 0.61	< 1.75
16d	1,2,3,6,7,8-HxCDD	9	9	< 0.69	< 1.87
16e	1,2,3,7,8,9-HxCDD	9	9	< 0.87	< 2.71
16f	1,2,3,4,6,7,8-HpCDD	9	8	< 1.54	6.77
16g	OCDD	10	4	< 7.74	51.6
16h	2,3,7,8-TCDF	10	8	< 1.23	6.25
16i	1,2,3,7,8-PeCDF	9	9	< 0.67	< 2.25
16j	2,3,4,7,8-PeCDF	9	9	< 0.65	< 2.38
16k	1,2,3,4,7,8-HxCDF	9	9	< 0.71	< 2.38
16l	1,2,3,6,7,8-HxCDF	9	9	< 0.67	< 2.44
16m	2,3,4,6,7,8-HxCDF	9	9	< 0.71	< 3.06
16n	1,2,3,7,8,9-HxCDF	9	9	< 0.70	< 2.31
16o	1,2,3,4,6,7,8-HpCDF	9	8	< 1.14	3.57
16p	1,2,3,4,7,8,9-HpCDF	9	9	< 0.83	< 3.13
16q	OCDF	9	6	< 1.85	7.34
16-TEQ	TCDD-TEQ[4]	9	2	< 0.083	**0.394**
32-cis	cis-1,3-Dichloropropene	5	5	< 0.25	< 0.63
32-tran	trans-1,3-Dichloropropene	5	5	< 0.26	< 0.66
A	Trybutyltin[5]	63	61	< 0.002	0.005
B	Chlorpyrifos	6	6	< 0.038	< 0.064
C	Diazinon	5	5	< 0.041	< 0.067

1. Qualified values defined as "ND" or "<".
2. Averages computed with "ND" and "<" values evaluated at the detection limit. DNQs evaluated at the estimated value.
3. Where dataset consists of both detected and non-detected values, the highest detected value is listed.
4. Second highest value in database. Highest value (<0.603 pg/L) appears to have been incorrectly calculated.
5. Two high detection limit tributyltin values (<0.01) excluded from summary statistics.

Table A-3. SJ/SC Dioxins and Furans Data from Water Board Electronic Reporting System (ERS), 2002 - 2007

CTR	Pollutant	TEF	05-Mar-02	03-Sep-02	04-Mar-03	08-Mar-04	08-Mar-05
16a	2,3,7,8-TCDD	1	< 0.233	< 0.565	< 0.355	ND 0.465 *	< 1.25
16b	1,2,3,7,8-PeCDD	1	< 0.938	< 0.369	< 0.584	ND 2.81	
16c	1,2,3,4,7,8-HxCDD	0.1	< 0.666	< 0.584	< 0.208	ND 1.75	
16d	1,2,3,6,7,8-HxCDD	0.1	< 0.763	< 0.594	< 0.212	ND 1.87	
16e	1,2,3,7,8,9-HxCDD	0.1	< 0.662	< 0.586	< 0.361	ND 2.71	
16f	1,2,3,4,6,7,8-HpCDD	0.01	< 0.901	< 0.816	< 0.357	ND 3.05	
16g	OCDD	0.0001	9.7	2.38	< 1.32	2.68	DNQ 1.58
16h	2,3,7,8-TCDF	0.1	0.343	< 0.481	3.94	ND 0.294 *	< 6.25
16i	1,2,3,7,8-PeCDF	0.05	< 0.474	< 0.568	< 0.243	ND 2.25	
16j	2,3,4,7,8-PeCDF	0.5	< 0.406	< 0.461	< 0.245	ND 2.38	
16k	1,2,3,4,7,8-HxCDF	0.1	< 0.396	< 0.163	< 0.686	ND 2.38	
16l	1,2,3,6,7,8-HxCDF	0.1	< 0.4	< 0.167	< 0.687	ND 2.44	
16m	2,3,4,6,7,8-HxCDF	0.1	< 0.448	< 0.197	< 0.542	ND 3.06	
16n	1,2,3,7,8,9-HxCDF	0.1	< 0.552	< 0.304	< 0.579	ND 2.31	
16o	1,2,3,4,6,7,8-HpCDF	0.01	< 0.73	< 0.314	< 0.435	ND 3.57	
16p	1,2,3,4,7,8,9-HpCDF	0.01	< 1.06	< 0.426	< 0.697	ND 3.13	
16q	OCDF	0.0001	< 1.05	< 1.18		2.06	DNQ 0.611
16-TEQ	TCDD-TEQ, reported		< **0.035**	**0.00024**	< **0.603**	**0.000268**	**0.000219**
16-TEQ	TCDD-TEQ, EOA calc.		**0.035**	**0.00024**	**0.394**	**0.000474**	**0.000219**

CTR	Pollutant	TEF	07-Sep-05	07-Mar-06	07-Sep-06	06-Mar-07	05-Sep-07
16a	2,3,7,8-TCDD	1	< 0.3799406 *	< 0.145 *	< 0.192 *	< 0.192 *	< 0.192 *
16b	1,2,3,7,8-PeCDD	1	< 1.425828	< 0.568	< 0.0242	< 0.242	< 0.242
16c	1,2,3,4,7,8-HxCDD	0.1	< 1.330278	< 0.527	< 0.128	< 0.128	< 0.128
16d	1,2,3,6,7,8-HxCDD	0.1	< 1.857588	< 0.553	< 0.106	< 0.106	< 0.106
16e	1,2,3,7,8,9-HxCDD	0.1	< 2.034669	< 0.707	< 0.258	< 0.258	< 0.258
16f	1,2,3,4,6,7,8-HpCDD	0.01	< 1.315903	6.77	< 0.231	< 0.231	< 0.231
16g	OCDD	0.0001	DNQ 2.53	51.6	< 1.86	< 1.86	< 1.86
16h	2,3,7,8-TCDF	0.1	< 0.3899127 *	< 0.148 *	< 0.135 *	< 0.135 *	< 0.135 *
16i	1,2,3,7,8-PeCDF	0.05	< 1.255998	< 0.758	< 0.172	< 0.172	< 0.172
16j	2,3,4,7,8-PeCDF	0.5	< 1.491278	< 0.35	< 0.172	< 0.172	< 0.172
16k	1,2,3,4,7,8-HxCDF	0.1	< 1.618956	< 0.41	< 0.236	< 0.236	< 0.236
16l	1,2,3,6,7,8-HxCDF	0.1	< 1.333902	< 0.505	< 0.163	< 0.163	< 0.163
16m	2,3,4,6,7,8-HxCDF	0.1	< 1.13	< 0.376	< 0.198	< 0.198	< 0.198
16n	1,2,3,7,8,9-HxCDF	0.1	< 1.52	< 0.573	< 0.154	< 0.154	< 0.154
16o	1,2,3,4,6,7,8-HpCDF	0.01	< 1.796544	DNQ 2.45	< 0.333	< 0.333	< 0.333
16p	1,2,3,4,7,8,9-HpCDF	0.01	< 1.082697	< 0.43	< 0.206	< 0.206	< 0.206
16q	OCDF	0.0001	< 3.151752	7.34	< 0.405	< 0.405	< 0.405
16-TEQ	TCDD-TEQ, reported		**0.00596**	**0.0981**	**0.000**	**0.000**	**0.000**
16-TEQ	TCDD-TEQ, EOA calc.		**0.000253**	**0.0981**	**0.000**	**0.000**	**0.000**

* Values were reported in the ERS on both "E-001" and "EPA 1613" sheets, but at different reporting limits. The value with the lower reporting limit was listed.

In addition to the above, a value for 2,3,7,8-TCDD of <0.637 pg/L was reported (on the ERS E-001 sheet) on 9/8/04. Discrepancies in calculated TEQ values are highlighted.

Table A-4. Summary of WPCP Final Effluent Concentration Data for Conventional Pollutants, 2004-2007

All results are mg/L

	CBOD Daily	CBOD Monthly	TSS Daily	TSS Monthly	NH3	Oil & Grease
# of samples	461	48	645	48	48	25
# ND's	104	22	97	22	2	22
Minimum	2.00	2.00	1.00	1.05	0.21	5.0
Maximum	5.00	4.25	12.90	7.14	0.90	5.0
Median	3.00	2.83	1.70	1.68	0.40	5.0
Geo. Mean	2.64	2.76	1.68	1.69	0.42	5.0
Average	2.75	2.81	1.98	1.84	0.44	5.0
Std. Deviation	0.82	0.58	1.58	1.02	0.12	0.0
Coeff. of Variation	0.30	0.20	0.80	0.56	0.28	0.0
90th %ile	4.00	3.37	3.00	2.33	0.60	5.0
95th %ile	4.00	3.97	6.18	2.61	0.60	5.0
99th %ile	5.00	4.31	8.91	6.20	0.76	5.0

Ammonia and O&G values represent both daily maximum and monthly average.

Percentiles are based on ranked individual values (Excel percentile function).

Attachment B

Example Spreadsheet Model Printouts and Summary of Model Results

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Table B-1a. Impact of RO Reject on WPCP Final Effluent Quality (Metals and Cyanide)

RO Permeate Flow = 32 mgd; Final Effluent Data are 95%ile Values

Specified Values:		
RO Permeate Flow =	32.0	mgd
Secondary Effluent Flow =	115.3	mgd[1]
Tert. Effl/RO Perm. Blend Ratio	1.8	
RO Flow Recovery =	85%	
Final Effluent Conc. Data =	95%ile	values[2]

RO Feed Flow =	37.65	mgd
Adj. Secondary Effluent Flow =	57.7	mgd (Flow after deducting Tert. Effl./RO Bypass Flow)
Tert. Effl./RO Bypass Flow =	57.6	mgd
RO Reject Flow =	5.65	mgd
Total RW Blended Flow =	89.6	mgd (Includes RO Bypass Flow + RO Permeate Flow)
Combined Final Effluent Flow =	25.7	mgd (Final E-001 Discharge Flow Including RO Reject)

Pollutant	Historic Final Effluent[2]		RO Feed		RO	Permeate		RO Concentrate		Combined Final Effluent[2]		NPDES Permit Limits	Adj. CTR WQOs for RPA
	Conc. ug/l	Mass lb/day	Conc. ug/l	Mass lb/day	Rejection[4] %	Conc. ug/l	Mass lb/day	Conc. ug/l	Mass lb/day	Conc. ug/l	Mass lb/day	ug/l	ug/l
Arsenic	1.70	0.82	1.70	0.535	99%	0.02	0.005	11.2	0.529	3.80	0.81		36
Cadmium	0.15	0.07	0.15	0.046	99%	0.00	0.000	0.97	0.046	0.328	0.07		7
Chromium VI	0.68	0.33	0.68	0.214	99%	0.01	0.002	4.5	0.212	1.52	0.33		200
Copper - max. daily	4.74	2.28	4.74	1.489	99%	0.06	0.015	31.3	1.474	10.6	2.27	18	
Copper - avg. monthly	4.23	2.03	4.23	1.328	99%	0.05	0.013	27.9	1.314	9.43	2.02	12	13[7]
Lead	1.03	0.50	1.03	0.323	99%	0.01	0.003	6.8	0.320	2.30	0.49		8.52
Mercury[5]	0.0027	0.0013	0.0027	0.0009	99%	0.000	0.000	0.018	0.0008	0.0061	0.0013	0.023	0.051
Nickel - max. daily	9.00	4.33	9.00	2.826	99%	0.11	0.028	59.4	2.798	20.1	4.30	34	
Nickel - avg. monthly	7.48	3.60	7.48	2.347	99%	0.09	0.023	49.3	2.324	16.7	3.57	25	27[7]
Selenium	0.66	0.32	0.66	0.208	99%	0.01	0.002	4.4	0.206	1.48	0.32		5
Silver	0.112	0.054	0.11	0.035	99%	0.00	0.000	0.7	0.035	0.250	0.054		2.24
Zinc	68	33.0	68	21.50	99%	0.8	0.215	452	21.29	153	32.7		170
Cyanide-SSO/BPA[6]	3.2	1.54	3.2	1.003	99%	0.0	0.010	21	0.993	**7.1**	1.53	7.0	2.9[7]

Notes:

1. Equivalent to the secondary effl. flow (minus MF backwash) before any recycled water or RO system diversions. Value listed is avg. from minimum discharge flow month (8/2005).
2. Historic NPDES effluent from RWQCB ERS database, used to represent Sec. Effluent prior to RO System. Based on individual values from Jan 2004 - Dec 2006, except as noted in text.
3. Combined Final effluent (including RO reject) to outfall E-001. Values that exceed NPDES Permit or WQO-based limits are indicated in **bold**.
4. Defined as: Rejection = (1-Permeate Conc./Feed Conc) * 100. Note: Other definitions are sometimes used for rejection.
5. Mercury data is from "13267" dataset, monthly average values. Effluent limit is from Mercury Watershed Permit (AMEL).
6. Expected average monthly effluent limit (AMEL) under cyanide Site Specific Objectives/Basin Plan Amendment. Dataset is low DL "13267" monitoring data only.
7. Based on a constant TDS value of 750 mg/L at all percentiles. Rejection rate (93.3%) is the expected long-term value.

Table B-1b. Impact of RO Reject on WPCP Final Effluent Quality (Conventional Pollutants)

RO Permeate Flow = 32 mgd; Final Effluent Data are 99%ile Values

Specified Values:		
RO Permeate Flow =	32.0	mgd
Secondary Effluent Flow =	115.3	mgd[1]
Tert. Effl/RO Perm. Blend Ratio	1.8	
RO Flow Recovery =	85%	
Final Effluent Conc. Data =	99%ile	values[2]

RO Feed Flow =	37.65	mgd
Adj. Secondary Effluent Flow =	57.7	mgd (Flow after deducting Tert. Effl./RO Bypass Flow)
Tert. Effl./RO Bypass Flow =	57.6	mgd
RO Reject Flow =	5.65	mgd
Total RW Blended Flow =	89.6	mgd (Includes RO Bypass Flow + RO Permeate Flow)
Combined Final Effluent Flow =	25.7	mgd (Final E-001 Discharge Flow Including RO Reject)

Pollutant	**Historic Final Effluent[2]**		**RO Feed**		**RO Rejection[4]**	**RO Concentrate**		**Combined Final Effluent[2]**		**NPDES Permit Limits**
	Conc. mg/l	**Mass lb/day**	**Conc. ug/l**	**Mass lb/day**	**%**	**Conc. ug/l**	**Mass lb/day**	**Conc. ug/l**	**Mass lb/day**	**mg/l**
CBOD - max. daily	5.00	2406	5.00	1570	99%	33.0	1554	11.15	2390	20
CBOD - avg. monthly	4.31	2073	4.31	1353	99%	28.4	1339	9.61	2060	10
TSS - max. daily	8.91	4289	8.91	2798	99%	58.8	2770	19.88	4261	20
TSS - avg. monthly	6.20	2981	6.20	1945	99%	40.9	1926	**13.82**	2962	10
Ammonia-N	0.76	365	0.76	238	90%	4.6	214	1.59	341	3
TDS	750	360,914	750	235,482	93%	4,665	219,705	1,610	345,136	-

Notes:

1. Equivalent to the secondary effl. flow (minus MF backwash) before any recycled water or RO system diversions. Value listed is avg. from minimum discharge flow month (8/2005).
2. Historic NPDES effluent from RWQCB ERS database, used to represent Sec. Effluent prior to RO System. Based on individual values from Jan 2004 - Dec 2006, except as notec
3. Combined Final effluent (including RO reject) to outfall E-001. Values that exceed NPDES Permit or WQO-based limits are indicated in **bold**.
4. Defined as: Rejection = (1-Permeate Conc./Feed Conc) * 100. Note: Other definitions are sometimes used for rejection.

Table B-2. Mass Balance Results for 8 MGD RO Permeate Project

	WPCP Blended Effluent Concentration, ug/L				Effluent Limit or WQO
	Average	90%ile	95%ile	99%ile	
Arsenic	1.23	1.6	1.8	2.2	36
Cadmium	0.050	0.09	0.16	0.22	7
Chromium VI	0.57	0.72	0.74	0.76	200
Copper - daily max.	3.2	4.8	5.1	6.1	18
Copper - monthly avg	2.91	4.4	4.6	5.2	12
Lead	0.50	0.9	1.1	1.5	8.5
Mercury	0.0019	0.0026	0.0030	0.0044	0.025
Nickel - daily max	6.9	8.7	9.8	11.7	34
Nickel - monthly avg	6.8	7.8	8.1	9.4	25
Selenium	0.47	0.65	0.72	1.01	5
Silver	0.042	0.07	0.12	0.18	2
Zinc	41	66	74	89	170
Cyanide	2.4	3.3	3.5	3.7	7

	WPCP Effluent Concentration, mg/L				Effluent Limit
	Average	90%ile	95%ile	99%ile	
CBOD - daily max	3.0	4.3	4.3	5.4	20
CBOD - monthly avg	3.1	3.7	4.3	4.7	10
TSS - daily max	2.2	3.3	6.7	9.7	20
TSS - monthly avg	2.0	2.5	2.8	6.7	10
Ammonia-N	0.5	0.6	0.6	0.8	3.0
TDS	809	-	-	-	-

Specified Values:

RO Permeate Flow = 8 mgd
Sec. Effluent Flow = 115.3 mgd
Tert. Effluent / RO Perm. Blend Ratio = 1.8
RO Flow Recovery = 85%

Calculated Flows (mgd)

RO Feed Flow = 9.41
Adj. Secondary Effluent Flow = 100.9
Tert. Effl./RO Bypass Flow = 14.4
RO Reject Flow = 1.4
Total RW Blended Flow = 22.4
Combined Final Effl. Flow = 92.9

Table B-3. Mass Balance Results for 16 MGD RO Permeate Project

	WPCP Blended Effluent Concentration, ug/L				Effluent Limit or WQO
	Average	90%ile	95%ile	99%ile	
Arsenic	1.39	1.8	2.1	2.5	36
Cadmium	0.057	0.10	0.18	0.25	7
Chromium VI	0.65	0.82	0.84	0.85	200
Copper - daily max.	3.6	5.4	5.8	6.9	18
Copper - monthly avg	3.28	5.0	5.2	5.8	12
Lead	0.57	1.0	1.3	1.7	8.5
Mercury	0.0021	0.0029	0.0033	0.0049	0.025
Nickel - daily max	7.8	9.8	11.0	13.2	34
Nickel - monthly avg	7.7	8.8	9.2	10.6	25
Selenium	0.53	0.74	0.81	1.14	5
Silver	0.047	0.08	0.14	0.20	2
Zinc	47	74	84	100	170
Cyanide	2.7	3.7	3.9	4.1	7

	WPCP Effluent Concentration, mg/L				Effluent Limit
	Average	90%ile	95%ile	99%ile	
CBOD - daily max	3.4	4.9	4.9	6.1	20
CBOD - monthly avg	3.4	4.1	4.9	5.3	10
TSS - daily max	2.4	3.7	7.6	10.9	20
TSS - monthly avg	2.3	2.9	3.2	7.6	10
Ammonia-N	0.5	0.7	0.7	0.9	3.0
TDS	907	-	-	-	-

Specified Values:

RO Permeate Flow = 16 mgd
Sec. Effluent Flow = 115.3 mgd
Tert. Effluent / RO Perm. Blend Ratio = 1.8
RO Flow Recovery = 85%

Calculated Flows (mgd)

RO Feed Flow = 18.8
Adj. Secondary Effluent Flow = 86.5
Tert. Effl./RO Bypass Flow = 28.8
RO Reject Flow = 2.8
Total RW Blended Flow = 44.8
Combined Final Effl. Flow = 70.5

Table B-4. Mass Balance Results for 24 MGD RO Permeate Project

	WPCP Blended Effluent Concentration, ug/L				Effluent Limit or WQO
	Average	90%ile	95%ile	99%ile	
Arsenic	1.69	2.2	2.5	3.1	36
Cadmium	0.069	0.12	0.22	0.31	7
Chromium VI	0.79	0.99	1.02	1.04	200
Copper - daily max.	4.3	6.6	7.1	8.4	18
Copper - monthly avg	4.00	6.1	6.3	7.1	12
Lead	0.69	1.2	1.5	2.0	8.5
Mercury	0.0026	0.0035	0.0041	0.0060	0.025
Nickel - daily max	9.5	11.9	13.4	16.1	34
Nickel - monthly avg	9.3	10.7	11.2	13.0	25
Selenium	0.64	0.90	0.99	1.39	5
Silver	0.057	0.10	0.17	0.25	2
Zinc	57	90	102	122	170
Cyanide	3.2	4.5	4.8	5.0	7

	WPCP Effluent Concentration, mg/L				Effluent Limit
	Average	90%ile	95%ile	99%ile	
CBOD - daily max	4.1	6.0	6.0	7.5	20
CBOD - monthly avg	4.2	5.0	5.9	6.4	10
TSS - daily max	3.0	4.5	9.2	13.3	20
TSS - monthly avg	2.7	3.5	3.9	9.3	10
Ammonia-N	0.6	0.9	0.9	1.1	3.0
TDS	1095	-	-	-	-

Specified Values:

RO Permeate Flow = 24 mgd
Sec. Effluent Flow = 115.3 mgd
Tert. Effluent / RO Perm. Blend Ratio = 1.8
RO Flow Recovery = 85%

Calculated Flows (mgd)

RO Feed Flow = 28.2
Adj. Secondary Effluent Flow = 72.1
Tert. Effl./RO Bypass Flow = 43.2
RO Reject Flow = 4.2
Total RW Blended Flow = 67.2
Combined Final Effl. Flow = 48.1

Table B-5. Mass Balance Results for 32 MGD RO Permeate Project

	WPCP Blended Effluent Concentration, ug/L				Effluent Limit or WQO
	Average	**90%ile**	**95%ile**	**99%ile**	
Arsenic	2.5	3.3	3.8	4.6	36
Cadmium	0.10	0.18	0.33	0.46	7
Chromium VI	1.18	1.48	1.52	1.55	200
Copper - daily max.	6.5	9.8	10.6	12.6	18
Copper - monthly avg	6.0	9.1	9.4	10.6	12
Lead	1.0	1.8	2.3	3.0	8.5
Mercury	0.0039	0.0053	0.0061	0.0090	0.025
Nickel - daily max	14.3	17.8	20.1	24.1	34
Nickel - monthly avg	13.9	16.0	16.7	19.4	25
Selenium	0.96	1.35	1.48	2.08	5
Silver	0.09	0.15	0.25	0.37	2
Zinc	85	135	153	**182**	170
Cyanide	4.8	6.7	**7.1**	**7.5**	7

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	WPCP Effluent Concentration, mg/L				Effluent Limit
	Average	**90%ile**	**95%ile**	**99%ile**	
CBOD - daily max	6.1	8.9	8.9	11.2	20
CBOD - monthly avg	6.3	7.5	8.9	9.6	10
TSS - daily max	4.4	6.7	13.8	19.9	20
TSS - monthly avg	4.1	5.2	5.8	**13.8**	10
Ammonia-N	0.9	1.3	1.3	1.6	3.0
TDS	1610	-	-	-	-

Specified Values:

RO Permeate Flow = 32 mgd
Sec. Effluent Flow = 115.3 mgd
Tert. Effluent / RO Perm. Blend Ratio = 1.8
RO Flow Recovery = 85%

Calculated Flows (mgd)

RO Feed Flow = 37.65
Adj. Secondary Effluent Flow = 57.7
Tert. Effl./RO Bypass Flow = 57.6
RO Reject Flow = 5.65
Total RW Blended Flow = 89.6
Combined Final Effl. Flow = 25.7

Appendix C
RO Pilot Toxicity Test Workplan

Eisenberg, Olivieri & Associates
Environmental and Public Health Engineering

TECHNICAL MEMORANDUM

TO: Sanjay Reddy and Dan Lopez, Black & Veatch

FROM: Tom Hall, EOA
Scott Ogle, PER

DATE: October 30, 2009

SUBJECT: **South Bay Advanced Recycled Water Treatment Facility Project – DRAFT PILOT TOXICITY TESTING WORKPLAN**

INTRODUCTION

The Santa Clara Valley Water District (SCVWD) and San Jose/Santa Clara Water Pollution Plant (WPCP) are planning to construct a facility to reduce salinity levels in recycled water (RW) produced at the WPCP. The facility will utilize microfiltration (MF) and reverse osmosis (RO) to meet Title 22 filtration requirements for disinfected tertiary RW and to reduce salinity levels in the recycled water (RW) product. RW from these systems will be disinfected and delivered to the South Bay Water Recycling distribution system. The MF waste stream will be returned to the plant for processing, while the RO waste stream (RO reject) will be recombined with the WPCP effluent stream for discharge to the Bay.

Previously, EOA examined the likely impact of the RO reject on final effluent quality from the WPCP. The analysis considered conventional pollutants (CBOD, TSS and ammonia) and toxic pollutants which are regulated (or potentially regulated) under the WPCP's NPDES Permit. The analysis used a mass balance model to determine pollutant concentrations in the RO reject and the combined final plant effluent discharge streams. The projections were based on historic WPCP effluent quality and flow data, plus projected flows and performance data for the MF/RO system.

The initial analysis was for a Phase 1 project that would blend 8 mgd of RO product (permeate) with a slightly greater amount of tertiary effluent, to produce a total of 16.8 mgd blended recycled water. The project was shown to have only a minor impact on pollutant concentrations in the final effluent discharged to the Bay, raising concentrations by about 8% from current levels (see May 22, 2007 EOA Technical Memorandum). Under those assumed flow and operational conditions, the combined final effluent would contain approximately 1.4 percent RO reject.

The current 8 mgd scenario calls for an increase in the volume of tertiary effluent to be blended with the RO permeate from 8.7 mgd to 14.4 mgd (1.8 to 1 blend ratio) to achieve a target blended recycled water TDS concentration of approximately 500 mg/L. This scenario slightly raises the amount of RO reject in the combined effluent, to 1.5% (Figure 1).

In September 2009, EOA conducted a similar mass balance evaluation of the impacts of a potential future 32 mgd RO permeate project. This 32 mgd project would continue to blend 8 mgd of RO permeate with tertiary effluent (i.e. Phase 1 project) but direct the remaining 24 mgd for other future uses (Figure 2). Under the otherwise same assumed flow and operational conditions as in Phase 1, the combined final effluent of the 32 mgd project would contain approximately 8.7 percent RO reject.

{Note: If all the 32 mgd of RO permeate were instead blended with tertiary effluent for delivery into the recycled water distribution system, the effluent would contain about 20 percent RO reject. See EOA Technical Memo of March 28, 2008.}

Figures 1 and 2 are WPCP process flow schematics of the currently proposed 8 and 32 mgd RO systems, respectively, showing key elements of the mass balance analysis. Feedwater flows to the MF/RO system will be from the WPCP secondary effluent stream. MF backwash will be returned to the plant headworks. The RO reject stream will be routed to the head of the serpentine chlorine contact tanks and blended with the tertiary filtered effluent. The combined chlorinated RO reject/tertiary effluent stream will be dechlorinated and discharged to the Bay at the permitted EFF-001 discharge location. The RO permeate will be combined with the "RO Bypass" stream (filtered tertiary effluent). These streams will be disinfected to meet Title 22 requirements and pumped into the recycled water distribution system. For the 32 mgd RO permeate project, 24 mgd of the RO permeate will be delivered for other future uses (i.e. other than for TDS blend down).

Figure 1. Process Flow Schematic - 8 mgd RO Permeate Project

Final Effluent Contains 1.5% RO Reject

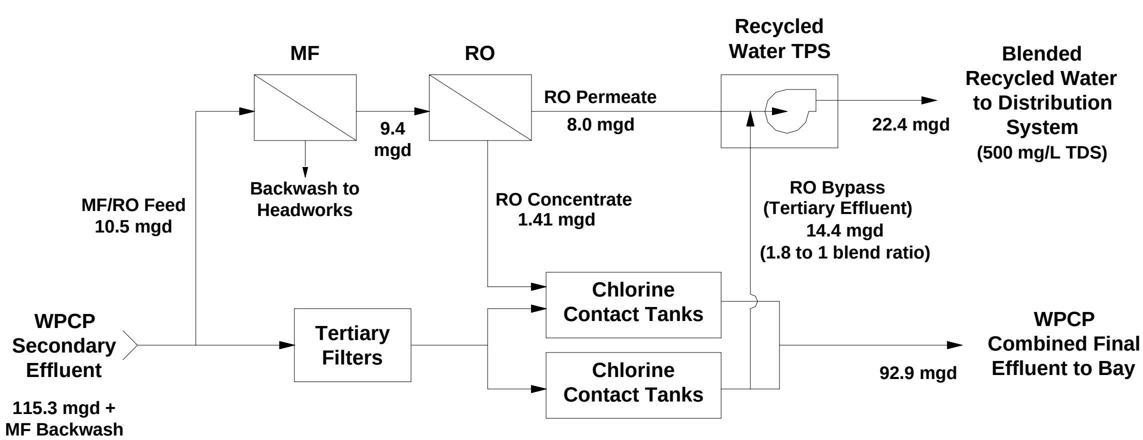
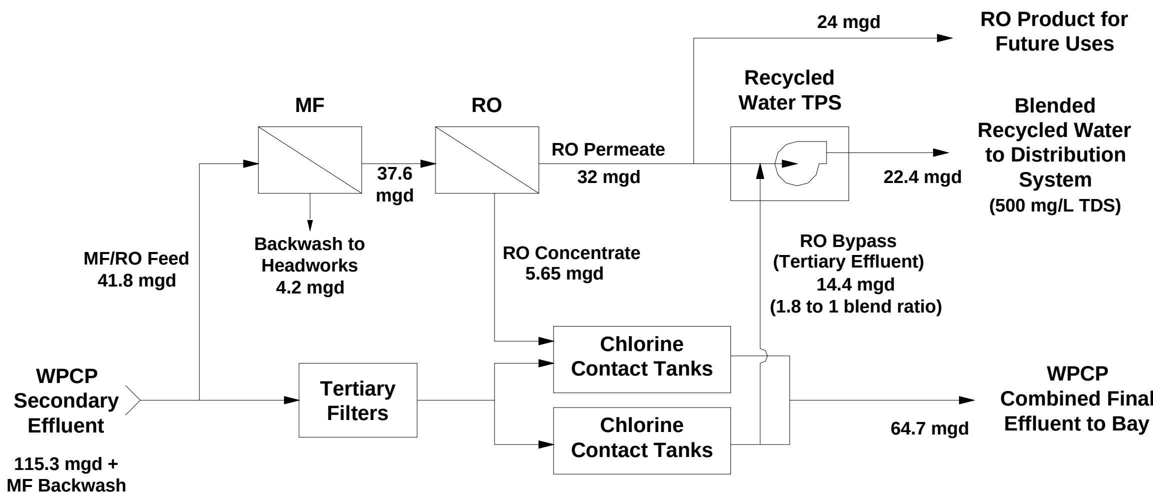


Figure 2. Process Flow Schematic - 32 mgd RO Permeate Project
Final Effluent Contains 8.7% RO Reject



RO PILOT TESTING

Whole Effluent Toxicity

As noted above, mass balance spreadsheet models were developed and used to evaluate projected blended effluent concentrations under different design and operational scenarios. There were no likely compliance issues identified based on comparison of projected blended effluent qualities to current and probable future NPDES permit effluent limits.

However, it is not possible to use this mass balance approach to predict in advance the potential impacts of RO reject/effluent blends on Whole Effluent Toxicity (WET) testing that is also required by the SJ/SC WPCP NPDES permit (Order No. R2-2009-0038). Neither acute nor chronic toxicity are amenable to analysis by the mass balance approach or by qualitative assessment. Therefore, to evaluate the effects the RO reject could have on the ability of the combined discharge to meet NPDES permit effluent acute and chronic WET requirements, screening level laboratory toxicity testing studies need to be undertaken using RO reject/final effluent blends generated from bench-top or pilot-scale RO units.

There are at least two other RO recycled water pilot projects that have previously been conducted in the Bay area in support of projects proposing to discharge RO reject into WPCP effluent streams. The City of Benicia intermittently operated on a batch basis a small pilot RO facility to generate RO reject used for testing the toxicity of a range of RO reject/effluent blends. EBMUD operated a 12-15 gpm pilot MF/RO continuously for about two months in mid-2005. EBMUD performed three rounds of acute toxicity testing and two rounds of chronic toxicity testing (and associated toxic pollutant testing) to assess the impact of adding RO reject to effluent discharged from the Chevron Richmond refinery wastewater treatment plant. Both the Benicia and EBMUD pilot project work plans were developed with consultant assistance and presented to Regional Water Board (RWB) staff to keep them apprised of the RO projects.

This workplan includes three rounds of approximately monthly 1) acute toxicity testing, 2) chronic toxicity testing, and 3) California Toxics Rule (CTR) priority pollutant testing beginning in December 2009 (Table 1). A contingency fourth round of testing has been provided in the event that unexpected test results occur, or in case there is interest in testing a different percentage RO reject to effluent blend (e.g., from a 16 mgd RO project), or in using a different source water (e.g., chlorinated/dechlorinated final effluent instead of undisinfected secondary effluent).

The basic pilot testing framework is shown in Table 1 below. Specific dates will be selected in consultation with the RO pilot testing workgroup. Toxicity testing will be conducted by Pacific EcoRisk (PER). For each round, static renewal acute toxicity tests run for 96-hours, chronic toxicity tests run from two to seven days, and priority pollutant samples will be collected on one day out of the seven day total test period. Ideally, the pilot testing dates would coincide (or at least overlap with) the dates of routine monthly acute (flow-through) and chronic toxicity testing conducted by the SJ/SC WPCP.

The monthly schedule shown assumes that the earliest that the pilot RO equipment could be purchased, delivered, installed, and fully operational would be early December. Thereafter it is assumed that it will take approximately one month for each round of testing to conduct the specified tests, generate and check the test results, review the results, determine what if any changes to make for the next round of testing, and for the logistical preparation needed to initiate the next round of RO operation and toxicity testing. While it may be possible to reduce this monthly interval slightly from a laboratory testing standpoint, various holidays during this period will complicate the scheduling logistics.

Table 1. Acute Toxicity, Chronic Toxicity and Priority Pollutant Testing Dates (2009 – 2010)

Testing Period	Acute Toxicity	Chronic Toxicity	Priority Pollutants
Round 1	December x – x	December x - x	December x
Round 2	January x – x	January x – x	January x
Round 3	February x - x	February x - x	February x
Round 4 (if required)	TBD	TBD	TBD

Final WPCP effluent and RO reject will need to be collected and generated, respectively, for seven consecutive days. This is necessary because three of the chronic toxicity tests extend for seven days (Table 2) and test protocols require that the test solutions for the test organisms be renewed daily with fresh sample from each 24-hour period. PER will make arrangements for picking up each day's samples at the WPCP and for preparing the RO reject and final effluent blends to be used for testing.

The estimated minimum necessary RO reject and final effluent sample volumes for the toxicity tests alone are shown in Table 2. Additional volumes (to be provided by SJ/SC WPCP laboratory staff) will be needed to conduct the priority pollutant and mineral analyses shown in Table 4. Preliminary estimates are that the additional volumes needed of each will be in the 10 liter range.

Table 2. Toxicity Testing Sample Volumes

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
RO Reject (L)	3	1.5	3	1.5	1.5	1.5	1.5
Final Effluent (L)	90	30	80	30	30	30	30

The tests listed in Table 3 are described below. As a QA measure, each test will include "Effluent Control" testing (which will consist of testing of the 100% effluent without any RO reject blended in) to determine if the effluent itself is contributing any toxicity; note that if the RO reject-effluent tests can be scheduled to run concurrently with ongoing SJ/SC WPCP WET testing, the SJ/SC WPCP test(s) could serve as the "Effluent Control" test(s).

Table 3. Toxicity Test Species and Number of Tests

Test Species	Test Duration (days)	Reference Toxicant Test	SJ/SC WPCP 100% Effluent	SJ/SC WPCP 100% Effluent Salinity Control	1.5% RO Reject/ SJ/SC Effluent Blend	9% RO Reject/ SJ/SC Effluent Blend
Acute Toxicity						
Rainbow Trout (*Onchorhynchus mykiss*)	4	3	3	0	3	3
Inland Silverside Minnow (*Menidia beryllina*)	4	3	3	0	3	3
Chronic Toxicity						
Water Flea (*Ceriodaphnia dubia*)	7	3	3	6	3	3
Fathead Minnow (*Pimephales promelas)*	7	3	3	6	3	3
Inland Silverside Minnow (*Menidia beryllina*)	7	3	3	0	3	3
Alga (marine diatom) (*Thalassiosira pseudonana*)	4	3	3	0	3	3
Mussel (optional) (*Mytilus galloprovincialis)*	2	TBD	TBD	0	TBD	TBD

a - The 1.5% RO reject blend test represents final effluent conditions that would be seen when operating the proposed 8 mgd RO permeate project.

b - The 9% RO reject blend test represents final effluent conditions that would be seen when operating the proposed 32 mgd RO permeate project.

c – For each round of testing, there will be two Salinity Controls tested for each of the freshwater species: one at the salinity of the 1.5% RO reject blend, and one at the salinity of the 9% RO reject blend.

As additional QA measures, “Salinity Controls” (in which the salinity of unadulterated SJ/SC WPCP effluent is adjusted to mirror that of the RO reject-effluent blends) will be run for the freshwater test organisms to determine if increases in test solution salinity due to addition of the RO reject is, in and of itself, responsible for any increase in toxicity (credit suggestion to Pete Schafer, San Jose); the “Salinity Controls” will be tested at the 100% effluent concentration only. Note that the SJ/SC WPCP NPDES permit requires concurrent reference toxicity testing to ensure that each particular batch of test organisms being used is responding to toxicant stress in a typical and consistent fashion (i.e., the organisms are not unusually less sensitive or more sensitive to toxicant stress); again, if the RO reject-effluent tests can be scheduled to run concurrently with ongoing SJ/SC WPCP WET testing, the SJ/SC WPCP’s reference toxicant tests(s) could serve as the reference toxicant testing for the RO reject-effluent test(s) as well.

Acute Toxicity Test Species. The SJ/SC WPCP NPDES permit requires monthly flow-through acute toxicity compliance monitoring in 100% effluent with rainbow trout (*Onchorhynchus mykiss*). It is not feasible to conduct flow-through testing under the pilot testing RO reject/effluent blend conditions. Therefore the contract laboratory will conduct acute (96-hour) static renewal (with renewal at 48 hours) testing with rainbow trout. Because mixing RO reject with WPCP effluent has the potential to increase the combined effluent salinity to levels that may stress freshwater fish such as rainbow trout, the estuarine/marine species *Menidia beryllina* (inland silversides) will also be tested in concurrent acute 96-hour static renewal acute bioassays (again with renewal at 48 hours).

The *Menidia* testing will help evaluate whether the increased (five- to seven-fold) salinity and/or altered relative concentrations of non-toxic minerals (e.g., calcium, magnesium, chlorides) from the RO reject may itself be a source of stress and toxicity to freshwater fish species. In the *Menidia* testing protocol, the test solution has high quality artificial sea salt added to the RO-reject-effluent blends to bring the salinity conditions up to that of the testing conditions.

If toxicity is observed in the freshwater test Salinity Controls, or if increased toxicity is observed with the freshwater species but not the estuarine species, that would support the hypothesis that it was the increased (or altered relative percentage) ion (salt) concentrations in the RO reject that were likely responsible. If increased toxicity were observed in both the rainbow trout/fathead minnow tests and the *Menidia* tests that might support an alternative hypothesis that elevated levels of toxic metals or organics in the RO reject were responsible.

Chronic Toxicity Test Species. The SJ/SC WPCP NPDES permit requires chronic toxicity compliance monitoring monthly with the freshwater crustacean *Ceriodaphnia dubia*. The NPDES permit specifies that "*The Discharger shall conduct tests with a control and five effluent concentrations (including 100% effluent) and using a dilution factor >/= 0.5*" and that a concurrent reference toxicant test be conducted with each test. All the chronic tests except the “Salinity Control” tests will be dilution series tests. If it turns out after Round 1 that the incremental salinity represented by the 1.5% and/or the 9% RO reject blends causes toxicity, dilution series may also be run in subsequent “Salinity Control” tests.

The WPCP typically conducts their chronic toxicity testing in-house. *Ceriodaphnia* has been found to be the most sensitive species based on several past (including the most recent 2007-2008) species screening studies that are required every five years by the NPDES permit. The other species tested in the last WPCP screening study were the fathead minnow, the mussel (*Mytilus*), *Menidia,* and the diatom *Thalassiosira,* per species screening study requirements that the testing include at least one plant, one invertebrate, and one fish.

An issue raised during prior RO reject pilot toxicity testing projects was that adding RO reject to the tertiary effluent might alter the character (e.g., ionic matrix) of the combined final effluent to the point where a different test species other than the current species might be more sensitive. To address this concern, three additional chronic species will be tested by the contract laboratory concurrently with their testing of the freshwater *Ceriodaphnia;* the freshwater fathead minnow, the marine/estuarine fish *Menidia* and marine diatom *Thalassiosira*.

Use of these four organisms (Table 3) almost replicates the suite of organisms used by the WPCP in the last chronic toxicity species screening study. The NPDES permit requires that another screening study by completed either by five years before the permit expires (i.e. by November 30, 2013) or "Subsequent to any significant change in the nature of the effluent discharged through changes in sources or treatment." If one additional species (such as *Mytilus*) were added to the Round 1 testing, the three rounds of monthly testing shown in Table 1 would then fulfill the requirements for the required screening test (i.e. one round of testing with five species and two rounds conducted monthly using the three most sensitive species found in the first round) and could save the SJ/SC WPCP the costs of doing another chronic species screening study at some later time prior to the 2013 deadline.

Priority Pollutant Monitoring

The SJ/SC WPCP final effluent (EFF-001) and the pilot RO reject stream will be monitored for one day during each of the three 7-day testing rounds (i.e. for a total of three daily monitoring events) for the full suite of California Toxics Rule (CTR) priority pollutants that the WPCP NPDES permit requires monitoring for twice a year (Table 4). Standard minerals will also be monitored to evaluate the extent to which the relative proportions (ionic balance) may be changed in the RO reject compared to the final effluent.

These data are intended to be used to characterize the 100% RO reject quality and to help investigate the cause(s) of any observed toxicity. The measured metals data will also be used to recompute projected combined final effluent concentrations using the mass balance spreadsheet model. These pilot study based mass balance values will then be compared to the values previously calculated using historic effluent quality and calculated RO reject values.

The data will similarly be used to perform Reasonable Potential Analyses (RPA) on the calculated concentrations in the two proposed combined RO reject/final effluent blends (i.e. 1.5% and 9%). This will be done to determine if the addition of RO reject to the WPCP effluent would raise concentrations to a level that would trigger Reasonable Potential (RP) (i.e. exceed any CTR water quality objectives) and thereby require that the Regional Water Board (RWB) include new effluent limitations in the WPCP NPDES during the next NPDES permit reissuance (2014) that would not otherwise be required if the RO reject were not present. Based on the mass balance calculations there would not be problems complying with any such new limits; there would be one or more additional effluent limits in the permit if RP were triggered.

The SJ/SC WPCP laboratory responsible for either conducting the Table 4 analyses or for arranging for analyses to be conducted by a contract lab. The SJ/SC WPCP laboratory will provide estimates of the volumes of final effluent and RO reject needed to conduct the Table 4 analyses. These volumes need to be added to those shown in Table 2 to determine the total volumes that will need to be collected for each round of testing. It is assumed that the SJ/SC WPCP laboratory will provide all necessary sample bottles, labels, and chain of custody forms. Pilot plant staff will fill the bottles provided and SJ/SC laboratory staff will collect the samples for analysis either at their laboratory or for delivery to and analysis by a contract laboratory.

Table 4. Pilot Test CTR Priority Pollutant Monitoring

ONE DAY COMPOSITE SAMPLE PER ROUND
Standard Minerals Package (a)
As & Se by Hydride AA (SM 3114) or (EPA 200.8 in DRC Mode)
CTR Metals (EPA 200.8)
Nitric Acid Digestion for Metals (EPA 200.2)
Hg (EPA 1631)
ONE DAY GRAB SAMPLES PER ROUND
Cyanide (EPA 3352)
Full Dioxin EQ (EPA 1613)
PAHs (EPA 610)
VOAs (EPA 624)
BNA (EPA 625)
Organophosphate Pesticides (EPA 614)
Pyrethroid Pesticides (EPA 632)
Tributyltin (Batelle N-0959-2606)
Hexavalent Chromium (EPA 7196)

(a) Standard Minerals Package includes pH, alkalinity, conductivity, chloride, ammonia, nitrate and nitrite as N, sulfate, TDS, Total phosphate, boron, iron, calcium, magnesium, hardness, sodium, potassium, and silica.

Pilot Plant Description

A small RO pilot unit will be operated to generate reject water with which to conduct acute and chronic toxicity testing of the two RO reject/effluent blends that model the most likely blended discharge scenarios for the proposed 8 mgd and 32 mgd RO permeate projects. A secondary effluent (prior to chlorination and filtration) composite sample of approximately 20 liters (plus the Table 4 priority pollutant analysis volume on one day per Round) will be collected from the Filter Influent Pump Station wetwell using the existing sample lines.

Sampling from this location will model most closely the secondary effluent that will be diverted to the full scale RO facilities and thus produce RO reject that will be most similar to that produced by the full scale RO facilities.

This secondary effluent sample will be used as feedwater for the approximately 250 gpd RO pilot unit which will be operated as a batch process daily for seven days during each round to generate the necessary (Table 2) RO reject sample volume for toxicity testing. The RO unit will be run from approximately 9 am to 10 am on each of the seven days to allow for pickup of the final effluent and RO reject samples by PER by 11:00 am each day. The largest RO reject volumes will be needed on days one and three of each round as noted above.

As noted above, on one day of each Round, additional RO reject and final effluent will need to be collected to conduct the priority pollutant analyses shown in Table 4. The actual additional volumes needed will depend on the laboratory conducting the analyses, particularly for the RO reject (since the samples will likely need to be diluted prior to analysis). A preliminary volume estimate is approximately 10 liters each on the priority pollutant testing day. The SJ/SC WPCP will need to provide the actual volumes they will require.

The full scale RO project reject is proposed to be discharged into the inlet of the serpentine chlorine contact basins and combined with and chlorinated and dechlorinated together with the tertiary (filtered secondary) effluent. The proposed pilot testing plan approximates this as closely as possible by using chlorinated/dechlorinated final effluent as the toxicity testing “blend” water along with the RO reject from treating the secondary effluent stream. This approach captures the impacts from chlorinating and dechlorinating the tertiary effluent but does not capture any potential effects that may result from chlorinating and dechlorinating the RO reject.

However, since the RO reject is only ~1.5% or ~9% of the total final effluent flow, it is likely that potential impacts on effluent quality from chlorinating and dechlorinating the RO reject would be overwhelmed (masked) by the impacts of chlorinating and dechlorinating the much larger volume of tertiary effluent. The only way to more closely approximate the full scale operation would be for PER to make up the 1.5% and 9% bulk blend solutions each day at the lab, then chlorinate them at the typical WPCP dosage, hold them for the typical WPCP serpentine basin contact time, then dechlorinate them at the typical WPCP level. This would be both time consuming and introduces several additional variables (and opportunities for experimental error) into the protocol and still not fully replicate full-scale chlorination/dechlorination conditions.

The SJ/SC WPCP NPDES permit specifies that final effluent (EFF-001) samples for chronic toxicity and metals be 24-hour flow composites. To be most representative of compliance monitoring, and particularly if the WPCP chooses to use the 100% effluent chronic toxicity test results to fulfill its NPDES screening test requirements, it would be desirable to obtain 24-hour composite samples of the final effluent. The NPDES permit allows for 24 hourly grab samples to be collected and combined to prepare a 24-hour composite sample.

Given the large volumes of final effluent required by the toxicity testing, the sample pump and control apparatus from two ISCO type samplers (to be provided by the WPCP) will be used to collect these approximately hourly samples from both the final effluent and secondary effluent (it is assumed that flow signals will not be available to be used to trigger for the pilot testing). The samples will be collected in large carboys or plastic tanks. All samples will need to be refrigerated or chilled.

Alternatively, if it is not feasible to collect composite samples, WPCP final effluent quality is believed to be quite consistent over a 24-hour period. Therefore it may be adequate, for purposes of this short-term pilot test, to collect the sample volumes needed per day over a relatively short period of time (i.e. large grab samples). The final effluent sample could be collected an appropriate number of hours after the secondary effluent sample for the RO feedwater were collected, to reflect the nominal time for secondary effluent to transit through the tertiary filters and the chlorine contact tank to the final effluent sampling location. This would approximate sampling and testing the same batch of water in the RO reject and the final effluent.

Attachments:

A. Updated 8 mgd RO Mass Balance with ~500 mg/L TDS Blended Recycled Water
B. Updated 32 mgd RO Mass Balance with 8 mgd ~500 mg/L TDS Blended Recycled Water and 24 mgd Diverted for Future Uses
C. PER Acute and Chronic Toxicity Testing Protocols

Attachment A

Updated 8 mgd RO Mass Balance with ~500 mg/L TDS Blended Recycled Water

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Attachment A. Impact of RO Reject on WPCP Final Effluent Quality (Metals and Cyanide)

RO Permeate Flow = 8 mgd; RO Permeate Diversion = 0 mgd; Final Effluent Data are 95%ile Values

Specified Values:		
Total RO Permeate Flow =	8.0	mgd
RO Permeate Diversion =	0.0	mgd
Secondary Effluent Flow =	115.3	mgd[1]
Tert. Effl/RO Perm. Blend Ratio	1.8	
RO Flow Recovery =	85%	
Final Effluent Conc. Data =	95%ile	values[2]

RO Feed Flow =	9.41	mgd
Adj. Secondary Effluent Flow =	100.9	mgd (Flow after deducting Tert. Effl./RO Bypass Flow)
RO Permeate Avail. for Blending =	8.0	mgd
Tert. Effl./RO Bypass Flow =	14.4	mgd
RO Reject Flow =	1.41	mgd
Total RW Blended Flow =	22.4	mgd (Includes RO Bypass Flow + Avail. RO Permeate Flow)
Combined Final Effluent Flow =	92.9	mgd (Final E-001 Discharge Flow Including RO Reject)

Pollutant	Historic Final Effluent[2]		RO Feed		RO Rejection[4]	RO Concentrate		Combined Final Effluent[2]		NPDES Permit Limits	Adj. CTR WQOs for RPA
	Conc. ug/l	Mass lb/day	Conc. ug/l	Mass lb/day	%	Conc. ug/l	Mass lb/day	Conc. ug/l	Mass lb/day	ug/l	ug/l
Arsenic	1.70	1.43	1.70	0.134	99%	11.2	0.132	1.85	1.43		36
Cadmium	0.15	0.12	0.15	0.012	99%	0.97	0.011	0.160	0.12		7
Chromium VI	0.68	0.57	0.68	0.054	99%	4.5	0.053	0.74	0.57		200
Copper - max. daily	4.74	3.99	4.74	0.372	99%	31.3	0.368	5.1	3.99	19	
Copper - avg. monthly	4.23	3.56	4.23	0.332	99%	27.9	0.329	4.59	3.55	11	
Lead	1.03	0.87	1.03	0.081	99%	6.8	0.080	1.12	0.87		8.52
Mercury[5]	0.0027	0.0023	0.0027	0.0002	99%	0.018	0.0002	0.0030	0.0023	0.023	
Nickel - max. daily	9.00	7.57	9.00	0.706	99%	59.4	0.699	9.8	7.57	33	
Nickel - avg. monthly	7.48	6.29	7.48	0.587	99%	49.3	0.581	8.1	6.28	25	
Selenium	0.66	0.56	0.66	0.052	99%	4.4	0.052	0.72	0.56		5
Silver	0.112	0.094	0.11	0.009	99%	0.7	0.009	0.122	0.094		2.24
Zinc	68	57.6	68	5.38	99%	452	5.32	74	57.6		170
Cyanide[6]	3.2	2.69	3.2	0.251	99%	21	0.248	3.5	2.69	5.7	

Notes:

1. Equivalent to the secondary effl. flow (minus MF backwash) before any recycled water or RO system diversions. Value listed is avg. from minimum discharge flow month (8/2005).
2. Historic NPDES effluent from RWQCB ERS database, used to represent Sec. Effluent prior to RO System. Based on individual values from Jan 2004 - Dec 2006, except as noted in
3. Combined Final effluent (including RO reject) to outfall E-001. Values that exceed NPDES Permit or WQO-based limits are indicated in **bold**.
4. Defined as: Rejection = (1-Permeate Conc./Feed Conc) * 100. Note: Other definitions are sometimes used for rejection.
5. Mercury data is from "13267" dataset, monthly average values. Effluent limit is from Mercury Watershed Permit (AMEL).
6. Dataset is low DL "13267" monitoring data only. Model probably overestimates combined final effluent cyanide concentration.

Attachment B

Updated 32 mgd RO Mass Balance with ~500 mg/L TDS Blended Recycled Water and 24 mgd Diverted for Future Uses

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Attachment B. Impact of RO Reject on WPCP Final Effluent Quality (Metals and Cyanide)

RO Permeate Flow = 32 mgd; RO Permeate Diversion = 24 mgd; Final Effluent Data are 95%ile Values

Specified Values:		
Total RO Permeate Flow =	32.0	mgd
RO Permeate Diversion =	24.0	mgd
Secondary Effluent Flow =	115.3	mgd[1]
Tert. Effl/RO Perm. Blend Ratio	1.8	
RO Flow Recovery =	85%	
Final Effluent Conc. Data =	95%ile	values[2]

RO Feed Flow =	37.65	mgd
Adj. Secondary Effluent Flow =	100.9	mgd (Flow after deducting Tert. Effl./RO Bypass Flow)
RO Permeate Avail. for Blending =	8.0	mgd
Tert. Effl./RO Bypass Flow =	14.4	mgd
RO Reject Flow =	5.65	mgd
Total RW Blended Flow =	46.4	mgd (Includes RO Bypass Flow + Avail. RO Permeate Flow)
Combined Final Effluent Flow =	68.9	mgd (Final E-001 Discharge Flow Including RO Reject)

Pollutant	Historic Final Effluent[2]		RO Feed		RO Rejection[4]	RO Concentrate		Combined Final Effluent[2]		NPDES Permit Limits	Adj. CTR WQOs for RPA
	Conc. ug/l	Mass lb/day	Conc. ug/l	Mass lb/day	%	Conc. ug/l	Mass lb/day	Conc. ug/l	Mass lb/day	ug/l	ug/l
Arsenic	1.70	1.43	1.70	0.535	99%	11.2	0.529	2.48	1.43		36
Cadmium	0.15	0.12	0.15	0.046	99%	0.97	0.046	0.215	0.12		7
Chromium VI	0.68	0.57	0.68	0.214	99%	4.5	0.212	1.00	0.57		200
Copper - max. daily	4.74	3.99	4.74	1.489	99%	31.3	1.474	6.9	3.97	19	
Copper - avg. monthly	4.23	3.56	4.23	1.328	99%	27.9	1.314	6.17	3.55	11	
Lead	1.03	0.87	1.03	0.323	99%	6.8	0.320	1.50	0.86		8.52
Mercury[5]	0.0027	0.0023	0.0027	0.0009	99%	0.018	0.0008	0.0040	0.0023	0.023	
Nickel - max. daily	9.00	7.57	9.00	2.826	99%	59.4	2.798	13.1	7.55	33	
Nickel - avg. monthly	7.48	6.29	7.48	2.347	99%	49.3	2.324	10.9	6.27	25	
Selenium	0.66	0.56	0.66	0.208	99%	4.4	0.206	0.97	0.56		5
Silver	0.112	0.094	0.11	0.035	99%	0.7	0.035	0.163	0.094		2.24
Zinc	68	57.6	68	21.50	99%	452	21.29	100	57.4		170
Cyanide[6]	3.2	2.69	3.2	1.003	99%	21	0.993	4.7	2.68	5.7	

Notes:

1. Equivalent to the secondary effl. flow (minus MF backwash) before any recycled water or RO system diversions. Value listed is avg. from minimum discharge flow month (8/2005).
2. Historic NPDES effluent from RWQCB ERS database, used to represent Sec. Effluent prior to RO System. Based on individual values from Jan 2004 - Dec 2006, except as noted in
3. Combined Final effluent (including RO reject) to outfall E-001. Values that exceed NPDES Permit or WQO-based limits are indicated in **bold**.
4. Defined as: Rejection = (1-Permeate Conc./Feed Conc) * 100. Note: Other definitions are sometimes used for rejection.
5. Mercury data is from "13267" dataset, monthly average values. Effluent limit is from Mercury Watershed Permit (AMEL).
6. Dataset is low DL "13267" monitoring data only. Model probably overestimates combined final effluent cyanide concentration.

Attachment C

PER Acute and Chronic Toxicity Testing Protocols

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PACIFIC ECORISK LABORATORY PROTOCOLS

Receipt and Handling of the RO Brine Samples

Samples of the RO Brine will be collected into appropriately-cleaned sample containers; basic water quality data (temperature, pH, conductivity) will recorded at that time. The sample will be transported and delivered, on ice and under chain-of-custody, to the PER testing laboratory in Fairfield on the day of sample collection. Upon receipt at the testing laboratory, aliquots of the sample will be collected for analysis of initial water quality characteristics. The remainder of the sample will be stored at 0-6˚C, except when being used to prepare test solutions.

Acute Toxicity Testing with Rainbow Trout

The rainbow trout used in this test will be obtained from a commercial supplier. These fish will be maintained at 12°C in aerated aquaria containing EPA synthetic moderately-hard water prior to their use in this testing. During this pre-test period, the fish will be fed trout chow *ad libitum*.

The Lab Control water for this test will consist of EPA synthetic “moderately hard” water, prepared by addition of reagent-grade chemicals to reverse-osmosis, de-ionized water. The RO Brine sample will be tested at the 100% concentration only. Water quality characteristics (pH, dissolved oxygen [D.O.], and conductivity) will be determined for each treatment test solution prior to the start of the test.

There will be 2 replicates at each test treatment, each replicate consisting of 4-L of test solution in a 6-L HDPE beaker. The test will be initiated by randomly allocating 10 rainbow trout into each replicate. The replicate beakers will be then placed in a temperature-controlled room at 12°C under a 16L:8D photoperiod.

Each replicate container will be examined daily, and the number of live fish in each will be recorded. Fresh test solutions will be prepared on Day 2 of the test, and will be characterized as before; that same day, approximately 80% of the old media in each replicate container will be carefully poured out and replaced with the fresh test solution. “Old” water quality characteristics (pH, D.O., and conductivity) will be measured for the old test solution that had been discarded from one randomly selected replicate at each treatment.

After 96 (±2) hrs, the test will be terminated and the number of live fish in each replicate will be determined. The resulting survival data will be analyzed to evaluate any impairment due to the RO Brine; all statistical analyses will be performed using the CETIS® statistical software (TidePool Scientific, McKinleyville, CA).

Acute Reference Toxicant Testing of the Rainbow Trout
In order to assess the sensitivity of the rainbow trout to toxic stress, a reference toxicant test will be performed concurrently with the RO Brine test. The reference toxicant test will be performed similarly to the RO Brine test except that test solutions will consist of Lab Control water spiked with NaCl at concentrations of 2.5, 5, 10, 15, and 20 gm/L. The resulting test response data will be statistically analyzed to determine key dose-response point estimates; all statistical analyses will be made using the CETIS® software. These response endpoints will be then compared to the "typical response" range established by the mean ± 2 SD of the point estimates generated by the most recent previous reference toxicant tests performed by PER.

Acute Toxicity Testing with Larval *Menidia beryllina*

The *Menidia beryllina* used in these tests will be obtained from a commercial supplier. These fish will be maintained at 20˚C in aerated aquaria containing artificial seawater at a salinity of 25 ppt prior to their use in the tests. During this pre-test period, the fish will be fed brine shrimp nauplii *ad libitum*.

The Lab Control water for these tests will consist of reverse-osmosis, de-ionized (RO/DI) water salted up to a salinity of 25 ppt using a commercial artificial sea salt (Crystal Sea®-bioassay grade). The RO Brine samples will be tested at the 100% concentration only. Routine "new" water quality characteristics (pH, dissolved oxygen [D.O.], and salinity) will be measured for each treatment test solution prior to use in these tests.

There will be 2 replicates at each treatment level, each replicate consisting of 400 mL of test solution in a 600-mL glass beaker. The tests will be initiated by randomly allocating 10 *Menidia beryllina* into each replicate beaker. The beakers will be randomly positioned in a temperature-controlled room at 20˚C under a 16L:8D photoperiod.

Each replicate container will be examined daily, and the number of live fish in each will be recorded. Fresh test solutions will be prepared on Day 2 of the test, and will be characterized as before; that same day, approximately 80% of the old media in each replicate container will be carefully poured out and replaced with the fresh test solution. "Old" water quality characteristics (pH, D.O., and conductivity) will be measured for the old test solution that had been discarded from one randomly selected replicate at each treatment.

After 96 (±2) hrs, the test will be terminated and the number of surviving organisms will be determined. The resulting survival data will be analyzed to evaluate any impairments due to the RO Brine; all statistical analyses will be performed using the CETIS® statistical software.

Acute Reference Toxicant Testing of the Larval *Menidia beryllina*
In order to assess the sensitivity of the fish test organisms to toxic stress, a concurrent reference toxicant test will be performed. This reference toxicant test will be performed similarly to the RO Brine tests, except that test solutions will consist of Lab Control (25 ppt water) spiked with KCl at

concentrations of 0.125, 0.25, 0.5, 1, and 2 gm/L. After 96 (±2) hrs exposure, the survival data will be evaluated. The resulting test response data will be analyzed to determine key dose-response point estimates; all statistical analyses will be made using the CETIS® software. These response endpoints will be then compared to the "typical response" range established by the 20 most-recently performed tests.

Survival and Reproduction Toxicity Testing with *Ceriodaphnia dubia*

The short-term chronic *Ceriodaphnia* test consists of exposing individual females to a series of RO Brine dilutions for the length of time it takes for the Control treatment females to produce 3 broods (typically 6-8 days), after which effects on survival and reproduction are evaluated. The specific procedures used in this test are described below.

The Control/dilution water for this test will consist of Lab Water (comprised of a mixture of commercial spring waters [80% deionized water:20% Perrier]. The Control/dilution water and the RO Brine samples will be used to prepare daily test solutions at the designated test treatment concentrations. For each test treatment, a 200 mL aliquot of test solution will be amended with the alga *Selenastrum capricornutum* and Yeast-Cerophyll-Trout Food (YCT) to provide food for the test organisms. "New" water quality characteristics (pH, D.O., and conductivity) will be measured on these food-amended test solutions prior to use in this testing.

There will be 10 replicates for each test treatment, each replicate consisting of 15 mL of test solution in a 30-mL plastic cup. These "3-brood" tests will be initiated by allocating one neonate (<24 hrs old) *Ceriodaphnia*, obtained from in-house laboratory cultures, into each replicate cup. The test replicate cups will be placed into a temperature-controlled room at 25˚C, under cool white fluorescent lighting on a 16L:8D photoperiod.

Each day of the test, fresh test solutions will be prepared and characterized as before, and a "new" set of replicate cups will be prepared. The original test replicate cups will be examined, with surviving "original" individual organisms being transferred to the corresponding new cup. The contents of each of the remaining "old" replicate cups will be carefully examined and the number of neonate offspring produced by each original organism will be determined, after which the "old" water quality characteristics (pH, D.O., and conductivity) will be measured for the old media from one randomly-selected replicate at each treatment.

After it is determined that ≥60% of the *Ceriodaphnia* in the Receiving Water Control treatment had produced their third brood of offspring, the test will be terminated. The resulting survival and reproduction data will be analyzed to evaluate any impairment caused by the RO Brine; all statistical analyses will be performed using the CETIS® statistical software.

Reference Toxicant Testing of the *Ceriodaphnia dubia*

In order to assess the sensitivity of the test organisms to toxic stress, a reference toxicant test will be performed concurrently with the RO Brine test. The reference toxicant test will be performed similarly to the RO Brine test except that test solutions will consist of Lab Control water spiked with NaCl at test concentrations of 250, 500, 1000, 1500, and 2000 mg/L. The resulting test response data will be statistically analyzed to determine key dose-response point estimates; all statistical analyses will be made using the CETIS® software. These response endpoints will be then compared to the “typical response” range established by the mean ± 2 SD of the point estimates generated by the most recent previous reference toxicant tests performed by PER.

Survival and Growth Toxicity Testing with Larval Fathead Minnows

The short-term chronic fathead minnow test consists of exposing larval fish to a series of RO Brine dilutions for 7 days, after which effects on survival and growth are evaluated. The specific procedures used in this testing are described below.

The larval fathead minnows used in this test will be obtained from a commercial supplier; upon receipt at the testing lab, the larval fish will be maintained in aerated tanks of US EPA moderately-hard water at 25˚C, and will be fed brine shrimp nauplii *ad libitum*.

The Control/dilution water for this test will consist of Lab Water (comprised of EPA synthetic moderately-hard water). The Control/dilution water and the RO Brine samples will be used to prepare daily test solutions at the designated test treatment concentrations. "New" water quality characteristics (pH, D.O., and conductivity) will be measured on these test solutions prior to use in the test.

There will be 4 replicates for each test treatment, each replicate consisting of 400 mL of test solution in a 600-mL glass beaker. The test will be initiated by randomly allocating 10 larval fathead minnows (<48 hrs old) into each replicate. The replicate beakers will be placed in a temperature-controlled room at 25˚C, under cool-white fluorescent lighting on a 16L:8D photoperiod. The test fish will be fed brine shrimp nauplii twice daily.

Each day of the test, fresh test solutions will be prepared for each treatment, and water quality characteristics will be determined as before. The replicate beakers will be examined, with any dead animals, uneaten food, wastes, and other detritus being removed. The number of live fish in each replicate will be determined and then approximately 80% of the old test media in each beaker will be carefully poured out and replaced with fresh test solution. “Old” water quality characteristics (pH, D.O., and conductivity) will be measured on the old test water that had been discarded from one randomly-selected replicate at each treatment.

After 7 days exposure, the test will be terminated and the number of live fish in each replicate beaker will be recorded. The fish from each replicate will be then carefully euthanized in methanol, rinsed in de-ionized water, and transferred to a pre-dried and pre-tared weighing pan.

These fish will be then dried at 100°C for ~24 hrs and re-weighed to determine the total weight of fish in each replicate; the total weight will be then divided by the initial number of fish per replicate (n=10) to determine the "biomass value". The resulting survival and growth ("biomass value") data will be analyzed to evaluate any reductions caused by the RO Brine; all statistical analyses will be performed using the CETIS® statistical software.

Reference Toxicant Testing of the Larval Fathead Minnows
In order to assess the sensitivity of the fish to toxic stress, a reference toxicant test will be performed. The reference toxicant test will be performed similarly to the RO Brine test, except that test solutions will consist of "Lab Control" media spiked with NaCl at test concentrations of 0.75, 1.5, 3, 6, and 9 gm/L. The resulting test response data will be analyzed to determine key dose-response point estimates; all statistical analyses will be made using the CETIS® software. These response endpoints will be then compared to the 'typical response' range established by the mean ± 2 SD of the point estimates generated by the 20 most recent previous reference toxicant tests performed by PER.

Larval Fish Survival and Growth Toxicity Testing with *Menidia beryllina*

The short-term chronic *Menidia beryllina* test consists of exposing larval fish to a series of RO Brine dilutions for 7 days, after which effects on survival and growth are evaluated. The specific procedures used in this testing are described below.

The larval fish used in this bioassay will be obtained from a commercial supplier. These fish will be maintained at 25˚C in aerated aquaria containing Lab Control water (described below) prior to their use in this test. During this pre-test period, the fish will be fed brine shrimp nauplii *ad libitum*.

The Lab Control/dilution water for this bioassay will be prepared by salting up reverse-osmosis, de-ionized water to a salinity of 25 ppt using a commercial artificial sea salt (Crystal Sea® - bioassay grade). The Lab Control/dilution water and the RO Brine samples will be used to prepare daily test solutions at the designated RO Brine concentrations. "New" water quality characteristics (pH, D.O., and conductivity) will be measured on these test solutions prior to use in the test.

There will be 4 replicates for the Lab Control and each RO Brine treatment, each replicate consisting of 400 mL of test media in a 600-mL glass beaker. This test will be initiated by randomly allocating 10 fish into each replicate. These replicate beakers will be placed in a temperature-controlled room at 25°C, under cool-white fluorescent lighting on a 16L:8D photoperiod. The test fish will be fed brine shrimp nauplii twice daily.

Each day of the test, fresh test solutions will be prepared and characterized as before. The replicate beakers containing the larval fish will be examined, with any dead animals, uneaten food, wastes, and other detritus being removed. The number of live fish in each replicate will be determined and then approximately 80% of the test media in each beaker will be carefully poured out and replaced with fresh media. "Old" water quality characteristics (pH, D.O., and conductivity) will be measured on the old test water collected from one randomly selected replicate at each treatment.

After 7 days exposure, the number of live fish in each replicate beaker will be recorded. Then, the fish from each replicate will be carefully euthanized in methanol, rinsed in de-ionized water, and transferred to a pre-dried and pre-tared weighing pan. These will be then dried at 100◘C for >24 hrs and re-weighed to determine the total weight of fish in each replicate. The total weight will be then divided by the initial number of fish per replicate (n=10) to determine the "biomass value". The resulting survival and growth data will be analyzed to determine any impairment, or toxicity, caused by the RO Brine. All statistical analyses will be performed using the CETIS® statistical software.

Reference Toxicant Testing of the *Menidia beryllina*

In order to assess the sensitivity of the fish test organisms to toxic stress, a reference toxicant test will be performed concurrently with the RO Brine test. This reference toxicant test will be performed similarly to the RO Brine toxicity test, except that test solutions will consist of Lab Control (25 ppt water) spiked with KCl at concentrations of 0.5, 1, 1.25, 1.5, and 2 gm/L. The resulting test response data will be analyzed to determine key dose-response point estimates; all statistical analyses will be made using the CETIS® software. These response endpoints will be then compared to the typical response range established by the mean ± 2 SD of the point estimates generated by the 20 most recent previous reference toxicant tests performed by PER.

Chronic Algal Growth Toxicity testing with *Thalassiosira pseudonana*

The short-term chronic diatom toxicity test consists of exposing *Thalassiosira pseudonana* to dilutions of the RO Brine for ~96-hrs, after which the effects on cell growth are evaluated. The specific procedures used in this testing are described below.

The Lab Control water for these tests will consist of natural seawater (obtained from the U.C. Granite Canyon Marine Laboratory) adjusted up to the test salinity. The Lab Control water and ambient waters will be filtered through sterile 0.45 µm filters, and then spiked with nutrients (as per ASTM guidelines). The filtered and nutrient-amended Lab Control/dilution water and RO Brine will then be used to prepare daily test solutions at the designated concentrations of RO Brine. Water quality characteristics will be measured on the resulting test solutions prior to use in this testing.

There will be 4 replicates at each test treatment, each replicate consisting of a 250-mL glass Erlenmeyer flask containing 100 mL of test solution; an additional replicate will be established at each test treatment for the measurement of test solution water quality characteristics during the test and at test termination. Each flask will be inoculated to an initial diatom cell density of 20,000 cells/mL from a from a laboratory culture of *Thalassiosira* that is maintained in log growth phase. These flasks will be loosely-capped and randomly positioned within a temperature-controlled room at 20°C, under continuous illumination from cool-white fluorescent bulbs.

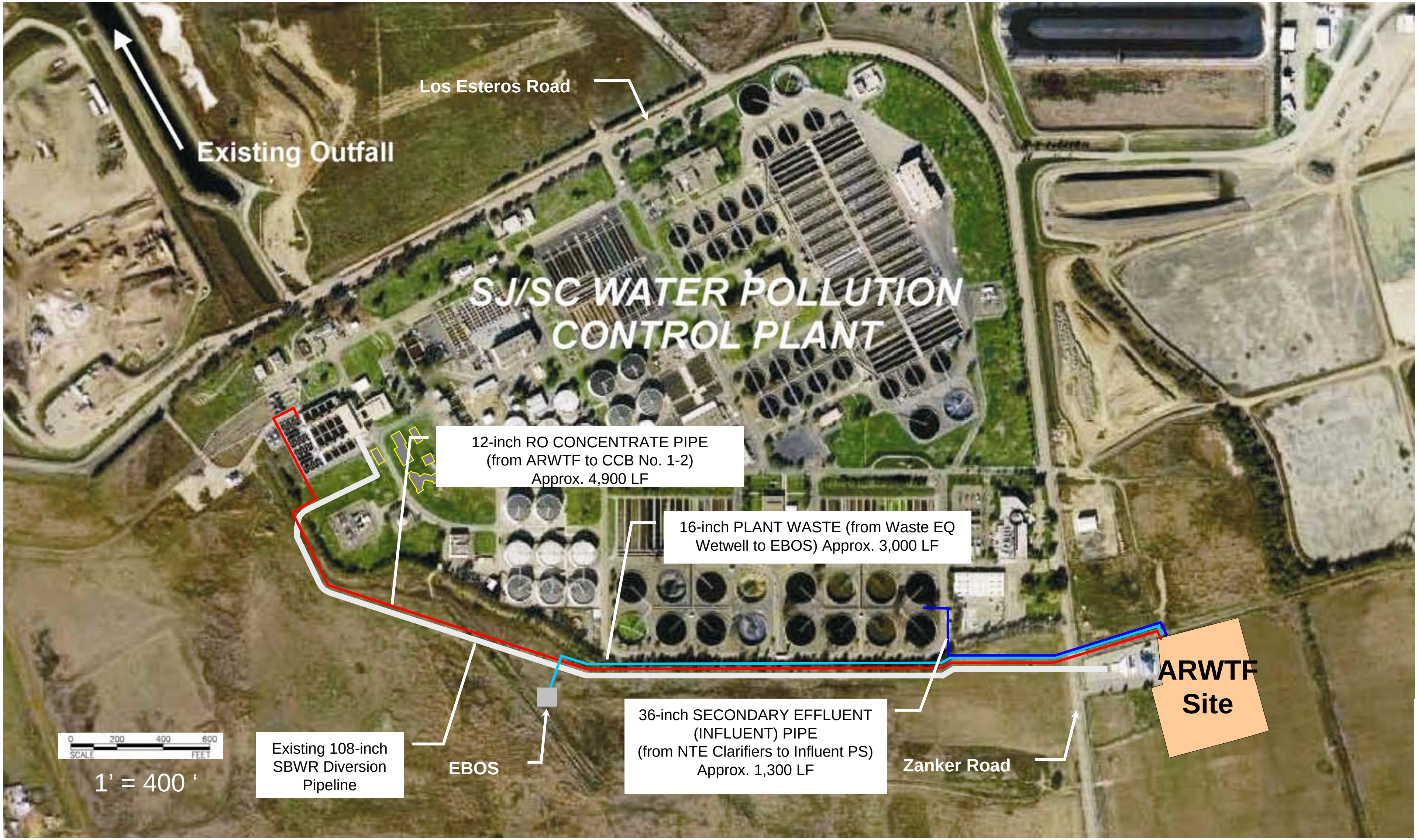
Each replicate flask will be shaken once daily. The temperature and pH will be determined daily for the designated "water quality" replicate at each treatment.

After 96 (+2) hrs exposure, the algal cell density in each replicate flask will be determined by microscopic analysis. The resulting cell density data will be analyzed to determine any growth impairment, or toxicity, caused by the RO Brine; all statistical analyses will be performed using CETIS® statistical software.

Reference Toxicant Testing of the *Thalassiosira pseudonana*

In order to assess the sensitivity of the *Thalassiosira* to toxic stress, a reference toxicant test will be performed concurrently with the RO Brine test. The reference toxicant test will be performed similarly to the RO Brine test except that test solutions consisted of Lab Control water spiked with KCl. The resulting test response data will be statistically analyzed to determine key dose-response point estimates; all statistical analyses will be performed using the CETIS® software. These response endpoints will be compared to the "typical response" range established by the mean ± 2 SD of the point estimates generated by the most recent previous reference toxicant tests performed by PER.

Appendix D
Off-Site Piping Figure


Los Esteros Road
Existing Outfall
SJ/SC WATER POLLUTION CONTROL PLANT
12-inch RO CONCENTRATE PIPE (from ARWTF to CCB No. 1-2) Approx. 4,900 LF
16-inch PLANT WASTE (from Waste EQ Wetwell to EBOS) Approx. 3,000 LF
ARWTF Site
0 200 400 600
SCALE FEET
1' = 400 '
Existing 108-inch SBWR Diversion Pipeline
EBOS
36-inch SECONDARY EFFLUENT (INFLUENT) PIPE (from NTE Clarifiers to Influent PS) Approx. 1,300 LF
Zanker Road