

Project Title: Tecolote Creek Bacterial Source Tracking Investigation Phase I-III

Originator: City of San Diego

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Publication Info.: Published as part of the Mission Bay Watershed Management Area- Tecolote Creek Microbial Source Tracking Study (August 2008), Tecolote Creek Microbial Source Tracking Study Phase II (June 2009), and the Tecolote Creek Summary Report (June 2010).

Coordinate System: WGS84

Project Background and Objectives: The Tecolote Creek Microbial Source Tracking Study is a Tier II activity under the City's *Five Year Strategic Plan for Watershed Activity Implementation* (Strategic Plan). The study was conducted from 2007 through 2010 throughout the watershed to investigate bacterial sources, origins, and loads in the Tecolote Creek Watershed and to assess and characterize specific priority activity contributions. The results obtained from each phase of this project provide background for the City of San Diego (City) to address bacterial load and concentration reduction strategies to comply with the Total Maximum Daily Loads (TMDL) for Indicator Bacteria, Bacterial Project I – Twenty Beaches and Creeks San Diego Region, Including Tecolote Creek (Bacterial Bacterial Project I TMDL) recently adopted by the San Diego Regional Water Quality Control Board (Regional Board).

The study had the following overall objectives:

1. Gather further information for the refinement of the Bacterial Project I TMDL and State Water Resources Control Board (State Board) Section (§)303(d) list support.
2. Verify priority sectors identified in the Strategic Plan through characterization of bacterial loadings to Tecolote Creek Watershed by targeting primary sources of high bacterial loading (e.g., anthropogenic and non-anthropogenic sources).
3. Determine the presence or absence of human contamination within the watershed, and pinpoint any sources of human contamination.
4. Determine the relative contribution and origin of bacterial regrowth to bacterial loading in the creek during wet weather and dry weather.
5. Further develop bacterial load and concentration reduction strategies for Tecolote Creek based on the results of study elements designed around the four previous objectives.

Geographical Setting/ Sampling Locations: The Tecolote Creek Watershed is located within the Mission Bay WMA in the City of San Diego, California. The Mission Bay WMA is approximately 43,200 acres in size. The Mission Bay WMA supports a variety of ecosystems and provides many beneficial uses. Contact and non-contact recreation, cold and warm freshwater habitat and wildlife, and endangered species habitat uses are supported in the inland surface waters. The waters of Mission Bay support a variety of uses, including contact and non-contact recreation as well as a variety of estuarine; wildlife; marine; and rare, threatened, or endangered species habitats. In addition to water resources, the watershed contains Mission Bay Park, which provides 4,235 acres of land and aquatic recreation areas. Annual precipitation in the watershed ranges from 10.5 inches near the coast to 13.5 inches in the eastern portion of the WMA.

The Tecolote Creek Watershed runoff area covers over 5,992 acres, which is approximately 14% of the Mission Bay WMA. Tecolote Creek discharges to the south-eastern portion of Mission Bay. The primary land uses within the contributing runoff area are residential (45%), transportation (21%), parks (18%) and public (8%). The remaining 8% consists of commercial, industrial, military and vacant land.

Within the Tecolote Creek Watershed, sampling locations (Table 1) were chosen that characterized key creek sites as well as specific land uses and activities.

Table 1. Tecolote Monitoring Locations

Site ID	Study_Name	Season	Latitude	Longitude
Site 3	Phase I	Dry	32.7745148	-117.1911619
Site 4	Phase I	Dry	32.7840248	-117.1851619
Site 4b	Phase I	Dry	32.7836348	-117.1847019
Site 10	Phase I	Dry	32.8245748	-117.1973919
Site 11	Phase I	Dry	32.8205748	-117.1993019
Site 12	Phase I	Dry	32.8278448	-117.1940919
Site 13	Phase I	Dry	32.8287348	-117.1876519
Site 22	Phase I	Dry	32.8252308	-117.1832239
Site 23	Phase I	Dry	32.8242348	-117.1782919
Site 14	Phase I	Dry	32.7985348	-117.1785419
Site 15	Phase I	Dry	32.8020248	-117.1741919
Site 16	Phase I	Dry	32.7985348	-117.1713819
Site 17	Phase I	Dry	32.8034948	-117.1740719
Site 18	Phase I	Dry	32.8058918	-117.1731059
Site 19	Phase I	Dry	32.8085748	-117.1759619
Site 7	Phase I	Dry	32.8027948	-117.1920419

Site ID	Study_Name	Season	Latitude	Longitude
Site 8	Phase I	Dry	32.8058548	-117.1941219
Site 24	Phase I	Dry	32.8114848	-117.1675319
Site 9UP	Phase I	Dry	32.8123848	-117.1960619
Site 11UP	Phase I	Dry	32.8205748	-117.1993019
Site 14UP	Phase I	Dry	32.7988248	-117.1781499
Site 14UP2	Phase I	Dry	32.7989208	-117.1813919
Site 4b1	Phase I	Dry	32.7836448	-117.1847219
Site 4b2	Phase I	Dry	32.7835548	-117.1846319
Site 4b3	Phase I	Dry	32.7840248	-117.1851619
Site 9 UP2	Phase I	Dry	32.8177848	-117.1964519
Site 22A	Phase I	Dry	32.8252748	-117.1832619
Site 5	Phase I and II	Wet/Dry	32.7932448	-117.1883619
Site 6	Phase I and II	Wet/Dry	32.7980848	-117.1890419
Site 9	Phase I and II	Wet/Dry	32.8110948	-117.1965619
Site 2	Phase I and II	Dry	32.7753748	-117.2005319
Site 1	Phases I, II, and III	Wet	32.7728898	-117.2029919

Project/ Task Description:

Phase I: This monitoring study was separated into two major tasks: two Dry Weather surveys and one Wet Weather survey. All three surveys consisted of sampling for fecal coliform and enterococci, visual observations, and estimation of flow.

During each dry weather survey, 23 sites along Tecolote Creek were sampled. At each of these sites, samples were collected for bacterial concentrations and flow was measured. The dry weather events occurred during dry weather and were preceded by greater than 72 hours with no measurable rainfall. The first dry weather monitoring event was conducted over approximately a 12-hour period, from approximately 9:00 PM until 9:00 AM, to capture peak flows from irrigation runoff and restaurant washing activities. It was anticipated that flows and associated loads were greater during late night/early morning hours due to the timing of irrigation practices. Conducting sampling events during these peak flows helped to quantify the highest bacterial loads within the watershed. One round of sampling was conducted during each sampling event, targeting the suspected times of highest flow from the targeted sources.

During the wet weather survey, four sites along Tecolote Creek were sampled. At each of these sites, samples were collected for bacterial concentrations and flow was measured. One storm event was sampled between October 1, 2007 and April 30, 2008 (wet weather season as defined by the NPDES permit). The first storm (“first flush”) of the wet weather season was monitored. A storm event was described as 0.1 inches of rainfall or greater and was preceded by greater than 72 hours with no measurable rainfall. Based on

previous storm flow data, peak flow was expected to last approximately 2 hours. Therefore, pollutograph sampling occurred approximately every 15 minutes, resulting in 6-8 samples at each of the four sub-watershed locations. Flow was monitored at each of these locations.

Phase II: Four Dry Weather Surveys and two Wet Weather Surveys were conducted during Phase II. All six surveys consisted of sampling for fecal coliform and enterococci, visual observations, and estimation of flow.

The Dry Weather Surveys were conducted between December 2008 and June 2009. The dry weather events occurred during dry weather and were preceded by greater than 72 hours with no measurable rainfall. The first dry weather monitoring event was conducted over approximately an 8-hour period, from 5:00 AM until 2:00 PM.

Two wet weather surveys were conducted as part of Phase II. The first wet weather survey consisted of sampling at the MLS (Site 1) only to collect a pollutograph of key contaminants of concern. The second wet weather survey consisted of sampling for indicator bacteria at four creek locations and composite water chemistry analysis for nutrients, pesticides, solids and metals. Two storm events were sampled between October 1, 2008 and April 30, 2009 (wet weather season as defined by the National Pollutant Discharge Elimination System (NPDES) permit). A storm event was described as 0.1 inch of rainfall or greater and was preceded by greater than 72 hours with no measurable rainfall.

In addition to the Dry and Wet Weather Surveys, a special Site-Specific Source Identification Study was performed at four Creek sites identified in Phase I of the Tecolote Project that consistently showed elevated bacterial concentrations or the presence of human fecal contamination. These sites include Site 4b, Site 13, Site 19, and Site 20. These sites were investigated at locations upstream of the high bacterial loading locations in order to assess the potential sources of elevated bacterial concentrations. Up to 20 samples were collected at each site to assess these potential loads. Samples were analyzed for fecal coliforms and enterococci.

Phase III: Three wet weather surveys were conducted during Phase III. All wet weather surveys consisted of sampling at the MLS (Site 1) only to collect a series of grab samples throughout the storm hydrograph. The three storm events were sampled between October 1, 2009 and April 30, 2010 (wet weather season as defined by the National Pollutant Discharge Elimination System (NPDES) permit). A storm event is described as 0.1 inch of rainfall or greater and was preceded by greater than 72 hours with no measurable rainfall. The three surveys consisted of sampling for indicator bacteria and composite water chemistry analysis for nutrients, pesticides, solids and metals.

A summary of the analytes, reporting limits, analytical methods, units, and number of samples is presented in Table 2.

Analyte Name	Fraction Name	Method Name	Reporting Limit	Unit	Number of Samples
Allethrin	Total	EPA 625mNCI	2	ng/L	17
Ammonia as N	None	SM 4500-NH3 F	0.03	mg/L	35
Azinphos methyl	Total	EPA 625m	100	ng/L	17
Bifenthrin	Total	EPA 625mNCI	2	ng/L	17
Bolstar	Total	EPA 625m	4	ng/L	17
Cadmium	Dissolved	EPA 200.8m	0.4	µg/L	24
	Total	EPA 200.8m	0.4	µg/L	22
Chlorpyrifos	Total	EPA 625m	2	ng/L	17
Coliform	Fecal	SM9221E	20	MPN/100 mL	197
	Total	SM9221B	20	MPN/100 mL	8
Copper	Dissolved	EPA 200.8m	0.8	µg/L	63
	Total	EPA 200.8m	0.8	µg/L	78
Cyfluthrin, total	Total	EPA 625mNCI	2	ng/L	17
Cyhalothrin, lambda, total	Total	EPA 625mNCI	2	ng/L	17
Cypermethrin, total	Total	EPA 625mNCI	2	ng/L	17
Danitol	Total	EPA 625mNCI	2	ng/L	17
Deltamethrin	Total	EPA 625mNCI	2	ng/L	17
Demeton,Total	Total	EPA 625m	2	ng/L	17
Diazinon	Total	EPA 625m	4	ng/L	17
Dichlorvos	Total	EPA 625m	6	ng/L	17
Dimethoate	Total	EPA 625m	6	ng/L	17
Dissolved Solids	None	SM 2540 C	5	mg/L	78
Disulfoton	Total	EPA 625m	2	ng/L	17
Enterococcus	None	SM9223B	10	MPN/100 mL	196
Esfenvalerate	Total	EPA 625mNCI	2	ng/L	17
Ethoprop	Total	EPA 625m	2	ng/L	17
Ethyl parathion	Total	EPA 625m	20	ng/L	17
Fenchlorphos	Total	EPA 625m	4	ng/L	17
Fenitrothion	Total	EPA 625m	100	ng/L	17
Fensulfothion	Total	EPA 625m	2	ng/L	17
Fenthion	Total	EPA 625m	4	ng/L	17
Fenvalerate	Total	EPA 625mNCI	2	ng/L	17
Fluvalinate	Total	EPA 625mNCI	2	ng/L	17
Hardness as CaCO3	None	SM 2340 B	5	mg/L	74
Lead	Dissolved	EPA 200.8m	0.1	µg/L	63
	Total	EPA 200.8m	0.1	µg/L	78
Malathion	Total	EPA 625m	6	ng/L	17
Merphos	Total	EPA 625m	2	ng/L	17

Analyte Name	Fraction Name	Method Name	Reporting Limit	Unit	Number of Samples
Methamidophos	Total	EPA 625m	100	ng/L	17
Methidathion	Total	EPA 625m	20	ng/L	17
Methyl parathion	Total	EPA 625m	2	ng/L	17
Mevinphos	Total	EPA 625m	16	ng/L	17
Nitrate as N	None	EPA 300.0	0.05	mg/L	52
			0.11	mg/L	1
Nitrite as N	None	EPA 300.0	0.05	mg/L	52
			0.15	mg/L	1
Nitrogen, Total	Total	SM 4500-N	4	mg/L	15
Nitrogen, Total Kjeldahl	None	SM 4500-N D	1	mg/L	5
OrthoPhosphate as P	Dissolved	EPA 300.0	0.16	mg/L	1
	None	EPA 300.0	0.01	mg/L	41
		SM 4500-P E	0.01	mg/L	38
PCB 030(Surrogate)	Total	EPA 625m	-88	% Recovery	17
PCB 112(Surrogate)	Total	EPA 625m	-88	% Recovery	17
PCB 198(Surrogate)	Total	EPA 625m	-88	% Recovery	17
Permethrin, total	Total	EPA 625mNCI	25	ng/L	4
Permethrin-1	Total	EPA 625mNCI	25	ng/L	13
Permethrin-2	Total	EPA 625mNCI	25	ng/L	13
Phorate	Total	EPA 625m	12	ng/L	17
Phosmet	Total	EPA 625m	100	ng/L	17
Phosphorus-Low Range	None	SM 4500-P E	0.05	mg/L	38
Prallethrin	Total	EPA 625mNCI	2	ng/L	17
Resmethrin	Total	EPA 625mNCI	25	ng/L	16
Selenium	Dissolved	EPA 200.8m	0.5	µg/L	11
	Total	EPA 200.8m	0.5	µg/L	7
Suspended Solids	None	SM 2540 D	5	mg/L	79
	Total	SM2540 D	20	mg/L	31
TCMX(Surrogate)	Total	EPA 625m	-88	% Recovery	17
Tetrachlorvinphos	Total	EPA 625m	4	ng/L	17
Tokuthion	Total	EPA 625m	6	ng/L	17
Trichloronate	Total	EPA 625m	2	ng/L	17
Turbidity	None	EPA 180.1	2	NTU	51
Zinc	Dissolved	EPA 200.8m	0.5	µg/L	63
	Total	EPA 200.8m	0.5	µg/L	78
Organic Carbon	Dissolved	SM 5310 B	0.2	mg/L	18
		SM 5310 D	1	mg/L	7

Analyte Name	Fraction Name	Method Name	Reporting Limit	Unit	Number of Samples
Organic Carbon	Total	SM 5310 B	0.2	mg/L	18
		SM 5310 D	0.5	mg/L	7
		SM5310B	1	mg/L	12
			2	mg/L	4

Quality Control: The quality control requirements employed in this project are those described in *Tecolote Creek Bacteria Source Investigation Monitoring Plan August 2007*, *Phase II Tecolote Creek Bacteria Source Investigation Monitoring Plan December 2008*, and *Phase III Tecolote Creek Bacteria Source Investigation Monitoring Plan November 2009* (included with this submittal). These include methods used for sample collection and handling, data management, validation, and record keeping (including proper chain of custody procedures), data quality objectives for laboratory measurements, and personnel training.