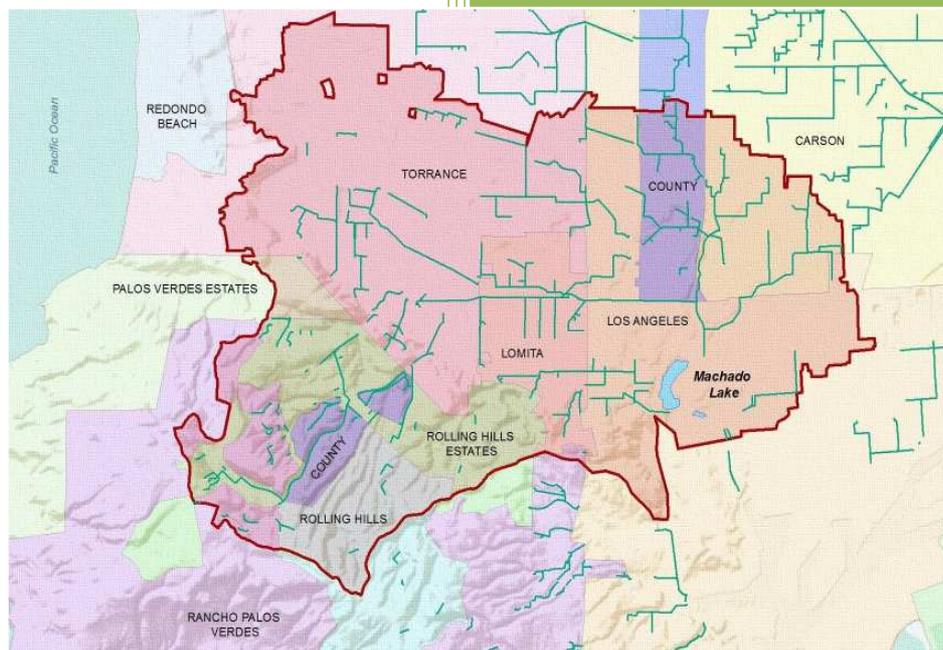


Machado Lake Nutrient & Toxics TMDL Monitoring & Reporting Plan for the Los Angeles County Flood Control District



Submitted to:

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Los Angeles Region**
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APPENDICES

Appendix A. LACFCD Background Information

List of Abbreviations

BPA	Basin Plan Amendment
LACFCD	Los Angeles County Flood Control District
MS4	Municipal Separate Storm Sewer System
MRP	Monitoring and Reporting Program
PCBs	Polychlorinated Biphenyls
QA/QC	Quality Assurance/Quality Control
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
USEPA	United State Environmental Protection Agency
WLA	Waste Load Allocation

Section 1. Introduction

1.1 BACKGROUND

Machado Lake is located in the Dominguez Channel Watershed Management Area and has a total drainage area of approximately 23 square miles. The lake is located in the City of Los Angeles and under the jurisdiction of the City of Los Angeles, while the drainage area is within the jurisdiction of several cities, including Rancho Palos Verdes, Rolling Hills, Rolling Hills Estates, Palos Verdes Estates, Torrance, Lomita, and Carson, and unincorporated Los Angeles County. The map of the drainage area of the lake, the various jurisdictions, and major storm drains within the drainage area is shown in **Figure 1**.

The Total Maximum Daily Load for Nutrients in Machado Lake (Nutrient TMDL) was adopted by the Los Angeles Regional Water Quality Control Board (Regional Board) on May 1, 2008 and approved by the State Water Resources Control Board (State Board) on December 2, 2008. Upon subsequent approval of the TMDL by the United States Environmental Protection Agency (USEPA), the TMDL became effective on March 11, 2009. The Nutrient TMDL was developed to address beneficial use impairments due to eutrophication, algae, ammonia, and odor in Machado Lake.

The Total Maximum Daily Load for Pesticides and PCBs in Machado Lake (Toxics TMDL) was adopted by the Regional Board on September 2, 2010 and approved by the State Board on December 6, 2011. Upon approval by the USEPA, the TMDL became effective on March 20, 2012. The Toxics TMDL addresses impairments due to organochlorine pesticides (chlordane, dieldrin, and DDT) and PCBs in fish tissue.

Both the Nutrients TMDL and the Toxics TMDL named the LACFCD as a responsible party. The LACFCD operates and maintains storm drains within the Machado Lake watershed. These storm drains serves as a conveyance for flood waters within the watershed and the LACFCD has no jurisdiction over the land uses within the watershed that generate the pollutants of concern in the TMDLs. Further description of the LACFCD and its functions is provided in **Appendix A**.

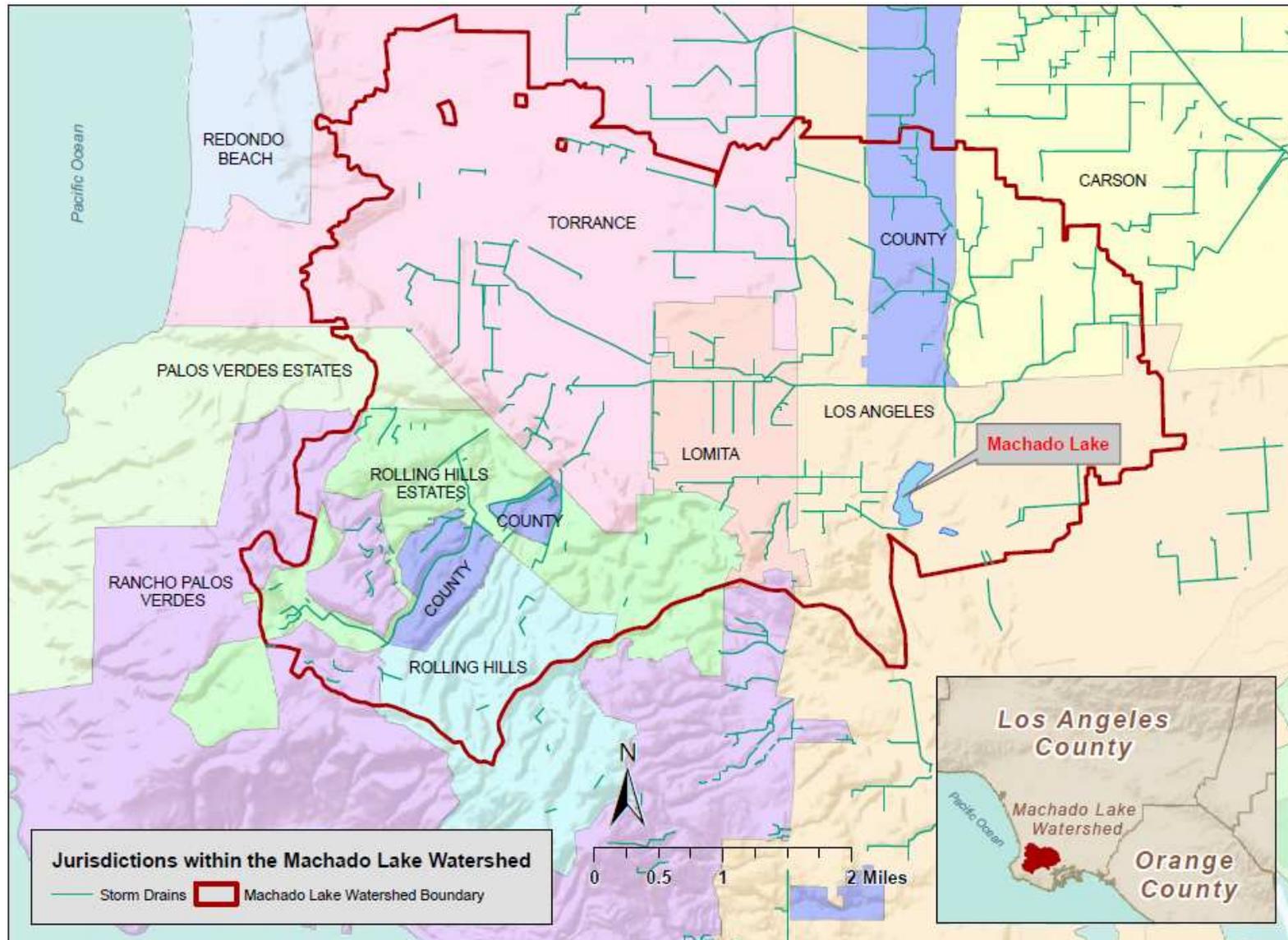


Figure 1: Machado Lake Watershed and Jurisdictions within the Watershed

1.2 PURPOSE AND OBJECTIVES

Both the Nutrient TMDL and the Toxics TMDL require the preparation of a Monitoring and Reporting Program (MRP). As identified in the TMDLs, there are three LACFCD storm drains (Wilmington Drain, Project 77, and Project 510 Line C) which carry flows from other jurisdictions and directly discharge into Machado Lake. Approximately 88 percent of discharge to Machado Lake flows through Wilmington Drain, 11 percent through Project 77, and less than 1 percent through Project 510 Line C. The LACFCD will conduct water quality sampling at the Wilmington Drain outlet as a representative characterization of discharges into Machado Lake.

In addition, the Toxics TMDL requires bed sediment monitoring in Wilmington Drain. The TMDL states:

“The Los Angeles County Flood Control District shall monitor Wilmington Drain to demonstrate that Wilmington Drain is not re-contaminating Machado Lake. Monitoring shall include bed sediment sampling and visual inspection of channel maintenance and operation of best management practices (BMPs). Monitoring shall be required by Regional Board order or a conditional Water Quality Certification under section 401 of the Clean Water Act. This monitoring shall be initiated at the same time as all other required WLA monitoring” (Resolution No. R10-008, Attachment A, Page 9).

Pursuant to Resolution No. R10-008, the MRP for the Toxics TMDL is due to the Regional Board six months after the effective date of the Toxics TMDL. This MRP will address both Nutrient and Toxics TMDL requirements. The core objectives of the MRP include the following:

- Monitor water quality of storm drain discharges as they relate to the TMDLs;
- Monitor the sediment quality and deposition rate within Wilmington Drain; and
- Potentially assist pollutant source investigations efforts done by upstream jurisdictions.

As part of the Machado Lake Ecosystem Rehabilitation and Wilmington Drain Multi-use Projects, the City of Los Angeles (City) is planning to conduct monitoring at all three LACFCD storm drain which discharge to Machado Lake. Future dialogue with the City may lead to the LACFCD coordinating its monitoring efforts with the City.

Section 2. Approach

The LACFCD's approach is to establish a representative monitoring program to characterize the watershed discharges into Machado Lake. The LACFCD proposes to monitor at the outlet of Wilmington Drain which drains 88 percent of the Machado Lake watershed. The water quality data from this location will reflect the loading from the majority of the upstream municipalities within the watershed. All pollutants of concern identified in the Nutrient and Toxics TMDLs shall be monitored and reported to the Regional Board. As previously mentioned, the LACFCD may coordinate its monitoring efforts with the City of Los Angeles to avoid duplication of efforts.

2.1 NUTRIENT TMDL MONITORING APPROACH

The Nutrient TMDL monitoring will consist of quarterly dry weather grab samples at the proposed monitoring location for analysis of constituents including, but not limited to: solids, nitrogen compounds, and phosphorous compounds. In addition, at least two wet weather sampling events per year will be conducted at the proposed monitoring site. Wet weather monitoring will be collected as a flow-weighted composite sample in conjunction with the Toxics TMDL sampling. Further details regarding the monitoring site locations, frequencies, and parameters are described in subsequent sections.

2.2 TOXICS TMDL MONITORING APPROACH

The Toxics TMDL monitoring will consist of two phases of wet weather monitoring designed to collect sufficient volume of storm-borne sediments for the analysis of pollutants associated with the bulk sediments. Analysis will be done for organochlorine pesticides, PCBs, and organic carbon. Phase 1 monitoring will be conducted for a two year period. In Phase 1 monitoring, samples will be collected during three wet weather events each year, including the first large storm event of the season. Phase 2 monitoring will commence upon the completion of Phase 1 monitoring. During Phase 2, samples will be collected during one wet weather event every other year for a duration of five years. In addition, bed sediment monitoring will be conducted in Wilmington Drain once a year until the Toxics TMDL's final compliance date in 2019. Thereafter, monitoring will be adjusted based on results and may be reduced to once every three years. Further details regarding the monitoring site locations, frequencies, and parameters are described in subsequent sections.

Section 3. Monitoring Site

The southern-most portion of the Wilmington Drain is a 150-foot wide soft bottom channel located west of the 110 Harbor Freeway and east of Vermont Avenue between Lomita Boulevard and Pacific Coast Highway. Wilmington Drain directly discharges into the riparian area north of Machado Lake. Approximately 88 percent of the Machado Lake Watershed area flows through Wilmington Drain into Machado Lake. This accounts for approximately 12,097 acres from several subwatershed areas, which include discharges from all responsible jurisdictions listed in the Nutrients and Toxics TMDLs (Caltrans, General Stormwater Permit Enrollees, and MS4 Permittees). Monitoring results at the Wilmington Drain site will be representative of the cumulative contribution from all of these jurisdictions. An aerial view and photo of the Wilmington Drain monitoring site are shown in **Figure 2** and **Figure 3**, respectively.



Figure 2: Aerial View of Wilmington Drain Monitoring Site



Figure 3: Wilmington Drain at Pacific Coast Hwy

Table 1 lists the monitoring site, type, nearest intersection and rationale for site selection.

Table 1: Site Location

Monitoring Site	Type	Nearest Intersection	Rationale for Selection
Wilmington Drain	Open Channel	Pacific Coast Hwy / Vermont Ave	LACFCD-owned storm drain that directly discharges into Machado Lake. Representative of 88% of the total Machado Lake Watershed area. Runoff comes from all responsible jurisdictions listed in the TMDL.

Section 4. Sampling Frequency

4.1 NUTRIENT TMDL SAMPLING

Dry weather sampling at the Wilmington Drain monitoring site will be conducted on a quarterly basis for the duration of the monitoring program. In addition to dry weather sampling, at least two wet weather sampling events will be conducted per year. After each monitoring year, the LACFCD will review the monitoring results to assess whether modifications should be made to the monitoring program.

4.2 TOXICS TMDL SAMPLING

The frequency for the Toxics TMDL Sampling will follow the requirements set forth in the Toxics TMDL. It will consist of two phases of wet weather monitoring designed to collect a sufficient volume of storm-borne sediments for the analysis of pollutants associated with the bulk sediments. Phase 1 monitoring will be conducted for a two year period. In Phase 1 monitoring, samples shall be collected during three wet weather events each year, including the first wet weather event of the season. The first wet weather event of the season is defined as the first storm that produces at least 0.25 inches of rainfall between October 1st and April 30th. Phase 2 monitoring will commence once Phase 1 monitoring has been completed. Samples will be collected during one wet weather event every year during Phase 2 monitoring through five years. At the end of the fourth year of a five year period, LAFCD will review the monitoring results to assess whether the proposed approach should be modified.

A summary of the sampling schedule and frequency for both the Nutrient TMDL and Toxics TMDL is presented in **Table 2**.

Table 2: Summary of Nutrient and Toxics TMDL Sampling.

Monitoring Site	TMDL	Dry Weather Sampling Frequency	Wet Weather Sampling Frequency
Wilmington Drain	Nutrient	Quarterly	2 storm events per year
	Toxics	N/A	<i>Phase 1: 3 storm events per year for first two years; Phase 2: 1 storm event every other year for five years</i>

Section 5. Monitored Parameters

5.1 NUTRIENT TMDL SAMPLING PARAMETERS

A list of the constituents for which samples will be analyzed for the Nutrient TMDL and the associated analytical methods, project method detection limits and project reporting limits is provided in **Table 3**.

Table 3: Nutrient TMDL Constituents, Analytical Methods, and Quantitation Limits

Constituent Class	Constituent	Method	Detection Limit ¹ (mg/L)	Reporting Limit ¹ (mg/L)
Conventional	Total Suspended Solids (TSS)	SM 2540D	0.5	1.0
	Total Dissolved Solids (TDS)	SM 2540C	1.0	10
Nutrient	Total Kjeldahl Nitrogen (TKN)	EPA 351.1	0.455	0.50
	Nitrate as Nitrogen (NO ₃ -N)	EPA 300.0	0.01	0.10
	Nitrite as Nitrogen (NO ₂ -N)	EPA 300.0	0.01	0.05
	Total Nitrogen	calculation	NA	NA
	Ammonia as Nitrogen (NH ₃ -N)	EPA 350.1	0.02	0.06
	Total Phosphorus	SM 4500-P E or F	0.02	0.1
	Dissolved Phosphorus	SM 4500-P E or F	0.02	0.1
	Total Orthophosphate (PO ₄ -P)	SM 4500-P E or F	0.01	0.02

¹ Detection Limits (MDLs) and Reporting Limits (RLs) may change depending on the chosen laboratory that will be conducting the analysis; however, the LACFCD will ensure that all MDLs and RLs are below the numeric targets specified in the TMDL.

5.2 TOXICS TMDL SAMPLING PARAMETERS

A list of the constituents for which samples will be analyzed for the Toxics TMDL, and the associated analytical methods, project method detection limits and project reporting limits are provided in **Table 4**.

Table 4: Toxics TMDL Constituents, Analytical Methods, and Quantitation Limits

Sample Medium	Constituent	Method	Detection Limit	Reporting Limit
Water	Total Suspended Solids (TSS)	SM 2540D	0.5 mg/L	1.0 mg/L
Sediment (collected as suspended sediment)	Organochlorine Pesticides ¹	EPA8270C(m)	0.1-1 Ng/dry g	0.5-5 Ng/ dry g
	Total PCBs ²		10 Ng/dry g	20 Ng/dry g
	Total Organic Carbon (TOC)	EPA 9060 Dry combustion/IR detection	0.05 % dry weight	0.05%-66% dry weight

¹Organochlorine Pesticides to be analyzed include chlordane-alpha, chlordane gamma, 2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dieldrin.

²PCBs in water and sediment are measured as sum of seven Aroclors identified in the CTR (1016, 1221, 1232, 1242, 1248, 1254, and 1260).

A list of the method detection levels and method reporting levels for the organochlorine pesticide analyses of particulate matter is provided in **Table 5**.

Table 5: Pesticides and the Associated Method Detection Levels (MDL) and Method Reporting Levels (MRL).

Organochlorine Pesticides	Laboratory MDL Ng/g – dry weight	Laboratory MRL Ng/g – dry weight
Chlordane Compounds		
Heptachlor	0.1	0.5
Heptachlor Epoxide	0.1	0.5
gamma-Chlordane	0.1	0.5
alpha-Chlordane	0.2	1
Oxychlordane	0.1	0.5
trans-Nonachlor	0.1	0.5
cis-Nonachlor	0.1	0.5
Other Organochlorine Pesticides		
2,4'-DDD	1	2
2,4'-DDE	1	2
2,4'-DDT	1	2
4,4'-DDD	1	2
4,4'-DDE	1	2
4,4'-DDT	1	2
Total DDT	1	2
Dieldrin	1	5

Table 6 lists the parameters for field measurements to be measured during each event.

Table 6: Project Reporting Limits for Field Measurements

Parameter/Constituent	Range	Project RL
Velocity/Flow ¹	-0.5 to +20 ft ³ /s	NA
pH	0 – 14 pH units	NA
Temperature	-5 – 50 °C	NA
Dissolved oxygen	0 – 50 mg/L	0.5 mg/L
Turbidity	0 – 3000 NTU	0.2 NTU
Conductivity	0 – 10000 µmhos/cm	2.5 µmhos/cm

RL – Reporting Limit NA – Not applicable

¹For velocity/flow, range refers to velocities measured by a handheld flow meter. The lower limit for measuring flow is dependent upon the size of the specific pipe or channel.

Section 6. Wilmington Drain Sediment Monitoring

6.1 BACKGROUND

The Machado Lake Toxics TMDL identifies Wilmington Drain as a discharge point into Machado Lake through which approximately 88 percent of the Machado Lake Watershed area flows. Any sediment within or that makes its way into Wilmington Drain would need to be transported downstream towards Machado Lake by flowing water. The source of water is typically surface water runoff from rain or lawn irrigation. Some of the runoff travels by surface flow into storm drains directly connected to Wilmington Drain, while other runoff goes first to a detention basin in the upper watershed before being pumped to Wilmington Drain after the storm event has passed.

As Wilmington Drain approaches Pacific Coast Highway (PCH) nearest the upstream end of Machado Lake, the soft bottom channel gets deeper and narrower. As water in the channel slows down and pools behind a dirt berm on the south side of PCH, sediment carried by the flowing water settles out in the channel. Sediment accumulated in Wilmington Drain over the past 40 years or so has affected the channel's hydraulic capacity so much that the LACFCD has recently initiated a sediment removal project.

As discussed in a meeting with Regional Board staffⁱ, the LACFCD's project to remove sediment from Wilmington Drain has been incorporated into the City of Los Angeles' Proposition O Wilmington Drain Multi-Use Project. Although the sediment removal is to increase the hydraulic capacity of the channel for flood control purposes, it will likely remove most, if not all, legacy pollutants deposited and accumulated within the soft bottomed invert of Wilmington Drain. The project construction is currently scheduled for completion in 2015.

The Machado Lake Toxics TMDL states:

“The Los Angeles County Flood Control District shall monitor Wilmington Drain to demonstrate that Wilmington Drain is not re-contaminating Machado Lake. Monitoring shall include bed sediment sampling and visual inspection of channel maintenance and operation of best management practice (BMPs). Monitoring shall be required by Regional Board order or a conditional Water Quality Certification under section 401 of the Clean Water Act. This monitoring shall be initiated at the same time as all other required WLA monitoring” (Resolution No. R10-008, Attachment A, Page 9).

6.2 BED SEDIMENT SAMPLING APPROACH

The intent of the Wilmington Drain Monitoring is to show that sediment in Wilmington Drain is not going to cause toxics re-contamination of Machado Lake. This will be accomplished by taking bed sediment samples following the Surface Water Ambient Monitoring Program (SWAMP) protocols. This involves sampling the top 2 cm of sediment, once a year after flow from the Wilmington Drain has subsided following each storm season.

ⁱ Meeting with Regional Board Staff (Ms. Jenny Newman and Dr. Kangshi Wang) on August 21, 2012

Based on the proposed contours in the current Wilmington Drain Multi-Use Project construction plans, the LACFCD's approximate sampling area is likely to be as shown in **Figure 4**. This location is the lowest accessible-by-foot area that is likely to be dry within a reasonable timeframe after the storm season, but outside of bird nesting season. The location is subject to adjustment based off of final contouring as shown in the project as-built drawings.



Figure 4: Aerial View of the Wilmington Drain Bed Sediment Sampling Location

6.3 BED SEDIMENT SAMPLING FREQUENCY

Bed sediment sampling will start after the sediment removal part of the Wilmington Drain Multi-Use Project is complete. Sampling will occur once a year after Wilmington Drain flow has had a chance to subside following each storm season, to determine how much sediment and associated toxic contaminants have accumulated in the drain invert.

Monitoring will continue yearly until the Toxics TMDL's final compliance date in 2019. After that, monitoring will be adjusted based on results and may be reduced to once every three years.

6.4 VISUAL INSPECTION

LACFCD maintenance activities within Wilmington Drain are done in compliance with its Waste Discharge Requirements (WDR) File Number 99-011-2010WDR, Order No. R4-20100021. Wilmington Drain is identified as Reach 25, County Reach 27. Section 43 Best Management Practices of the WDR requires in part that “All appropriate Best Management Practices (BMPs) shall be implemented in order to avoid impacts to water quality that would result in exceedances of water quality standards.” Section 49 Water Quality Monitoring of the WDR requires in part that “BMPs are to be implemented in association with maintenance activities to avoid impacts to water quality which would result in exceedances of water quality standards.”

Since visual inspection of BMPs is an integral component of the LACFCD’s practices to ensure compliance with its WDR, additional activities will not be necessary to meet the TMDL’s requirements. However, if in the future, it is determined that there is a continued in-flow of sediment from the watershed, the LACFCD, in collaboration with upstream municipalities, may take additional action to reduce sediment into Wilmington Drain. All regulatory agencies will be duly notified at that time, if such action is to be taken.

Section 7. Reporting

7.1 ANNUAL MONITORING REPORT

Monitoring results will be reported annually to the Regional Board. Each annual report will be submitted to the Regional Board within six months from the final sampling event of the year.

The Annual Monitoring Report will contain at minimum the following components:

- Methods
- Monitoring Results/Analyses
- Quality Assurance/Quality Control
- Conclusions and Recommendations

Section 8. Monitoring Event Preparation

Monitoring event preparation will include mobilizing field equipment, placing bottle orders, and contacting the necessary personnel regarding site access and scheduling. The following steps will be completed prior to each sampling event:

1. Contact laboratories or other suppliers to obtain sample containers.
2. Confirm scheduled monitoring date with the field crew and set up sampling day itinerary, including courier pickup/drop-off if applicable.
3. Mobilize sampling equipment. Examine all equipment for defects and replace if necessary. Ensure that all samplers have appropriate personal protective equipment prior to going to the field.
4. All samplers to confirm contact information, review sampling and urgent care location maps, and review/discuss safety protocols when in the field. Samplers should also discuss informal rescue plans in case of a serious incident occurring while on site.
5. Prepare sample container labels with sample date, sample time, sample point, sample type (grab/composite), preservatives added (if needed), and analyses needed.
6. Prepare field log sheet to indicate the type of field measurements, field observations and samples to be collected.
7. Prepare chain of custody forms.
8. Calibrate field measurement instruments and fill out calibration logs.

The following equipment will be mobilized prior to each sampling event:

- First aid kit
- Cellular phone
- Field log, H&S Plan
- Nitrile or latex powder-free gloves
- Flow meter
- Camera
- Coolers for all sample bottles
- GPS
- Multi-parameter meter (temperature, pH, DO, conductivity, and turbidity)
- Ladder
- Cleaning solutions as required by sampling equipment
- Clipboard
- Chain of custody forms
- Sample bottles
- Intermediate bottles
- Labels
- Ice
- Bucket and Rope
- Sand Bag
- Field kit (tape, knife, zip-lock bags, tie-wraps, sharpie pens, pencils, screw driver, and other miscellaneous supplies)
- Confined space entry equipment and permits, if necessary
- Rinse water as required by sampling equipment.

8.1 BOTTLE ORDER

Sample bottle orders will be placed with the appropriate analytical laboratory at least two weeks prior to each sampling event. Containers will be ordered for all water samples, including quality control samples, as well as extra containers in case the need arises for intermediate containers or replacements. The containers must be of the proper type and size and contain preservative as appropriate for the specified laboratory analytical methods. **Table 7** and **Table 8** list specific constituents for which samples will be analyzed and specifies the sample container, volume required, and immediate processing, storage, and holding time requirements. The field crew will inventory sample containers upon receipt from the laboratory to ensure that adequate containers have been provided to meet analytical requirements for each monitoring event.

Table 7: Nutrient TMDL Sample Container Requirements

Constituent	Sample Container and Volume ¹	Immediate Processing And Storage	Holding Time
Total Suspended Solids (TSS)	1 L HDPE	4° C	7 days
Total Dissolved Solids (TDS)	500 mL HDPE	4° C	7 days
Nitrate as Nitrogen (NO ₃ -N)	500 mL HDPE	4° C	48 hours
Nitrite as Nitrogen (NO ₂ -N)			
Dissolved Phosphorus			
Total Orthophosphate (PO ₄ -P)			
Total Kjeldahl Nitrogen (TKN)	500 mL HDPE	H ₂ SO ₄	28 days
Ammonia as Nitrogen (NH ₃ -N)			
Total Phosphorus			

¹ Additional volume may be required for QC analyses.

Table 8: Toxics TMDL Sample Container Requirements

Sample Medium	Constituent	Sample Container and Volume ³	Immediate Processing And Storage	Holding Time
Water	Total Suspended Solids (TSS)	1L HDPE	4° C	7 days
Sediment (collected as suspended sediment)	Organochlorine Pesticides ¹	2-4 grams (min 0.5 grams)	4° C	1 year ⁴
	Total PCBs ²			
	Total Organic Carbon (TOC)	1 gram (min 0.25 grams)	4° C	28 days

¹Organochlorine Pesticides to be analyzed include chlordane-alpha, chlordane gamma, 2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dieldrin.

²PCBs in water are measured as sum of seven Aroclors identified in the CTR (1016, 1221, 1232, 1242, 1248, 1254, and 1260). Individual congeners will also be analyzed.

³Additional volume may be required for QC analyses.

⁴One year if frozen, otherwise 14 days to extract and 40 days from extraction to analysis.

8.2 SAMPLE BOTTLE LABELING

All samples will be identified with a unique identification code to ensure that results are properly reported and interpreted. Samples will be identified such that the site, sampling location and sample type (*i.e.*, environmental sample or QC sample) can be distinguished by a data reviewer or user. Sample identification codes will consist of a site identification code and a unique sample ID number assigned by the monitoring manager.

Labels will be placed on the appropriate bottles in a dry environment; applying labels to wet sample bottles will be avoided. Labels will be placed on sides of bottles rather than on bottle caps. Labels will be produced by the LACFCD's Integrated Water Quality System Database, to uniquely identify samples, the required analyses, and for subsequent uploading of data to the database.

Section 9. Sample Collection

9.1 NUTRIENT TMDL SAMPLING TECHNIQUES FOR DRY AND WET WEATHER

Samples will be collected in a manner that minimizes the possibility of sample contamination. These sampling techniques are summarized below:

- Samples are collected only into rigorously pre-cleaned sample containers.
- At least two persons are required on a sampling crew.
- Clean, powder-free nitrile gloves must be worn while collecting samples and must be changed whenever something not known to be clean has been touched.
- To reduce the potential for contamination and to ensure crew safety, field crews must observe the following precautions while collecting samples:
 1. Smoking is prohibited.
 2. Collecting samples near a vehicle, running or otherwise, is prohibited.
 3. Eating or drinking during sample collection is prohibited.
 4. Sampling personnel should avoid breathing, sneezing or coughing in the direction of an open sample container.

Each person on the field crew will wear clean clothing that is free of dirt, grease, or other substances that could contaminate the sampling apparatus or sample bottles.

Grab samples will be collected at approximately mid-channel, mid-depth at the location of greatest flow (where feasible) by direct submersion of the sample bottle. This is the preferred method for grab sample collection; however, due to monitoring site configurations and safety concerns, direct filling of sample bottles may not always be feasible. If a site is inaccessible due to safety, staff will not sample and note the unsafe condition. Monitoring site configuration will dictate grab sample collection technique. Grab samples will be collected directly into the appropriate bottles whenever feasible. As protocols are developed by the LACFCD to uniquely address the urban conveyance system sampling, they will supersede the procedures outlined in the MRP.

During dry weather sampling events, some channels and drains may not contain sufficient flow to collect samples by direct submersion. Intermediate containers will be used in instances where flows are too shallow for the direct submersion of sampling containers, and in instances where sheet flow is present. In these instances, a HDPE bottle free of preservative will be used as the intermediate container to fill sample bottles.

It is considered very important to not scoop up algae, sediment, or other particulate matter on the bottom of the channel because such debris is not representative of surface flows. To prevent collection of such debris:

- A location should be found where the channel bottom is relatively clean and allows for the intermediate container to fill, or
- A clean Ziploc bag should be placed on the bottom of the channel and water should be collected from on top of the bag.

The potential exists for monitoring sites to lack discernable flow. The lack of discernable flow may generate unrepresentative data. To address the potential confounding interference that can

occur under such conditions, sites sampled should be assessed for the following conditions and sampled or not sampled accordingly:

- Pools of water with no flow or visible connection to another surface water body should **NOT** be sampled. The field log should be completed for non-water quality data (including date and time of visit) and the site condition should be photo-documented.
- Flowing water (*i.e.*, based on visual observations, flow meter data, and a photo-documented assessment of conditions immediately upstream and downstream of the sampling site) site **SHOULD** be sampled.

Field personnel will adhere to established sample collection protocols to ensure the collection of representative and uncontaminated (*i.e.*, contaminants not introduced by the sample handling process itself) samples for laboratory analyses. Deviations from the standard protocols must be documented in the field log at the time of sampling. Sampling gear and utensils which come in direct contact with the sample will be made of non-contaminating materials and will be thoroughly cleaned between sampling stations according to appropriate cleaning protocols. Sample containers will be of the recommended type and will be free of contaminants (*i.e.*, pre-cleaned). Conditions for sample collection, preservation and holding times will be followed.

Field crews (2 persons per crew, minimum; 3 persons per crew, minimum, when confined space entry is required) will be mobilized for sampling only when weather conditions and flow conditions are considered to be safe. For safety reasons, sampling will occur only during daylight hours. Sampling events should proceed in the following manner:

1. Before leaving the sampling crew base of operations, confirm number and type of sample containers as well as the complete equipment list.
2. Proceed to the first sampling site.
3. Record the general information on the field log sheet.
4. Collect the samples indicated on the event summary sheet in the manner described herein. Collect additional volume and blank samples for field-initiated Quality Control (QC) samples, if necessary. Place filled sample containers in coolers and carefully pack and ice samples as described herein. Using the field log sheet, confirm that all appropriate containers were filled.
5. Collect field measurements and observations, and record these on the field log sheet.
6. Complete the chain of custody forms using the field log sheets.
7. After sample collection is completed at the monitoring site, deliver and/or ship samples to the appropriate laboratory.

Wet weather samples will be collected as flow-weighted composite samples in conjunction with the Toxics TMDL monitoring. Wet weather sampling techniques are discussed in the subsequent section.

9.2 TOXICS TMDL WET WEATHER SAMPLING TECHNIQUES

9.2.1 Background

Compliance monitoring specified in the Basin Plan Amendment requires that pollutant concentrations are measured by collecting sufficient volumes of stormwater such that quantities of suspended solids are suitable for direct analyses in bulk sediments filtered from the

discharges. In addition, stormwater is to be sampled using procedures that allow for representative samples proportioned based upon flow rates during the storm events. As noted, earlier pollutants specified for direct analysis in the bulk sediment include:

- Total Organic Carbon
- Total PCBs
- DDT and Derivatives
- Dieldrin
- Total Chlordane

Although a number of studies have been performed to directly measure the concentration of contaminants associated with suspended solids, there are no standardized procedures for this type of testing. Given the lack of a standard method, a brief review of the various methods used to collect, concentrate and quantify suspended sediments and to quantify pollutant loads associated with suspended sediments is warranted.

The usual approach for measuring hydrophobic chemicals associated with suspended particulates has been to analyze whole water samples. Mahler et al. (2006) noted that most water samples with less than a couple hundred mg/L of TSS could still result in mostly non-detects even when the pollutant concentrations in the suspended sediment exceeded Probable Effects Levels (PELs) if they had been measured in bedded sediments. The combined use of more sensitive analytical methods such as GCMS-NCIS and increasing sample volumes can substantially improve sensitivity but values are still often within 10 times the reporting limits and thus would be expected to have limited value in determining loads.

The number of strategies used to determine the concentrations and loads associated with suspended sediments (and those in the dissolved or colloidal form) nearly match the number of studies conducted. All require a method to separate suspended sediment from the water samples and very high volumes of water. Horowitz (1995) used centrifugation but most other studies have used some type of filtration. Studies conducted in the Raritan Bay area by USGS and the New Jersey Department of the Environment (Bonin and Wilson, 2006) used Trace Organic Platform Samplers (TOPS) units to collect and filter water. These units typically use stainless steel canister filters fitted with 0.5 µm Glass Fiber Filters (GFF) to remove the coarser material without substantial flow restriction. Since these filters tend to get breakthrough of approximately 10% of the suspended sediment, they are followed by large (142 mm or 293 mm) flat GFF filter with a nominal pore size of 0.7 or 1.0 µm and no binders. The water then passes through an XAD resin to extract the dissolved fraction. The volume of water passing through the system is collected and measured to establish the volume for use in calculating concentrations. Other studies conducted in the Great Lakes Region (McCarty et al. 2004) have simply quantified the mass of pollutants present in the particulate fraction relative to the total volume of water.

Sediment trapped in the canister filter and flat GFF cannot be recovered for quantification so most studies collect additional TSS samples to use in calculating the total mass of sediment trapped by the sampler. The average concentration of TSS is then multiplied by the total volume of water to estimate the mass of particulates captured by the filters. Other studies conducted in the Great Lakes Region (McCarty et al. 2004) have simply quantified the mass of pollutants present in the particulate fraction relative to the total volume of water.

A more recent USGS study conducted in Austin, Texas (Mahler et al. 2006) explored use of large volume suspended sediment sampling to measure concentrations and loads of both metals and organic compounds that were associated with suspended sediment during storm events in Barton Creek. Initially, this study eliminated use of the GFF filter cartridges typically used in such studies and only used 293 mm GFF filters with nominal pore sizes of 0.7 μm . Seven 9 L samples were taken at fixed time intervals and later composited based upon average flow within each time interval. As the study proceeded, 0.45 μm PTFE filters were tested as replacements for the GFF filters. USGS found that these filters, when handled correctly, were able to fully recover all sediment so that particulates could be directly quantified. As the filter periodically became clogged, they would be removed from the filter holder and placed in a sealed plastic bag. The filter would then be gently massaged to remove the sediment and typically reused two more times with the same sample. Although the PTFE filters successfully allowed complete recovery of sediment from the water samples they required some special handling due to their hydrophobicity. A light spray with methanol was necessary to get water to start flowing through the membrane. Complete recovery of the sediment allowed the sample to be freeze-dried in the laboratory prior to analysis.

Stenstrom and Suffet (2009) used similar methods to collect and fractionate samples of stormwater entering Puddingstone Lake in Los Angeles County. Water samples were filtered to separate total suspended solids (TSS) from the aqueous phase using pre-weighed 142 mm, 0.7 μm pure glass (no binder) TCLP filters (Whatman Inc., UK) and a Hazardous Waste Pressure Filter System (Millipore, Billerica, MA). They then dried the filters containing the TSS in 250 mL glass jars containing calcium chloride over a 24-hour period and then refrigerated the samples at 4°C until extracted. Filters were reweighed after drying to determine the amount of particulates collected on the filters.

9.2.2 Recommended Sampling Procedures

Major factors considered in the development of sampling procedures for the specified hydrophobic pesticides included:

- the ability to obtain flow-weighted stormwater samples;
- collect the necessary volumes of stormwater to assure that sufficient sediment is available to meet analytical requirements inclusive of QA/QC;
- sampling equipment is comprised of materials that are both non-contaminating and resistant to both adsorption or desorption of organic materials; and
- suitable for direct quantification of solids.

Water samples will be collected using stormwater sampling equipment capable of obtaining flow-weighted composite samples. If automated flow-weighted sampling is not possible, manual collection of sampling is permissible with the condition that it is done at discrete intervals and the samples are mixed in proportion to the measured flow rates to achieve a flow-weighted composite sample. The efficiency of autosamplers is known to decline once particle sizes start to exceed 250 μm (Clark, 2009) but ability to obtain large numbers of samples over the duration of a storm event is a significant benefit. Although USGS normally prefers use of isokinetic samplers for obtaining representative samples of suspended solids, they also recognize that this sampling method is often not practical. Mauler et al. (2006) compared suspended sediment

concentrations collected using a fixed point autosampler with samples obtained using isokinetic samplers and concluded that differences were not significant for the Barton Creek site.

Equipment selected to monitor flow will be based upon specific characteristics of the selected site. Unless suitable rating curves exist for the selected site, it is likely that an Area Velocity Bubbler (AVB) will be used to estimate open channel flows. An autosampler equipped with a peristaltic pump will be used to collect water samples. The intake hose will consist of pre-cleaned FEP (Teflon) hose fitted with stainless steel strainer and secured to the bottom of the channel. The autosampler will use a minimal length of peristaltic hose to connect to the FEP intake hose and pass it through the peristaltic pump. Another length of FEP hose will be connected to the peristaltic hose and directed into the sampling container.

Sample volumes will depend largely on the concentrations of sediment in the discharges and storm volumes. The filtrations should be performed using 0.45 µm PTFE membrane filters. These can be either 143 mm or 250 mm in diameter. Initial settings will be based upon a target of 10 grams of suspended sediment to analyze all target analytes and maintain suitable reporting limits. The minimum sample mass will be 1.5 grams. Since these objectives are based upon dry weight, professional judgment will be needed to determine if adequate volumes are available. If sediment is limited, the laboratory should provide dry weight measurements to the Project Manager as soon as they become available to determine if the laboratory should proceed with the designated analyses or reconsider allocation of sediment for the required analyses.

Standard 20-L borosilicate media bottles composite containers should be used to collect the stormwater samples. Alternatively, 32 gallon roughneck trash cans or other comparable plastic containers can be used with 33-gallon Teflon liners. A similar design was used by Mauler (2006) in Austin. Although this provides more than adequate capacity to collect the sample in a single container, the potential weight can be prohibitive. If Teflon liners are used, tie wraps should be used to secure the bag around the discharge hose. A short length of hose (approx. 4-5 inches) should be included to assure the bag is vented.

9.2.3 Clean Sample Collection Techniques

To prevent contamination of samples, clean metal sampling techniques using USEPA protocols outlined in USEPA Method 1669ⁱⁱ will be used throughout all phases of the sampling and laboratory work, including equipment preparation, sample collection, and sample handling, storage, and testing. All containers and test chambers will be acid-rinsed prior to use. Filled sample containers will be kept on ice until receipt at the laboratory.

The protocol for clean metal sampling, based on USEPA Method 1669, is summarized below:

- Samples are collected in rigorously pre-cleaned sample bottles with any tubing specially processed to clean sampling standards.
- At least two persons, wearing clean, powder-free nitrile or latex gloves at all times, are required on a sampling crew.

ⁱⁱ USEPA. April 1995. *Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels*. EPA 821-R-95-034.

- One person, referred to as “dirty hands”, opens only the outer bag of all double-bagged sample bottles.
- The other person, referred to as “clean hands”, reaches into the outer bag, opens the inner bag and removes the clean sample bottle.
- Clean hands rinses the bottle at least two times by submerging the bottle, removing the bottle lid, filling the bottle approximately one-third full, replacing the bottle lid, gently shaking and then emptying the bottle. Clean hands then collects the sample by submerging the bottle, removing the lid, filling the bottle and replacing the bottle cap while the bottle is still submerged.
- After the sample is collected, the sample bottle is double-bagged in the opposite order from which it was removed from the same double-bagging.
- Clean, powder-free gloves are changed whenever something not known to be clean has been touched.
- The time of sample collection is recorded on the field log sheet.

9.3 FIELD MEASUREMENTS AND OBSERVATIONS

Field measurements (listed in **Table 6**) will be taken, and observations made and recorded, at the sampling site after a sample is collected. All field measurement results and field observations will be recorded on a field log. Field measurements will include dissolved oxygen, temperature, conductivity, pH, turbidity, and flow. Measurements (except for flow) will be collected at approximately mid-stream, mid-depth at the location of greatest flow (if feasible) with a multi-probe meter, or comparable instrument(s). For measurements of relatively deep flows, the sensors will be placed directly into the flow path. For measurements of shallow flows, water will be collected in a rinsed intermediate container prior to measurement.

Prior to each day of each sampling event, water quality meters will be calibrated using fresh calibration solutions. After each calibration, the sensor will be checked to verify the accuracy is within an acceptable range. Otherwise, this process will be repeated until the calibration is verified. The acceptable range of accuracy will be included on a calibration sheet included in the field log.

Flow measurements will be obtained from an existing telemetry system located at the Wilmington Drain Pump Station, which monitors and records flow rates and pump operations. Flow measurements may also be obtained through appropriate flow meters installed with the automated sampler used to collect flow-weighted composite samples.

9.4 FIELD LOGS

In addition to field measurements, observations shall be made at the monitoring location and noted on the field log form. Observations will include color, odor, floating materials, and foreign matter. Field crews will keep a field log book for each sampling event. The field log book will contain a calibration log sheet, field log sheet, and appropriate contact information. The following items will be recorded in the field log for each sampling event:

- Monitoring station location (Site ID);
- Date and time(s) of sample collection;
- Name(s) of sampling personnel;

- Sampling depth;
- Sample ID numbers and unique IDs for any replicate or blank samples;
- QC sample type (if appropriate);
- Requested analyses (specific parameters or method references);
- Sample type, (*i.e.*, grab);
- The results of any field measurements (*e.g.*, flow, temperature, dissolved oxygen, pH, conductivity, turbidity), and the time that field measurements were made;
- Qualitative descriptions of relevant water conditions (*e.g.*, water color, flow level, clarity) or weather (*e.g.*, wind, clouds) at the time of sample collection; and,
- A description of any unusual occurrences associated with the sampling event, particularly those that may affect sample or data quality.

9.5 CHAINS OF CUSTODY

Sample custody procedures provide a mechanism for documenting information related to sample collection and handling. Sample custody must be traceable from the time of sample collection until results are reported. A sample is considered under custody if:

- It is in actual possession.
- It is in view after in physical possession.
- It is placed in a secure area (accessible by or under the scrutiny of authorized personnel only after in possession).

A chain-of-custody (COC) form will be completed after sample collection and prior to sample shipment or release. The COC form, sample labels, and field documentation will be cross-checked to verify sample identification, type of analyses, and number of containers, sample volume, preservatives, and type of containers. A complete COC form will accompany the transfer of samples to the analyzing laboratory.

9.6 SAMPLE HANDLING AND DELIVERY

The field crews will have custody of samples during each monitoring event. COC forms will accompany all samples during shipment or delivery to contract laboratories to identify the shipment contents. All water quality samples will be transported to the analytical laboratory by the field crew or by shipment. The original COC form will accompany the shipment, and a signed copy of the COC form will be sent, typically via fax, by the laboratory to the field crew to be retained in the project file.

While in the field, samples will be stored on ice in an insulated container, so that they will be kept at approximately 4°C. Samples must have lids securely tightened and must be placed on ice to maintain the temperature at approximately 4°C. The original COC form(s) will be bagged in re-sealable plastic bags and either taped to the outside of the cooler or to the inside lid. Samples will be hand delivered or shipped to the laboratory according to Department of Transportation standards.

Coolers will be sealed with packing tape before shipping and must not leak. It is assumed that samples in tape-sealed ice chests are secure whether being transported by field staff vehicle, by common carrier, or by commercial package delivery. The laboratory's sample receiving

department will examine the shipment of samples for correct documentation, proper preservation, and compliance with holding times.

Section 10. Quality Assurance/Quality Control

Quality assurance and quality control (QA/QC) measures are built into the Study to assure data will be credible. Data quality objectives are listed in **Table 9**.

10.1 FIELD QA/QC

Field QA/QC for this project includes the following:

- Equipment Blanks
- Field Blanks
- Field Duplicates
- Proper collection, handling, and preservation of samples
- Maintenance of a field log

10.1.1 Equipment Blanks

The purpose of analyzing equipment blanks is to demonstrate that sampling equipment is free from contamination. Equipment blanks will be collected by the analytical laboratory responsible for cleaning equipment, before sending cleaned equipment back to the field crew for use. Equipment blanks will consist of laboratory-prepared blank water (certified to be contaminant-free by the laboratory) processed through the sampling equipment that will be used to collect environmental samples.

It is unlikely that equipment blanks will be required for this monitoring program. However, if collected, the blanks will be analyzed using the same analytical methods specified for environmental samples. If any analytes of interest are detected at levels greater than the MDL, the source(s) of contamination will be identified and eliminated (if possible), the affected batch of equipment will be re-cleaned, and new equipment blanks will be prepared and analyzed before the equipment is returned to the field crew for use.

10.1.2 Field Blanks

The use of field blanks is intended to test whether contamination is introduced from sample collection and handling, sample processing, analytical procedures, or the sample containers. The field crew will use blank water provided by the laboratory to generate field blanks by pouring blank water directly into the appropriate sample containers. Field blanks will be identified with a unique Site ID prior to each monitoring event and submitted “blind” to the laboratory. If any analytes of interest are detected at levels greater than the MDL, the source(s) of contamination will be identified and eliminated, if possible. The sampling crew will be notified so that the source of contamination can be identified (if possible) and corrective measures implemented prior to the next sampling event. Field blanks will be collected for all constituents in water samples. If no contamination is detected for conventional constituents repeatedly following multiple events, field blanks may be discontinued for these constituents. Field blanks will not be collected for sediment samples.

10.1.3 Field Duplicates

The purpose of analyzing field duplicates is to demonstrate the precision of sampling and analytical processes. Field duplicates will be analyzed along with the associated environmental samples. Field duplicates will consist of two aliquots from the same grab sample.

10.2 LABORATORY QA/QC

Laboratory QA/QC for this project includes the following:

- Use of the lowest available method detection limits (MDLs) for trace elements.
- Analysis of method blanks and laboratory duplicates.
- Use of matrix spikes (to test analytical accuracy) and matrix spike duplicates (to test analytical precision) (MS/MSD).
- Routine analysis of standard reference materials (SRMs) and method blanks.

10.2.1 Method Blanks

The purpose of analyzing method blanks is to demonstrate that sample preparation and analytical procedures do not result in sample contamination. Method blanks will be prepared and analyzed by the contract laboratory at a rate of at least one for each analytical batch. Method blanks will consist of laboratory-prepared blank water processed along with the batch of environmental samples. If the result for a single method blank is greater than the MDL, the source(s) of contamination should be corrected, and the associated samples should be reanalyzed.

10.2.2 Laboratory Duplicates

The purpose of analyzing laboratory duplicates is to demonstrate the precision of the sample preparation and analytical methods. Laboratory duplicates will be analyzed at the rate of one pair per sample batch. If the Relative Percent Difference (RPD) for any analyte is greater than 25% and the absolute difference between duplicates is greater than the RL, the analytical process is not being performed adequately for that analyte. In this case, the sample batch should be prepared again, and laboratory duplicates should be reanalyzed. Since the quantity of suspended solids is likely to be limited, reanalysis may not be an option. This will need to be separately assessed based upon available sediment in each sample.

10.2.3 Matrix Spikes and Matrix Spike Duplicates

The purpose of analyzing matrix spikes and matrix spike duplicates is to demonstrate the performance of the sample preparation and analytical methods in a particular sample matrix. Double or triple the sample volume will be necessary for each set of MS/MSD samples. MS/MSD samples will be analyzed for OC pesticides and PCBs and metals samples. If sufficient sediment is not available to run both MS and MSD samples, analyses may be limited to a single matrix spike to assess potential matrix impacts on the analyses and utilize either laboratory duplicates or blank spike/spike duplicates to assess precision.

10.2.4 Laboratory Control Samples

The purpose of analyzing laboratory control samples (or a standard reference material) is to demonstrate the accuracy of the sample preparation and analytical methods. Laboratory control samples will be analyzed at the rate of one per sample batch. Laboratory control samples will

consist of laboratory fortified method blanks or a standard reference material. If recovery of any analyte is outside the acceptable range, the analytical process is not being performed adequately for that analyte. In this case, the sample batch should be prepared again, and the laboratory control sample should be reanalyzed.

Table 9: Data Quality Objectives

Parameter	Accuracy	Precision	Recovery	Target Reporting Limits
Field Analyses - Water				
pH	± 0.2 pH units	± 0.5 pH units	NA	NA
Temperature	± 0.5 °C	± 5%	NA	NA
Dissolved Oxygen	± 0.5 mg/L	± 5%	NA	0.5 mg/L
Turbidity	± 10%	± 10%	NA	0.2 NTU
Conductivity	± 5%	± 5%	NA	2.5 umhos/cm
Laboratory Analyses – Water				
Total Suspended Solids (TSS)	80-120%	25%	80-120%	1 mg/L
Total Dissolved Solids (TDS)	80-120%	25%	80-120%	10 mg/L
Total Kjeldahl Nitrogen	80-120%	25%	80-120%	0.3 mg/L
Ammonia-Nitrogen	80-120%	25%	80-120%	0.1 mg/L
Nitrate-Nitrogen	80-120%	25%	80-120%	0.1 mg/L
Nitrite-Nitrogen	80-120%	25%	80-120%	0.1 mg/L
Total Phosphorus	80-120%	25%	80-120%	0.01 mg/L
Dissolved Phosphorus	80-120%	25%	80-120%	0.01 mg/L
Total Orthophosphate	80-120%	25%	80-120%	0.03 mg/L
Laboratory Analyses – Sediment				
Organochlorine Pesticides	25 – 145%	0 – 30%	25 – 145%	0.1-0.5 Ng/g dry weight
PCBs	60 – 135%	0 – 30%	60 – 135%	5-20 ¹ Ng/g dry weight
TOC	80-120%	25%	80-120%	0.05% dry weight

¹Target RL for aroclors is 20 Ng/g and target RLs for congeners is 5 Ng/g.

10.3 QUALITY CONTROL SAMPLE COLLECTION SCHEDULE

A field blank, field duplicate, and matrix spike and matrix spike duplicate will be conducted during every event for the Nutrient TMDL dry weather sampling only.

10.5 MANAGEMENT OF DATA

The LACFCD utilizes the Integrated Water Quality Database System (IWQDBS), an Oracle[®] database developed to support water quality monitoring, analysis, and reporting activities. The system is accessed via interfaces running on web browsers (i.e. Internet Explorer).

The IWQDBS is set up in six different modules to assist the user with several tasks including:

- Sampling event preparation (creating and printing sampling bottle labels, chain of custody forms, etc.).
- Capturing field observation data (site and sampling event conditions, field parameters such as water temperature, etc.).
- Storing and analyzing water quality data.
- Preparing customized water quality data reports, executing of water quality queries including on-the-fly water quality results comparison with established water quality standards (i.e. Basin Plan, Ocean Plan, and California Toxics Rule)
- Exporting water quality data using the Standardized Data Exchange Format (SDEF) developed by the Stormwater Monitoring Coalition (SMC). Exported files are created in MS Excel. Alternatively, the user may export data using additional templates.
- Using Geographic Information Systems (GIS) to facilitate spatial analysis and direct query to the database.
- Accounting System to facilitate laboratory invoicing reconciliation.

The IWQDBS uses usernames and passwords to grant different levels of access to the user.

Data can be entered either manually (field observation data and specific event information) or it can be uploaded using tab delimited files following specific formats.

10.5.1 Data Review

The data review process begins with the preparation of the data for upload to the IWQDBS. Formatting the data for upload allows checks on data completeness and gross errors. Once uploaded and internal to the IWQDBS, there are checks between required samples for each event against the data received by the LACFCD.

10.5.2 Data Validation

The IWQDBS is used to cross validate the sample results to the corresponding QA/QC information.

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APPENDIX A.

LACFCD Background Information

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LACFCD Background Information

In 1915, the Los Angeles County Flood Control Act was adopted by the California State Legislature after a disastrous regional flood took a heavy toll on lives and property. The act established the LACFCD and empowered it to manage flood risk and conserve stormwater for groundwater recharge. In coordination with the United States Army Corps of Engineers the LACFCD developed and constructed a comprehensive system that provides for the regulation and control of flood waters through the use of reservoirs and flood channels. The system also controls debris, protects existing vegetal covers, collects surface storm water from streets, replenishes groundwater with storm water, imported and recycled waters. The LACFCD covers the 2,753 square-mile portion of Los Angeles County south of the east-west projection of Avenue S, excluding Catalina Island. It is governed as a special district by the County of Los Angeles Board of Supervisors and its functions are carried out by the Los Angeles County Department of Public Works. The LACFCD service area is shown on the map on the following page.

