KEN MALLOY HARBOR REGIONAL PARK DEVELOPMENT PROGRAM

VOLUME II

Machado Lake Watershed Management Plan

Prepared for

City of Los Angeles Department of Recreation and Parks
and
Palos Verdes/Southbay Audubon Society

Prepared by

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May 2002

SECTION 3

RUNOFF QUANTIFICATION AND POLLUTANT LOADING CALCULATIONS

3.1 PURPOSE OF THE TASK

The purpose of this task is to estimate annual loading of each identified pollutant to Machado Lake, which is attributable to each city/community situated within the Machado Lake Watershed.

3.2 RUNOFF QUANTIFICATION

The quantity of runoff from each storm drain system, which discharges to Machado Lake, is derived from various hydrology studies obtained from LACDPW. The hydrology data for each storm drain system were first converted to a common return period (50 years), the predominant return period used in most hydrology studies of LACDPW. For the systems with incomplete hydrology data available, pro rata of flow rates were undertaken based on (1) relative values of other watersheds in the project study, and (2) LACDPW design standards. Results of the designed capital flood flow rate conversion to a 24-hr volume for a 50-year event are presented in Table 3-1. The conversion factors were developed from the Ventura County Public Works Agency's "Hydrologic Multipliers". These are applicable to neighboring Los Angeles County. A hydrograph plot of each drainage system is presented in Figure 3-1.

Two methods of an annual runoff within Machado Lake Watershed were calculated as described in the following subsections:

3.2.1 Total Annual Runoff Calculation by Drainage System

A total annual runoff based on 50-yr 24-hr storm for each storm drain system was calculated. The calculation steps include:

1. Converting the 24-hr designed storm runoff to inches of rainfall using LACDPW Hydrology Manual data for the project location;
2. Determining the equivalent number of 50-yr 24-hr storms (of runoff) that would be generated by the 13.5" average annual rainfall (i.e., the average annual rainfall that was averaged for the four rain gage stations in the overall project watershed);
3. Multiplying this number with the runoff in a single 50-yr 24-hr storm to yield the total annual runoff.

Results of the calculations are presented in Table 3-2. Detailed calculations and explanations are included in Appendix A-2.

Table 3-1
Capital Flood Flow Rate for Each Storm Drain System Within Machado Lake Watershed(1)

Drainage Area Description	Capital Flood Flow Rate (cfs)	24-hr Runoff Volume for a Designed Storm (acre-feet)	Designed Storm Frequency (year)	Conversion Factor Applied	Runoff Volume for 24-hr 50-yr Storm (acre-feet)
Private Drain No. 553	4,096	1,602	50	-	1,602
Project No. 643[2]					
Figueroa Street Drain	467	118	50	-	118
72-inch Strom Drain	543	47	<1	12.5	590
Wilmington Drain	3,140	1,228	43	1.04	1,280
Project Nos. 77/510 (total)	**1,955**	**860**			**2,161**
Project No. 77	1,553	783	4	2.63	2,062
Project No. 510	402	77	18	1.30	100
Harbor City Relief Drain[3]	2,173	334	50	-	334
Walteria Lake[4]	1,439	361	50	-	361

Note: (1) Data compiled from LACDWP hydrology reports; pro rata of flow rates was performed when data are not available; conversion to 50-yr storm event was performed by Parsons.

(2) Project No. 643 discharges to the wetland area south of the lake, not directly to the lake.

(3) Harbor City Relief Drain relieves flow from Project 510 and a portion of Project 77.

(4) Only 35% of flow from Waltaria Lake watershed is assumed discharging to Machado Lake via Wilmington Drain System.

Table 3-2
Total Annual Runoff for Each Storm Drain System Within Machado Lake Watershed Based on 50-Yr Return Period

Drainage Area	50-yr 24 hr Runoff Volume (Acre-ft)	Conversion Factor	Total Annual Runoff (acre-ft/yr)
Project No. 643 (Figueroa Drain)	118	2.18	258
Project No. 643 (72" Storm Drain)	590	2.18	1,286
Wilmington Drain (including Private Drain 553)	2,882	2.18	6,282
Project No. 77/510 (total)	2,161	2.18	4,712
Project No. 77	2,062	2.18	4,494
Project No. 510	100	2.18	218
Harbor City Relief Drain	334	2.18	728
Walteria Lake	361	2.18	787
Total Runoff within Machado Lake Watershed	**6,112**		**13,323**
Total Runoff to Machado Lake[1]	**5,404**		**11,779**

Note: (1) Total runoff to Machado Lake is a sum of runoff from Wilmington Drain, Project 77/510, and Walteria Lake.

MACHADO LAKE ASSESSMENT

FINAL PROJECT REPORT

Prepared by

City of Los Angeles
Department of Public Works
Bureau of Sanitation
Watershed Protection Division

March 2004

A project funded under Section 205(j) of the Clean Water Act and the City of Los Angeles

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EXECUTIVE SUMMARY

In June 2000, the City of Los Angeles, Department of Public Works, Bureau of Sanitation, Watershed Protection Division (WPD) submitted a grant application to the State Water Resources Control board (SWRCB) for funding under Section 205(j) of the Clean Water Act (CWA) to undertake a Machado Lake Assessment study. The scope of work, as described under the grant application, included water quality assessment, pollutant of concerns identification, control measures selection, and preliminary engineering design of the selected control measures. The SWRCB issued the notice of award on April 2, 2001, and the contract was executed on February 4, 2002. This project was administered by the WPD, and 75 percent of the cost (or up to $93,750) was funded by the federal grant under Section 205(j) of CWA.

In December 2000, while the grant application was under review, the City of Los Angeles Department of Recreation and Parks and the Palos Verdes South Bay Audubon Society commissioned the Ken Malloy Harbor Regional Park (KMHRP) Habitat Restoration Plan in an attempt to improve the invaluable habitat within the KMHRP, which has been degraded by human misuse, and to clean up Machado Lake, which has been polluted because of urban and stormwater runoff. As part of this 18-month project, a Machado Lake Watershed Management Plan (WMP) was also prepared. Several tasks undertaken to develop the Machado Lake WMP were similar to the scope of work proposed under the Section 205(j) grant application. Therefore, once the Section 205(j) grant application was approved, the scope of work for this project was modified to supplement and enhance the Machado Lake WMP and to prepare the preliminary engineering design of the selected control measures, which was not undertaken as part of the Machado Lake WMP.

The modified scope of work under Section 205(j) of the CWA grant includes:

- Conduct dry and wet weather sampling
- Identify and confirm targeted pollutants
- Specify alternative structural and source control management measures
- Select structural and/or source control Best Management Practices (BMPs)
- Conduct preliminary engineering design of the selected structural BMPs
- Prepare an evaluation framework for the other urban lakes in the City of Los Angeles

This Project Report presents the results of water quality sampling conducted between January and May 2003. The results of this water quality sampling and the review of previous studies were used to develop the Pollution Abatement Plan, which explored various pollution control measures (or BMPs) to improve the water quality of the lake. Based on the water quality evaluation, trash is the major pollutant of concern at the lake. Coliform and fecal bacteria levels in the runoff and lake water samples during the wet season were also high, but levels in the lake dropped during dry weather. Total suspended solid concentrations, which contribute to sediment in the lake, were within the normal ranges of urban stormwater runoff. Copper (Cu) and lead (Pb) concentrations in the runoff samples were also found within the normal ranges of the urban runoff. Organopesticides and polychlorinated biphynyls (PCBs) were below the laboratory reporting limits within the runoff samples and lake water samples.

Based on examination of various alternatives, three BMPs were selected for further development, including the construction of a sedimentation basin to trap sediments from entering the lake via the Wilmington Drain, the installation of the netting system to trap trash at the Project 77/510 drains to collect trash and debris discharging to the lake, and the use of catch basin inserts and covers at various locations throughout the watershed. This report presents a preliminary engineering design of the proposed BMPs. Due to space limitation and the decreasing level of sediment loading at the lake, construction of the sedimentation basin is not considered as a top priority among the three types of BMPs evaluated.

In addition to the structural BMPs, nonstructural or source control BMPs will be a key to success in the long-term water quality improvement of Machado Lake. A number of source control BMPs have been identified, such as public education, outreach, and enforcement of rules and regulations.

This Project Report also presents the City of Los Angeles Urban Lake Evaluation Framework, which is prepared using the experience obtained from the work undertaken at Machado Lake. This framework is prepared to evaluate other lakes within the City of Los Angeles to improve their water quality.

SECTION 1

INTRODUCTION

1.1 PROJECT BACKGROUND

The forty-acre Machado Lake is located within the Ken Malloy Harbor Regional Park (KMHRP) in the Wilmington section of Los Angeles, about 15 miles south of downtown Los Angeles (Figure 1-1). The lake is a polluted freshwater system with limited water circulation and continuous siltation. Contaminants found in the lake, such as trash, pesticides, minerals, nutrients, organics, and heavy metals, are attributable to general pollutants contained in urban runoff from the 20-square-mile watershed (Figure 1-2). These pollutants may pose a threat to the aquatic life, wildlife, or plant habitats found in the lake and the KMHRP. They also impair the beneficial uses of this ecosystem, including recreational fishing.

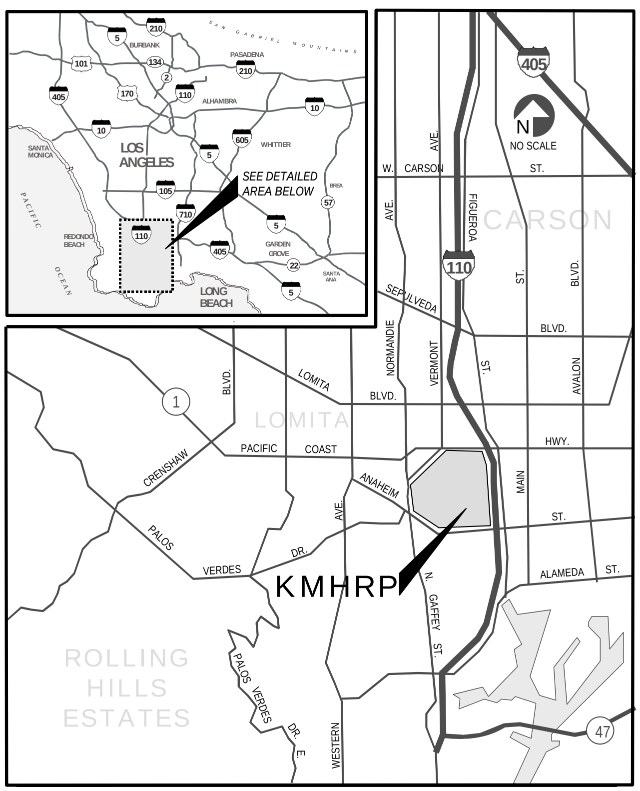
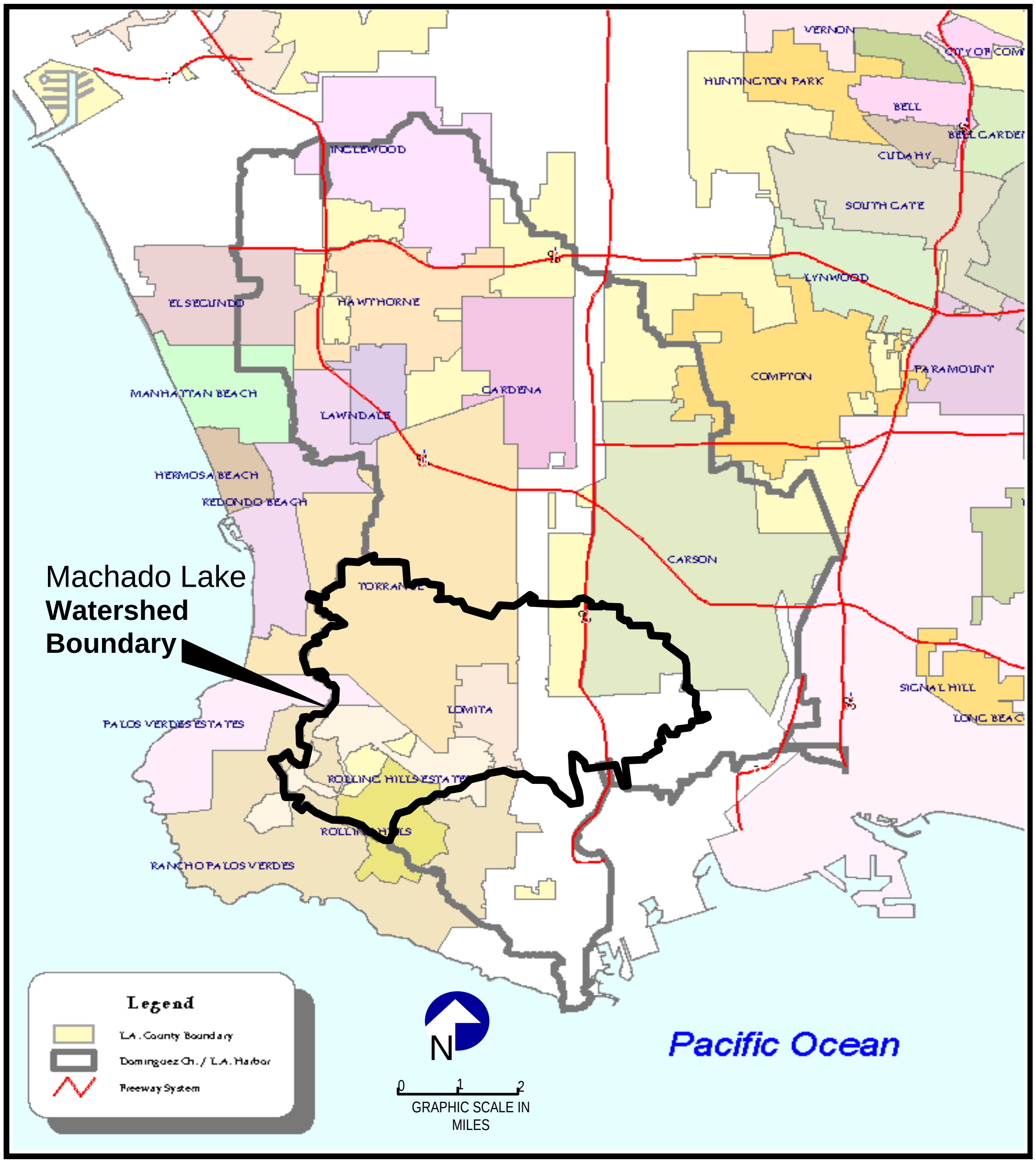


Figure 1-1 Location Map



SOURCE: Modified from Los Angeles County Public Works, Dominguez Channel/L.A. Harbor Watershed Management Area Plan

Figure 1-2 Machado Lake Watershed Boundary

Machado Lake and its environs support a diverse and rich ecosystem. This includes over 300 species of birds. The endangered least tern forages around the lake during summer. The park is also the home to a number of endangered and rare plant species, such as the southern tarweed and Palmer's goldenbush. The lake supports wetland-dependent communities of tule (rushes) and surrounding willow forest, which are among the last of their type in southern California. Fish found in the lake include large-mouth bass, bluegill, sunfish, goldfish, and channel catfish. Recreational fishing is impaired due to the high concentration of pesticides and heavy metals found in fish tissues.

Existing beneficial uses for Machado Lake designated by the Los Angeles Regional Water Quality Control Board (RWQCB) in its Water Quality Control Plan or Basin Plan (RWQCB, 1994) include Water Contact Recreation (REC-1); Non-contact Water Recreation (REC-2); Warm Freshwater Habitat (WARM); Wildlife Habitat (WILD); Rare, Threatened, or Endangered Species (RARE); and potential for Municipal and Domestic Supply (MUN). These beneficial uses support several activities within the KMHRP and Machado Lake, such as picnicking, bird watching, hiking, fishing, boating, and canoeing. Trash, litter, and odors impair the recreational activities around the lake. The level of nutrients (i.e., nitrogen and phosphorus compounds) found in the lake water has been a historical concern that they may reduce the dissolved oxygen levels and contribute to lake's eutrophication.

Over the past 15 years, a number of water quality improvement projects have been implemented, which included dredging, installation of aeration pipes, and frequent removal of aquatic plants. During the same period, a number of studies have also been conducted. A study conducted by University of California, Riverside (April 1994), on behalf of the RWQCB, found the lake and its beneficial uses to be impaired due to trash, nutrients, and heavy metals.

In June 2000, the City of Los Angeles, Department of Public Works, Bureau of Sanitation, Watershed Protection Division (WPD) submitted a grant application to the State Water Resources Control board (SWRCB) for funding under Section 205(j) of the Clean Water Act (CWA) to undertake a Machado Lake Assessment study. The scope of work, as described under the grant application, included water quality assessment, pollutant of concerns identification, control measures selection, and preliminary engineering design of the selected control measures. The SWRCB issued the notice of award on April 2, 2001, and the contract was executed on February 4, 2002.

In December 2000, while the Section 205(j) grant application approval process was in progress, the City of Los Angeles Department of Recreation and Parks and the Palos Verdes South Bay Audubon Society had commissioned the KMHRP Habitat Restoration Plan in an attempt to improve the invaluable habitat within the KMHRP and to clean up Machado Lake. As part of this 18-month project, a Machado Lake Watershed Management Plan (WMP) was also prepared.

1.2 SCOPE OF WORK

Several tasks undertaken to develop the preceding Machado Lake WMP (City of Los Angeles Department of Recreation and Parks, 2002), prepared as part of the KMHRP Habitat Restoration Plan Development Program, were similar to the scope of work proposed under the Section 205(j) grant application. Therefore, once the Section 205(j) grant application was approved, the scope of work for this project was modified to supplement and enhance the Machado Lake WMP and to prepare the preliminary engineering design of the selected control measures, which was not carried out as part of the Machado Lake WMP.

The overall scope of work for this phase of the project includes:

- Conduct dry and wet weather sampling
- Identify and confirm targeted pollutants
- Specify alternative structural and source control management measures
- Select structural and/or source control Best Management Practices (BMPs)
- Conduct preliminary engineering of the selected structural BMPs
- Prepare an evaluation framework for the other urban lakes in the City of Los Angeles

The study utilized a systematic approach to reach the goals and objectives for improving the water quality of Machado Lake. Pollution sources into the lake were identified through monitoring and watershed investigations. Water quality monitoring data was then used to calculate the pollutant loads into the lake and to identify the pollutants that impair the beneficial uses of the lake. Based on this information, the Pollution Abatement Plan was developed to identify appropriate BMPs, which included public education, source control, and various engineering solutions for implementation within the watershed to improve the water quality of the lake. Following the preparation of the Pollution Abatement Plan, the Preliminary Engineering Report was prepared to examine the implementation, feasibility, preliminary design, and cost estimates for these systems. This component of the project advances the City's efforts from a study into the implementation of engineering solutions. This will assist in preparing grant applications and attracting the needed funds for a comprehensive solution. Finally, the study can be used as a model for managing and improving other lakes within Los Angeles, utilizing the proposed "Urban Lake Evaluation Framework".

1.3 PROJECT DURATION

The project study began in February 2002 after the contract was approved by the SWRCB. A water quality sampling and analysis plan was prepared and approved by the SWRCB in January 2003. Water quality sampling and analysis were completed in May 2003. Data analysis and BMP selection were performed following completion of the sampling program. The project was completed in March 2004.

1.4 PROJECT ADMINISTRATION AND STAKEHOLDER PROCESS

The WPD staff administered the study. Seventy-five percent of the project cost (or up to $93,750) was funded by Section 205(j) of the CWA federal grant. The grant was administered by the SWRCB.

The Technical Advisory Committee (TAC) was formed to provide technical input to the project development staff. The members of the TAC included the following:

- City of Los Angeles Department of Public Works, WPD
- City of Los Angeles Department of Public Works, Regulatory Affair Division
- City of Los Angeles Department of Recreation and Parks
- County of Los Angeles Department of Public Works (LACDPW)
- RWQCB and SWRCB
- KMHRP Advisory Board
- Dominguez Watershed Advisory Council (DWAC)
- Harbor Regional Park Task Force

The project team consisted of WPD staff. However, the consulting firm, Parsons provided technical assistance in conducting the sampling and analysis program, preparing the preliminary engineering report, compiling the Project Report, and developing the Urban Lake Evaluation Framework.

1.5 REPORT ORGANIZATION

This Project Report presents the results of the water quality and analysis program, the Pollution Abatement Plan, and the preliminary engineering design of the selected BMPs and the Urban Lake Evaluation Framework. The report is organized as described below:

Executive Summary
The executive summary summarizes project background, project objectives, scope of work, and results of the studies.

Section 1 – Introduction
This section provides a brief overview of the Machado Lake Assessment Project, scope of the study, project status, and report organization.

Section 2 – Water Quality and Lake Sampling
This section describes water quality sampling methodologies, presents the sampling and analysis results, and discusses the analysis results.

Section 3 – Pollution Abatement Plan
This section identifies pollutants of concern, explores various treatment and source control alternatives to minimize pollutants discharging to Machado Lake, and makes recommendations for the selection of the treatment and/or source controls.

Section 4 – Preliminary Engineering Report
This section provides a preliminary engineering design of the appropriate BMPs evaluated and selected as part of the Pollution Abatement Plan development.

Section 5 – City of Los Angeles Urban Lake Evaluation Framework
This section provides a guidance to evaluate other lakes within the City of Los Angeles to improve water quality. The framework is prepared using the experience obtained from the work undertaken at Machado Lake.

Section 6 – References

Appendixes
Reference materials, sampling data, and other information collected during the course of the study are presented in the appendixes.

SECTION 2

WATER QUALITY SAMPLING

2.1 SAMPLING PROGRAM DEVELOPMENT

A water quality sampling and analysis program was conducted to validate and supplement the work of the previous Machado Lake WMP study. The sampling program was developed to be consistent with the 2001 program conducted as part of the Machado Lake WMP development. This section of the report presents the sampling program and the results of each sampling event.

Two wet weather sampling events and one dry weather sampling event were carried out in accordance with the sampling procedures outlined in the Quality Assurance Project Plan (QAPP), prepared by the City, and approved by the SWRCB in January 2003 (Appendix A).

2.2 WET WEATHER SAMPLING

Sampling Locations

Water samples were collected from two major storm drains discharging to Machado Lake and three locations within the lake, as shown in Figure 2-1 and described below:

- Sampling Location A – Wilmington Drain Pump Station, north of Pacific Coast Highway
- Sampling Location B – The first manhole upstream of Project 77/510 Storm Drain Outlet at the junction of Vermont Avenue/Normandie Avenue
- Sampling Location C – Northern portion of the lake adjacent to an old willow tree just south of the day labor trailer
- Sampling Location D – Middle portion of the lake north of the boathouse
- Sampling Location E – Southern portion of the lake north of the dam

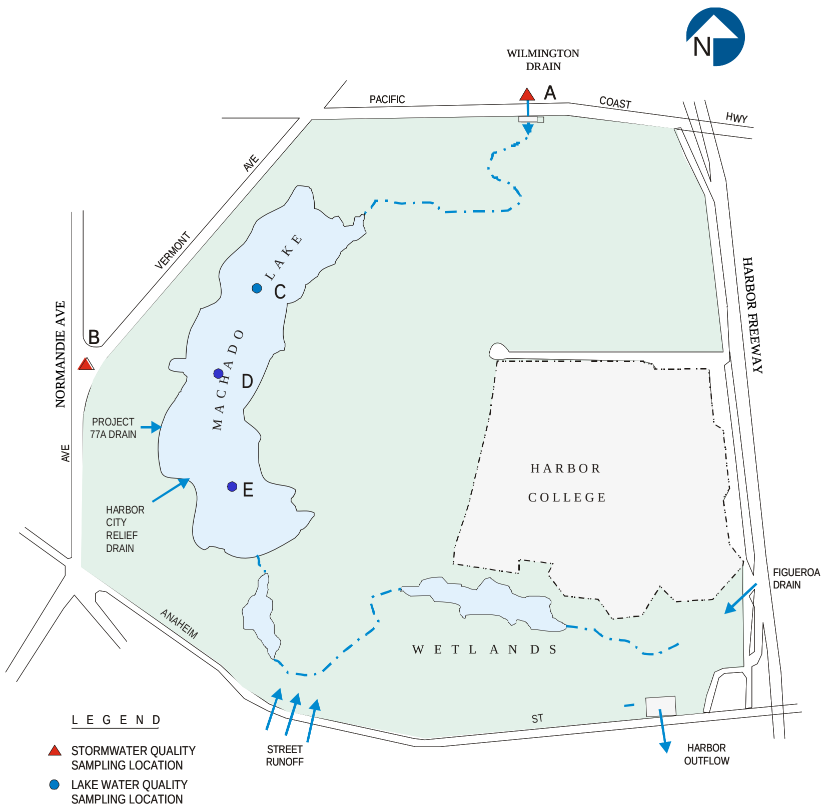


Figure 2-1: Sampling Locations

Sampling Events

The first wet weather sampling took place February 12-13, 2003. Stormwater runoff samples from Sampling Locations A and B were collected on February 12, and the lake samples were collected on February 13 after the rain tapered off. The detailed activities during the February 12-13 sampling event are provided in Appendix B.

The second wet weather sampling took place February 24-26, 2003. Stormwater runoff samples from Sampling Locations A and B were collected on February 24, and the lake samples were collected on February 26 after the rain tapered off. The detailed activities during the February 24-26 sampling event are provided in Appendix B.

Note that the real time flow measurement at Sampling Location A (Wilmington Drain Pump Station) was not conducted because of the flooding of culvert and baffle underneath the Pacific Coast Highway during the rain. The real time flow measurement at Sampling Location B (a manhole upstream of Project 77/510 storm drain outlet) could not be done because of the high depth (about 18 feet below ground surface), which disallowed the equipment installation.

Sample Analysis

In-Field Measurement

The following parameters were measured in the field immediately following the collection of grab samples.

- Dissolved oxygen (DO) (lake only)
- pH
- Temperature
- Water clarity using a Secchi Disk (lake only)
- Physical appearance

Laboratory Analysis

The following constituents were analyzed at Del Mar Analytical Laboratory, a State Environmental Laboratory Accreditation Program (ELAP)-certified laboratory.

- Total suspended solids (TSS)
- Biological oxygen demand (BOD)
- Ammonia – nitrogen
- Nitrate – nitrogen
- Nitrite – nitrogen
- Total phosphorus
- Organochlorine pesticides and polychlorinated biphenyls (PCBs)
- Copper
- Lead
- Fecal and total coliform (lake only)

Sampling Results

Tables 2-1 and 2-2 present the results of each wet weather sampling.

Table 2-1: Wet Weather Sampling Results (February 11 and 13, 2003)

IN FIELD MEASUREMENTS						
		Sampling Locations				
Parameter	**Reporting Limit**	**A**	**B**	**C**	**D**	**E**
pH	--	6.0	6.5	6.1	6.4	6.5
Temperature (^oF)	--	54	58	60	60	62
Dissolved Oxygen (mg/L)	--	--	--	5.6	10.5	10.3
Conductivity (mS/cm)	--	--	--	0.20	0.19	0.20
Secchi Depth (inches)	--	--	--	11.0	12.0	10.7

		Sampling Locations				
Parameter	**Reporting Limit**	**A**	**B**	**C**	**D**	**E**
ORGANOCHLORINE PESTICIDES (µg/L) (EPA 608)						
Aldrin	0.10	ND	ND	ND	ND	ND
Alpha-BHC	0.10	ND	ND	ND	ND	ND
Beta-BHC	0.10	ND	ND	ND	ND	ND
Delta-BHC	0.20	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	0.10	ND	ND	ND	ND	ND
Chlordane	1.00	ND	ND	ND	ND	ND
4,4' –DDD	0.10	ND	ND	ND	ND	ND
4,4' –DDE	0.10	ND	ND	ND	ND	ND
4,4' –DDT	0.10	ND	ND	ND	ND	ND
Dieldrin	0.10	ND	ND	ND	ND	ND
Endosulfan I	0.10	ND	ND	ND	ND	ND
Endosulfan II	0.10	ND	ND	ND	ND	ND
Endosulfan sulfate	0.20	ND	ND	ND	ND	ND
Endrin	0.10	ND	ND	ND	ND	ND
Endrin aldehyde	0.10	ND	ND	ND	ND	ND
Endrin ketone	0.10	ND	ND	ND	ND	ND
Heptachlor	0.10	ND	ND	ND	ND	ND
Heptachlor epoxide	0.10	ND	ND	ND	ND	ND
Methoxychlor	0.10	ND	ND	ND	ND	ND
Toxaphane	5.00	ND	ND	ND	ND	ND
TOTAL PCBs (µg/L) (EPA 608)						
Aroclor 1016	1.00	ND	ND	ND	ND	ND
Aroclor 1221	1.00	ND	ND	ND	ND	ND
Aroclor 1232	1.00	ND	ND	ND	ND	ND
Aroclor 1242	1.00	ND	ND	ND	ND	ND
Aroclor 1248	1.00	ND	ND	ND	ND	ND
Aroclor 1254	1.00	ND	ND	ND	ND	ND
Aroclor 1260	1.00	ND	ND	ND	ND	ND
METALS (mg/L)						
Copper (total)	0.010	0.022	0.029	0.013	0.013	0.013
Lead (total)	0.0050	0.0085	0.012	ND	ND	ND
GENERAL MINERALS/INORGANICS (mg/L)						
Ammonia-N	0.50	0.89	1.20	ND	ND	ND
BOD	2	12	18	3.30	3.40	3.40
Nitrate-N	0.11	0.93	0.76	0.64	0.62	0.64
Nitrite-N	0.15	ND	0.18	ND	ND	ND
Phosphorus	0.05	0.56	0.28	0.34	0.38	0.37
TSS	10	100	100	24.00	25.00	28.00
BACTERIA (MPN/100 mL)						
Total Coliform	<2	--	--	24,000	50,000	>1,600
Fecal Coliform	<2	--	--	3,000	11,000	>1,600

°F: degrees Fahrenheit
ND: Non Detectable mg/L: milligrams per liter
mS/cm: microohm per centimeter MPN: Most Probable Number

Table 2-2: Wet Weather Sampling Results (February 24-26 2003)

IN FIELD MEASUREMENTS						
		Sampling Locations				
Parameter	**Reporting Limit**	**A**	**B**	**C**	**D**	**E**
pH	--	7.0	6.5	6.6	6.3	6.6
Temperature (°F)	--	51	57	58	58	59
Dissolved Oxygen (mg/L)	--	--	--	9.9	10.0	10.1
Conductivity (mS/cm)	--	--	--	0.15	0.15	0.17
Secchi Depth (inches)	--	--	--	11.4	12.4	14.1
ORGANOCHLORINE PESTICIDES (µg/L) (EPA 608)						
Aldrin	0.10	ND	ND	ND	ND	ND
Alpha-BHC	0.10	ND	ND	ND	ND	ND
Beta-BHC	0.10	ND	ND	ND	ND	ND
Delta-BHC	0.20	ND	ND	ND	ND	ND
gamma-BHC (Lindane)	0.10	ND	ND	ND	ND	ND
Chlordane	1.00	ND	ND	ND	ND	ND
4,4' –DDD	0.10	ND	ND	ND	ND	ND
4,4' –DDE	0.10	ND	ND	ND	ND	ND
4,4' –DDT	0.10	ND	ND	ND	ND	ND
Dieldrin	0.10	ND	ND	ND	ND	ND
Endosulfan I	0.10	ND	ND	ND	ND	ND
Endosulfan II	0.10	ND	ND	ND	ND	ND
Endosulfan sulfate	0.20	ND	ND	ND	ND	ND
Endrin	0.10	ND	ND	ND	ND	ND
Endrin aldehyde	0.10	ND	ND	ND	ND	ND
Endrin ketone	0.10	ND	ND	ND	ND	ND
Heptachlor	0.10	ND	ND	ND	ND	ND
Heptachlor epoxide	0.10	ND	ND	ND	ND	ND
Methoxychlor	0.10	ND	ND	ND	ND	ND
Toxaphane	5.00	ND	ND	ND	ND	ND
TOTAL PCBs (µg/L) (EPA 608)						
Aroclor 1016	1.00	ND	ND	ND	ND	ND
Aroclor 1221	1.00	ND	ND	ND	ND	ND
Aroclor 1232	1.00	ND	ND	ND	ND	ND
Aroclor 1242	1.00	ND	ND	ND	ND	ND
Aroclor 1248	1.00	ND	ND	ND	ND	ND
Aroclor 1254	1.00	ND	ND	ND	ND	ND
Aroclor 1260	1.00	ND	ND	ND	ND	ND
METALS (mg/L)						
Copper (total)	0.010	0.029	0.037	ND	ND	ND
Lead (total)	0.0050	0.014	0.022	ND	ND	ND
GENERAL MINERALS/INORGANICS (mg/L)						
Ammonia-N	0.50	ND	ND	ND	ND	ND
BOD	2	16	6.6	3.60	3.60	3.80
Nitrate-N	0.11	0.52	0.68	0.43	0.39	0.34
Nitrite-N	0.15	ND	0.15	ND	ND	ND
Phosphorus	0.05	0.54	0.45	0.35	0.23	0.30
TSS	10	86	150	21	23	19
BACTERIA (MPN/100 mL)						
Total Coliform	<2	--	--	8,000	14,000	8,000
Fecal Coliform	<2	--	--	8,000	8,000	3,000

°F: degrees Fahrenheit ND: Non Detectable mg/L: milligrams per liter
mS/cm: microohm per centimeter MPN: Most Probable Number

2.3 DRY WEATHER SAMPLING

Sampling Locations

Due to the absence of runoff from the storm drain system during the dry weather period, only lake water samples were collected. The sampling locations in the lake were the same as those of the wet weather sampling events.

Sampling Events

Dry weather water quality samples for Lake Machado were collected on May 29, 2003. No measurable rainfall had occurred in the area since May 3, 2003. Appendix B provides the detailed activities during the sampling event on May 29.

Sample Analysis

In-Field Measurement

The following parameters were measured in the field immediately following the collection of grab samples.

- DO
- pH
- Temperature
- Water clarity using a Secchi Dist
- Physical appearance

Laboratory Analysis

The following constituents were analyzed at Del Mar Analytical Laboratory.

- TSS
- BOD
- Organochlorine pesticides and PCBs
- Fecal and total coliform

Sampling Results

Table 2-3 presents the results of the dry weather sampling.

Table 2-3: Dry Weather Sampling Results (May 29, 2003)

IN FIELD MEASUREMENTS				
		Sampling Locations		
Parameter	**Reporting Limit**	**C**	**D**	**E**
pH	--	6.2	6.3	6.2
Dissolved Oxygen (mg/L)	--	8.8	8.2	8.7
Conductivity (mS/cm)	--	0.55	0.55	0.57
Temperature (°F)	--	74	74	74
Secchi Depth (inches)	--	36.5	41.5	38.5
ORGANOCHLORINE PESTICIDES (µg/L) (EPA 608)				
Aldrin	0.10	ND	ND	ND
Alpha-BHC	0.10	ND	ND	ND
Beta-BHC	0.10	ND	ND	ND
Delta-BHC	0.20	ND	ND	ND
gamma-BHC(Lindane)	0.10	ND	ND	ND
Chlordane	1.00	ND	ND	ND
4,4' –DDD	0.10	ND	ND	ND
4,4' –DDE	0.10	ND	ND	ND
4,4' –DDT	0.10	ND	ND	ND
Dieldrin	0.10	ND	ND	ND
Endosulfan I	0.10	ND	ND	ND
Endosulfan II	0.10	ND	ND	ND
Endosulfan sulfate	0.20	ND	ND	ND
Endrin	0.10	ND	ND	ND
Endrin aldehyde	0.10	ND	ND	ND
Endrin ketone	0.10	ND	ND	ND
Heptachlor	0.10	ND	ND	ND
Heptachlor epoxide	0.10	ND	ND	ND
Methoxychlor	0.10	ND	ND	ND
Toxaphane	5.00	ND	ND	ND
TOTAL PCBs (µg/L) (EPA 608)				
Aroclor 1016	1.00	ND	ND	ND
Aroclor 1221	1.00	ND	ND	ND
Aroclor 1232	1.00	ND	ND	ND
Aroclor 1242	1.00	ND	ND	ND
Aroclor 1248	1.00	ND	ND	ND
Aroclor 1254	1.00	ND	ND	ND
Aroclor 1260	1.00	ND	ND	ND
GENERAL MINERALS/INORGANICS (mg/L)				
BOD	2.0	4.2	3.6	ND
TSS	10	ND	ND	11
COLIFORM BACTERIA (MPN/100 mL)				
Total Coliform	<2	3,000	210	220
Fecal Coliform	<2	8	11	13

°F: degrees Fahrenheit
ND: Non Detectable
mS/cm: microohm per centimeter
mg/L: milligrams per liter
MPN: Most Probable Number

2.4 WATER QUALITY EVALUATION

Wet Weather Sampling Results

Physical Conditions. During the weather sampling events, a lot of floating trash was observed discharging into the lake (i.e., Styrofoam cups, plastic bottles, aluminum cans, paper goods, etc.) from the various discharge locations. The pH values of the runoff samples during the two sampling events ranged from 6.0 to 7.0 while the pH values of the lake water ranged from 6.1 to 6.6. The temperature of the water samples from the lake ranged from 58°F to 62°F. DO concentrations were averaged between 9 and 10 mg/L for all except one sample. This indicates that the DO levels are in satisfactory range during the wet season. BOD_5 concentrations measured in the runoff samples ranged from 6 to 18 mg/L, higher than the 2001 MLWMP wet weather sampling results. The lake water samples had BOD_5 concentrations less than 4 mg/L, which indicate a moderately low concentration of organic contents in the water body.

General Minerals. TSS concentrations in the runoff samples ranged from 86 mg/L to 150 mg/L, with the highest concentration measured at the Project 77/510 sampling location (Location B). TSS concentrations in the lake water varied between 19 mg/L and 28 mg/L, averaging less than the 2001 wet weather sampling results. The BOD and TSS concentrations of all stormwater runoff samples are within the typical ranges of urban runoff quality. Based on the historic sediment accumulation problems in the lake over the past decades, these TSS concentrations in the runoff samples seem to be very low to cause the fast buildup of sediments within the lake. It is possible that several recent control measures within the watershed, such as enforcement of the Stormwater Pollution Prevention Plan (SWPPP) and some source control measures have resulted in a reduction of sediment loading to the lake, as evidenced by the moderate concentrations of TSS in the runoff samples.

Nutrients. Total phosphorus concentrations in the runoff samples ranged from 0.28 mg/L to 0.54 mg/L, and the lake water samples showed a total phosphorus concentration between 0.23 mg/L and 0.38 mg/L. According to the United States Department of Agriculture (USDA), lake water phosphorus concentrations above 0.2 mg/L generally accelerate eutrophication (a process by which a body of water becomes rich in dissolved nutrients and minerals, markedly phosphate and nitrate). Nitrate-N concentrations in the runoff samples ranged from 0.52 mg/L to 0.93 mg/L, while the Nitrate-N concentrations in the lake water ranged from 0.34 mg/L to 0.64 mg/L. Most nitrite concentrations were found to be less than 0.15 mg/L, which is the laboratory reporting limit for nitrite, except for the Project 77/510 manhole, where nitrite was detected at 0.18 mg/L and 0.15 mg/L during the two wet weather samplings, respectively.

In conclusion, nitrate and phosphorus were detected at higher levels at the storm drain discharging points than within the lake water body. The difference in concentration is likely to result from the dilution effect of the lake water body. All nutrient indicators have concentrations within the same ranges of urban stormwater quality published by the United States Environmental Protection Agency (EPA) and the LACDPW, as presented in the Machado Lake WMP (City of Los Angeles, 2002).

2.8.5 Laboratory Data Validation

The contracted laboratory shall follow the procedures outlined in this QAPP, including sample bottles preparation, chain-of-custody requirements, analytical methods to be used, control samples to be run, and the requirements for storage and disposal of samples.

The contracted laboratory are to notify the Parsons project manager in a timely manner if any non-conformances occur prior to and during the analysis of samples. This may necessitate the resampling of samples. The laboratories are to provide at a minimum level 2 reviews of the data prior to sending reports to the Parsons project manager. A text report on the data package is to be provided if any anomalies are found. The reports are to be signed by the Laboratory Director/ an officer of responsibility.

An audit of the laboratory by a Parsons's scientist may be made at an undisclosed time while the samples for this project are being analyzed.

Parsons will perform data validation of the data generated by the certified laboratories used to perform the analysis of samples for this project.

The EPA Contracted Laboratory Program guidelines will be followed to verify that:

1. The control data associated with the data are run and submitted to Parsons.
2. The control data which will be required with this project are: Chain of Custody, Blanks, Matrix Spike (MS) and Matrix Spike Duplicates (MSD), Laboratory Control Sample (LCS), Continuous Calibration Verification (CCV) Standard (This standard will be analyzed prior to analysis of samples), Surrogates for Organic Analyses, Control Ranges for the MS, MSD, LCS, CCV and Surrogate percent recoveries, control range for the relative percent differences and the reporting limits for all methods.
3. The chain-of-custody will be examined for the sample collection data and compared to the date stated in the analytical report, the proper signatures of relinquishing and receiving of samples, the temperature of the cooler holding the samples, and if the correct amount of preservative require by the method was added. Also, if the methods stated on the chain-of-custody were used to analyze the samples and if the proper number were collected as required by the analytical methods.
4. The elapsed time will be checked to determine if the extraction/ analysis date is performed within the appropriate time required by the analytical method.
5. The content of the blanks will be examined to determine if contamination exists in the reagents used in the digestion or extraction. The field and equipment blanks will also be examined for potential contamination. The criteria for allowable contamination in a blank will be determined by the 5x Rule. Any compound detected in the sample, which was also detected in any associated blank, must be qualified as estimated when the sample concentration is less than five times the blank concentration. If some sample concentrations are greater than or equal to five times the concentration of the blank, no further action is required. If an analyte is detected in a field blank but is not detected in the associated sample, no action is taken.

Based on the levels of nutrients and DO in the lake water samples and field observation, there is no clear evidence of eutrophication in Machado Lake during the wet season.

Coliform Bacteria. The total coliform bacteria in the lake water for the two sampling events ranged from 8,000 to 50,000 MPN/100 mL, while the fecal coliform bacteria ranged from 3,000 to 11,000 MPN/100 mL. These bacteria levels do not meet the criteria for REC-1 or REC-2 beneficial uses set forth by the RWQCB.

Trace Metals. Total copper (Cu) concentrations at the storm drain sampling locations ranged from 22 µg/L to 37 µg/L, while the lake water samples had Cu concentrations around 13 µg/L, consistent with the 2002 sampling results. Total lead (Pb) concentrations at the storm drain sampling locations ranged from 8.5 µg/L to 22 µg/L, with none detected within the lake. The levels of Cu and Pb in the runoff samples are within the normal range of Cu and Pb found in the urban runoff (EPA, 1983). The Cu and Pb concentrations in the lake water samples are within the recommended water quality criteria to protect freshwater aquatic life in the water body containing moderate hardness levels established by the California Toxic Rule and EPA (RWQCB, 2003).

Toxicity. Organochlorine pesticides and PCBs were detected below the reporting limits at all sampling stations.

<u>Dry Weather Sampling Results</u>

Physical Conditions. During the dry weather sampling event on May 29, 2003, floating trash was observed in the discharge to the lake. Due to the absence of storm drain runoff, only lake water samples were collected. The average pH value of the lake water was 6.3 with the temperature measuring at 74°F. DO concentrations were at satisfactory levels, above 8 mg/L for all samples.

General Minerals. BOD_5 concentrations in the lake water were around 4 mg/L, which indicate a moderately low concentration of organic contents in the water body. TSS concentrations in the lake water ranged from non-detectible to 11 mg/L. The levels of TSS in the lake water decreased during the dry season compared to the wet season, consistent with the 2001 sampling results. This is because there is no stormwater transporting suspended pollutants into the lake during such periods, and the lack of circulation within the lake has promoted the settlement of the suspended solids.

Coliform Bacteria. The total coliform bacteria for the lake water samples ranged from 210 to 3,000 MPN/100 mL, while the fecal coliform bacteria ranged from 8 to 13 MPN/100 mL. The coliform bacteria levels in the lake water during the dry weather sampling are lower than the levels observed during wet weather. However, the data were not adequate to determine if the water quality criteria for REC-1 and REC-2 beneficial uses are consistently met.

Toxicity. Organochlorine pesticides and PCBs were detected below the reporting limits at all sampling stations.

Conclusion

Results of water quality analyses during both the previous investigation (2001 MLWMP) and this study were consistent. The TSS levels in the lake water were normally higher during the wet weather period due to stormwater runoff discharging to the lake. The TSS levels in the lake water decreased during the dry season because there is no stormwater transporting suspended pollutants into the lake during the dry season, and the lack of circulation within the lake has promoted the settlement of the suspended solids. Based on the TSS levels in the runoff and the lake water samples of the recent sampling events, it is not evident that the sediment accumulation rate within the lake is occurring at the rate as high as that previously reported. As mentioned before, it is likely that several recent control measures within the watershed, such as enforcement of the construction SWPPP and some source control measures have resulted in a reduction of sediment loading to the lake, as evidenced by the moderate concentrations of TSS in the runoff samples.

Trash is the most visible pollutant at the lake and has been most noticeable near the storm drain outlets into the lake, especially around the Wilmington drain. Based on the results of phosphorus and nitrogen analysis during the 2001 and 2003 sampling programs, there is a slight potential for eutrophication in the lake, although there was no clear evidence of algal bloom during the sampling events. This observation, compounded by the satisfactory DO readings in the lake, diminishes the nutrients as pollutants of concern.

Total Cu and Pb concentrations in the runoff samples were found to be within the normal ranges of the urban runoff (EPA, 1983). While the Cu levels in the lake water were consistent during the 2001 and 2003 sampling events, Pb was not detectible during both wet weather sampling events in 2003. In addition, Pb levels in the lake water were found to be drastically decreased over time as compared to the levels found in 1975, 1976, and 1977 of 64 mg/L, 194 mg/L, and 224 mg/L, respectively. The current Cu and Pb levels in the lake water samples are within the recommended water quality criteria to protect freshwater aquatic life in the water body containing moderate hardness level established by the California Toxic Rule and EPA.

Organopesticides and PCBs were below the laboratory reporting limits during both 2001 and 2003 sampling programs. The results of analysis performed between 1983 and 1997 found elevated PCBs and DDT in fish tissues sampled from Machado Lake (California Department of Fish and Game, 1983-1997). Sediment sampling and analysis conducted within the lake in 2001 found low levels of one pesticide compound (DDE) and one PCB compound (archlor 1260) in the lake sediments. The absence of organopesticides, PCBs, and polynuclear aromatic hydrocarbons (PAHs) in the stormwater runoff samples and the presence of these compounds in the sediments during the 2001 sampling event suggested that these pollutants may have entered the lake from the historic inputs and could persist in the sediments. However, most of these toxic substances are hydrophobic, and are only rarely detected during water column sampling, as they tend to adsorb to sediments or organic materials. Even though PCB and DDE compounds have been banned for many years they persist in soil deposits throughout the watershed. Therefore, stormwater runoff is expected to carry some of these contaminants to the lake. However, the amounts can only be quantified if lower detection limits are used in the sample analysis. This study can conclude however that because of the drastic reduction of these the application of these substances in the watershed, the predominant source of organopesticides and PCBs in the lake is due to historical inputs.

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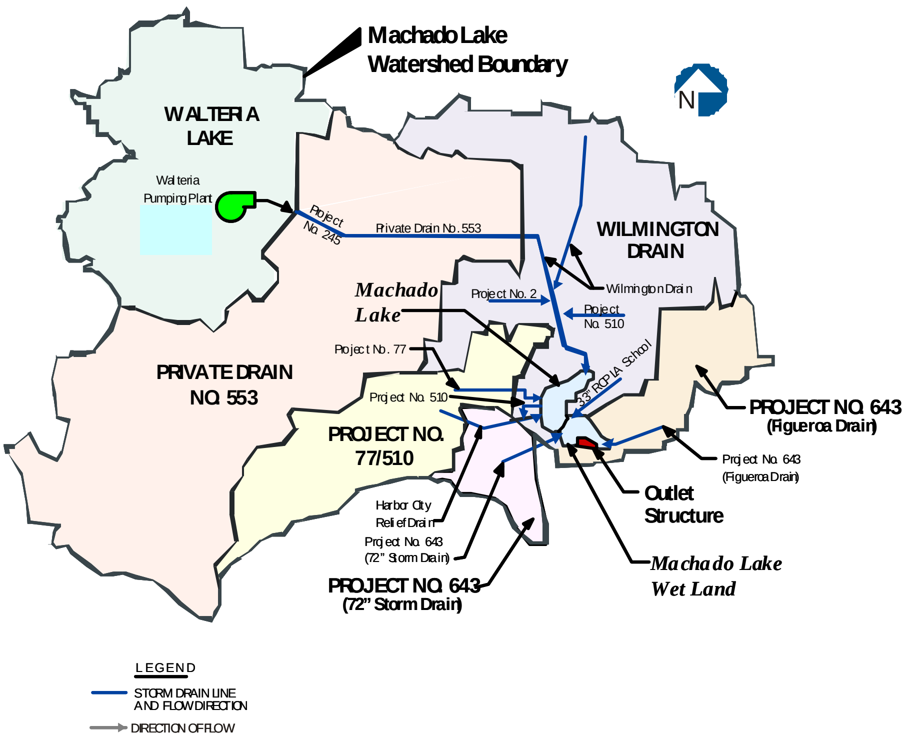
SECTION 3

POLLUTION ABATEMENT PLAN

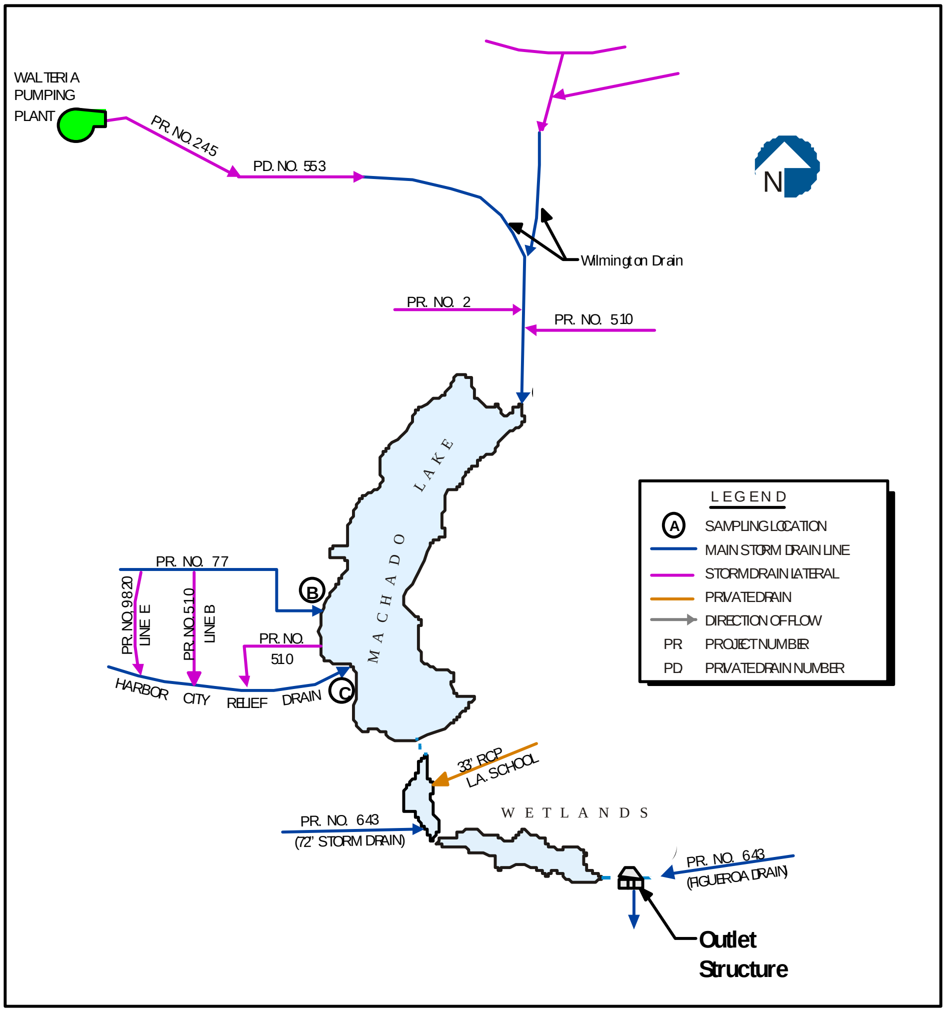
3.1 RUNOFF QUANTIFICATION

Discharging points to Machado Lake are from two major drain systems, the Wilmington Drain, and the interconnected Project No. 77 and Harbor City Relief Drains (project 77/510 Drains). Flows discharging to the Wilmington Drain are from two major subdrainage areas, including Wilmington Drain and Private Drain 553. Flow from Walteria Lake is discharged to the Wilmington Drain by pumping during the overflow periods. Since no information on the pumping volume and schedule is available, the contribution from Walteria Lake is not included in the calculation. Figure 3-1 shows the boundary of subdrainage areas within the Machado Lake Watershed. Figure 3-2 shows a schematic layout of drainage systems discharging to Machado Lake. Table 3-1 summarizes the subwatershed areas and the amount of runoff entering the lake based on the average annual rainfall of the area.



Source: KMHRP WMP, 2002

Figure 3-1: Machado Lake Watershed Boundary and Subdrainage Areas



Source: KMHRP WMP, 2002 (Note: Sampling locations shown were for 2001 sampling events.)

Figure 3-2: Schematic Layout of Drainage Systems Discharging to Machado Lake

Table 3-1: Average Annual Runoff from Subdrainage Areas within the Machado Lake Watershed

Drainage Area	Area (acre)	Average Annual Rainfall (inches)	Runoff Coefficient[1]	Average Annual Runoff (acre-ft/yr)
Project 77/510	1,636	13.5	0.46	847
Wilmington Drain (includes Private Drain 553)	9,737	13.5	0.52	5,697

[1] The runoff coefficient is calculated as .1+.8*Imperviousness, utilizing LACDPW imperviousness table for all landuse polygons within the respective subwatersheds. (Los Angeles County 1994-2000 Integrated Receiving Water Impacts Report, 2002)

As shown in Table 3-1, the majority of pollutants are transported to the lake via the Wilmington Drain.

3.2 POLLUTANT LOADING

In absence of real time flow data and continuous water quality monitoring data, pollutant loading from each discharge point to Machado Lake was roughly estimated by multiplying the volume of runoff (Table 3-1) with the average concentration of each pollutant of concern during the wet weather sampling events (Table 3-2). The average annual runoff from each subwatershed was calculated by multiplying an average annual rainfall of 13.5 inches with the acreage of each subwatershed. Table 3-3 shows the results of the pollutant load calculations.

Table 3-2: Average Pollutant Concentration

Constituent	Sampling Event 1 – 2/11/03 (mg/L)		Sampling Event 2 – 2/24/03 (mg/L)		Average Concentration of Constituent (mg/L)	
	Wilmington Drain	Project 77/510	Wilmington Drain	Project 77/510	Wilmington Drain	Project 77/510
Copper	0.022	0.029	0.029	0.037	0.026	0.033
Lead	0.0085	0.012	0.014	0.022	0.011	0.017
Ammonia-N	0.89	1.2	ND	ND	0.89	1.2
BOD	12	18	16	6.6	14	12
Nitrate-N	0.93	0.76	0.52	0.68	0.73	0.72
Nitrite-N	ND	0.18	ND	0.15	ND	0.17
Phosphorus	0.56	0.28	0.54	0.45	0.55	0.37
TSS	100	100	86	150	93	125

Table 3-3: Pollutant Loading Estimate

Constituents	Average Concentration (mg/L)		Annual Runoff (acre-ft/yr)		Conversion Factor (lb/454,000mg)* (1,233,000 L/ac-ft)	Pollutant Loading[1] (lb/year)	
	Wilmington Drain	Project 77/510	Wilmington Drain	Project 77/510		Wilmington Drain	Project 77/510
Copper	0.026	0.033	5,696	847	2.72	400	76
Lead	0.011	0.017	5,696	847	2.72	170	39
Ammonia -N	0.89	1.2	5,696	847	2.72	14,000	2,800
BOD	14	12	5,696	847	2.72	220,000	28,000
Nitrate - N	0.73	0.72	5,696	847	2.72	11,000	1,700
Nitrite - N	ND	0.17	5,696	847	2.72	-	380
Phosphorus	0.55	0.37	5,696	847	2.72	8,500	840
TSS	93	125	5,696	847	2.72	1,440,000	290,000

[1]Values are rounded to two significant figures

3.3 POLLUTANTS OF CONCERN

Based on historical water quality data, the pollutants of concern at the lake are trash, heavy metals, pesticides, and nutrients. These pollutants with the exception of heavy metals are also listed in the most recent CWA 303(d) list for Machado Lake. In addition, sediments had previously reported to accumulated at the bottom of the lake at an accelerated rate.

Based on this study, the trash is the most visible pollutant at the lake. Based on field observations, trash is most noticeable near the storm drain outlets into the lake, especially around the Wilmington drain. Other than urban runoff, a secondary source of trash is direct disposal into the park and lake by park users, and homeless people.

Based on the TSS loading (a major contributing factor to sediments) shown in Table 3-3, the annual sediment accumulation level is estimated to be less than 1 percent of the lake volume. This sediment-loading rate is, therefore, not considered as high as that historically observed. Other contributing factors to sediment deposits within the lake could include plant growth, eutrophication phenomenon, and irrigation runoff during dry weather periods.

The nutrient levels in the lake water during the recent samplings indicate that a potential eutrophication could occur; however, there is no evidence of algal bloom within the lake during many recent observations. Finally, the relatively high D.O. readings minimize the concern of lake eutrophication.

Heavy metals also were not found at an alarming level and much lower than the levels reported in the 1970s. Bacterial levels appear elevated during storm events and seem relatively low during the dry weather conditions. Finally, organopesticides, PCBs, and PAHs were not detectible within the runoff and lake water samples. However, these substances were found in the recent sediment sampling. This study could not quantify the loadings of these substances to the lake. However, with respect to organopesticides, and PCBs, there has been a drastic reduction of the application of these substances in the watershed.

3.4 BMP EVALUATION

The Machado Lake WMP evaluated various lake water quality improvement alternatives to address the identified pollutants of concern, including in-lake treatment, structural and nonstructural BMPs, and administrative improvement. Those proposed improvement efforts and additional BMPs considered as part of this project are summarized below:

In-Lake Treatment

In-lake treatment alternatives previously examined included:

- Aeration system improvement
- Lake dredging
- Lake flushing
- Alum treatment system

Aeration System Improvement: Currently, there is an aeration system within the lake. The system has not been properly functioning over a long period of time. This proposed improvement would include a complete replacement of the aeration piping and dredging of the areas in which the piping would be installed.

Lake Dredging: Several dredging scenarios were explored as part of the KMHRP Habitat Restoration and Water Quality Improvement Design Development Project. The purposes of lake dredging are to construct nesting islands for bird nesting, increase the lake volume, and promote water circulation within the lake.

Lake Flushing: A flow rate of approximately 1.7 million gallons per day (MGD) would be required to maintain continuous dry season overflow at the lake. Alternative sources of water supply considered include the use of secondary effluent from the County Sanitation Districts of Los Angeles County (CSDLAC) Joint Water Pollution Control Plant (JWPCP). Other potential water supply sources include recycled water from the City of Los Angeles' Terminal Island Treatment Plant (TITP), and recycled water from the West Basin Municipal Water District (WBMWD) reclamation plant. To avoid wasting of water, reuse of water being flushed out would be essential.

Alum Treatment System: This system injects alum liquid into the storm drain before runoff can be discharged into the lake. The alum binds with suspended solids, heavy metals, and phosphorus, causing them to precipitate out to the bottom of the lake in a stable, inactive state. The system is generally used with existing pipes discharging into existing lakes, but it may also be designed in conjunction with creating a new holding pond or with offline floc settling ponds and automatic floc disposal systems.

Structural BMPs

The Machado Lake WMP evaluated a variety of structural BMPs. These BMPs can treat the stormwater as it enters the collection system, and can be installed in-line, off-line, or at end of pipe. The following describes various treatment control BMPs currently available that were considered candidates for removing and preventing pollutants of concern at Machado Lake. Please note, the study team was limited to evaluating the available technology and providing advice regarding the suitability of the system for a particular use, and it does not endorse or have any financial interest in any particular commercially available BMP system.

Sedimentation Basin: The Machado Lake WMP proposed the construction of a sedimentation basin at the north end of the lake, below the Wilmington Drain within the KMHRP, to trap the sediments from entering the lake from the majority of the incoming flow to the lake. However, the proposed site has limited space, and it is environmentally sensitive because it contains native plants. Therefore, new, less-sensitive locations would have to be determined.

Netting Systems: These technologies are designed to reduce or eliminate trash, debris, and associated pollutants in storm drain systems. This technology can be installed on land or on water and uses the passive energy of the effluent stream to drive the floatable materials into disposable mesh bags (Figures 3-3 to 3-5). These bags are suspended horizontally in the storm drain flow stream within a support system. Currently the two commercially available systems are by Fresh Creek Technologies Inc and by P.J. Hannah Inc. These systems can be installed in-line or end-of-line, and are supplied as prefabricated unit that are delivered to the site for installation. The life expectancy of the system is at least 20 years.

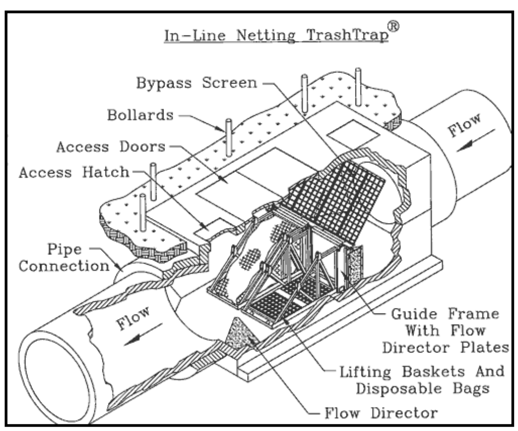


Figure 3-3: In-Line System by Fresh Creek Technologies, Inc.

Figure 3-4: End-of-Line System by Fresh Creek

Figure 3-5: Floating Unit by Fresh Creek

Hydrodynamic Separators: Hydrodynamic separators, which are widely used in storm water treatment, are flow-through structures with a settling or separation unit to remove sediments and other pollutants from storm water and urban runoff. No outside power source is required, because the energy of the flowing water allows the sediments to efficiently separate generally through swirl action and gravity. An example of these systems is the Continuous Deflective Separation (CDS) unit. The CDS unit is designed to remove trash and debris, as well as sediments from urban and stormwater runoff. The technology utilizes a non-blocking, non-mechanical screening process to remove pollutants from storm drain flow (Figures 3-6 and 3-7). CDS units are available in precast concrete for flows up to 64 cubic feet per second (cfs). For larger flows, units are designed as cast-in-place, which can handle flow up to 300 cfs.

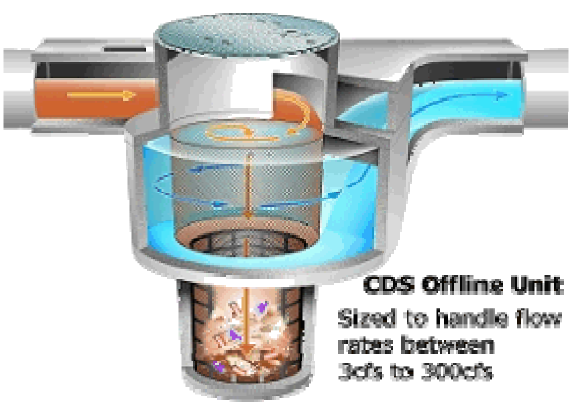


Figure 3-6: Hydrodynamic Separator Off-line Unit by CDS Technologies

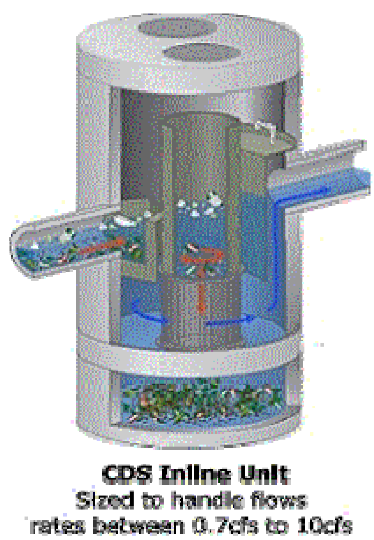


Figure 3-7:Hydrodynamic Separator In-line Unit by CDS Technologies

Filtration: Filtration of stormwater runoff is the most advanced form of stormwater runoff treatment. This technology is readily available under various products supplied by vendors. One such product is the Stormfilter™ by Stormwater Management, Inc., of Portland, Oregon. The patented *Stormfilter*™ technology utilizes a stormwater filtration system that incorporates various types of filtration media to treat a variety of pollutants (Figure 3-8). This system typically treats smaller watersheds; hence, water quality flow rates are on an order of magnitude not greater than 10 cfs. Installation of the system is very similar to that of a maintenance hole or utility vault structure. The precast vault is set in place and the external plumbing is attached. Larger systems would be field cast.

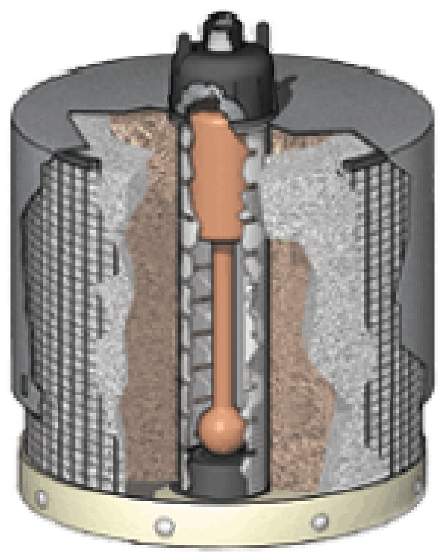


Figure 3-8: Stormwater Filtration Technology by Stormwater Management, Inc.

Catch Basin Filters: Various types of filter inserts are typically placed in catch basins to treat runoff from oil and grease, heavy metals, and other pollutants before they can enter the storm drain. These devices may be considered for the beginning of pipe treatment methods rather than the end of pipe treatment devices illustrated above. The filter inserts trap trash, floating debris, sediment, hydrocarbons, and leaves and grass clippings from the streets. Examples of catch basin filters commercially available are shown in Figures 3-9 and 3-10.

Figure 3-9: Catch Basin Filter
by KriStar Enterprises, Inc.

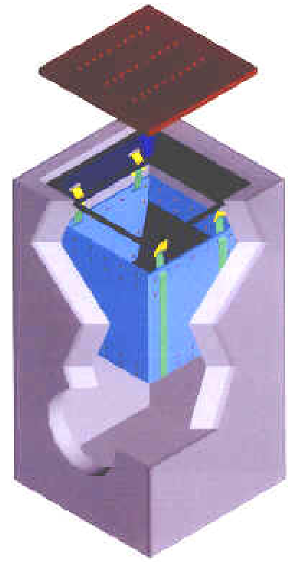


Figure 3-10: Catch Basin Filter
by Abtech Industry

Catch Basin Opening Screens: Catch basins can also be retrofitted by placing screens on the opening to prevent trash from entering the stormwater collection system. The simplest configuration consists of plain screen board that is permanently bolted to the face of the catch basin opening (Figure 3-11). One concern with this system is the potential for flooding that can occur if the screen is clogged with trash and debris. To minimize this problem, two types of modified screens have been developed that open when water builds up against the screen. The first utilizes a hydraulic system to open the screen when flow is detected above a certain level (Figure 3-12). The second uses magnets that allow the screen to open when sufficient pressure builds as the water level rises against the screen (Figure 3-13).

Figure 3-11: Catch Basin Opening Screen
by United Stormwater, Inc.

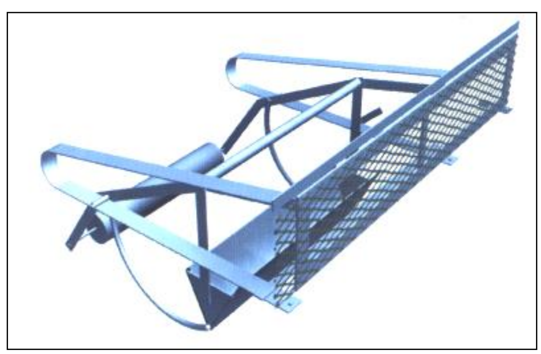


Figure 3-12: Catch Basin Opening Screen
by Asbury Environmental Services

Figure 3-13: Catch Basin Opening Screen by Practical Technologies, Inc.

Catch Basin Inserts: There are a number of commercially available inserts that consist of baskets inserted into the catch basin that can trap trash and debris. The walls of the baskets can consist of a fabric that can trap trash and sediments (Figure 3-14) or screens to just trap trash (Figure 3-15).

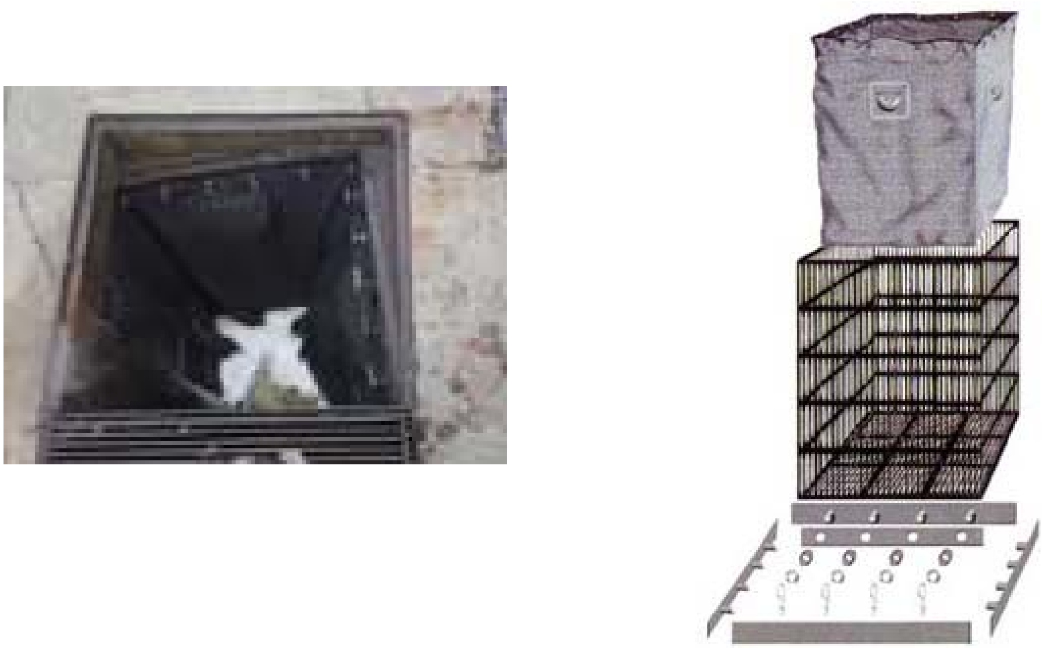


Figure 3-14: Catch Basin Inserts by United Stormwater, Inc.

Figure 3-15: Catch Basin Inserts by Practical Technologies, Inc.

Nonstructural/Source Control BMPs

Public Education: An institutional BMP intended to educate the public to change the way it manages many of the pollutants that wind up in stormwater runoff.

Planning Management of Developing Areas: These practices by local governments can be aimed at reducing runoff and the discharge of pollutants through stormwater from new development or redevelopment, and they are most effective when applied during the site-planning phase of new developments.

Material Use, Exposure, and Disposal Control: These practices include controlling the use, storage, and disposal of chemicals that could pollute runoff. The objective is to reduce the opportunity for rainfall or runoff to be exposed to these chemicals. BMPs include material use controls, material exposure controls, and material disposal and recycling controls.

Spill Prevention and Cleanup: Includes programs that reduce the risk of spills during outdoor handling and the transportation of chemicals and other materials, and the development of plans and programs to respond, contain, and rapidly clean up spills when they occur.

Enforcement of Rules and Regulations: Several regulations and requirements regarding stormwater pollution prevention and control are in place at both local and state levels. Strict enforcement of these requirements by relevant agencies would ensure success in stormwater pollution prevention within the watershed.

3.5 BMP SELECTION

Findings

Aeration System Improvement: The Machado Lake WMP indicated that renovation of the existing aeration system would entail complete replacement of the aeration piping and possibly dredging of the areas where piping would be installed. All sampling events over the past several decades have shown no serious DO depletions. In addition, the aeration system affects only a small part of the lake at the southern end. As a result, this study supports the Machado Lake WMP's recommendation to discontinue the aeration system.

Lake Dredging: Lake dredging would help remove the sediment buildup at the bottom of the lake. The cost of dredging and dredge spoil disposal would be very high, and it would not prevent future pollutants from coming into the lake. In addition, without adequate data on sediment characteristics (the amount of toxic substance deposits and the deposit profile), the impacts on water quality as a result of dredging cannot be assessed.

Sedimentation Basin: Sediment has historically been a problem at Machado Lake, although the current levels of suspended solids found in the runoff samples do not indicate that an accelerated rate of sediment accumulation does occur now. Field observations revealed a substantial amount of sediments at various discharging points to the lake. Based on the historical problems and the results of field observation, sediment trapping maybe needed for Machado Lake. If adequate space is available, construction of the sedimentation basin would help reduce the amount of sediment entering the lake.

Lake Flushing: Lake flushing would require reliable sources of water supply or recycled water, which can potentially be a major constraint. Additionally, construction of the distribution system and the water needed for the flushing may be very costly. To conserve water, the effluent water would need to be reused.

Alum Treatment: Results of the pilot studies described in the Machado Lake WMP revealed no clear results of total nitrogen reduction from alum treatment. In addition, no coliform bacteria removal data were presented. Based on the pilot study results, the size of the Machado Lake Watershed, and the tendency of the system to aggravate the sedimentation problem in Machado Lake, this treatment method does not look promising for Machado Lake.

Netting Systems: The netting systems have proven to be an efficient BMP for end-of-line installations to capture trash and other floatables. Because the system will be installed at the storm drain outlets, excavation and construction costs will be kept to a minimum. Additionally, the proposed locations will simplify maintenance activities.

Hydrodynamic Separators: These systems such as CDS units are typically installed in-line or, on some occasions, installed off-line with a diversion chamber; therefore, they are not appropriate for the high flow channel such as the Wilmington Drain. To treat the required flow from upstream of Wilmington Drain, multiple units would be needed, and it may not be cost effective when compared with other BMP options. Due to the very deep invert elevation of the Project 77/510 drains (15 to 17 ft below ground surface), installation of this system will require extensive excavation efforts and can be quite costly.

Filtration: These systems potentially offer high water quality, but are typically designed to treat smaller watersheds with flow rates not greater than 10 cfs. Given the treatment capacity of the system, this option may not be feasible for Machado Lake. These systems are suitable for small development areas and are not cost effective to install at the end of pipes like those at Machado Lake.

Catch Basin Filters: Inlet devices are typically installed at the beginning of the storm drain systems in catch basins and not at end-of-line. These units can be concentrated at high pollutant areas or at sensitive sites such as industrial or automobile repair facilities.

Catch Basin Opening Screens: These devices are typically inexpensive (about $500 for a 7-ft curb face opening catch basin) and would be effective in removing trash. Screen openings are typically about 1-inch and vary in configuration. Preliminary data gathered by the City of Los Angeles indicate that they prevent approximately 90 percent of the trash generated from small to moderate storms from entering the stormwater collection system.

Catch Basin Inserts: These devices, if correctly specified and properly maintained, may trap all of the trash.

Nonstructural/Source Control BMPs: Source-control BMPs, such as public education and outreach, are one of the simplest control measures and perhaps the least costly of all. Nonstructural/source control can often be integrated into a comprehensive watershed management plan comprising both structural and nonstructural BMPs.

Selected Structural/Proprietary BMPs

Based on the results of BMP evaluation, the following structural/proprietary BMPs are proposed for further exploration and preliminary engineering design.

1. Installing the netting systems at discharging points of the Project 77/510 storm drain system, which includes Project 77 outfall and Harbor Relief Drain outfall on the west side of the lake.

2. Exploring the possibility of constructing a sedimentation basin to treat runoff discharge from the Wilmington Drain.

3. Installing catch basin inserts within the subdrainage areas contributing flows to Wilmington Drain or in areas where no other end-of-pipe BMP is installed.

Netting Systems

The netting systems can be installed on land or in water. A netting system is a modular collection system for floatables that uses the passive energy of the effluent stream to drive the materials into disposable mesh bags. These bags are suspended horizontally within a support structure. The standard nets used in the system are designed to hold up to 25 cubic feet of floatables and a weight of 500 pounds each.

The system is supplied as a prefabricated unit, which is delivered to the site and typically can be assembled and installed in less than 2 days. Nets with captured floatables can be removed from the system by several methods. Nets can be lifted by a boom truck crane and placed in a carting container for proper disposal. The life expectancy of the system is at least 20 years.

Sedimentation Basin

The Wilmington Drain contributes the majority of the stormwater inflow (60 percent of the total flow to Machado Lake) and, subsequently, sediment to Machado Lake. Two subwatersheds, with a total drainage area of 9,737 acres, directly discharge runoff to the Wilmington Drain. The total runoff from these two subwatersheds is approximately 5,700 acre-feet per year. The Machado Lake WMP proposed the construction of the sedimentation basin at the area north of Lake Machado within the KMHRP. Not only does the site have limited space, but also it is covered with dense vegetation. Several sensitive plants are found in the area. To use this area for the proposed sedimentation basin would require major dredging and removal of trees. The Harbor Regional Park Task Force does not recommend and support this site.

The alternative site proposed by LACDPW is located at the Wilmington Drain at Lomita Boulevard, immediately west of the Harbor Freeway (SR-110). According to LACDPW, the site is privately owned. Presently, there are a few oil wells scattered within the site. This site was investigated under this study, as described in Section 4. No other locations within the vicinity of the Wilmington Drain are found to be appropriate to site the proposed sedimentation basin. If constructed, part of the sedimentation would be located in-stream of the existing Wilmington Drain.

Catch Basin Inserts and Screens

Catch basin inserts and opening screens are appropriate BMPs for any area of the watershed that will not be covered by end-of-the line treatment systems. Therefore, these systems can be applied for all but the Project 77/510 drainage area. For the purpose of trash control, it is recommended that the inserts and opening screens be required for all land uses other than single-family residential (SFR) and vacant. For SFR and vacant land uses, individual cities may need to examine the locations to determine if litter is generated. Cities may also consider site-specific considerations in selecting the type of catch basin BMP. A more detailed discussion on the selection of the appropriate catch basin BMPs is discussed in Section 4.4.

The structural BMP selection described above is acknowledged by the Harbor Regional Park Task Force and various stakeholder groups, such as the Palos Verdes/South Bay Audubon Society; the communities of Harbor City, Lomita, Carson, Wilmington, and Torrance; and the

Dominguez Watershed Advisory Council. The proposed water quality improvement objectives are consistent with the Dominguez Watershed Management Master Plan and the *High Trash-Generation Areas and Control Measures Study* conducted by WPD.

In addition to the structural BMPs, nonstructural or source control BMPs will be the key to success in long-term water quality improvement of Machado Lake. Stakeholder groups, agencies governing the watershed management, and general public must implement this at a watershed level.

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SECTION 4

PRELIMINARY ENGINEERING DESIGN

This section presents preliminary engineering design of each selected BMP based on the data available at the time of this study.

4.1 NETTING SYSTEM

System Sizing

The amount of runoff from Project 77/510 Drains to be treated is 300 cfs. This amount is calculated based on the following formula:

Q = CIA

Q:	Amount of flow to be treated (cfs)
C:	Runoff coefficient based on percent imperviousness (per Los Angeles County Hydrology Manual)
I:	Rainfall intensity based on a 1-year return frequency (inches/hour)
A:	Drainage area (acre)
Imp:	Percent imperviousness (per Machado Lake WMP)

C = 0.9(Imp) + (1-Imp) and for the entire drainage area it can be calculated by weighting the runoff coefficient for each landuse polygon using the Geographical Information System (GIS) landuse information developed by Southern California Associations of Government (SCAG), as follows:

$$C = \frac{\sum_{i}^{n} (0.9 \cdot \mathrm{Imp}_i + (1 - \mathrm{Imp}_i) * 0.1) * A_i}{\sum_{i}^{n} A_i} = 0.46$$

Q = (0.46)(0.40 in/hr)(1,636 acres)(1.008333 ft^3-hr/acre-inches-seconds)

Q = 300 cfs

Proposed Locations

The Project 77/510 Drains would have four netting units each treating half the flow calculated above. Two units each would be installed at the discharged point of the Project 77 drain and the

Harbor City Relief Drain. The net system to be installed would be similar to the picture shown in Figure 4-1.

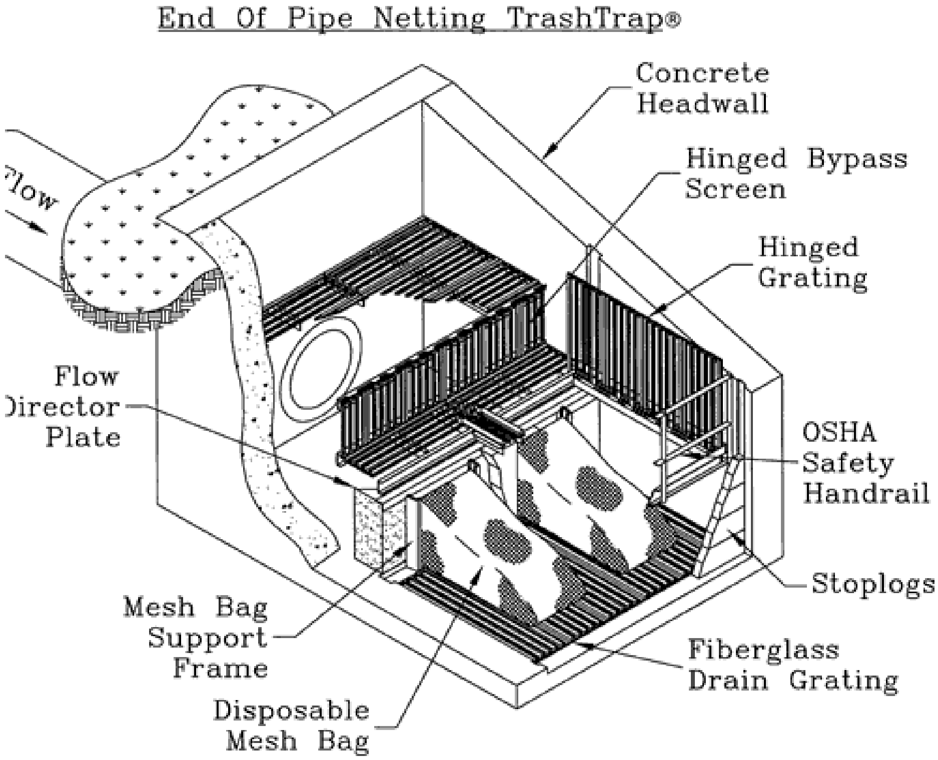

Figure 4-1: Proposed Netting System to be Installed at Project 77/510 Storm Drain Outlets
(Photograph shows the End-of-Line Netting TrashTrap™ of Fresh Creek Technologies, Inc.)

Performance Criteria

The standard mesh net is rated for 500 pounds or 25 cubic ft of captured pollutants. Nets shall be constructed of knotless knitted mesh synthetic material with openings of 0.5-inch by 0.5-inch mounted on a wood frame. The size of the net shall be 30 inches square at the mouth by 8 ft long and have the capacity to hold 500 pounds of captured pollutants in a drip-dry condition or 25 cubic ft without tearing or bursting either in service or during the change-out process. The system shall be capable of treating 100 percent of the above-calculated flow and shall be capable of capturing in excess of 90 percent of the floatables of a size and shape that cannot pass through a mesh opening of 0.5 inches.

System Maintenance

System maintenance is dependent on the frequency of storm events and pollutant loading. Maintenance shall include net removal, installation of new nets, trash cleanup, and systems inspection. Nets should be changed and disposed of at least prior to each rain event and as necessary during the dry seasons. On an average, the nets would need to be changed out 8 to 10 times per year.

Cost Estimate

Cost for construction and installation of the netting system is estimated at $400,000. The costs associated with design and construction management are approximately $100,000, for a total project cost of $500,000.

Typical maintenance cost to remove and change the nets is estimated at $2,000 to $3,000 per change-out event.

4.2 SEDIMENTATION BASIN

System Sizing

The amount of runoff from the Wilmington Drain to be treated is 1,850 cfs. This amount is calculated based on the following formula:

Q = CIA

Q: Amount of flow to be treated (cfs)
I: Rainfall intensity based on a 1-year return frequency (inches/hour)
A: Drainage area of Wilmington Drain at Lomita Blvd (acre), and
C = 0.9(Imp) + (1-Imp)Cu, and for the entire drainage area C can be calculated by weighting the runoff coefficient for each landuse polygon using SCAG's GIS landuse information:

$$C = \frac{\sum_{i}^{n} (0.9 \cdot \text{Imp}_i + (1 - \text{Imp}_i) * 0.1) * A_i}{\sum_{i}^{n} A_i} = 0.52$$

Q = (0.52)(0.40 in/hr)(8,914acres)(1.008333 ft^3-hr/acre-inches-seconds)

Q = 1,850 cfs

The runoff volume needed to be retained for maximized water capture volume (WCV) is 365 acre-feet. The volume is calculated as follows:

Vol = $(A_D)(R)$

Vol: Volume of runoff needed to be retained
A_D: Wilmington Drainage Area (acres)
R: First flush runoff[1] (inches)

R = C(0.75 inches) = 0.52(0.75) = 0.39 inches
Vol = (8,913 acres)(0.39 inches)(1 ft/12 inches)

Vol = 290 acre-feet

Based on a typical basin depth of 3 to 8 ft, the required area for a sedimentation basin is estimated between 40 and 100 acres.

Figure 4-2 shows a typical configuration of the sedimentation basin that would be required to treat the flow at Wilmington Drain.

Note that the above calculation did not include the flow periodically pumped from Walteria Lake, which combines with Wilmington Drain flow downstream of the entrance to the proposed basin (along Lomita Boulevard).

Site Selection

The Machado Lake WMP proposed the construction of the sedimentation basin at the area north of Lake Machado within the KMHRP. This area is currently covered with dense vegetation. Several sensitive plants are found in the area. To use this area for the proposed sedimentation basin would require major dredging and removal of trees. The Harbor Regional Park Task Forces does not recommend and support this site.

The alternative site proposed by LACDPW is located at the Wilmington Drain at Lomita Boulevard, immediately west of SR-110. According to LACDPW, the site is privately owned. Presently, there are a few oil wells scattered within the site.

[1] Runoff occurring from a 0.75-inch rainfall event in accordance with the State Water Resources Control Board (SWRCB) Municipal Stormwater NPDES Permit (NPDES Permit No. CAS004001).

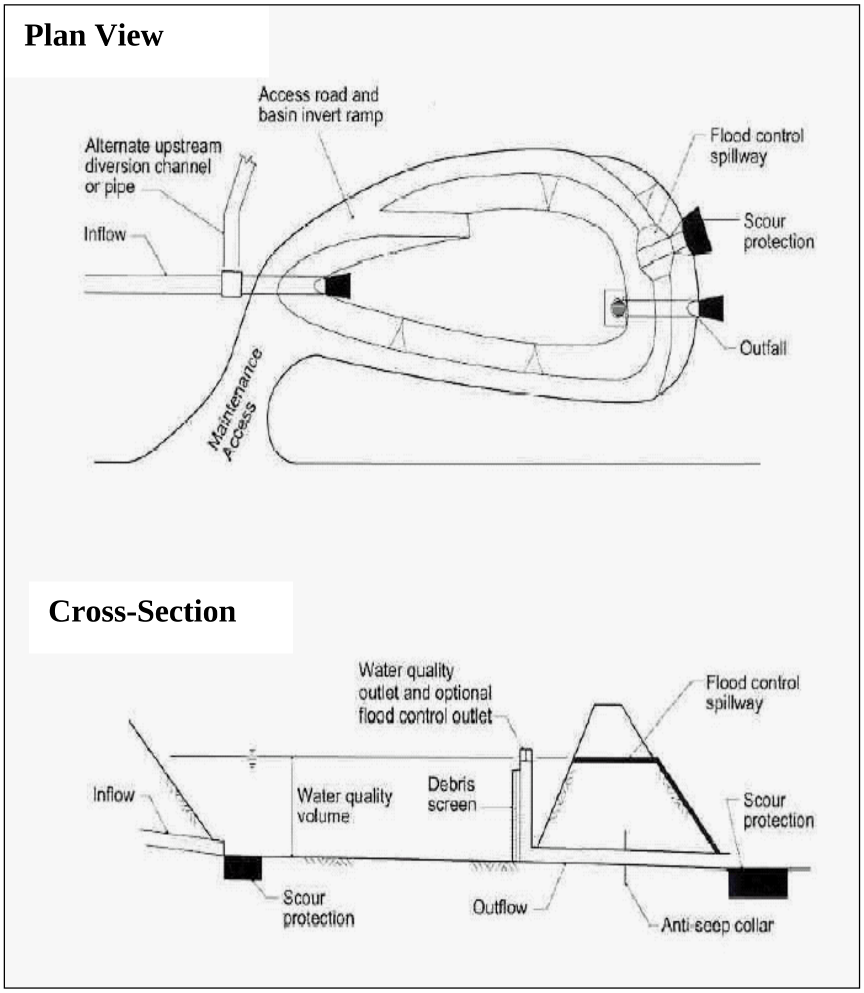

Figure 4-2: Schematic of Sedimentation Basin

Based on a preliminary site survey, the available land is not adequate to enable sediment removal from the estimated 365 acre-feet of stormwater flow volume. Based on the available aerial photographic map and topographic map covering the site, an approximate 5-acre detention basin with a 40-acre-foot detention capacity could be located immediately adjacent to the channel on its west side. This could be connected to an approximate 3-acre detention basin with a 24-acre-foot detention capacity located immediately south of Lomita Boulevard. The total basin capacity is estimated at 64 acre-feet for this entire site. This capacity is insufficient to provide adequate sediment removal efficiencies for stormwater from the combined Wilmington Drain and Private Drain 533 subwatersheds. One option is to divert flow from the smaller of these two watersheds (the Wilmington Drain subwatershed) into the proposed site. This option is viable without much retrofit to the existing system since the sedimentation basin site is located at the outlet of the East and West Channels of the Wilmington Drain. The East Channel conveys flow from the

Wilmington Drain subwatershed, while the West Channel conveys flow from the Private Drain 533 Drain subwatershed. Some sort of source control (e.g., catch basin inserts throughout the developed portions of the watershed) within the Private Drain 533 drainage area is recommended in lieu of providing sediment removal for this particular watershed. The following subsections provide a preliminary design for treatment of stormwater from the Wilmington Area only.

<u>Performance Criteria</u>

The sedimentation basin shall be designed in accordance with the California Stormwater Quality Association (CASQA) Stormwater Best Management Practices Handbook for New Development and Redevelopment, January 2003, BMP designation TC-22: Extended Detention Basin (Appendix D).

The runoff volume needed to be retained for maximized WCV is 118 acre-feet. The volume is calculated as follows (see previous section for parameter definitions):

Vol = $(A_D)(R)$
R =C(0.75 inches) = 0.52(0.75) = 0.39 inches
Vol = (3637 acres)(0.39 inches)(1 ft/12 inches)
= <u>118</u> acre-feet.

Unfortunately, the site has a maximum capacity of 64 acre-feet (assuming a maximum 8-ft depth), and it would not accommodate the maximized WCV of 118 acre-feet. It would, however, provide moderate sediment removal efficiency.

As per the sizing procedures provided in the California Stormwater Quality Association's "Stormwater Best Management Practice Handbook" (BMP Handbook), the proposed basin would remove approximately 55 percent of the contaminants (predominately suspended solids) that enter the system during an 85^{th} percentile storm occurring in the Wilmington Drain subwatershed. This is estimated assuming an outlet capacity of the detention basin that allows for complete drawdown within 48 hours (as recommended in the BMP Handbook). Figure 4-3 displays the detention basin "Capture/Treatment Curves" provided in the BMP Handbook for Los Angeles County given the overall watershed runoff coefficient. The unit basin storage volume is calculated by dividing the basin volume by the watershed size (= 64 acre-ft/3637 acres = .018 ft or 0.22 inches). As shown, for a runoff coefficient of 0.52 and unit basin storage volume of 0.22 inches, the treatment capacity is approximately 55 percent. Figure 4-4 presents a preliminary plan of the detention basin.

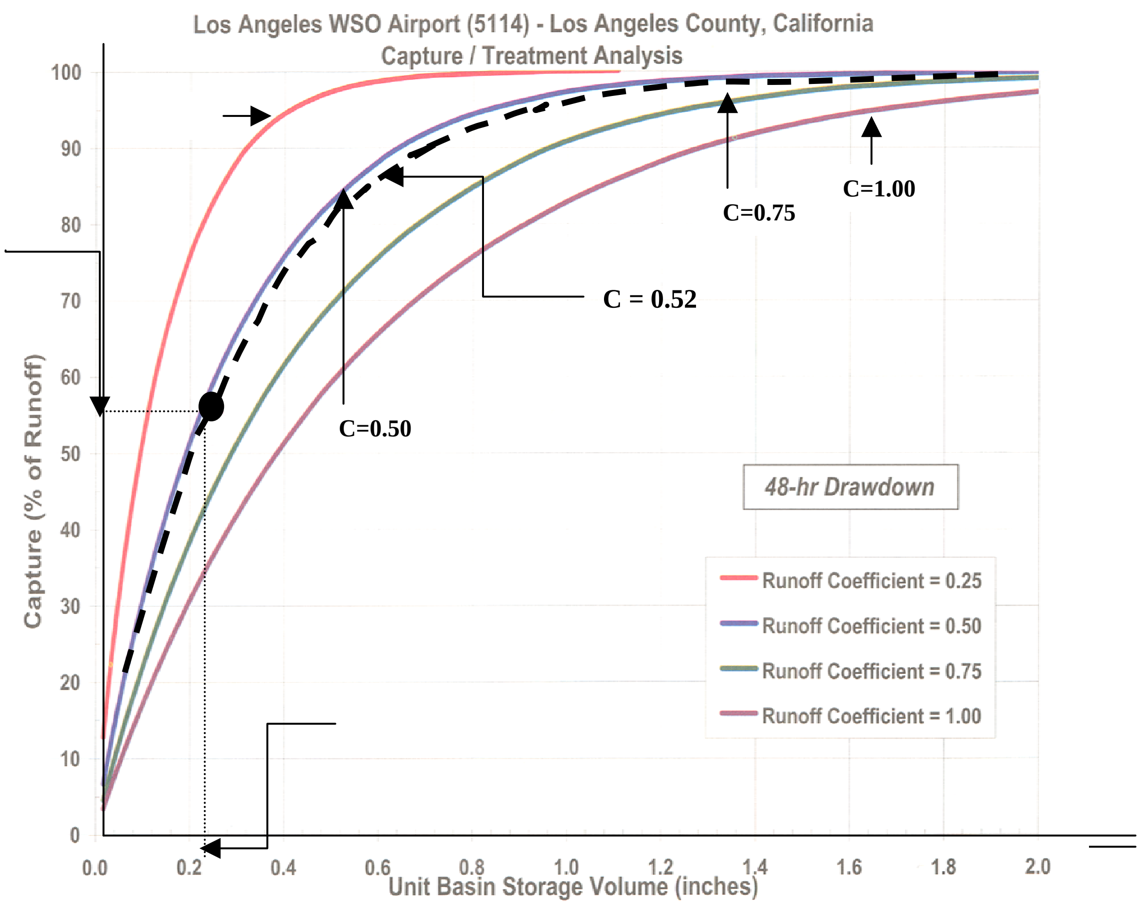

Figure 4-3: Capture/Treatment Curves for Sedimentation Basin (CASQA BMP Handbook, 2003)

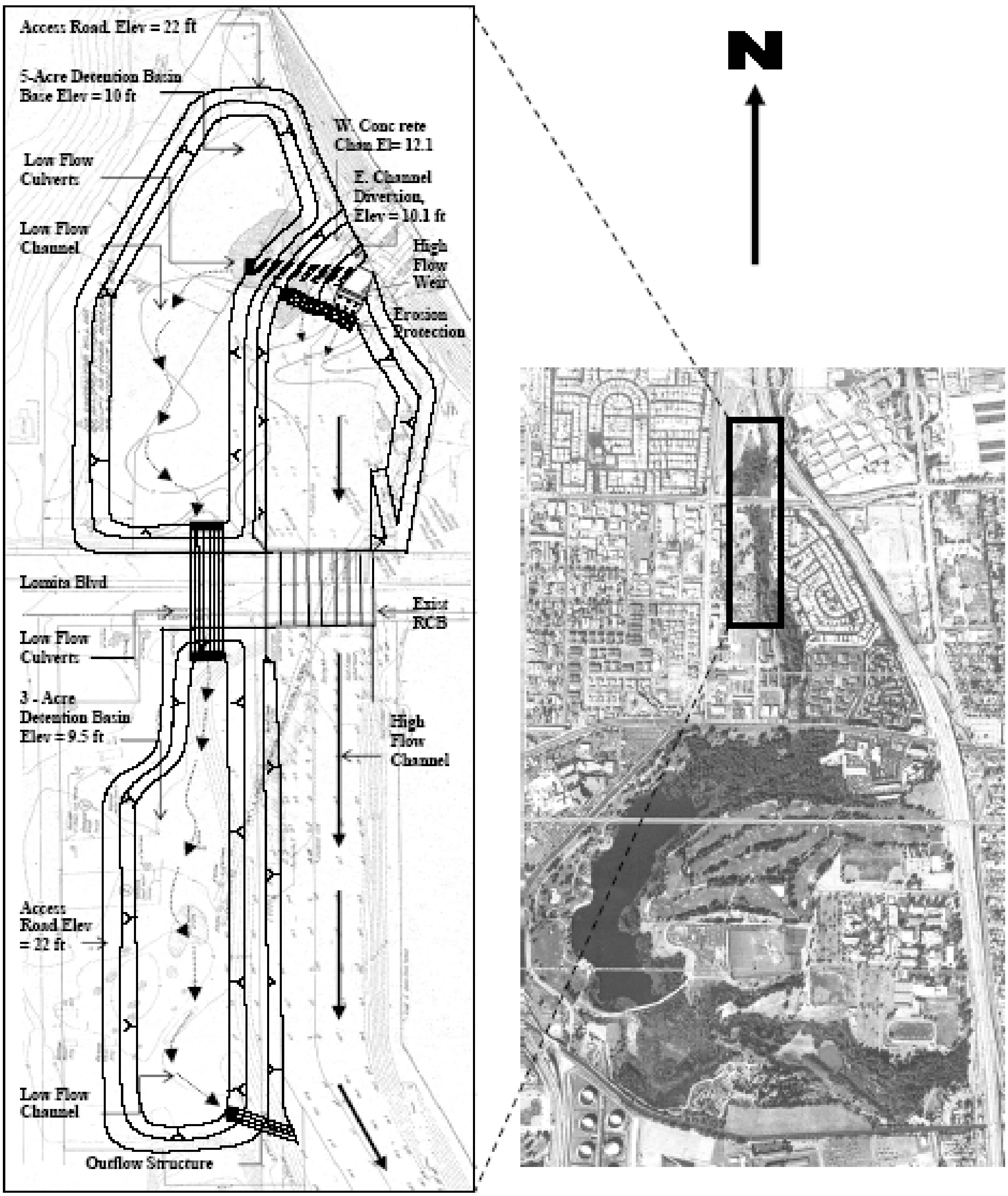

Figure 4-4: Proposed Sedimentation Basin Preliminary Plan (Not to Scale)

Preliminary Design Considerations

Various factors were considered in the preliminary design of the sedimentation basin. As described previously, the siting of the basin played a significant role in the overall size of the basin. As shown in Figure 4-4, the basin would be placed within City and County of Los Angeles right-of-way limits.

Maintenance Road and Embankments: A 12-ft-wide maintenance access road would be placed around the perimeter of the basin at an elevation of approximately 1 to 1.5 ft above the 100-year water surface in the Wilmington Drain outlet. Maintenance would be required throughout the basin to: 1) manage vegetative growth, 2) remove debris, 3) remove accumulated sediment and regrade as necessary, and 4) maintain inlet and outlet structures. The road is located on top of the sedimentation basin embankment, which has side slopes of 3:1. The adjacent properties are at the approximate elevation of the maintenance road.

Diversion Structure and Overflow Weir: A diversion structure is proposed at the end of the East Channel of the Wilmington Drain. This concrete structure would include a 1.5-ft drop (from 11.6 ft invert to 10.1 ft invert) to enable low flows to be diverted through a series of 12- to 18-inch culverts with their headworks located along the bottom of the diversion structure. The culverts would convey the low flow to the sedimentation basin as shown. Note that a drop was necessary to enable the culverts to be placed underneath a proposed concrete channel located adjacent to this structure. This second channel would convey flow from the West Channel of the Wilmington Drain downstream along its existing flow path (bypassing the sedimentation basin). The diversion structure also includes a high-flow weir that would enable high-level storm flows in the East Channel of the Wilmington Drain to bypass the sedimentation basin and follow the existing flow path. The overflow weir is made of concrete and incorporates a spillway with baffle blocks for energy dissipation on its downstream side. The weir length is approximately 50 ft and is placed at an elevation of approximately 17 ft. Note; the 100-year water surface elevation is approximately 21 ft. To sustain the 100-year water surface elevation (to prevent a backwater effect in the Wilmington Drain), the weir elevation was calculated using the 100-year storm flow of 1,100 cfs in the East Channel of the Wilmington Drain. The elevation was calculated from the required head to pass the 100-year storm using the weir equation as follows:

$$Q=CLH^{3/2}$$

Where:

Q = 100-year storm flow = 1,100 cfs
C = Weir Coefficient = 3 (for broad crested weirs with H>2 ft)
L = Weir Length = 50 ft
H = Height of water above weir
= $(1100/(3(5.0))^{0.67}$ = 4 ft
Weir Elevation = 21 – 4 = 17 ft

Sedimentation Basin Inlet Structure: The diverted flows would enter the basin via pipe culverts located on the side of the diversion structure. The inlet invert would drop to approximately 10.1 ft, enabling approximately 1 ft of cover under the proposed West Side concrete channel. It also enables approximately 7 ft of headwater at the upstream end of the culverts before flow enters the overflow weir. The culverts would be approximately 150 ft long. To reduce resuspension of accumulated sediments in the sedimentation basin, a rip-rap energy dissipater is proposed at the culvert outlet.

Low Flow Channel: An earthen low-flow channel with a triangular cross section (10:1 side slopes) is proposed to convey flow from the inlet structure to the outlet structure. This path is approximately 1,200 ft long with a slope of approximately 0.06 percent. As shown in Figure 4-4, a 100-ft-long low-flow culvert would be required within the low-flow channel under Lomita Boulevard. This culvert would be similar to the culverts located at the inlet structure.

Outlet Structure: The outlet structure would be located approximately 700 ft south of Lomita Boulevard. The invert elevation is estimated at 99.5 ft. The recommended drawdown time for the entire basin is 48 hours (CASQA BMP Handbook, 2003). For an estimated 64 acre-feet of storage, this results in an outflow of approximately 16 cfs. This can be accommodated by dual 12-inch pipes equipped with trash racks. The outlet structure should be fitted with a valve to halt the basin discharge in the event of a spill within the watershed. A high-level outfall in the shape of an overflow spillway into the adjacent “high-flow” channel may also be required. Note that the outlet structure can be designed in several ways. An alternative outlet structure could include a perforated riser pipe equipped with a trash rack at its top. The riser pipe would be placed up to an elevation of the sedimentation basin high-water level for the desired water quality volume. In this case, that would require an 8-ft-high riser.

High-Flow Channel: The overflow weir located at the diversion structure along with the adjacent concrete-lined West Channel would convey high flows into the existing “high-flow” channel. Rip-rap at the confluence of the two structures is recommended to prevent downstream scour effects in this unlined channel. This conveyance facility is the original channel that conveyed flow to Machado Lake. It is designed to accept up to 5,400 cfs of stormwater runoff. The earthen channel is oriented in a north to south direction with a width of approximately 130 ft and slope between 0.03 percent and 0.06 percent. The channel is slightly modified along its eastern edge north of Lomita Boulevard. Here, a channel embankment with a side slope of 2:1 stabilized with rock slope protection is proposed. This channel embankment coincides with the western embankment of the proposed sedimentation basin.

Liner: To prevent potential contamination of groundwater below the sedimentation basin, an impermeable liner is recommended. The proposed liner is a 10-millimeter flexible polyvinyl chloride (PVC) liner placed at an elevation that would allow 2 ft of topsoil to be placed above the liner. The liner would be located at the bottom and interior side-slopes of the basin. The 2 ft of top soil would protect the liner from bubbling up should adjacent lake water levels rise to an elevation greater than that of the sedimentation basin bottom. The liner would also prevent deep-rooted vegetation from establishment within the basin.

Figure 4-5 shows a hydraulic profile schematic from the proposed sedimentation basin to Machado Lake.

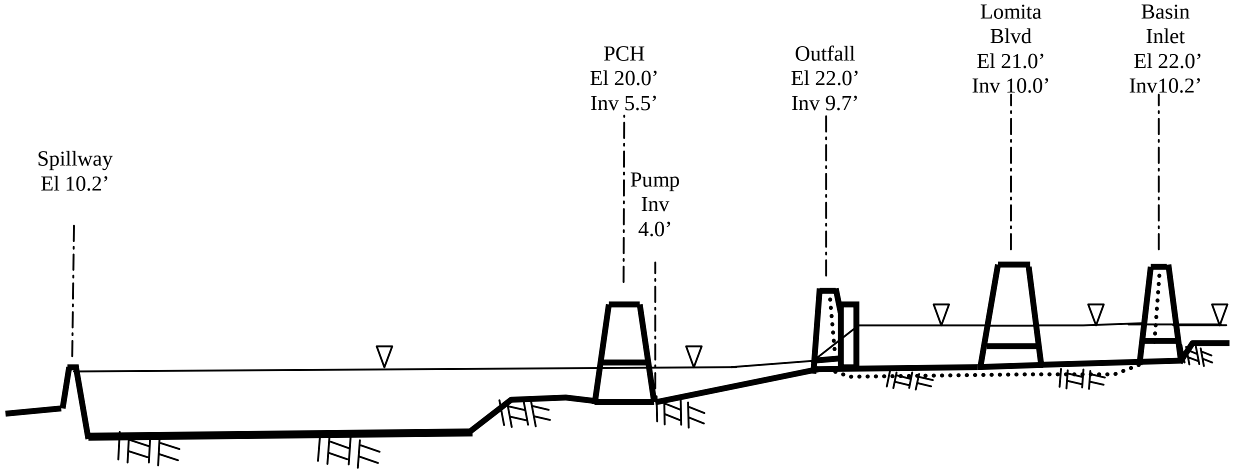

Figure 4-5: Hydraulic Profile Schematic – Sedimentation Basin to Machado Lake

System Operation and Maintenance

As described previously, maintenance would be required throughout the basin to: 1) manage vegetative growth, 2) remove debris, 3) remove accumulated sediment and regrade as necessary, and 4) maintain inlet and outlet structures. To maintain the basin appropriately throughout the year, the following activities and respective scheduling are recommended:

- Semiannually (beginning and end of wet season) inspect for standing water, slope stability, sediment, debris, and burrows. Remove trash and debris, accordingly.
- Remove trash from the basin and the Wilmington Drain after every major storm event.
- Inspect vegetation monthly and trim at beginning and ending of wet season. Remove woody vegetation, as necessary.
- Every 10 years (or when sediment volume exceeds 10 percent of basin volume), remove accumulated sediment and regrade.

Cost Estimate

The following is an itemized breakdown of the proposed sedimentation basin construction costs. Note that land acquisition and permitting costs are not included.

Description	Unit	Quantity	Unit Cost	Amount
Mobilization	LS	1	$150,000	$150,000
Clearing and Grubbing	LS	1	$50,000	$50,000
Excavation	CY	55,000	$10	$550,000
Fill	CY	10,000	$10	$100,000
Diversion Structure	LS	1	$100,000	$100,000
Low Flow Culverts	LS	1	$75,000	$75,000
Concrete Channel	LS	1	$100,000	$100,000
Liner	SY	13,000	$20	$260,000
High Flow Weir	LS	1	$100,000	$100,000
Rock Slope Protection	CY	2000	$50	$100,000
Subtotal				$1,635,000
25% Engineering/Contingencies				$405,000
Total				$2,030,000

Estimate approximately 160 hours of labor annually for system operation and maintenance. At $30 per hour, this amounts to approximately $5,000 per year.

Permitting Requirements

Regulatory permits and approvals that may apply to the construction activities for this project are described below.

Water Quality Certification: Section 401 of the Clean Water Act stipulates that any action that requires a federal license or permit and that may result in a discharge of pollutants into waters of the United States (U.S.) requires water quality certification. Locally, this program is administered by the Los Angeles RWQCB and is designed to ensure that the discharge would comply with applicable federal and state effluent limitations and water quality standards. Certification applies to both construction and operation.

Storm Water Pollution Prevention Plan: Section 402(p) of the Water Quality Protection Act of 1987 requires that a Storm Water Pollution Prevention Plan (SWPPP) be prepared for construction projects that disturb more than 1-acre of land as part of the National Pollutant Discharge Elimination System (NPDES). In California, the SWRCB is responsible for implementing this requirement through the RWQCB.

Section 404 Permit: Section 404 of the Clean Water Act requires a "Section 404 Permit" for the discharge of dredged or fill material into all waters of the U.S. This permit is administered by the United States Army Corps of Engineers (Corps).

Section 1601 Streambed Alteration Agreement: Section 1601 of the California State Department of Fish and Game (DFG) Code requires a Streambed Alteration Agreement for any alteration to the bank or bed of a stream or lake. This includes any waters of the U.S.

County Encroachment Permit: LACDPW would require an Encroachment Permit for construction within a County easement, property, or right-of-way.

Floodplain Evaluation and Letter of Map Revision: A Floodplain Evaluation is required under the National Flood Insurance Program (23 *Code of Federal Regulations* [CFR] 650, Subpart A Section 650) for project work within the 100-year floodplain. Section 650.111 of the regulations calls for location hydraulic studies to be performed with detailed engineering design drawings. Hydraulic modeling would be required along with a hydraulic report summarizing the results (to be submitted for review by the local agencies listed in the Flood Insurance Rate Maps or FIRMs). A Conditional Letter of Map Revision (CLOMR) and a Letter of Map Revision (LOMR) may be required by the Federal Emergency Management Administration (FEMA) for work within a floodway or for work resulting in significant impacts to the 100-year floodplain.

Permit Summary: A Section 404 permit would be required for this project because construction would result in impacts to wetlands and other waters of the U.S. A Section 401 Water Quality Certification would also be required to address how the project would avoid the release of pollutants into waters of the U.S. A Section 1601 Streambed Alteration Agreement would be required because the project requires alterations within the streambed and of the associated stream banks in the project area. A SWPPP would be required for the proposed project during construction since it would disturb more than 1-acre of land. A Los Angeles County Encroachment Permit would be required because the project includes work within a County easement, property, or right-of-way. A Floodplain Hydraulic Evaluation Report would be required because work is being conducted within the 100-year floodplain. A CLOMR and LOMR may be required if construction results in a significant impact to the 100-year floodplain.

Limitations:

The following is a summary of the limitations of the proposed sedimentation basin:

- The available land identified near Lomita Boulevard is limited. Only approximately 3 acres south of Lomita Boulevard belongs to LACDPW; the 5-acre land north of Lomita Boulevard is privately owned. It might be cost prohibitive to acquire this property for the purpose of sedimentation basin construction.
- Although the land could be acquired, the proposed basin would not treat the majority of the flow in the Wilmington Drain; thus, other BMPs may still be required.
- Water table levels in the proposed area are reportedly high; thus, the sedimentation basin may have to be shallower than the proposed depth. This would result in even greater land requirement.

4.3 CATCH BASIN OPENING SCREENS AND INSERTS

Systems Characteristics and Specifications

Conventional screens shown in Section 3.4 can be used if there are no concerns with localized ponding near the catch basin that would be retrofitted. The screen should be sized to cover the entire width of the catch basin curb face opening and be flush with the curb face. A 1-inch opening may be allowed on the top of the screen to allow overflow in the event of clogging. Typical screen openings are 1-inch by 1-inch, but they may vary in geometrical configurations. Many of the current screening opening vendors use a hot-dipped galvanized steel material for the fabrication of the screens, which may emit zinc; therefore, it is recommended that future fabrication of screen covers be made of powder-coated galvanized steel or stainless steel material.

For opening screens that use the magnets shown in Figure 3-12, it is recommended that the magnets be designed to allow them to open when the water level reaches 50 percent to100 percent of the curb height.

Inserts, such as those shown in Figures 3-13 and 3-14, should be fitted in the catch basin to maximize trash and debris collection volume. If designed for trash, the screen opening size should be 5 millimeters (mm). This corresponds to the Total Maximum Daily Load (TMDL) design requirement for the Los Angeles River and Ballona Creek. If inserts are designed to also capture debris, a fabric mesh liner should be used. Table 4-1 examines the various catch basin opening screens and inserts and summarizes the characteristics of the five products commercially available at present.

Table 4-1: Characteristics of Various Types of Catch Basin Opening Screens and Inserts

Product and Vendor	Screen by United Stormwater, Inc.	Screen by Asbury Environmental Services	Screen with Magnets by Practical Technologies	Insert by Practical Technologies	Insert by United Stormwater, Inc.
Type of BMP	Opening screen	Opening screen	Opening screen	Inserts (screen)	Insert (screen or liner)
Screen Openings	1-inch by 1-inch	1-inch by 1-inch	1.75 inches by 0.75-inch	5 mm	Fabric used. A 5-mm-mesh can be used instead
Material	Galvanized steel	Galvanized steel	Hot-dipped galvanized steel	0.125-inch galvanized steel plate	Steel frame with non-woven polypropylene liner
Overflow/ Hydraustatic release	On top	Fill bucket overturns and opens screen	Increased pressure disengages magnets	Overflows weir	Overflows basket
Typical cost per catch basin	$350	$1,200	$500	$1,000	$1,000

Product and Vendor	Screen by United Stormwater, Inc.	Screen by Asbury Environmental Services	Screen with Magnets by Practical Technologies	Insert by Practical Technologies	Insert by United Stormwater, Inc.
Concerns	May cause localized flooding	May allow litter to escape	Minor litter may escape	Galvanized steel may release zinc	None
Advantages	Low cost and minimum maintenance	No flooding	No flooding and simple mechanism	Traps all trash	Traps all trash and debris

Selected Catch Basins

This plan proposes that all areas not equipped with the end-of-pipe trash control device, or in the event the sedimentation basin is not a viable option, be retrofitted with a trash-control BMP at the catch-basin level. An exception can be made for single residential land use, vacant land, and areas where there is no observable litter. The various municipalities can easily survey the number of catch basins in the watershed. For this preliminary engineering report, the number of catch basins for each jurisdiction is estimated to be one catch basin for every 5 acres. Based on the drainage area of each jurisdiction within the subwatersheds discharging to the Wilmington Drain, the estimated number of catch basins is presented in Table 4-2. Exception has been made for certain single residential and vacant land uses. The typical cost of retrofit per catch basin is estimated at $1,000. However, the cost to individual Cities may vary based depending fo the type of catch basin BMP(s) that is selected

Table 4-2: Estimated Number of Catch Basins within the Subwatersheds Discharging to the Wilmington Drain

City	Estimated Catch Basins	Cost ($)
Los Angeles	100	1,0000
Torrance	200	200,000
Lomita	160	160,000
Carson	240	240,000
Unincorporated	160	160,000
Total	**860**	**860,000**

Performance Criteria

Catch basin opening screens are expected to be effective in preventing trash from entering the stormwater collections system. However, not enough documented studies have been done to quantify removal efficiencies. The City of Los Angeles is currently expanding an existing study to further determine the removal efficiency of these systems. The two catch basin insert technologies that are presented here are expected to trap all of the litter greater than the screen or mesh opening assuming it is properly maintained so that the litter does not overflows. If the inserts were fitted with a fabric liner, most of the sediment would also be trapped.

Maintenance

Installation of catch basin opening screens would reduce the cleaning frequency of the catch basins. While these screens have not been tested for an extended time, they are expected to need periodic replacement. A typical life of each screen is estimated at 10 to 20 years.

Cleaning of the catch basin with the insert is expected to be twice a year – double the routine cleaning frequency of a catch basin. Typical catch basin cleaning costs are $50 per event or about $100 per year. These inserts would also need periodic replacement. The typical life of each screen is estimated to be 10 to 20 years.

Cost

Typical costs for each catch basin BMP were shown in Table 4-2. The cost may vary for each catch basin because of their configuration, such as the opening and size of the catch basin. The material specifications, contract requirements, and periodic replacement costs would determine the actual cost.

SECTION 5

URBAN LAKE EVALUATION FRAMEWORK

Most of the urban lakes within the City of Los Angeles are man-made lakes, and they are directly affected by urban runoff. The Urban Lake Evaluation Framework is prepared to provide an outline for assessing water quality in the urban lakes within the City of Los Angeles, such as Echo Park Lake, Hollenbeck Park Lake, and Lincoln Park Lake. This framework is developed based on the WPD's experience in performing Machado Lake water quality assessment. The purpose of the Urban Lake Evaluation Program is to improve water quality of the urban lakes within the City to meet the designated beneficial uses and associated water quality objectives for the respective lakes.

The City of Los Angeles Urban Lake Evaluation Framework is prepared to be a self-explanatory, stand-alone document with the Machado Lake evaluation provided as a sample for the readers to use as a guidance. The plan is presented in Appendix D of this Project Report.

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SECTION 6

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Appendix A

Quality Assurance Project Plan

Quality Assurance Project Plan
for
Machado Lake Water Quality Assessment Project

Prepared by

City of Los Angeles
Department of Public Works
Bureau of Sanitation
Watershed Protection Division

Date: January 21, 2003

Approved by

Shahram Kharaghani, Ph.D., P.E. City of Los Angeles Watershed Protection Division Project Director ______________________________	Anne Kochaon, QEP Parsons Project Manager-Sampling and Analysis ______________________________
Wing Tam City of Los Angeles Watershed Protection Division Project Manager ______________________________	David Dawes Del Mar Analytical Laboratory QA Officer ______________________________
Lin Tseng SWRCB, Division of Water Quality Contract Manager ______________________________	________________________ (NAME) SWRCB, Division of Water Quality Quality Assurance Officer ______________________________

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1 PROJECT MANAGEMENT

1.1 Introduction

The City of Los Angeles, Department of Public Works, Bureau of Sanitation, Watershed Protection Division (WPD) is carrying out the Machado Lake Water Quality Assessment Project under Agreement No. 01-046-250-0 between the California State Water Resources Control Board (SWRCB) and the City of Los Angeles (Contractor) dated February 4, 2002.

This Quality Assurance Project Plan (QAPP) is prepared to address the plan to be carried out to accomplish the project objectives. The QAPP is prepared in accordance with the U.S. Environmental Protection Agency (EPA) Guidance for Quality Assurance Project Plans EPA QA/G-5 (EPA/600/R-98/018, February 1998).

1.2 Project Organization

Organizations and individuals participating in the project are presented in Figure 1. Roles and responsibilities of each key personnel are summarized in the following paragraphs.

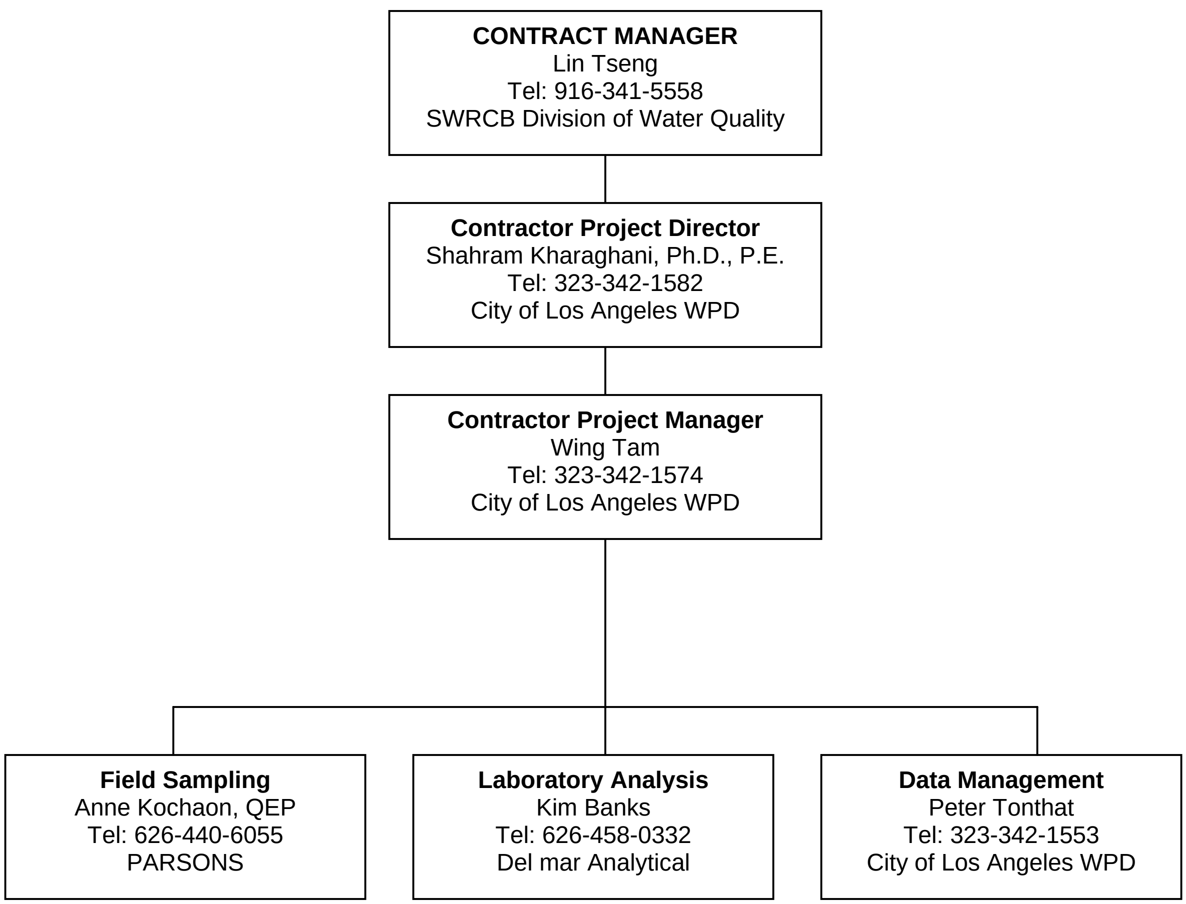


Figure 1: Project Organization Structure

SWRCB's Contract Manager – Ms. Lin Tseng of the Division of Water Quality: The Contract Manager will be the day-to-day representative for administration of this project and will have full authority to act on behalf of the SWRCB with respect to this agreement.

Contractor's Project Director – Dr. Shahram Kharaghani, Director of WPD: The Project Director will be the Contractor's representative for the technical conduct and administration of the agreement and will have full authority to act on behalf of the Contractor.

Contractor's Project Manager – Mr. Wing Tam, Planning Section Manager of WPD: The Project Manager will be the lead liaison for the day to day administration of the project and will have full authority to act on behalf of the Project Director.

Field Sampling Team – Parsons: Ms. Anne Kochaon of Parsons will provide overall project management for the field sampling task of this project. She will be the point of contact with the Contractor's Project Manager (Mr. Wing Tam) and the contracted laboratory. The Parsons' field sampling leader is Mr. Jay Officer, a water quality specialist. Quality control and laboratory analysis data validation for this task will be performed by Ms. Connie Sobel, a chemist and data validation specialist.

Laboratory – Del Mar Analytical: Ms. Kim Banks of Del Mar Analytical, a State Environmental Laboratory Accreditation Program (ELAP) certified laboratory, will be the point of contact for all laboratory analytical work. Del Mar Analytical is located at 2852 Alton Avenue, Irvine, CA 92602, Telephone No. 626-458-0332.

Data Management – Mr. Peter Tonthat, Planning Section Engineer of WPD, will coordinate the data collection and management efforts of this project. He will be the point of contact with the field sampling team and contracted laboratory.

1.3 Problem Definition/Background

Machado Lake is located within the Ken Malloy Harbor Regional Park (KMHRP) in the Wilmington section of Los Angeles, about 15 miles south of downtown Los Angeles (Figure 2). Discharging points into Machado Lake are from three (3) storm drains, the Harbor City Relief Drain and Project No. 77 Drain on the west, and the Wilmington Drain on the north. The lake is a freshwater system with limited water circulation and low dissolved oxygen content. Contaminants found in the lake such as trash, pesticides, minerals and nutrients, organics, and heavy metals are carried into the lake by urban runoff. The pollution contribution to the lake through urban runoff poses a tremendous threat to the aquatic life, wildlife, and plant habitats found in the lake and adjacent park. It also impairs the beneficial uses of this ecosystem, including recreational fishing.

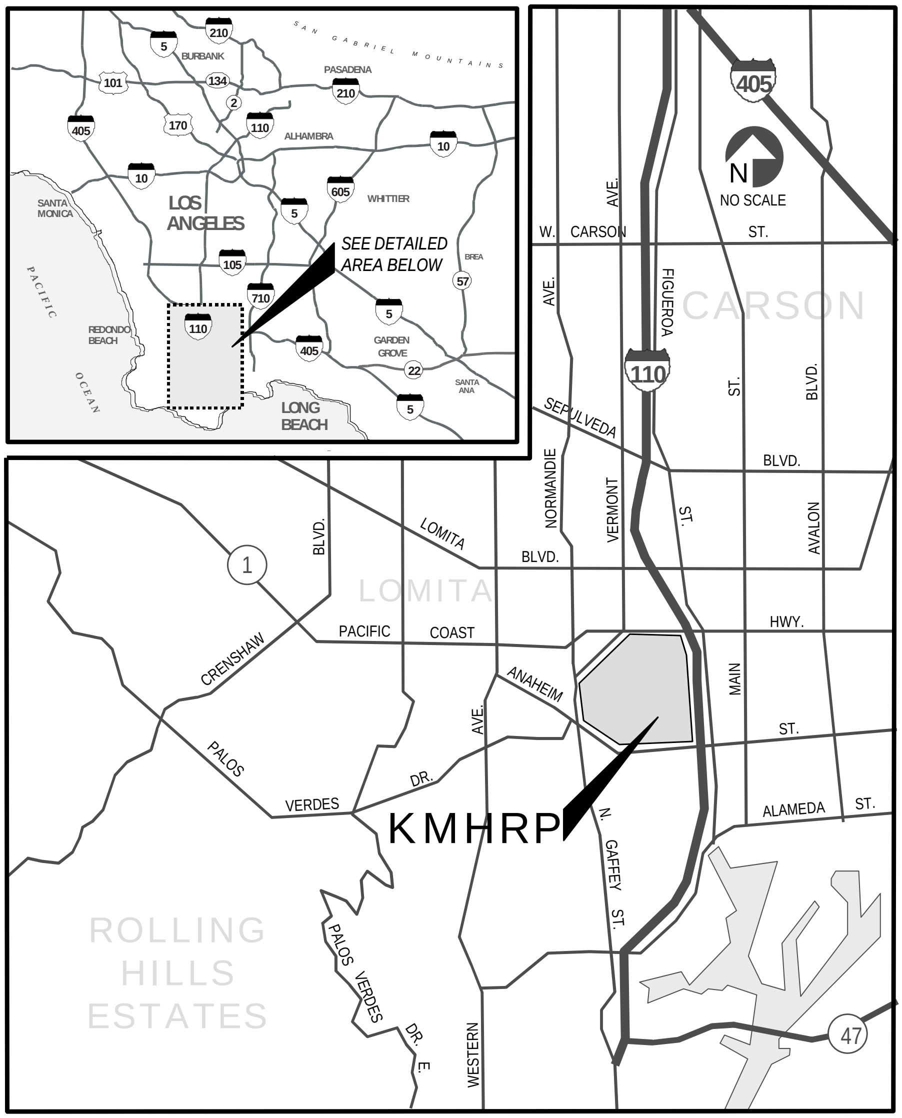


Figure 2: Project Location Map

The lake and the surrounding ecosystem already support a diverse and rich ecosystem. This includes over 300 species of birds. The endangered Least Tern forages around the lake during summer. The park is also the home to a number of endangered and rare plant species, such as the southern tarweed and Palmer's goldenbush. The lake supports wetland-dependent communities of tule (rushes) and surrounding willow forest, which are among the last of their type in southern California. Fish in the lake includes large-mouth bass, bluegill, sunfish, goldfish, and channel catfish. Fishing as a recreational activity is impaired due to the high concentration of pesticides found in fish.

The Water Quality Control Plan for Los Angeles and Ventura Counties (Basin Plan) identifies existing beneficial uses for Machado Lake which include activities such as fishing in the lake, picnicking, birding, boating, canoeing, and hiking (Los Angeles Regional Water Quality Control Board, 1994).

Trash, litter, and odors impair the recreational activities around the lake. The presence of nutrients (i.e., nitrogen and phosphorus compounds) contributes to eutrophication of the lake. This in turn impairs the lake's recreational value.

Over the past 15 years a number of water quality improvement projects have been implemented including dredging, installation of aeration pipes and frequent removal of aquatic plants. During the same period a number of studies have also been conducted. A study conducted by the University of California, Riverside on behalf of the Los Angeles Regional Water Quality Control Board (RWQCB) found the lake and its beneficial uses to be impaired due to trash, nutrient and heavy metals. In December 2000, the City of Los Angeles-Department of Recreation and Parks initiated a year-long study under the name Machado Lake Watershed Management Plan. As part of the study, a limited water quality sampling and analysis program of stormwater runoff and lake water was carried out. The current Machado Lake Water Quality Assessment Project serves as a supplement to the Machado Lake Watershed Management Plan study, and will further define the needed pollution abatement systems.

1.4 Project Objectives

Pollution in Machado Lake has impacted the Lake's water quality and ecosystem. This has resulted in the 303(d) listing as an impaired water body. One of the objectives of the study is to identify and provide potential water quality data needs for the upcoming Total Maximum Daily Loads (TMDLs) determination. The following scope of work, as proposed, will be integrated with ongoing and other future studies and projects to maximize our efforts at improving water quality in the Machado Lake watershed. This study will supplement the assessment of the pollution sources to Machado Lake.

The proposed study follows a systematic approach to reach its goals and objectives. Pollution sources into the lake will be identified through monitoring and watershed investigations. These data will be used to calculate the pollutant loads into the lake and identify the pollutants that impair the beneficial uses of the Lake. Based on this information, Best Management Practices (BMPs) will be evaluated and developed in the watershed to improve Lake water quality. The product of this work will be a pollution abatement plan to address the pollution problems for the lake and the surrounding park. These BMPs will be incorporated into the local watershed management plan, which can include public education, source control, and engineering solutions. The largest component of the study is the preliminary engineering that will identify, and propose pollution control systems. This will examine the implementation and regulatory feasibility, preliminary design, and cost estimates for these systems. This component will advance our efforts from a study into the implementation of engineering solutions and will assist in preparing grant applications and attracting the needed funds for a comprehensive solution. Finally, the study will be used as a model for managing and improving other lakes within urban watershed in California.

1.5 Project Description

Task 1: Project Management and Administration

Subtask 1.1 Project Management

The City of Los Angeles (Contractor) will provide all technical and administrative services associated with performing and completing the work for this project. Technical and administrative tasks will include: project management, budgeting, scheduling, coordination, crew supervision, report preparation, contract management, equipment maintenance and data collection, storage and analysis, subcontract management, and all other tasks that may be necessary to complete the scope of work specified in this agreement.

Subtask 1.2 Quarterly Progress Reports

Prepare and submit written quarterly reports to the SWRCB's Contract Manager. The progress reports will detail work accomplished, discuss any problems encountered, and potential solutions to those problems; detail costs incurred during the subject quarter, and document delivery of any intermediate work products. A brief outline of upcoming work scheduled for the subsequent quarter will also be provided. Progress reports will be submitted by the 10^{th} day of the month following each calendar quarter (January, April, July, October) throughout the duration of the project.

Subtask 1.3 Data Management

Prepare and submit all water quality-related data generated by the project to the SWRCB for input into the STORET system (a federal database for water quality). Data formats and report guidance for STORET will be provided by the Contract Manager. Data will be submitted to the SWRCB Office of Information Technology through email or on computer diskette. The Contractor will be responsible for verifying the quality of data.

Task 2: Public Participation

Subtask 2.1 Formation of a Technical Advisory Committee

Form a Technical Advisory Committee (TAC) to oversee the progress and technical aspects of the project. The TAC will include representatives from City of Los Angeles WPD, Department of Recreation and Parks, Los Angeles County Department of Public Works, KMHRP Advisory Board, Dominguez Channel Watershed Management Group, RWQCB, the Contract Manager, and other representatives from various entities as agreed upon by the Contractor and the Contract Manager.

Guide the overall management of the project through periodic formal reviews with the TAC. The TAC will be asked to review interim project reports and the project draft final report. To the extent possible, TAC comments on the project draft final report will be addressed and incorporated into the project final report. Additional activities of the TAC are described in the appropriate tasks below.

Subtask 2.2 Public Meetings and Responsive Summaries

Conduct a minimum of two publicly noticed meetings for the duration of the project to describe the goals, objectives, and progress of the study and to receive comments and suggestions from public agencies, affected entities, and interested persons. Hold the first meeting prior to completion of Task 6 (Pollution Abatement Plan) and one additional meeting upon release of the project draft final report.

Document public participation in the project by preparing responsive summaries as identified in 40 CFR Part 25 (Public Participation). Prepare a responsive summary for each public meeting conducted for the project. The responsive summary will identify the public participation activity conducted; describe the matters on which the public was consulted; summarize the public views, significant comments, criticisms and suggestions; and set forth the agency's specific responses in terms of modifications of the proposed action or an explanation for rejection of proposals made by the public. Submit responsive summaries to the Contract Manager with the quarterly progress report for the quarter in which the meeting was conducted. Responsive summaries will be made available to the public upon request.

Task 3: Develop Quality Assurance Project Plan (QAPP)

Prepare a QAPP which adequately addresses the requirements of Section 31.45 of 40 CFR Part 31 (53 Federal Register 8074). March 11, 1988) in accordance with "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations" (EPA QA/R-5), May 1995. The QAPP will be reviewed and approved by the SQRCB's QA Officer prior to any sample collection or analysis activities.

Task 4: Sampling and Analysis

As part of the recently completed Machado Lake Watershed Management Plan, stormwater and lake water quality samplings, one dry weather event and two wet weather events, were conducted in 2001. The current sampling program is developed to supplement data to the 2001 sampling program.

Subtask 4.1 Wet Weather Sampling

Conduct two wet weather sampling events between October 1, 2002 and May 1, 2003:

- The first sampling event will be during the first flush of the first storm event of the wet season (to the extent practicable). This sampling will be conducted during the first hour of storm runoff discharge.
- The second wet weather sampling event will be of a subsequent storm at least 72 hours apart.

The proposed sampling locations are shown in Figure 3. Two storm water runoff sampling locations are proposed including Project 77/510 Drain and the Wilmington Drain prior to discharging to the lake (Locations A and B). Lake water quality samples will be collected at three locations, including the northern portion, central portion, and southern portion of the lake (Locations C, D, and E, respectively).

Figure 3: Sampling Locations

All samples will be analyzed for the following constituents:

- Total suspended solids (TSS)
- Ammonia – nitrogen
- Nitrate – nitrogen
- Nitrite – nitrogen
- Total phosphorus
- Organochlorine pesticides & PCBs
- Copper
- Lead
- Dissolved oxygen (DO) (field)
- pH (field)
- Temperature (field)
- Water clarity using a Secchi Disk (Lake only)
- Fecal and Total Coliform (Lake only)

Subtask 4.2 Dry Weather Sampling

Conduct one dry weather sampling event prior to the first rain event of 2003. Lake water quality samples will be collected at three locations, including the northern portion, central portion, and southern portion of the lake (Locations C, D, and E, respectively). Due to limited runoff into the lake during the dry weather period, no storm drain sampling will be carried out. The lake water samples will be analyzed for the following constituents:

- TSS
- Organochlorine pesticides & PCBs
- Fecal and Total Coliform
- DO (field)
- pH (field)
- Temperature (field)
- Water clarity using a Secchi Disk (field)

Task 5: Data Analysis and Mass Balances

Summarize existing and newly gathered information and share electronic files for STORET and the Information Center for the Environment (ICE) use. These data will also be used throughout the project duration. These data will supplement and update the work of the Machado Lake Watershed Management Plan study to calculate the pollutant loads into the lake and be used to identify the pollutants that impair the beneficial uses of the lake.

This task will use the results of past studies, the recently completed Machado Lake Watershed Management Plan study, and newly collected results from Task 4 to supplement and compile hydrologic and hydraulic information. Available data including that from Task 4 will be used to generate a complete analysis of the flow and pollutants mass balances, as well as the pollutants that accumulate in the lake. Pollutant loads can be calculated by multiplying the concentration with the volume of runoff, lake or other volumetric quantity such as the volume of sediments. A mass balance is the accounting of the pollutant.

Task 6: Pollution Abatement Plan

The key pollution problems will be screened and ranked for prioritization. This task will also supplement and complete the work of the Machado Lake Watershed Management Plan study. A core part of this task and of the project as a whole is the evaluation of BMPs to address the pollution problems. This process will involve a number of stakeholders (parties interested in the lake and surrounding park). Likely stakeholders will be the City of Los Angeles, the KMHRP and its Advisory Board, the Dominguez Channel Watershed Management Group, the County of Los Angeles, the RWQCB, and the Cities within the drainage area. This watershed-based approach will select various sources and/or treatment control strategies for implementation. The product of this work will be a pollution abatement plan to address the pollution problems for the lake and the surrounding park.

Subtask 6.1. Identification and Selection of Best Management Practices

Expand and modify the work conducted under the Machado Lake Watershed Management Plan study. Based on the identified pollutants of concern, screen potential BMPs for further evaluation.

Subtask 6.2 Stakeholder Process for BMP Selection

This task will evaluate BMPs to address the pollution problems. This process will involve stakeholders such as the City of Los Angeles, the KMHRP and its Advisory Board, the County of Los Angeles, the RWQCB, and the Cities within the drainage area. This watershed-based approach will select various sources and/or treatment control strategies for implementation. The product of this work will be a pollution abatement plan to address the pollution problems for the lake and the surrounding park.

Subtask 6.3 Source Control Measures for Greater Watershed

This task will identify and develop an implementation strategy for source control BMPs for the pollutants of concern, such as trash and debris, nutrients, pesticides, and heavy metals.

Task 7: Pollution Control Preliminary Engineering

This task will include in-depth evaluation of the engineering systems selected in Task 6. A number of potential technologies that could be used to improve the water quality include the following:

- Installation of screens, nets, and other devices to catch trash and debris flowing in the storm drains;
- Use of a detention (wet) pond to provide pollutant settling;
- Use of constructed wetlands or existing vegetation to strip pollutants from entering the lake;
- Storm drain flow dispersion across the existing vegetation to facilitate pollutant uptake; and
- Use of aerators to increase oxygen content in the lake.

These and other systems could be evaluated for implementation. This task will also examine implementation and regulatory feasibility, preliminary engineering, and cost estimates for these systems.

Subtask 7.1 Concept Development for Selected BMPs

Identified BMPs will be further screened based on anticipated performance, reliability, implementability, constructability, regulations, permitting, cost considerations, and community acceptance. Various treatment configurations and locations will be identified for further evaluation. This process will yield a limited number of systems (such as two or three) for preliminary engineering.

Subtask 7.2. Preliminary Engineering

A preliminary engineering for the various screened structural BMPs will be conducted and will include the following components:

- Performance criteria
- Alternative configurations
- Alternative locations
- Hydraulic profiles
- Schematics of various engineered systems
- Environmental and permitting requirements
- Operational and maintenance considerations
- Implementation schedules and recommended assignments
- Cost estimate

Subtask 7.3. Preliminary Engineering Report

A preliminary engineering report will be prepared to assist after the completion of this study in the engineering of pollution control systems. The report will also assist in preparation of grant applications for the implementations of capital projects that will safeguard the Lake's water quality.

Task 8: City-Wide Application

Inclusion of Machado Lake into the State Fish and Game's Urban Fishing Game Program will be evaluated. A framework and guideline for similar evaluation of the other urban lakes located within the City of Los Angeles will also be created. This model can be utilized for assessment of the Echo Park, Lincoln Park, and Hollenbeck Lakes.

The three other City of Los Angeles urban lakes will be visited. A Los Angeles Urban Lakes Evaluation Plan will be prepared for future focus on enhancing the water quality and recreational uses of these lakes.

Task 9: Draft and Final Report

Subtask 9.1 Prepare and Circulate Project Draft Final Report

Prepare a draft final report, which represents the results of the work completed by this project. Include in this report the elements of Tasks 4, 5, 6, 7, and 8 including subtasks under each of those sections. Submit the draft final report to the Contract Manager, the TAC, and other affected public and private agencies, and interested parties for comment. Prepare an evaluation and response to comments made on the draft final report.

Subtask 9.2 Revise, Complete, and Distribute Final Report

Incorporate relevant comments into the final report. Distribute the final report to members of the TAC, and public and private agencies and individuals with an interest in the project.

As part of the final report, complete a Data Entry Form provided by the Contract Manager and submit this to the ICE at U.C. Davis for posting on the Internet on their Natural Resource Project Inventory Website. The Project Director will provide the Contract Manager with a final print out or copy of the completed form as submitted to U.C. Davis ICE. The form can be found on http://ice.ucdavis.edu site.

1.6 Project Schedule

Estimated project schedule is presented in Table 1.

Table 1
Project Schedule

Task	Deliverable	Completion Dates
1	Quarterly Report Quarterly Invoice	April 10, 2002, ongoing through end of project
2	Form TAC Hold Meetings Prepare & Submit Responsive Summaries	January 8, 2002 April 10, 2002, Bimonthly Ongoing
3	Quality Assurance Plan	November 10, 2002
4	Stormwater Runoff Data Lake Water Quality Sampling	April 10, 2003 October 10, 2003
5	Pollution Loading Data	November 10, 2003
6	Screened BMPs Source Control Strategies Pollution Abatement Plan	February 10, 2004 February 10, 2004 February 10, 2004
7	Preliminary Engineering Report	May 10, 2004
8	Los Angeles Urban Lakes Evaluation Plan	August 10, 2004
9	Draft Final Report Final Report Submit Completed ICE Form Project Summary	October 31, 2004 January 31, 2005 January 31, 2005 January 31, 2005

2. MEASUREMENT DATA ACQUISITION

2.1 Sampling Process Design

The sampling plan has been developed to supplement data to the recently completed sampling program conducted as part of the Machado Lake Watershed Management Plan study. The sampling program is presented in Section 1.5 Task 4. The sampling plan is described in detail below.

2.1.1 Wet Weather Sampling

Sampling Locations

Figure 3 of Section 1.5 shows the storm drain and lake water quality sampling locations for the Wet Weather Sampling Program. The sampling locations are described below.

- Sampling Location A - Wilmington Drain Pump Station, north of Pacific Coast Highway
- Sampling Location B - Project 77/510 Storm Drain Outlet
- Sampling Location C - northern portion of the lake in the middle of the lake adjacent to an old natural willow tree just south of the day labor trailer
- Sampling Location D – middle portion of the lake north of the boathouse

- Sampling Location E - southern portion of the lake north of the dam

Sampling Schedule

Two wet weather sampling events will be conducted during the wet weather period (October 1, 2002 and April 30, 2003). The sampling crew will collect storm water samples using automatic samplers placed in a storm sewer maintenance hole immediately upstream of Sampling Location A and at the pump house at the terminus of the Wilmington Drain, north of Pacific Coast Highway (Location B) for both events. For the first sampling event of the wet season, a grab sample will be collected during the first hour of discharge to sample the first flush for analysis. For the second sampling event, a three-hour composite sample will be collected starting within the first hour of discharge. All samples will be submitted to the certified laboratory for analysis.

The sampling crew will monitor the weather forecast on a regular basis to determine when a measurable storm event is predicted. When this storm is predicted, automatic samplers will be set up at the two locations at least 12 hours in advance of the storm.

For the subsequent sampling event, the whether forecast will be monitored on a regular basis to determine when a storm event with a 60% chance of measurable precipitation is predicted. When a storm meets this requirement, automatic samplers will be set up the same as for the first sampling event.

During each sampling event, the sampling crew will also collect grab samples of the lake water at Locations C, D, and E shortly following the cessation of the storm event or the next day.

In-Field Measurement

The parameters listed below will be measured in the field immediately following the collection of grab samples. Results will be recorded on the Sample Field Data Sheet (*Refer to Section 2.4.4*).

- Dissolved oxygen (DO)
- pH
- Temperature
- Water clarity using a Secchi Disk (Lake only)
- Physical Appearance
- Water Depth (Lake only)

Laboratory Analysis

The following constituents will be analyzed at the selected laboratory:

- Total suspended solids (TSS)
- Ammonia – nitrogen
- Nitrate – nitrogen
- Nitrite – nitrogen
- Total phosphorus
- Organochlorine pesticides & PCBs
- Copper
- Lead
- Fecal and Total Coliform (Lake only)

2.1.2 Dry Weather Sampling

Sampling Locations

Dry weather sampling will be conducted during the dry weather season (May 1, 2003 through October 1, 2003). Grab samples will be collected from Sampling Locations C, D, and E within the lake only.

In-Field Measurement

The parameters listed below will be measured in the field immediately following the preparation of the composite sample at each sampling location. Results will be recorded on the Sample Field Data Sheet (*Refer to Section 2.4.4*).

- Dissolved oxygen (DO)
- pH
- Temperature
- Water clarity using a Secchi Disk
- Physical Appearance
- Water Depth

Laboratory Analysis

The following constituents will be analyzed at the selected laboratory:

- Total suspended solids (TSS)
- Organochlorine pesticides & PCBs
- Fecal and Total Coliform

2.2 Analytical Method

Analytical methods including sample containers, volumes, preservatives, and holding times are presented in Table 2.

Table 2
Sample Containers, Volumes and Preservatives for Storm Water Runoff Sampling

Parameters	Test Method		Container		Preservative	Holding Time
	Method	Reference	Type	Sample Size		
BOD*	405.1	1	Polyethylene	500 ml	Refrigerate	48 hrs
Fecal Coliform Bacteria	SM9221E	2	Polyethylene, glass (sterile)	100 ml	$Na_2S_2SO_3$, refrigerate	6 hrs
Total Coliform Bacteria	SM9221B	2	Polyethylene, glass (sterile)	100 ml	$Na_2S_2SO_3$, refrigerate	6 hrs
Ammonia Nitrogen	350.3	1	Polyethylene	400 ml	Add H_2SO_4 to pH<2, refrigerate	28 days
Nitrate	300	1	Polyethylene	125 ml	Refrigerate	48 hrs
Nitrite	300	1	Polyethylene	125 ml	Refrigerate	48 hrs
Total Phosphorus	365.2	1	Polyethylene	100 ml	Add H_2SO_4 to pH<2, refrigerate	28 days
Total Suspended Solids	160.2	1	Polyethylene	100 ml	Refrigerate	7 days
Lead	200.7	1	Polyethylene	200 ml	Add HNO_3 to pH<2	6 months
Copper	200.7	1	Polyethylene	200 ml	Add HNO_3 to pH<2	6 months
Organochlorine pesticides & PCBs	608	1	Amber glass	2 L	None	7 days

References:

1. "Methods for Chemical Analysis of Water and Wastes," EPA--600/4-79-020, U.S. Environmental Protection Agency.
2. "Standard Methods for Examination of Water and Wastewater", 18th Edition.

* The sample to be analyzed for BOD has a recommended holding time of 6 hours under refrigeration or cooling to 4º C and analysis should begin before 24 hours of collection (Standard Methods for the Examination of Water and Waste Water, page 5-3).

2.3 Sample Collection Procedures

2.3.1 Pre-sampling Checklist

In order to facilitate an orderly sampling program, the following equipment, information, and supplies will be prepared by the sample collection crews:

- A map of the site showing access roads and locations of sampling points;
- Sample Field Data Sheets for recording observations;
- Waterproof marking pens or pencils;
- Pole swing sampler for each sampler (*in the event an automatic sampler cannot be installed*);
- Wide bottle mouth to attach to a swing sampler at each sampling location (*in the event an automatic sampler cannot be installed*);
- Secchi Disk with rope;
- 10-foot PVC pipe marked in 1-inch increments
- 1-foot rulers

- Disposable bailers for lake water sampling locations
- A 1000-ml bottle with cap for each sampling location to transfer the sample from the sampling device to the composite bucket
- A sample compositing bucket (5-gallon container) with lid per each sampling location
- Sample bottles with preservative (as required) as well as coolers containing ice to cool the samples (provided by the laboratory)
- A pocket thermometer for each sampler
- A potable instrument (Horiba U-10 Water Checker) to measure pH, conductivity, dissolved oxygen and temperature
- Chain-of-Custody forms provided by the laboratory
- Two 1000-ml squirt bottles filled with distilled water and a bucket for rinsing sampling equipment for each sampling location
- A scrub brush for cleaning sampling equipment for each sampler
- Two 1-gallon jugs of distilled water for equipment cleaning per each sampler
- Boat with electric motor for collecting samples on the lake
- Rain gear, including jacket with hood and pants
- Safety equipment including gloves, safety glasses, steel-toed boots
- First aid kit including bandages, antiseptic solution, and A&D ointment
- A small bottle of Liquinox or non-phosphate detergent per each sampler

All sampling equipment must be thoroughly cleaned with non-phosphate detergent (liquinox), triple rinsed with tap water, and triple rinse with distilled water prior to sampling. Rinsed water should be kept in the bucket provided until the end of the sampling period and disposed of properly.

2.3.2 Pre-Sampling Preparation

1. Field Sampling Leader (Jay officer) will contact the KMHRP Recreation Director (Tim Hayes or John Popoch) to inform her/him about the scheduled sampling. The KMHRP Recreation Director would notify the security officers of the expected sampling activities and sampling locations.
2. Field Sampling Leader (Jay Officer) will contact Kim Banks of Del Mar Analytical with sampling information at least one week in advance for Dry Weather Sampling to provide date, time, number of samples, analyses desired for each sampling event. For Wet Weather Sampling, contact the laboratory once the weather forecast agency predicts the first storm event of the season and any upcoming 60 percent chance of storm to prepare for automatic sampler installation and sample pick-up and analyses.
3. Note the sampling locations where equipment blank and field duplicate samples would be collected (to be determined by the task manager for each sampling event).

4. An assigned sampling crew will check the equipment for good working order, calibrate field test instrument.
5. An assigned sampling crew will familiarize himself or herself with chain-of-custody procedures.

2.3.3 Sample Collection

Wet Weather Sampling

Storm Drain Sampling: For the first sampling event of the wet season, a grab sample will be collected at Sampling Locations A and B during the first hour of discharge to sample the first flush for analysis. For the second sampling event, a three-hour composite sample will be collected starting within the first hour of discharge. To the extent possible, an automatic sampler will be pre-installed at each storm drain sampling location (A and B). The hourly-collected sample of approximately four liters each will be transferred (using the one liter transfer bottle) to the composite container. The composite sample will be transferred to the sample containers (Table 3) prepared for by the laboratory for the analyses of parameters listed in Section 2.1. Leave approximately 1 liter in the composite container to test for pH, temperature, and DO using the Horiba U-10 Water Checker. Record the field analysis result including weather condition and sample appearance in the field notebook.

Table 3
Sample Containers to be Prepared by Contracted Laboratory

Container Type	Analyte(s)
1 x 1L Amber glass jar w/ H_2SO_4	Ammonia, Phosphorous
100 ml Sterile bottle w/ $Na_2S_2SO_3$	Fecal and Total Coliform Bacteria
2 x 1L Poly w/o preservative	Nitrate, Nitrite, TSS, BOD
1 x ½L Poly w/ HNO_3	Copper and Lead
2 x 1L Amber w/o preservative	Organochlorine pesticides, PCBs,

In the event an automatic sampler cannot be installed, a manual sample collection will be performed. In this case, transfer four liters (using the one liter transfer bottle) to the composite container. The sampler will measure temperature immediately for each hourly grab sample and record results in the field notebook. The composite container shall be covered at all times to prevent dilution by rainfall. At the end of the third hour, the composite sample will be transferred to the sample containers prepared for by the laboratory for the analyses of parameters listed in Section 2.1. Leave approximately one liter in the composite container to test for pH, conductivity, temperature, and DO using the Horiba U-10 Water Checker.

Lake Water Sampling: Grab samples will be collected at Locations C, D, and E (lake water) shortly after the cessation of the storm. Prior to sample collection, measure the depth of the lake at the sampling point; drop the secchi disk into the lake water and measure the clarity of water by measuring the distance to which the secchi disk disappears. Use a 3-foot long disposable bailer with rope attached to collect water from the lake. Lower bailer into lake so that the top of the bailer is approximately 6 inches below the water surface. Collect approximately 10 liters of sample (using the one liter transfer bottle) to the five-gallon container. Transfer the sample from the container to the sample bottles prepared by the laboratory for the analysis of parameters listed in Section 2.1. Leave approximately one liter in the five-gallon container to test for pH, conductivity, temperature, and DO using the Horiba U-10 Water Checker.

Dry Weather Sampling

One grab sample will be collected at Sampling Locations C, D, and E (in lake only). Follow the same instruction as described in the Wet Weather Sampling Program above.

Equipment Blank Sample Collection

Prior to each sampling event, the Task Manager will notify the sampling crew of the designated sampling location for the equipment blank sample collection. The sampler at the equipment blank designated location will follow the same procedure for sample collection. However, the rinse water (distilled) from the sampling bucket prior to sample collection will be transferred to sample bottles prepared by the laboratory and sent to the laboratory for the same analyses as other samples.

Field Duplicate Sample Collection

Prior to each sampling event, the Task Manager will notify the sampling crew of the designated sampling location for the field duplicate sample collection. The sampler at the field duplicate designated location will follow the same procedure for sample collection but will collect twice the volume of sample (i.e., 20 liters instead of 10 liters). Water will be divided into two composite containers. The samples will then be transferred into two sets of sample bottles prepared by the laboratory and sent to the laboratory for the same analyses as other samples. The duplicate sample bottles will be labeled so that the laboratory will not know the location of the duplicate.

2.4 Sample Handling and Custody

2.4.1 Sample Containers and Preservation

The appropriate sample containers and preservatives required for each type of analysis will be prepared by the laboratory as listed in Table 2 under Section 2.1

2.4.2 In-Field Measurement

The samplers will check each sample for temperature immediately after collecting the sample, using their pocket thermometers.

The following parameters will be measured soon after the samples are composited using the Horiba U-10 Water Checker: pH, temperature, and dissolved oxygen. The device shall be calibrated according to the manufacturer's instructions prior to the measurement of these constituents. The monitoring results will be recorded in the "Sample Field Data Sheet" (refer to Sample Documentation Section).

2.4.3 Sample Handling

Sample containers will be pre-labeled and immediately filled out following compositing. Samples will be kept cool with ice or cold packs until received by the laboratory. At the time of sampling, each sample will be logged on a sampling and analysis chain-of-custody record that will accompany the samples to the laboratory.

2.4.4 Sample Documentation

The following procedures will be used during sampling and analysis to provide chain-of-custody control during sample handling from collection through storage.

- Field logbook to document sampling activities in the field.
- Labels to identify individual sample.
- Chain-of-custody record sheets for documenting possession and transfer of sample.

Field Logbook

In the field, the sampler will record the following information on the "**Sample Field Data Sheet**" (**Attachment 1**) for each monitoring event:

- Facility Name
- Sample location
- Name of sampler
- Weather condition
- Date and time
- Results of field analyses
- General comments

The field logbook must be signed by the sampler after each sampling event.

Sample Labeling and Identification

Each sample bottle will be labeled with the following information at the time of sampling:

- Project name (Machado Lake)
- Sample identification number
- Sampling date and time
- Sample type (grab or composite)
- Preservatives (filled out by the laboratory)
- Analytes (filled out by the laboratory)
- Sampler's initial

The following sample identification system will be used:

Sampling Location/Sample Type	Sample ID
Sampling Location A	SL-A-xxxx03
Sampling Location B	SL-B-xxxx03
Sampling Location C	SL-C-xxxx03
Sampling Location D	SL-D-xxxx03
Sampling Location E	SL-E-xxxx03
Duplicate	SL-F-xxxx03
Equipment Blank	SL-G-xxxx03

Note: first two x's are the month, next two x's are the day

Seals

Seals will be applied to each container immediately after sample collection to prevent tampering with the samples. The seal will display the following information:

- Project name
- Sample number
- Sample date
- Sampler's name

Label and Seal instructions are provided in **Attachment 2**.

Sampling and Analysis Chain-of-Custody Record

The sampling and analysis chain-of-custody record will be initiated at the time of sampling. The record will contain the following information:

- Project name (Machado Lake)
- Sample Identification Number
- Sampling location
- Sampling date and time
- Sample type
- Analytical request
- Number and type of containers
- Sampler's signature

Custody transfers will be recorded for each individual sample location. The number of custodians in the chain of possession will be kept to a minimum. A copy of the Sampling and Analysis Chain-of-Custody Record will be returned with the analytical results.

An example of a chain-of-custody record is provided in **Attachment 3**.

2.4.5 Sample Transportation

The Field Sampling Leader will coordinate with the laboratory prior to each sampling event to arrange a vehicle and crew to pick up the samples from the site at the completion of sampling activity. The contracted laboratory will transport the sample containers to their laboratory. Samples will be kept cold and unfrozen at all times. The laboratory will be notified in advance of the time when the analysis must begin so that the sample holding times are not exceeded.

2.5 Quality Control (Field Application)

The following Quality Control/Quality Assurance procedures will be undertaken to confirm the integrity of field and laboratory data generated during the monitoring program:

- Rinse the sampling equipment thoroughly with distilled water prior to sampling at each location.
- Collect one equipment (equipment rinsing water) blank for each analyte per sampling event.
- The laboratory is to provide one trip blank for each analyte per each sampling event.

- Collect one field duplicate per each sampling event. Prior to the sampling event, the task manager will notify the sampling crews of the sampling location where the field duplicate would be collected. At the designated sampling location, two sets of samples will be collected for the same analysis. However different sample identifications will be used for the duplicated set of samples.
- Split the sample in separate containers for separate analysis. Preserve the samples according to the instructions from the laboratory.
- Clean sampling equipment between sampling events with a non-phosphate detergent, rinse three times with tap water, then rinse three times with distilled water. Take special care when rinsing after a detergent wash to make sure all the detergent is removed. Dispose of rinse water properly.
- For constituents measured in the field, the relative percent difference (RPD) for aqueous samples is less than 30 percent. If the RPD between the duplicates is greater than 30 percent, then reanalysis of the duplicate samples should be conducted following recalibration of the instrument (Horiba U-10 Water Checker).

2.6 Safety Procedures

The following safety measures must be followed by the sampling crews at all times during the sampling events:

1. Always notify the Recreation Director of the City of Los Angeles Department of Recreation and Parks in charge of KMHRP about the sampling activities and the expected length of sampling during the daytime sampling events.
2. Always wear protective equipment such as gloves, and protective eyeglass during sample collection and sample preparation.
3. Notify the Recreation Director once the sampling is completed and the crew is ready to leave KMHRP.

2.7 Field Instrument Calibration Frequency

The Horiba U-10 Water Checker must be calibrated prior to each sampling event. Calibration of the U-10 will be conducted in accordance with Section 3 of the Instruction Manual (Code: 040801000HK-5).

2.8 Laboratory Analysis

2.8.1 Selected Laboratory and Contact

All samples will be analyzed at Del Mar Analytical Laboratory, a State Environmental Laboratory Accreditation Program (ELAP) certified laboratory. Del Mar Analytical is located at 2852 Alton Avenue, Irvine, California 92602, Telephone: (949) 261-1022, Fax: (949) 435-0858. Contact person at Del Mar Analytical is:

Kim Banks (626) 458-0332

Del Mar Analytical will provide all required sample bottles, preservatives, and coolers prior to the scheduled sampling events. Del Mar Analytical also provides a sample pick-up service from the sampling site.

In addition to sample analysis, Del Mar Analytical will provide automatic sampler installation service at the specified sampling locations as well.

2.8.2 Sample Bottles Delivery and Pick Up Procedures

Wet Weather Sampling

Since the wet weather sampling date cannot be predicted too far in advance, Del Mar Analytical will provide a full set of sample bottles and coolers to be kept at Parsons office. Once the first storm event of the wet season is predicted and a subsequent storm with 60 percent chance of occurring is predicted, Del Mar Analytical will be notified to prepare for a potential automatic sampler installation and sample pick-up from the project site. Once the sampling begins, Del Mar Analytical will be notified of the expected time to pick-up the samples.

Dry Weather Sampling

Del Mar Analytical will be notified of the sampling date at least 5 days in advance. A set of sample bottles and containers should be delivered to Parsons office at least five days before the sampling event so that the sampling crew could be familiar with the package. All bottles should be pre-labeled and preservative added (as necessary) for the parameter(s) to be analyzed. All the bottles required for each sampling location shall be placed together in the same container to avoid confusion to the sampling crew.

At the end of the sampling event, Del Mar Analytical's courier shall be contacted to pick up all the samples to deliver back to the laboratory for immediate analyses of certain parameters. Del Mar Analytical should notify Parsons Field Sampling Leader (Jay Officer) or Project Manager (Anne Kochaon) of any desired arrangement on the day the first batch of sample bottles and containers are delivered.

2.8.3 Analytical Method

All analyses will be performed in accordance with the current edition of the following documents:

- Standard Methods for the Examination of Water and Wastewater, latest Edition, APHA-AWWA-WPCF.
- Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, U.S. EPA.

Sample storage and disposal will follow the procedures set forth in Del Mar Analytical's Quality Assurance (QA) Manual Sections 7.5 and 7.6. Samples will be stored at the laboratory in a refrigerator at 4ºC for a period of 30 days. After this period, the samples will be archived for an additional 30 days before disposal. Immediately prior to disposal of samples, the pH of the samples will be adjusted to meet industrial wastewater discharge limits and then discharged into the laboratory's sewer system.

2.8.4 Analytical Results Reporting

Del Mar Analytical shall submit all analytical results to Parsons Project Manager (Anne Kochaon) as soon as they are available (no more than 10 working days after the sampling date). The report shall identify analytical methods and laboratory reporting limits for various parameters analyzed. All quality assurance/quality control results shall be attached to the result reporting sheet(s).

2.8.5 Laboratory Data Validation

The contracted laboratory shall follow the procedures outlined in this QAPP, including sample bottles preparation, chain-of-custody requirements, analytical methods to be used, control samples to be run, and the requirements for storage and disposal of samples.

The contracted laboratory are to notify the Parsons project manager in a timely manner if any non-conformances occur prior to and during the analysis of samples. This may necessitate the resampling of samples. The laboratories are to provide at a minimum level 2 reviews of the data prior to sending reports to the Parsons project manager. A text report on the data package is to be provided if any anomalies are found. The reports are to be signed by the Laboratory Director/ an officer of responsibility.

An audit of the laboratory by a Parsons's scientist may be made at an undisclosed time while the samples for this project are being analyzed.

Parsons will perform data validation of the data generated by the certified laboratories used to perform the analysis of samples for this project.

The EPA Contracted Laboratory Program guidelines will be followed to verify that:

1. The control data associated with the data are run and submitted to Parsons.
2. The control data which will be required with this project are: Chain of Custody, Blanks, Matrix Spike (MS) and Matrix Spike Duplicates (MSD), Laboratory Control Sample (LCS), Continuous Calibration Verification (CCV) Standard (This standard will be analyzed prior to analysis of samples), Surrogates for Organic Analyses, Control Ranges for the MS, MSD, LCS, CCV and Surrogate percent recoveries, control range for the relative percent differences and the reporting limits for all methods.
3. The chain-of-custody will be examined for the sample collection data and compared to the date stated in the analytical report, the proper signatures of relinquishing and receiving of samples, the temperature of the cooler holding the samples, and if the correct amount of preservative require by the method was added. Also, if the methods stated on the chain-of-custody were used to analyze the samples and if the proper number were collected as required by the analytical methods.
4. The elapsed time will be checked to determine if the extraction/ analysis date is performed within the appropriate time required by the analytical method.
5. The content of the blanks will be examined to determine if contamination exists in the reagents used in the digestion or extraction. The field and equipment blanks will also be examined for potential contamination. The criteria for allowable contamination in a blank will be determined by the 5x Rule. Any compound detected in the sample, which was also detected in any associated blank, must be qualified as estimated when the sample concentration is less than five times the blank concentration. If some sample concentrations are greater than or equal to five times the concentration of the blank, no further action is required. If an analyte is detected in a field blank but is not detected in the associated sample, no action is taken.

6. The percent recoveries of the MS, MSD, LCS, CCV and surrogates will be checked to determine if the recoveries are within the control limits supplied by the laboratory (Accuracy). The criteria set forth in Del Mar Analytical's QA Manual, Section 9.1.2 will be used. If the criteria are exceeded, reanalysis of the sample should be conducted.
7. The relative percent difference (RPD) between the MS and the MSD will be checked to determine if it is within the control limits (Precision). The criteria set forth in Del Mar Analytical's QA Manual, Section 9.1.3 will be used. If the criteria are exceeded, the MS and MSD should be re-prepared and re-analyzed.
8. Flags often assigned to discrepancies will not be performed at this level of validation, however, if more than two controls are out of the control limits, the data will be considered estimates. If holding times are exceeded, the data will be rejected and resampling will be recommended.

2.9 Data Management

Data and lab results will be sent to the City of Los Angeles' Watershed Protection Division (WPD) where it will be summarized using a spreadsheet in excel. The form will compile results from Del Mar Analytical and incorporate the sample ID, sample location, weather condition, date and time, concentration results, and comments. A graphical representation of the data will also be created to analyze results. Upon completion, all water quality-related data generated by the project will be submitted to the State Board for input into the STORET system. Data will be submitted to the State Board Office of Information Technology and ICE through email or a computerized diskette. This data will supplement and update the work of the Machado Lake Watershed Management Plan (MLWMP) study to calculate the pollutant loads into the lake. Identifying pollutants that impair the beneficial uses of the lake will also be examined to improve the overall water quality.

3. ASSESSMENT OVERSIGHT

Assessment of lake water quality will be done to identify options to meet water quality objectives and beneficial uses of the lake. Criteria used for assessing water quality will be taken from the LARWQCB Water Quality Assessment & Documentation (1996). Water quality standards will be looked at to see if they meet standards for use such as, bathing, fishing, and recreation. Parameters such as, odor, nutrients, DO, TSS, nitrogen, coliform bacteria and some heavy metals will be examined in order to focus on improving the water quality of the lake.

As part of WPD plan to improving the water quality of the lake assessing the calculated pollutant loads from stormwater runoff will also be calculated. A further look of land use and activity from the contributing watersheds will also help in determining the source of certain pollutants. Assessment of lake water quality with allow WPD to identify appropriate BMPs for stormwater runoff pollution control and further define the needed pollution abatement systems.

4. DATA VALIDATION AND USABILITY

All the data will be reviewed by the staff of WPD and will evaluate the accuracy and precision. Review of blank, spikes and replicates, which provide indications of quality of data being compromised, will be viewed as a voided sample. Data will then be used to determine if the pollutant concentrations are within the normal range of urban storm water runoff. Results will then be compared to those generated by the Department of Recreation and Parks' study of December 2000. Upon validation of the data WPD will use the data as a benchmark to assess the water quality of Machado Lake. Furthermore, various alternatives will be looked at in order to improve the water quality of Machado Lake. Through this effort, both short and long-term goals will be established to maintain and improve the water quality of the lake.

Appendix B

Water Quality Sampling Field Notes
And Water Quality Data

Machado Lake Water Quality Assessment
Field Note for First Wet Weather Sampling Event

Sampling Date:	February 11 and 13, 2003
Sampling Crews:	Jay Officer, Parsons Charles Holmes, Del Mar Analytical Darin Guthrie, Parsons
Sampling Locations:	Runoff samples were collected at Wilmington Drain and a Manhole at the junction of Vermont Avenue/Normandie Avenue (the first manhole upstream of Project 77/510 discharging point to Machado Lake) Machado Lake water quality samples were collected at three locations within the Lake
Sampling Procedures:	Followed the procedures outlined in the Quality Assurance Project Plan (QAPP), January 2003, which was approved by the State Water Resources Control Board

Field Notes:

Parsons continuously monitored the whether forecast since the final QAPP was submitted to the State Water Resources Control Board in January, 2003. A measurable rainfall event was predicted to commence Tuesday evening, February 11, with heavy rainfall predicted for Wednesday, February 12. On Monday, February 10, Jay Officer of Parsons met with Charles Holmes, the sampler from Del Mar Analytical, to visit the sampling sites for storm water runoff sample collection, including Wilmington Drain, north of Ken Malloy Harbor Regional Park (KMHRP), and at a storm drain manhole at the junction of Normandie Avenue and Vermont Avenue.

The sampling team first visited the Wilmington Drain's pump house located north of the Pacific Coast Highway (PCH) to identify an appropriate location for automatic sampler installation. Greg Sarpy, Flood Control Construction Supervisor with the Los Angeles County Department of Public Works (LACDPW), was there to open the pump house. It was noted that the pump house only contains the pump controls and piping; therefore, the sampling team decided to set up the automatic sampler outside the pump house. During the site visit, it was also noted that the water level in the Wilmington Drain was well below the baffle under the PCH.

Next, the sampling team visited the storm drain manhole located in the street between Vermont Avenue and Normandie Avenue. This sampling location is located upstream of the Project 77/510 discharging point to Machado Lake. The manhole was very deep (in excess of 15 feet). No flow was observed in the manhole.

Steady rainfall started early in the day on February 11, and Charles Holmes of Del Mar Analytical went out to the site to set up the equipment. He tried to set up the sampler at the storm drain manhole, but due to the depth of the manhole, he could not pull a sample up to street level. Since the first wet weather sample required a grab sample within the first hour of runoff, the sampler took a grab sample from the manhole. The sample at this location was collected at approximately 10 a.m.

At the Wilmington Drain sampling location, the sampler observed flow starting to go over the dam at the Wilmington Drain; he grabbed a runoff sample on the south side of

PCH as the runoff was entering KMHRP. The sample at this location was collected at approximately 11 a.m.

The runoff samples were submitted to Del Mar Analytical for analysis. The samples were analyzed for: ammonia nitrogen, nitrate, nitrite, total phosphorus, total suspended solids, biochemical oxygen demand, copper, lead, and organochlorine pesticides and PCBs.

The storm started to taper off on Thursday, February 13. Jay Officer and Darin Guthrie of Parsons went out to Machado Lake to collect lake water samples. The samples were collected from the north, central, and south areas of Machado Lake using disposable bailers. A profile of the lake water from surface to approximately 3 feet deep was collected. The lake level was high and the water was brownish in color and murky. The day was overcast with occasional drizzle. The aeration systems were operating in the central and south areas of the lake, which resulted in higher dissolved oxygen levels in the samples. The lake water samples were collected between 11:00 a.m. and noon. A duplicate sample was collected from the central area of the lake and a field blank was prepared. The samples were picked up by Del Mar Analytical at 1:00 p.m. and transported on ice to the lab for analysis. The samples were analyzed for: ammonia nitrogen, nitrate, nitrite, total phosphorus, total suspended solids, biochemical oxygen demand, copper, lead, organochlorine pesticides and PCBs, and fecal and total coliform bacteria.

Field sample results:

Constituent	SL-A (North)	SL-B (Central)	SL-C (South)	Trip Blank
pH	6.14	6.37	6.52	6.23
Dissolved Oxygen (mg/L)	5.63	10.52	10.32	0
Conductivity (mS/cm)	0.198	0.186	0.203	0
Temperature (°F)	60	60	62	69
Secchi Depth (inches)	11	12	10.75	N/A

N/A: not applicable

The total rainfall measured for this storm was 3.31 inches; February 11 = 0.37 inches, February 12 = 2.52 inches, and February 13 = 0.42 inches (AccuWeather.com).

Sample Identification:

The following are keys to the Sample I.D.

Sampling Location	Laboratory ID	Client (Parsons) ID
Wilmington Drain	IMB0492-01	Location A
Upstream of Project 77/510 Drain	IMB0492-02	Location B
North End of the Lake	IMB0759-01	SL-A-021303
Central Area of the Lake	IME0759-02	SL-B-021303
South End of the Lake	IME0759-03	SL-C-021303
Duplicate Sample (Duplicate of Central Area Sample)	IME0759-04	SL-I-021303
Trip Blank	IME0759-05	SL-G-021303

Machado Lake Water Quality Assessment
Field Note for Second Wet Weather Sampling Event

Sampling Dates:	February 25 and 26, 2003
Sampling Crews:	Jay Officer, Parsons Charles Holmes, Del Mar Analytical Darin Guthrie, Parsons
Sampling Locations:	Runoff samples were collected at Wilmington Drain and a Manhole at the junction of Vermont Avenue/Normandie Avenue (the first manhole upstream of Project 77/510 discharging point to Machado Lake) Machado Lake water quality samples were collected at three locations within the Lake
Procedures:	Follow the procedures outlined in the Quality Assurance Project Plan (QAPP), January 2003, which was approved by the State Water Resources Control Board

Field Note:

A measurable rainfall event was predicted to commence late Monday evening, February 24, and continue into Tuesday, February 25, 2003. Charles Holmes of Del Mar Analytical set up automatic samplers at Wilmington Drain next to the pump house north of Pacific Coast Highway and in the storm drain manhole at the intersection of Vermont Avenue and Normandie Avenue on Monday afternoon. Samples at these locations were collected at approximately 11:00 p.m. on Monday night.

These samples were transported to Del Mar Analytical for analysis the next morning. The samples were analyzed for: ammonia nitrogen, nitrate, nitrite, total phosphorus, total suspended solids, biochemical oxygen demand, copper, lead, and organochlorine pesticides and PCBs.

The storm continued through Tuesday, February 25, tapering off later in the day. Jay Officer and Darin Guthrie of Parsons went out to Machado Lake to collect lake water samples on Wednesday, February 26. The samples were collected from the north, central, and south areas of Machado Lake at a depth of approximately 1 foot. The lake level was up and the water was brownish in color and murky. The day started out with overcast skies which turned to partly cloudy towards the end of the sampling event. The air temperature was 68º F. The aeration systems were operating in the central and south areas of the lake, which resulted in higher dissolved oxygen levels in the samples. The lake water samples were collected between 10:30 a.m. and 11:30 a.m. A duplicate sample was collected from the north area of the lake and a field blank was prepared. The samples were picked up by Del Mar Analytical at 12:37 a.m. and transported on ice to the lab for analysis. The samples were analyzed for: ammonia nitrogen, nitrate, nitrite, total phosphorus, total suspended solids, biochemical oxygen demand, copper, lead, organochlorine pesticides and PCBs, and fecal and total coliform bacteria.

Field sample results:

Constituent	SL-A (North)	SL-B (Central)	SL-C (South)	Trip Blank
pH	6.55	6.34	6.62	5.42
Dissolved Oxygen (mg/L)	9.87	9.98	10.09	9.45
Conductivity (mS/cm)	0.147	0.150	0.166	0.01
Temperature (°F)	58	58	59	N/A
Secchi Depth (inches)	11.375	12.375	14.125	N/A

N/A: not applicable

The total rainfall measured for this storm was 0.39 inches; February 24 = 0.23 inches and February 25 = 0.16 inches (AccuWeather.com).

Sample Identification:

The following are keys to the Sample I.D.

Sampling Location	Laboratory ID	Client (Parsons) ID
Wilmington Drain	IMB1447-01	Location A
Upstream of Project 77/510 Drain	IMB1447-02	Location B
North End of the Lake	IMB1511-01	SL-A-022603
Central Area of the Lake	IME1511-02	SL-B-022603
South End of the Lake	IME1511-03	SL-C-022603
Duplicate Sample (Duplicate of North End Sample)	IME1511-04	SL-I-022603
Trip Blank	IME1511-05	SL-G-022603

Machado Lake Water Quality Assessment
Field Note for Dry Weather Sampling Event

Sampling Date: May 29, 2003
Sampling Crews: Jay Officer, Parsons
Brynna McNulty, Parsons
Sampling Locations: Machado Lake water quality samples were collected at three locations within the Lake
Procedures: Follow the procedures outlined in the Quality Assurance Project Plan (QAPP), January 2003, which was approved by the State Water Resources Control Board

Field Note:

Dry weather water quality samples for Lake Machado were collected on May 29, 2003. No measurable rainfall has occurred in the area since May 3, 2003 (see attached precipitation record for May 2003).

Lake water samples were collected from the north, central, and south areas of Machado Lake; the same general sampling locations used for the two wet weather sampling events. The day started off with low cloud cover and was replaced with full sun towards the end of the sampling event. The air temperature at the beginning of the sampling event was 73º F. The lake water had a yellowish/brown tint. The aeration system in the lake was not operating during sample collection. The samples were collected between 10:20 a.m. and 11:05 a.m. A duplicate sample was collected from the south area of the lake and a trip blank was prepared. The duplicate sample was designated as SL-I and the collection time is shown as 11:20 a.m. on the Chain-of-Custody form so that the lab doesn't know which sampling location the duplicate sample was collected. The sample collected at the south area of the lake had an abundance of small organisms in the sample i.e., daphnia (water fleas). A trip blank was prepared using distilled water and was designated as SL-G.

The samples were picked up by Del Mar Analytical at 12:52 p.m. and transported on ice to the lab for analysis. The samples are to be analyzed for: total suspended solids, biochemical oxygen demand, organochlorine pesticides and PCBs, and total and fecal coliform.

Field measurements of the samples were conducted using a Horiba U-10 Water Checker. The unit was calibrated immediately prior to measuring the samples. A Secchi disk was used to measure the clarity of the lake water. The field results are shown below.

Field sample results:

Parameter	SL-A (North)	SL-B (Central)	SL-C (South)	SL-G (Trip Blank)
pH	6.21	6.33	6.24	5.82
Dissolved Oxygen (mg/L)	8.75	8.21	8.67	8.57
Conductivity (mS/cm)	0.548	0.545	0.569	0.001
Temperature (°F)	74	74	74	N/A
Secchi Depth (inches)	36.5	41.5	38.5	N/A
Depth of Lake (inches)	40	51.75	58	N/A

mg/L: milligrams per liter
mS/cm: micro Siemens per centimeter
N/A: not applicable

Sample Identification:

The following are keys to the Sample I.D.

Sampling Location	Laboratory ID	Client (Parsons) ID
North End of the Lake	IME1571-01	SL-A-052903
Central Area of the Lake	IME1571-02	SL-B-052903
South End of the Lake	IME1571-03	SL-C-052903
Duplicate Sample (Duplicate of South End Sample)	IME1571-04	SL-I-052903
Trip Blank	IME1571-05	SL-G-052903

Appendix C

Extended Basin Design Information

Appendix D

City of Los Angeles
Urban Lake Evaluation Framework

CITY OF LOS ANGELES
URBAN LAKE EVALUATION FRAMEWORK

INTRODUCTION

Most of the urban lakes within the City of Los Angeles (City) are man-made lakes, and are directly effected by urban runoff. A common effect of urban runoff on lake ecosystems is that the sediment load in the inflowing stream(s) drops out near the inlet and impacts bottom dwelling biota in the near vicinity. Depending on the extent and composition of the deposition, a percentage of the natural bottom dwelling biota might be destroyed, thereby altering the food chain of the ecosystem.

Another common effect on lakes is that floatables carried into the lake by the runoff stream are blown onto the shore or into small pocket embayments, thereby impairing the aesthetic value of the water body.

The third common effect is increased algae production in the lake. In summer, algae population growth is often sufficiently high to create algae blooms that are aesthetically displeasing. Algae blooms can deplete lake oxygen supplies sufficiently to cause fish kills. The most significant ecological effect attributed to an algae bloom is that the increased primary productivity results in an aquatic environment with decreased diversity. Once this occurs, elimination of the source of nutrients will have a limited short-term effect on biota – a heavily polluted lake may take decades to recover naturally.

OBJECTIVE

This Urban Lake Evaluation Framework is prepared to provide an outline for assessing water quality in the urban lakes within the City, such as Echo Park Lake, Hollenbeck Park Lake, and Lincoln Park Lake. This framework is developed based on the City's experience in performing Machado Lake water quality assessment and evaluation. The purpose of the Urban Lake Evaluation Program is to improve water quality of the urban lakes within the City to meet the designated beneficial uses and associated water quality objectives for the respective lakes.

BACKGROUND

In 2001, the City of Los Angeles Department of Recreation and Parks and the Palos Verdes South Bay Audubon Society commissioned the Ken Malloy Harbor Regional Park (KMHRP) Habitat Restoration Plan and the Machado Lake Watershed Management Plan (WMP) as part of an attempt to improve the invaluable habitat within the KMHRP which has been degraded by human misuse, and to clean up Machado Lake, which has been polluted as a result of uncontrolled stormwater runoff. Following up on the two-year project development, the City of Los Angeles Bureau of Sanitation, Watershed Protection Division requested and received a matching fund from the State of California Water Quality Control Board (SCWRCB) to perform additional water quality assessment of Machado Lake, and to develop preliminary engineering designs of the appropriate Best Management Practices (BMPs) that would improve water quality in Machado Lake.

EVALUATION FRAMEWORK

This Urban Lake Evaluation Framework has been developed based on the experience gained from the comprehensive Machado Lake water quality assessment and watershed development tasks. An objective and general steps for each key task to be undertaken as part of the evaluation program are provided below. Each evaluation plan should include a background of the specific lake and a conclusion. A sample evaluation plan prepared for Machado Lake is attached for reference.

Note that some of the tasks listed herein may not be required for certain evaluation plans.

1. Watershed Characterization

Objective: Identify the drainage and sub-drainage areas which discharge runoff to a specific lake, and identify land-use types within each subwatershed area.

General Steps:

- Obtain Geographic Information System (GIS) maps, if available, and storm drain network maps covering the drainage and sub-drainage areas which discharge runoff to the lake under investigation. These maps are generally available at the City or County of Los Angeles Department of Public Works.
- Identify watershed and subwatershed boundaries and study their physiological characteristics..
- Obtain land use maps covering the watershed and subwatershed areas and identify percent land use distribution in each subwatershed area.
- Identify key characteristics of watershed or subwatershed including imperviousness, precipitation, major industries, traffic volumes, etc.
- Obtain meteorological data such as rainfall intensity/duration/frequency of storms.
- Identify runoff discharging locations to the lake, and subwatersheds attributable to the runoff.

2. Runoff Quantification

Objective: Estimate runoff quantity from each subwatershed area discharging to the lake under investigation.

General Steps:

- Obtain hydrology and/or design data for each storm drain network within each subwatershed from the City or County of Los Angeles Department of Public Works.
- Identify watershed runoff coefficient (the ratio of direct runoff volume to rainfall volume, calculated over the duration of an event from beginning of rainfall to end of runoff resulting from that rainfall).

- Calculate runoff from each storm drain system discharging to the lake based on the same storm event.
- Calculate annual runoff volumes based on precipitation and watershed area and imperviousness.
- If time and budget permit, develop a monitoring program to collect hydrological data to analyze discharge volume and distribution. These data can be used to develop information about storm runoff peaks, runoff volumes, or storms and base flow.

3. Preliminary Pollutants of Concern Determination

Objective: Identify pollutants of concern for further study.

General Steps:

- Gather published and unpublished relevant data (e.g. runoff and lake water quality, sediment quality, and fish tissue analysis data), which could provide an indication of the pollutants of concern.
- Research for legacy pollutants (e.g. pesticides) through public records to determine any past problem raised within the watershed covering the lake under investigation.
- Review designated beneficial uses and water quality objectives established for the lake under investigation by the Regional Water Quality Control Board, Los Angeles Region (RWQCB).
- Review latest list of impaired water bodies (Section 303(d) of 1972 Water Quality Act) and the schedule for Total Maximum Daily Loads (TMDL) established by the RWQCB and the State Water Resources Control Board (SWRCB).
- Review land use maps.
- Review National Pollutant Discharge Elimination System (NPDES) permits and Waste Discharge Requirements (WDR) of major dischargers within the watershed on file with the RWQCB to identify types of pollutants that may be discharged to the lake under investigation.
- Conduct field reconnaissance study within the watershed boundaries to identify major pollutant sources and types of pollutants that are discharged to the lake under investigation.
- Contact local stakeholder organizations to inquire about specific issues of concern.

4. Water Quality Characterization

Objective: Assess historic and present water quality of the lake and of the runoff flowing into the lake under investigation.

General Steps:

- Gather published and unpublished water quality data collected and analyzed previously by various agencies, private entities, and non-profit organizations.
- Use this data to assess water quality trends of the lake under investigation, including the runoff.
- Identify data gaps.

- Fill the data gaps - Develop a sampling and analysis plan to collect additional data as needed. Plan may include runoff, and outflow sampling and analysis.
- Collect lake water and runoff samples for analysis at a State certified laboratory.
- Analyze, validate, and interpret data. Conduct fate and transport modeling if necessary.
- Confirm pollutants of concern.

Water Quality Sampling Program Development:

- Water quality parameters of interest for an urban lake assessment should include physical parameters (e.g. temperature, conductivity, pH, turbidity, dissolved oxygen, total suspended solids) and chemical parameters (e.g. nutrients, pesticides, metals). Other parameters may be required based on historical problems at the specific lakes.
- Biological parameters such as fish, benthic macroinvertebrates, algae, aquatic plants can be monitored for general health, abundance, composition, and diversity. These biological indicators have the advantage of naturally integrating water quantity and quality impacts within the watershed.
- Toxicity measurements may be required to determine if the lake water is contaminated by industrial and wastewater discharging sources.
- Sampling locations should be selected to meet the objectives of evaluation. For the purpose of an urban lake assessment, sampling locations should include all storm drain inlets to the lake for runoff sampling, and representative locations within the lake for lake water column sampling. The number of sampling locations within the lake would depend on its size and configuration.
- Sampling frequencies would also depend on assessment objectives and budget. For the urban lake evaluation purpose, the sampling program should cover both wet and dry weather seasons. During the wet season, runoff samples should be collected during the first flush event and at least one regular storm event. The rainfall event to be selected for sample collection should produce a measurable volume of runoff (normally a predicted rainfall of more than 0.1 inches depending on the pervious/impervious characteristic of the watershed). During the dry season, at least one sampling event should be undertaken. Note that during the dry season, there may not be enough runoff in the storm drain system for sample collection. In this case, only lake water sampling may be undertaken.
- For storm runoff sampling, a three one-hour interval composite sample starting within the first hour of discharge should be considered. If possible, an automatic sampler with real-time flow records should be used. For lake water quality sampling, a grab sample after the storm tapers off (for wet season sampling) should be collected. Depending upon the depth of the lake and the historic stratification effects, a composite sample at various depths of the lake may be required for each sampling location.
- Equipment blanks, trip blanks, and duplicate samples should be collected as stated in the sampling protocols.

5. Sediment Characterization

Objective: Assess historic and present sediment quality within the lake under investigation.

General Steps:

- Gather published and unpublished sediment quality data collected and analyzed previously by various agencies.
- Identify data gaps
- Develop a sampling protocol, QA/QC plan, and analysis plan to collect additional data as needed.
- Consider taking a core sample to provide historical trends. Sampling locations should statistically cover the lake bed and any wetland area connecting to the lake. Sampling depth and sample composite method should be designed based on the bottom configuration of the lake and historic pollution problem, if known. Parameters to be analyzed would depend on historic pollution problem and pollutants of concern, normally including total organic carbon (TOC), volatile and non-volatile organic compounds, pesticides, and heavy metals.
- Analyze, validate, and interpret data.
- Confirm pollutants of concern.

6. Fish Tissue Analysis

Objective: Identify if there are any toxic substance residuals in fish tissues from the lake

General Steps:

- Gather published and unpublished fish tissue analysis data collected and analyzed previously by various agencies.
- Identify data gaps
- Develop a sampling and analysis plan to collect additional data as needed. Type of fish to be analyzed, parameters to be analyzed would depend on historic pollution problem and pollutants of concern, normally including pesticides, heavy metals, and organic carbons.
- Analyze, validate, and interpret data.
- Confirm pollutants of concern.

7. Pollutant Loading Calculations

Objective: Estimate the quantity of pollutants of concern being discharged to the lake under investigation per unit time.

General Steps:

- Using the runoff volume and water quality data collected, calculate the annual mass loading of each pollutant from each drainage or subwatershed area that discharges to the lake. In an absence of hydrological or real-time flow data, the runoff volume may be estimated by multiplying the average annual rainfall by the area of watershed and runoff coefficient (ratio of imperviousness) may be used to roughly estimate the average annual runoff volume. Similarly, constituent concentrations may be averaged from the available water quality data. The pollutant loading calculated from this method could provide the order of magnitude of the amount of pollutants entering the lake. However, it may not be accurate for use to design the BMP.

- Compare the relative significance of the various sources, such as specific drain, upstream discharges, etc.

8. BMP Evaluation and Selection

Objective: Identify appropriate BMPs that can be implemented to reduce the level of pollutants in the lake under investigation to improve water quality to meet the water quality and TMDL objectives.

General Steps:

- Identify candidate structural and non-structural BMPs that are applicable for use to remove pollutants of concern.
- Develop evaluation criteria for selecting the most appropriate BMPs (e.g. percent removal, cost to install, cost for operation and maintenance, ecological and recreational benefits, etc.).
- Evaluate and select the BMPs.

9. Implementation Plan Development

Objective: Develop an Implementation Plan to improve Water Quality.

General Steps:

- Identify a sole agency or joint agencies/partners which would be responsible for implementation.
- Identify stakeholders.
- Identify funding sources.
- Develop an Implementation Plan, including an outreach program.

10. Monitoring Program Development

Objective: Monitor the effectiveness of the Implementation Plan.

General Steps:

- Develop a monitoring program that specifies pollutants to be monitored, frequency of monitoring, and duration of monitoring based on previous steps of evaluation framework.
- Conduct monitoring program.
- Modify the Implementation Plan as necessary based on the results of monitoring.
- Survey recreational users of the lake to quantify application of improvement.

SAMPLE

MACHADO LAKE EVALUATION PLAN

BACKGROUND

Ken Malloy Harbor Regional Park (KMHRP or the Park) is a 231-acre Los Angeles City park serving Wilmington and Harbor City areas as well as the South Bay region. The Park was developed in 1971 as Harbor Regional Park and renamed in 1992 to honor Ken Malloy, a long-time advocate of the park. The lake within the Park was named in 1989 to honor the Machado family that has an historic connection to the park site. Currently, the Park is owned and operated by the City of Los Angeles Department of Recreation and Parks (RAP). Figure 1 shows the location map of the Park.

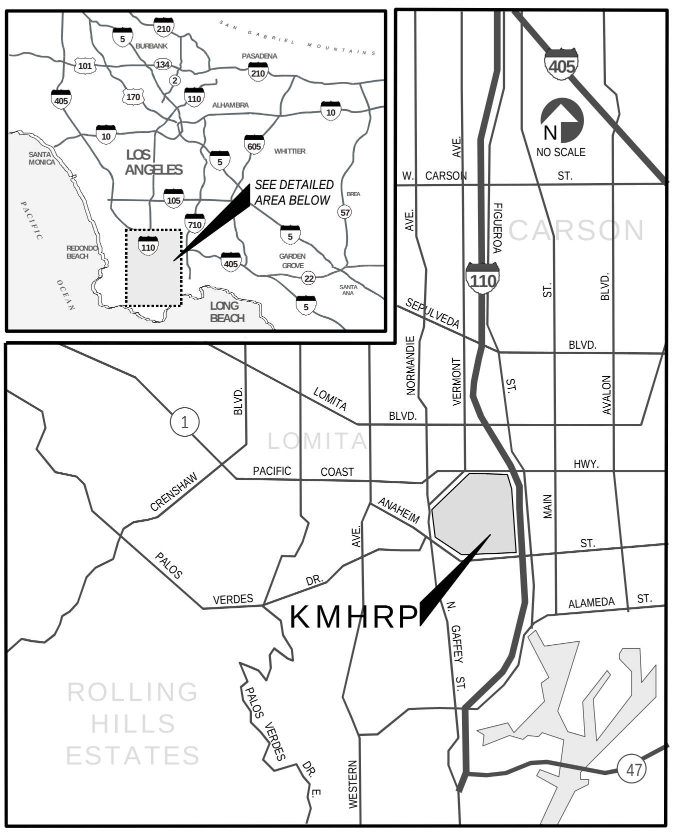


Figure 1: Location Map

The 40-acre Machado Lake (Lake) is one of the last wetlands in the City of Los Angeles, which also serves as a flood control retention basin. The Lake receives stormwater runoff from a network of storm drains covering the 25 square mile (sq. mi.) watershed area. Boating and fishing were originally allowed in the Lake, and until recently fish were regularly stocked in the Lake.

KMHRP is a home to a large number of plants and animals. A combination of several terrestrial natural plant communities, which form a patchy mosaic of dominant vegetation types, occupies the Park including southern cottonwood-willow riparian forest, southern willow scrub, mule fat scrub, Venturan coastal sage scrub, "modified" coastal freshwater marsh, vernal marsh, and non-native grassland. Immediately bordering Machado Lake are emergent wetland vegetation types such as southern willow scrub; and bulrushes, cattails, and water primroses (*Ludwigia peploides*).

KMHRP is presently a day-use area that offers picnicking and nature study. The boathouse, which is used to house canoes, also serves as a temporary nature center. The Park offers an overnight campground for group camping. However, daytime and campground uses are compromised by the park's well-known ecological problems including mosquito infestations, water quality problems and siltation (that have effectively eliminated traditional boating and swimming), homeless encampments, and inappropriate activities within environmentally sensitive areas of the property.

Much of the habitat within the Park is degraded as a result from interplay between internal and external forces. Examples of internal forces included inadequate enforcement of rules and regulations and ineffective park maintenance activities including trash removal. External forces that adversely affect the park environment include unauthorized access to sensitive environmental areas, particularly by off road vehicles, illegal dumping, unsupervised environmental mitigation projects, and uncontrolled storm water runoff from the 20-sq.mi.watershed.

In addition to degradation of habitat, water quality in the lake has been deteriorated and toxic sediment accumulated, boating was stopped and signs have been posted with warnings about the risk of eating fish from the Lake. The Los Angeles Regional Water Quality Control Board (RWQCB) has identified Machado Lake as an impaired body of water. Mosquitoes have been a chronic problem that has been exacerbated by flourishing tule growth in the accumulated sediments along the east shore.

MACHADO LAKE WATER QUALITY EVALUATION

Water quality in Machado Lake has been deteriorated over the past several years. In 2001, the City of Los Angeles Department of Recreation and Parks and the Audubon Society took an initiative to develop a Machado Lake Watershed Management Plan (WMP). The main objective of Machado Lake WMP development is to utilize the watershed management approach to clean up Machado Lake and improve the most valuable habitat and recreation resources of the South Bay area.

Steps conducted in developing the Machado Lake WMP included:

- Identified watershed and subwatershed boundaries based on the storm drain system network covering the areas, which drain to Machado Lake and KMHRP.
- Determined percent land use distribution by city/community over each subwatershed area.

- Calculated runoff quantity from each subwatershed area based on hydrology data obtained from the Los Angeles County Department of Public Works (LACDPW).
- Estimated pollutant loadings by each subwatershed and by city/community based on runoff volume and average concentration of each pollutant of concern. The event mean concentration (EMC) of each pollutant of concern by land use type was adopted from the LACDPW stormwater monitoring program.
- Conducted a wet and dry sampling and analysis program to study the quality of runoff discharging to Machado Lake and Machado Lake, and to characterize the bottom sediment of Machado Lake.
- Conducted a field investigation at the facilities in the vicinity of KMHRP (including Harbor Park Municipal Golf Course, Los Angeles Harbor College, TOSCO Refinery, Kaiser Foundation Hospital, and residential and commercial areas surrounding the KMHRP) to determine the potential for pollutant discharge to the Lake.
- Explored and evaluated potential BMP alternatives to minimize and prevent water pollution at Machado Lake.
- Developed a stakeholder group and a watershed management area plan.

Watershed Characterization and Runoff Quantification

The 231-acre KMHRP is located west of the Harbor Freeway and east of Vermont Street between the Tosco Refinery on the south and Pacific Coast Highway on the north (Figures 1). The Park contains 40-acre Machado Lake, which is a receiving body of stormwater runoff from a network of storm drains covering the 25 sq. mi. of residential and industrial urbanized lands of the cities/communities in the southern portion of Los Angeles County.

The boundary of the Machado Lake Watershed was determined by LACDPW based on the system of storm drain networks, which discharge directly to the Lake. LACDPW owns and operates most of the storm drain systems within the County of Los Angeles. Subwatershed boundaries within Machado Lake Watershed were identified based on a review of hydrology reports and storm drain system drawings available at LACDPW.

Based on hydrology reports and storm drain system analysis, there are six storm drain networks within the Machado Lake Watershed as shown in Figure 2. However, discharges to Machado Lake are from the following storm drain channels: Wilmington Drain (which receives flows from Private Drain 553 and Walteria Lake); Project No. 77; and Harbor City Relief Drain. Project 643 (72-inch Storm Drain and Figueroa Drain) discharges to the wetland area within the KMHRP but not directly to the Lake. All of these storm drains are owned and operated by the LACDPW. In addition, several of the smaller City of Los Angeles drains are also discharged to Machado Lake. A schematic layout of the overall drainage system flowing to Machado Lake is shown in Figure 3.

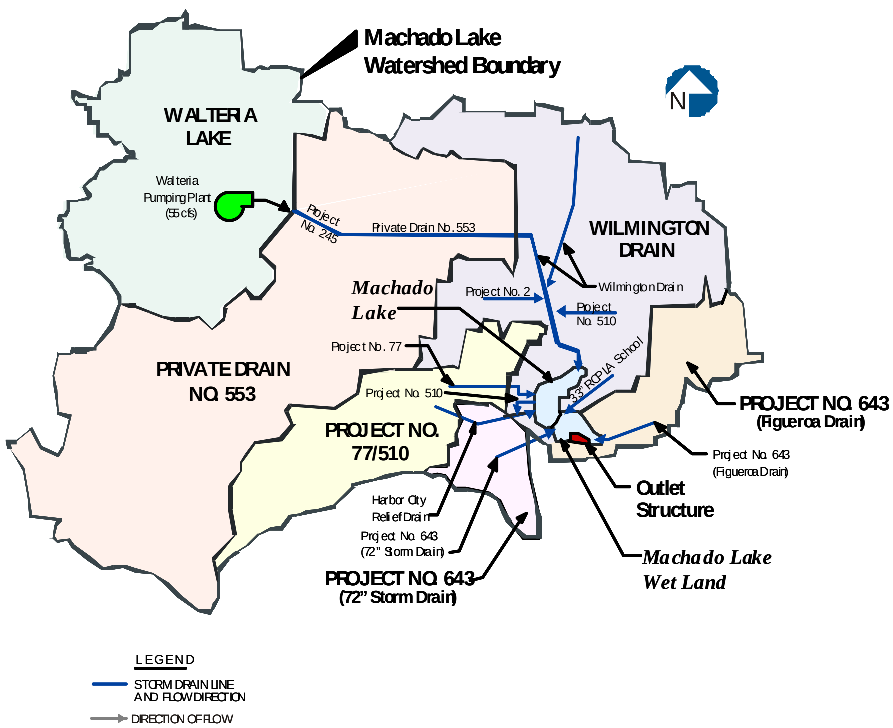


Figure 2: Machado Lake Watershed Boundary and Sub-drainage Areas

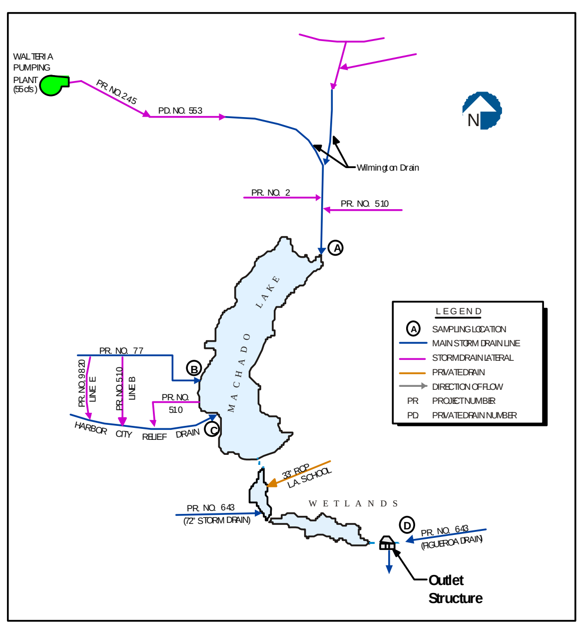


Figure 3: Schematic Layout of Drainage Systems Discharging to Machado Lake

Table 1 summarizes a 50-year flow rate and a total runoff of each storm drain system within the Machado Lake Watershed.

Table 1: Summary of Flow Rate and 24-Hr Storm Water Runoff for Each Subdrainage Area Within Machado Lake Watershed

Drainage Area Description	Capital Flood Flow Rates (cfs)	Total 24-hr Runoff Volume for a Designed Storm (acre-feet)	Designed Storm Frequency (year)	Total 24-hr Runoff Volume for 50-yr Storm Event (acre-feet)
Wilmington Drain*	3,140	1,228	43	1,280
Private Drain No. 553*	4,096	1,602	50	1,602
Walteria Lake*	1,439	361	50	361
Project No. 643				
Figueroa Street Drain	467	118	50	118
72-inch Strom Drain	543	47	<1	590
Project Nos. 77/510 (total)	**1,955**	**860**		**2,161**
Project No. 77	1,553	783	4	2,062
Project No. 510 (not in service)	402	77	18	100
Harbor City Relief Drain**	2,173	334	50	334

* These drains discharge to Machado Lake via Wilmington Drain.
** Harbor City Relief Drain relieves flow of Project No. 510 and a portion of flow from Project No. 77.

Land Use Identification

There are ten cities/communities situated within the Machado Lake Watershed including City of Los Angeles, City of Torrance, City of Lomita, Rolling Hills, Rolling Hills Estates, City of Carson, Palos Verdes Estates, Rancho Palos Verdes, City of Redondo Beach, and Unincorporated Los Angeles County. A land use map covering the Machado Lake Watershed was obtained from LACDPW Mapping Department.

Land use categories used in this study include the following:

- High Density Single Family Residential (HDSFR)
- Heavy Industrial (HI)
- Light Industrial (LI)
- Vacant (V)
- Retail/Commercial (R/C)
- Multi-Family Residential (MFR)
- Transportation (T)
- Educational Institutions (EI)
- Mixed Residential (MR)
- All Other (AO) – a combination of all the other remaining categories, which could include open space, parks, industry, military or communications.

The above land use categories are those used by the LACDPW in its "Los Angeles County 1994-2000 Integrated Receiving Water Impacts Report." This report was a result of an extensive stormwater quality monitoring program conducted by LACDPW during the year 1994-2000. The purpose of this study was to develop information to support an effective watershed stormwater quality management program.

Tables 2 and 3 summarize land use distribution by subwatershed and city/community within each subwatershed area of the Machado Lake Watershed, respectively.

Table 2: Percent Land Use Distribution by Subwatershed Within Machado Lake Watershed

Subwatershed	Area (acres)	Land Use Distribution (percent)								
		HDSFR	HI/LI	V	R/C	MFR	T	EI	MR	AO
Private Drain 553	6,100	48.76	4.76	8.55	6.30	3.98	3.00	3.09	0.33	21.23
Project 643 (Figueroa Drain)	704	59.60	0.01	0.19	11.25	5.20	2.24	9.99	6.42	5.11
Project 643 (72" Storm Drain)	474	20.18	0.61	0.00	0.92	12.71	1.55	0.00	0.00	64.02
Wilmington Drain	3,637	35.64	9.65	3.76	5.81	7.14	2.45	5.40	4.39	25.77
Project 77/510	1,636	39.58	3.03	1.64	5.93	8.93	1.63	2.69	2.16	34.42
Walteria Lake	3,149	46.26	5.79	1.73	13.85	9.55	3.66	4.30	0.68	14.18
Total Acerage	**15,701**	**43.88**	**5.58**	**4.72**	**7.72**	**6.66**	**2.78**	**4.04**	**1.79**	**22.81**

Sources: LACDPW and Parsons
Note: The total numbers may not add up due to rounding.

Table 3: Percent Land Use Distribution by City/Community Within Machado Lake Watershed

City/Community	Area (acres)	Land Use Distribution (percent)								
		HDSFR	HI/LI	V	R/C	MFR	T	EI	MR	AO
City of Los Angeles	3,217	33.88	8.72	3.66	6.82	9.19	1.58	7.10	5.70	23.35
City of Torrance	5,171	46.47	6.77	1.14	11.97	7.20	5.77	3.28	0.79	16.60
City of Lomita	1,233	61.43	0.37	0.00	13.97	11.34	1.08	2.52	2.54	6.76
Rolling Hills	875	2.97	0.00	31.00	0.00	0.00	0.00	0.06	0.00	65.96
Rolling Hills Estates	1,777	47.28	0.00	4.70	4.33	3.13	0.80	5.56	0.00	34.20
City of Carson	1,225	44.27	12.25	0.00	3.62	5.22	2.72	2.22	1.50	28.20
Palos Verdes Estates	248	83.72	0.00	10.95	0.00	0.00	0.00	3.43	0.00	1.90
Rancho Palos Verdes	712	58.20	0.00	12.55	0.34	4.93	0.00	5.53	0.00	18.45
City of Redondo Beach	1	4.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	95.06
Unincorporated L.A. County	1,243	49.06	7.30	7.47	6.22	6.74	2.20	2.56	0.64	17.81
Total Acreage	**15,701**	**43.88**	**5.58**	**4.72**	**7.72**	**6.66**	**2.78**	**4.04**	**1.79**	**22.81**

Sources: LACDPW and Parsons
Note: The total numbers may not add up due to rounding.

Machado Lake Water Quality Characterization

Machado Lake is approximately 103.5 acres in total size. The upper portion, including open water, is approximately 40 acres and the lower seasonal wetland is about 63.5 acres. The lake surface is held at approximately ten feet above mean sea level (MSL) by the low dam separating the upper lake and the lower wetland portion. Below the dam, the wetland system is hydrologically controlled by an outlet weir with a low water culvert set at about five feet above MSL and a high water box weir set at about eight feet above MSL.

Machado Lake is a receiving body for urban and stormwater runoff from storm drain systems covering an approximately 20 sq.mi. watershed. The Lake water has a constant brownish-yellow color with a red tint in the summer months. The Lake is bordered by a public golf course on the east side and a grassy park area on the west side. There is a marsh area at the upper north end of the Lake downstream of the Wilmington Drain discharge point. This area is heavily vegetated with aquatic plants including cattails and reed plants. The lower end of the lake is bounded by a concrete dam. Water from the lake overflows the concrete dam to a wetland area prior to flowing out to the ocean through the Harbor Outflow located at the southeast corner of the Park. The Harbor Outflow structure is connected to the West Basin of Los Angeles Harbor.

Review of Past Water Quality Data. Limited lake water quality data are available for review. The 1974-1977 quarterly water quality monitoring program concluded that during the monitoring period the lake did not appear to have been adversely affected by man-induced changes in the surrounding environment. The high turbidity of the lake is largely attributable to the composition of the soil in that area. The increase in water temperature and total dissolved solids (TDS) were a reflection of the continuing drought condition that existed in this area.

Twelve water quality sampling events were conducted between 1991-1993. The study rated the Machado Lake water quality as highly impaired based on nutrients, organics, productivity, and aesthetics. The most likely source of nutrients was from fertilizers applied to lawns, parks, and golf courses. To improve the water quality of the Machado Lake, the report recommended park cleanup, nutrient reduction, and metal reduction.

2002 Water Quality Sampling Program. Stormwater runoff and lake water were sampled and analyzed during the course of the project, one during the wet weather season and two during the dry weather season. Sampling locations were identified at each significant storm drain outlet (Figure 5) to the Lake as follows:

Sampling Location A: Discharging point of the Wilmington Drain System.
Sampling Location B: Discharging point of Project No. 77 Drain System.
Sampling Location C: Discharging point of the Harbor Relief Drain System.
Sampling Location D: Discharging point of Project No. 643 -Figueroa Drain System.
Sampling Location E: Outlet Structure

Water quality parameters analyzed are presented in Table 4.

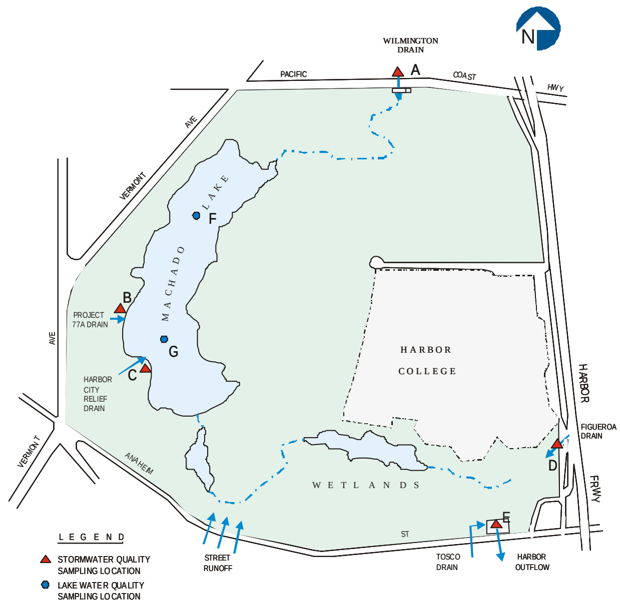


Figure 5: Water Quality Sampling Locations

Table 4: Sample Analytical Parameters

Type of Analysis	Parameters Analyzed	
Field Analyses	Temperature Conductivity	pH Dissolved Oxygen (DO)
Laboratory Analyses	Ammonia Chlorophyll Total Phosphorous Total Volatile Solids Chromium (VI) Fecal Coliform Bacteria Nitrite Organochlorine Pesticides Polynuclear Aromatic HC (PAH)	Biological Oxygen Demand (BOD) Ortho Phosphorus Total Suspended Solids (TSS) Total Dissolved Solids (TDS) Total Coliform Bacteria Nitrate TTLC 17 Metals PCBs

Results of limited water quality analysis reveals that pollutant levels in the lake water tend to increase during the dry season due mainly to evaporation and stagnant conditions of the Lake as a result of the lack of make-up water from any sources. Due to a small amount of runoff discharging to the lake during the dry season, elevated levels of some pollutants in the runoff samples did not contribute to significant pollutant loading to the lake water.

Based on the phosphorus and nitrogen concentrations within the lake water during the dry season, there is a slight potential for eutrophication in the Lake, although there was no clear evidence of algal bloom during the sampling events.

Trash is the most visible pollutant at the Lake and is believed to be one of the contributing factors to elevated levels of coliform bacteria at the discharge points into the Lake. Due to aesthetic and public health reasons, trash removal should be taken as the top priority in an effort to clean up the Lake. Duck and geese droppings also contribute to the higher coliforma bacteria levels at the runoff discharging points and in the lake water body. Limiting duck and geese populations could help improve the lake water quality.

Although the TSS concentration in the runoff is within the normal range of urban stormwater runoff, it is a major cause of accumulated sediment in the Lake. Installing a sediment trap at the north end of the lake immediately downstream of Wilmington Drain would help preventing the sediments from entering the Lake significantly.

Copper (Cu), lead (Pb), and zinc (Zn) concentrations in the lake water are found at elevated levels, which is attributable to stormwater runoff. Source controls should be implemented at the watershed level to reduce the level of trace metals entering the Lake.

Organopesticides, PCBs, and PAHs were all detected below the Practical Quantitative Limits.

Due to time constraints, only one wet weather sampling event was conducted and was towards the end of the wet season. Additional stormwater runoff and lake water quality sampling should be conducted during the wet weather season, especially during the first flush of the first storm event of the season. Key parameters that should be analyzed in the wet weather samples include TSS, total phosphorus, ammonia nitrogen, nitrate, nitrite, Cu, Pb, fecal and total coliform bacteria. During the dry season, additional lake water quality testing should be conducted for physical parameters (pH, temperature, turbidity (using secchi disk) and observation of color, floating materials, and odor), DO, total phosphorus, ammonia nitrogen, nitrate, nitrite, fecal and total coliform bacteria.

2003 Water Quality Sampling Program. In 2003, the City of Los Angeles Watershed Protection Division received a matching fund from the State of California Water Resources Control Board (SWRCB) to conduct a supplemental water quality assessment for Machado Lake. Under this study program, two additional wet-weather sampling events and one dry-weather sampling event were conducted. Sampling locations in the Lake were the same as the 2002 sampling program; however, the constituents analyzed were paved down. Runoff sampling locations were in the manholes and Wilmington Drain upstream of the Lake. The results of this sampling program were in the same range as the 2002 data.

Beneficial Uses and Water Quality Objectives

The Water Quality Control Plan Los Angeles Region, 1994 (Basin Plan) designated several beneficial uses for Machado Lake including Water Contact Recreation (REC-1), Non-contact Water Recreation (REC-2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD), Rare, Threatened, or Endangered Species (RARE), and potential for Municipal and Domestic Supply (MUN).

No waterbody specific objectives were established for Dominguez Channel Watershed, including Machado Lake. However, narrative or numerical water quality objectives have been developed for several parameters and apply to all inland surface waters and enclosed bays and estuaries (including wetlands) in the Region. Table 5 compared water quality standards set forth in the Basin Plan and other sources with Machado Lake water quality.

Table 5: Comparison of Machado Lake Water Quality to Basin Plan Water Quality Standards

Constituent	Basin Plan Designated Water Quality Standard*	Machado Lake Water Quality**
Ammonia	Standard varies depending on pH and temperature. For pH between 7 and 8 at the temperature between 15 and 20^{o}C, the four-day average concentration of ammonia is from 0.79 to 1.74 mg/l for waters designated as WARM.	The composited samples (collected every hour for 3 hours) showed the levels of ammonia in the lake water ranging from <0.2 to 0.3 mg/l .
Coliform bacteria	In waters designated for REC-1, the fecal coliform concentration shall not exceed a log mean of 200 MPN/100 ml (based on a minimum of not less than four samples for any 30-day period), nor shall more than 10 percent of total samples during any 30-day period exceed 400 MPN/100 ml. In waters designated for REC-2 and not designated for REC-1, the fecal coliform concentration shall not exceed a log mean of 2000 MPN/100 ml (based on a minimum of not less than four samples for any 30-day period), nor shall more than 10 percent of total samples during any 30-day period exceed 4000 MPN/100 ml.	There are not enough data to compare with the standard. However, based on the three sampling events, the fecal coliform concentrations exhibited the value higher than the standard set forth for REC-1 but within the standard for REC-2 during the two dry weather sampling events.
Biochemical Oxygen Demand	Waters shall be free of substances that result in increases in the BOD_5 which adversely affect beneficial uses.	BOD_5 concentrations in the lake were found in the range of <0.2 to 1 mg/l during the wet season and increased to the range of 4.2 to 8.9 mg/l during the dry season.
Biostimulatory Substances	Waters shall not contain biostimulatory substances (nitrogen, phosphorus) that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.	No clear evidence of algal bloom in the lake during all sampling events.
Dissolved Oxygen	The DO content of all surface waters designated as WARM shall not be depressed below 5 mg/l as a result of waste discharges.	DO levels in Machado Lake ranged from 5.9 to 6.9 mg/l.
Nutrients	No specific ranges of nitrogen and phosphorus were set forth in the Basin Plan. However, for nutrients, the Basin Plan objective for nitrates-N plus nitrites-N is not greater than 10 mg/l.	Total phosphorus concentrations in the lake water increased from the range of 0.43-0.46 mg/l during wet weather sampling to the range of 1.0-1.4 mg/l during dry weather sampling. The nitrate plus nitrite concentrations were below 1 mg/l in the samples collected during wet and dry weather sampling events with a slight reduction during the dry weather sampling event.
Color	Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.	Machado Lake water always exhibits a brownish color. The color becomes darker in the dry weather season.
Floating Materials	Waters shall not contain floating materials,	Trash is presence at various stormwater

	including solids, liquids, and scum, in concentrations that cause nuisance or adversely affect beneficial use.	discharging locations to the lake, especially during the storm events.
Pesticides	Water designates for use as MUN shall not contain concentrations of pesticides in excess of the limiting concentrations specified in Table 64444-A of Section 64444 (organic chemicals) of Title 22 of the California Code of Regulations.	No pesticide concentrations in the water during the three sampling events exceeded the designated standards.

* Basin Plan, 1994
** Machado Lake Water Quality Monitoring Program, 2001

Total Maximum Daily Loadings (TMDL)

Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology.

Machado Lake is listed as an impaired waterbody on the California 303(d) list, and scheduled for several TMDLs including pesticides (ChemA, chlordane, DDT, PCBs), nutrients (algae, eutrophication, ammonia (NH_3)), and trash. In addition, Wilmington Drain is on the California 303(d) list scheduled for several TMDLs including coliform bacteria, NH_3, Cu, and Pb. TMDLs schedules for Machado Lake and Wilmington Drain are summarized in Table 6.

Table 6: Machado Lake and Wilmington Drain Impairments and Approximate TMDL Schedule

303(d) Listed Waterbody(Reach)	Pollutant	Type of TMDL	TMDL Start Date - FY (start of monitoring)	TMDL Completion Date - FY (Basin Plan Amendment)
Machado Lake (Harbor Lake)	ChemA, chlordane, DDT, PCBs	PCBs, DDT, other hist. Pest. and their effects	2004/05	2007/08
Machado Lake (Harbor Lake)	algae, eutrophication, NH_3, odors	nitrogen and its effects	2006/07	2010/11
Wilmington Drain	NH_3	NH_3	2005/06	2007/08
Wilmington Drain	coliform	Bacteria	2000/01	2001/02
Machado Lake (Harbor Lake)	trash	trash	2006/07	2007/08
Wilmington Drain	Cu, Pb	Metals	2003/04	2006/07

Source: Regional Water Quality Control Board, Los Angeles Region

Sediment Characterization

A sediment characterization investigation was conducted to support the park improvement project. The objectives were to collect and analyze sediment samples from Machado Lake and use the analytical data to characterize lake sediment for the assessment of disposal options of dredged tailings.

Fieldwork for sediment characterization sampling was conducted on May 14 and 15, 2001. During fieldwork, sediment samples were collected from 18 locations, which were considered to be representative of the Lake and wetland environments: one sample from the north end of the park near the outlet of the Wilmington Drain (OF1), 15 samples from the Lake (three samples were collected along each transect [west, center, and east of the transect line] and were composited by the laboratory: LT1, LT2, LT3, LT4, and LT5), and two samples from the south end of the Park in the wetland area (M1W and M1E). Figure 6 shows the locations of collected samples.

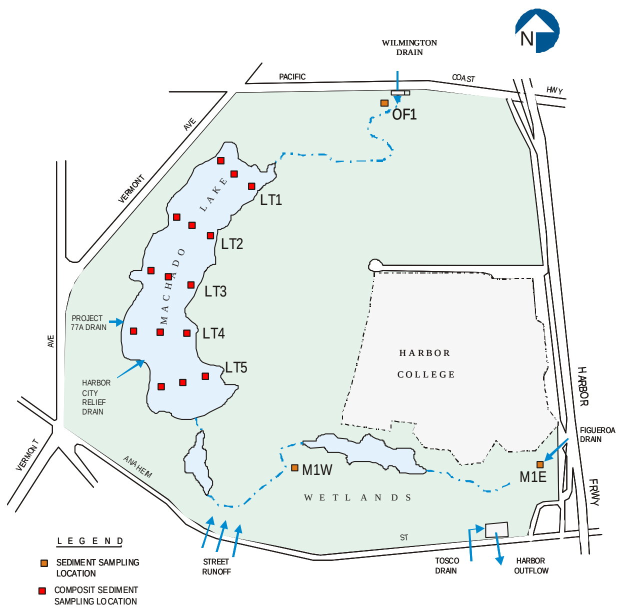


Figure 6: Sediment Sampling Locations

Each sample, including the composted LT1 to LT5, was analyzed for diesel and oil, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), organochlorine pesticides, polychlorinated biphenyls (PCBs), CCR Title 22 metals, hexavalent chromium, tributyl tin, dioxin/furan (only two of the samples), total organic carbon (TOC), and grain size distribution. Several of these compounds were detected in the sediment samples. Concentrations of detected chemicals were compared to a variety of applicable state and federal regulatory guidelines and/or risk screening levels to characterize Machado Lake sediment for (1) pre-dredging tailings disposal assessment and (2) reuse of the tailings for construction of artificial islands within the lake.

Based on the analytical results, none of the chemicals detected in the lake sediment are at concentrations that would preclude dredged tailings disposal at landfills or sediment reuse as artificial islands in the Lake. Although the preliminary screening indicates the dredged tailings probably could also be disposed of offshore, a more rigorous assessment, based on comparative chemistry to a specific offshore disposal site, per U.S. EPA and U.S. Army Corps of Engineers evaluation procedures, would need to be conducted before a definitive answer could be provided on this option.

Fish Tissue Analysis

Fish tissue analysis is not part of the scope of KMHRP improvement program development. However, the California Department of Fish and Game conducted fish sampling annually in the Lake between 1983 and 1997 as part of the California Toxic Substances Monitoring Program (TSMP). The sampling results were furnished to the Parsons study team by RWQCB. Parsons' toxicologist performed a review of the sampling results for fish collected from Machado Lake to determine whether the U.S.EPA Screening Values for Target Analytes had been exceeded for recreational fishermen. In reviewing the chemical analyses conducted on the fish tissues, Parsons utilized the most recent U.S.EPA guidance document namely "*Section 5, Screening Values for Target Analytes, Guidance for Assessing Chemical Contaminants Data for Use in Fish Advisories, Volume 1, Fish Sampling and Analysis, Third Edition* (EPA 823-B-00-007, November 2000)."

Results of data evaluation are summarized below:

- Arsenic was the only metal to exceed the screening value of 0.026 ppm in three separate years at 0.100 ppm (1983), 0.070 ppm (1990) and 0.081 ppm (1997).
- Total Chlordane exceeded the screening value of 0.114 ppm ranging from 2.215 ppm in1983 to 0.276 ppm in 1997.
- Total DDT exceeded the screening value of 0.117 ppm ranging from 4.449 ppm in1983 to 0.328 ppm in 1997.
- Dieldrin, an organochlorine pesticide, exceeded the screening value of 0.002 ppm ranging from the highest detection of 0.020 ppm in 1983 to 0.006 ppm in 1997.
- Heptachlor epoxide, also an organochlorine pesticide, exceeded the screening value of 0.004 ppm at 0.018 ppm in 1984.
- Total PCBs exceeded the screening value of 0.02 ppm ranging from 1.540 ppm in1983 to 0.444 ppm in 1997.
- Lindane (g-HCH) exceeded the screening values of 0.030 ppm in 1983 at 0.054 ppm and in 1985 at 0.092 ppm.
- Arsenic exceeded screening values in three widely separated years and remained at similar levels in 1997 as those in 1983. Total Chlordane exceeded screening values in 10 of the 13 years that sampling was performed. The values for Total Chlordane have trended consistently downward. Total DDT exceeded screening values in 12 of the 13 years that sampling was performed. The values for Total DDT have trended consistently downward. Dieldrin exceeded screening values in 9 of the 13 years that sampling was performed. The values for Dieldrin have trended downward with the exception of the years 1988 to 1993 when the compound remained at an average level of 0.015 ppm each year. Heptachlor epoxide exceeded the screening value during 1984. Total PCBs exceeded screening values in 11 of the 13 years that sampling was performed. The values for Total PCBs have trended downward. Lindane exceeded the screening value in 1983 and 1984 then was detected in 1985 but did not exceed screening values. Lindane has not been above detection levels since 1985.

Based on the review of fish tissue data from Machado Lake, several analytes exceeded the U.S. EPA recommended screening values. Section 5 of the U.S. EPA *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories* states that exceedance of Screening Values "should be taken as an indication that more intensive site-specific monitoring and/or evaluation of human health risk should be conducted."

Pollutant Sources Identification

Pollutant sources discharging to Machado Lake were identified based on site investigation, National Pollutant Discharge Elimination System (NPDES) permits review, and storm drain system analysis. The Machado Lake Watershed is largely comprised of urban area.

Source Investigation. Several facilities adjacent to Machado Lake were investigated to determine if any pollutants of concern were directly discharged to the Lake. These facilities are Harbor Park Municipal Golf Course; Los Angeles Harbor College; TOSCO Refinery; Kaiser Foundation Hospital - Harbor City; and residential and commercial areas adjacent to the park. None of these facilities exhibit unusually high pollutant discharge.

NPDES Permit Identification. The RWQCB provided a list of NPDES permittees for the general area of the KMHRP watershed. After reviewing the list of permittees, only one NPDES permitted discharger was identified within the watershed. This discharger is TOSCO located just south of the park. As stated above, TOSCO has a stormwater pollution prevention plan and BMPs on site to minimize or eliminate pollutants in storm runoff.

Pollutants Attributable to Runoff. The majority of the stormwater runoff within the Machado Lake Watershed is discharged through a storm drain network owned and operated by the LACDPW. Due to the complicated network of storm drains within the watershed and limited time and budget, sampling of stormwater runoff at the major tributaries of each storm drain system was not conducted during the course of this study. Therefore, specific pollutant sources could not be identified through the sampling program.

The study assumed that each city and community in the watershed boundary generates pollutants based on average flow and land use types. Stormwater samples from various discharge points to KMHRP were collected for analysis to determine if the pollutant concentrations are within the normal range of urban stormwater runoff.

Machado Lake Watershed encompassed an area of approximately 15,700 acres. Almost 50 percent of the total area is residential land use. Retail/commercial and heavy/light industrial land use accounted for approximately 13 percent of the total land. The rest of the watershed is distributed into different types of land use in small percentages.

Based on the land use map maintained by the LACDPW, Machado Lake watershed contains ten cities/communities, including City of Los Angeles, City of Torrance, City of Lomita, Rolling Hills, Rolling Hills Estates, City of Carson, Palos Verdes Estates, Rancho Parlos Verdes Estates, Redondo Beach, and an unincorporated area of the County of Los Angeles. Figure 7 is a graphical presentation of the acreage of each city/community within the Machado Lake watershed.

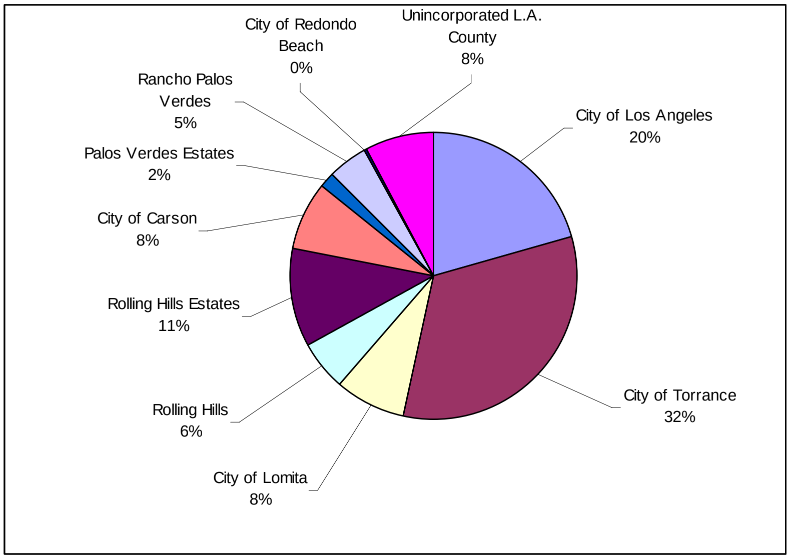


Figure 7: Area Distribution by Cities/Communities within Machado Lake Watershed

Pollutants of concern in Machado Lake Watershed are similar to those of urban runoff, which include sediments/debris, trash, nutrients (nitrogen, phosphorus), some heavy metals, and pesticides. Pollutant load calculations were performed using runoff data from each storm drain system and EMCs of target pollutants per each land use type collected by LACDPW, and supplementing with the data published by U.S. EPA. To determine the level of pollutant contribution to Machado Lake, pollutant loading by subwatershed and by city/community were calculated. Tables 6 and 7show percent contribution of pollutant loads by subwatershed and by city/community, respectively.

Table 6: Percent Pollutant Load Contribution by Subwatershed

Subwatershed Discharging to Machado Lake	Percent Contribution of Pollutants of Concern								
	TSS	NO3-N	Total-P	Fecal Coliform	BOD	Cu	Pb	Ni	Zn
Annual Loading (1,000 lbs except for Coliform in MPN x 10^{15})	13,046	111	37	463	1,803	3	1	0.3	25
Wilmington Drain	62	62	62	60	62	61	61	61	61
Project 77/510 (including Harbor City Relief Drain)	38	38	38	40	38	39	39	39	39

Source: Parsons, 2002

Table 7: Percent Pollutant Load Contribution by City/Community

City/Community Discharging to Machado Lake	Percent Contribution of Pollutants of Concern								
	TSS	NO3-N	Total-P	Fecal Coliform	BOD	Cu	Pb	Ni	Zn
Annual Loading (1,000 lbs except for coliform in MPN x 10^{15})	13,046	111	37	463	1,803	3	1	0.3	25
Los Angeles	13	13	13	19	13	14	14	14	14
Torrance	21	21	21	28	21	18	18	18	18
Lomita	19	19	19	13	19	19	19	19	19
Rolling Hills	0	0	0	9	0	0	0	0	0
Rolling Hills Estates	25	25	25	21	25	25	25	25	25
Carson	8	8	8	8	8	9	9	9	9
Palos Verdes Estates	1	1	1	1	1	1	1	1	1
Rancho Palos Verdes	5	5	5	4	5	5	5	5	5
Redondo Beach	0	0	0	0	0	0	0	0	0
Unincorporated County Areas	8	8	8	7	8	9	9	9	9

Source: Parsons, 2002

Based on the data shown in the tables, approximately 60-62 percent of pollutants discharged into Machado Lake are via Wilmington Drain. Cities/communities contributing significant amounts of pollutants to Machado Lake include Rolling Hills Estates, Torrance, Lomita, Los Angeles, Carson, and Unincorporated areas within the County of Los Angeles, respectively.

Conclusion. Based on a review of available data from limited field sampling, pollutants generated from Machado Lake Watershed are in the normal ranges of pollutants generated from any urban area and most likely are attributable to a wash-off of the surrounding areas by stormwater. Pollutants of concern at Machado Lake include suspended solids (which contribute to sedimentation of the Lake), nutrients (which could result in eutrophication to the Lake), coliform bacteria (which prohibit the beneficial uses of the Lake), and some heavy metals (which could deposit in the sediment as well as fish tissue). In addition, a high volume of trash was observed at each storm drain inlet to the Lake and the wetland area. Trash is, therefore, another pollutant of concern for the Lake.

Analyses of land use distribution, storm drain system, and runoff quantity from each subwatershed revealed that the majority of pollutants of concern are transported to the Lake via Wilmington Drain. No specific point sources can be concluded as major contributors of these pollutants since all pollutant concentrations are within the normal ranges of urban stormwater runoff. Based on this information, it is suitable to conclude that all cities/communities discharging to the storm drain networks, which flow to Machado Lake, contribute to pollutant loads in the ratio equivalent to their land use distribution and the amount of flow. Therefore, future efforts to clean up the Lake and to control pollutants discharging to the Lake would require participation from all cities/communities within the watershed. Effort and/or monetary contribution could be made to the ratio of pollutant load generation outlined in Table 7.

Potential BMP Evaluation

Several Best Management Practices (BMPs) have been explored to use as tools for lake clean-up as summarized below:

In-Lake Treatment:
- Aeration System Improvement
- Sedimentation Basin and Lake Dredging
- Lake Flushing
- Alum Treatment System

Structural BMPs
- Netting Systems For Floatables Control
- Continuous Defective Separation System (CDS)
- Stormwater Management Technology
- Inlet Devices

Nonstructural BMPs
- Sources Control
- Restorative Redevelopment
- Manual Trash Collection

Park Administrative Improvement:
- Assign full-time personnel with a permanent office located within the park
- Develop and enforce park use guidelines/procedures.

Based on the above water quality improvement alternatives, in-lake treatment and structural BMPs would treat the downstream symptoms while the upstream sources would still be generating the same amount of runoff and pollutants. However, some of these BMPs could be immediately implemented and temporarily minimize the lake's water quality problem. Watershed management initiatives including source controls and restorative redevelopment would be a long-term but permanent solution in solving a water quality problem at Machado Lake. However, these activities require collaboration from several parties. Park administrative improvement, although not a direct solution to water quality improvement, will ensure that the Park maintains its value as the most scarce habitat resource in the southland and as a much needed recreational center in the region. This, in turn, will encourage the public to participate in the park restoration process.

In considering the BMP options for immediate lake water quality improvement, the following criteria were used:

- Trash removal efficiency
- Sediment removal efficiency
- Pesticide removal efficiency
- nutrient removal efficiency

- Capital cost
- Operation and maintenance (O&M) cost
- Ease of operation and maintenance

In evaluating the BMPs, it is assumed that every criterion has the same level of importance (same weight). A scale of 1 to 5 is used to identify the favorable level of each criterion for each BMP option, with "1" signifying the least favorable and "5" signifying the most favorable. Table 8 shows the result of this preliminary evaluation.

Table 8: Evaluation Results of Various BMP Options for Machado Lake Water Quality Improvements

	Evaluation Criteria							
Proposed BMPs	Trash Removal Efficiency	Sediment Removal Efficiency	Pesticides Removal Efficiency	Nutrient Removal Efficiency	Capital Cost	O&M Cost	Ease of Operation and Maintenance	Total Score
Aeration System	1	1	1	3	3	3	2	14
Sedimentation Basin	1	4	2	2	2	3	3	17
Lake Flushing During Dry Season	1	2	3	4	4	1	4	19
Alum Treatment	1	1	2	4	1	2	2	13
Netting Trash Trap System	5	2	1	1	4	3	4	20
CDS	3	3	1	1	2	3	3	16
Stormwater Management Technology	3	3	1	1	2	3	3	16
Inlet Devices	4	3	1	3	2	1	2	16
Manual Trash Removal	3	1	1	1	4	3	4	17

Based on the results of the evaluation, lake flushing and a netting trash trap system received the highest scores. It should be noted that this evaluation is only based on the criteria stated above. Other constraints have not been brought into consideration. For example, construction of the sedimentation basin for the sole purpose of retaining sediments prior to discharging to the Lake would be very costly and require a lot of regulatory involvement if the lake dredging as part of the proposed habitat restoration is not carried out at the same time. In addition, to obtain more land to construct a larger sedimentation basin, the willow forest at the north end of the Lake may be disturbed. This BMP would definitely require careful planning prior to implementation and therefore it is not considered as an immediate water quality improvement option.

Lake flushing, although it receives a high score, will require reliable sources of water supply or recycled water (at least tertiary treated effluent), which is a major constraint of this BMP implementation. In addition, the evaluation does not account for the associated costs of recycled water distribution system construction. However, if there is a need for recycled water by any users nearby the KMHRP that would warrant the distribution system construction by the supply agency, lake flushing would be one of the most promising options to maintain good water quality of the Lake during the dry season.

The Netting Trash Trap System receives the highest score among the end-of-the-pipe proprietary BMPs evaluated in this study. This does not mean that the other end-of-the-pipe BMP systems are not efficient but the technologies are not built to handle large flows at the end of the discharge lines like those at Machado Lake.

The inlet device BMP may not be suitable for installation over the entire Machado Lake Watershed due to the large watershed area. However, further investigation may be conducted to identify the smaller drainage area with high pollutant loads for installation of such device.

Manual trash collection is one of the simplest technologies and perhaps the least cost of all. However, without Park administrative improvement, this operation is still not very promising.

In conclusion, installation of the Netting Trash Trap System may help improve the Lake's aesthetics in the immediate term. Since Machado Lake is listed on the California 303(d) list for trash TMDL, this BMP would bring the Lake into compliance with the required TMDL. The cost for system installation should be shared among the responsible parties. Since LACDPW owns and operates most of the storm drain systems within the Machado Lake Watershed, LACDPW would have to be responsible for the capital and maintenance costs of removing trash discharged to the Lake from its storm drain systems. Trash collection within the park area would be the responsibility of the City of Los Angeles RAP. LACDPW may have to look for various funding sources to pay for the capital investment. Some potential funding sources including grant funds, capital improvement budget, contributions from stakeholders and responsible parties, and/or fee collection. Maintenance costs would involve the change out of the trash bags and trash removal from the bagging system. These costs should be paid by the LACDPW from its annual operation and maintenance budget.

For lake flushing, water supplies from the City of Los Angeles Department of Water and Power (DWP), the current supplier, may not be a reliable source especially during a drought period. However, a discussion with DWP to confirm this information and to identify alternative water supply sources should be initiated. If City of Los Angeles DWP can supply the water for lake flushing, the cost should be shared between the City of Los Angeles RAP and LACDPW through the stakeholder contribution. Construction of a recycled water distribution system for the purpose of lake flushing only may not justify the costs. The City of Los Angeles RAP, PAB, and LACDPW should continue following up with the recycled water program development in the region and identify the KMHRP and Machado Lake as one of the main user for the program.

As early as possible, the City of Los Angeles RAP should carry out the park administrative improvement initiatives. Without which several of the proposed habitat and lake water quality improvement goals may not be met.

For long-term water quality improvement, watershed management initiatives including source controls and restorative development would have to be undertaken.

Proposed Monitoring Program

The main objectives of the proposed monitoring program at Machado Lake are to:

- develop a stormwater runoff quality database
- identify pollutant sources
- use as a basis for de-listing some TMDL pollutants which are no longer pollutants of concern and to develop TMDLs for those on the list which are virtually pollutants of concern
- monitor the effectiveness of the program implementation.

Table 11 summarizes the proposed monitoring program.

Table 11: Proposed Machado Lake Watershed Monitoring Program

Type	Location	Parameter	Monitoring Frequency
Storm Drain System	Main tributary of each storm drain system discharging to Machado Lake, including the unlined portion of Wilmington Drain	Pollutants of concerns (Temp, pH, turbidity, NO2, NO3, P, TSS, Coliform Bacteria, total and dissolved Pb, total and dissolved Cu, pesticides)	Twice annually, one during wet season (storm event) and one during dry season
Machado Lake water body	At the north and south ends of the Lake	All TMDL pollutants, pollutants of concern indicated above	Twice annually, one during wet season (immediately following the intense first flush storm event) and one during dry season
Machado Lake Sediment	Four locations: discharging point of Wilmington Drain, north, mid, and south portions of the lake	PCBs, pesticides, Cu, Pb	Every other year
Fish Tissue Analysis	Fish in Machado Lake	Same as previously conducted by RWQCB	Annually

CONCLUSION

KMHRP, a habitat to precious native plants and animals and a recreational facility to the South Bay population, has been degraded because of internal and external factors. Based on the results of lake water quality assessment include trash and suspended solids. Nutrients, coliform bacteria, and some heavy metals are found, but not at alarming levels. Organopesticides, PCBs, and PAHs were all detected below the Practical Quantitative Limits. Both structural and non-structural BMPs were proposed to improve water quality in the lake. For long-term water quality improvement, watershed management initiatives including source controls and restorative development would have to be undertaken.

Due to the lack of recent data on toxic substances in fish tissue, no conclusion can be made if the fish in the lake today is free of toxic substance residuals. Additional fish tissue analysis would be needed for the Department of Fish and Game to reconsider stocking the fish in the Lake for recreational fishing purpose.

REFERENCES

City of Los Angeles Department of Recreation and Parks, 2001. Ken Malloy Harbor Region Park Improvement Program, *Habitat Restoration and Lake Water Quality Improvement Design Development Report*. Prepared by Parsons. July.

City of Los Angeles Department of Recreation and Parks, 2002. Ken Malloy Harbor Region Park Improvement Program, *Machado Lake Watershed Management Plan*. Prepared by Parsons. May.

Wilmington Drain Restoration Multiuse Project
Feasibility Study

June 2006

Prepared by:
Watershed Management Division
Bureau of Sanitation
Department of Public Works
City of Los Angeles

OVERVIEW:

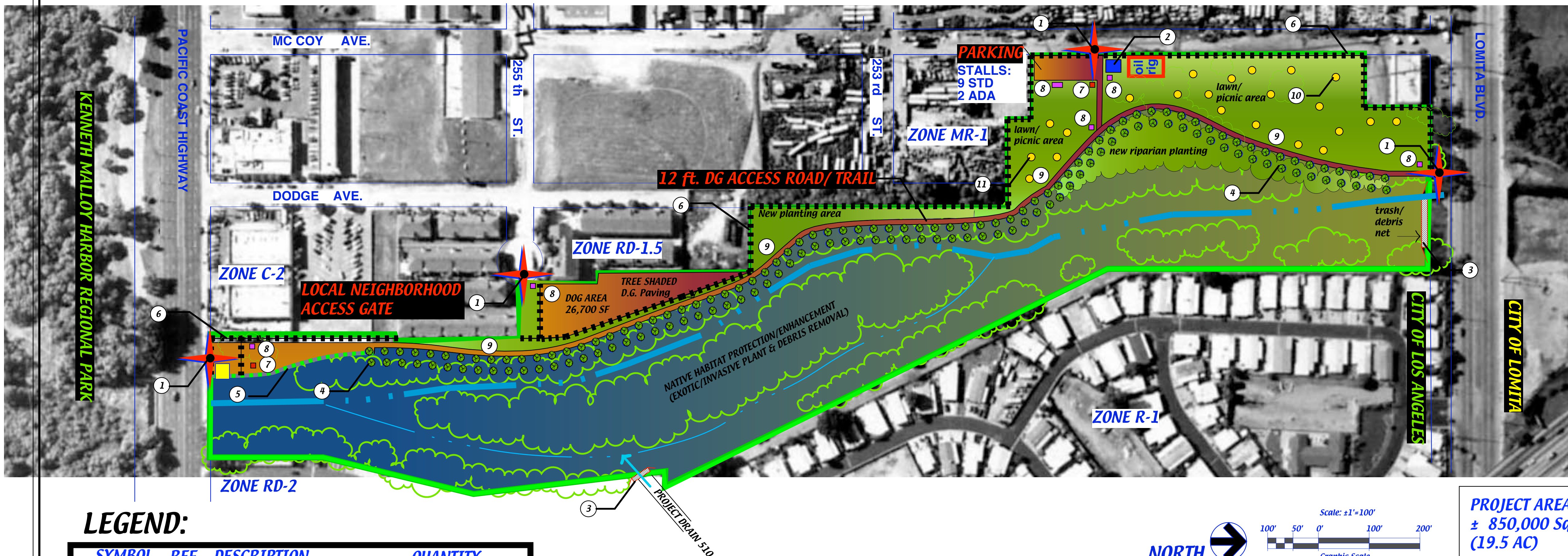
This report represents the current status of the conceptual scope of work for the proposed restoration of Wilmington Drain via a multi-step approach. The preliminary vision of using natural on-site processes to pre-treat and remove sediment from storm water underscores the need for open space to serve these natural processes and provide storm water containment. The lack of the necessary open space to allow this site to provide adequate water-treatment of inflow to Machado Lake does not preclude the need for additional riparian habitat, site-circulation, recreational, educational, safety, linkage and access enhancements. To the contrary, the lack of necessary open space at this sensitive site is further justification for: the development of a system of trails, viewing areas and interpretive exhibits that educate the public and provide safe circulation to protect nesting habitat; the creation of easily accessible and thereby defensible "safe space" for local residents' use in passive recreational activities; and for mitigating the water quality of inflow into the adjacent lake and wetlands to the fullest extent possible. Water quality monitoring will further extend the utility of this project with collected TMDL data.

This integrated project is not intended to replace future and necessary public land acquisitions in this watershed, but to provide a measure of improvements that will mitigate the quality of flow through this channel habitat and into Machado Lake as intra-jurisdictional, joint-use, and other necessary agreements and land acquisitions may be pursued.

The schematic on the next page presents the layout of the proposed project.

EXISTING SITE FEATURES & LOCATION:

The majority of the project site occupies a drainage easement between the city of Lomita to the north, and the City of Los Angeles Kenneth Malloy Harbor Regional Park to the south. The site is currently maintained by Los Angeles County with the southern end of the channel zoned as open space, and the north end occupying an A1 (Agricultural) zone The project core is a 150 ft



NORTH

Scale: ±1'=100'

100' 50' 0' 100' 200'

Graphic Scale

PROJECT AREA:
± 850,000 Sq ft
(19.5 AC)

LEGEND:

SYMBOL	REF. #	DESCRIPTION	QUANTITY
	1	NEW PUBLIC &/or UTILITY ACCESS GATE 4 ped. gates 2 vehicular gates	4
	2	NEW ADA restroom	2-STALL
	3	TRASH NETTING SYSTEM	2
		24" BOX TREE (Location not indicated)	22
		5 G. Tree (Location not indicated))	33
	4	WATTLES	1000
	5	GABION BANK STABILIZATION (VEGETATED)	350 LF/ 1100 CY
	6	NEW 6 FT. TUBE STL. FENCING	3000 LF
	7	INTERPRETIVE KIOSK	2
	8	WASTE RECEPTACLE	5 +1 DUMPSTER
	9	INTERPRETIVE SIGNAGE (at VIEWING AREA)	15
	10	PICNIC TABLE	22
		IRRIGATED LANDSCAPE AREA (lawn or native planting)	158,000 SF / 4.3 AC
		3" DECOMPOSED GRANITE (D.G.) PAVING	69,900 SF
		NATIVE HABITAT PROTECTION/ENHANCEMENT (EXOTIC/INVASIVE PLANT & DEBRIS REMOVAL)	592,000 SF (13.6 Ac)

EXISTING GABIONS 1.

TYPICAL EXOTICS FOR REMOVAL 2.

COMMUNITY ACCESS 3.

CHANNEL AREA 4.

SEDIMENT & DEBRIS AT STREET BRIDGE 5.

DEBRIS AT WILDLIFE AREA 6.

CITY OF LOS ANGELES - DEPARTMENT OF PUBLIC WORKS - BUREAU OF SANITATION

WILMINGTON DRAIN RESTORATION MULTIUSE PROJECT

PRELIMINARY CONCEPT DIAGRAM

1625 W. PACIFIC COAST HWY., LOS ANGELES, 90744

WATERSHED PROTECTION DIVISION
1149 S. BROADWAY ST., 10TH FL
LOS ANGELES, CA 90015

CD 15 // T.G. 764-B4

L-1

SHEET 1 OF 1
05-11-06 DD

wide county drainage easement conveying combined flow from two major sub-drainage areas: Wilmington Drain and private drain No. 553 at the upper reach which transfers pumped overflow drainage from Walteria Lake. Drain 510 enters from the east at approximately midpoint along the channel. Other uses surrounding the project include multi-family, mobile home, oil-drilling and commercial.

SCOPE OUTLINE:

A. Site Amenities/Improvements

1. **Gabion reconstruction**: (FIG. 1) Scope includes removal of the existing (failing) rip-rap filled gabions and replacement with rounded stone-filled gabion baskets. Baskets will be installed in a sinuous bank alignment that promotes smooth/even channel flow, rather than at 90 degrees to flow as is presently the case. Gabion bank protection shall be battered, and sited to allow vegetation with both seed and locally harvested willow wattles. Its northern endpoint shall be integrated into the natural bank slope at an irrigated planting area.
2. Budget includes a 2 stall ADA accessible restroom, parking area and drinking fountain.
3. A fenced off-leash dog area with drinking fountain & dog watering area is recommended, along with accompanying benches, waste receptacles, shade trees & appropriate regulatory signage with the reserved area. If this option is not selected, then this area will be landscaped using native vegetation as per (B) below. The justification for implementing this option is based on both the needs of park users and the adjacent multi-family housing to exercise and unleash their pets, and the need to enforce the existing requirements for dogs to either be on-leash and on-trails, or excluded in park outside of the off-leash dog area.
4. Site Furnishings: Tree shaded benches, drinking/dog watering fountains, quality concrete waste receptacles, and picnic tables shall offer visible seating and safe gathering spaces.
5. Utility access (west bank): Re-graded and compacted 12 ft wide access roads with compacted stabilized decomposed granite paving, fencing and access gates. Potential runoff shall be diverted away from channel and through planted treatment swales. Gates and access road layout shall facilitate park trash removal, observation, and drive-through maintenance.
6. Pedestrian Trails: Graded 6 ft wide compacted stabilized decomposed granite paving. Design layout to provide safe circulation, provide wildlife viewing areas and mitigate current problems with impacted channel habitat.

7. Signage: Kiosks, monument signage, and trail signage (regulatory, interpretive and safety).
8. Fencing/Safety: Removal and disposal of existing chain link fencing and installation of new tubular steel fencing to surround and enclose project perimeter. Existing concrete masonry unit perimeter walls will remain, and be vegetated with vines to reduce graffiti vandalism. Fence, trail and planting design layout will provide clear sight lines from perimeter circulation and roadways, and allow for ease of access for clean-up & debris removal.
9. Existing Community access location (FIG. 3): Further community input is required regarding planting, benches, gate, new fencing, and pedestrian access at existing RD1.5 housing access area. This entry is located at the west project boundary, at intersection of 255th Street. The community need for garden and or dog exercise space should be evaluated and refined in the in the design phase.

B. Vegetation

1. Primary planting goal: removal of known exotic and invasive plants from project area (FIG. 2) and overhanging neighboring properties where feasible. This removed vegetation shall be replaced with selected, locally-grown, native plant material from the riparian and coastal sage-scrub communities, that will be capable of naturalizing (especially in riparian areas) or reseeding from park into channel areas. Plantings shall include tress, shrubs, grasses, lawn, groundcover and vines. Vines shall be useful in preventing graffiti on common perimeter block walls and selected for use as forage for wildlife. It is expected that the minimal irrigation runoff from bank plantings may be used to extend the wetted bank habitat area. All plantings shall be irrigated either temporarily for plant establishment, or permanently as required to provide a green planted barrier for fire control and public use.

2. Secondary planting goal: To create a native plant and trail edge barrier between circulation paths and the channel that protects nesting and foraging habitat from dust, debris, canines, and human traffic (FIG. 4). This planting barrier will be augmented with a two-rail fence barrier in the heaviest use and public viewing areas of the park. Stock propagated from on site cuttings will assist in preventing windblown debris from blowing into channel, facilitate maintenance, and provide a degree of pollutant removal and water treatment benefits for surface flow into channel. Additionally, if youth at risk are employed to help with harvesting propagating of this material, it will instill an appreciation of the processes at hand including biology, botany, water quality improvement and environmental stewardship. Bank planting locations will be above

the designated scour line as determined by hydrological data, survey and design storm information.

3. Tertiary planting goal: To extend and improve the use area of both riparian habitat (FIG. 6), and neighborhood/community green park space. This will be done through installation of enhanced passive park recreational planting areas including a picnic area, a neighborhood entry, and trailside plantings.

C. Storm Water Quality Improvements (FIG. 5)
   1. Trash netting system: at north end of channel (At Lomita Blvd) with the following design criteria
      i. Drainage Area: 9,050 acres
      ii. Tributary Area Imperviousness: 46%
      iii. 1-yr storm Intensity: 0.6 in/hr
      iv. Ave. Sediment & Vegetation: 550,000 lbs/yr
      v. Anthropogenic Trash: 50,000 lbs/yr
      vi. Culvert Shape: 8 Rectangular Boxes
      vii. Box size: 16'-9" wide by 5'-6' high
   2. Trash netting system: at Pine Creek Lane Drain
      i. Drainage Area: 690 acres
      ii. Tributary Area Imperviousness: 50%
      iii. 1-yr storm Intensity: 0.6 in/hr
      iv. Ave. Sediment & Vegetation: 40,000 lbs/yr
      v. Anthropogenic Trash: 4,000 lbs/yr
      vi. Channel Shape: Trapezoidal
      vii. Channel size: 10' wide bottom with 1.5:1 side slope (H:V). Depth of about 10'
      viii. Channel slope: 0.001
   3. Park surface flow mitigation: via trails, grass filters, channel perimeter planting and restricted dog and public-use areas
   4. Channel perimeter: New roads and gates for improved maintenance access.
   5. Quality concrete waste receptacles and biodegradable dog waste disposal bags at off-leash dog area, trails, and parking/picnic area. Provide a dumpster sited for ease of access at utility entrance.

COST ESTIMATE

The attached tables provide the overall project costs as well as the detail construction/implementation cost breakdown for the project. See Concept Diagram for locations of item. Below are the quantities that the estimate is based.

QTY./unit	Description
(5) /ea.	5 -Foot wide Pedestrian Gates
(2) /ea.	20-Ft wide vehicular gates
(1) /ea.	2- Stall (or unisex) ADA restroom
(2) /ea.	Trash/Debris netting systems
(22) /ea.	24” box specimen trees
(33) /ea.	5-Gallon trees
(1000) /ea.	Willow canes (in wattles)
850 /lf	2-Rail concrete fence
350/ lf	Vegetated Gabion bank stabilization
3000/ lf	6 ft. Tubular steel fencing
(2) /ea.	Trash/Debris netting systems
2) /ea.	Interpretive Kiosks
(22)	Picnic Tables
160,000 /sf	Picnic area
71,000 /sf	Decomposed granite paving areas
592,000 /sf	Native habitat protection and enhancement

Table 1 – Project Budget Components

	Budget Category		City Share	State Share	Total
(a)	Direct Project Administration Costs		$60,000	-	$60,000
(b)	Land Purchase/ Easement		$4,900,000	-	$4,900,000
(c)	Planning/ Design/ Engineering/ Environmental Doc		$800,000	-	$800,000
(d)	Construction/ Implementation		$700,000	$3,300,000	$4,000,000
(e)	Environmental Compliance/ Mitigation/ Enhancement		$600,000	-	$600,000
(f)	Construction Administration		$400,000	-	$400,000
(g)	Other Costs		$60,000	-	$60,000
(h)	Construction/ Implementation contingency		$1,000,000	-	$1,000,000
(i)	**Grand Total**		**$8,520,000**	**$3,300,000**	$11,820,000
Sources of Funds for Non-State Share (Funding Match) and Other State Funds		**Local Sources** **$700,000 Public Works Trust Fund** **$1,000,000 Los Angeles County Proposition K** **$2,000,000 Wastewater Capital Improvement Program** **$8,120,000 City of Los Angeles Proposition O**			

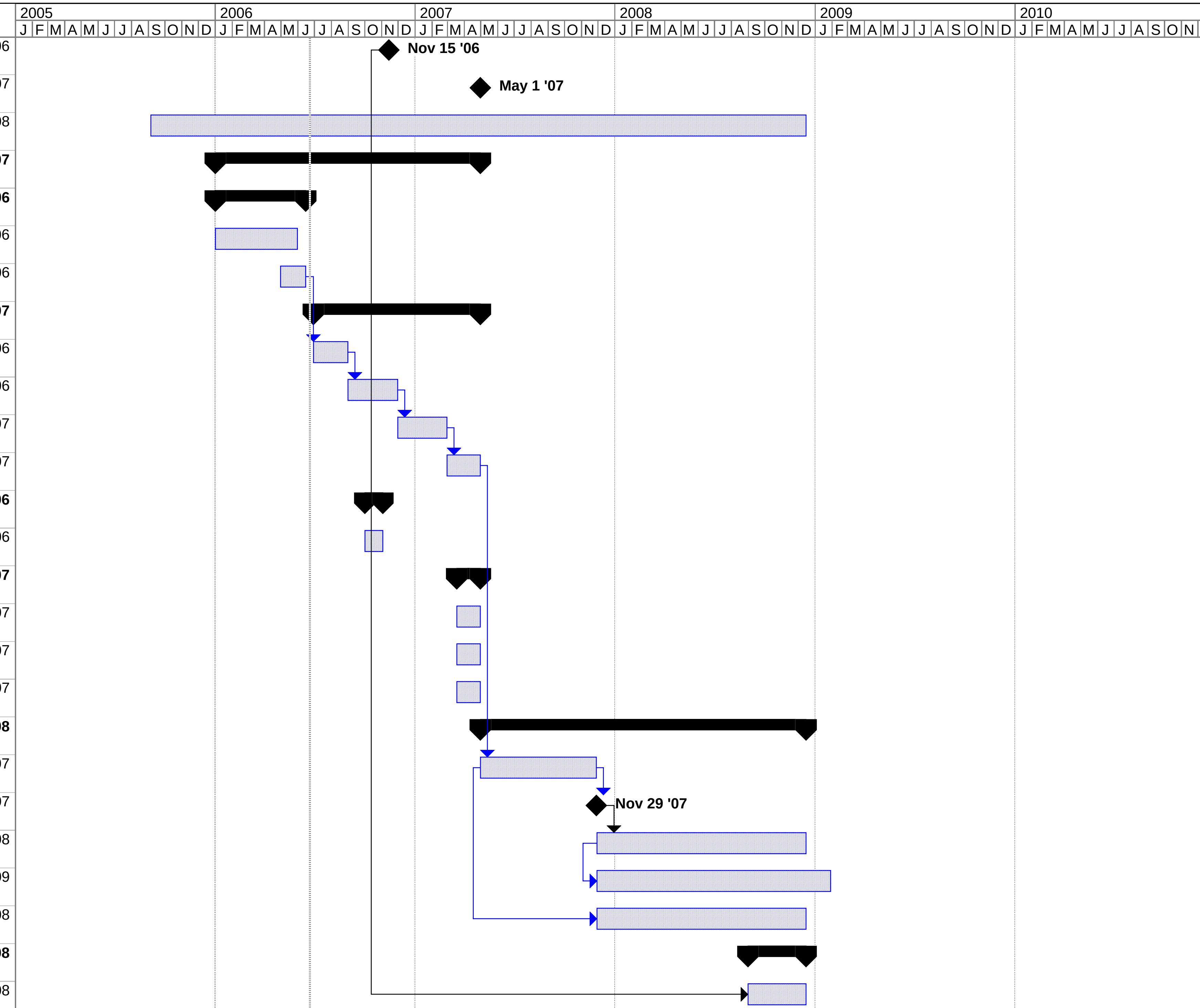
Table 2. Construction Cost Estimate

Cost Item	Quantity	Unit	Unit Price	Total
Mobilization - Permits. Insurance. etc.	1	L.S.	$200.000	$200.000
Site SWPPP Preparation and Execution	1			$40.000
Creation of Wetlands and Riparian Areas				
Clear and Grub Site	4	acres	5050	$20.200
Excavate and Remove soil	26.000	CY	15	$390.000
Disposal of spoils offsite	26.000	CY	10	$260.000
Purchase & Install Liner	4	acre	13068	$52.272
Purchase & Place Topsoil	6.500	CY	35	$227.500
Purchase herbaceous plant plugs	8200	plugs	0.75	$6.150
Install Cat-Tail Plugs	140	hours	45	$6.300
Purchase and plant trees	220	trees	150	$33.000
Purchase and install shrubs	870	shrubs	105	$91.350
Clear and Grub Site	4	acres	5050	$20.200
Stormwater Pumping and Conveyance Facilities	1	EA		
Pump Station (62 cfs. 20' of head)	1	EA		$510.000
Trenching and Piping	1420	lf	200	$284.000
Stormwater Pre-treatment System				
Traffic Control	30	Day	$1.000	$30.000
Pavement Removal (Breakup & Disposal)	1500	S.F	$2.88	$4.320
Excavation. Backfill. & Miscellaneous	1	L.S.	$25.000	$25.000
Install & Remove Excavation Shield	1	S.F	$60.000	$60.000
Set Sump & CDS Unit. Backfill	1	L.S.	$3.000	$3.000
Breakout Storm Drain	1	L.S.	$6.000	$6.000
Concrete Structures	30	C.Y.	$1.253	$37.590
Screen Installation	1	L.S.	$1.800	$1.800
Stainless Steel Basket	2	L.S.	$8.000	$16.000
CDS Unit Cost. incl. 2 baskets	1	L.S.	$170.000	$170.000
Furnish Lid & Install	1	L.S.	$15.000	$15.000
Pavement Restoration. Including Curb &	1	L.S.	$10.000	$10.000
Striping	1	L.S.	$1.000	$1.000
Monolithic Connection	2	L.S.	$1.000	$2.000
Concrete Collar	2	Each	$1.000	$2.000
36" S.D. Manhole Cover	2	Each	$2.000	$4.000
Traffic Bearing Slab H20	1	L.S.	$10.000	$10.000
Access Hatch	1	L.S.	$4.000	$4.000
Temporary S.D. Bypass	1	L.S.	$10.000	$10.000
Wetlands Flow Recirculation System		EA		$320.000
Wetlands Area Peripheral Landscaping		EA		$220.000
Clarifier abandonment and soil removal	3	clarifiers	107.000	$321.000
Perimeter Fencing	4100	lf	$15	$59.450
Subtotal				**$3.473.132**
General Conditions	1%			$34.731
Liability Insurance	2%			$69.463
Contractors Fees	10%			$347.313
Performance Bond	2%			$69.463
Gross Receipts Tax	0.13%			$11.831
Total				**4.005.933**
Total Construction Cost	**$4.005.933**		**Rounded:**	**$4.000.000**

IV. SCHEDULE

Attached is the project schedule.

Task	Task Name	Duration	Start	Finish
	Grant Notification	0 days	Wed 11/15/06	Wed 11/15/06
	Grant Contract	0 days	Tue 5/1/07	Tue 5/1/07
(a)	**Project Administration**	855 days	Tue 9/6/05	Mon 12/15/08
(c)	**Planning / Design / Engineering / Environmental Documentation**	**346 days?**	**Mon 1/2/06**	**Mon 4/30/07**
	Planning	**119 days?**	**Mon 1/2/06**	**Thu 6/15/06**
	Preliminary Study	108 days?	Mon 1/2/06	Wed 5/31/06
4.1.2	Outreach Program	34 days?	Mon 5/1/06	Thu 6/15/06
	Design / Engineering	**217 days**	**Fri 6/30/06**	**Mon 4/30/07**
	10% Design / Preliminary Design	45 days	Fri 6/30/06	Thu 8/31/06
	50% Design	65 days	Fri 9/1/06	Thu 11/30/06
	90% Design	64 days	Fri 12/1/06	Wed 2/28/07
	100% Design / Final Design & Construction Documents	43 days	Thu 3/1/07	Mon 4/30/07
	Environmental Documentation	**25 days**	**Mon 10/2/06**	**Fri 11/3/06**
	CEQA Documentation	25 days	Mon 10/2/06	Fri 11/3/06
	Permit Acquisition	**31 days**	**Mon 3/19/07**	**Mon 4/30/07**
4.4.1	Animal Control	31 days	Mon 3/19/07	Mon 4/30/07
4.4.2	Fish and Game	31 days	Mon 3/19/07	Mon 4/30/07
	Regional Water Quality Control Board	31 days	Mon 3/19/07	Mon 4/30/07
(d)	**Construction / Implementation**	**425 days**	**Tue 5/1/07**	**Mon 12/15/08**
	Bid Solicitation	152 days	Tue 5/1/07	Wed 11/28/07
	Contract Award / NTP	1 day	Thu 11/29/07	Thu 11/29/07
	Construction Duration	272 days	Fri 11/30/07	Mon 12/15/08
(e)	**Environmental Compliance / Mitigation / Enhancement**	305 days	Fri 11/30/07	Thu 1/29/09
(f)	**Construction Administration**	272 days	Fri 11/30/07	Mon 12/15/08
(g)	**Other**	**76 days**	**Mon 9/1/08**	**Mon 12/15/08**
	PAEP	76 days	Mon 9/1/08	Mon 12/15/08



Project: South LA Wetlands
Date: Thu 6/22/06

Task		Progress		Summary		External Tasks		Deadline	
Split		Milestone		Project Summary		External Milestone			