**Project Title:** Carlsbad Hydrologic Unit (CHU) Lagoon Monitoring Project

Originator: County of San Diego Dept. of Public Works Watershed Protection Program

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Project Background and Objectives: The San Diego Regional Water Quality Control Board (RWQCB) issued Investigation Order (IO) No. R9-2006-076 to the City of Carlsbad, City of Encinitas, City of Escondido, City of Oceanside, City of San Marcos, City of Solana Beach, City of Vista, County of San Diego, California Department of Transportation (CalTrans), and the Hale Avenue Resource Recovery Facility (HARRF). These municipalities are the dischargers to the creeks and lagoons in San Diego County that are 303(d) listed for bacteria, total dissolved solids (TDS), sediment, and nutrients. The IO required collection of monitoring data for the development of Total Maximum Daily Loads (TMDLs) as authorized by the Clean Water Act (CWA). According to the IO, the coastal lagoons in Southern California are heavily influenced by their urbanized watersheds. Runoff from these watersheds, coupled with reduced tidal influence from restricted inlets, has resulted in beneficial use impairments within Agua Hedionda Lagoon, Buena Vista Lagoon, Loma Alta Slough, and San Elijo Lagoon. All four lagoons and Agua Hedionda Creek are listed as impaired water bodies (303(d) list) for at least one of the following constituents: indicator bacteria, nutrients, sediment/siltation, TDS (Agua Hedionda Creek only), and/or eutrophic conditions. TMDLs must be developed for the critical constituents in each of the lagoons pursuant to CWA section 303(d).

To comply with the IO, the Carlsbad Hydrologic Unit’s dischargers collected data in four lagoons: Aqua Hedionda Lagoon, Buena Vista Lagoon, Loma Alta Slough, and San Elijo Lagoon. The data were collected to support the development of TMDLs in one or more of these lagoons for bacteria, eutrophic conditions, and sedimentation. Additionally, data for TDS were collected for Aqua Hedionda Creek. Data collected during this monitoring program may be utilized in future efforts to develop TMDLs for these lagoons.

**Geographical Setting/ Sampling Locations:** The monitoring locations (Table 1) included mass emission stations, targeted segment locations, and ocean inlets.

Table 1: Carlsbad Hydrologic Unit monitoring locations

| **Site ID** | **Site Description** | **Latitude** | **Longitude** |
| --- | --- | --- | --- |
| TMAHME | Agua Hedionda Mass Emissions Station | 33.1495 | -117.2969 |
| TMAHO5 | Agua Hedionda Ocean Inlet 1 Depth 1 - Sample | 33.14583 | -117.34353 |
| TMAHO6 | Agua Hedionda Ocean Inlet 1 Depth 2 - Sample | 33.14583 | -117.34353 |
| TMAHO7 | Agua Hedionda Ocean Inlet 2 Depth 1 - Sample | 33.1472 | -117.33075 |
| TMAHO8 | Agua Hedionda Ocean Inlet 2 Depth 2 - Sample | 33.1472 | -117.33075 |
| TMAHS2 | Agua Hedionda Segment 1 – Sample | 33.1439 | -117.3246 |
| TMAT01 | Agua Hedionda Transect 1 | 33.1439 | -117.3383 |
| TMAT02 | Agua Hedionda Transect 2 | 33.1447 | -117.3417 |
| TMAT03 | Agua Hedionda Transect 3 | 33.1416 | -117.3394 |
| TMBT01 | Buena Vista Transect 1 | 33.179 | -117.3413 |
| TMBT02 | Buena Vista Transect 2 | 33.177 | -117.3439 |
| TMBT03 | Buena Vista Transect 3 | 33.1766 | -117.3465 |
| TMBT04 | Buena Vista Transect 4 | 33.1767 | -117.3482 |
| TMBT05 | Buena Vista Transect 5 | 33.1755 | -117.3471 |
| TMBT06 | Buena Vista Transect 6 | 33.1725 | -117.3508 |
| TMBT07 | Buena Vista Transect 7 | 33.1714 | -117.3522 |
| TMBT08 | Buena Vista Transect 8 | 33.1701 | -117.3506 |
| TMBT09 | Buena Vista Transect 9 | 33.168 | -117.3523 |
| TMBT10 | Buena Vista Transect 10 | 33.1681 | -117.355 |
| TMBVME | Buena Vista Mass Emissions Station | 33.1808 | -117.3267 |
| TMBVS3 | Buena Vista Segment 1 - Sample | 33.1798 | -117.3412 |
| TMBVS4 | Buena Vista Segment 2 - Sample | 33.1682 | -117.3562 |
| TMLAME | Loma Alta Mass Emissions Station | 33.1885 | -117.3615 |
| TMLAO1 | Loma Alta Ocean Inlet 1 | 33.1774 | -117.3688 |
| TMLAS1 | Loma Alta Segment 1 | 33.1793 | -117.3672 |
| TMLT01 | Loma Alta Transect 1 | 33.1799 | -117.3667 |
| TMLT02 | Loma Alta Transect 2 | 33.1794 | -117.3669 |
| TMLT03 | Loma Alta Transect 3 | 33.1793 | -117.3671 |
| TMLT04 | Loma Alta Transect 4 | 33.1786 | -117.3675 |
| TMLT05 | Loma Alta Transect 5 | 33.1779 | -117.368 |
| TMLT06 | Loma Alta Transect 6 | 33.1778 | -117.3682 |
| TMLT07 | Loma Alta Transect 7 | 33.1775 | -117.3684 |
| TMLT08 | Loma Alta Transect 8 | 33.1772 | -117.3686 |
| TMSEME | San Elijo Mass Emissions Station | 33.04818 | -117.2267 |
| TMSEO1 | San Elijo Ocean Inlet 1 - Sample | 33.01626 | -117.28114 |
| TMSES1 | San Elijo Segment 1 | 33.01 | -117.265 |
| TMSES2 | San Elijo Segment 2 | 33.0117 | -117.2727 |
| TMST01 | San Elijo Transect 1 | 33.0067 | -117.2698 |
| TMST02 | San Elijo Transect 2 | 33.0083 | -117.2705 |
| TMST03 | San Elijo Transect 3 | 33.0107 | -117.2766 |
| TMST04 | San Elijo Transect 4 | 33.0101 | -117.2647 |
| TMST05 | San Elijo Transect 5 | 33.0093 | -117.2657 |
| TMST06 | San Elijo Transect 6 | 33.0085 | -117.2644 |
| TMST07 | San Elijo Transect 7 | 33.0067 | -117.266 |
| TMST08 | San Elijo Transect 8 | 33.0056 | -117.2684 |
| TMST09 | San Elijo Transect 9 | 33.0053 | -117.2704 |
| TMST10 | San Elijo Transect 10 | 33.0073 | -117.2711 |
| TMST11 | San Elijo Transect 11 | 33.0077 | -117.2693 |
| TMST12 | San Elijo Transect 12 | 33.0095 | -117.2697 |
| TMST13 | San Elijo Transect 13 | 33.0108 | -117.2713 |
| TMST14 | San Elijo Transect 14 | 33.0114 | -117.2732 |
| TMST15 | San Elijo Transect 15 | 33.0122 | -117.2746 |
| TMST16 | San Elijo Transect 16 | 33.0142 | -117.2758 |
| TMST17 | San Elijo Transect 17 | 33.0133 | -117.2774 |
| TMST18 | San Elijo Transect 18 | 33.0134 | -117.2791 |

**Project/ Task Description:**

Sample collection was conducted for wet weather monitoring during and immediately following three storm events at the mass emission stations along the main tributaries of the lagoons, at targeted segment locations within the lagoons, and at the ocean inlets to the lagoons. After the first wet weather event only, post-storm sediment sampling was conducted.

Dry weather monitoring was conducted during four index period events designed to capture representative seasonal cycles of physical forcing, such as tides and currents acting on the lagoons, as well as biological activity within the lagoons. During each index period event, sampling was conducted at the mass emission stations along the main tributaries of the lagoons, at targeted segment locations within the lagoons, and at the ocean inlets to the lagoons. Index period events also included longitudinal transect sampling and targeted storm drain and tributary sampling.

Constituents monitored at all Agua Hedionda Lagoon sampling locations were *Enterococcus* bacteria*,* total and fecal coliform bacteria, and total suspended solids (TSS). In addition to these constituents, totaldissolved solids (TDS) were monitored at the mass emission station only.

Constituents monitored at all sampling locations at Buena Vista Lagoon, Loma Alta Slough, and San Elijo Lagoon were *Enterococcus* bacteria*,* total and fecal coliform bacteria, TSS, ammonia as nitrogen (N), carbonaceous biochemical oxygen demand (CBOD), nitrate + nitrite (N+N), soluble reactive phosphorus (SRP), total and dissolved nitrogen (TN and TDN), and total and dissolved phosphorus (TP and TDP). Chlorophyll *a* was monitored at all lagoon segments and the ocean inlet sites during wet weather events and all sampling locations during index period events.

Aqueous sediment grain size was analyzed from composite water samples generated from the mass emission station pollutograph samples during each of the first two wet weather events. The samples were analyzed for grain size distribution among the following size categories: clay <0.0039 millimeters, silt 0.0039 to < 0.0625 millimeters, sand 0.0625 to < 2.0 millimeters, and granule 2.0 to < 4.0 millimeters. Table 2, below provides a summary of all analytical data collected for this project.

This submittal includes receiving waters data only.

Table 2: Constituents Monitored

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Constituent** | **Analysis Method** | **Unit** | **MDL** | **RL** | **No. Samples Analyzed** |
| Ammonia as N | SM 4500-NH3 G | mg/L | 0.001 | 0.004 | 831 |
| Nitrate + Nitrite as N | SM 4500-NO3+NO2 F | mg/L | 0.007-0.02 | 0.007-0.02 | 831 |
| Nitrite as N | SM 4500-NO2 B | mg/L | 0.001 | 0.004 | 273 |
| Total Dissolved Nitrogen | USGS 1-2650-03 | mg/L | 0.003-0.02 | 0.1-1 | 772 |
| Total Nitrogen (calc) | USGS 1-4650-03 | mg/L | 0.003-0.02 | 0.1 | 772 |
| Total Dissolved Phosphorus | USGS 1-2650-03 | mg/L | 0.002-0.02 | 0.05-1 | 772 |
| Total Phosphorus | USGS 1-4650-03 | mg/L | 0.002-0.02 | 0.05-0.5 | 772 |
| Soluble Reactive Phosphorus | SM 4500 P C | mg/L | 0.003 | 0.009 | 833 |
| Carbonaceous Biochemical Oxygen Demand | SM 5210 B | mg/L | 0-2 | 1-2 | 530 |
| Chlorophyll a | SM 10200 H | mg/m3 | 1 | 2 | 734 |
| Dissolved Solids | SM 2540 C | mg/L | 0.1 | 5 | 66 |
| Suspended Solids | SM 2540 D | mg/L | 0.5-1 | 1-5 | 1162 |
| Turbidity | SM 2130 B | NTU | 0.1-0.2 | 0.1-0.2 | 12 |
| Enterococcus | EPA 1600 | CFU/100mL | 1 | 1-1000 | 881 |
| Fecal Coliform | SM 9221 E | MPN/100mL | 2 | 2 | 125 |
| SM 9222 D | MPN/100mL | 1 | 2-1000 | 756 |
| Total Coliform | SM 9221 | MPN/100mL | 2 | 2 | 125 |
| SM 9221 B | MPN/100mL | 1 | 2-1000 | 756 |
| Clay <0.0039 mm | ASTM D422 | % | NA | 1 | 33 |
| Silt 0.0039 to <0.0625 mm | ASTM D422 | % | NA | 1 | 44 |
| Sand 0.0625 to <2.0 mm | ASTM D422 | % | NA | 1 | 55 |
| Granule 2.0 to <4.0 mm | ASTM D422 | % | NA | 1 | 11 |

**Quality Control:**

The *Carlsbad Hydrologic Unit SDRWQCB Investigative Order R9-2006-076 Lagoon TMDL Monitoring Quality Assurance Project Plan* (QAPP) (September 1, 2007) is included with this submittal together with *Section 3 of the Carlsbad Hydrologic Unit Lagoon Monitoring Report’s Section 3.0: QA/QC Results* . The QAPP was developed to establish activities and procedures to assure both chemical and physical measurements would meet the Surface Water Ambient Monitoring Program (SWAMP) requirements and provide the quality of data needed to calibrate and validate future TMDL models.

Field sampling and laboratory quality assurance activities and procedures were implemented to meet the objectives provided in the QAPP. Quality assurance activities began with field protocols designed to minimize errors introduced during field sampling and measurements. Field QA/QC processes included equipment calibration, field protocols to meet analytical holding times, field duplicates, and field blanks.

Laboratory QA/QC samples were used to evaluate the analytical processes for contamination, accuracy, and precision (reproducibility). All data are considered usable. No data were rejected. Data were qualified and flagged in the project database with the appropriate SWAMP QA codes. Flagged data are usable as qualified.

Laboratory duplicates were analyzed for a minimum of five percent of the total number of samples analyzed per constituent. The percentage of duplicates that met the DQOs for individual constituents ranged between 66 percent and 100 percent, with all but one constituent in the range of 91 percent to 100 percent.

Laboratory control samples were analyzed for a minimum of six percent of the total samples collected for the following constituents: ammonia as nitrogen, N+N, SRP, TN, TDN, TP, and TDP. All results met the DQOs, except for two samples.

Matrix spikes/matrix spike duplicates were analyzed on a minimum of five percent of the total number of samples collected for the following constituents: TDS, ammonia as nitrogen, N+N, TN, TDN, TP, and TDP. All sample results met the DQOs, except for one TN sample tested during Index Period 1.

Laboratory blanks were analyzed on a minimum of five percent of the total number of samples collected.

All sample results met the DQOs except for one of 79 total samples tested for chlorophyll *a*.

**Enclosed Documents in Electronic Format:**

*Carlsbad Hydrologic Unit SDRWQCB Investigative Order R9-2006-076 Lagoon TMDL Monitoring Quality Assurance Project Plan* (QAPP) (September 1, 2007) Electronic Folder: *QAPP FINAL*

*Section 3 of the Carlsbad Hydrologic Unit Lagoon Monitoring Report’s Section 3.0: QA/QC Results.* Electronic Filename: *Carlsbad Lagoon Monitoring QAQC Report.pdf*

**Enclosed Electronic Data File:**

Carlsbad Hydrologic Unit (CHU) Lagoon Monitoring Project Data. Electronic Filename: *Carlsbad Lagoon Monitoring\_Data.xls*.