Tijuana River WMA

12.1 Monitoring Site Descriptions

The Tijuana River watershed management area includes the Tijuana River watershed (HU 911.00), which is the largest of the San Diego watersheds covering over 1.1 million acres (Figure 12-1). The watershed is divided by the U.S. / Mexico border with just over 27% lying within the San Diego Region. The watershed is comprised of the following hydrologic areas: Tijuana Valley, Potrero, Barrett Lake, Monument, Morena, Cottonwood, Cameron, and Campo. Major water bodies include the Tijuana River, Cottonwood Creek, and the Tijuana River Estuary.

Mexico governs the majority of the Tijuana River watershed (73%) with the remaining areas belonging to the United States. Undeveloped areas account for 58% of U.S. lands, with another 25% devoted to parks. Much of the land classified as undeveloped is used for low intensity cattle and goat grazing (SANDAG 1998). Population within the U.S. areas of the watershed is sparse with the major population centers located at Campo and San Ysidro. The cities of Tecate and Tijuana are the major population centers on the Mexican side of the watershed. The population for the entire watershed is approximately one million (San Diego County 2002).

The Tijuana River is formed by two drainage networks that merge in the City of Tijuana, then flow across the U.S. border into the Tijuana River Estuary, and finally the Pacific Ocean. The Tijuana River watershed suffers from a wide variety of water quality problems. Major impacts to the watershed include surface water quality degradation, trash, sedimentation, eutrophication, habitat degradation and loss, flooding, erosion, and invasive species. Constituents that have been placed on the SWRCB 2002 303(d) list for water bodies throughout the watershed include bacteria indicators, eutrophic conditions, trace elements, pesticides, solids, synthetic organics, low dissolved oxygen, and trash. The sources of the pollutants are varied including urban runoff, sewage spills, industrial discharges, agriculture, livestock and domestic animals, and septic systems (San Diego County 2002). The RWQCB has 303(d) listed the Pacific Ocean Shoreline for bacterial indicators (RWQCB 2003).

The Tijuana River watershed provides a variety of beneficial uses and sensitive habitats, including the Tijuana River Estuary, which is a National Estuarine Sanctuary (Table 12-1). The major aquifer in the watershed is the Lower Tijuana River Valley Basin. Annual precipitation varies from less than 10.5 inches near the coast to more than 22.5 inches in the inland areas (Figure 12-1).

The Tijuana River (TJR) mass loading station is located under the Hollister Street Bridge in San Diego, downstream from the International Boundary and Water Commission's diversion structure and treatment plant. During periods of low flow the river is diverted through the treatment plant. The River flows freely once the water level rises over the diversion structure. The Tijuana River at the sampling site is an unimproved channel. The River flows through Tijuana, Mexico and runoff contributions come from both Mexico and the United States.

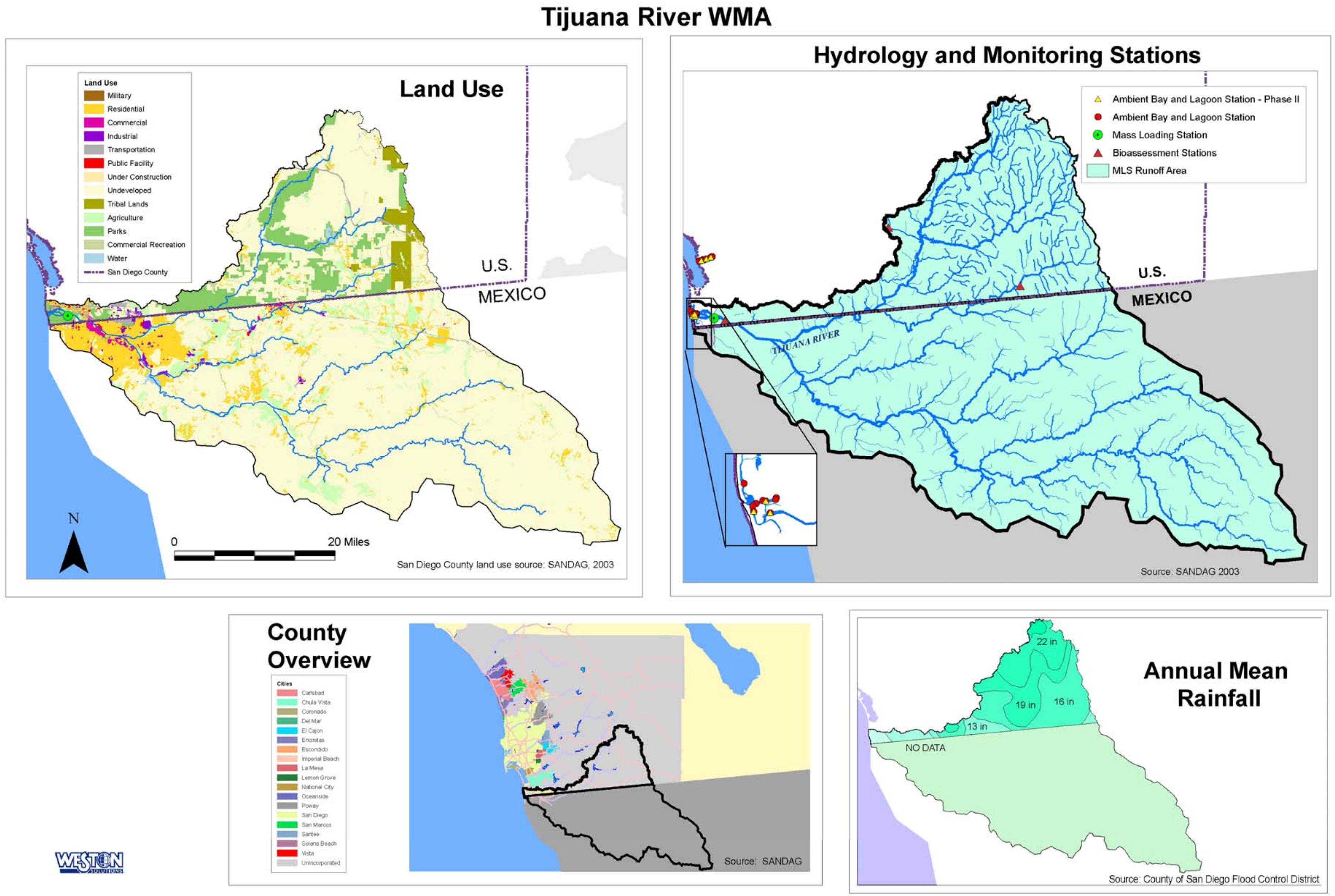

Figure 12-1. Tijuana River Watershed Management Area.

Table 12-1. Beneficial uses within the Tijuana River watershed.

Beneficial Uses	Inland Surface Waters	Coastal Waters [(a)]	Reservoirs and Lakes	Ground Waters
Municipal and Domestic Supply	●		●	●
Agricultural Supply	●		●	●
Industrial Service Supply	●		●	●
Industrial Process Supply	●		●	
Navigation				
Commercial & Sport Fishing		●		
Freshwater Replenishment	●		●	
Contact Water Recreation	●	●	●	
Non-Contact Water Recreation	●	●	●	
Biological Habitats of Special Significance		●		
Warm Freshwater Habitat	●		●	
Cold Freshwater Habitat	●		●	
Estuarine Habitat		●		
Wildlife Habitat	●	●	●	
Rare, Threatened, or Endangered Species	●	●	●	
Marine Habitat		●		
Migration of Aquatic Organisms		●		
Aquaculture				
Shellfish Harvesting		●		
Spawning, Reproduction, and/or Early Development				

[(a)] Tijuana River Estuary
Source: Basin Plan September 8, 1994 (Tables 2-2, 2-3, 2-4, 2-5)

Stream Bioassessment monitoring in the Tijuana River WMA has occurred at three urban affected sites. The upstream sites are located in Cottonwood Creek at the USGS Gauging station on Highway 94, and in Campo Creek at the Highway 94 crossing in the town of Campo. The Cottonwood Creek site does not flow in the dry season, but the Campo Creek site does, and will likely be sampled regularly in the future. The downstream monitoring reach is between Dairy Mart Road and the International Boundary in San Ysidro. This reach is low gradient with a substrate of unconsolidated sand and cobble. Pollution from the City of Tijuana has a substantial impact here, and the stream bed is highly susceptible to erosion. Due to river diversion to the International Wastewater Treatment Plant (IWTP), flow at this site does not occur during the dry season. There was adequate flow in May of 2005, and the site was sampled for the second time since the current program began.

The Tijuana River flows into the Tijuana River Estuary before it enters the ocean. The Estuary is located in the southwestern corner of San Diego County, between the City of Imperial Beach and Tijuana, Mexico. The Estuary is large, encompassing 1,780 acres of wetland habitat, all of which is contained within the Tijuana River National Estuarine Sanctuary (Coastal Conservancy 2000). The Estuary consists of three major areas: the main stem in the center of the Estuary, a northern arm known as Tijuana Slough, and a southern arm, which lies in Border Field State Park. The northern and southern arms roughly parallel the beach in a series of narrow, shallow channels. Two of the three sites selected to be assessed in the Ambient Bay and Lagoon Monitoring Program were located in the mainstream

(Figure 12-1). The other was located in a small side channel adjacent to the mainstream. The Tijuana River is the primary source of fresh water to the Estuary, although an unconfined aquifer underlying the river valley can contribute fresh water periodically. The ocean inlet is relatively shallow and restricts the tidal prism of the Estuary, but there are no anthropogenic obstructions to flow. Raw sewage has been discharged to the River and side channels intermittently for over fifty years and water quality has been a concern. The Tijuana River Estuary is listed on the SWRCB 2002 303(d) list for several constituents, including bacteria indicators, eutrophic conditions, lead, low dissolved oxygen levels, nickel, pesticides, thallium, and trash (Table 12-2).

Table 12-2. Water bodies on the SWRCB 303(d) list in the Tijuana River watershed.

Water Body Name	Hydrologic Sub Area (HSA)	HSA #	Pollutant/Stressor
Tijuana River	Tijuana Valley	911.11	Bacteria Indicators, Eutrophic conditions, Low Dissolved Oxygen, Pesticides, Solids, Synthetic Organics, Trace Elements, Trash
Tijuana River Estuary	Tijuana Valley	911.11	Bacteria Indicators, Eutrophic conditions, Lead, Low Dissolved Oxygen, Nickel, Pesticides, Thallium, Trash
Pacific Ocean Shoreline, Tijuana HU	Tijuana Valley	911.11	Bacteria Indicators
Pine Valley Creek (Upper)	Monument	911.41	Enterococci

Source: SWRCB 2003

12.2 Storm Water Monitoring Summary

Three storm events were monitored at the MLS on Tijuana River during the 2004-2005 storm season. These storm events occurred on October 27, 2004, February 11 and 18, 2005. The results from these storms are discussed in the following section (12.2.1) and presented in Table 12-3. A comparison of these results to previous years is provided in Section 12.2.2.

12.2.1 2004-2005 Results

Two conventional constituents exceeded water quality criteria for all three storms monitored, including total suspended solids (TSS) and turbidity. Additionally, there were WQO exceedances for BOD, COD, and surfactants during the February 11, 2005 storm event.

All three of the bacterial indicators, total and fecal coliform, and enterococcus, had extremely elevated densities during all three storm events. Fecal coliform consistently exceeded the Basin Plan objective of 400 MPN/100 mL with maximum observed densities of 5,000,000 MPN/100 mL.

Table 12-3. Analytes measured at the Tijuana River mass loading station.

ANALYTE	UNITS	WQO	SOURCE	2001-02			2002-03			2003-04			2004-05			Frequency Above WQO	Mean Ratio to WQO
				1/29/02	2/17/02	3/17/02	11/8/02	2/11/03	2/25/03	11/12/03	1/25/04	2/3/04	10/27/04	2/11/05	2/18/05		
General / Physical / Organic																	
Electrical Conductivity	umhos/cm			1610	2300	2490	1664	1830	2890	1174	1471	25000	430	1449	1075		
Oil and Grease	mg/L	15	USEPA Multi-Sector General Permit	4	2	1	3.93	1.23	8.56	9.1	2.38	6.44	2	4.69	5.28	0%	0.28
pH	pH Units	6.5-8.5	Basin Plan	7.4	8.1	7.6	7.30	**8.51**	7.32	7.43	7.76	7.96	7.75	7.65	7.43	9%	0.09
Bacteriological																	
Enterococci	MPN/100 mL			170,000	500,000	17,000	2,400,000	50,000	30,000	500,000	5,000,000	2,400,000	800,000	3,000,000	1,700,000		
Fecal Coliform	MPN/100 mL	4000	Basin Plan	**800000c**	**300000c**	**300000c**	**5,000,000**	**500,000**	**16,000,000**	**1,700,000**	**800,000**	**800,000**	**5,000,000**	**2,400,000**	**2,200,000**	100%	745.83
Total Coliform	MPN/100 mL			1,700,000	800,000	1,100,000	>16,000,000	1,300,000	16,000,000	3,000,000	2,800,000	1,300,000	5,000,000	5,000,000	9,000,000		
Wet Chemistry																	
Ammonia As N	mg/L			8	7.2	6.4	5.22	8.00	10.40	1.9	8.05	6.4	4.5	8.14	3.28		
Un-ionized Ammonia as N	µg/L	25 (a)	Basin Plan				**39.2**	**636**	**63.0**	16.7	**127**	**124**	24.1	**86.1**	**42.7**	78%	5.15
Biological Oxygen Demand	mg/L	30	USEPA Multi-Sector General Permit	27.3	**46.2**	**33.3**	3.56	**86.4**	23.2	**70.9**	**72.5**	**98.6**	23.9	**67**	26.6	58%	1.61
Chemical Oxygen Demand	mg/L	120	USEPA Multi-Sector General Permit	95	**263**	**122**	**152**	**257**	113	**319**	**217**	**903**	76	**197**	50	67%	1.92
Dissolved Organic Carbon	mg/L						30.6	35.7	23.4	45.8	29.3	14.4	39.2	20.3	8.65		
Dissolved Phosphorus	mg/L	2	USEPA Multi-Sector General Permit	**2.2**	**2.9**	**2.28**	1.75	1.90	0.93	1.56	**3.41**	1.99	1.69	1.73	1.26	33%	0.98
Nitrate As N	mg/L	10	Basin Plan	1.6	0.8	1.1	3.12	0.72	0.44	8.75	1.72	1.5	4.08	1.97	2.12	0%	0.23
Nitrite As N	mg/L	1	Basin Plan	0.34	**1.44**	0.6	0.98	0.37	0.13	0.42	0.59	0.34	0.11	0.37	<0.05	8%	0.48
Surfactants (MBAS)	mg/L	0.5	Basin Plan	<0.5	**3.3**	**0.7**	0.3	**2.0**	<0.1	<0.5	**1.7**	<0.5	<0.5	**0.7**	0.5	42%	1.71
Total Dissolved Solids	mg/L	2500	Basin Plan by watershed	737	1080	965	885	883	794	650	476	491	400	938	664		
Total Kjeldahl Nitrogen	mg/L			10.3	12	16.8	9.5	13.6	22.0	16.4	19.8	19.5	19.4	18.2	10.4		
Total Organic Carbon	mg/L						47.5	51.0	18.6	41.8	69.1	72.9	55.5	25.7	23.5		
Total Phosphorus	mg/L	2	USEPA Multi-Sector General Permit	**3.2**	**4.7**	**2.52**	**2.37**	**2.04**	**2.38**	1.8	**3.41**	**2.97**	1.73	**2.7**	1.74	75%	1.32
Total Suspended Solids	mg/L	100	USEPA Multi-Sector General Permit	**240**	48	**176**	**160**	97	**1070**	**590**	**120**	**128**	**7440**	**890**	**2900**	83%	11.55
Turbidity	NTU	20	Basin Plan	**48.4**	19.9	**54.7**	**141**	**72.8**	**1000**	**383**	**90.6**	**3270**	**4540**	**60.2**	**537**	92%	42.57
Pesticides																	
Chlorpyrifos	µg/L	0.02	CA Dept. of Fish & Game	**0.06**	**0.08**	**0.09**	**0.168**	<0.03*	<0.03*	<0.01	**0.085**	<0.01	<0.01	<0.01	<0.01	42%	2.24
Diazinon	µg/L	0.08	CA Dept. of Fish & Game	**0.74**	**0.53**	**0.57**	**0.372**	**0.506**	**0.339**	**0.584**	**0.276**	**0.907**	<0.01	**0.394**	**0.169**	92%	5.62
Malathion	µg/L	0.43	CA Dept. of Fish & Game				**1.00**	**0.88**	0.27	**1.46**	**0.788**	0.284	<0.01	**0.498**	<0.01	56%	1.34
Hardness																	
Total Hardness	mg CaCO3/L			970	352	286	279	334	395	328	308	417	702	376	350		
Total Metals																	
Antimony	mg/L	0.006	Basin Plan	0.003	0.003	0.003	<0.002	0.002	0.003	<0.005	<0.006	<0.005	<0.005	<0.005	<0.005	0%	0.42
Arsenic	mg/L	0.34/0.05	40 CFR 131/ Basin Plan	0.007	0.008	0.006	0.005	0.008	0.018	0.011	0.009	**0.055**	0.013	0.01	0.003	8%	0.26
Cadmium	mg/L	(b)	40 CFR 131	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.005	0.001	<0.001	<0.001	0%	0.05
Chromium	mg/L	(b)	CTR (Cr VI)	0.02	0.013	0.006	<0.005	0.006	0.049	0.026	<0.005	0.189	<0.005	0.014	0.006	0%	0.01
Copper	mg/L	(b)	40 CFR 131	0.028	0.013	0.016	0.008	0.021	**0.053**	**0.058**	0.02	**0.197**	0.017	0.038	0.043	25%	0.84
Lead	mg/L	(b)	40 CFR 131	0.025	0.005	0.009	0.004	0.011	0.045	0.048	0.007	0.278	0.009	**0.057**	**0.056**		
Nickel	mg/L	(b)/0.1	40 CFR 131/ Basin Plan	0.044	0.033	0.028	0.003	0.021	0.040	0.029	0.013	**0.101**	0.051	0.015	0.019	0%	0.02
Selenium	mg/L	0.02	40 CFR 131	<0.002	0.008	<0.002	<0.004	<0.004	<0.004	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	0%	0.14
Zinc	mg/L	(b)	40 CFR 131	0.120	0.041	0.062	<0.020	0.077	0.269	0.288	0.056	**1.53**	0.165	**0.392**	0.337	17%	0.72
Dissolved Metals																	
Antimony	mg/L	(e)	40 CFR 131	<0.002	<0.002	0.002	0.004	0.003	0.004	<0.005	<0.006	<0.005	<0.005	<0.005	<0.005		
Arsenic	mg/L	0.34 (c)	40 CFR 131	0.005	0.004	0.005	0.010	0.008	0.005	0.003	0.006	0.006	<0.002	<0.002	<0.002	0%	0.00
Cadmium	mg/L	(b)	40 CFR 131	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0%	0.03
Chromium	mg/L	(b)	40 CFR 131	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0%	0.00
Copper	mg/L	(b)	40 CFR 131	0.008	<0.005	<0.005	0.011	**0.060**	0.013	0.005	0.01	0.005	0.005	<0.005	<0.005	8%	0.24
Lead	mg/L	(b)	40 CFR 131	<0.002	0.002	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.003	<0.002		
Nickel	mg/L	(b)	40 CFR 131	0.033	0.028	0.024	0.018	0.017	0.013	0.003	0.011	0.007	0.006	0.009	0.006	0%	0.01
Selenium	mg/L	0.02 (d)	40 CFR 131	<0.002	<0.002	<0.002	<0.004	<0.004	<0.004	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0%	0.10
Zinc	mg/L	(b)	40 CFR 131	<0.020	0.026	0.057	0.062	0.130	0.046	<0.02	<0.02	<0.02	<0.02	0.023	<0.02	0%	0.10

Table 12-3. Analytes measured at the Tijuana River mass loading station.

ANALYTE	UNITS	WQO	SOURCE	2001-02			2002-03			2003-04			2004-05			Frequency Above WQO	Mean Ratio to WQO
				1/29/02	2/17/02	3/17/02	11/8/02	2/11/03	2/25/03	11/12/03	1/25/04	2/3/04	10/27/04	2/11/05	2/18/05		
Toxicity																	
Ceriodaphnia 96-hr	LC50 (%)	100		**36.11**	**17.36**	**32.99**	**19.5**	**10.15**	**32.98**	**14.36**	**18.95**	**17.68**	**50**	**25**	**25**	100%	4.79
Ceriodaphnia 7-day survival	NOEC (%)	100		**12.5**	**12.5**	**12.5**	**12.5**	**6.25**	**12.5**	**6.25**	**12.5**	**6.25**	**25**	**25**	**25**	100%	9.00
Ceriodaphnia 7-day reproduction	NOEC (%)	100		**6.25**	**12.5**	**6.25**	**12.5**	**6.25**	**12.5**	**6.25**	**12.5**	**12.5**	**50**	**25**	**25**	100%	9.50
Hyalella 96-hr	NOEC (%)	100		100	100	100	100	100	**50**	**50**	100	**50**	100	100	100	25%	0.50
Selenastrum 96-hr	NOEC (%)	100		100	100	100	100	100	100	100	100	100	100	100	100	0%	0.00

Blank spaces have been verified and no data is available due to changes in the monitoring program.

(a) Un-ionized Ammonia is a calculated value, non-detectable values calculated at the detection limit. Basin Plan WQO is 0.025 mg/L; values shown here have been converted to $\mu g/L$
(b) Water Quality Objective for dissolved metal fractions are based on total hardness and are calculated as described by the USEPA Federal Register Doc. 40 CFR Part 131, May 18, 2000
(c) Water Quality Objectives for dissolved metal fractions are based on water effects ratios (WER) and are calculated as described by the USEPA Federal Register Doc. 40 CFR Part 131, May 18, 2000
(d) Water Quality Objective is based on the total recoverable form as described by the USEPA Federal Register Doc. 40 CFR Part 131, May 18, 2000
(e) USEPA has not published an aquatic life criterion value.

Shaded text – exceeds water quality objective.

* Indicates detection limit exceeds water quality objective.

<u>Sources</u>

USEPA National Pollutant Discharge Elimination System (NPDES) Storm Water Multi-Sector General Permit for Industrial Activities, 65 Federal Register (FR) 64746, Final Reissuance, October 30, 2000. Table 3 - Paramete

Siepmann and Finlayson 2000.
Basin Plan, September 8, 1994.
Assembly Bill 411 - Title 17 of the California Code of Regulations, Section 7958.
USEPA Federal Register Document 40 CFR Part 131, May 18, 2000.

Un-ionized ammonia-N concentrations exceeded water quality objectives during the last two storm events monitored during the 2004-2005 wet weather season. Total phosphorus concentrations exceeded the water quality objective during the February 11, 2005 storm event. Nitrate, nitrite and TKN did not exceed the water quality objectives during any storm event in 2004-2005.

Diazinon concentrations exceeded water quality objectives during two of the storms and Malathion concentrations exceeded water quality objectives during one storm event. Chlorpyrifos was not detected during any of the storms monitored in 2004-2005.

Total lead concentrations exceeded water quality objectives during two storm events and total zinc exceeded the WQO during one storm event. All other metals, including metals in the dissolved state, were either not detected or were below their respective water quality objectives during the 2004-2005 storm events.

All of the storms sampled during 2004-2005 (October 27, 2004, February 11 and 18, 2005) from Tijuana River showed toxicity to *Ceriodaphnia* (See Section 3.1.6.2 for details on toxicity testing). The NOEC for 96-hour survival was 50%, 25%, and 25% of the test sample for the three storms; the NOEC for 7-day survival was 25% of the test sample for each of the storms, and the NOEC for 7-day reproduction was 50%, 25%, and 25% of the test sample for the three storm events. No toxicity to *Hyalella* or *Selenastrum* was observed in any of the Tijuana River samples collected for the three storm events.

12.2.2 Relationships/Analyses

The four conventional constituents mentioned in the previous section (BOD, COD, TSS and turbidity) are persistent constituents of concern in the watershed. Over the last four years of monitoring, TSS concentrations have exceeded WQOs 10 times (83%); turbidity levels have exceeded WQOs 11 times (92%); BOD concentrations have exceeded WQOs 7 times (58%), and COD concentrations have exceeded WQOs 8 times (67%). TSS concentrations have been increasing significantly (R^2=0.34) over time at the Tijuana MLS, while there has been a significant decrease in TDS concentrations (R^2=0.35). MBAS was less persistent during the last three years, only exceeding water quality objectives during 5 of the last 12 storms monitored (42%). These elevated levels of COC are consistent with levels expected of surface waters contaminated with untreated wastewater.

Nutrients that regularly exceed water quality objectives in the watershed include un-ionized ammonia-N (58% exceedance) and total phosphorus (75% exceedance). Dissolved phosphorus has exceeded water quality objectives in 4 out of 12 storms, however, only one of these exceedances has occurred in the last two years.

All bacterial indicators show persistent, extremely elevated density levels in all 12 storms monitored during the past 4 years. These elevated densities are also consistent with the presence of untreated wastewater. There is a significant increasing trend in enterococcus densities (R^2=0.40).

Pesticides have also been consistently present in the water. Diazinon has been detected above water quality objectives in 11 out of 12 storms monitored since 2001 (92%). Chlorpyrifos has exceeded objectives in five storms (42% of the storms monitored); only one of these five has occurred since 2003. Additional monitoring is required to determine if this is a decreasing trend. Malathion has only been monitored for in the last nine storms, but has exceeded objectives in five of these (56% of the time), including one in 2004-2005.

Metals have not been observed persistently above WQOs in the Tijuana River watershed. Of the nine metals analyzed for in total and dissolved form, only total copper, total lead and total zinc have exceeded the water quality objectives more than once. Total copper concentrations exceeded the criteria in 3 out of 12 storms monitored (25%), and total lead and zinc concentrations exceeded the WQO in 2 out of 12 storms monitored (17%). Decreasing trends have been observed for dissolved arsenic (R^2=0.33) and dissolved nickel (R^2=0.79).

Because all of the *Ceriodaphnia* tests showed toxicity in all 12 storm events, the chi-square test used in the other watersheds was not appropriate for the Tijuana River. COC that were above water quality objectives consistently may have contributed to the observed toxicity. These COC include Diazinon, turbidity, and TSS. Chi-square tests showed significant relationships between concentrations of total copper and *Hyalella* 96-hour (p=0.003).

In order to illustrate the magnitude of the water quality exceedances for 2004-2005, the ratio of water quality results to the WQOs were plotted for several of the most common constituents of concern. The results are shown in Figure 12-2. The largest ratios of exceedance were for fecal coliform, which exceeded the WQO by 1250 times during the October 27, 2004 storm, by 600 times during the February 11, 2005 storm and by 550 times during the February 18 storm. Turbidity and TSS concentrations also had large ratios of exceedance. Turbidity ratios of exceedance ranged from 3 to 227 times the WQO and TSS ratios ranged from 9 to 74 times the WQO. There were also noticeable ratios of exceedance for Diazinon (4.9 times the WQO) and ammonia (3.5 times the WQO). The average magnitude of water quality exceedances was also determined for each constituent by calculating the mean ratio of water quality results to the WQOs from all storm events from October 2001 through April 2004. Mean ratios are illustrated in Figure 12-2. The largest average exceedance for the period of record was for fecal coliform (728 times the WQO). Other notable average exceedances were for turbidity (28 times the WQO), Ceriodaphnia survival (9.8 times the WQO), and Diazinon and ammonia (6.7 times the WQO).

In addition to wet weather monitoring discussed above, there are seven sites in the Tijuana River WMA where water quality is monitored during dry weather. Of these, five sites are located upstream of the MLS on Tijuana River (See Section 3.4 for details on dry weather sampling).

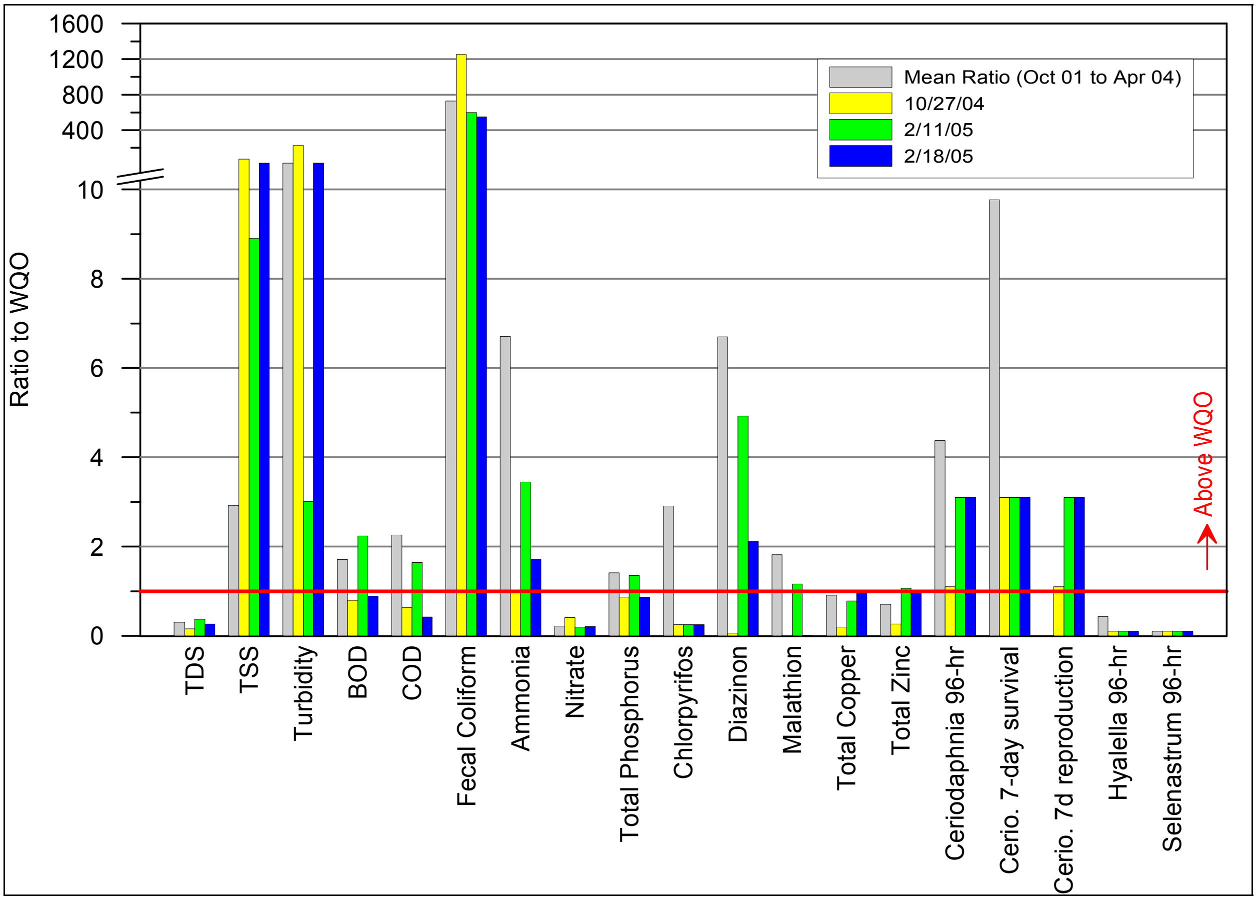

Figure 12-2. Tijuana River water quality ratios.

Table 12-4 lists exceedances of dry weather action levels and the ratios of exceedance for COC that were measured during the 2004 dry weather monitoring program for dry weather stations upstream of the MLS. The only dry weather exceedance was for turbidity. A map showing dry weather exceedances for all sites in the WMA is presented in Figure 12-3. Turbidity WQOs were also exceeded during the wet weather monitoring in 2004-2005.

Table 12-4. Tijuana River WMA 2004 Dry Weather Exceedance Matrix.

Constituent	Number of Exceedances	Number of Samples Collected	Average Ratio of Exceedance*	St. Dev. Ratio of Exceedance
Turbidity	2	4	1.17	1.02

* Average ratio of exceedance is equal to the average concentration for all samples collected divided by the Water Quality Objective.

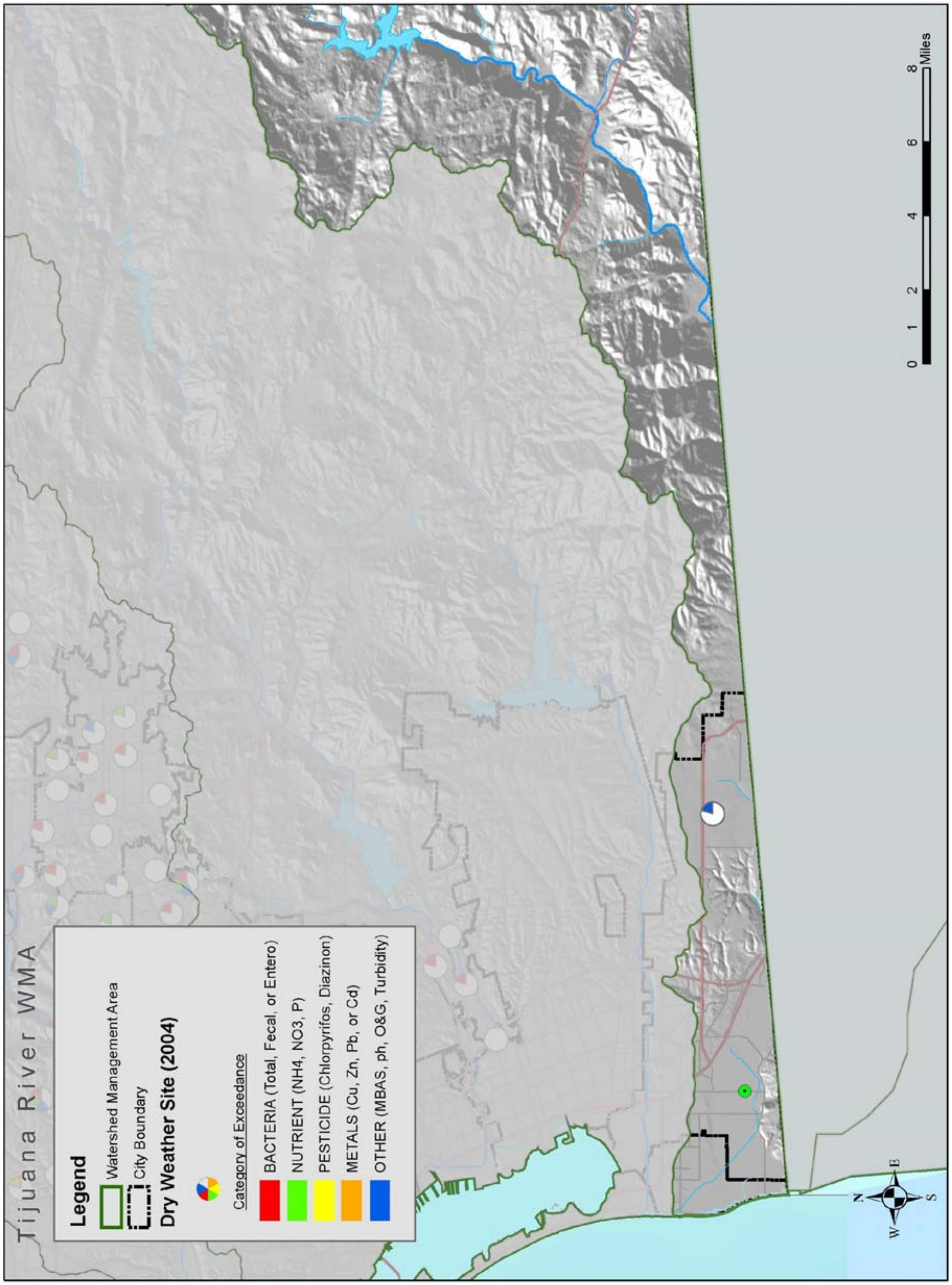

Figure 12-3. Tijuana River WMA dry weather exceedance map.

12.2.3 TIEs

Tijuana River was identified as a TIE candidate site based on the Triad Decision Matrix. Toxicity was observed in *Ceriodaphnia* in all three 2004-2005 storm events. TIE testing was conducted on the February 11 and 18, 2005 samples. These investigations were inconclusive due to the loss of toxicity in the unmanipulated sample at the time of testing. Heavy particulate load within the sample may have ameliorated the toxic effects of the sample by binding to the contaminants.

Non-polar organic compounds were identified in the 2002-2003 and 2003-2004 TIE testing. Diazinon was the suspect contaminant in these testing periods as determined by methanol fractionation procedures. Given the presence of Diazinon exceeding the WQO during the February storm events, it is probable that Diazinon was a contributor to the toxicity of the Tijuana River samples to *Ceriodaphnia*. Diazinon (log Kow=3.81) has a low solubility and a tendency to bind to organic matter and sediments (Ladaa et al. 1998). The persistence of this and other non-polar organic compounds may have been reduced by the high solids content of the Tijuana River samples.

12.2.4 Summary and Conclusions

Constituents most prevalent in Tijuana River that pose the greatest concern are typical of conditions found with untreated wastewater. BOD, COD, TSS, turbidity, and nutrients (un-ionized ammonia-N and total phosphorus) consistently exceeded water quality objectives. Although total coliform and enterococci do not have corresponding water quality objectives, they consistently have highly elevated densities and are also indicative of conditions found with untreated wastewater. In addition, pesticides are also prevalent in elevated concentrations. Diazinon, in particular, has exceeded water quality objectives in 11 of the last 12 storms and has been identified as the likely cause of toxicity in the Tijuana River.

12.3 Stream Bioassessment

Stream bioassessment monitoring in the Tijuana River WMA was conducted at a single site in October 2004; Campo Creek at the Highway 94 overcrossing in the town of Campo. Three sites were sampled in May 2005; Campo Creek, Tijuana River at Dairy Mart Road, and a reference site in Wilson Creek at Lyons Valley Road, upstream of Barrett Lake. This was the first time Wilson Creek has been sampled in this program. The Tijuana River and Wilson Creek sites could not be sampled in October 2004 due to dry conditions.

12.3.1 Results and Discussion

Campo Creek monitoring site: CC-C

The Campo Creek monitoring site had a benthic macroinvertebrate community with an Index of Biotic Integrity rating of Very Poor for both surveys (Table 12-5) (See Section 3.2 for details on the sampling approach). There were 17 and 12 different taxa collected, including 1 and 2 different EPT taxa in October and May, respectively. There were no organisms collected that are highly intolerant to impairment, and the percent tolerant taxa comprised 80% of the community in October 2004 and 7% of the community in May 2005.

Table 12-5. Selected Biological Metrics and Physical Measures of the Tijuana River WMA.

Tijuana River Watershed Management Area	Campo Creek in Campo (CC-C)		Tijuana River-Dairy Mart Road (TJ-DM)	Wilson Creek Reference Site at Lyons Valley Road (REF-WC)
Survey	**Oct-04**	**May-05**	**May-05**	**May-05**
Index of Biotic Integrity/ Qualitative Rating	**6 Very Poor**	**4 Very Poor**	**17 Poor**	**36 Fair**
Metrics				
Taxa Richness	17	12	7	14
EPT Taxa (mayflies, stoneflies, and caddisflies)	1	2	0	6
% Intolerant Taxa	0%	0%	0%	5%
% Tolerant Taxa	80%	7%	10%	0%
Average Tolerance Value	7.4	6.0	6.2	5.6
% Collector Filterers +Collector Gatherers	87%	93%	92%	92%
Physical Measures				
Elevation	2550		2200	
Physical Habitat Score	93	128	98	156
Riffle Velocity (ft/sec)	0.4	1.0	1.3	0.8
Substrate Composition				
Silt	66%	2%	10%	
Sand	7%	35%	7%	8%
Gravel	7%	41%	13%	37%
Cobble	20%	8%	40%	55%
Boulder		14%		
Bedrock/Solid			30%	
Water Quality				
Temperature °C	12.8	14.6	17.8	17.9
pH	7.2	7.6	7.1	8.1
Specific Conductance (ms/cm)	0.906	1.190	1.584	0.363
Relative Chlorophyll (µg/L)	6.8	6.1	4.7	0.8

In October 2004, the physical habitat of the monitoring reach was marginal due to slow riffle velocity and a predominance of anoxic, silty substrate. There was a moderate amount of cobble, boulder, and emergent vegetation that provided some stable habitat. In May 2005, in-stream conditions had improved, and it appeared that the heavy winter rains had scoured out much of the silty deposits, which decreased from 66% in October to 2% of the streambed in May. There was a good willow canopy over the stream, but the riparian zone was very narrow due to the proximity of Highway 94, as well as residential and agricultural land uses. Specific conductance was relatively low at 0.906 mS/cm in October and 1.190 mS/cm in May. Values for pH were 7.2 and 7.6 for the October and May surveys, respectively.

The benthic community was seasonally variable. In October the benthic community was dominated by Sphaeriid clams, Ostracods, and Oligochaetes (Table 12-6). In May, the dominant taxa were Chironomid midges, the black fly, *Simulium*, and the minnow mayfly, *Baetis*. The predatory damselfly, *Argia,* was present in relatively high numbers, and two individuals of the sensitive caddisfly, *Oxyethira,* were collected. Campo Creek was the only non-reference site in the San Diego County program where Sphaeriid clams, the mite, *Lebertia*, and the water penny beetle, *Psephenus falli,* were collected.

Table 12-6. Tijuana River WMA Community Summary.

		Taxon	Common Name	Percent Composition	Tolerance Value	Functional Feeding Group
Campo Creek in Campo (CC-C)	**Oct-04**	**Sphaeriidae**	**clam**	**35%**	**8**	**Collector Filterer**
		Ostracoda	seed shrimp	31%	8	Collector Gatherer
		Oligochaeta	earth worm	12%	5	Collector Gatherer
		Hyalella	amphipod	8%	8	Collector Gatherer
		Physa	aquatic snail	4%	8	Scraper
Campo Creek in Campo (CC-C)	**May-05**	**Chironomidae**	**non-biting midges**	**64%**	**6**	**Collector Gatherer/Filterer**
		Simulium	black fly	18%	6	Collector Filterer
		Baetis	minnow mayfly	5%	5	Collector Gatherer
		Oligochaeta	earth worm	5%	5	Collector Gatherer
		Physa	aquatic snail	4%	8	Scraper
Tijuana River at Dairy Mart Road (TJ-DM)	**May-05**	**Chironomidae**	**non-biting midges**	**73%**	**6**	**Collector Gatherer/Filterer**
		Psychoda	moth fly	10%	10	Collector Gatherer
		Pericoma/ Telmatoscopus	moth fly	7%	4	Collector Gatherer
		Culicoides	biting midge	5%	6	Predator
		Muscidae	common fly	2%	6	Predator
Wilson Creek Reference site at Lyons Valley Road (REF-WC)	**May-05**	***Simulium***	**black fly**	**54%**	**6**	**Collector Filterer**
		Chironomidae	non-biting midges	31%	6	Collector Gatherer/Filterer
		Baetis	minnow mayfly	7%	5	Collector Gatherer
		Rhyacophila	free living caddisfly	2%	0	Predator
		Plecoptera	stonefly (immature)	2%	1	Predator/Shredder

The Tijuana River mass loading station was too spatially disconnected from Campo Creek to correlate any of the storm water information with the benthic community.

Tijuana River at Dairy Mart Road: TJ-DM
The Tijuana River monitoring site had a benthic macroinvertebrate community with an Index of Biotic Integrity rating of Poor for the May 2005 survey (Table 12-5). The IBI score was 17, making this one of the higher rated urban sites in the county program. This ranking is not representative of the true quality of the benthic community of the site, which indicated that the site is actually severely degraded.

Taxa richness and abundance were the lowest of any site in the county, and there were no EPT taxa collected. Overall abundance was extremely low, with a total of 84 individuals collected from three combined samples, and a population density of about 5 organisms per square foot of substrate. One of the replicate samples had a total of four individual organisms. Individual IBI metric scores for percent tolerant taxa and percent non-insect taxa were not truly representative, and the investigators have noted other instances when the Southern California IBI scoring system may be subject to inaccuracies when organism abundance is exceptionally low.

Information from the mass loading stations have indicated high levels of pesticides in the river and exceedances for total dissolved solids, nutrients, and some metals, and there has been consistent toxicity to *Ceriodaphnia* (Table 12-3). Additionally, bacteria levels were extremely high, indicating probable high levels of organic pollution. These indicators of very poor water quality confirm the assertion that the IBI score for the site is higher than the actual benthic community quality.

Wilson Creek Reference Site at Lyons Valley Road: REF-WC
The Wilson Creek reference monitoring site had a benthic macroinvertebrate community with an Index of Biotic Integrity rating of Fair (Table 12-5). Taxa richness was moderate, with 14 different taxa collected, including 6 different EPT taxa. Organisms collected that are highly intolerant to impairment comprised 5% of the community, and there were no highly tolerant taxa collected.

The physical habitat of the monitoring reach was optimal with a good oak canopy and a substrate dominated by small layered cobble. Specific conductance was low with a value of 0.363 mS/cm and pH was 8.1.

The benthic community was dominated by the black fly, *Simulium,* and Chironomid midges (Table 12-6). Together, these two taxa accounted for 85% of the community. The remainder of organisms collected at the site, although in relatively small numbers, included a majority of highly intolerant stonefly and caddisfly taxa, and predaceous beetle taxa. There were also relatively high numbers of the very sensitive dobsonfly larvae (*Neohermes*), a large predatory insect that may live three years in its aquatic larval form (Usinger 1956). The presence of these intolerant organisms indicated very good water quality in the stream.

The Tijuana River mass loading station was too spatially disconnected from Wilson Creek to correlate any of the storm water information with the benthic community.

12.3.2 Summary and Conclusions

Three stream bioassessment monitoring sites were sampled in the Tijuana River WMA. One site in Campo Creek was sampled in October and May. A site in the Tijuana River at Dairy Mart Road and a reference site in Wilson Creek at Lyons Valley Road were sampled in May 2005. The Index of Biotic Integrity rating for the Campo Creek site was Very Poor, but there were several organisms collected that were otherwise found only at reference sites, and specific conductance was very low. The Tijuana River site was rated Poor, but the investigators in this study feel that the IBI score was much higher than the actual benthic community quality. The Wilson Creek reference site was rated Fair, and the presence of many highly intolerant organisms indicated very good water quality at the site.

12.4 Ambient Bay and Lagoon Monitoring

12.4.1 Results and Discussion

12.4.1.1 Phase I Results and Discussion

Sediment samples were collected in Tijuana River Estuary for the ABLM Program on June 10, 2004 (See Section 3.3 for details on the sampling approach). The nine sites sampled as part of the Phase I assessment are shown in Figure 12-4. The median grain size ranged from 2.15 μm at Site 2L-1 to 408.9 μm at Site 3L-1 (Table 12-7). Although this range is fairly broad, the median grain size was fairly consistent among sites, except Site 2L-1. The percentage of fine grained sediments at Site 2L-1 was more than twice that found at all the other sites in the Tijuana Estuary. The TOC content was also very high in sediments at Site 2L-1compared to the other sites. Sediments at Site 2L-1 consisted primarily of clay, while sediments at all the other sites monitored in the Estuary consisted predominantly of sand. Sediments with the highest proportion of sand were found at all three outer strata sites and at Site 2M-1 in the middle stratum. These four sites also had some of the lowest TOC contents.

Figure 12-4. Map of Phase I site locations in Tijuana River Estuary. Sites with yellow triangles were selected for Phase II assessment.

Site 2L-1 received the highest rank sum of the nine sites sampled in Tijuana River Estuary due to the high percentage of fine grained sediments and elevated TOC levels found at this site (Table 12-7). Three sites with the highest summed ranks in the Phase I assessment were found in each of the three strata (1L-2, 2L-1, and 3M-1)

Table 12-7. Results of Phase I sediment analyses and subsequent ranking for Phase II site selection at Tijuana River Estuary.

Sampling Site	TOC and Grain Size Distribution in Phase I								Ranking for Phase II				
	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Median (µm)	Mean (µm)	Fines (%)	TOC (%)	Fines Rank	TOC Rank	Rank Sum	Highest Rank	Phase II
TRE-1L-2	0.00	72.9	7.49	19.59	203	27	27.08	0.57	7	6	13	*	Yes
TRE-1M-1	0.00	98.1	1.08	0.79	265	261	1.87	0.10	1	2	3		
TRE-1R-2	0.02	87.9	3.34	8.70	285	251	12.03	0.39	3	3	6		
TRE-2L-1	0.00	13.4	29.1	57.5	2.15	NC	86.57	1.28	9	9	18	*	Yes
TRE-2M-1	0.00	95.2	2.53	2.24	161	158	4.77	0.09	2	1	3		
TRE-2R-1	0.00	83.8	6.8	9.4	131	111.6	16.20	0.40	4	4	8		
TRE-3L-1	0.11	82.3	6.4	11.2	408.9	156.3	17.55	1.05	5	8	13		
TRE-3M-1	0.12	66.1	14.5	19.3	97.0	20.9	33.82	0.67	8	7	15	*	Yes
TRE-3R-1	0.16	81.8	6.10	12.0	407	145.4	18.07	0.51	6	5	11		
Mean of all Sites	0.05	75.74	8.58	15.63	217.73	141.27	24.22	0.56					
St. Dev.	0.07	25.39	8.60	16.96	137.45	88.90	25.40	0.40					

NC = Not calculable (%silt + %clay > 84%)

12.4.1.2 Phase II Results and Discussion

The three sites selected in Tijuana River Estuary as part of Phase I were sampled in Phase II on July 6, 2004. Sediments from Sites 1L-2, 2L-1 and 3M-1 were composited and analyzed for chemistry, toxicity, and benthic community structure. The results are summarized in Table 12-8.

Sediment Chemistry. Sediments from each of the 12 coastal embayments in the ABLM Program were analyzed for four basic constituents: metals, PCBs, PAHs, and pesticides. Of these, seven metals that were common to all the embayments were detected above the detection limit in Tijuana River Estuary: arsenic, cadmium, chromium, copper, lead, nickel, and zinc (Table 12-8).

Concentrations of all metals were low, well below their respective ERL values. The same metals were detected during the 2003 ABLM program with the exception of cadmium. All of the metal concentrations during the 2003 program were low and well below their respective ERL values. There were no PAHs, PCBs, or pesticides found above the detection limit in Tijuana River Estuary.

The mean ERM quotient, which is a measure of the cumulative effects of the COC for which ERMs are available, was 0.128. This value was above the threshold of 0.10. Sediments with mean ERM-Q values above this threshold have a higher probability of producing adverse biological effects (Long et al. 1998). During the 2003 ABLM program the mean ERM quotient was 0.052 and was well below the threshold of 0.10.

Toxicity. The percent survival of *E. estuarius* exposed to Tijuana River Estuary sediments in a 10-day acute toxicity test was 97% (Table 12-8). Percent survival was not significantly different from that of the Control (99%), suggesting that Tijuana River Estuary sediments were not significantly toxic to the test organisms. This is similar to the results from the 2003 ABLM program where no toxicity was observed.

Table 12-8. Summary of chemistry, toxicity, and benthic community structure in the Tijuana River Estuary.

CHEMISTRY*					TOXICITY*	BENTHIC COMMUNITY						
Analyte	ERL	ERM	Result	ERM-Q	Percent Survival	Index	1L-2	2L-1	3M-1	Mean	St. Dev.	Total
METALS (mg/kg)						Abundance	475	189	319	327	143	983
Antimony	NA	NA	<1.74	NA		Richness	31	18	18	22.3	7.51	39
Arsenic	8.2	70	5.36	0.077		Diversity	1.75	2.05	1.67	1.8	0.20	NA
Cadmium	1.2	9.6	0.374	0.039		Evenness	0.51	0.71	0.58	0.6	0.10	NA
Chromium	81	370	28.4	0.077	**97 %**	Dominance	3	4	3	3.3	0.58	NA
Copper	34	270	18	0.067								
Lead	46.7	218	19.9	0.091	Not Significantly Different from Control							
Nickel	20.9	51.6	11.1	0.215								
Selenium	NA	NA	<1.74	NA								
Zinc	150	410	98.4	0.240								
Mean ERM-Q				**0.128**								

* Analysis performed on composite samples from the three sites.
NA-Not applicable
Bold – exceeds ERL or ERM value

Benthic Community Structure. A total of 983 organisms were collected from Tijuana River Estuary, representing 39 taxa (Table 12-8). During the 2003 ABLM program a total of 1,354 organisms were collected, representing 33 taxa. Taxa abundance and richness were greatest at Site 1L-2 in the outer stratum during the 2004 ABLM program, but all of the other benthic community structure indices were greatest at Site 2L-1. This site was located in a small side channel of the middle stratum. Based on these indices, the benthic community structure in Tijuana River Estuary ranked intermediate compared to the other embayments assessed in the ABLM Program with an accumulative rank of six where 1 represents the healthiest community with the lowest combined index score and 12 the least-healthy community.

The benthic community in Tijuana River Estuary was dominated by the polychaete worm, *Streblospio benedicti*, which accounted for 38.2 % of the community (Table 12-9). Second in abundance was the gammarid amphipod, *Grandidierella japonica*, which accounted for 27.3 %. Another polychaete worm, *Polydora nuchalis,* made up 6.9% of the sampled population. During the 2003 ABLM program the Tijuana River Estuary was co-dominated by three taxa: the polychaete worm *Pseudopolydora paucibranchiata,* which accounted for 28.1% of the community, *Protothaca* sp., a molluscan genus that includes the littleneck clam, which accounted for 23.8%, and *Grandidierella japonica, which accounted for 22%.*

Table 12-9. Dominant infaunal species found in Tijuana River Estuary during the 2004 ABLM Program.

Embayment	Taxa (Species)	Higher Taxa	Abundance	Percent Composition
TRE	*Streblospio benedicti*	Polychaete	376	38.2
	Grandidierella japonica	Crustacean	269	27.3
	Polydora nuchalis	Polychaete	68	6.9

Values were calculated from the total of all sites assessed.

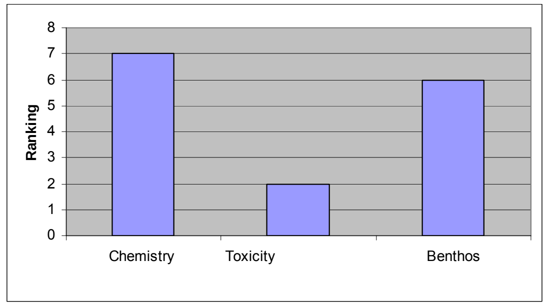

Figure 12-5. Relative rankings for sediment in Tijuana River Estuary.

Relative Ranking. The results of the chemistry, toxicity, and benthic community assessments for Tijuana River Estuary were ranked against the same parameters for the other embayments monitored in the ABLM Program (see Section 3.3.5 for a complete discussion). For chemistry, a rank of 1 represents the lowest ERM-Q and 12 represents the highest. For toxicity, a rank of 1 represents the highest percent survival of test organisms and 12 represents the lowest. For benthos, a rank of 1 represents the highest species diversity, abundance and richness and a rank of 12 represents the lowest species diversity, abundance and richness. The results are presented in Figure 12-5. For Tijuana River Estuary, the relative ranks were seven for chemistry, two for toxicity, and six for benthic community structure.

These results suggest that the Estuary is lightly impacted by the upstream watershed relative to the other embayments assessed. This is a somewhat unexpected result because historically wet weather water quality in the Tijuana River has been among the worst of any of the watersheds in San Diego County (MEC 2003). The lack of high concentrations of metals and low toxicity associated with the Estuary sediments indicate that the heavy COC loading observed during storm events in the Tijuana River does not lead to a persistent accumulation of COC downstream. Future monitoring will help determine the strength of this relationship.

12.4.1.3 Summary and Conclusions

Sediments in Tijuana River Estuary were monitored as part of the 2004 ABLM Program to assess the potential for adverse effects from the watershed and to compare sediment quality with other coastal embayments in San Diego County. In Phase I, a stratified random approach was used to identify the three sites where COC were most likely to be found (i.e., those with the highest TOC and smallest grains size). In Tijuana River Estuary, one site was located in the outer stratum, 1L-2, one in the middle stratum 2L-1, and one was located in the inner stratum 3M-1. These sites were sampled in Phase II of the assessment and analyzed for sediment chemistry, toxicity, and benthic community structure. The results of the chemistry assessment indicated that seven metals common to all embayments were also found in Tijuana River Estuary sediments. Concentrations were low and none exceeded their respective ERLs. In addition, there were no PAHs, PCBs, or pesticides found in the Estuary above the detection limit. As a result, the mean ERM-Q for Tijuana River Estuary was intermediate compared to the other embayments assessed in the ABLM Program. In addition, percent survival of test organisms exposed to Tijuana River Estuary sediments was not significantly different from that of the Control, suggesting that the sediments were not significantly toxic to the test organisms. Benthic community indices suggested that the biotic community in Tijuana River Estuary was intermediate compared to the other embayments assessed. The infaunal community was dominated by a common polychaete worm and a gammarid amphipod. The relative ranks for Tijuana River Estuary were seven for chemistry, two for toxicity, and six for benthic community structure. Compared to the other embayments in the 2004 ABLM program, Tijuana River Estuary had an overall rank of four. During the 2003 ABLM program the Lagoon had an overall rank of one. An increase in overall ranking indicates a decrease in relative quality compared with last year's ranking. More data will need to be collected before any definitive trends can be identified.

12.5 WMA Assessment

The Tijuana River Watershed Management Area was assessed utilizing chemistry and toxicity data collected during storm events from a single MLS, chemistry data collected from three dry weather monitoring sites upstream of the MLS, and IBI scores generated at three bioassessment sites. The watershed management area assessment methods presented in Section 3.4 were applied to these data to determine which constituents were of concern and to develop a high, medium, or low frequency of occurrence for these constituents. The results of this assessment are presented in Table 12-10.

Six constituents were determined to have a high frequency of occurrence and are listed below as COC. All of these constituents received a rating of three diamonds based on Criteria No. 1. These include:

- Total Coliform
- Fecal Coliform
- Enterococcus
- Total suspended solids
- Turbidity
- Diazinon

Four constituents were found to have a medium frequency of occurrence (two diamonds) based on Criteria No. 6. These constituents include:

- BOD
- COD
- Un-Ionized Ammonia
- Total Phosphorus

Five constituents were found to have a low frequency of occurrence (one diamond) based on Criteria No. 9. These include:

- Dissolved Phosphorus
- Surfactants (MBAS)
- Total Copper
- Chlorpyrifos
- Malathion

BOD and COD are unique among the COC assessed in the storm water program because they provide an indirect measure of the total oxidizable material available in the water column due to other factors, including anthropogenic contaminants as well as natural processes (as opposed to other methods which only provide results for the specific analyte tested). The presence of BOD or COD above their respective water quality criteria indicates the presence of other contaminants that may have caused the exceedance. Thus, management actions aimed at reducing BOD or COD may be most effective if the source or sources of the elevated levels are addressed directly. In this way, a reduction in BOD or COD levels would be a by-product of actions taken against more easily rectified COC.

Potential contaminants of concern are other synthetic organics, trace elements and trash as indicated by the SWRCB 303(d) list for the Tijuana River. The SWRCB 303(d) list also specifies lead, nickel and thallium as COC for the Tijuana River Estuary, downstream of the MLS.

Table 12-10. Constituent exceedances in the Tijuana River WMA.

Constituents With Any Wet Weather (MLS) WQO or Dry Weather Action Level Exceedance	MLS (Wet Weather) Results										Dry Weather Results *		Frequency of Occurrence	Criterion No.
	2001/2002		2002/2003		2003/2004		2004/2005		CUMULATIVE		2004			
	#/3	%	#/3	%	#/3	%	#/3	%	#/12	%	#	%		
Conventional Parameters														
pH	0	0	1	33	0	0	0	0	1	8	0	0	-	-
BOD	2	67	1	33	3	100	1	33	7	58	NA	NA	♦♦	6
COD	2	67	2	67	3	100	1	33	8	67	NA	NA	♦♦	6
Surfactants (MBAS)	2	67	1	33	1	33	1	33	5	42	0	0	♦	9
Total Suspended Solids	2	67	2	67	3	100	3	100	10	83	NA	NA	♦♦♦	1
Turbidity	2	67	3	100	3	100	3	100	11	92	2	50	♦♦♦	1
Nutrients														
Un-ionized Ammonia as N	NA	NA	3	100	2	67	2	67	7	58	NA	NA	♦♦	6
Dissolved Phosphorus	3	100	0	0	1	33	0	0	4	33	NA	NA	♦	9
Total Phosphorus	3	100	3	100	2	67	1	33	9	75	NA	NA	♦♦	6
Bacteriological														
Total Coliform	3	100	3	100	3	100	3	100	12	100	0	0	♦♦♦	1
Fecal Coliform	3	100	3	100	3	100	3	100	12	100	0	0	♦♦♦	1
Enterococcus	3	100	3	100	3	100	3	100	12	100	0	0	♦♦♦	1
Pesticides														
Chlorpyrifos	3	100	1	33	1	33	0	0	5	42	0	0	♦	9
Diazinon	3	100	3	100	3	100	2	67	11	92	0	0	♦♦♦	1
Malathion	NA	NA	2	67	2	67	1	33	5	42	NA	NA	♦	9
Total Metals														
Arsenic	0	0	0	0	1	33	0	0	1	8	NA	NA	-	-
Copper	0	0	1	33	2	67	0	0	3	25	NA	NA	♦	9
Lead	0	0	0	0	0	0	2	67	2	17	NA	NA	-	-
Nickel	0	0	0	0	1	33	0	0	1	8	NA	NA	-	-
Zinc	0	0	0	0	1	33	1	33	2	17	NA	NA	-	-
Dissolved Metals														
Copper	0	0	1	33	0	0	0	0	1	8	0	0	-	-
Toxicity													**EVIDENCE OF PERSISTENT TOXICITY?**	
Ceriodaphnia 96-hour	3	100	3	100	3	100	3	100	12	100	NA	NA	Yes	
Ceriodaphnia 7-day survival	3	100	3	100	3	100	3	100	12	100	NA	NA	Yes	
Ceriodaphnia 7-day reproduction	3	100	3	100	3	100	3	100	12	100	NA	NA	Yes	
Hyalella 96-hour	0	0	1	33	2	67	0	0	3	25	NA	NA	No	
Bioassessment	IBI Rating												**EVIDENCE OF BENTHIC ALTERATION?**	
Campo Creek	NA		NA		Poor		Very Poor		Very Poor		NA		Yes	
Tijuana River, at Dairy Mart Rd.	NA		Very Poor		NA		Poor		Very Poor		NA			

* = Total number of observations varied among constituents.
NA = Not assessed
\- = Constituent results are below the defined requirements for a Low Frequency of Occurrence rating.
♦ = Low Frequency of Occurrence rating.
♦♦ = Medium Frequency of Occurrence rating.
♦♦♦ = High Frequency of Occurrence rating.

All of the bioassay tests conducted on *Ceriodaphnia dubia* have shown evidence of persistent toxicity in all three years of monitoring. Although there has been toxicity to *Hyalella azteca* during some of the storm events, there is no evidence of persistent toxicity to *Hyalella* throughout the monitoring period.

Cumulative IBI scores resulting from bioassessment monitoring on the Tijuana River throughout the monitoring period indicated a rating of very poor at both sites, suggesting evidence of benthic alteration. It should be noted, though, that the bioassessment monitoring site in Campo is spatially segregated from the water quality monitoring stations located much further downstream. The bioassessment site in Campo is not affected by the communities of Tijuana, Mexico.

Figure 12-6 summarizes the number of water quality exceedances for six categories of constituents. Categories include conventionals, nutrients, bacteria, pesticides, metals and toxicity. The stacked bars were developed using number of exceedances from values in Table 12-10 for each constituent category. The overall number of water quality objectives exceedances at the Tijuana River MLS has been consistently high and has the highest number of exceedances in comparison to all other MLS sites. A slight decrease in the total number of exceedances was exhibited in 2004-2005, but with very little relative change within the different constituent categories in comparison to the last three monitoring seasons.

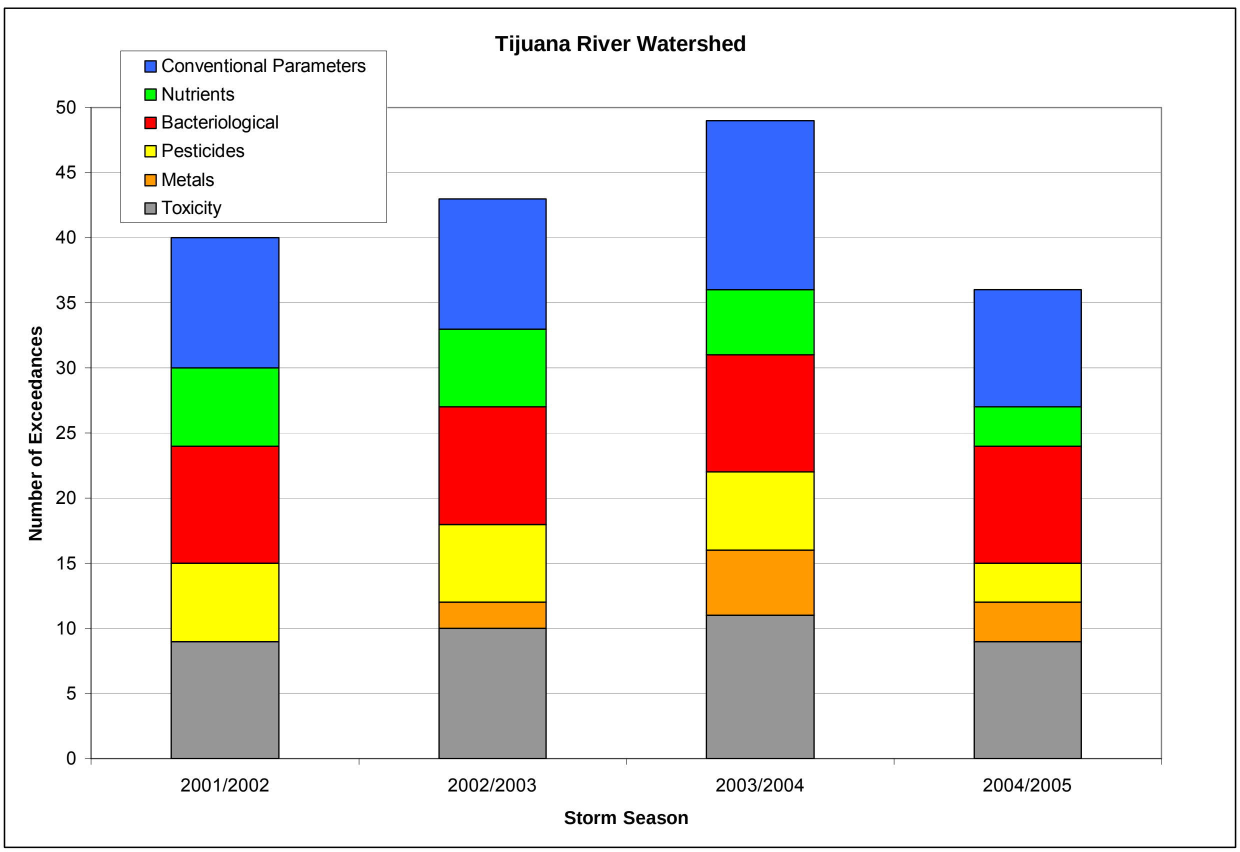

Figure 12-6. Stacked bar chart of the number of wet weather exceedances of constituent groups in Tijuana River.

Evaluation of scatterplots for the Tijuana River presented in Appendix C indicate a statistically significant decreasing trend for conductivity (R^2=0.41), TDS (R^2=0.35), dissolved arsenic (R^2=0.33), and dissolved nickel (R^2=0.79). A statistically significant increasing trend is evident for TSS (R^2=0.34) and enterococcus (R^2=0.40) which are two of the six high frequency COC.

Triad Decision Matrix

The triad decision matrix combines the occurrence of COC with the toxicity and bioassessment results to determine possible conclusions about the watershed and provide possible actions for future monitoring or assessment. Table 12-11 summarizes these results and lists possible conclusions and actions.

Table 12-11. Decision matrix results for Tijuana River watershed.

Chemistry	Toxicity	Benthic Alteration	Possible Conclusion(s)	Possible Actions or Decisions
Persistent exceedances of water quality objectives (High frequency of occurrence)	Evidence of persistent toxicity	Indications of benthic alteration	Connections of water quality degradation and toxicity to benthic condition difficult due to spatial disparity.	1) Continue monitoring to gather long-term trend information. 2) Evaluate upstream source as a high priority.

The water quality degradation and persistent toxicity observed from monitoring at the MLS in the lower Tijuana River may cause benthic alterations. Unfortunately, without bioassessment data downstream of the MLS, this conclusion cannot be confirmed. As mentioned earlier in this section, hydrologic conditions prevented bioassessment monitoring lower in the Tijuana River.

Baseline Long-Term Effectiveness Assessment (BLTEA) Rating Comparison for the Tijuana River WMA

The water quality priority ratings presented in Table 12-12 are based on the methodology presented in the BLTEA report (WESTON, MOE, & LWA 2005) and are presented in the Methods Section 3.4. Constituent groups and stressor groups are given a ranking from A to D with A being the highest priority rating and D the lowest priority rating. Items ranked with a D indicate that the constituent group or stressor is a low priority or does not have sufficient data to support a higher ranking. The ratings were based on current results presented in this 2004-2005 annual report and data from the following programs:

- Storm water Mass Loading Monitoring (MLS) – Wet Weather Data
- Co-permittee Dry Weather Data Monitoring
- Ambient Bay, Lagoon, and Coastal Receiving Water Monitoring (ABLM)
- Urban Stream Bioassessment Monitoring
- Triad Assessment – Toxicity Testing of Storm water
- 303d Listing

Table 12-12. Baseline Long-Term Effectiveness Assessment (BLTEA) Ratings for the Tijuana River WMA

Watersheds/Sub-watersheds	Percentage of Total Area	Priority Ratings*									
		Constituent Groups								Stressor Groups	
		Heavy Metals	Organics	Oil and Grease	Sediments	Pesticides	Nutrients	Gross Pollutants	Bacteria/ Pathogens	Benthic Alterations	Toxicity
Tijuana River WMA	**100 %**	**D**	**D**	**D**	**B**	**C**	**B**	**B**	**B**	**B**	**C**
Tijuana Valley HA (911.10)	7%	A	A	D	A	A	A	A	A	A	C
Potrero HA (911.20)	18%	D	D	D	B	C	B	B	B	B	C
Barrett Lake HA (911.30)	20%	D	D	D	B	C	B	B	B	B	C
Monument HA (911.40)	8%	D	D	D	B	C	C	C	A	B	C
Morena HA (911.50)	5%	D	D	D	B	C	B	B	B	B	C
Cottonwood HA (911.60)	10%	D	D	D	B	C	C	C	C	B	C
Cameron HA (911.70)	10%	D	D	D	B	C	B	B	B	B	C
Campo HA (911.80)	23%	D	D	D	B	C	B	B	B	B	C

Notes:

** = Rating Calculated Based on Area Weighted Averages of Score Value from the sub-watershed areas.*

*** = Priority Level (Highest-A to Lowest-D)*

The purpose of the BLTEA ratings is to identify water quality priorities within a watershed based on weighted averages of the sub-watershed ratings. Because it is a weighted average, larger sub-watersheds will have a greater influence in the overall watershed rating.

The Tijuana River WMA did not have any high priority (A) ratings for the overall WMA. The highest rated constituents were sediments, nutrients, gross pollutants, bacteria, and benthic alteration which were all given a B rating.

The Tijuana Valley sub-watershed which makes up only 7% of the watershed did have several high priority (A) rated constituents which include, heavy metals, organics, sediments, pesticides, nutrients, gross pollutants, bacteria and benthic alteration. Only toxicity and oil and grease were found to have a low priority in this sub-watershed. The only other high priority (A) rating was for bacteria in the Monument sub-watershed due to bacteria being on the 303(d) list in this area.

A regional evaluation and description of the BLTEA is presented in the Regional Assessment Section 13. The complete tables used to calculate the ratings are presented in Appendix G.

12.6 Conclusions and Recommendations

The Tijuana River watershed management area is the largest of the San Diego watersheds covering over 1.1 million acres. Mexico governs the majority of the Tijuana River watershed (73%) with the remaining areas belonging to the United States. Undeveloped areas account for 58% of U.S. lands, with another 25% devoted to parks. The River flows through Tijuana, Mexico and runoff contributions come from both Mexico and the United States. For the Tijuana River WMA, TSS, turbidity, all three bacterial indicators, and Diazinon were identified as high frequency of occurrence COC, followed by BOD, COD, ammonia, and total phosphorus which were identified as medium frequency of occurrence COC, and MBAS, dissolved phosphorus, Chlorpyrifos, Malathion, and total copper were identified as low frequency of occurrence COC. The elevated densities of all three bacterial indicators and elevated levels of BOD, COD, and nutrients (un-ionized ammonia as N and total phosphorus) are indicative of wastewater discharges. Pesticides are also persistently found above WQOs in the watershed. Stream bioassessment monitoring rated the Tijuana River site as Poor, but the investigators in this study feel that this rating is much higher than the actual benthic community quality suggests. The two other bioassessment sites are upstream of any influence from the City of Tijuana and surrounding communities and are not representative of the lower reaches of the Tijuana River directly affected by runoff from these communities. Data collected during the Ambient Bay and Lagoon Monitoring program suggest the elevated concentrations of numerous constituents observed in the Tijuana River are not impacting estuarine sediments. The Tijuana Estuary sediments did not contain any PAHs, PCBs or pesticides and results of toxicity tests were similar to those of a control. Overall, the Tijuana River Estuary received a rating of five compared to other embayments within San Diego County. The Tijuana River Estuary experienced a decrease in relative quality compared with the 2003 ABLM ranking.

The BLTEA rating priorities agreed with the WMA assessment findings for the Tijuana Valley sub-watershed but since this sub-watershed is only 7% of the entire Tijuana River WMA, it suggests that the high priorities and COCs may be more localized to the area near the MLS. The Tijuana River WMA did not have any high priority (A) ratings for the overall WMA. The highest rated constituents were sediments, nutrients, gross pollutants, bacteria, and benthic alteration which were all given a B rating.

The information provided from the triad matrix results used in conjunction with the BLTEA ratings can assist the jurisdictions in making informed decisions in developing their WURMP programs. The two reports also allow for an evaluation of where data gaps exist and where efforts should be targeted.

Utilizing the BLTEA rating methods for future data evaluations would also allow for long-term BMP effectiveness assessment. Incorporation of additional useable data from other third party sources such as the San Diego Coastkeeper, other non-profit organizations, and other POTWs would also help to increase the confidence of the BLTEA ratings and overall WMA assessments.

The recommendation for this watershed is to continue monitoring to gather long-term trend information and to identify upstream sources of contamination.