

## CHAPTER 2

### EFFLUENT QUALITY

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#### INTRODUCTION

The goal of the Terminal Island Water Reclamation Plant (TIWRP) effluent monitoring program is to characterize the physical and chemical properties of treated wastewater discharged to the Outer Los Angeles Harbor. The effluent data, in conjunction with the receiving water monitoring data, are used to assess the impact of the effluent discharge on the Los Angeles Harbor.

TIWRP has a dry weather design capacity of 30 million gallons per day (MGD) and receives wastewater from San Pedro and neighboring cities (CLA, EMD 1994). Approximately 60% of the wastewater is from the industrial and commercial sector, while the remaining 40% is domestic. Domestic sewage sources include the cities of Wilmington, San Pedro, and Harbor City. Major industrial sources include the seafood processing, petroleum, and metal finishing industries. Other non-domestic sources include docking and storage facilities around the Los Angeles Harbor and the United States Coast Guard facility.

TIWRP has been a full secondary treatment facility with biosolids handling capability since 1977. Solids produced during wastewater treatment at TIWRP are anaerobically digested and dewatered. The resultant biosolids are 100% beneficially reused. In December 1996, the plant was upgraded to include a sand filtration system. Since 1997, essentially all TIWRP effluent discharged to the Harbor has

been tertiary-treated wastewater. In 2001, the plant was further upgraded to include an Advanced Wastewater Treatment Facility (AWTF). The AWTF treatment process consists of microfiltration, reverse osmosis (RO), lime stabilization, chlorination, and dechlorination. The AWTF is designed to generate advanced tertiary effluent that will be used by the City's Harbor Water Recycling Project (HWRP) for nonpotable applications (e.g. industrial, irrigational, and recreational purposes) and for ground water recharge in the Dominguez Gap Barrier Project. The AWTF began delivery of water to the Dominguez Gap Barrier Project in March 2006. From January 2006 to December 2007, TIWRP discharged an average of 15.8 MGD of tertiary-treated wastewater into the Outer Los Angeles Harbor at the TIWRP Outfall (see Figure 1-1).

This chapter reports the concentrations of the TIWRP effluent constituents from January 2006 through December 2007 and summarizes trends in effluent quality from 1995 to 2005. TIWRP received a new NPDES permit in May 2005 and updated the monitoring program. Table 2-1 lists the constituents measured in the effluent under the TIWRP NPDES effluent monitoring program.

The California State Water Resources Control Board adopted two water quality control plans in April 1991: the Inland Surface Water Plan and the Enclosed Bays and Estuaries Plan. These two

statewide plans include numeric water quality criteria for priority toxic pollutants. However, these plans were rescinded when a lawsuit brought by several dischargers successfully challenged how the plans were adopted. Since 1994, California has been without water quality standards for most priority pollutants for inland surface waters, enclosed bays, and estuaries as required by Section 303(c)(2)(B) of the Clean Water Act (CWA).

The California Toxics Rule (CTR), which became effective on May 18, 2000, was promulgated by the EPA to establish numeric water quality criteria to replace the criteria that were rescinded by the California state court. The CTR established ambient aquatic life criteria for 23 priority toxics, ambient human health criteria for 57 priority toxics, and a compliance schedule provision which authorizes the State to issue schedules of compliance for new or revised NPDES permit limits based on the federal criteria when certain conditions are met. The State must use the CTR together with the State's existing water quality standards when controlling pollution in inland waters, enclosed bays, and estuaries. The numeric water quality criteria contained in the final rule are identical to EPA's recommended Clean Water Act section 304(a) criteria.

The California State Water Resources Control Board also adopted the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* (also known as the State Implementation Plan or SIP) on March 2, 2000. The SIP incorporated the May 16, 1974 *Enclosed Bays and Estuaries Policy*, which contains narrative and numerical water quality objectives for the protection of beneficial uses. The SIP applies to discharges of toxic pollutants in the inland surface waters, enclosed bays, and estuaries of California, which are subject to regulation under the State's Porter-Cologne Water Quality Control Act and the Federal Clean Water Act. This SIP also establishes the following:

- A. Implementation provisions for priority pollutant criteria promulgated by USEPA through the CTR and for priority pollutant objectives established by Regional Boards in their Basin Plans;
- B. Monitoring requirements for priority pollutants with insufficient data to determine reasonable potential;
- C. Monitoring requirements for 2, 3, 7, 8 – TCDD equivalents; and
- D. Chronic toxicity control provisions.

Toxic substances are regulated in the current TIWRP NPDES permit by water quality based effluent limitations derived from the 1994 Basin Plan, the CTR, and/or best professional judgment (BPJ) pursuant to 40 CFR Part 122.44. If a discharge causes, has a reasonable potential to cause, or contributes to a receiving water excursion above a narrative or numeric objective within a State water quality standard, federal law and regulations, as specified in 40 CFR 122.44(d)(1)(i), and in part, the SIP, establishment of Water Quality Based Effluent Limits (WQBELs) that will protect water quality is required.

Regional Board staff used tertiary-treated effluent data collected at TIWRP between July 1997 and June 2004 and the most conservative dilution credit of 61 (approved by the State Board on September 3, 2004) in the Reasonable Potential Analysis. Reasonable potential was not triggered for most of the 126 priority pollutants and final numerical limits were not established. TIWRP is required to gather the appropriate data on an annual basis and submit it to the Regional Board who will determine if additional final effluent limits need to be established. The City of Los Angeles' Bureau of Sanitation Regulatory Affairs Division has provided the necessary data. During the two years since adoption of the current permit in 2005, Regional Board staff has not identified any new constituents with "reasonable potential" (i.e., any new constituents requiring NPDES permit limits). In the future, if additional final effluent limits are needed, the current NPDES permit will be reopened, and the limits will be included in the permit.

## MATERIALS AND METHODS

### SAMPLE COLLECTION

Representative TIWRP effluent samples were collected from the effluent pumping plant wet-well. Raw sewage is delivered to the plant by the Fries Avenue, Terminal Way, San Pedro, and Navy forcemains. Representative raw influent samples were collected after a convergence point of the four forcemains. Bi-hourly samples of raw influent and wet-well effluent were collected using automatic samplers and composited by laboratory personnel based on the sampling date flow. Grab samples were collected manually by plant operators or laboratory technicians (see Table 2-1) during the expected peak flow.

Samples for oil and grease and organic analyses were collected in glass bottles. Grab samples for VOCs were collected with no headspace in amber glass vials with Teflon-coated screw caps. All other samples were collected in plastic bottles. Samples were preserved and stored as detailed in Standard Methods (APHA 1998).

### LABORATORY ANALYSIS

#### Analytes

All samples were analyzed according to Environmental Laboratory Accreditation Program (ELAP) approved procedures. Specific methods used for individual analyte measurements are listed in Table 2-1.

#### Acute Toxicity

Acute toxicity testing of the TIWRP effluent was conducted in accordance with procedures outlined in the USEPA acute toxicity testing manual (EPA 2002). In accordance with the NPDES permit, two species of marine organisms were screened using acute toxicity testing protocols in 2005 and 2007. This screening occurs every two years in order to determine the most sensitive species, and thus

determine the species of test organism to be used in acute toxicity testing for a two year period. The first of the two most-sensitive-species screenings affecting the 2006-07 biennial period was initiated in July of 2005. Of the two species selected for the screening, *Atherinops affinis* and *Americamysis bahia*, it was determined that the larvae of mysid (*Americamysis bahia*) was the most sensitive species (Table 2-2). As a result, the mysid was used in monthly static renewal acute toxicity testing of the effluent starting in July 2005 and continuing throughout 2006.

Beginning in March 2007, the second of the two most-sensitive-species screenings relevant to the biennial period of 2006-2007 was initiated for acute toxicity testing. As in the 2005 screening, the 2007 screening involved the species *Atherinops affinis* and *Americamysis bahia*. However, during this round of screening, it was determined that the topsmelt (*Atherinops affinis*) was more sensitive to TIWRP effluent than the mysid (Table 2-3). Because of the results of the screening, the topsmelt was used in monthly static renewal acute toxicity testing of the effluent starting in June of 2007 and continuing throughout 2008.

#### Chronic Toxicity

Chronic toxicity testing of the TIWRP effluent was conducted in accordance with procedures outlined in the USEPA chronic toxicity testing manual for west coast marine organisms (EPA 1995). In accordance with the NPDES permit, chronic toxicity tests were conducted using the most sensitive species, which is determined by biennial screening tests of three west coast marine species: sporophytes of the giant kelp (*Macrocystis*), larvae of the red abalone (*Haliotis*), and larvae of the topsmelt (*Atherinops*). The first of the most-sensitive-species screenings affecting the 2006-07 biennial period was initiated in July of 2005. It was determined that the larvae of the red abalone (*Haliotis rufescens*) was the most sensitive species (Table 2-4). As a result, red abalone was used in monthly static non-renewal chronic toxicity testing of the effluent starting in July 2005 and continuing throughout 2006.

**Table 2-1.** Constituents measured in the effluent monitoring program from January 2006 to December 2007.

Constituent	Units of Analysis	Frequency of Analysis	Sample Type	Method
Total Waste Flow	MGD	continuous	recorder/totalizer	
Total chlorine residual	mg/L	continuous	--	
Turbidity	NTU	continuous	--	
pH	pH units	weekly	grab	SM 4600-H+ B
Temperature	°F	weekly	grab	
Settleable solids	ml/L	weekly	grab	SM 2540F
Suspended solids	mg/L	weekly	24-hr composite	SM 2540D
BOD5 @20 C	mg/L	weekly	24 hr composite	SM 5210B
Oil & Grease	mg/L	weekly	grab	EPA 1664
Dissolved Oxygen	mg/L	weekly	grab	SM 4500 O G
Ammonia Nitrogen	mg/L	weekly	24 hr composite	SM 4500 NH3 C
Nitrate + Nitrite Nitrogen	mg/L	weekly	24 hr composite	EPA 353.2
Organic Nitrogen	mg/L	weekly	24 hr composite	SM 4500 NH3 C
Total Nitrogen	mg/L	weekly	24 hr composite	Calculation
Surfactants (MBAS)	mg/L	weekly	24 hr composite	SM 5540C
Surfactants (CTAS)	mg/L	weekly	24 hr composite	SM 5540D
Chronic Toxicity	TUc	monthly	24-hr composite	*
Acute Toxicity	% Survival	monthly	grab	*
Copper	µg/L	monthly	24 hour composite	SM 3030H, 3120B
Lead	µg/L	monthly	24 hour composite	SM 3030H, 3113B
Mercury	µg/L	monthly	24 hour composite	SM 3030G, 3112B
Nickel	µg/L	monthly	24 hour composite	SM 3030H, 3120B
Silver	µg/L	monthly	24 hour composite	SM 3030H, 3113B
Cyanide	µg/L	monthly	grab	EPA 335.2
Bis(2-ethylhexyl)phthalate	µg/L	monthly	24-hour composite	EPA 625
Dieldrin	µg/L	monthly	24-hour composite	EPA 608
Tributyltin	µg/L	semi-annually	24 hour composite	**
Pesticide†	µg/L	semi-annually	24 hour composite	EPA 8141A
TCDD	µg/L	semi-annually	24 hour composite	EPA 1613
Remaining EPA priority pollutants, excluding asbestos	µg/L	semi-annually	24 hour composite/ grab for VOCs	‡
Radioactivity	pCi/L	semi-annually	24 hour composite	EPA 900

SM = Standard Methods, 20th Edition, 1998 (APHA, 1998)

EPA = U.S. Environmental Protection Agency test method

\* Acute toxicity is measured as described under EPA (2002) using Method 2006. Chronic toxicity is measured using EPA methods 600/4 87/028 (Weber et al., 1988) and Marine Bioassay Project, 90 10WQ (Anderson et al., 1990).

\*\* Tributyltin was analyzed by CRG Marine Lab, Torrance, CA using a method by Krone et al. for Organotins by GCMS.

† Per the Monitoring and Reporting Program Pesticides are demeton, guthion, malathion, methoxychlor, mirex, and parathion.

‡ The following methods are used for the specified types of analyses: EPA 200.7 & 200.8 for metals, EPA 608 for organochlorine pesticides, and EPA 625 for semi-volatile organic compounds, except polyaromatic hydrocarbons (PAHs), EPA 8270C – SIM method for PAHs, and EPA 624 for volatile organic compounds.

Beginning in August 2007, the second of the three most-sensitive-species screenings relevant to the biennial period of 2006-2007, was initiated for chronic toxicity testing. As in the 2005 screening, the 2007 screening involved the species *Haliotis rufescens*, *Macrocystis pyrifera*, and *Atherinops affinis*. However, during this round of screening, it was determined that the topsmelt was more sensitive to TIWRP effluent than the red abalone (Table 2-5). The selection of the topsmelt as the most-sensitive species, however, caused some uncertainty as to which species should be used in the monthly chronic testing. At the time of this determination, the initial investigation TRE was being conducted using the red abalone. Since the initial investigation

TRE had not been completed, EMD requested the RWQCB to permit postponing topsmelt effluent testing and continuing the initial investigation TRE with the red abalone. This was approved, and the TIWRP effluent was once again tested using the red abalone beginning January 2008.

## DATA ANALYSIS

### Analytes

For the purpose of compliance reporting, analytical data were reported following specific protocols. A discharger does not report the actual measured

**Table 2-2.** 2005 most-sensitive-species screening, acute toxicity.

SPECIES	% Survival			
	July	August	September	Avg.
<i>Americamysis bahia</i>	96.7	96.7	96.7	96.7
<i>Atherinops affinis</i>	96.7	100	100	98.9

**Table 2-3.** 2007 most-sensitive-species screening, acute toxicity.

SPECIES	% Survival				
	March	April	May	June	Avg.
<i>Americamysis bahia</i>	100	96.6	93.3	100	97.5
<i>Atherinops affinis</i>	100	83.3	100	73.3	89.2

analytical results that are below the Minimum Level (ML) due to the statistical uncertainty of the result. The ML represents the lowest quantifiable concentration in a sample based on the proper application of all method based analytical procedures and the absence of any matrix interference. The ML also represents the lowest standard used in the calibration curve for a specific analytical method. The ML is adjusted to compensate for any dilution or concentration factors to calculate the Reporting Minimum Level (RML). The Method Detection Limit (MDL) is the lowest concentration at which an analyte can be detected in a sample and can be distinguished from a blank sample with 99% certainty. The ML is typically about 3 to 5 times the MDL but is dependent on the analytical method used.

When the result of an analysis for a constituent was greater than the RML of the constituent, the measured chemical concentration in the samples was reported. When the result of an analysis for a constituent was less than the RML but greater than the MDL of the constituent, the result was reported as “Detected, but Not Quantified” (DNQ), and an estimated value is reported. Sample results that were less than the MDL were reported as “Not Detected” or ND.

For the purpose of calculating annual averages of individual constituents, the measured result was used if the sample was greater than or equal to the ML. If the result was less than the ML, zero was used in the calculation of the average. If the final calculated average was less than the MDL, the annual average was reported as ND. If the final calculated average was less than the RML, then the annual average was reported as DNQ with the estimated value in parenthesis.

### Toxicity

Data resulting from toxicity testing were analyzed in accordance with procedures outlined in the acute toxicity testing manual (EPA 2002) for acute toxicity testing, and in the chronic toxicity testing manual for west coast marine organisms (EPA 1995) for chronic toxicity testing. Acute toxicity testing results were reported as percent survival in the undiluted effluent. Chronic toxicity testing results were reported in chronic toxicity units (TUc), which is a function of the No-Observed Effect Concentration (NOEC)—the highest concentration of effluent in which the measured response, the percent normal observed, is not statistically different from that of the control.

**Table 2-4.** 2005 most-sensitive-species screening, chronic toxicity.

SPECIES	TU c			
	July	August	November	Avg.
<i>Haliotis</i>	<1.7	<1.7	3.3	<2.2
<i>Atherinops</i>	<1.7	<1.7	<1.7	<1.7
Macrocystis	<1.7	<1.7	<1.7	<1.7

**Table 2-5.** 2007 most-sensitive-species screening, chronic toxicity.

SPECIES	TU c			
	August	September	November	Avg.
<i>Haliotis</i>	<1.7	<1.7	<1.7	<1.7
<i>Atherinops</i>	3.3	<1.7	<1.7	<2.2
<i>Macrocystis</i>	<1.7	<1.7	<1.7	<1.7

## RESULTS AND DISCUSSION

### CONVENTIONAL CONSTITUENTS AND NUTRIENTS

The main objectives in the treatment of wastewater are the removal of suspended and floatable materials and the treatment of biodegradable organics (Metcalf and Eddy 1979). The discharge of materials with high total suspended solids (TSS), biochemical oxygen demand (BOD), and oil and grease (O&G) can cause degradation of the receiving environment through eutrophication and introduction of toxic materials (Morel and Schiff 1983).

TIWRP's 2006 and 2007 effluent discharge limits for major wastewater constituents, as well as the 2006 and 2007 effluent averages and the number of permit exceedances, are listed in Table 2-6. The 2006 and 2007 averages for all the major wastewater constituents were much lower than the discharge permit limits.

During 2006, the 30-day average concentration and mass emission limits for BOD were 15 mg/L and

3800 lbs/day, respectively, while the 2006 effluent quality averages were < 2 mg/L and 114 lbs/day, respectively. Similarly, the 30-day average discharge limits for suspended solids, O&G, ammonia, and settleable solids are 15 mg/L, 10 mg/L, 7.4 mg/L, and 0.1 ml/L, while the 2006 effluent concentrations of these constituents were <1 mg/L, <3.0 mg/L, 0.4 mg/L, and <0.03 ml/L, respectively.

During 2007, the 30-day average concentration and mass emission limits for BOD were 15 mg/L and 3800 lbs/day, respectively, while the 2007 effluent quality averages were < 3 mg/L and 244 lbs/day, respectively. Similarly, the 30-day average discharge limits for suspended solids, O&G, ammonia, and settleable solids were 15 mg/L, 10 mg/L, 7.4 mg/L, and 0.1 ml/L, while the 2007 effluent concentrations of these constituents were <1 mg/L, <3.0 mg/L, 0.8 mg/L, and <0.03 ml/L, respectively.

Table 2-7a and Table 2-7b list the 2006 and 2007 monthly averages and annual removal efficiencies for most of the major wastewater constituents. The 2007 average percent removals ranged from 95% for oil and grease, 97% for ammonia, 99% for BOD to greater than 99% removal of both suspended and settleable solids. The 2006 average percent removals ranged from 93% for oil and grease, 98%

**Table 2-6.** The NPDES effluent limits and annual averages of major effluent constituents in 2006 and 2007.

CONSTITUENT	UNITS	LIMITS			ANNUAL AVERAGES		# of EXCEEDANCES
		30-DAY AVERAGE	7-DAY AVERAGE	DAILY MAXIMUM	2006	2007	
BOD-5	mg/L	15	30	40	<2	<3	0
	lbs/day	3,800	7,500	10,000	114	244	0
Suspended Solids	mg/L	15	30	40	<1	<1	0
	lbs/day	3,800	7,500	10,000	96	101	0
Settleable Solids	ml/L	0.1	---	0.3	<0.03	<0.03	0
Oil and Grease	mg/L	10	---	15	<3	<3	0
	lbs/day	2,500	---	3,800	<399	<396	0
Residual Chlorine	mg/L	---	---	0.1	<0.01	<0.01	0
MBAS	mg/L	0.5	---	---	0.26	0.25	
	lbs/day	130	---	---	35	33	
Ammonia-N†							
• Summer (May – Oct.)	mg/L	0.71 <sup>a</sup>	---	4.7	0.25	1.28	0
	lbs/day	180	---	1,200	33	167	0
• Winter (Nov. – Apr.)	mg/L	1.3	---	8.4	0.5	0.33	
	lbs/day	330	---	2,100	66	44	
pH	pH units	6 - 9			7.3	7.3	0
Temperature	°F			100	80	80	0
Turbidity	NTU			2* 5NTU**	1.1	1.1	1

\* Daily average

\*\*Turbidity shall not exceed 5 NTU for more than 5% of the time (72 minutes) during any 24-hour period.

† - The interim limits for Ammonia-N are as follows: Monthly Average – 7.4 mg NH<sub>3</sub>-N/L and Daily Max – 20 mg NH<sub>3</sub>-N/L

for ammonia, to greater than 99% removal of BOD, suspended solids, and settleable solids.

Table 2-8 lists the annual averages from 1997 to 2007 for major wastewater constituents. Prior to 1994, most of the exceedances at TIWRP were associated with a high level of settleable solids caused by occasional bulking in the aeration tanks. At that time, after excessive bulking occurred, there were several successive days of high settleable solids before the biological aeration process could be brought under control. Since then, improved process control has led to fewer process upsets.

TIWRP's secondary filtration system started operating in December 1996, and since 1997, the entire flow of secondary-treated effluent has received sand filtration. This additional treatment has further improved and stabilized the quality

of the effluent. Since 1997, with the exception of acute and chronic toxicity, there have been only three permit violations, two for turbidity and one for lead.

### Priority Pollutant Inorganic Constituents

Tables 2-9a and 2-9b list the effluent discharge limits, the 2006 and 2007 annual effluent averages, as well as the maximum and minimum analytical results detected during each year for priority pollutant inorganics. Pollutants under these groups include heavy metals, cyanide, and tributyltin. All inorganic constituents were detected in 2006, except hexavalent chromium, cadmium, and cyanide. In 2007, all inorganic constituents except hexavalent chromium, cadmium, and tributyl tin were detected. Several of the annual maximum values were detected but below the reporting limit (DNQ). In these

**Table 2-7a.** 2006 monthly averages for major wastewater constituents.

	FLOW		TEMP.		TURB.		pH		TSS		5-d BOD		OIL & GREASE		SETT. SOLIDS		AMMONIA-N		
	INF	MGD	EFF	°F	EFF	NTU	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	
2006																			
JAN	16.3		76		0.28		7.6	7.3	173	<1	265	<2	38	<3	11.1	<0.03	25.3	0.25	
FEB	16.3		77		0.38		7.8	7.2	183	<1	282	<3	43	<3	16.0	<0.03	25.5	1.7	
MAR	15.9		75		0.26		7.7	7.2	170	<1	247	<2	39	<3	13.9	<0.03	27.0	<0.05	
APR	15.7		76		0.36		7.8	7.2	143	<2	234	<2	41	<3	16.2	<0.03	26.0	0.6	
MAY	15.0		79		0.39		7.7	7.3	143	<1	234	<2	42	<3	12.5	<0.03	26.5	<0.10	
JUN	15.4		82		0.43		7.5	7.4	147	<1	238	<2	36	<3	13.5	<0.03	26.0	0.5	
JUL	16.0		84		0.28		7.4	7.4	147	<1	204	<2	32	<3	13.4	<0.03	24.3	0.3	
AUG	16.3		84		0.32		7.4	7.3	159	<1	232	<2	131	<3	12.6	<0.03	25.7	0.1	
SEP	16.4		84		0.55		7.5	7.4	148	<1	182	<2	41	<3	12.4	<0.03	22.9	0.2	
OCT	15.8		82		0.46		7.5	7.4	146	<1	199	<2	28	<3	13.3	<0.03	24.5	0.4	
NOV	16.0		80		0.60		7.5	7.4	170	<1	204	<2	40	<3	14.0	<0.03	25.0	0.4	
DEC	15.3		77		0.49		7.5	7.4	180	<1	236	<2	34	<3	11.4	<0.03	26.9	0.1	
*MAX	20.6		85		1.30		8.6	7.7	282	4	438	9	524	<3	130	<0.03	40.3	1.7	
*MIN	11.3		74		0.00		6.7	6.7	72	<1	102	<2	17	<3	2.50	<0.03	18.8	<0.05	
MEAN	15.9		80		0.39		7.6	7.3	157	<1	229	<2	46	<3	13.4	<0.03	25.3	<0.39	
% REMOVAL										99.4		99.1		93		100		98	

\* Daily maximum and minimum results for 2006

**Table 2-7b.** 2007 monthly averages for major wastewater constituents.

	FLOW		TEMP.		TURB.		pH		TSS		5-d BOD		OIL & GREASE		SETT. SOLIDS		AMMONIA-N		
	INF	MGD	EFF	°F	EFF	NTU	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	INF	EFF	
2007																			
JAN	15.9		75		0.4		7.5	7.4	190	<1	254	<2	32	<3	13.7	<0.03	28.1	0.6	
FEB	16.7		76		0.4		7.5	7.4	185	<1	248	<2	38	<3	13.6	<0.03	29.1	0.4	
MAR	15.9		77		0.5		7.3	7.5	181	<1	233	<2	30	<3	12.1	<0.03	27.9	0.3	
APR	15.9		78		0.5		7.4	7.5	186	<1	229	<2	38	<3	12.7	<0.03	25.0	0.3	
MAY	15.4		79		0.5		7.5	7.4	207	<1	246	<2	29	<3	12.5	<0.03	30.0	0.2	
JUN	14.7		80		0.4		7.7	7.4	193	<1	263	<2	36	<3	12.6	<0.03	25.9	0.4	
JUL	15.4		84		0.5		7.3	7.4	182	<1	305	<3	89	<3	14.2	<0.03	23.5	0.4	
AUG	16.3		86		0.4		7.4	7.4	168	<1	>272	<2	88	<3	17.0	<0.03	23.9	0.6	
SEP	15.8		85		0.4		7.4	7.4	204	<1	270	3	66	<3	14.9	<0.03	25.4	1.1	
OCT	15.9		84		0.8		7.5	7.5	198	<1	274	6	96	<3	20.6	<0.03	27.9	5	
NOV	15.4		81		0.5		7.5	7.5	173	<1	277	<2	85	<3	13.7	<0.03	24.9	0.2	
DEC	15.9		77		0.6		7.4	7.3	164	<1	255	<2	54	<3	12.4	<0.03	26.7	0.2	
*MAX	19.2		88		3.2		8.3	7.9	1420	6	>880	13	194	<3	81	0.04	48.9	5	
*MIN	12.2		73		0.2		6.8	6.8	64	<1	126	<2	16	<3	3.5	<0.03	19.2	0.2	
MEAN	15.8		80		0.5		7.5	7.4	186	<1	>261	<2.5	57	<3	14.2	<0.03	26.5	0.8	
% REMOVAL										99.5		99.0		95		99.8		97.0	

\* Daily maximum and minimum results for 2007

cases, an estimated value was calculated applying the method described in Materials and Methods. Except for lead (14.8 µg/L) in February 2007, there were no permit exceedances for these constituents.

The removal efficiency of metals through the treatment processes is related to the chemical and physical characteristics of the individual metal. In general, higher removal efficiencies are found in metals that are less soluble in wastewater and have greater tendencies to associate with particles in the

wastewater (Chen et al., 1974). This group of less soluble metals includes chromium, mercury, lead, copper, silver, and zinc. Arsenic and selenium are more soluble in wastewater and are not easily removed.

The average concentrations of eight detected priority pollutant metals are shown in Table 2-10. Consistent with the above findings, the levels of chromium, mercury, copper, silver and zinc are much lower in the effluent as compared to the influent. The

**Table 2-8.** Annual average of major wastewater constituents from 1997 to 2007.

Year	FLOW	TURB.	pH		Suspended Solids		BOD-5		Oil & Grease		Settleable Solids		Ammonia-N	
	INF MGD	EFF NTU	INF	EFF	INF mg/L	EFF mg/L	INF mg/L	EFF mg/L	INF mg/L	EFF mg/L	INF ml/L	EFF ml/L	INF mg/L	EFF mg/L
1997	16.3	1.0	7.6	7.4	185	2	193	2	48	2.0	12.5	<0.03	28.5	1.8
1998	16.6	1.0	7.4	7.3	195	1	192	4	43	1.0	43	<0.03	29.7	6.2
1999	15.1	<0.5	7.5	7.4	234	2	251	3	41	1.0	41	<0.03	32.6	3.4
2000	15.9	0.5	7.5	7.3	227	1	237	2	40	2.0	40	<0.03	33.7	1.6
2001	15.2	0.5	7.4	7.3	216	1	251	<2	39	1.2	1.2	<0.03	30.6	0.6
2002	15.1	0.5	7.5	7.4	193	1	233	<2	42	3.2*	12.1	<0.03	24.9	0.3
2003	15.3	0.5	7.5	7.4	195	1	224	2	36	<3	13.1	<0.03	23.8	0.6
2004	15.6	0.4	7.5	7.4	180	1	229	<2	38	<3	13.7	<0.03	23.7	0.2
2005	16.0	0.3	7.5	7.4	170	1	241	<2	37	<3	12.6	<0.03	24.1	0.4
2006	15.9	0.4	7.6	7.3	157	<1	229	<2	46	<3	13.4	<0.03	25.3	<0.4
2007	15.8	0.5	7.5	7.4	186	<1	261	<2.5	57	<3	14.2	<0.03	265	0.8

\* MDL changed in 2002

removal of arsenic and selenium from the effluent is not as efficient. There has also been a gradual decline in the influent concentration of most metals over time.

### Organic Constituents

Tables 2-11a and 2-11b list the organic priority pollutants tested under the current TIWRP NPDES permit. Where applicable, current effluent discharge limits are listed, along with the 2006 and 2007 annual effluent averages, as well as the maximum and minimum analytical results detected during the year for priority pollutant organics. A numerical limit in the current TIWRP NPDES permit is not defined unless a constituent shows a reasonable potential to exceed State water quality standards or has been defined in a previous TIWRP NPDES permit. Among the organic constituents tested in 2006, only Chloroform, 2,4,6-Trichlorophenol, Bis-(2-ethylhexyl) phthalate, and Di-n-butyl phthalate were detected. Among the organic constituents tested in 2007, only Chloroform, Dichlorobromomethane, 2,4,6-Trichlorophenol, Bis-(2-ethylhexyl) phthalate and Total PAHs were detected. There were no permit exceedances for these constituents during either year.

### Residual Chlorine

The current NPDES permit of TIWRP does not require chlorination of the final effluent. Since chlorination may occur in upstream processes,

residual chlorine in the TIWRP final effluent is monitored continuously with an on-line meter. During 2006 and 2007, residual chlorine was not detected in the effluent.

### Radioactivity

Low levels of gross alpha and beta radioactivity were detected in the TIWRP effluent during the semiannual sampling in 2006-2007. However, the amounts of alpha and beta radioactivity detected were always below the NPDES permit daily maximum limits of 15 and 50 pCi/L, respectively.

### TOXICITY

The Terminal Island Treatment Plant is required under its NPDES permit to conduct both acute and chronic toxicity tests. To control discharge of toxic chemicals to the environment, the Federal Clean Water Act mandates a national policy that “the discharge of toxic pollutants in toxic amounts be prohibited.” The EPA, as authorized by the Clean Water Act, implements this policy through the use of “whole effluent testing” (WET) for toxicity using the sensitive life stage of aquatic organisms exposed to wastewater effluent. TIWRP conducts WET, both acute and chronic, to meet these monitoring requirements. Monthly acute toxicity testing (EPA 2002) and chronic toxicity testing (EPA 1995) of TIWRP effluent is conducted by the Environmental Monitoring Division. The results of toxicity testing of the effluent serve as indicators

**Table 2-9a.** The NPDES effluent limits and annual averages of priority pollutant inorganics in 2006.

<u>PRIORITY POLLUTANT INORGANICS:</u>		<u>CURRENT PERMIT LIMITS</u>		2006	2006	2006	<u># OF EXCEEDANCES</u>
<u>CONSTITUENT</u>	<u>UNITS</u>	<u>MONTHLY AVERAGE</u>	<u>DAILY MAXIMUM</u>	<u>ANNUAL AVERAGE</u>	<u>ANNUAL MAX</u>	<u>ANNUAL MIN</u>	
Antimony	µg/L	---	---	DNQ(0.6)	DNQ(0.6)	DNQ(0.5)	0
Arsenic	µg/L	---	---	2.5	3.8	0.9	0
Beryllium	µg/L	---	---	ND	DNQ(0.4)	ND	0
Cadmium	µg/L	---	---	ND	ND	ND	0
Chromium (hexavalent)	µg/L	---	---	ND	ND	ND	0
Chromium (total)	µg/L	---	---	DNQ(0.4)	DNQ(0.6)	ND	0
Copper	µg/L	74*	---	DNQ(3)	DNQ(4)	DNQ(1)	0
Lead	µg/L	8.6*	---	DNQ(1.3)	DNQ(2.9)	ND	0
Mercury†	µg/L	0.3*	---	DNQ(<0.012)	<0.022	ND	0
Nickel	µg/L	120	---	5.7	12.9	4	0
Selenium	µg/L	---	---	5.7	6.6	4.8	0
Silver	µg/L	3.8*	---	DNQ(0.12)	DNQ(0.24)	ND	0
Thallium	µg/L	---	---	DNQ(0.02)	DNQ(0.03)	DNQ(0.02)	0
Zinc	µg/L	---	---	22	24	20	0
Cyanide	µg/L	11*	---	ND	ND	ND	0
Tributyltin	ng/L	---	---	ND	3.9	ND	0
MBAS	mg/L	0.5	---	0.26	0.49	0.11	0

DNQ=Detected but Not Quantified

Note - A numerical limit in the current NPDES permit is not defined unless a constituent shows a reasonable potential to exceed State water quality standards or has been defined in a previous permit.

\* -Current permit limits are interim effluent limits and expire on March 10, 2010.

† - The MDL changed from 0.022 µg/L to 0.004 µg/L in May 2006.

of possible adverse effects that the effluent might have on marine life once it is discharged into the receiving water. In addition, if toxicity testing of the effluent indicates levels of toxicity that exceed permit requirements, then further testing may yield the offending toxicant(s) and plant processes may be altered to reduce the levels of these toxicants and thus reduce effluent toxicity.

### Acute Toxicity Testing Results

The permit requirements mandate that percent survival for the acute toxicity test organism be 70% or greater in 100% effluent for a single test. Furthermore, the average percent survival for three consecutive tests must not fall below 90%. If either of the above requirements is not met, TIWRP is to conduct six accelerated tests within a 12-week period. A Toxicity Identification Evaluation (TIE) shall be initiated by the discharger if two of the six accelerated tests are less than 90%. Should any of the six accelerated acute toxicity tests yield

results that are less than 70% survival, TIWRP shall immediately implement an Initial Investigational Toxicity Reduction Evaluation (TIRE). The discharger may return to monthly acute toxicity testing if the additional tests indicate compliance with acute toxicity limitations. During the 2006 calendar year, the TIWRP discharge was in complete compliance with the permit requirements (Table 2-12).

The results of the acute toxicity testing at TIWRP was in compliance January through March 2007 (Table 2-13). However, the average percent survival from April through June of 2007 was 87.7%, which is less than the three consecutive 96-hour test requirement of 90%. As a result of not meeting the average three test minimum toxicity limit, acute accelerated testing was initiated at TIWRP. The first accelerated sample was collected on July 10 with testing commencing on July 11. The topsmelt survival in 100% TIWRP effluent was 86.7%. The second accelerated sample was collected on July 17 and the associated test was initiated on July 18.

**Table 2-9b.** The NPDES effluent limits and annual averages of priority pollutant inorganics in 2007.

PRIORITY POLLUTANT INORGANICS:		CURRENT PERMIT LIMITS		2007 ANNUAL AVERAGE	2007 ANNUAL MAX	2007 ANNUAL MIN	# OF EXCEEDANCES
CONSTITUENT	UNITS	MONTHLY AVERAGE	DAILY MAXIMUM				
Antimony	µg/L	---	---	DNQ(0.7)	1.03	DNQ(0.5)	0
Arsenic	µg/L	---	---	2.2	2.7	1.2	0
Beryllium	µg/L	---	---	ND	DNQ(0.06)	ND	0
Cadmium	µg/L	---	---	ND	ND	ND	0
Chromium (hexavalent)	µg/L	---	---	ND	ND	ND	0
Chromium (total)	µg/L	---	---	DNQ(0.4)	DNQ(0.7)	DNQ(0.2)	0
Copper	µg/L	74*	---	DNQ(4)	8	DNQ(1)	0
Lead	µg/L	8.6*	---	DNQ(<2.4)	14.8	ND	1
Mercury	µg/L	0.3*	---	DNQ(<0.006)	DNQ(0.14)	ND	0
Nickel	µg/L	120	---	DNQ(5.6)	4.4	ND	0
Selenium	µg/L	---	---	6.6	7.8	3.7	0
Silver	µg/L	3.8*	---	DNQ(<0.06)	0.17	DNQ(0.02)	0
Thallium	µg/L	---	---	DNQ(0.04)	DNQ(0.04)	DNQ(0.02)	0
Zinc	µg/L	---	---	22	35	11	0
Cyanide	µg/L	11*	---	ND	5	ND	0
Tributyltin	ng/L	---	---	ND	ND	ND	0
MBAS	mg/L	0.5	---	0.25	0.44	0.10	0

DNQ=Detected but Not Quantified

Note - A numerical limit in the current NPDES permit is not defined unless a constituent shows a reasonable potential to exceed State water quality standards or has been defined in a previous permit.

\* -Current permit limits are interim effluent limits and expire on March 10, 2010.

Survival in 100% TIWRP effluent was 83.3%.

The TIWRP permit mandates that if the results of two accelerated tests are less than 90% survival, the discharger will immediately initiate a Toxicity Identification Evaluation (TIE). Since both accelerated test results are less 90%, a TIE was initiated in August 2007.

In the first TIE test conducted in August 2007, TIWRP effluent was manipulated by two methods; one sample aliquot was passed through a C8 SPE column to remove non-polar organics and another aliquot through zeolite to remove ammonia. Passing the TIWRP effluent through a C8 solid phase extraction (SPE) column and a separate TIWRP sample aliquot through zeolite reduced the topsmelt mortality in the 100% TIWRP effluent of both aliquots to 96.6% survival.

The results of the August Baseline Toxicity Test (83.3% survival in 100% TIWRP effluent) indicated

a toxicity level similar to that of the toxicity tests conducted in July. Passing the TIWRP effluent through a C8 solid phase extraction (SPE) column reduced the topsmelt mortality in the 100% TIWRP effluent (96.6% survival), suggesting that non-polar organic compounds may be partially responsible for the toxicity present in the effluent.

The zeolite manipulation of the effluent proved just as effective at removing toxicity as the C8 SPE treatment of TIWRP effluent (96.6% survival). Zeolite is commonly used in toxicity studies to remove ammonia; however, the ammonia concentration of the effluent, prior to the zeolite treatment was low (0.463 mg/L) and not in the range that causes measurable toxicity. After passing TIWRP effluent through zeolite, the ammonia was considerably reduced (0.08 mg/L). Although the zeolite treatment reduced toxicity; the low ammonia concentrations suggest that ammonia is not responsible for effluent toxicity. Zeolite removes compounds in addition to ammonia, and it appears

**Table 2-10.** Priority pollutant metal annual average concentrations in influent and effluent from 1997 to 2007.

YEAR	As		Cr		Cu		Pb		Hg		Se		Ag		Zn	
	INF µg/L	EFF µg/L	INF µg/L	EFF µg/L	INF µg/L	EFF µg/L	INF µg/L	EFF µg/L	INF µg/L	EFF µg/L	INF µg/L	EFF µg/L	INF µg/L	EFF µg/L	INF µg/L	EFF µg/L
1997	4	3	<4	<4	32	<10	4	<3	<0.3	<0.3	29	19	0.9	<0.4	86	25
1998	3	1	<4	<4	40	<10	3	<3	<0.3	<0.3	25	12	0.8	<0.4	103	8
1999	3	2	<4	<4	26	<10	<3	<3	<0.3	<0.3	22	14	0.7	<0.4	107	34
2000	4	3	4	3	33	<10	<3	<3	<0.3	<0.3	26	10	0.5	<0.4	103	27
2001	3	3	<10	<10	39	<10	<5	<5	<0.3	<0.3	21	10	1.0	<0.6	127	26
2002	3	3	<10	<3	37	7	16	<3	<0.2	<0.1	19	10	0.7	<0.6	115	22
2003	3	2	3	<1	47	<4	5	3	0.2	<0.1	14	12	2.8	0.3	129	22
2004	4	3	3	<1	37	7	3	<3	0.13	<0.03	12	6	0.6	<0.3	96	24
2005	3	3	2	<1	41	7	2.5	<1	0.11	<0.02	14	8	1.1	<0.4	97	24
2006	4	3	3	<0.4	37	<3	4	<1.3	0.16	<0.12	10	6	0.9	<0.12	151	22
2007	4	2	4	0.4	47	4	<2	<2.4	0.35	<0.006	21	7	1.1	<0.06	166	22

at least one of these compounds is toxic.

The Toxicity Identification Evaluation continued with a second series of tests on September 12, 2007. Two manipulations in addition to the baseline test were employed; 1) the addition of ethylenediamine tetraacetic acid (EDTA), a common metal chelator, was added to the TIWRP effluent and 2) filtering the effluent through a 0.45 micron filter was employed. The baseline and both manipulations resulted in >90% survival. Due to the lack of effluent toxicity, no reduction in the mortality of the topsmelt could be attributed to the manipulations. This type of inconsistent toxicity makes it difficult to determine the toxicant that initiated the TIWRP acute TIE.

A third series of TIE tests was conducted on October 17, 2007. In addition to the baseline test, two effluent manipulations were employed; 1) passing the effluent through a C8 SPE column to remove non-polar organics and 2) addition of EDTA to chelate any available metals. All three tests resulted in >90% survival. The TIWRP baseline effluent survival (93.3%) was not significantly different from the EDTA manipulated effluent (96.7%) or the effluent passed through the C8 SPE column (96.7%). The lack of measurable toxicity in the baseline effluent may indicate a reduction in toxicity due to plant treatment or a reduction in the source of the toxicity. Average survival during August 2007 and October 2007 was 91.1%. Since this met the

three test average limit of 90%, TIWRP returned to the routine monthly testing. In November and December the acute results (100% and 86.7%, respectively) were again within compliance.

### Chronic Toxicity Testing Results

The monthly chronic toxicity test limit is based on a TUc=1.0. This is equivalent to a no observable effect concentration (NOEC) of 100% effluent. Due to procedural difficulties of testing a low saline effluent with the saltwater species *Haliotis rufescens* (red abalone), the highest possible concentration of effluent tested is 60%. Therefore, no effect at the highest concentration tested (60%) is not considered a violation, but a TUc > 1.67 is. If the chronic toxicity of the effluent exceeds the monthly median of 1.67 TUc, TIWRP is required to immediately implement accelerated chronic toxicity testing. If any three out of the initial test and accelerated tests results exceed 1.67 TUc, TIWRP shall initiate a TIE and implement the Initial Investigational TRE Workplan.

The chronic toxicity test limit is currently set at 1.0 TUc (chronic toxicity units) under the TIWRP NPDES permit. To comply with the TUc limit of 1.0, test organisms must not show any chronic toxic response in 100% plant effluent (dilution credits are not allowed since the TIWRP effluent is presently being discharged into a harbor).

**Table 2-11a.** The NPDES effluent limits and annual averages of priority pollutant organics in 2006.

Constituents	Current NPDES Limit		Concentrations (ug/L) in TITP FINAL EFFLUENT during 2006		
	Monthly Avg.(ug/L)	Daily Max.	Avg.	Max.	Min.
<b><u>PRIORITY POLLUTANT ORGANICS:</u></b>					
<b><u>PESTICIDES</u></b>					
Aldrin	----	----	ND	ND	ND
Dieldrin	0.004*	----	ND	ND	ND
Endrin	----	----	ND	ND	ND
Toxaphene	----	----	ND	ND	ND
DDT & Derivates	----	----	ND	ND	ND
HCH's	----	----	ND	ND	ND
Endosulfan	----	----	ND	ND	ND
PCB's	----	----	ND	ND	ND
Chlordane & Related Compounds	----	----	ND	ND	ND
Heptachlor	----	----	ND	ND	ND
Heptachlor Epoxide	----	----	ND	ND	ND
<b><u>VOLATILE ORGANIC COMPOUNDS:</u></b>					
Acrolein	----	----	ND	ND	ND
Acrylonitrile	----	----	ND	ND	ND
Benzene	----	----	ND	ND	ND
Halomethanes	----	----	ND	ND	ND
Carbon tetrachloride	----	----	ND	ND	ND
Chlorobenzene	----	----	ND	ND	ND
Chloroform	----	----	0.4	0.5	0.4
Vinyl Chloride	----	----	ND	ND	ND
1,3-Dichloropropene	----	----	ND	ND	ND
Ethylbenzene	----	----	ND	ND	ND
Methylene chloride	----	----	ND	ND	ND
1,1,2,2-Tetrachloroethane	----	----	ND	ND	ND
Tetrachloroethene	----	----	ND	ND	ND
Toluene	----	----	ND	ND	ND
1,1,1-Trichloroethane	----	----	ND	ND	ND
1,1,2-Trichloroethane	----	----	ND	ND	ND
Trichloroethene	----	----	ND	ND	ND
1,1-Dichloroethylene	----	----	ND	ND	ND
1,2-Dichloroethane	----	----	ND	ND	ND
Dichlorobromomethane	----	----	ND	ND	ND
Chlorodibromomethane	----	----	ND	ND	ND
<b><u>ACID EXTRACTABLE COMPOUNDS:</u></b>					
Non-Chlorinated Phenolic Compounds	----	----	ND	ND	ND
2,4-Dinitrophenol	----	----	ND	ND	ND
4,6-Dinitro-2-Methyl Phenol	----	----	ND	ND	ND
Chlorinated Phenolic Compounds	----	----	ND	ND	ND
2,4,6-Trichlorophenol	----	----	DNQ(0.29))	DNQ(0.84)	ND
<b><u>BASE AND NEUTRAL EXTRACTABLE COMPOUNDS:</u></b>					
PAHs	----	----	ND	ND	ND
Fluoranthene	----	----	ND	ND	ND
Benzidine	----	----	ND	ND	ND
Bis (2-chloroethyl) ether	----	----	ND	ND	ND
Bis (2-chloroethoxy) methane	----	----	ND	ND	ND
Bis (2-chloroisopropyl) ether	----	----	ND	ND	ND
Bis (2-ethylhexyl) phthalate	190	560	DNQ(0.8)	DNQ(1.2)	ND
Di-n-butyl phthalate	----	----	0.6	1.1	0.2
3,3-Dichlorobenzidine	----	----	ND	ND	ND
Diethyl phthalate	----	----	ND	ND	ND
Dimethyl phthalate	----	----	ND	ND	ND
2,4-Dinitrotoluene	----	----	ND	ND	ND
Hexachlorobenzene	----	----	ND	ND	ND
Hexachlorobutadiene	----	----	ND	ND	ND
Hexachlorocyclopentadiene	----	----	ND	ND	ND
Isophorone	----	----	ND	ND	ND
Nitrobenzene	----	----	ND	ND	ND
N-Nitrosodimethylamine	----	----	ND	ND	ND
N-Nitrosodiphenylamine	----	----	ND	ND	ND
N-Nitrosodi-N-propylamine	----	----	ND	ND	ND
Hexachloroethane	----	----	ND	ND	ND
Dichlorobenzenes	----	----	ND	ND	ND
<b><u>OTHERS:</u></b>					
2,3,7,8-Dioxin	----	----	ND	ND	ND

Note - A numerical limit in the current NPDES permit is not defined unless a constituent shows a reasonable potential to exceed State water quality standards or has been defined in a previous permit

\* -Current permit limit is an interim effluent limit and expires on March 10, 2010.

**Table 2-11b.** The NPDES effluent limits and annual averages of priority pollutant inorganics in 2007.

Constituents	Current NPDES Limit		Concentrations (ug/L) in T1TP FINAL EFFLUENT during 2007		
	Monthly Avg.(ug/L)	Daily Max.	Avg.	Max.	Min.
<b><u>PRIORITY POLLUTANT ORGANICS:</u></b>					
<b><u>PESTICIDES</u></b>					
Aldrin	----	----	ND	ND	ND
Dieldrin	0.004*	----	ND	ND	ND
Endrin	----	----	ND	ND	ND
Toxaphene	----	----	ND	ND	ND
DDT & Derivates	----	----	ND	ND	ND
HCH's	----	----	ND	ND	ND
Endosulfan	----	----	ND	ND	ND
PCB's	----	----	ND	ND	ND
Chlordane & Related Compounds	----	----	ND	ND	ND
Heptachlor	----	----	ND	ND	ND
Heptachlor Epoxide	----	----	ND	ND	ND
<b><u>VOLATILE ORGANIC COMPOUNDS:</u></b>					
Acrolein	----	----	ND	ND	ND
Acrylonitrile	----	----	ND	ND	ND
Benzene	----	----	ND	ND	ND
Carbon tetrachloride	----	----	ND	ND	ND
Chlorobenzene	----	----	ND	ND	ND
Chloroform	----	----	2.0	7.64	ND
Vinyl Chloride	----	----	ND	ND	ND
1,3-Dichloropropene	----	----	ND	ND	ND
Ethylbenzene	----	----	ND	ND	ND
Methylene chloride	----	----	ND	ND	ND
1,1,2,2-Tetrachloroethane	----	----	ND	ND	ND
Tetrachloroethene	----	----	ND	ND	ND
Toluene	----	----	ND	ND	ND
1,1,1-Trichloroethane	----	----	ND	ND	ND
1,1,2-Trichloroethane	----	----	ND	ND	ND
Trichloroethene	----	----	ND	ND	ND
1,1-Dichloroethylene	----	----	ND	ND	ND
1,2-Dichloroethane	----	----	ND	ND	ND
Dichlorobromomethane	----	----	DNQ(0.1)	DNQ(0.3)	ND
Chlorodibromomethane	----	----	ND	ND	ND
<b><u>ACID EXTRACTABLE COMPOUNDS:</u></b>					
Non-Chlorinated Phenolic Compounds	----	----	ND	ND	ND
2,4-Dinitrophenol	----	----	ND	ND	ND
4,6-Dinitro-2-Methyl Phenol	----	----	ND	ND	ND
Chlorinated Phenolic Compounds	----	----	ND	ND	ND
2,4,6-Trichlorophenol	----	----	1.6	5.9	ND
<b><u>BASE AND NEUTRAL EXTRACTABLE COMPOUNDS:</u></b>					
PAHs	----	----	ND	0.08	ND
Fluoranthene	----	----	ND	ND	ND
Benzidine	----	----	ND	ND	ND
Bis (2-chloroethyl) ether	----	----	ND	ND	ND
Bis (2-chloroethoxy) methane	----	----	ND	ND	ND
Bis (2-chloroisopropyl) ether	----	----	ND	ND	ND
Bis (2-ethylhexyl) phthalate	190	560	DNQ(1.3)	4	ND
Di-n-butyl phthalate	----	----	ND	ND	ND
3,3-Dichlorobenzidine	----	----	ND	ND	ND
Diethyl phthalate	----	----	ND	ND	ND
Dimethyl phthalate	----	----	ND	ND	ND
2,4-Dinitrotoluene	----	----	ND	ND	ND
Hexachlorobenzene	----	----	ND	ND	ND
Hexachlorobutadiene	----	----	ND	ND	ND
Hexachlorocyclopentadiene	----	----	ND	ND	ND
Isophorone	----	----	ND	ND	ND
Nitrobenzene	----	----	ND	ND	ND
N-Nitrosodimethylamine	----	----	ND	ND	ND
N-Nitrosodiphenylamine	----	----	ND	ND	ND
N-Nitrosodi-N-propylamine	----	----	ND	ND	ND
Hexachloroethane	----	----	ND	ND	ND
Dichlorobenzenes	----	----	ND	ND	ND
<b><u>OTHERS:</u></b>					
2,3,7,8-Dioxin	----	----	ND	ND	ND

Note - A numerical limit in the current NPDES permit is not defined unless a constituent shows a reasonable potential to exceed State water quality standards or has been defined in a previous permit

\* -Current permit limit is an interim effluent limit and expires on March 10, 2010.

**Table 2-12.** 2006 TIWRP effluent acute toxicity testing results.

Month	Species	% Survival	Pass/Exceed
Jan	<i>Americamysis bahia</i>	100	PASS
Feb	<i>Americamysis bahia</i>	93.3	PASS
Mar	<i>Americamysis bahia</i>	100	PASS
Apr	<i>Americamysis bahia</i>	97	PASS
May	<i>Americamysis bahia</i>	97	PASS
Jun	<i>Americamysis bahia</i>	100	PASS
Jul	<i>Americamysis bahia</i>	90	PASS
Aug	<i>Americamysis bahia</i>	97.5	PASS
Sep	<i>Americamysis bahia</i>	100	PASS
Oct	<i>Americamysis bahia</i>	100	PASS
Nov	<i>Americamysis bahia</i>	96.7	PASS
Dec	<i>Americamysis bahia</i>	100	PASS

However, during a meeting held on October 15, 1998, the Environmental Protection Agency and the RWQCB mandated that for the red abalone the highest concentration to be tested is 60% effluent. Since the red abalone *Haliotis rufescens* cannot be tested in 100% effluent, the lowest TUC that can be calculated is <1.67.

In 2005 the chronic limit was out of compliance during the months of June, July, August, September, November, and December. The source(s) or possible cause(s) of these exceedances was not determined. Accelerated testing began in July and the third exceedance in August prompted the Initial Toxicity Reduction Evaluation (TRE) testing in September. Various manipulations of the TIWRP final effluent and additional samples were tested to help determine the cause(s) and changes necessary to reduce the chronic toxicity of the TIWRP effluent.

The TIE continued in 2006 (Table 2-14) and initially

focused on by products of the Advanced Water Treatment Facility (AWTF), toxins removed by aeration, and toxins introduced through the digestion of solids. The TIE included both non-manipulated testing (baseline effluent, low flow effluent samples, and microfiltration backwash) and manipulated samples (addition of EDTA, aerated effluent, and effluent plus polymer). Treatment processes were also examined, including effluent samples with and without centrifugation and increasing treatment mean cell retention time (MCRT). Although increased MCRT was considered as a means of reducing toxicity, it was not conducted in 2006 due to treatment plant construction.

A total of 21 baseline effluent tests were conducted in 2006; 11 exceeded the permit limit and 10 were within the limit. In order for TIWRP to resume monthly testing, six consecutive baseline effluent tests must meet the permit limit. Although 10 baseline effluent tests met the permit limit, the tests

**Table 2-13.** 2007 TIWRP effluent acute toxicity testing results.

Month	Species	% Survival	Pass/Exceed	Comments
Jan	<i>Americamysis bahia</i>	100	PASS	
Feb	<i>Americamysis bahia</i>	100	PASS	
Mar	<i>Americamysis bahia</i>	100	PASS	
Apr	<i>Americamysis bahia</i>	96.6	PASS	
May	<i>Americamysis bahia</i>	93.3	PASS	
Jun	<i>Atherinops affinis</i>	73.3	EXCEED	Apr, May, June avg = 87.7%
Jul	<i>Atherinops affinis</i>	86.7	PASS	1st accelerated test
	<i>Atherinops affinis</i>	83.3	PASS	
Aug	<i>Atherinops affinis</i>	83.3	PASS	TIE initiated
Sep	<i>Atherinops affinis</i>	96.6	PASS	
Oct	<i>Atherinops affinis</i>	93.3	PASS	Aug, Sep, Oct avg = 91.1%
Nov	<i>Atherinops affinis</i>	100	PASS	Monthly testing resumed
Dec	<i>Atherinops affinis</i>	86.7	PASS	

were not consecutive and testing continued.

Testing with varying amounts of polymer added to the effluent and with and without centrifugation appeared to have little effect on the toxicity of TIWRP effluent. Low flow samples and the AWTF also appear to contribute very little to the effluent toxicity. Both EDTA and aeration has had mixed success, sometimes removing the toxicity and other times not. An attempt was made to eliminate the toxicity through increased MCRT rather than trying to identify the toxin(s) and then removing it (them). Increased MCRT allows for increased processing of the effluent and better removal of solids and the toxins associated with them. With the current construction on the plant, increased MCRT at this time is not feasible. When the construction is complete increasing the MCRT and testing will be a priority. In the mean time additional testing to remove metals and effluent aeration will continue and different methods will be explored.

In 2007 (Table 2-15) the chronic limit was out of compliance at least once during the months of January, February, March, April, June, August, July, and October. A total of 22 baseline effluent tests were conducted; 9 exceeded the permit limit and 13 were within the limit (Table 2-15). Although 13 baseline effluent tests met the permit limit, six consecutive tests never met the limit, so testing continued.

The source(s) or possible cause(s) of these exceedances was not determined; although as in 2006, various manipulations of the TIWRP final effluent were tested to help determine the cause(s) and changes necessary to reduce the chronic toxicity of the TIWRP effluent. Testing with C8, EDTA, and aeration has had mixed success sometimes removing the toxicity and other times not. Beginning in February 2007, MCRT was increased in an attempt to remove toxicity. Increased MCRT allows for increased processing of the effluent and better

**Table 2-14.** 2006 TIWRP effluent chronic toxicity testing results.

DATE	CHRONIC TU c	PASS/EXCEED	COMMENTS
9-Jan	3.33 <i>Haliotis rufescens</i>	EXCEED	Aeration removed toxicity.
24-Jan	<.167 <i>Haliotis rufescens</i>	PASS	Aeration, Low flow, microfiltration non-toxic; polymer addition toxic
6-Feb	5.0 <i>Haliotis rufescens</i>	EXCEED	Aeration does not remove toxicity; microfiltration toxic
13-Feb	2.5 <i>Haliotis rufescens</i>	EXCEED	Aeration removed toxicity; Low flow non-toxic, microfiltration toxic
28-Mar	<1.67 <i>Haliotis rufescens</i>	PASS	Aeration non-toxic
10-Apr	<1.67 <i>Haliotis rufescens</i>	PASS	Aeration, Low flow non-toxic; Microfiltration toxic.
24-Apr	<1.67 <i>Haliotis rufescens</i>	PASS	Effluent with and without centrifugation toxic; addition of polymer toxic
8-May	10.0 <i>Haliotis rufescens</i>	EXCEED	Effluent with polymer toxic; Effluent with 0.469 mg/l polymer non-toxic
22-May	2.5 <i>Haliotis rufescens</i>	EXCEED	Effluent retested 5/23 still toxic; Effluent with EDTA tested 5/23 non-toxic
5-Jun	5.0 <i>Haliotis rufescens</i>	EXCEED	Addition of 0.469 mg/l polymer reduces toxicity.
4-Jul	<1.6 <i>Haliotis rufescens</i>	PASS	Effluent with 0.625 0.469 mg/l non-toxic
11-Jul	2.5 <i>Haliotis rufescens</i>	EXCEED	Addition of polymer and EDTA does not remove toxicity
24-Jul	>10.0 <i>Haliotis rufescens</i>	EXCEED	Addition of polymer and EDTA does not remove toxicity
14-Aug	10.0 <i>Haliotis rufescens</i>	EXCEED	Aeration and EDTA does not remove toxicity
28-Aug	>10.0 <i>Haliotis rufescens</i>	EXCEED	EDTA reduces toxicity
11-Sep	<1.67 <i>Haliotis rufescens</i>	PASS	Addition of EDTA toxic
25-Sep	<1.67 <i>Haliotis rufescens</i>	PASS	EDTA non-toxic
1-Oct	3.33 <i>Haliotis rufescens</i>	PASS	Addition of EDTA toxic
24-Oct	5.0 <i>Haliotis rufescens</i>	EXCEED	Filtered effluent non-toxic; Addition of EDTA reduces toxicity
28-Nov	<1.67 <i>Haliotis rufescens</i>	PASS	ATL conducts test

**Table 2-15.** 2006 TIWRP effluent chronic toxicity testing results.

<b>DATE</b>	<b>CHRONIC TU c</b>	<b>PASS/EXCEED</b>	<b>COMMENTS</b>
8-Jan	5.0 <i>Haliotis rufescens</i>	EXCEED	MCRT = 7.5 days
22-Jan	3.33 <i>Haliotis rufescens</i>	EXCEED	MCRT = 11.6 days
7-Feb	5.0 <i>Haliotis rufescens</i>	EXCEED	Increased MCRT maintained (up to 10 days)
20-Feb	10.0 <i>Haliotis rufescens</i>	EXCEED	
5-Mar	2.5 <i>Haliotis rufescens</i>	EXCEED	
19-Mar	<1.67 <i>Haliotis rufescens</i>	PASS	
9-Apr	<1.67 <i>Haliotis rufescens</i>	PASS	
23-Apr	>10.0 <i>Haliotis rufescens</i>	EXCEED	
20-May	<1.67 <i>Haliotis rufescens</i>	PASS	
JUN 4	2.5 <i>Haliotis rufescens</i>	EXCEED	
1-Jul	<1.67 <i>Haliotis rufescens</i>	PASS	
16-Jul	2.5 <i>Haliotis rufescens</i>	EXCEED	
5-Aug	<1.67 <i>Haliotis rufescens</i>	PASS	
26-Aug	<1.67 <i>Haliotis rufescens</i>	PASS	
10-Sep	<1.67 <i>Haliotis rufescens</i>	PASS	
23-Sep	<1.67 <i>Haliotis rufescens</i>	PASS	
14-Oct	3.33 <i>Haliotis rufescens</i>	PASS	
21-Oct	2.5 <i>Haliotis rufescens</i>	EXCEED	
5-Nov	<1.67 <i>Haliotis rufescens</i>	PASS	
25-Nov	<1.67 <i>Haliotis rufescens</i>	PASS	
2-Dec	<1.67 <i>Haliotis rufescens</i>	PASS	
9-Dec	<1.67 <i>Haliotis rufescens</i>	PASS	

removal of solids and the toxins associated with them. From January 2006 to December 2006, the average Mean Cell Residence Time (MCRT) for TIWRP was approximately 5 days. It was hypothesized that increasing the MCRT would decrease toxicity. The initial effort to increase MCRT was met with mixed success. On January 8 the MCRT was 7.5 days, whereas on January 22 the MCRT was increased to 11.6 days. Both the January 8 and the January 22 effluent samples exceeded the permit limit (TUc 5.0 and TUc 3.33, respectively), indicating the presence of toxicity for the abalone larvae. Although the TUc was lower (3.33) for the January 22 sample than for the January 8 sample (5.0 TUc) we cannot conclude that this was due to the increase in MCRT of 4.1 days; furthermore, TIWRP effluent exceeded the permit limit for both samples. Also, the two previous months (November and December 2006) TIWRP effluent had an average MCRT of approximately 5 days, and the effluent was within the permit limit. Plant operations at TIWRP continued to focus on increasing the mean cell residential time (MCRT), up to ten days, as a means of increasing treatment and decreasing toxicity. In the first three months of implementation of increased MCRT TIWRP was out of compliance five out of six tests. Since April a total of 16 tests were conducted, of the 16 tests 12 tests were within compliance and four were not. During this time many effluent manipulations were attempted (EDTA addition, aerating effluent, and passing through a C8 column); none of which resulted consistent toxicity removal. While these additional manipulations were being performed, each with varying success, increased MCRT was maintained consistently. Although not conclusive, it appears that increasing the MCRT may have helped reduce the toxicity at the TIWRP.

## CONCLUSION

In general, TIWRP achieved overall excellent effluent quality in 2006 and 2007. This is due, in part, to continuous efforts to upgrade the plant. The current level of effluent quality can be attributed

mainly to the following:

- 1) Aggressive industrial pretreatment enforcement,
- 2) Activated sludge selector system,
- 3) Intensive process control program, and
- 4) Capital improvements, such as the addition of an advanced filtration system.

Low level chronic toxicity is still a problem, but this is being investigated, and increased MCRT appears to be reducing this toxicity.

The goal at TIWRP is to reuse and recycle the effluent and eventually eliminate the discharge of effluent into the Los Angeles Harbor. The quality of the effluent and the capital improvements allowed TIWRP to begin delivering advanced tertiary effluent from the AWTF facility in March 2006 to be used in the City's Harbor Water Recycling Project (HWRP).

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