City of Torrance, California

MACHADO LAKE NUTRIENT TOTAL MAXIMUM DAILY LOAD

SPECIAL STUDY WORK PLAN

May 18, 2011

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SPECIAL STUDY WORK PLAN

1.0 INTRODUCTION

This Field Sampling Plan (FSP) presents the approach and procedures to implement stormwater sampling activities in 2011 for a Special Study of the City of Torrance (City) storm drains discharging stormwater into Machado Lake. The field study sampling procedures, methods, and analyses for stormwater are described in this document.

1.1 Background

The City is subject to the requirements of the Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) Total Maximum Daily Load (TMDL) per the Los Angeles Regional Quality Control Board's (Regional Board's) Resolution R08-006. Under the Regional Board's resolution, the City shall submit to the Regional Board's Executive Officer a Monitoring and Reporting Plan (MRP) within 1 year of the effective date of the resolution or propose a Special Study Work Plan following the requirements of one of three optional studies. This Special Study Work Plan details the approach proposed by the City to perform Optional Study No. 3, to assess compliance with the Waste Load Allocations (WLA) on a mass basis for total nitrogen and total phosphorus originating from the City's watersheds. The Special Study Work Plan proposes a pre-Best Management Practices (BMP) Implementation Study including field sampling and data collection to be followed by submittals to the Regional Board including a BMP Evaluation and Selection Report, a MRP, and a BMP Implementation Report to be provided at a later date.

Machado Lake is identified on the 1998 and 2002 Clean Water Act 300(d) list of impaired water bodies as impaired due to eutrophic conditions, algae, ammonia, and odors. Resource agencies, local governments, project implementers, the scientific community, environmental groups, decision-makers at the city, county, state, and federal levels, and many others have continued to take meaningful steps towards the restoration of Machado Lake and its basin. Among these efforts, restoration activities are expanding through continued implementation of erosion control, stormwater management, and riparian restoration projects, development of the Machado Lake Nutrient TMDL that is providing a quantitative, science-based approach for pollutant reduction, and a strong research/monitoring effort to evaluate key ecological processes and response to water quality improvement projects.

The Machado Lake Nutrient TMDL allows for the establishment of annual mass-based WLAs for total phosphorus (TP) and total nitrogen (TN) equivalent to monthly average concentrations of 0.1 mg/L TP and 1.0 mg/L TN, based on approved flow conditions. When the concentration based WLAs are met under the approved flow condition of 8.45 hm3, the annual mass of the TP discharged to the lake will be 845 kg and the annual mass of TN discharged to the lake will be 8,450 kg. The City of Torrance mass-based WLA will be proportional to the City owned area in the sub-watershed. The City of Torrance area

accounts for 35.6% of the Machado Lake Watershed. Table 1 lists the interim and final WLAs based on this area.

Table 1 Waste Load Allocations

Responsible Party	Years after TMDL Effective Date	TP (kg)	TN (kg)
City of Torrance	5	3,760	7,370
	9.5 (final WLAs)	301	3,008

1.2 Site Conditions and Characteristics

1.2.1 Study Site Location

The City is located about 15 miles south of Downtown Los Angeles (LA), in southern LA County, just north of the Palos Verdes Hills. The City was incorporated on May 12, 1921, and is just over 20.5 square miles in area. The City is bounded by Redondo Beach on the west and north, Lawndale and Gardena on the north, LA on the east, Lomita to the southeast, and Rolling Hills Estates and Palos Verdes Estates on the south. The City is also bounded by approximately 4,000 feet of Santa Monica Bay coastline. The City's storm conveyance systems are interconnected with neighboring city systems. Neighboring cities located at generally higher elevation such as Rolling Hills Estate and Palos Verde Estate discharge stormwater into the City's and/or LA County's storm conveyance systems located within the City's boundaries. Figure 1 shows a regional location map of the City.

1.2.2 Hydrology and Hydraulics

The Machado Lake subwatershed is located in the southwestern area of the Dominguez Watershed and includes portions of the Cities of Los Angeles, Torrance, Lomita, Rolling Hills, Rolling Hills Estates, Carson, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, and the communities of unincorporated Los Angeles County, including Wilmington and Harbor City. However, much of the Machado Lake watershed consists of the hilly regions of Rolling Hills Estates and Rolling Hills. This portion of the watershed is unique, as it consists of relatively steep hills with drainage into the canyons. The Machado Lake Watershed covers an area of approximately 20 square miles and is itself divided into six primary subdrainage areas. These subdrainages are the Walteria Lake, Project 77/510, Wilmington Drain, Project 643 (72-inch Storm Drain), Project 643 (Figueroa Drain), and Private Drain 553.

Machado Lake, about 40 acres in area and the Machado Lake Wetlands (64 acres) are located within the Ken Malloy Harbor Regional Park in the southeastern corner of the Machado Lake Watershed. Both Machado Lake and the Machado Lake wetlands serve as flood retention basins for the Machado Lake Watershed.

1.2.2.1 Storm Drain

As the area is highly urbanized, drainage is primarily conducted through an extensive network of underground storm drain facilities. The Los Angeles County Department of Public Works maintains the system of storm drains in the City of Rolling Hills Estates. The primary use of the Dominguez Channel and all other open channels in the Dominguez Watershed (including Wilmington Drain, Machado Lake, and Madrona Marsh) is flood protection.

Machado Lake receives urban and storm water runoff from a complex network of storm drain systems. The first of three primary storm drain channels that flow into Machado Lake is the Wilmington Drain. Approximately 65 percent of the runoff from the Machado Lake Watershed flows through the Wilmington Drain into Machado Lake. The other two primary storm drain channels are the Project No. 77 Drain and the Harbor City Relief Drain. Several smaller storm drains also discharges into Machado Lake, including Project No. 643's Figueroa Street Outlet and a 72-inch storm drain outlet. Machado Lake discharges at the southern end by overflowing a concrete dam into the Machado Lake wetland. Water discharges from the wetland through the Harbor Outflow structure and into the West Basin of the Los Angeles Harbor.

The Walteria Lake, located within the City's boundaries, is owned and operated by LA County. It is approximately 1,005 acre-feet in capacity and receives raw stormwater mainly from Rolling Hills Estates and Palos Verdes Estates. Effluent from the lake is pumped at a maximum rate of 57 cubic feet per second (cfs) through a force main system into a 54-inch drain line that lies under Skypark Drive. The discharge eventually leaves the City near the intersection of Crenshaw Boulevard and Amsler Street.

Figure 2 shows the drainage basins and stormwater conveyance infrastructure in the City. The figure also shows nearby communities discharging stormwater into the City's drainage system.

1.2.3 Land Use

The City of Torrance is predominantly residential land use, with concentrations of industrial and commercial uses. This reflects the City's history as a "company town," where homes were built to house the local work force of industries. Residential development covered almost half of the City's land area. Industrial uses occupied the second largest land area, at 22 percent. Commercial and Public/Quasi-Public/Open Space uses represent the third largest land uses in the City, about 12 percent each. Torrance also had a limited supply of vacant land mostly within commercial and industrial areas. Given the built-out character of the community, only minor land use changes from baseline year 2010 conditions will occur over the long term.

Residential uses are located throughout Torrance at varying development densities. The highest residential densities occur along major streets and near major transportation corridors, in older neighborhoods, and in apartment or condominium developments and Planned Development communities around Sepulveda Boulevard and Plaza Del Amo between Hawthorne and Crenshaw Boulevards. The lowest residential densities are largely

located in the western and southern portions of the City. Figure 3 identifies the land uses in Torrance.

1.2.4 Water Quality Issues

Machado Lake, located in the Dominguez Channel watershed in southern LA County, is identified on the 1998 and 2002 Clean Water Act 303(d) list of impaired water bodies as impaired due to eutrophic conditions, algae, ammonia, and odors. The Machado Lake eutrophic, algae, and odor impairments are caused by excessive loading of nutrients, including nitrogen and phosphorus, to Machado Lake (Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL, Revised Draft – April 2008). Ammonia is found to be at levels below the toxicity standards, but nevertheless, these concentrations contribute to the total nitrogen loading in the Lake. Table 2 provides a summary of the quantifiable loads entering Machado Lake on an annual basis (Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL, Revised Draft – April 2008). Nutrient flux from the sediments and atmospheric nitrogen deposition are the two directly quantifiable non-point sources included as part of the total nutrient load. The total annual nitrogen and phosphorus loads are estimated to be 24,327 kg and 10,421 kg, respectively.

Machado Lake is located in the Ken Malloy Harbor Regional Park (KMHRP), which is a 231 acres LA City Park serving the Wilmington and Harbor City areas. As shown on Figure 4, the park is located west of the Harbor freeway (110) and east of Vermont Avenue between the Tosco Refinery on the south and the Pacific Coast Highway on the North. Machado Lake is one of the last lake and wetland systems in LA; the area is approximately 103.5 acres in total size. The upper portion, which includes the open water area, is approximately 40 acres and the lower wetland portion is about 63.5 acres. Machado Lake is a shallow polymictic lake; the depth is generally 0.5 to 1.5 meters; the *average* depth is approximately 1.0 meter. The lake was originally developed as part of Harbor Regional Park in 1971 and intended for boating and fishing. Over the years water quality generally declined; boating was stopped and signs were posted warning of the risk of eating fish from the lake.

Table 2 Total Annual Nutrient Load Entering Machado Lake[(1)]

Source	Total N (kg)	Total P (kg)	Ortho-P (kg)	Inorg-N (kg)
External Load	7,587	3,260	737	3,736
Sediment Flux	16,520	7,161	4,963	16,520
Atmospheric Deposition	220			
Total Annual Load	**24,327**	**10,421**	**5,700**	**20,256**

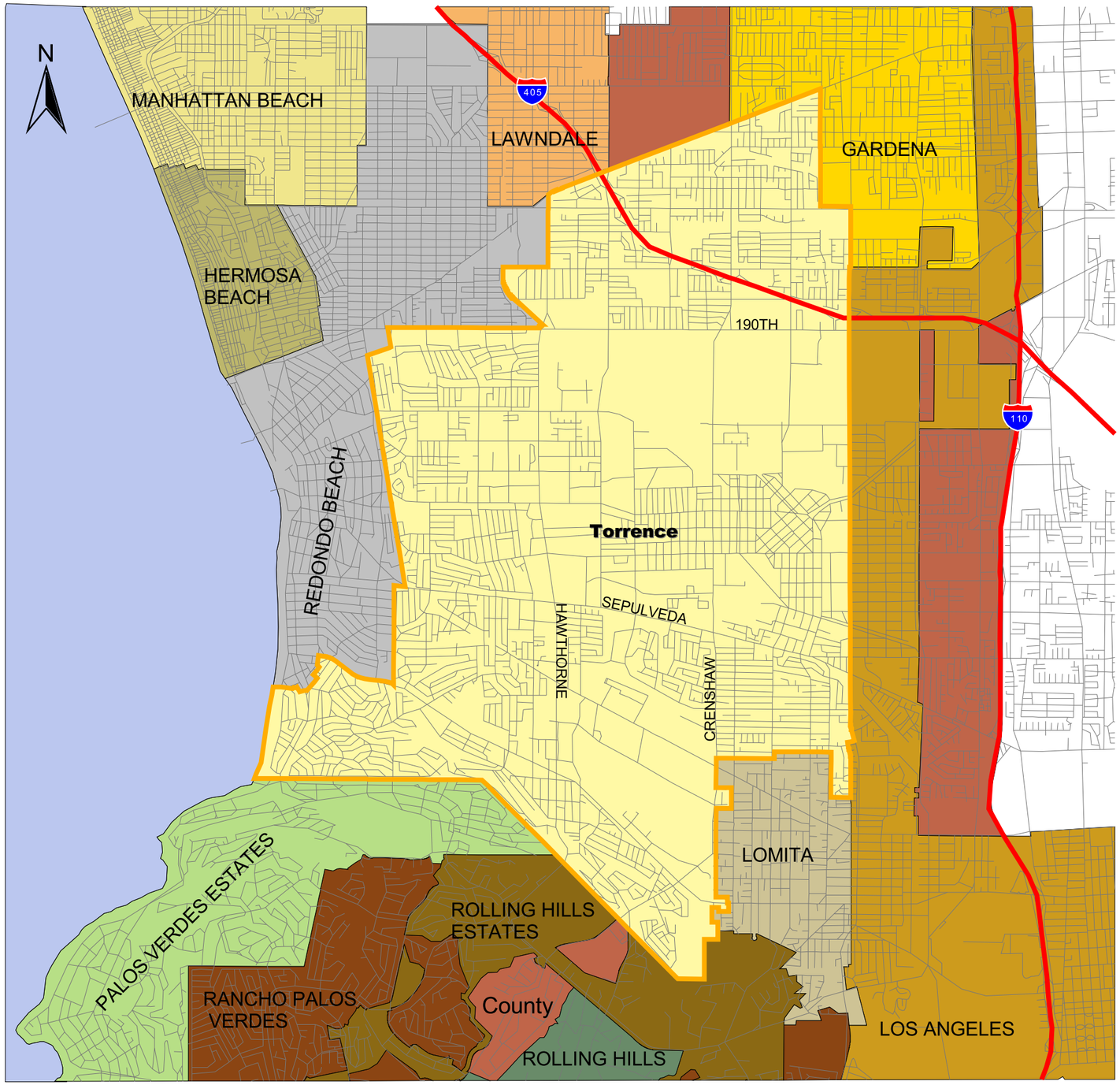
Notes:
1. Source: Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL, Revised Draft - April 2008.

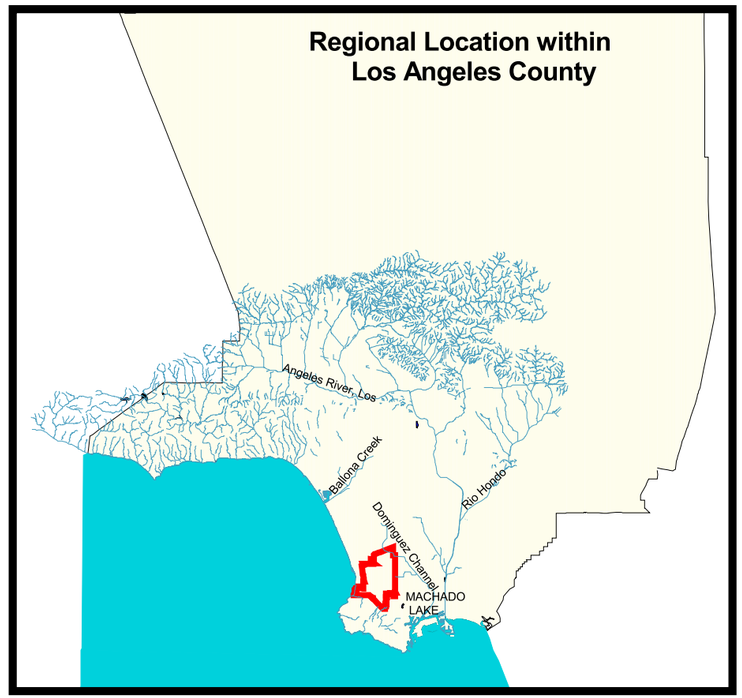
The dominant land use in the Machado Lake Watershed is high-density single-family residential, accounting for approximately 45 percent of the land use. Industrial, vacant, retail/commercial, multi-family residential, transportation, and educational institutions each account for 5 to 7 percent of the land use, while "all other" accounts for the remaining 23

percent. Machado Lake is a receiving body of urban and stormwater runoff from a network of storm drains throughout the watershed. As indicated on Figure 4, there are three discharge points into Machado Lake from the following storm drain channels:

- Wilmington Drain.
- Project No. 77.
- Harbor City Relief Drain.

Approximately 88 percent of the Machado Lake Watershed drainage area flows through the Wilmington Drain into Machado Lake.





0 2 Miles

Figure 1 Regional Map of Torrance

Storm Drain
Torrance
Retention Basins
Santa Monica Bay Watershed
Dominguez Channel Watershed
Machado Lake Watershed

0.9 0 0.9 Miles

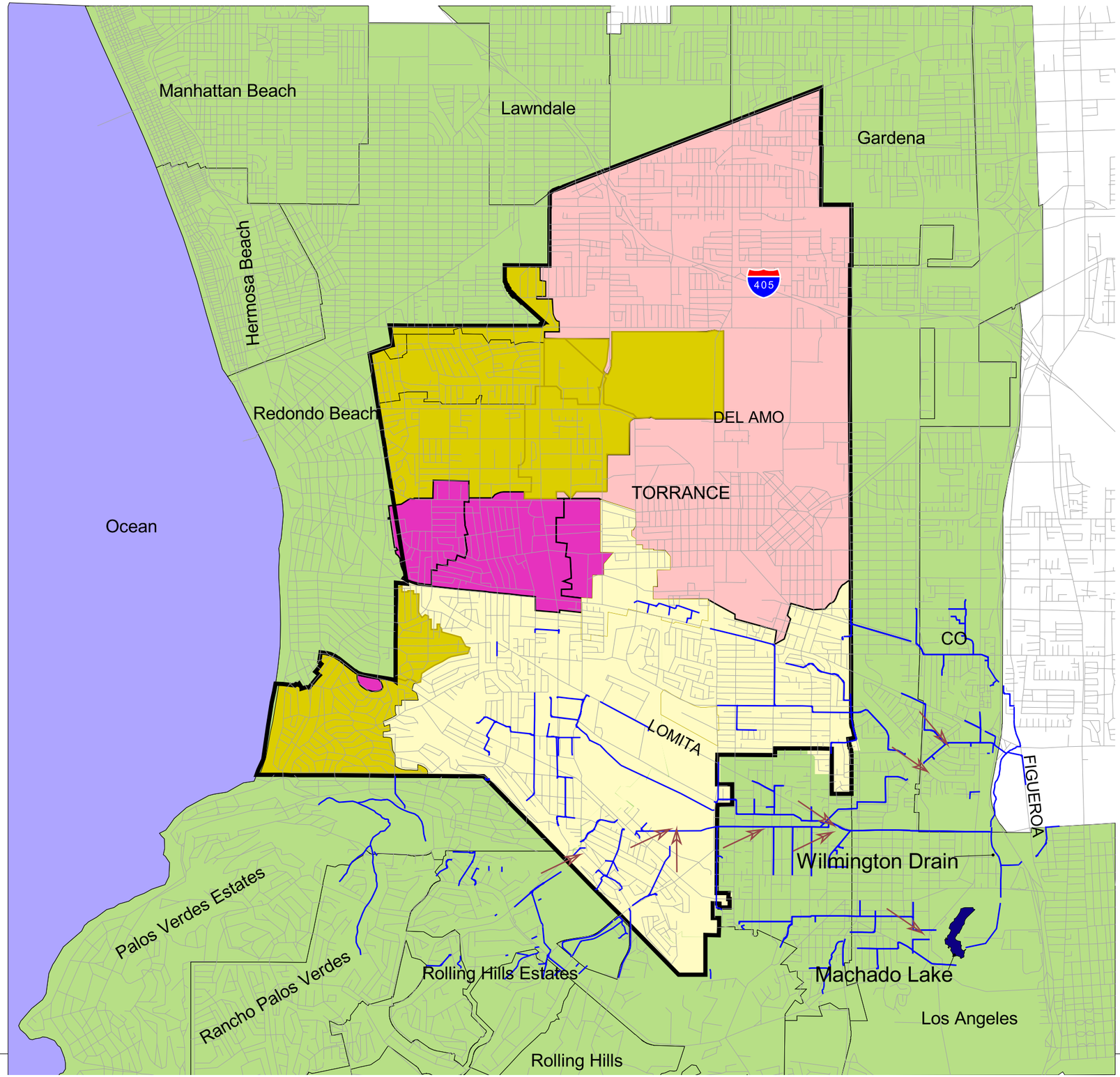


Figure 2 Subregional Watersheds

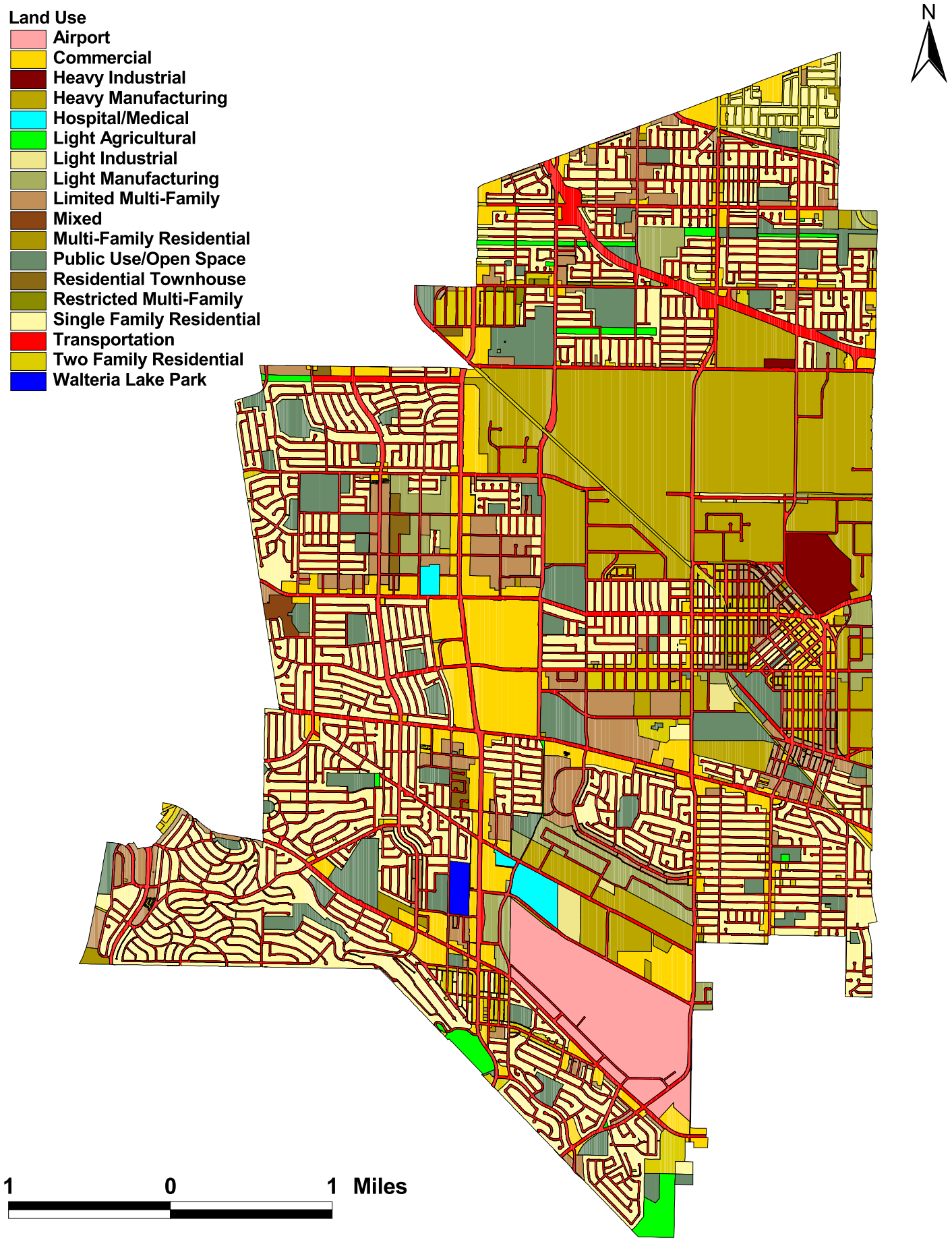


Figure 3 Existing Land Use of Torrance

Figure 4 2007 Satellite Imagery of Machado Lake and Ken Malloy Harbor Park Overview

1.3 Special Study Work Plan

This document provides the overall structure of the Special Study Work Plan with submittals to the Regional Board, as well as providing the initial Pre-BMP Implementation Study Plan (including a proposed field data collection and sampling plan). The Special Study Work Plan addresses the requirements of Optional Study No. 3 to assess compliance with WLAs for total nitrogen and total phosphorus originating from the City's watersheds. The scope of work for this plan includes the following:

- Pre-BMP Implementation Study Period - Including conducting dry weather sampling as outlined within this submittal as well as reviewing water quality models developed by LA County for wet weather events and Machado Lake.
- BMP Evaluation and Selection Study Report - This study report is to be submitted at a later date (see proposed schedule of work plan elements), and will summarize the collected field data and the applicable results obtained from the regional water quality model being developed by LA County for wet weather conditions. The field data and the water quality model data will be used to assess compliance with WLAs under the TMDL. Based on the assessment of compliance, the BMP and Selection Study Report will identify and screen structural BMPs for mitigation to bring the City into compliance with the TMDL.
- Monitoring and Reporting Plan - Subsequent to acceptance by the Regional Board of the findings and conclusions of the City's BMP Evaluation and Selection Study Report, the City will submit an MRP specific to the needs for assessment of future compliance with the TMDL.
- BMP Implementation Report - This report will summarize the monitoring data collected after 12 months of BMP implementation and will provide to the Regional Board an assessment of the success of the structural BMPs implemented by the City to support compliance with the TMDL.

The actual start date for the sampling will be determined following the Regional Board's approval of this Special Study Work Plan. Other conditions that may affect the sampling schedule are weather and equipment conditions and availability. The schedule for the work plan is summarized in Table 3.

The Special Study Work Plan identifies the proposed tasks the City agrees to perform, their timelines, and the roles and responsibilities of various parties in completing the work. The purpose of this document is to serve as a starting point for work planning discussions between the City and the Regional Board.

Table 3 Schedule or Work Plan Elements		
ID	**Work Plan Element**	**Schedule**
1	Special Study Work Plan	May, 2011 (submittal)
2	Regional Board Review/Approval	June, 2011 (approval)
3	Pre-BMP Implementation Study	July, 2011 – July, 2012 (field sampling)
4	BMP Evaluation, Monitoring and Reporting Plan	September, 2011 (submittal)
5	Regional Review/Approval	August, 2012 (approval)
6	BMP Implementation	Nov., 2012 (implementation)
7	BMP Implementation Report	Nov., 2013 (submittal)

2.0 PRE-BMP IMPLEMENTATION STUDY

2.1 Introduction

The Pre-BMP Implementation Study includes a 12-month FSP and evaluation of regional water quality models for wet weather conditions and Machado Lake to assess the City's current compliance with WLAs. The FSP covers sample collection methods, analytical procedures, data analysis and reporting, and health and safety aspects. The FSP will generate a variety of data including discharge rates and flow volumes, the concentrations of chemical parameters, and the measurement of physical parameters. Utilizing the mass balance approach, the data will be used to estimate the mass of nutrients originating from the City as well as nearby agencies discharging stormwater into the City's storm drain system. The data will also be examined for patterns and trends, comparing stormwater quality between different sampling locations over time.

The Pre-BMP Implementation Study will be undertaken once approval is obtained from the Regional Board for the Special Study Work Plan.

The remaining sections of this document contain the FSP providing field sampling methods and analytical procedures that will be used to collect dry weather water quality data and continuous flow data.

2.2 Objectives of the Pre-BMP Implementation Study

The Pre-BMP Implementation Study will provide the City data needed to assess water quality impacts to the City's drainage network. The objective of this study is to support the City's compliance with the Machado Lake Nutrient TMDL by performing Special Study No. 3. Data and information elements that are part of the Pre-BMP Implementation Study include:

1. Dry weather flow data including calculation of continuous volume data and water quality data obtained through field monitoring and sampling (data to be collected by implementing the FSP included within this document).

2. Estimates of wet weather stormwater quality impacts identified using an integrated water quality model developed by the City of Torrance. The water quality model is described in Section 2.2.1.
3. Identification of BMPs that will be implemented by the City to mitigate observed water quality impacts in the City's outflows to Machado Lake.

2.2.1 Pollutant Loading and Analysis Tool (PLAT)

In order to estimate wet weather stormwater quality impacts, the City has developed an integrated watershed modeling tool to simulate watershed hydrology, nutrient, sediment, and contaminant dynamics. This tool called Pollutant Loading and Analysis Tool (PLAT), incorporates existing and commonly used watershed models. The main models used by PLAT are PLOAD, Program for Predicting Polluting Particle Passage thru Pits, Puddles, and Ponds (P8), and U.S EPA SUSTAIN model. PLAT is based on spatially distributed inputs derived from high resolution satellite imagery. PLAT has four main components: pollutant hot-spots characterization, BMP screening, continuous simulation, and BMP design, optimization, and placement. The SUSTAIN model provides an optimization routine that helps identify the appropriate size of BMPs for treating stormwater runoff from respective source areas to meet TMDL reduction goals. The tool has been validated with results from the LA County Watershed Management Model System (WMMS).

3.0 FIELD SAMPLING PLAN

The 12-month FSP is designed to collect continuous flow data and discrete dry weather water quality data to support the overall study objectives summarized in Section 2.

3.1 Sampling Locations and Access

Site selection is a major challenge, given the scarcity of funding for sampling and laboratory analysis. The number of locations to be sampled was decided based on the program objectives, regulatory requirements, and the size and complexity of the drainage sub-basins and conveyance system. In addition, the frequency of sampling at each location was considered.

As a first step in the selection process, the City's watersheds, sub-basins and drainage system network were reviewed. Based on this review, nine locations were identified that could be used to characterize the flows in and out of each subbasin. Four of these locations are needed at a minimum to characterize the flows conveyed to Machado Lake. The final selection of sample locations was based on factors such as site permission, access, clustering, personal safety, equipment safety, and the likelihood that stormwater would flow at the location. Table 4 summarizes the proposed stormwater sampling locations, types, and characteristics. The general sampling locations are depicted on Figure 5. Appendix A shows detailed characteristics of each sampling location.

At a minimum, four sampling locations will meet the objectives of this program. However, the City will sample five additional locations, Tor-S3, Tor-S6, Tor-S7, Tor-S8, and Tor-S9 as shown on Figure 4 because the results will support critical decisions including identifying sources originating outside of the City's boundaries or sources not under the direct control of the City. The sampling locations Tor-S6, Tor-S7, Tor-S8, and Tor-S9 are discharge points for Rolling Hills and Palos Verdes Estates.

The sampling locations are described below.

Tor-S1

This site is located 40 ft north and 80 ft east of the intersection of Plaza Del Amo and Western Avenue. The total upstream drainage area is approximately 63 acres. The drainage area is mainly residential and commercial land use. Residential and commercial land uses represent 36 percent and 33 percent, respectively, of the drainage area. This site is easily accessible and safe for conducting sampling during both dry and wet weather conditions. The storm sewer conveying stormwater to this site is a 36-inch reinforced concrete pipe. This site is one of the four sites that will provide information on the amount of pollutants leaving the City limits.

Sampling Site: TOR-S1

Table 4 Sampling Location Characteristics

Sampling Location Name	Description	Land Use	GPS Coordinates	Associated Upstream Storm Drain Name	Diameter (in) and Material
Tor-S1	Located 40 ft north and 80 ft east of the intersection of Plaza Del Amo and Western Avenue. .	Residential/ commercial	33° 49.3572' 118° 18.5208'	City	36 RCP
Tor-S2	Approximately 50 ft west of 246th Place and Pennsylvania Avenue intersection.	Mixed	33°48.093' 118° 19.5252'	City	33 RCP
Tor-S3	Effluent of Walteria Lake, approximately 100 ft east of Madison St. and Skypark Drive intersection.	Mixed	33°48.6312 118° 20.8674'	Walteria Lake	54
Tor-S4	Approximately 210 ft north and 85 ft east of 236th Street and Western Avenue intersection.	Mostly residential	33° 48.7056' 118° 18.5196'	City	9'-2"Wx11'H RCB
Tor-S5	About 25 ft west of intersection of Bani Avenue and 250th Street (two pipes intersect from south and west).	Residential/ Airport	33° 47.8956' 118° 19.6872'	City	8'-9"Wx9'-7"H RCB
Tor-S6	Approximately 600 ft east of Estates Lane and Crenshaw Boulevard.	Mostly residential	33° 47.1822' 118° 20.43'	Rolling Hills Estates	36 RCP
Tor-S7	About 160 ft south and 280 ft east of Rolling Hills Road and Hawthorne Blvd. intersection. Will monitor dry weather flow originating from Rolling Hills Estates.	Mostly residential	33° 47.6826 118° 20.9232'	Rolling Hills Estates	10'x10' RCB
Tor-S8	About 500 ft northwest of Paseo De Las Tortugas and Mesa St. intersection. Will monitor dry weather flow originating from Rolling Hills Estates.	Mostly residential	33° 48.0522' 118° 21.4254'	Rolling Hills Estates	24 RCP
Tor-S9	About 830 ft east and 120 ft south of Paseo de las Tortugas and Vista Montana intersection. Will monitor dry weather flow originating from Palos Verdes Estates.	Mostly residential	33° 48.2742' 118° 21.7776'	Palos Verdes Estates	42 RCP

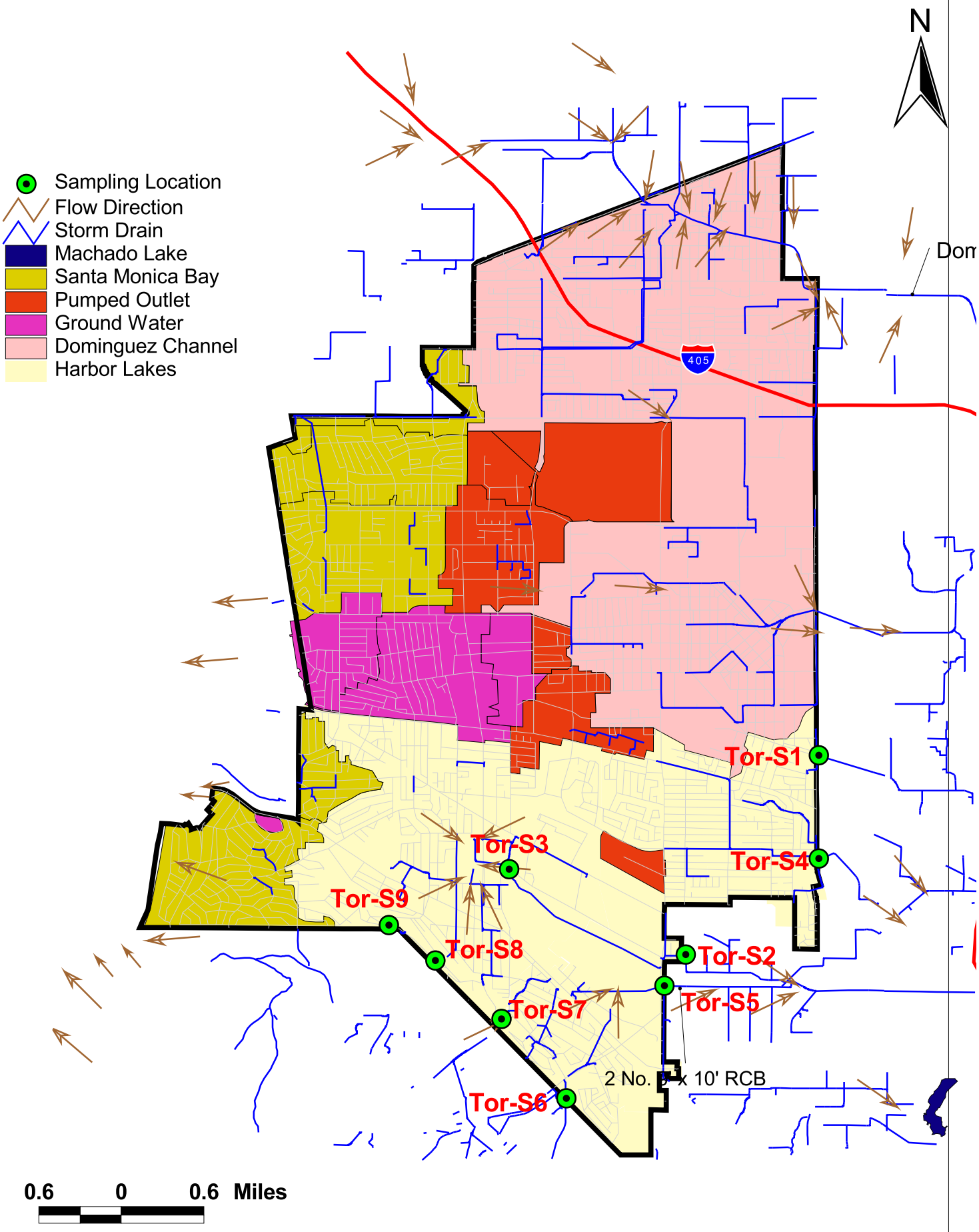


Figure 5 General Location Map of Sampling Locations

Tor-S2

Tor-S2 is approximately 50 ft west of the intersection of 246th Place and Pennsylvania Avenue. The total upstream drainage area is about 2,605 acres. The drainage area is a mixed land use, about 32 percent residential, 10 percent commercial and 11 percent industrial. The Torrance Airport accounts for 12 percent of the drainage area. Tor-S2 is easily accessible and safe for conducting sampling during both dry and wet weather conditions. Stormwater is conveyed to this site through an 8' x 7' reinforced concrete box. This site is one the four sites that will provide information to quantify the amount of pollutants leaving the City limits.

Sampling Site: TOR-S2

Tor-S3

This site, which is approximately 100 ft east of Madison St. and Skypark Drive intersection, will assist the City in characterizing discharges from Walteria Lake. The total upstream drainage area is approximately 2,285 acres. This site is upstream of Tor-S2. Land use is mixed with 37 percent residential, 10 percent commercial and 9 percent industrial. A 54-inch pipe conveys stormwater to this site. The site is easily accessible and safe for all weather sampling.

Sampling Site: TOR-S3

Tor-S4

Tor-S4 is approximately 210 ft north and 85 ft east of 236th Street and Western Avenue intersection. The total drainage area upstream of this sampling location is approximately 1,014 acres. Residential land use represents nearly 60 percent of the drainage area. Commercial and industrial land uses represent only 9 percent of the drainage area. The storm drain serving this site is a 9'-2" x 11' RCB. The site is safe for all weather sampling and it is easily accessible.

Sampling Site: TOR-S4

Tor-S5

This site is about 25 ft west of the intersection of Bani Avenue and 250th Street (two pipes intersect from south and west). This sampling site serves an upstream drainage area of approximately 661 acres. This site is mainly residential and airport land use; residential and airport land uses represent 43 and 24 percent of the drainage area, respectively. The storm drain discharging stormwater to this site is an 8'-9" x 9'-7' RCB. This site is easily accessible and safe for sampling activities.

Sampling Site: TOR-S5

Tor-S6

Tor-S6 is located at approximately 600 ft east of Estates Lane and Crenshaw Boulevard. This site will monitor flow entering the City's storm drain from Rolling Hills Estate. The sampling site is safe and easily accessible.


Sampling Site: TOR-S6

Tor-S7

This site is about 160 ft south and 280 ft east of Rolling Hills Road and Hawthorne Blvd. intersection. It will monitor dry weather flow originating from Rolling Hills Estates. The site is easily accessible and safe for sampling at all weather conditions.


Sampling Site: TOR-S7

Tor-S8

This site is located at about 500 ft northwest of Paseo De Las Tortugas and Mesa St. intersection. It will monitor dry weather flow originating from Rolling Hills Estates. The site is easily accessible and safe for sampling at all weather conditions.

Sampling Site: TOR-S8

Tor-S9

Tor-S9 is about 830 ft east and 120 ft south of Paseo de Las Tortugas and Vista Montana intersection. This site will monitor dry weather flow originating from Palos Verdes Estates. The site is accessible and safe for sampling activities.

Sampling Site: TOR-S9

3.2 Sample Collection Frequency

The City's sampling program consists of three major elements:

1. Monthly sampling during dry weather conditions for all sampling locations. Grab samples will be collected from each sampling location. Dry weather conditions must be preceded by at least 24 hours of no greater than trace precipitation or have an intensity of less than 0.1 inches of rain in a 24-hour period.

2. Samples will be collected from Tor-S3 during four discrete storm events and anytime time the LA County pumps stormwater from the Walteria Lake into the 54-inch storm drain. Pumping schedule will be obtained from LA County.

3. Continuous recording of stage or flow depth during dry weather periods for flow estimation will be collected from the proposed sample locations during dry weather flow conditions.

Regarding Tor-S3, one grab sample for each of the four storm events will be collected under the following conditions:

1. Sampling will occur during a storm event with at least 0.1 inch of precipitation (defined as a "measurable" event). Weather forecasts will be evaluated before deciding whether or not to sample a particular rain event. The monitoring manager will periodically establish a modem connection with each sampling unit to monitor rainfall, flow rates, and sampling activity. The monitoring manager will download stored data from the National Weather Service as needed.
2. Sampling will not occur at a frequency greater than once every 72 hours.
3. Sampling will not occur unless there has been at least 72 hours of continuous dry weather immediately preceding the "measurable" event.
4. Grab samples will be collected from this location during approximately the first 30 minutes to 1 hour of stormwater discharge (where possible).

The intention of the sample collection frequency and stormwater event requirements described above is to collect samples that are representative of runoff conditions from Tor-S3. No samples will be collected from the remaining eight sampling locations during storm events. The City's Pollutant Loading and Analysis Tool (PLAT) will be used to estimate nutrient loading for these sampling location during storm events.

3.3 Selection of Analytical Parameters

The City proposes to use a mass based WLA compliance option to evaluate TMDL compliance. Samples submitted for nutrients will be tested for ammonia-N (NH_3^+), ammonium, nitrite (NO_2), nitrate (NO_3), total Kjeldahl nitrogen (TKN), total phosphorus (TP), and phosphate (PO_4). Water samples submitted for conventional water parameters (general chemistry) will be tested for alkalinity, pH, chloride, total suspended solids (TSS), total solids, dissolved solids, turbidity, dissolved organic carbon (DOC), total organic carbon (TOC), and standard metals. The constituents to be sampled are listed in Table 5.

Table 5 Monitoring Constituents		
Analyte	**Method of Analysis**	**Detection Limits**
NH_3^+	SM 4500-NH_3-H	0.02 mg/l
NO_3	SM 4500-NO_3-F	0.02 mg/l
NO_2	SM 4500-NO_3-F	0.01 mg/l
TKN	EPA 351.3	0.1 mg/l
TP	EPA 365.4	0.06 mg/l
PO_4	SM 4500-P-F	0.01 mg/l
TSS	EPA 160.2	0.5 mg/l
Turbidity	n/a	0.01 NTU

3.4 Continuous Flow Monitoring

Accurate assessment of flow is crucial to pollutant loads assessments and analysis. Continuous flow data will be collected as part of this sampling effort for all nine sampling locations. The primary benefit of these continuous monitoring sites is the ability to gauge the increase in flow due to a storm event and apply concentration data to calculate pollutant loading.

Global Water's FL16 Water Flow Logger will be used for flow data collection. The FL16 Water Flow Loggers will record over 81,000 depth, temperature, water flow and velocity readings in the drainage pipes. The specially engineered, non-fouling water level sensor works in depths as little as ½ inch and allows for deployment in manholes and other difficult to access areas without the need to enter the confined space.

FL16 Water Flow Recorder's user-friendly Windows-based software is tailored specifically for calculating water flows in partially filled sewer and drainage pipes using the Manning's Equation, with pull-down menus for selecting and entering the necessary information. The Water Flow Recorder software has a unique calibration feature which allows users to view calculated water velocity, compare this to actual measured data, and adjust the water flow parameters to calibrate for the water flow conditions of a specific application.

The flow measuring systems will be calibrated before data collection begins and that these will be re-calibrated monthly.

3.5 The Sampling Team

Grab samples from the nine sampling locations will be collected by a contract lab retained by the City. Pre-labeled sample bottles will be provided by the certified laboratory that will be conducting the analyses. The Sampling Team will be responsible for ensuring that all required equipment is ready for field operation. They are also responsible for performing the entire field sampling activities and most of the sampling preparation. Any member of the Sampling Team may recommend canceling sampling if the predicted conditions do not materialize or if health or safety of the team could be imperiled due to site conditions or extreme weather.

4.0 SAMPLE COLLECTION PROCEDURES

This section describes the sampling procedures, record keeping, sample handling, storage, and field quality control procedures that will be used during stormwater sampling.

4.1 Preparation for conducting the sampling

Several things will be done to prepare to conduct stormwater sampling. First, the laboratory to analyze the samples will be contacted. The following information will be sought from the lab:

- Type and size of bottles needed
- Procedures to filling the bottles
- Sample volume requirements
- Labels or additional forms required
- Explanation of the chain of custody form
- Sample preservation requirements and/or holding time restrictions
- Means of sample delivery to the lab
- Overnight delivery requirements
- Costs

Once a lab has been selected the sampling equipment (sampling bottles from a lab, sampling instruments, and personal safety equipment) will be made ready, as well as the field sheet to document the required information. Table 6 lists constituents and sample container requirements.

Field personnel will complete a field condition data sheet. The following items will be listed on the field sampling sheet and included in the stormwater discharge monitoring report:

- Person who conducted the sampling
- Date and time of discharge
- Length of storm event
- Time between sampled storm event and previous storm event (at least 72 hrs)
- Total rainfall during storm event
- Photo documentation

A field data sheet is attached as Appendix B.

4.1.1 Sampling Equipment

Monitoring equipment will be gathered ahead of time because opportunities to sample during rainfall events often come with little advanced notice. The following equipments will be required for the sampling efforts:

- Field forms
- Waterproof pens
- Permanent markers

- Powder-free nitrile gloves
- Clear glass jar for visual examinations
- Sample containers
- Sample preservatives
- Sample container labels
- COC forms
- COC seals
- Ice chests
- Ice
- Foul-weather gear
- Manhole sampler

Table 6 Monitoring Constituents and Sample Container Requirements

Analyte	Container	Volume	Preservation	Holding Time
NH_3^+	Plastic	50 ml	≤ 6°C H2SO4 PH < 2	28 days
NO_3	Plastic	50 ml	≤ 6°C, H2SO4 PH <2	48 hours
NO_2	Plastic	50 ml	≤ 6°C, H2SO4 PH <2	48 hours
TKN	Plastic	50 ml	≤ 6°C, H2SO4 PH <2	28 days
TP	Plastic	50 ml	≤ 6°C, H2SO4 PH <2	28 days
PO_4	Plastic	50 ml	≤ 6°C	48 hours
TSS	Plastic	200 ml	≤ 6°C	7 days

4.2 Sampling Method

Water samples will be collected from storm sewer manhole and outfall sites. All samples will be collected as individual grabs. Samples will be collected directly into sample containers or with a laboratory-supplied container attached to a pole with duct tape or other means. Sampling containers will be held with container openings facing upstream to prevent contamination during sampling. Field personnel will wear powder-free nitrile disposable gloves. Each sample will be given a field identification, tagged, and kept cool at 4 degrees C. Chain-of-custody (COC) procedures will be observed and samples delivered to the laboratory within the allowable holding times for each parameter.

It is assumed that sampling locations will have well-mixed conditions so that single grabs are representative of water quality. Field personnel will record the degree of turbulence or quiescence as well as the dimensions of the conveyance sampled and/or a description of water flowing in the conveyance. Field personnel will also record the date and time of sample collection and the flow rate.

Sampling containers for direct grabs (either by hand or with pole attached to laboratory supplied container) will be pre-cleaned by the laboratory. It will be made certain that if a sample is transferred (either for collection purposes or to form grab-composite samples), that only laboratory-supplied containers are permitted to come in contact with the sample.

4.3 Personal Safety

A Health and Safety Plan approved by the contract lab will be reviewed by the all field personnel before the sampling operations covered in this monitoring plan begin. Personal safety will be of primary concern while conducting all stormwater sampling related activities. All persons involved in the sampling operation will be made aware of the hazards associated with monitoring and should freely voice any concerns if potential hazards become apparent. The Occupational Safety and Health Administration (OSHA) provides regulations and guidance on occupational safety, many of which are directly applicable to the types of activities involved in stormwater monitoring. It is the direct responsibility of each person involved in the monitoring program to read the Health and Safety Plan and adhere to its requirements. The following list provides a few basic health and safety procedures that will help to create a safer sampling environment.

- Do not sample alone, a minimum of two-person field crews will be used for stormwater sampling.
- Do not enter a confined space without proper training, equipment, and surface support.
- Never remove or replace manhole covers with your bare hands or feet.
- Never leave an open manhole unattended.
- Do not start staging or sampling until traffic control has been established.

4.4 Clean Sampling Techniques

Clean sample collection techniques will be followed to minimize the potential for contamination of stormwater runoff samples. Care will be taken during all sampling operations to avoid contamination of the water samples by human, atmospheric, or other potential sources of contamination. The monitoring team should prevent contamination of any of the following items: composite bottles, lids, sample, tubing, and strainers.

4.5 Sample Packing and Shipping

Monitoring personnel will deliver the samples to the laboratory. Sample bottles will be placed in coolers or some other package that is rigid enough to provide protection of the samples and is insulated to keep samples cold. During packing, the sample from one monitoring location will not be separated into separate shipping containers unless bottles of one size need to be shipped together because of container size. If samples from a location are separated a copy of the field-sampling sheet pertaining to the bottles will be enclosed in each shipping container. Prior to shipping, all sample bottles will be recorded on the packing lists, which will include the shipping date and the method of transporting the samples. Samples will be delivered to the analytical laboratory within 4 hours of sampling to ensure the maximum holding time for bacteria of 6 hours is not exceeded.

4.6 Chain of Custody

After samples have been obtained and the collection procedures properly documented, a written record of the COC of each sample will be made. This record ensures that samples will not be tampered with or inadvertently compromised in any way, and it also tracks the requested analysis for the analytical laboratory. COC refers to the documented account of changes in possession that occur for samples.

The COC record tracks the sampling path from origin through laboratory analysis. Information necessary in the COC includes:

- Name of the persons collecting the sample(s).
- Date and time of sample collection.
- Location of sample collection.
- Names and signatures of all persons handling the samples in the field and in the laboratory.
- Laboratory analysis requested and control information (e.g., duplicate or spiked samples etc.) and any special instructions (e.g., time sensitive analyses).

To ensure that all necessary information is documented a COC form will accompany each sample or set of samples. COC forms will be printed on multipart carbonless paper so that all personnel handling the samples may obtain a copy. A COC record should accompany all sample shipments and the sample originator will retain a copy of the forms. When transferring custody of samples the transferee will sign and record the date and time of each transfer. Each person who takes custody will complete the appropriate portion of the chain of custody documentation. A sample COC form to be used for this field sampling is attached as Appendix C.

5.0 QUALITY ASSURANCE AND QUALITY CONTROL

5.1 Data Quality Objective

The quality assurance/quality control (QA/QC) program will be implemented to satisfy the data quality objectives of the monitoring program. The primary data quality objectives are to obtain defensible data of acceptable sensitivity and quality to:

- Evaluate the stormwater management program.
- Evaluate stormwater quality.
- Evaluate of BMP as corrective measure.

The analytical laboratory selected for this study will evaluate the accuracy of its sample extraction and/or analytical procedures using spiked samples, which may include matrix spikes (MS), laboratory control samples (LCS) and surrogate spikes. Acceptable spike recoveries must fall within statistically derived laboratory “control limits.” Precision is the agreement among a set a replicate measurements of the same parameter. The analytical laboratory will evaluate precision by performing matrix spike duplicate (MSD), laboratory control sample duplicate (LCSD) and duplicate stormwater sample analyses (typically

performed for inorganic parameters only). The data quality objectives also include obtaining data that are comparable and representative of the water quality conditions at each monitoring location. Comparable data will be collected if comparable sampling, analysis, QA/QC and reporting procedures are implemented throughout the monitoring program. Representative samples will be collected by performing sampling activities compliant with the procedures described in this monitoring plan. Duplicate samples will be collected and the results will be used to evaluate representativeness. Comparability expresses the confidence with which one data set can be compared to another. Data are comparable if collection techniques, measurement procedures, methods, and reporting are equivalent for the samples within a sample set. Data quality assurance objectives are summarized in Table 7.

Table 7 Quality Assurance Objective

Analyte	Units	Precision	Accuracy	Reporting Limit	Completeness
NH_3^+	mg/l	±20%	±30%	0.10 mg/l	90%
NO_3	mg/l	±20%	±30%	0.1 mg/l	90%
NO_2	mg/l	±20%	±30%	0.1 mg/l	90%
TKN	mg/l	±20%	±30%	0.1 mg/l	90%
TP	mg/l	±20%	±30%	0.1 mg/l	90%
PO_4	mg/l	±20%	±30%	0.025 mg/l	90%
TSS	mg/l	±20%	±30%	1 mg/l	90%

5.1.1 Field Quality Control Samples

Field quality control samples will be collected at a 10% frequency in order to provide quality performance information for the sampling program. One in ten samples submitted for analysis will be one of three field QC sample types: field blank; field duplicate; and/or performance evaluation blank. Table 8 lists the quality performance goals that each of the three types of field QC sample types is intended to address.

Table 8 Field Quality Control Sample Types

Quality Performance Goal	Field Blank	Field Duplicate	Performance Evaluation Blank
Minimize false positive results	**X**		**X**
Sample bottles free of contamination	**X**		
No contamination introduced by sampling process	**X**		
Measurement error attributable to sample inhomogeneity		**X**	

5.2 Field Quality Assurance/Quality Control

This section summarizes the QA/QC procedures that will be implemented by field personnel to evaluate sample contamination, sampling precision, and matrix interference.

5.2.1 Equipment Blanks

After the intermediate sample container or scoop is cleaned, an equipment blank will be collected by pouring reagent-grade water into the apparatus. The water will be transferred into sample bottles and analyzed for the full analytical suite.

5.2.2 Field Duplicate Samples

Field duplicate samples will be collected to evaluate the precision and representativeness of the sample collection procedures as well as sample homogeneity. The duplicate sample will be collected using the specified manual grab sampling techniques. Twice the volume required for the analytical suite will be collected with each duplicate sample. For grab samples, intermediate sample containers will be used, and the volume collected will be apportioned equally between the intermediate containers. The water in each intermediate container will be poured into a discrete set of sample bottles. One set of bottles will be labeled with fictitious sample identification and submitted “blind” to the laboratory.

5.2.3 Matrix Spike Samples

MS and MSD analyses will be performed by the laboratory using project samples. Field crews will submit twice the required sample volume for the sample selected as the matrix spike sample. Field personnel will identify the MS/MSD sample on the COC form.

5.3 Laboratory Quality Control

This sub-section summarizes the QC procedures the laboratory will perform and report with the analytical data packages. These procedures are not inclusive of the QA/QC that is required for compliance with the analytical method.

5.3.1 Method Blanks

A method blank is prepared using reagent-grade water, and is extracted and analyzed with each sample batch (typically 20 samples extracted and/or analyzed on a given day). Method blank results are used to identify potential sources of sample contamination resulting from laboratory procedures. Target analytes should not be detected in the method blank above the practical quantitative limit.

5.3.2 Matrix Spike and Laboratory Control Samples

MS, MSDs, LCS, and LCSDs will be performed by the laboratory to evaluate the accuracy of the sample extraction and analysis procedures. MS/MSDs will also be performed to evaluate matrix interference. Matrix interference is the effect of the sample matrix on the analysis, which may partially or completely mask the response of the analytical instrumentation to the target analyte(s). Matrix interference may affect the accuracy of the extraction and/or analysis procedures to varying degrees, and may bias the sample results high or low. The

MS/MSD is prepared by adding known quantities of target analytes to a sample. The sample is then extracted and/or analyzed as a typical environmental sample, and the results are reported as percent recovery.

6.0 DATA MANAGEMENT AND REPORTING

The sampling results will be reported by the laboratory as hard copy and as electronic files. Hard copy data will be entered into an electronic format, and checked at least once by a different person. Electronic submittal of results will be discussed with the analytical laboratory in advance of delivery and its format arranged. A separate record will be generated for each sample analysis.

In addition, the key information such as station ID, sample date and time, name of sampler, name of constituent, all results, units, detection limits, methods used, name of the laboratory, and any field notes will be entered into the database. Additional information, such as compositing of multiple samples, or the use of grab will also be included.

When reporting the laboratory results for each stormwater sample the following information will be provided:

- Sample site.
- Sample date and time.
- Sample number (or identification).
- Sampling technician(s).
- Detection limit and reliability limit of analytical procedure(s).
- Sample results with clearly specified units.

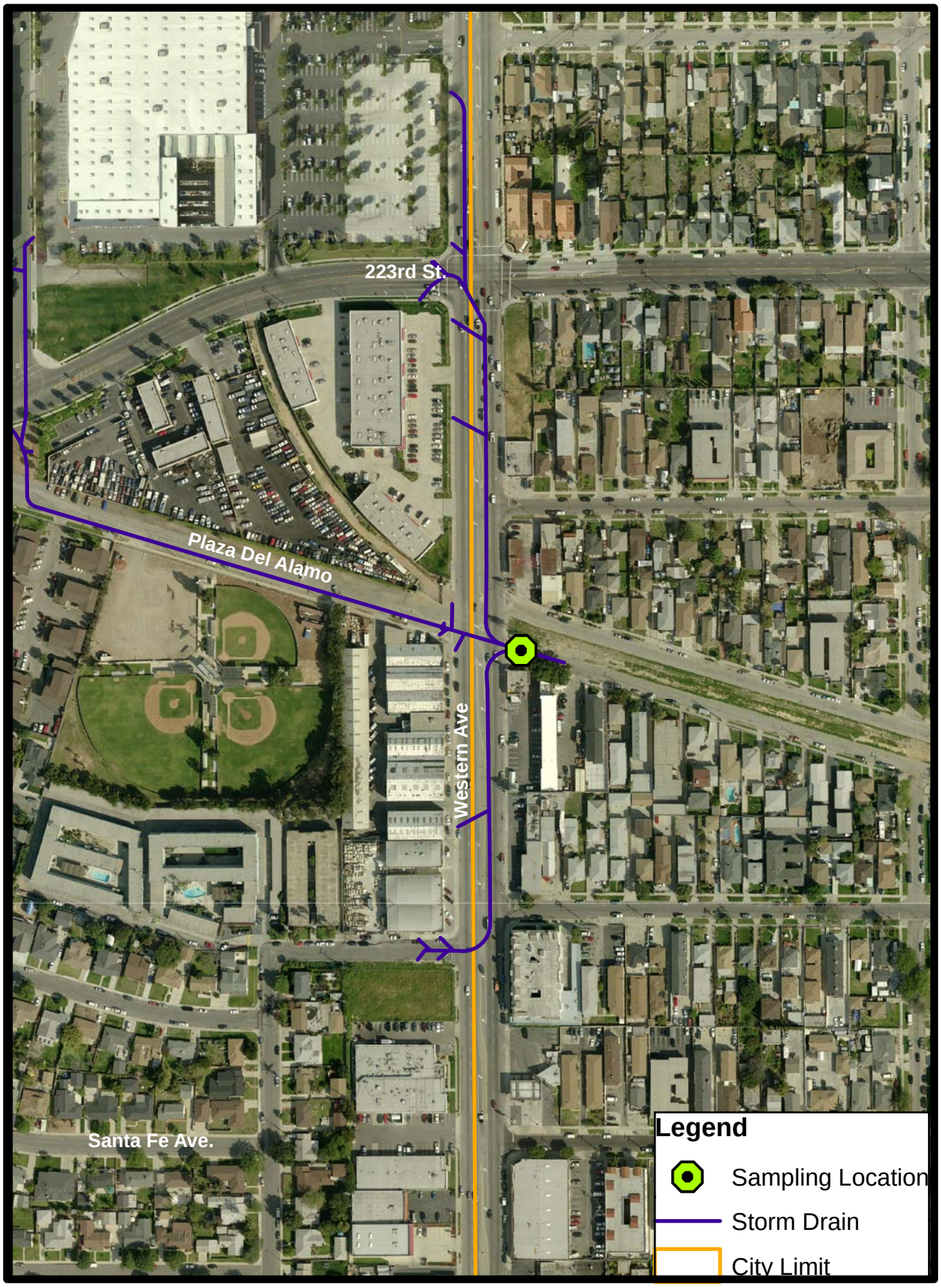
The results of all samples collected under this plan will be submitted to Regional Board in a monitoring report. Monitoring report will include:

- Introduction and background information
- Documentation and summary of each sampling event, including photos
- Electronic copies of field conditions data sheets
- Summary discussion of results
- Tabular results of all samples, including quality assurance quality control samples, in electronic format, (Excel)
- Evaluation data quality based on QAPP requirements.

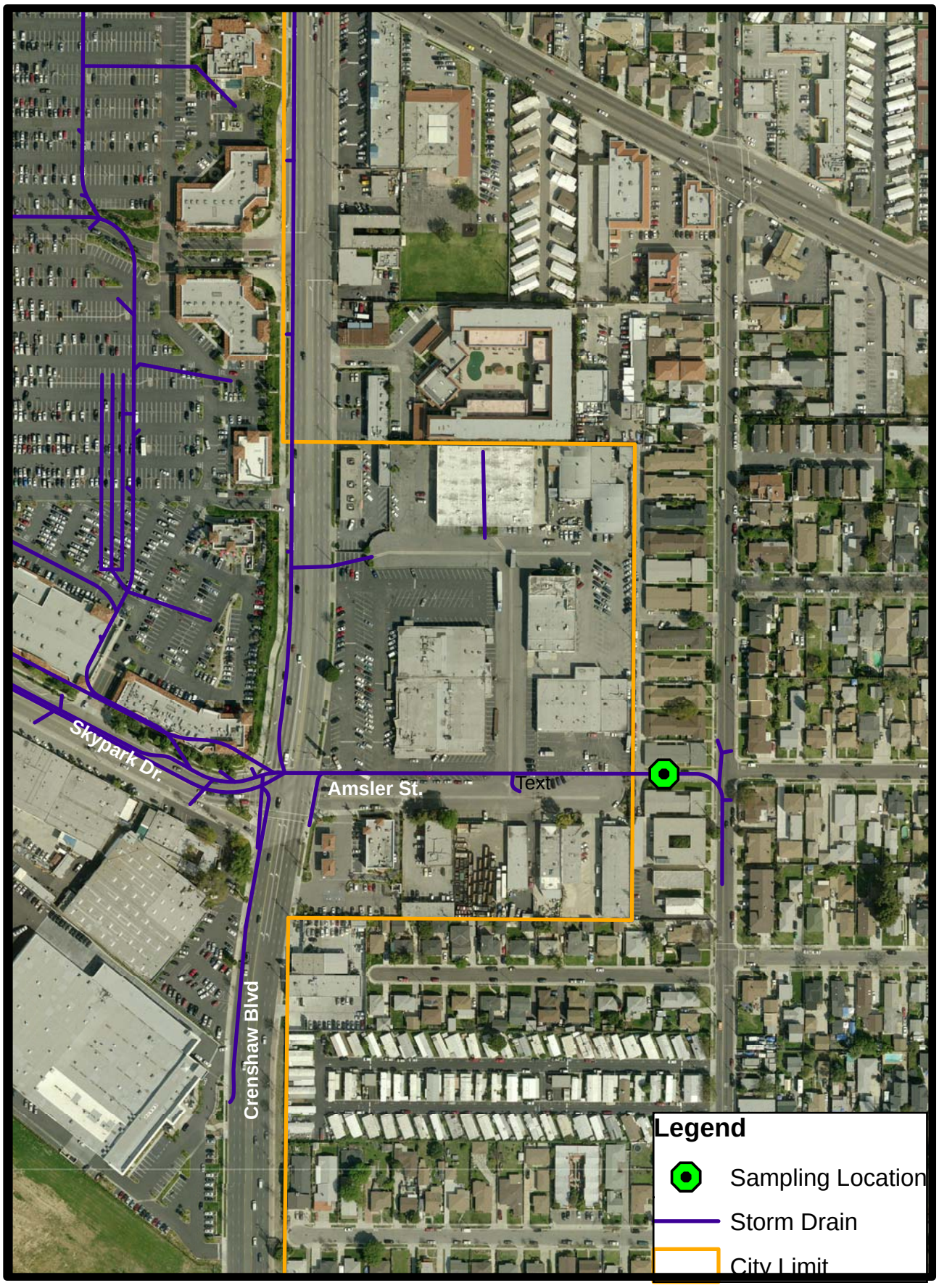
APPENDIX A

Detailed Maps of Sampling Locations

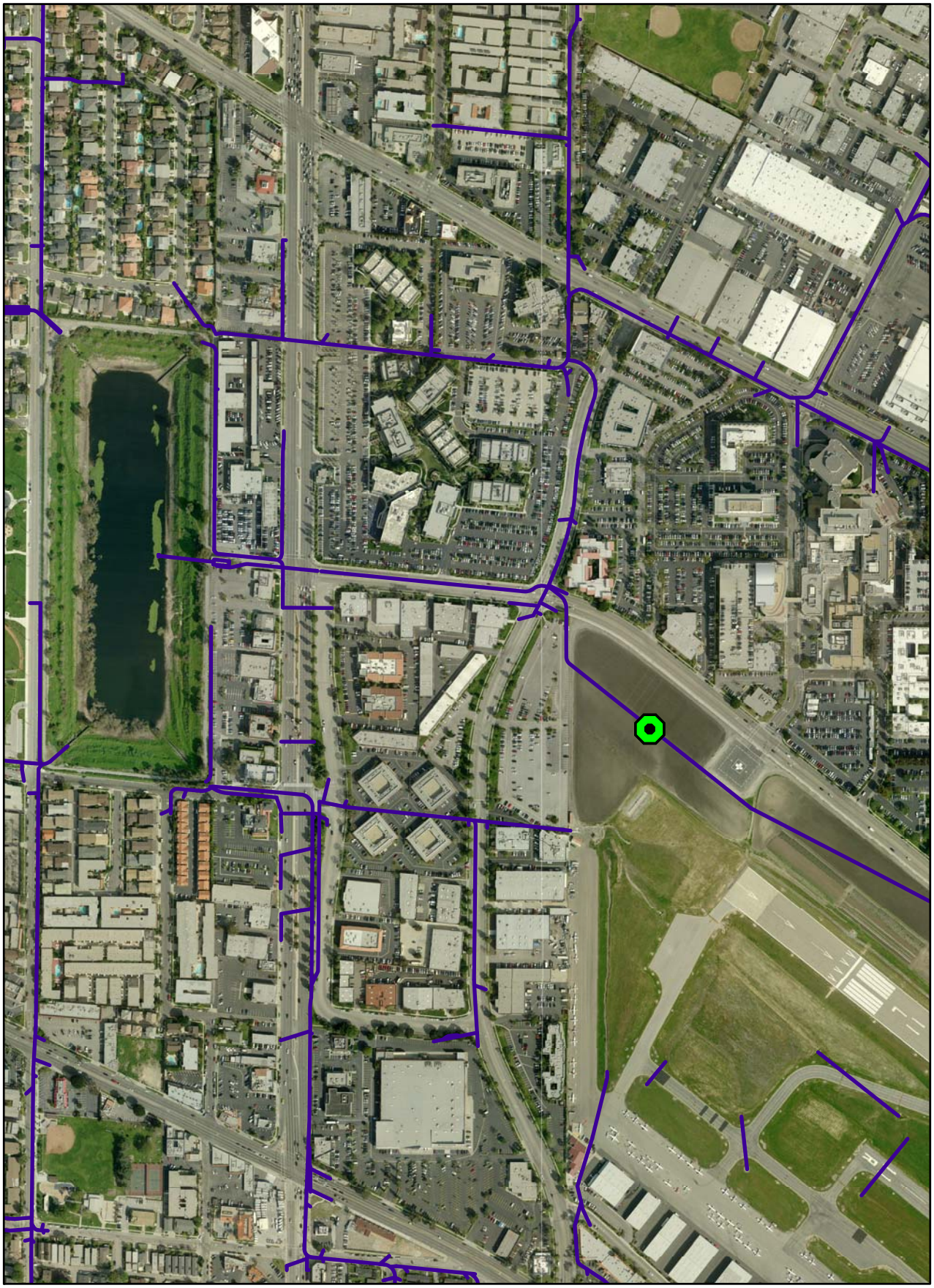
Stormwater Sampling Location - Tor-S1



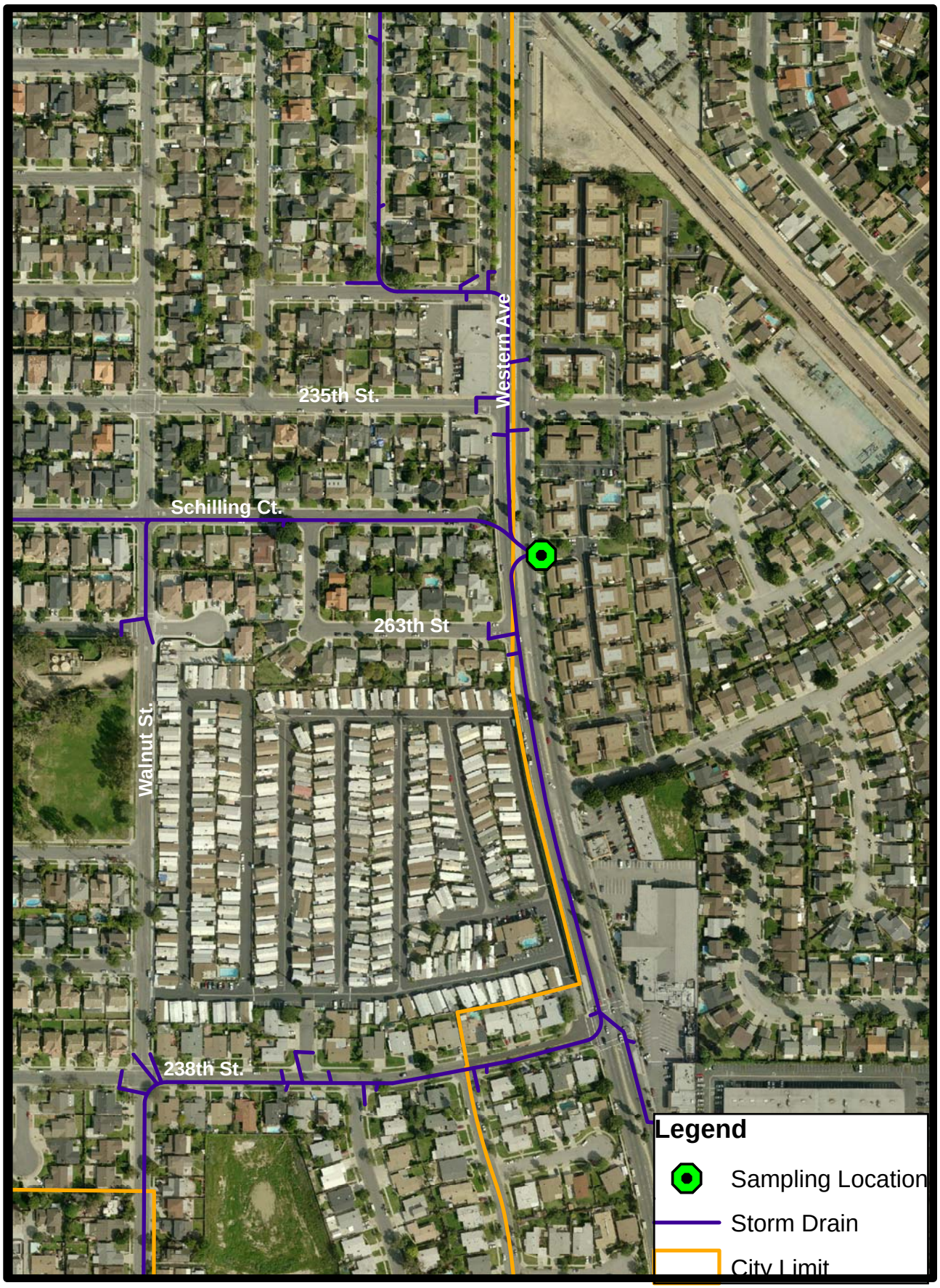
Stormwater Sampling Location - Tor-S2



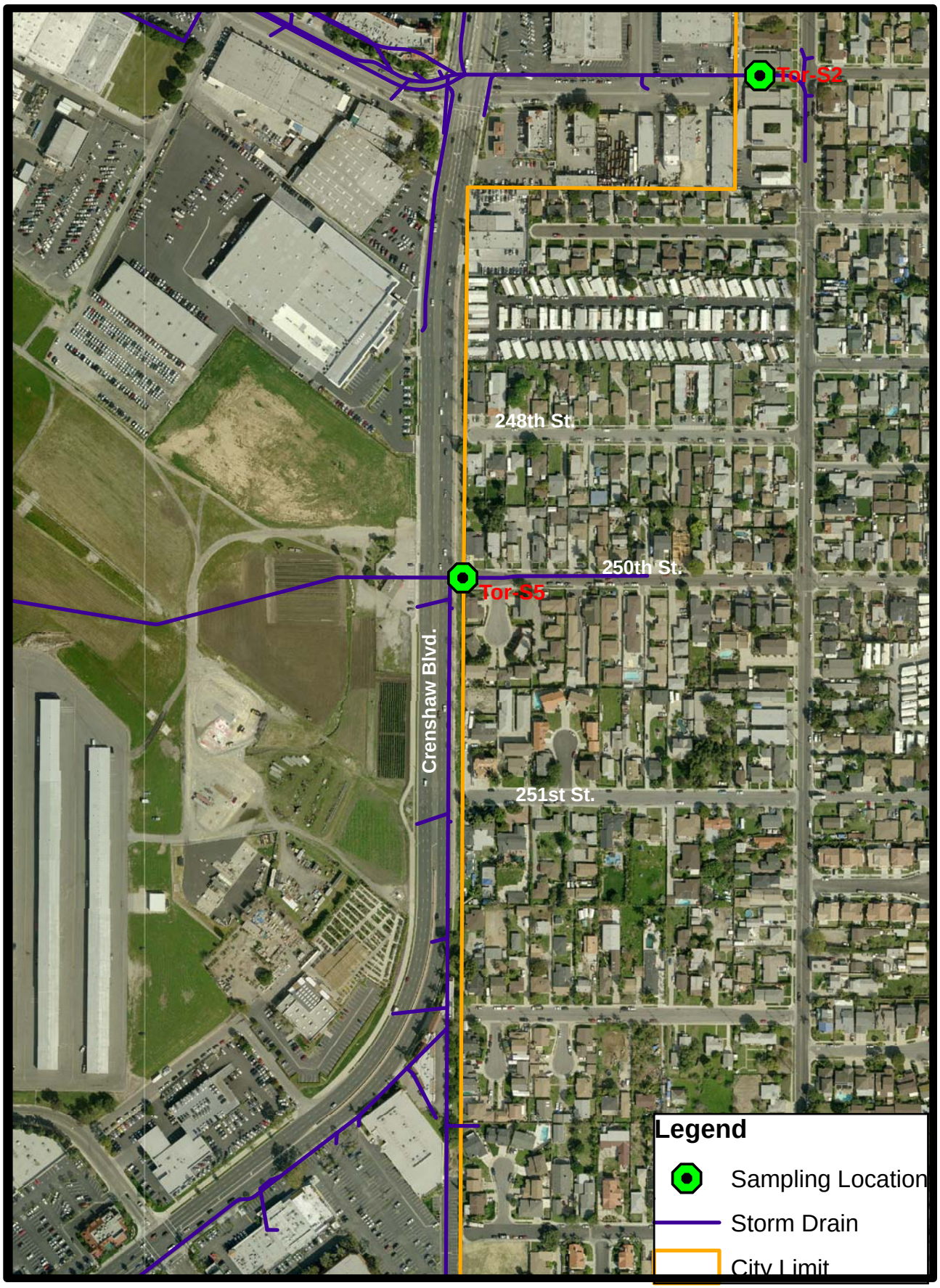
Stormwater Sampling Location: Tor-S3



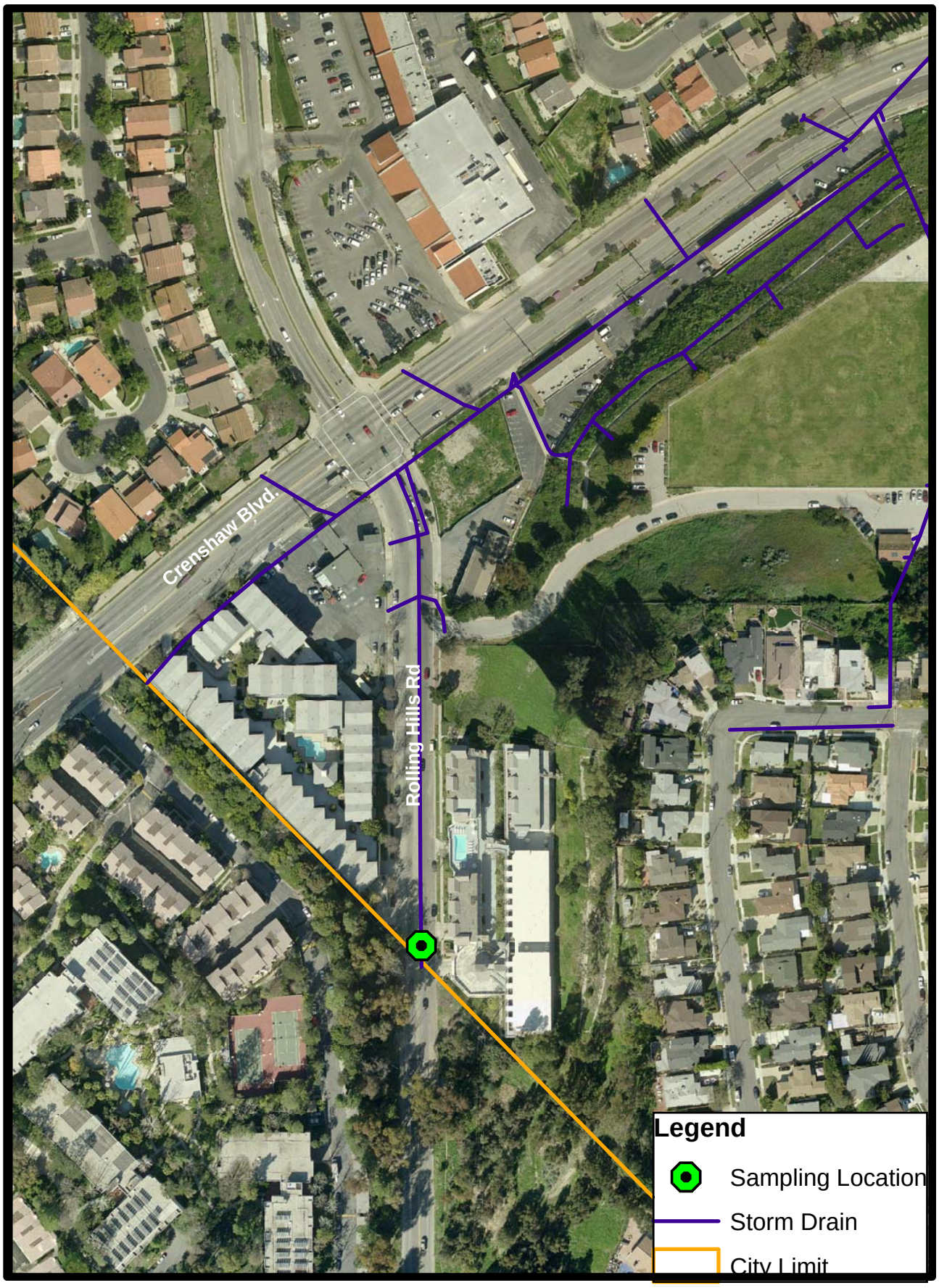
Stormwater Sampling Location - Tor-S4



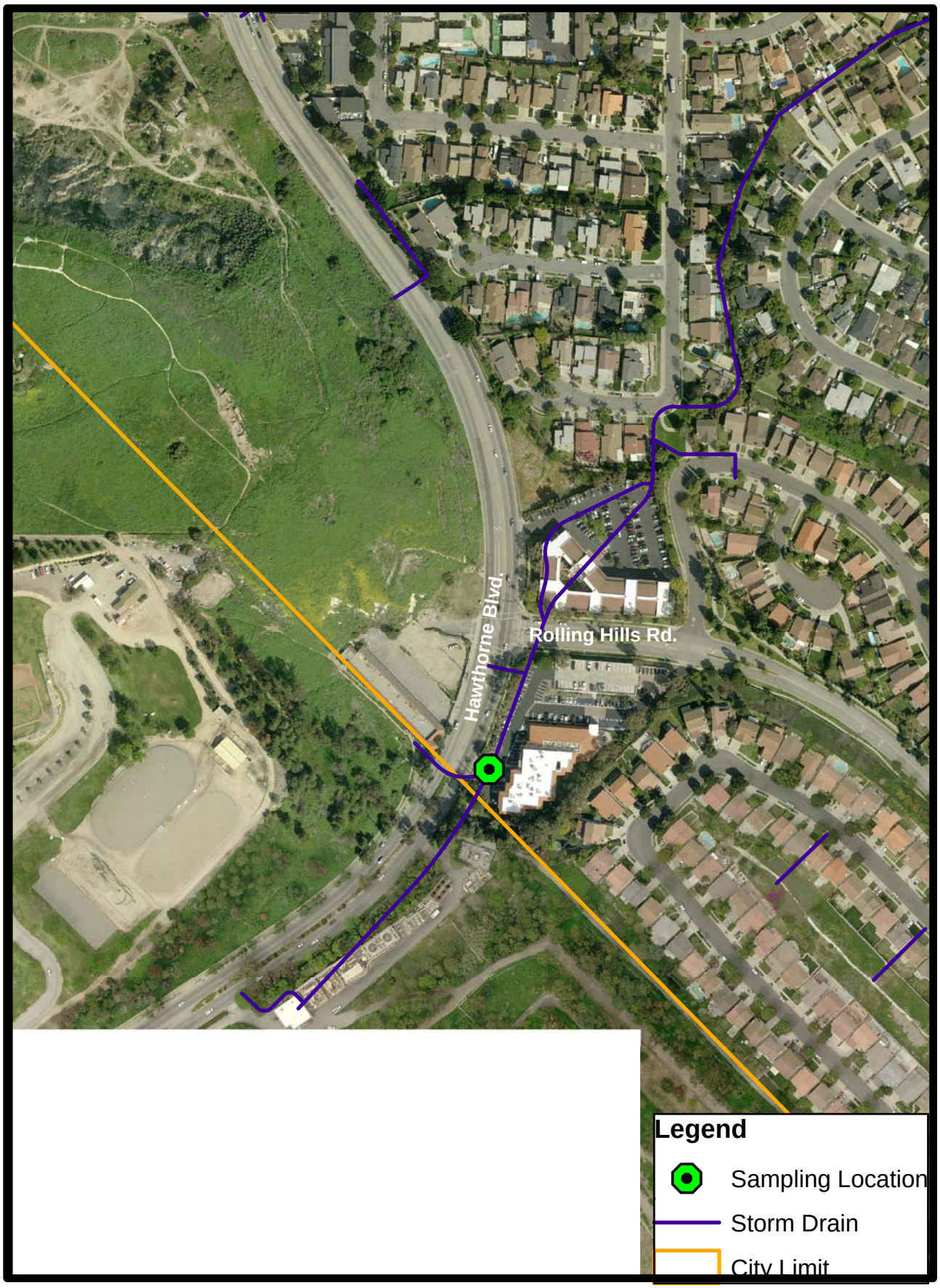
Stormwater Sampling Location - Tor-S5



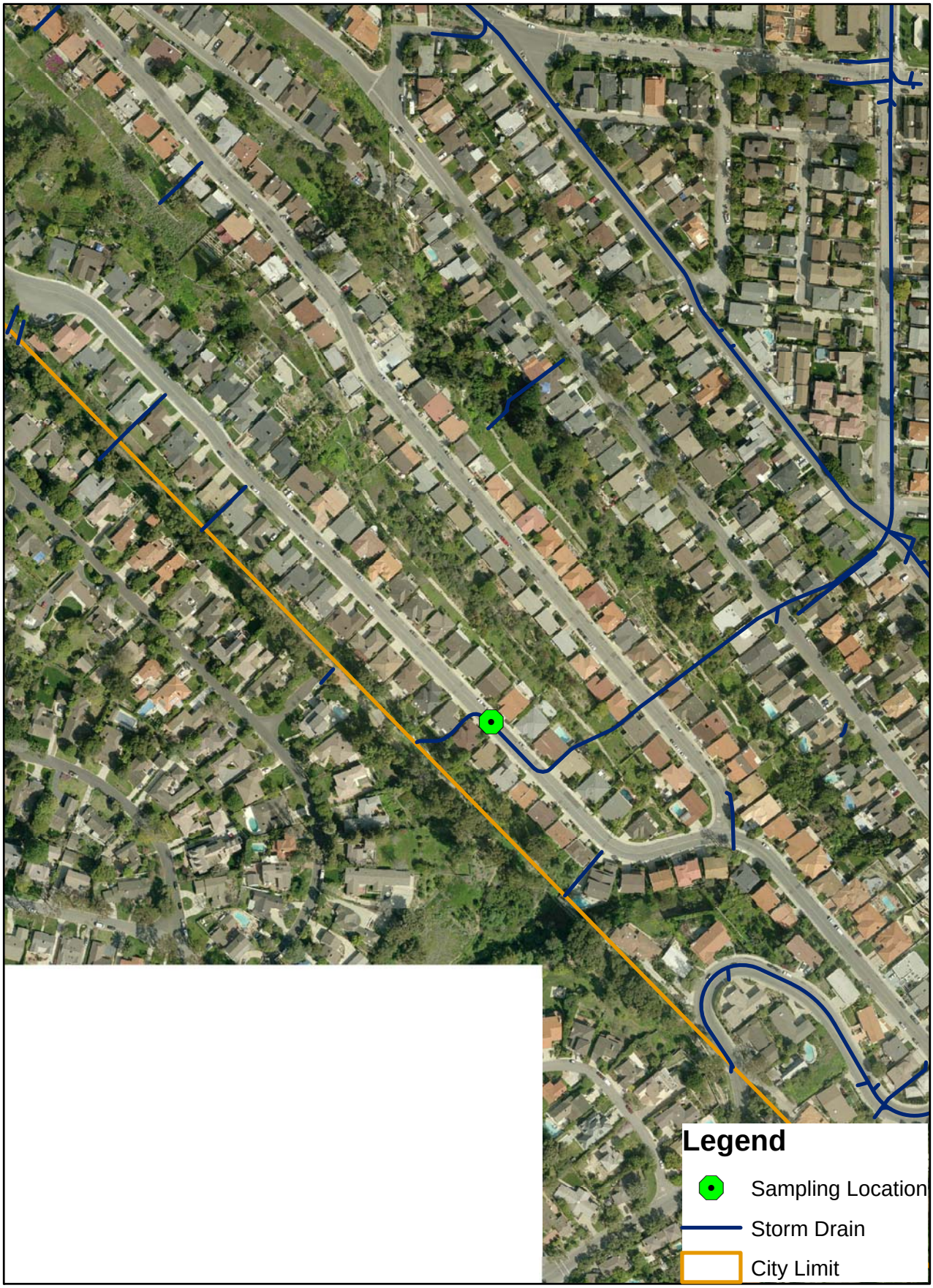
Stormwater Sampling Location - Tor-S6



Stormwater Sampling Location - Tor-S7



Stormwater Sampling Location - Tor-S8



Stormwater Sampling Location - Tor-S9

APPENDIX B

Field Data Sheet

Sampling Field Data

City of Torrance, California

Page_____ of_____

Area Letter & Name or Run #: _____

Run: Scheduled / Makeup / Reopen / Extra

Collected by: _____ **Initiated by:** _____

Date Collected: _____ **Date/time Initiated:** _____

Missed Station	Area Letter	Station #	Military Time	Boat /Land/ Clams/Mussels	Temp °C	Random / Adverse/ Extra	Condition or Adversity	Open or Closed	Wind	Salinity ‰	A-1 MPN/100 ml MF CFU/100ml EC MPN/100 ml	Comments

Remarks:

CHAIN OF CUSTODY:

Relinquished by:	Date, Time & Temp°C	# Samples	Relinquished to:	Received by:	Date, Time & Temp°C	# Samples

Circle Water Quality Lab: Boothbay or Lamoine | **WQ Lab Staff Acceptance:**

Entered by: _____ **Date:** _____

APPENDIX C

Chain of Custody

GENERAL CHAIN-OF-CUSTODY FORM

EVIDENCE/PROPERTY CUSTODY	Tracking Number Investigation ID Number	
NAME OF RECIPIENT FACILITY	LOCATION	
NAME, TITLE AND CONTACT NUMBER OF PERSON FROM WHOM RECEIVED	ADDRESS	
LOCATION FROM WHERE OBTAINED	REASON OBTAINED	DATE/TIME OBTAINED

ITEM NO	QUANTITY	DESCRIPTION OF ARTICLES (Include model, serial number, condition and unusual marks or scratches)

		CHAIN OF CUSTODY		
ITEM NO.	DATE	RELEASES BY	RECEIVED BY	PURPOSE OF CHANGE OF CUSTODY
		SIGNATURE	SIGNATURE	
		PRINTED NAME & CONTACT INFORMATION	PRINTED NAME & CONTACT INFORMATION	
		SIGNATURE	SIGNATURE	
		PRINTED NAME & CONTACT INFORMATION	PRINTED NAME & CONTACT INFORMATION	
		SIGNATURE	SIGNATURE	

Chain-of-Custody (continued)

ITEM NO.	DATE	RELEASES BY	RECEIVED BY	PURPOSE OF CHANGE OF CUSTODY
		SIGNATURE	SIGNATURE	
		PRINTED NAME & CONTACT INFORMATION	PRINTED NAME & CONTACT INFORMATION	
		SIGNATURE	SIGNATURE	
		PRINTED NAME & CONTACT INFORMATION	PRINTED NAME & CONTACT INFORMATION	
		SIGNATURE	SIGNATURE	
		PRINTED NAME & CONTACT INFORMATION	PRINTED NAME & CONTACT INFORMATION	
		SIGNATURE	SIGNATURE	
		PRINTED NAME & CONTACT INFORMATION	PRINTED NAME & CONTACT INFORMATION	
		SIGNATURE	SIGNATURE	

FINAL DISPOSAL ACTION
RELEASE TO OWNER OR OTHER (NAME/ORGANIZATION)
DESTROY
OTHER (Specify)
FINAL DISPOSAL AUTHORITY
ON THIS DOCUMENT PERTAINING TO THE INQUIRY/INVESTIGATION INVOLVING;
ITEM(S) (IS)(ARE) NO LONGER REQUIRED AS EVIDENCE AND MAY BE DOSPOSED AS INDICATED ABOVE. *If articles must be retained do not sign, but explain in separate correspondence.*
(Typed or Printed Name & Organization) (Signature) (Date)
WITNESS TO DESTRUCTION EVIDENCE
THE ARTICLES LISTED AT ITEM NUMBERS (WAS)(WERE) DESTROYED BY THE EVIDENCE CUSTODIAN IN MY PRESENCE, ON THE DATE INDICATED ABOVE
(Typed or Printed Name & Organization) (Signature) (pole)