Appendix 7-F: Oxford Retention Basin Multi-Use Enhancement Project

Supporting Documents

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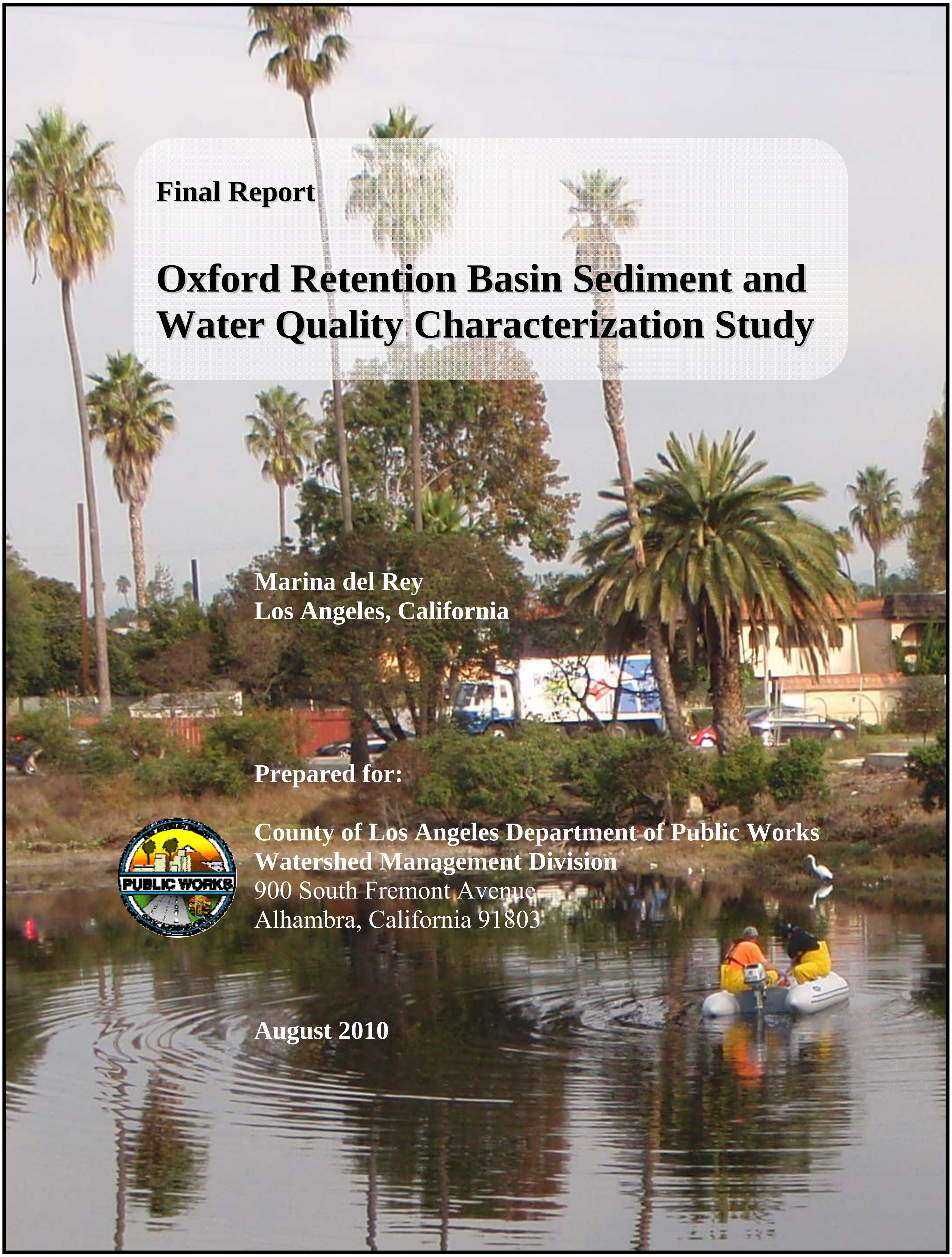

Final Report

Oxford Retention Basin Sediment and Water Quality Characterization Study

Marina del Rey
Los Angeles, California

Prepared for:

County of Los Angeles Department of Public Works
Watershed Management Division
900 South Fremont Avenue
Alhambra, California 91803

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Σ	sum
μg	microgram
AVS	acid volatile sulfides
BHC	hexachlorobenzene
BMP	best management practice
BOD	biochemical oxygen demand
CAM	California Assessment Manual
COC	chain of custody
COD	chemical oxygen demand
COP	California Ocean Plan
CTR	California Toxics Rule
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
DOC	dissolved organic carbon
ID	identification
IDW	Inverse Distance Weighted
LARWQCB	Los Angeles Regional Water Control Board
MDL	method detection limit
MdRH	Marina del Rey Harbor
MPN	most probable number
NDMA	N-Nitrosodimethylamine
NDPA	N-Nitrosodi-n-propylamine
NTU	nephelometric turbidity unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated bipheynl
PCE	tetrachloroethene
pH	hydrogen ion concentration
Q-PCR	Quantitative Polymerase Chain Reaction
QA	quality assurance
QC	quality control
SAP	sampling and analysis plan
SEM	Simultaneously Extracted Metal
SM	standard method
STLC	soluble threshold limit concentration
SVOC	semi-volatile organic carbon
SWRCB	State Water Resources Control Board
TCLP	Toxicity Characteristic Leaching Procedure
TDS	total dissolved solids
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily load
TOC	total organic carbon
TPH	total petroleum hydrocarbon
TSS	total suspended solids
TTLC	total threshold limit concentration
USEPA	United States Environmental Protection Agency
VOC	volatile organic carbon
WET	Waste Extraction Test
WQO	water quality objective

1.0 INTRODUCTION

1.1 Study Overview

Water and sediment samples were collected from Oxford Retention Basin and Basin E in Marina del Rey Harbor (MdRH) to characterize existing contaminant levels and to assess available options for water quality improvements and sediment disposal (Figure 1). Specifically, sediment and water quality characterizations were performed for the County of Los Angeles Department of Public Works (LADPW) for the following purposes:

- Characterize sediments that have been deposited in the Oxford Retention Basin so that informed management decisions can be made in the future regarding excavation and water quality management.
- Determine the spatial extent of bacterial and chemical contamination in the sediments and in the water column within Oxford Retention Basin.
- Determine the organic composition of the sediment to examine evaluate the feasibility of bioremediation.
- Characterize water quality conditions in Oxford Retention Basin in relation to the compliance requirements of the Bacteria Total Maximum Daily Load (TMDL) and Toxics TMDL for Basin E within MdRH.
- Satisfy the necessary requirements to evaluate the disposal options for sediment removal from Oxford Retention Basin.

The Oxford Retention Basin serves primarily as a flood control facility and is an integral part of the Marina del Rey local drainage system. The purpose of the basin is to retain urban and stormwater runoff until it can be safely discharged into Basin E of the MdRH. During storms, contaminants associated with development and street runoff are carried into Oxford Retention Basin and then into Basin E through two tide gates. The quality of the discharged water is speculated to be poor, mainly due to high recorded concentrations of bacteria and other pollutants of concern. Basin E is on the Clean Water Act (CWA) Section (§)303(d) list due to impairments caused by high concentrations of bacteria and toxic contaminants that on occasion have exceeded the water quality objectives (WQOs) contained in the California Ocean Plan (COP) (SWRCB, 2005). TMDLs for bacteria and toxics were adopted by the Los Angeles Regional Water Quality Control Board (LARWQCB) and became effective on March 18, 2004, and March 17, 2006, respectively. The current TMDL requirements call for improving water quality in the MdRH Mother's Beach and Basins D, E, and F. Because Oxford Retention Basin discharges directly into Basin E, excavation of accumulated sediments in the Oxford Retention Basin is considered a potential remediation measure to improve water quality discharged into Basin E and the MdRH.

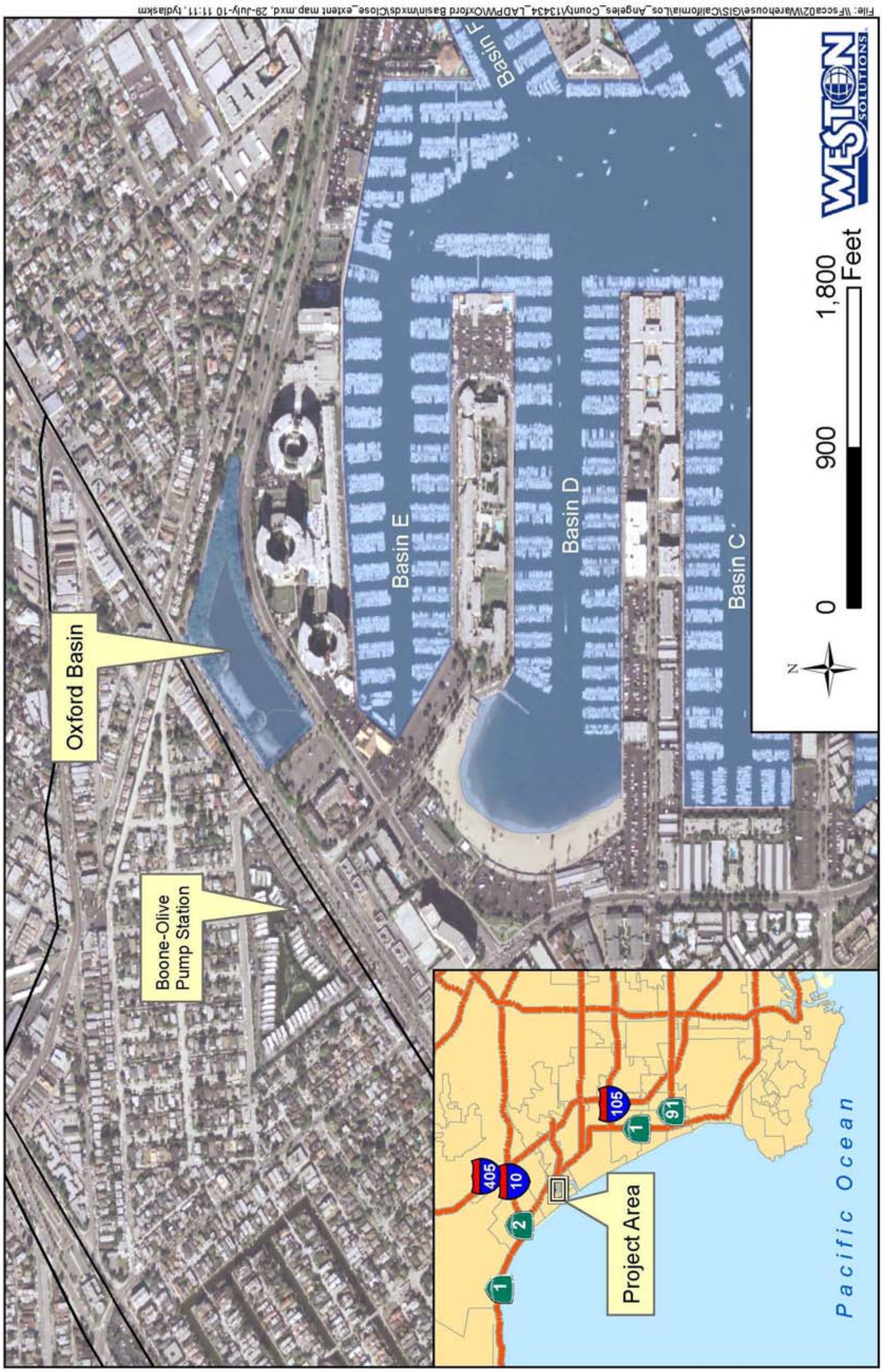

Figure 1. Project Area showing Oxford Retention Basin and Basin E in Marina del Rey Harbor and Boone Olive Pump Station

1.2 Study Objectives

Study objectives were defined for each of the three sampling components of the characterization study. The objectives of the sediment study were to define the spatial extent of sediment contamination using a scientifically defensible approach and to determine the overall organic content of the sediment so that bioremediation options could be evaluated. Specifically, the sediment study aimed to complete the following:

- Surficial sediment data were collected to determine feasibility of proposed bioremediation.
- Surficial sediment bacterial tests were conducted to determine if sediments are a likely source of bacteria.
- Surficial sediment acid volatile sulfides (AVS) / simultaneously extracted metals (SEM) analyses were conducted to determine bioavailability of metals in surface sediments.
- Sediment from the surface to the design depth was evaluated to characterize the bulk of the sediment proposed for excavation.
- Sediment at or below the design depth was evaluated to characterize what will become the new surface layer based on the proposed grading plan.

The objectives of the wet weather and dry weather water sampling were to characterize water quality in both Oxford Retention Basin and Basin E. Specifically, the water quality study aimed to complete the following:

- Understand the extent of chemical and bacterial contamination in the water column within the Oxford Retention Basin.
- Characterize water quality conditions in Oxford Retention Basin in relation to the Bacteria and Toxics TMDLs compliance requirements at Basin E within MdRH.
- Determine the relationship among contaminants found in the Oxford Retention Basin and their potential impacts to Basin E in MdRH.
- Satisfy the necessary requirements to evaluate the disposal options for sediment removal.

Analyses for sediment and water samples included semivolatile organic compounds (SVOCs), California Assessment Manual (CAM) 17 metals, organochlorine pesticides, total petroleum hydrocarbons (TPH), total organic carbon (TOC), hydrogen ion concentration (pH), nutrients, and indicator bacteria. Additional analyses for sediment samples included AVS/SEM, grain size, percent solids, total sulfides, and Toxicity Characteristic Leaching Procedure (TCLP) for metals, SVOCs, and organochlorine pesticides, whereas additional analyses for water included volatile organic compounds (VOCs), polychlorinated biphenyl (PCB) congeners, dissolved organic carbon (DOC), hardness, total dissolved solids (TDS), and total suspended solids (TSS).

1.3 Previous Studies

Results and findings from several previous studies were reviewed prior to creating a *Sampling and Analysis Plan (SAP) for the Oxford Retention Basin Sediment and Water Quality Characterization Study*. Sampling locations for this study were selected based upon information from these prior studies to provide high-resolution data regarding water quality and the vertical and horizontal distribution of sediment contamination within Oxford Retention Basin. A summary of the previous studies conducted in MdRH is presented below.

1.3.1 Mother's Beach and Back Basins' Bacteria Total Maximum Daily Load Non-Point Source Study

The Mother's Beach and Back Basins' Bacteria TMDL Non-Point Source Study was conducted to assess the bacterial sources that may potentially impact water quality at Mother's Beach and the back basins and attribute loads to these sources. A weight-of-evidence approach, including visual observations, a public questionnaire, temporal and spatial bacteria sampling studies during both wet conditions and dry conditions, an illicit boating discharge investigation, hydrologic modeling, sewerage infrastructure inspections, and a novel approach to bacterial source tracking known as the 'toolbox approach' using Quantitative Polymerase Chain Reaction (Q-PCR) and ribotyping techniques to determine the significant non-point sources of contamination continually affecting the quality of the waters within the back basins of MdRH and Mother's Beach. After completing the source identification (ID) aspect of this study, loading was assessed for the primary contributors of bacterial pollution.

Spatial and Temporal Bacterial Investigation—Circulation within MdRH is relatively poor in the back basins and limited in general. The highest concentration of fecal indicator bacteria occurred in Oxford Retention Basin and the Boone Olive Pump Station and Basin E during dry weather or wet weather monitoring events. Ribotyping analyses determined that the majority of bacteria contained in water samples collected from Basins D, E, and F during both dry weather and wet weather were avian in origin. Rodent and canine were secondary to avian sources during both dry weather and wet weather. Q-PCR analysis showed little human contamination throughout the back basins; human sources (direct human and/or sewage) were found to attribute 3% of the bacteria load for both wet weather and dry weather overall. Based on visual observation, the back basins appeared to be affected by contamination sources local to the basins themselves.

Sewerage Infrastructure Investigation—The sewerage infrastructure investigation determined that the sanitary sewer lines surrounding the back basins of MdRH did have structural defects and operational and maintenance problems.

Illicit Boat Discharge Investigation— Results based on this weight-of-evidence approach indicate that illegal discharges of sewage from boats in Basins D, E, and F were not likely a major cause of contamination. However, because illegal discharges of sewage from boat holding tanks is inherently episodic, results of this study do not rule out the potential for isolated events.

Sediment Investigation—Results from the sediment investigation conducted at Mother's Beach indicate that the surficial sediments in the inter-tidal zone and beach face were generally low in fecal indicator bacteria suggesting that it was unlikely that sediment re-suspension resulting from beach activity was contributing large amounts of bacteria to the water (Figure 2).

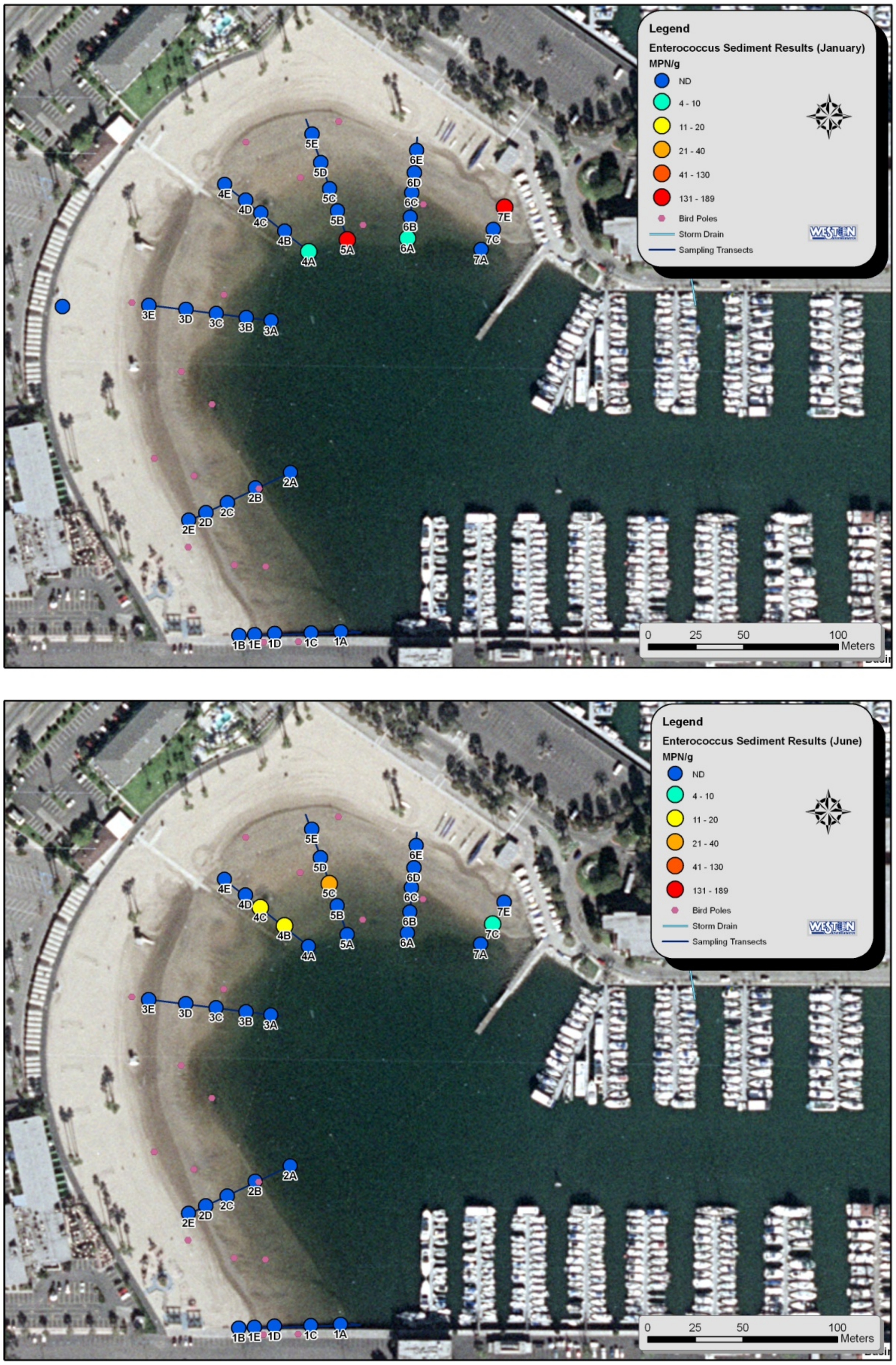

Figure 2. Sediment Results for Enterococci for January and June

Bacterial Loading Estimate—An Excel-based loading model was developed for the assessment of bacterial contributions. Because of the complexities of modeling bacteria in a tidal system, the model was limited in scope and was not designed for best management practice (BMP) development but rather as a tool for general assessment of different management actions. The bacterial results of a one-day comprehensive bacterial sampling event, coupled with the sampling of four upstream sampling locations within the MdRH watershed, was incorporated into a hydrologic mass balance model to estimate bacteria concentrations in Oxford Retention Basin and Basin E during dry weather. The model results suggested some of the greatest impacts to fecal coliform loads were attributable to effluent from Oxford Retention Basin as it drained into Basin E. Additionally, higher bacteria concentrations were measured from the Boone Olive Pump Station and were found to correlate with higher bacteria concentrations in Basin E.

Overall, the results of the Mother's Beach and Back Basins Bacteria TMDL Non-Point Source Study suggested that the majority of the indicator bacteria in MdRH originated from direct and indirect (i.e., through storm drains) avian sources. However, in the case of Basin E, dry weather and wet weather point sources were identified as including discharges from Oxford Retention Basin and (during wet weather) the Boone Olive Pump Station. This resulted in a number of BMP recommendations, including structural bird controls and sewerage infrastructure improvements.

Recommendations were also provided for reducing bacterial densities in the back basins with a focus on illicit boat discharges, irrigation, sediment management, wash down activities, sewerage infrastructure and BMPs of Boone Olive Pump Station and Oxford Retention Basin.

1.3.2 Marina del Rey Harbor Mother's Beach and Back Basins' Indicator Bacteria Total Maximum Daily Load Compliance Study

The MdRH Mother's Beach and Back Basins' Indicator Bacteria TMDL Compliance Study provided an analysis of compliance data collected in response to the MdRH Mother's Beach and Back Basins' Indicator Bacterial TMDL. Eight months of TMDL compliance monitoring indicator bacteria data were analyzed for compliance with TMDL goals, and sampling stations were assessed for the applicability of CWA §303(d) listing status based on historic data from ten years of sampling. The study also assessed differences between geometric mean calculation methods and how they affect TMDL compliance, as well as a comparison of bacterial levels before and after BMP implementation. The following findings were made during this study:

- TMDL compliance targets were mostly met with the exception of compliance monitoring stations during summer dry weather sampling events.

Station Type	% within TMDL Compliance Targets		
	Summer Dry Weather	Winter Dry Weather	Wet Weather
Compliance monitoring	22%	89%	78%
Ambient monitoring	80%	100%	100%

- Analysis of historical data showed that all stations exceeded the TMDL single sample compliance targets, although only four stations would have met the criteria for State Water Resources Control Board (SWRCB) §303(d) listing. Due to this difference in assessment methodology, the TMDL compliance targets are expected to be more difficult to achieve than meeting the SWRCB §303(d) listing policy.

- Data collected for TMDL and historical monitoring were used to evaluate differences between conditions before and after BMP implementation in Basins D, E, and F. Receiving water data in Basin E showed no significant difference between bacterial levels pre and post BMP implementation. Receiving water data in Basin D showed significantly higher levels of total coliforms and enterococci after BMP implementation when compared to pre-implementation levels. Receiving water data in Basin F showed significantly higher levels of enterococci after sewer lining was completed. Bacterial levels during days following mechanical circulation of water at Mothers Beach compared to bacterial levels on days when no mechanical circulation occurred showed no significant difference.

1.3.3 Marina del Rey Sediment Characterization

The MdRH Sediment Characterization Study was completed in April 2008 in compliance with the *Requirement of Submit Information* letter from the LA RWQCB regarding sediment contamination in MdRH (WESTON, 2008a). The letter specified that the responsible agencies were to design a study plan to assess the areal extent of sediment contamination in the harbor for constituents listed in the Toxics TMDL, including total PCBs, chlordane, copper, lead, and zinc.

In this study, 23 sites were assessed with the collection of sediment cores, with samples collected at the surface, top (0–10 cm) and bottom (11 cm and deeper). Sixteen predetermined sampling locations were assessed by removal of surface sediments and sediment cores. Pore water was collected from five of the 23 sites. Sediment samples were analyzed for benthic infauna, toxicity and physical/chemical composition with regard to sediment grain size, total organic content (TOC), metals, organochlorine pesticides, and PCBs.

Results from the surface sediment analyses indicated that chlordane distribution was most highly concentrated at the mouth of the main channel (Figure 3). Copper (Figure 4), lead (Figure 5), zinc, and PCB (Figure 6) concentrations were highest in the mouths of each Back Basin and in the main channel.

Metals were found to be higher in the main channel and the mouths of each Back Basin compared with concentrations further into the Back Basins (Figure 4 and Figure 5).

These results are consistent with those of the MdRH Annual Report, which suggests influences external to the harbor for higher concentrations of chlordane and PCBs at the mouth of the harbor.

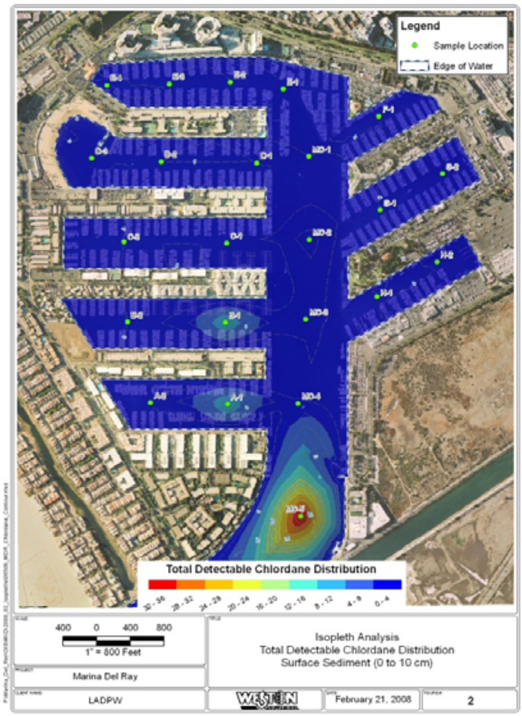

Figure 3. Distribution of Total Chlordane in Surface Sediment in Marina del Rey Harbor

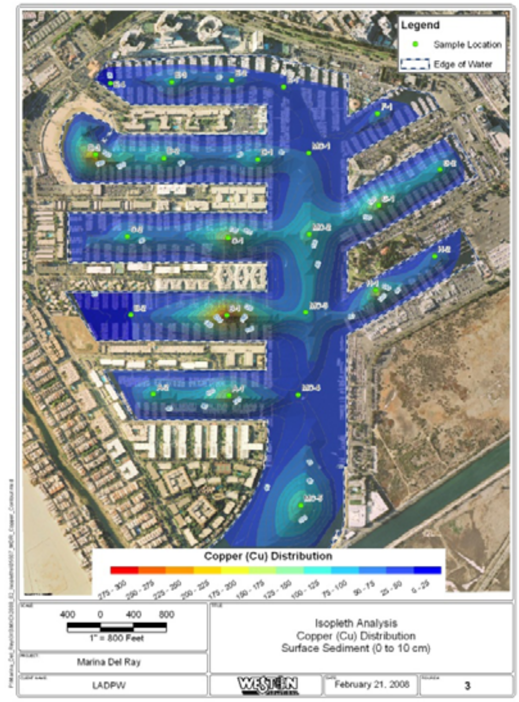

Figure 4. Distribution of Copper in Surface Sediment in Marina del Rey Harbor

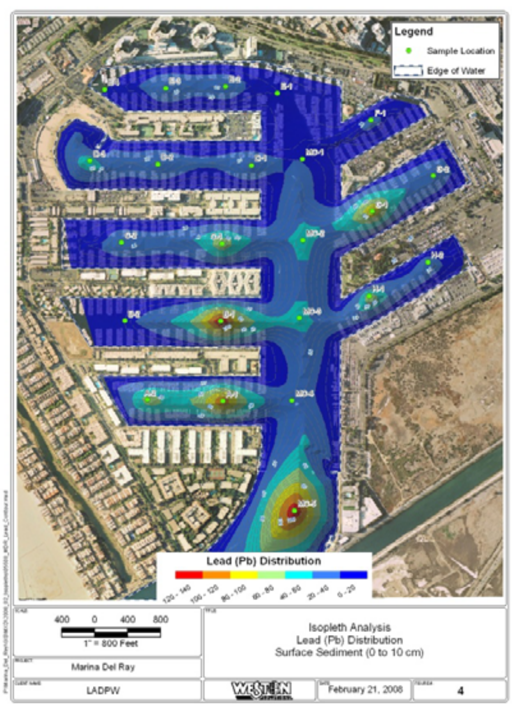

Figure 5. Distribution of Lead in Surface Sediment in Marina del Rey Harbor

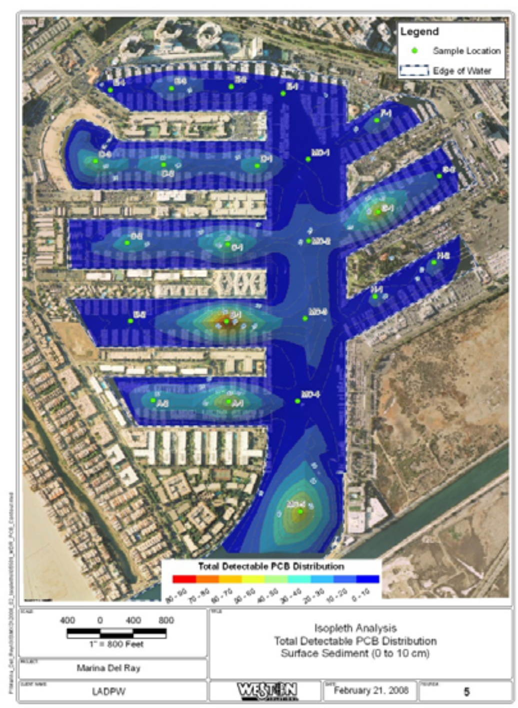

Figure 6. Distribution of Total Polychlorinated Biphenyls in Surface Sediment in Marina del Rey Harbor

2.0 MATERIALS AND METHODS

Water and sediment samples were collected from MdRH and Oxford Retention Basin between October 2009 and March 2010 as part of a sediment and water quality characterization study for the LADPW. Details of each of these monitoring components are provided below.

2.1 Sampling Locations and Sample Nomenclature

Sampling locations for wet weather and dry weather water samples were located in Oxford Retention Basin, Basin E, and Boone Olive Pump Station while sediment sampling was confined to Oxford Retention Basin. All station locations were pre-planned.

2.1.1 Sediment Sampling

Sediment cores were collected at all ten stations within the Oxford Retention Basin (Figure 7). Cores extended through recently deposited (unconsolidated) sediments and into the consolidated sediment layer at seven of the ten stations. At three stations, the consolidated layer was not encountered due to refusal. Once collected, the cores were delivered to an on-site processing station where a certified California geologist characterized the vertical stratification of cores. The targeted sampling latitude and longitude coordinates and targeted core lengths are provided in the approved SAP.

Multiple cores per location were collected to ensure an adequate volume of material (approximately 2 L) for all required testing and archival. Based on sediment stratification, the cores were split into vertical segments to assess the vertical resolution of potential chemical contamination. Since multiple samples were collected from each core, additional nomenclature was appended to the station ID to derive unique sample IDs (e.g., EL represents sediment from the excavation layer and NL represents sediment from the consolidated layer). Figure 8 illustrates the derivation of the sample IDs relative to the station ID and sample point for the sediment sampling event.

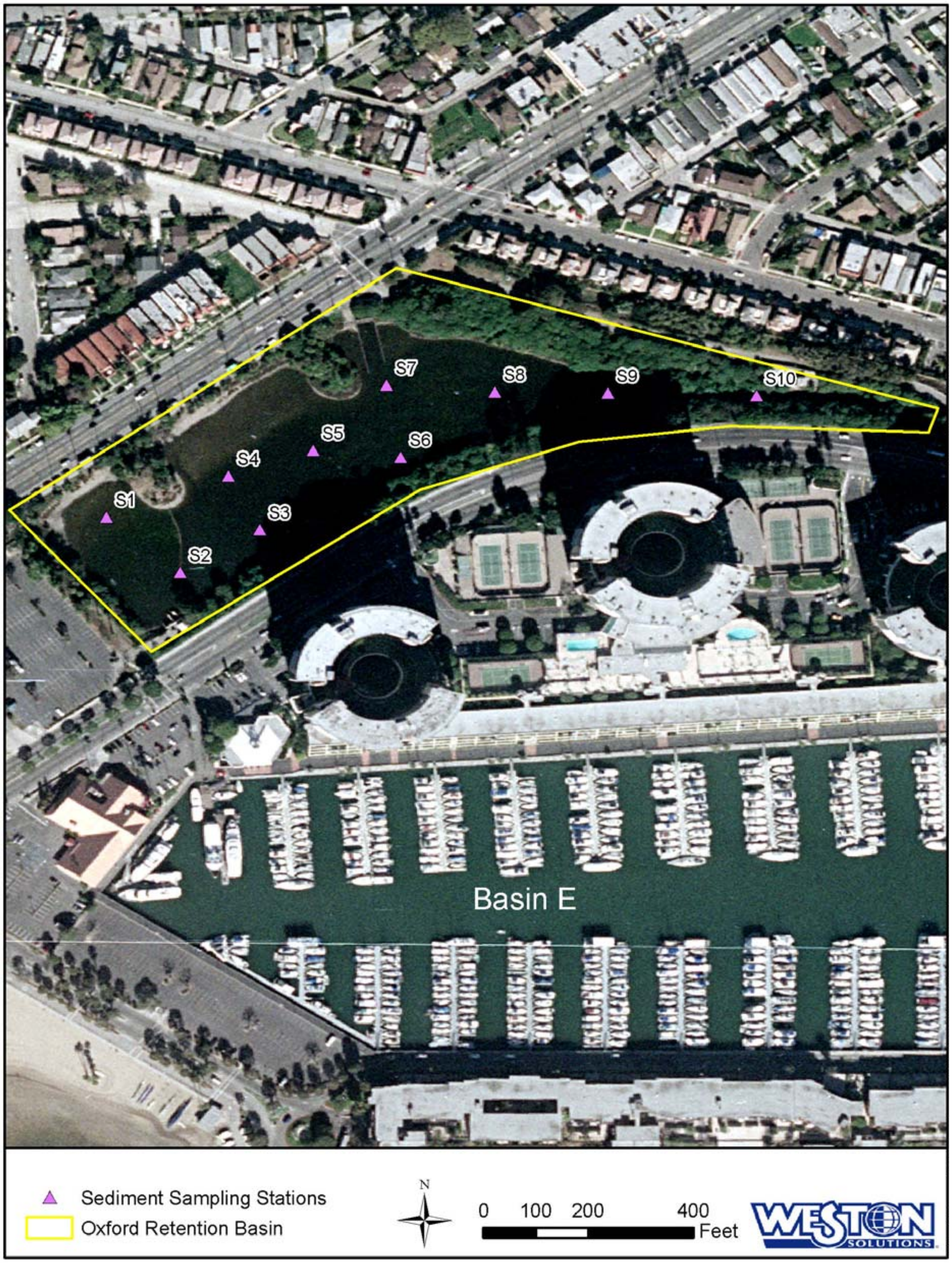

Figure 7. Sediment Sampling Stations within Oxford Retention Basin

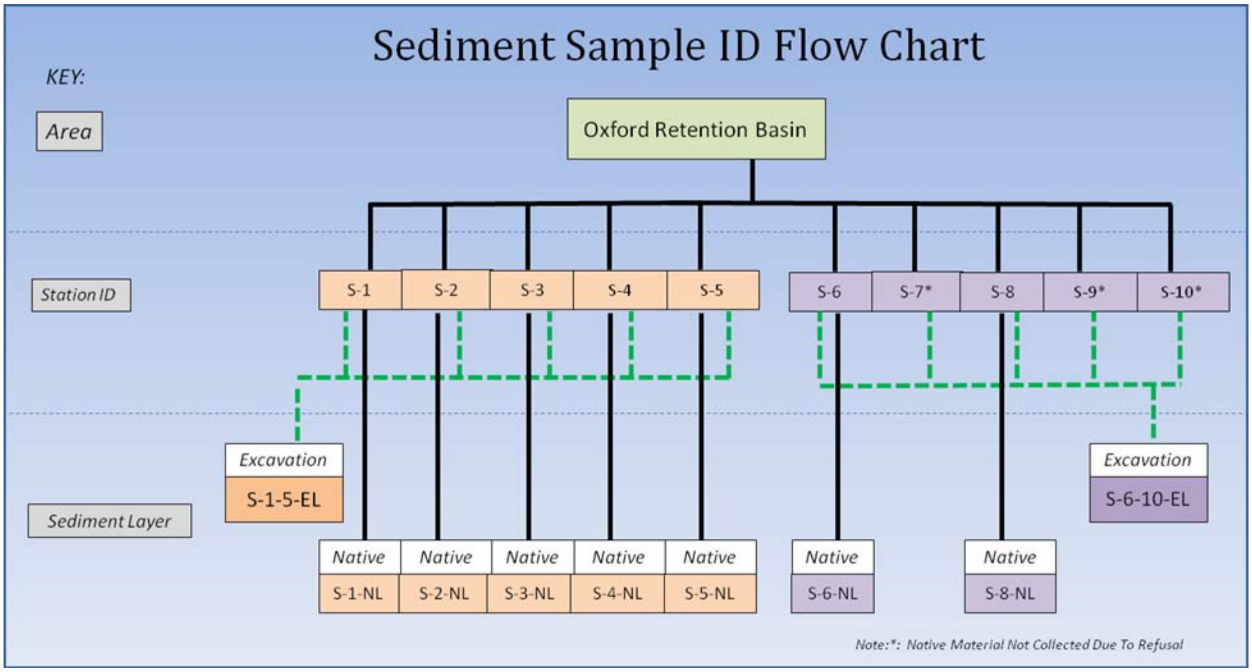

Figure 8. Sediment Quality Sample Identification Flow Chart

2.1.2 Water Sampling – Wet Weather

The sampling stations for the wet weather component of the water quality sampling are shown on Figure 9. Due to extremely shallow water during low tide, Station ORB-E was moved approximately 40 meters southwest of the proposed location as described in the SAP. The relocation of Station ORB-E to an area slightly deeper allowed for water collection without the draft of the inflatable boat disturbing the sediment layer during water sample collection. The targeted sampling latitude and longitude coordinates and targeted core lengths are provided in the approved SAP.

As the goal of these sampling events was to characterize the baseline wet weather water quality conditions in the two basins, water samples were collected from a number of locations and composited together to more accurately represent water quality conditions in each basin (Figure 10). In Oxford Retention Basin, water was collected from five sample locations and composited to represent one sample for analysis. Basin E samples were collected from three sample locations and composited into one sample for laboratory analysis. Three of the constituents from the analyte list were not conducive to composite analysis. Thus, for VOCs, TPH, and fecal indicator bacteria analysis, samples were collected from a single sample location (Station ORB-C in Oxford Retention Basin and Station E-C in Basin E) that was determined to best represent the basin water quality as a whole.

In addition to the samples collected in Oxford Retention Basin and Basin E, samples were also collected from Boone Olive Pump Station. During dry weather conditions, runoff entering Boone Olive Pump Station is diverted to the sanitary sewer system. However, during storm conditions the sanitary sewer diversion is shut off, and stormwater flows freely to Basin E, approximately 90 meters south of the Oxford Retention Basin outfall.

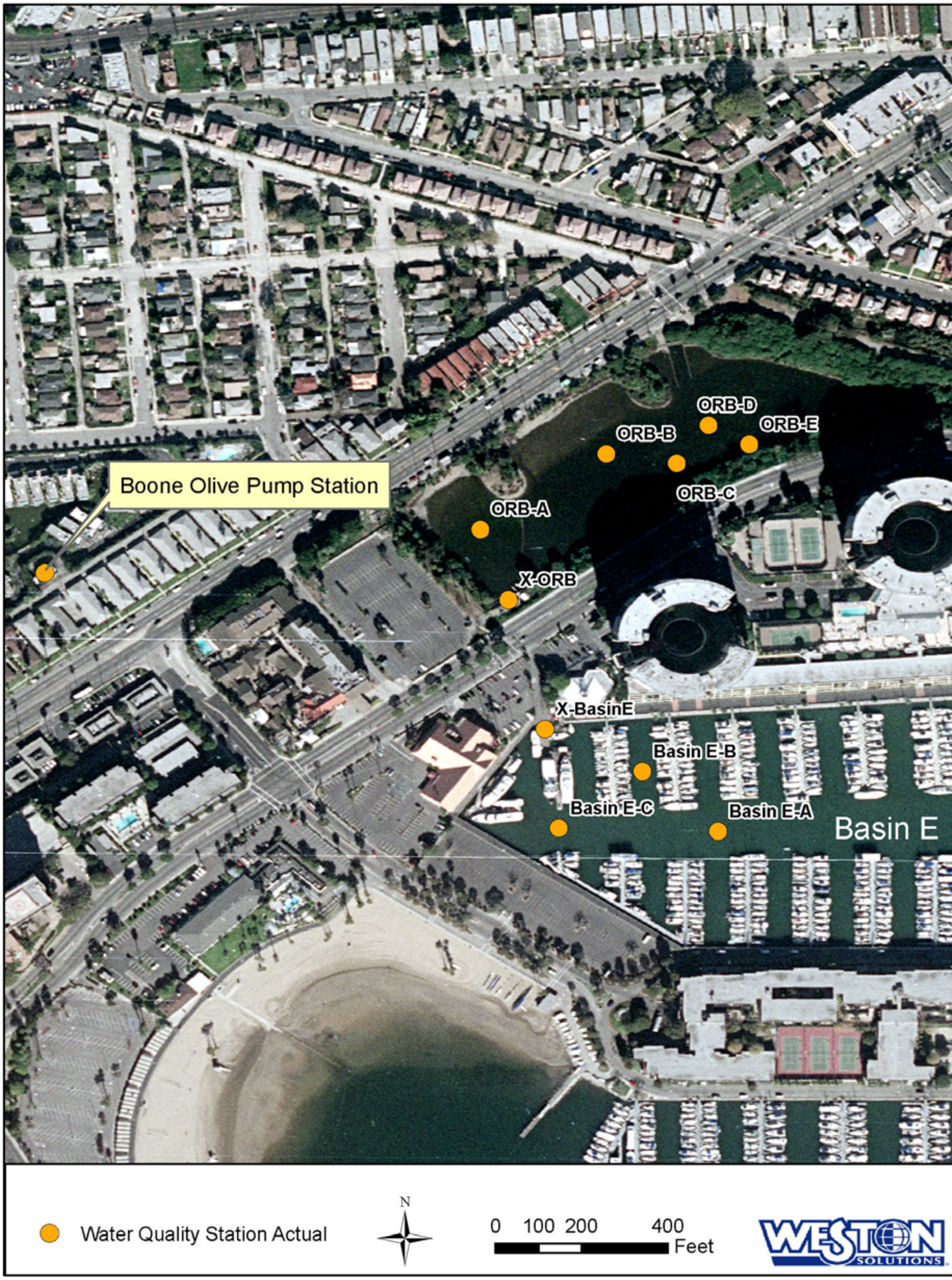

Figure 9. Water Quality Sampling Stations within Oxford Retention Basin, Basin E, and Boone Olive Pump Station

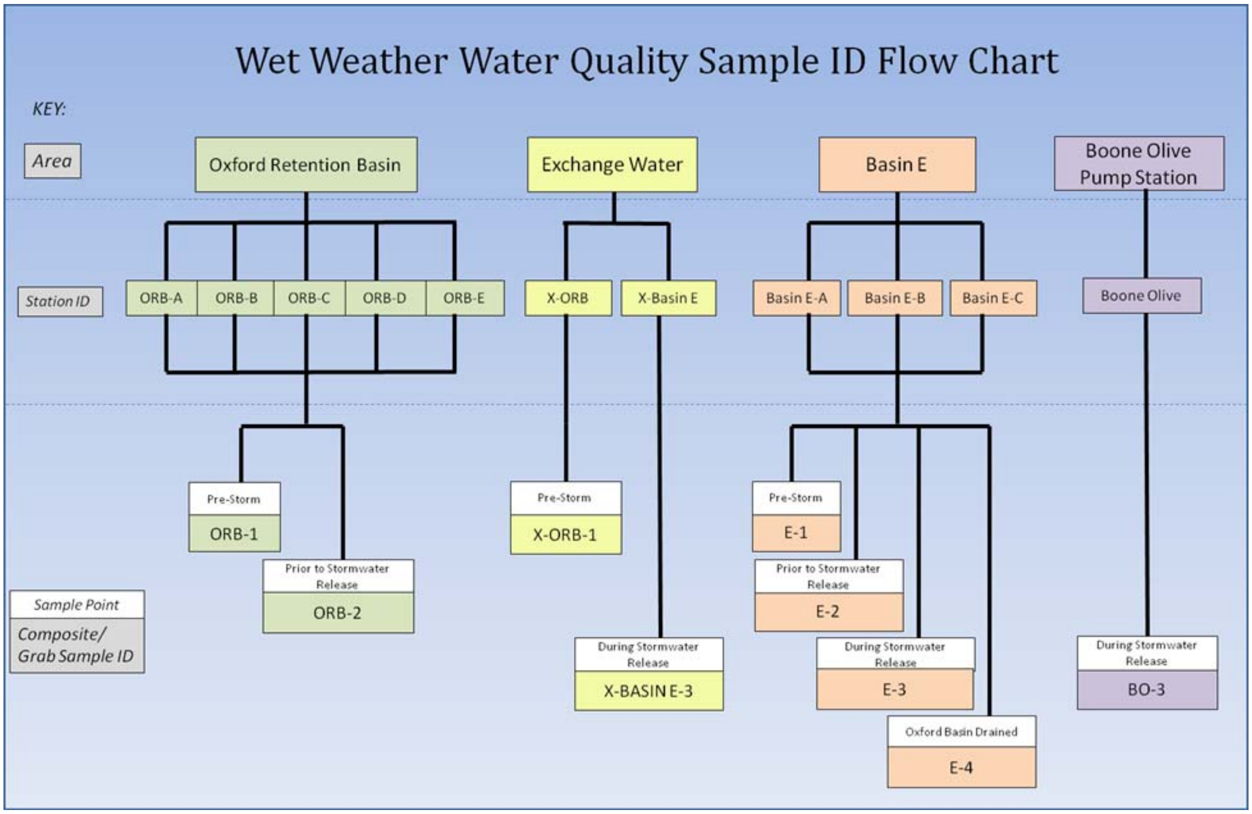

Figure 10. Wet Weather Water Quality Sample Identification Flow Chart

During the wet weather survey, an additional set of water quality grab samples were collected from Oxford Retention Basin and the Exchange water between Oxford Retention Basin and Basin E. These samples were collected for use in understanding the potential feasibility of bioremediation techniques on existing sediment within Oxford Retention Basin.

For the wet weather water sampling, Exchange water samples were collected on the Oxford Retention Basin side prior to the storm and on the Basin E side of the culverts during drainage of Oxford Retention Basin.

During the wet weather event, multiple samples were collected at each station representing each sampling period relative to the storm, therefore, additional nomenclature was appended to the station ID to derive unique sample IDs (e.g., '1' represents prior to the storm, '2' represents after the storm but before drainage of Oxford Retention Basin, '3' represents during the drainage of Oxford Retention Basin, and '4' represents conditions after Oxford Retention Basin had been completely drained). Figure 10 illustrates the derivation of the sample IDs relative to the station ID and sample point for the wet weather event.

2.1.3 Water Sampling – Dry Weather

The sampling stations for the dry weather component of the water quality sampling are shown on Figure 9. Due to extremely shallow water during low tide, Station ORB-E was moved approximately 40 meters southwest of the proposed location as described in the SAP. The relocation of Station ORB-E to an area slightly deeper allowed for water collection without the draft of the inflatable boat disturbing the sediment layer during water sample collection.

As the goal of these sampling events was to characterize the baseline dry weather water quality conditions in the two basins, water samples were collected from a number of locations and composited together to more accurately represent water quality conditions in each basin (Figure 11). In Oxford Retention Basin, water was collected from five sample locations and composited to represent one sample for analysis. Basin E samples were collected from three sample locations and composited into one sample for laboratory analysis. Three of the constituents from the analyte list are not conducive to composite analysis. Thus, for VOC, TPH, and fecal indicator bacteria analysis, samples were collected from a single sample location (Station ORB-C in Oxford Retention Basin and Station E-C in Basin E) that was determined to best represent the basin water quality as a whole.

In addition to the samples collected in Oxford Retention Basin and Basin E, samples were also collected from Boone Olive Pump Station. During dry weather conditions, runoff entering Boone Olive Pump Station is diverted to the sanitary sewer system.

For the dry weather water sampling, Exchange water samples were collected on the Basin E side of the culverts during flood tide and on the Oxford Retention Basin side during ebb tide.

During the dry weather sampling event, multiple samples were collected at each station representing different tidal stages, therefore, additional nomenclature was appended to the station ID to derive unique sample IDs (e.g., 1 represents ebb tide and 2 represents flood tide). Figure 11 illustrates the derivation of the sample IDs relative to the station ID and sample point for the dry weather event.

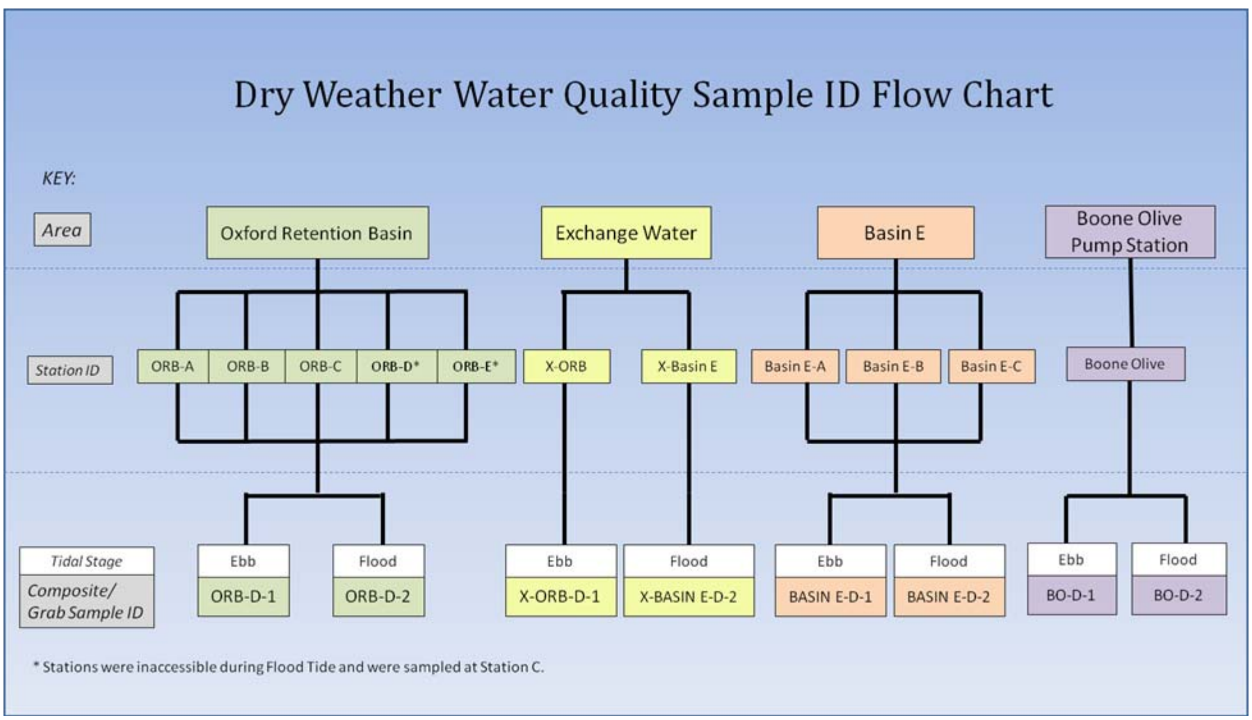

Figure 11. Dry Weather Water Quality Sample Identification Flow Chart

2.2 Navigation

Stations were located using a Garmin Wide Area Augmentation System (WAAS) enabled global positioning system (GPS) device. The system uses corrections provided by the Federal Aviation Administration (FAA) and is accurate to within 15 ft. All final station locations were recorded in the field using positions from the GPS.

2.3 Sampling Methods

2.3.1 Sediment Sampling

Sediment cores were collected at all stations using a piston core (Figure 12). The piston core was deployed from an inflatable vessel and was the preferred sampling device for areas inaccessible to larger vessels such as the Oxford Retention Basin. The piston core was equipped with a 3-inch outer diameter polycarbonate tube. Piston coring is the process of obtaining continuous well-preserved sediment core samples from water saturated, unconsolidated sediments. Penetration of the polycarbonate core tube was achieved by manually pushing the tube into the sediment via application of downward pressure on aluminum extensions attached to the piston core. To prevent compaction of the core during penetration, a plunger within the tube was set at the sediment water interface and maintained static pressure ensuring core integrity. To increase penetration, a hammering device was utilized to drive the core deeper into sediments. To eliminate the possibility of cross contamination between stations, a new polycarbonate tube was used at each station.

Figure 12. Piston Core Sampling

Following sampling, the piston core was retrieved to the deck of the boat and the liner with sediment removed from the piston device and placed in a core tray for processing. At the on-site processing station, the tube was placed vertically in a rack for 20 minutes to allow settling and then the tube was cut vertically along the length of the core to expose the sediment for processing. A certified geologist examined and classified the sediment as well as photographed the sediment core (Appendix A). The core stratigraphy, sediment grain-size distribution, color, texture, and other pertinent sediment characteristics were logged according to the Unified Soil Classification System (USCS). The station ID, actual latitude and longitude coordinates, and core lengths were also documented in the sample core logs (Appendix B).

At all stations, cores did not penetrate sediment to the anticipated target core length (based on existing bathymetry and planned design drawings). Refusal was encountered at shallower depths than expected. Refusal was defined as less than 2 inches of penetration per minute. Each time refusal was encountered, the vessel or sampling point was moved slightly and a second core attempted. If refusal was encountered again, additional cores were attempted until a sufficient amount of sample was collected. In cases where sediment cores with consolidated layers were insufficient to collect a full sample set, sample volume was reduced.

2.3.1.1 Sample Processing and Storage

Sediment cores were vertically subsampled to determine the vertical extent of sediment contamination and assess the presence of distinct layers of sedimentation. Each core was vertically segmented into two sections, representing the proposed excavation material in the upper section and the consolidated material in the lower section. No residual layers were found to be present in the sediment cores.

Once collected, subsamples from each of the ten cores were taken from the upper 6 inches of the excavation layer to be analyzed for grain size and indicator bacteria (i.e., total coliforms, fecal coliforms, enterococci, and *Escherichia coli*). The remaining sediment from the excavation layer was combined into two composite samples; Composite 1 was comprised of sediment from sites S1 through S5, and Composite 2 was comprised of sediment from sites S6 through S10. Consolidated sediment from each of the cores was analyzed separately.

All cores were processed on site, and the sediment samples homogenized to a uniform consistency using a stainless-steel mixing apparatus. Subsamples representing the distinct layers were placed in appropriate containers for all analyses. All samples were labeled (with project name, date, sampler ID, analysis, and preservative where applicable), logged into a field chain-of-custody (COC) form, and placed into a cooler. Samples were stored in the dark on ice or at 4°C until shipped or delivered to the appropriate analytical laboratory.

2.3.1.2 Decontamination of Field and Laboratory Equipment

All sampling equipment was cleaned prior to sampling. Between stations, the piston core was rinsed and a new polycarbonate tube used at each sample location. Before homogenizing each core segment, all stainless-steel utensils (i.e., stainless-steel bowls, spoons, spatulas, mixers, and other utensils) were cleaned with soapy water, rinsed with tap water, and then rinsed three times with deionized water.

2.3.2 Water Sampling – Wet Weather and Dry Weather

Water quality samples in Oxford Retention Basin and Basin E for both wet weather and dry weather sampling events were collected from an inflatable boat in Oxford Retention Basin and from a kayak in Basin E. The latitude and longitude, as well as station depth, depth of saltwater lens (if present), and physical water quality measurements, were recorded at the five locations within Oxford Retention Basin and three locations within Basin E. The physical water quality measurements that were recorded at each station were temperature, pH, specific conductivity, dissolved oxygen (DO), and turbidity.

During the wet weather and dry weather events, one water quality sample was collected from the Boone Olive Pump Station sump. The samples were collected using a telescoping sample pole with appropriate analyte sample containers. Physical water quality measurements, depth, and presence/depth of the saltwater lens were recorded as well.

At each water quality sample location, salinity measurements were collected to determine if any freshwater lenses or layers were present. If a freshwater lens was present, the depth of the lens at that location was recorded. Water quality samples for were collected from below the freshwater lens, if detected. During the course of this study, one field duplicate and one field blank sample were collected for quality assurance (QA) purposes.

Field scientists wearing clean, disposable gloves collected water grab samples in sterile, glass containers. Water to be tested for conventional analytes was collected from beneath the water surface to a depth of 6 inches (or below the freshwater lens, if determined present). The bottle was submerged open-end down approximately 6 inches below the water’s surface. The bottle was then turned face-up and allowed to fill. Care was taken to avoid contaminating the sample with debris and/or disturbed sediment.

2.3.2.1 Sample Processing and Storage

The composite water samples were collected directly into new 2-L glass jars and composited into 19-L borosilicate glass jugs. The composite sample was then partitioned from the glass jug into separate, appropriate analyte containers as needed.

The grab samples that were not conducive to composite sampling, as well as the Exchange water sites and additional analytes samples were collected in the field directly into the appropriate lab containers for each respective analyte.

After samples were partitioned to the appropriate analyte containers they were immediately placed in coolers on ice. The samples were kept in accordance with strict COC procedures until relinquished to laboratory couriers.

2.3.2.2 Decontamination of Field and Laboratory Equipment

All sampling equipment was cleaned prior to sampling. Water samples collected for composite analysis samples were collected in new lab certified precleaned 2-L jars. The composite samples were then poured into lab-cleaned 19-L borosilicate jars, and then homogenized and partitioned into appropriate containers for laboratory analysis.

Grab samples were collected in the field directly into the appropriate lab containers for analytes that were not conducive to composite sampling, such as oil and grease, and also for the Exchange water samples.

2.3.3 Shipping

Prior to delivery of samples to the various chemistry laboratories, sample containers were securely packed inside the cooler with ice. Then, COC forms were filled out, and the original signed COC forms were inserted in a sealable plastic bag and placed inside the cooler. The cooler lids were securely taped shut. Samples were delivered to the analytical laboratories listed in Table 1.

Table 1. Analytical Laboratories, Point-of-Contact Information, and Shipping Information

Laboratory	Analyses Performed	Point-of-Contact	Shipping Information
CRG Marine Laboratories, Inc.	Sediment and water chemistry	Mr. Eugene Chae (310) 533-5190 or Mr. Joseph Doak (310) 533-5190	CRG Marine Laboratories, Inc. 2020 Del Amo Blvd. Torrance, CA 90501

2.3.4 Chain-of-Custody Procedures

Samples were considered to be in custody if they were (1) in the custodian's possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a secured container. The principal documents used to identify samples and to document possession were COC records, field log books, and field tracking forms. COC procedures were used for all samples throughout the collection, transport, and analytical process, and for all data and data documentation, whether in hard copy or electronic format.

COC procedures were initiated during sample collection. A COC record was provided with each sample or sample group. Each person who had custody of the samples signed the form and ensured that the samples were not left unattended unless properly secured. Minimum documentation of sample handling and custody included the following:

- Sample ID.
- Sample collection date and time.
- Any special notations on sample characteristics.
- Initials of the person collecting the sample.
- Date the sample was sent to the laboratory.
- Shipping company and waybill information.

The completed COC form was placed in a sealable plastic envelope that traveled inside the ice chest containing the listed samples. The COC form was signed by the person transferring the custody of the samples. The condition of the samples was recorded by the receiver. COC records were included in the final analytical report prepared by the laboratory, and were considered an integral part of that report.

2.4 Sample Analyses

All chemical analyses were conducted in accordance with United States Environmental Protection Agency (USEPA) or Standard Methods (SMs) approved methods.

2.4.1 Sediment Samples

A total of ten sediment samples were submitted for laboratory analysis for the following list of analytes. Subsamples from each of the ten cores were taken from the upper six inches of the excavation layer to test for indicator bacteria (i.e., total coliforms, fecal coliforms, enterococci, and *E. coli*) and grain-size analyses. The remaining sediment from the excavation layer was combined into two composite samples. Composite 1 was comprised of sediment from stations S1 through S5, whereas Composite 2 was comprised of sediment from S6 through S10. The two composite samples were analyzed for the following parameters:

- General chemistry (i.e., TOC, pH, ammonia, nitrate, nitrite, percent solids, and total sulfides).
- SVOCs (i.e., polycyclic aromatic hydrocarbons (PAHs), base/neutral-extractables, phthalates, and acid extractables (phenols)).
- CAM 17 metals.
- AVS/SEM for TMDL-listed metals (i.e., copper, lead, and zinc).
- Organochlorine Pesticides (i.e., aroclor PCBs and PCB congeners).
- TPH (C6-C44).
- TCLP for metals, SVOCs, and organochlorine pesticides.
- Grain size.
- Organophosphorus pesticides.

Consolidated sediment from each of seven cores was analyzed separately (at three sites consolidated material was not sampled due to refusal). Sediment from the consolidated layer was analyzed for the same parameters as listed above for the composite samples with the exception of AVS/SEM for TMDL listed metals. A residual layer (i.e., in cases where the proposed grading depth was shallower than the consolidated layer) was not identified; therefore, no residual layer samples were collected. The compositing scheme and list of analyses performed on sediment samples is provided in Table 2.

To understand the potential feasibility of bioremediation techniques on existing sediment, Weston Solutions, Inc. (WESTON®), in consultation with Anderson Environmental, conducted the additional analysis of organophosphorus pesticides on the composite sediment samples.

Table 2. Analyses Performed on Oxford Retention Basin Sediment Samples

Sample Matrix	Sample Description		Number of Samples	Bacteria	Grain Size	Total Metals	Organochlorine Pesticides and PCBs	SVOCs	Organophosphorus pesticides	General Chemistry	TCLP Analyses		
											Metals	SVOCs	Organochlorine Pesticides
Sediment	Excavation layer	Subsamples from upper 6 inches	10	x	x								
		Entire excavation layer (composites)	2		x	x	x	x	x	x	x	x	x
	Consolidated layer		7		x	x	x	x	x	x	x	x	x

The sediment chemistry results were compared to the total threshold limit concentration (TTLC) and ten times the soluble threshold limit concentration (STLC) values. Briefly, TTLC and STLC values are published in Title 22 of the State of California Code of Regulations and are the benchmark for determining whether a solid, or its leachate, respectively, exhibits the characteristics of toxicity, thereby causing it to be classified as hazardous. If bulk chemistry values exceed ten times the STLC, it does not definitively classify the material as hazardous; rather, it suggests those analytes have the potential to exceed the STLC after conducting the Waste Extraction Test (WET). Sediment was also subjected to TCLP tests. Briefly, the TCLP values are published in the Code of Federal Regulations (40 CFR §261.24) and are the federal benchmark for determining whether the leachate from a solid would be classified as toxic and, therefore, hazardous.

2.4.2 Water Samples – Wet Weather

A total of 14 water samples plus one field duplicate and one blank were collected and analyzed during this project. Each water sample was analyzed for the following:

- VOCs.
- SVOCs.
- CAM 17 metals (total and dissolved).
- Chlorinated pesticides.
- TPH (C6-C44).
- PCBs.
- TOC.
- DOC.
- pH.
- Hardness.
- TDS.
- TSS.
- Indicator bacteria (i.e., total coliforms, fecal coliforms, *E. coli*, and enterococci) (not composited).
- Nutrients (i.e., ammonia, total Kjeldahl nitrogen (TKN), nitrate, nitrite, and orthophosphate).
- Sulfides.

Total and dissolved metals were also analyzed and ultra-low detection limits (0.1 ng/L) for PCB analysis were used to satisfy established TMDL requirements.

To understand the potential feasibility of bioremediation techniques on existing sediment, WESTON, in consultation with Anderson Environmental, collected an additional volume of water from Oxford Retention Basin and at the discharge point just prior to discharge to Basin E following the wet weather event. The following additional analyses on the composite water samples were performed:

- Oil and grease.
- Cyanide.
- Biochemical oxygen demand (BOD).
- Chemical oxygen demand (COD).
- Chloride.
- Organophosphorus pesticides.

The wet weather water quality results were compared to criteria presented in either the COP or the California Toxics Rule (CTR), as appropriate.

2.4.3 Water Samples – Dry Weather

A total of seven samples, plus one field duplicate and one field blank were collected and analyzed during this project. Each water sample was analyzed for the following:

- pH.
- TOC.
- DOC.
- Hardness.
- TDS.
- TSS.
- Nutrients (i.e., ammonia, TKN, nitrate, and nitrite)
- Indicator bacteria (i.e., total coliforms, fecal coliforms, *E. coli*, and enterococci) (not composited).
- CAM 17 metals (total and dissolved).
- SVOCs.
- TPH (C6-C44).
- Chlorinated pesticides.
- PCBs.
- VOCs.

Total and dissolved metals were also analyzed and ultra-low detection limits (0.1 ng/L) for PCB analysis were used to satisfy established TMDL requirements.

The dry weather water quality results were compared to criteria presented in either the COP or the CTR, as appropriate.

2.5 Quality Assurance / Quality Control Procedures

All data were reviewed and verified by participating team laboratories to determine that all data quality objectives were met and that appropriate corrective actions were taken when necessary. Analytical laboratories provided a QA / quality control (QC) narrative that described the results of the standard QA/QC protocols that accompanied analysis of field samples. All hard copies of results are maintained in the project file at WESTON in Carlsbad and included in this report. In addition, back-up copies of results generated by each laboratory are maintained at their respective facilities. At a minimum, the laboratory reports contained results of the laboratory analysis, QA/QC results, all protocols and any deviations from the project SAP, and a case narrative of COC details.

3.0 RESULTS AND DISCUSSION

3.1 Sediment Sampling Results

3.1.1 Field Results

Piston core sampling was conducted between October 19, 2009, and October 20, 2009, at ten stations located within the Oxford Retention Basin. All ten stations were successfully sampled, although consolidated material from stations S7, S9, and S10 was not recovered due to refusal. Field coordinates, number of cores per station, depth of core penetration, final core length (i.e., recovery length), and thickness of the consolidated and unconsolidated layers are summarized in Table 3.

3.1.2 Excavation Layer Results

3.1.2.1 Physical and Conventional Parameters

Results of the physical and conventional parameter analyses for sediments collected within the excavation layer of the Oxford Retention Basin are presented in Table 4 (the complete laboratory analytical data report for sediment samples is included in Appendix C). The composite sample S-1-5-EL consisted of 82.8% fine-grained material (47.5% silt and 35.3% clay); and 17.2% coarse-grained material (1.4% gravel and 15.8% sand). The composite sample S-6-10-EL consisted of 49.1% fine-grained material (30.8 silt and 18.3% clay); and 50.9% coarse-grained material (4.7% gravel and 46.2% sand). The ammonia-N concentrations reported for S-1-5-EL and S-6-10-EL were 19.61 mg/kg and 8.5 mg/kg, respectively. TKN results ranged from 732 mg/kg to 1130 mg/kg. TOC levels for both samples ranged from 4.07–5.62%, and percent solids ranged from 57.8–65.9%. Total sulfides and AVS ranged from 4.76 mg/kg to 5.02 mg/kg. TPH-CC ranged from 160 mg/kg to 200 mg/kg, and pH ranged from 8.3 to 8.4 for both excavation layer composite samples.

3.1.2.2 Chemical Analyses

Results of the bulk chemical analyses for sediments collected within the Oxford Retention Basin are presented in Table 4. In the results discussion below, ‘J flag’ values (i.e., estimated concentrations below the reporting limit) were considered not detected.

Trace Metals

Chromium and lead were the only metals to exceed the screening level assessment of ten times the STLC values (50 microgram per gram (µg/g)) in the proposed excavation layer composite samples. The chromium concentrations reported for S-1-5-EL and S-6-10-EL were 66.28 µg/g) and 52.11 µg/g, respectively. The lead concentrations reported for S-1-5-EL and S-6-10-EL were 306.3 µg/g) and 359.6 µg/g, respectively. All other metals listed in Table 4 were reported below the TTLC values, and none exceeded the federal TCLP criteria.

Table 3. Field Coordinates, Sample Depths, and Piston Core Recoveries for Samples Collected in the Oxford Retention Basin

Station ID	Attempt	Latitude (WGS 84)	Longitude (WGS 84)	Water Depth (ft)	Target Core Length (ft)	Actual Depth Sampled (ft)	Penetration (ft)	Final Core Length (ft)	Thickness of Consolidated Layer (ft)	Thickness of Un-consolidated Layer (ft)	Comments
S1	1	33.984971°	-118.456618°	3.9	8	6.4	2.5	0.3	0	0.3	Refusal encountered in consolidated layer due to sediment composition and/or compaction
	2	33.984971°	-118.456618°	3.9	8	6.4	2.5	1	0.5	0.5	
	3	33.984971°	-118.456618°	3.9	8	6.4	2.5	1.5	1	0.5	
S2	1	33.984679°	-118.456232°	3.9	8	6.4	2.5	0.3	0.15	0.15	Refusal encountered in consolidated layer due to sediment composition/compaction
	2	33.984679°	-118.456232°	3.9	8	6.9	3	0.7	0.2	0.5	
	3	33.984679°	-118.456232°	3.9	8	6.9	3	0.7	0	0.7	
	4	33.984679°	-118.456232°	3.9	8	NA	NA	NA	0	NA	
	5	33.984679°	-118.456232°	3.9	8	NA	NA	NA	0	NA	
	6	33.984679°	-118.456232°	3.9	8	6.9	3	1.5	0.3	1.2	
	7	33.984679°	-118.456232°	3.9	8	6.9	3	2.6	0.4	2.2	
S3	1	33.984904°	-118.455816°	3.9	8	6.4	2.5	0.7	0.4	0.3	Refusal encountered in consolidated layer due to sediment composition and/or compaction
	2	33.984904°	-118.455816°	3.9	8	6.9	3	1.4	0.3	1.1	
	3	33.984904°	-118.455816°	3.9	8	6.9	3	1.3	0	1.3	
	4	33.984904°	-118.455816°	3.9	8	6.9	3	1.1	0.3	0.8	
	5	33.984904°	-118.455816°	3.9	8	6.9	3	1.4	0	1.4	
S4	1	33.985186°	-118.455979°	3.9	8	6.4	2.5	1.5	0.3	1.2	Refusal encountered in consolidated layer due to sediment composition and/or compaction
	2	33.985186°	-118.455979°	3.9	8	6.4	2.5	1.4	0.8	0.6	
S5	1	33.985321°	-118.455536°	3.9	8	6.4	2.5	1.6	0.5	1.1	Refusal encountered in consolidated layer due to sediment composition and/or compaction
	2	33.985321°	-118.455536°	3.9	8	6.4	2.5	1.6	0	1.6	
	3	33.985321°	-118.455536°	3.9	8	6.9	3	2.2	0.3	1.9	
S6	1	33.985286°	-118.455077°	3.3	8	4.3	1	0.5	0	0.5	Refusal encountered in consolidated layer due to sediment composition and/or compaction
	2	33.985286°	-118.455077°	3.3	8	4.8	1.5	1	0.2	0.8	
	3	33.985286°	-118.455077°	3.3	8	6.3	3	2.1	0.4	1.7	
S7	1	33.985664°	-118.455151°	3.3	8	4.8	1.5	0.6	0	0.6	Refusal encountered in consolidated layer due to woody/vegetated debris and possible riprap
	2	33.985664°	-118.455151°	3.3	8	4.8	1.5	0.6	0	0.6	
S8	1	33.985627°	-118.454585°	2.6	8	5.6	3	1.2	0.6	0.6	Refusal encountered in consolidated layer due to sediment composition and/or compaction
S9	1	33.985624°	-118.453995°	3.3	8	6.3	3	1.3	0	1.3	Refusal encountered in consolidated layer due to woody/vegetated debris and possible riprap
	2	33.985624°	-118.453995°	3.3	8	5.8	2.5	1	0	1	
	3	33.985624°	-118.453995°	3.3	8	5.8	2.5	1.5	0	1.5	
S10	1	33.985609°	-118.453217°	3.3	8	6.3	3	2.3	0	2.3	Refusal encountered in consolidated layer due to woody/vegetated debris and possible riprap

Table 4. Summary of Oxford Retention Basin Sediment Chemistry

Parameter	Units	CRITERIA		EXCAVATION LAYER		CONSOLIDATED LAYER						
		TTLC	10x-STLC	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
Grain Size												
Gravel	%			1.4	4.7	0.4	2.0	2.5	1.5	2.2	2.6	2.0
Sand	%			15.8	46.2	23.4	47.5	35.8	29.0	37.1	47.5	39.9
Silt	%			47.5	30.8	51.0	35.0	39.8	41.4	35.7	31.4	35.3
Clay	%			35.3	18.3	25.3	15.6	21.9	28.0	25.0	18.5	22.8
General Chemistry												
Ammonia-N	mg/dry kg			19.61	8.5	3.41	22.82	8.27	6.96	11.6	9.25	8.66
Total sulfides	mg/dry kg			4.8	5	<0.2	5.3	<0.2	<0.2	<0.2	<0.2	1.7
AVS	mg/dry kg			4.76	5.02	<0.05	5.31	<0.05	<0.05	<0.05	<0.05	1.67
TKN	mg/kg			1,130	732	333	239	310	301	345	182	217
TOC	% Dry weight			4.07	5.62	0.54	0.63	0.56	1.15	0.76	0.33	0.86
TPH-CC (C6-C44)	mg/kg			160	200	150	22	12	<4.8	59	<4.8	<4.8
pH	pH units			8.3	8.4	9.3	8.9	8.8	9	8.9	9.3	9.2
Percent solids	Percent			57.8	65.9	76.2	77.1	81.9	80.9	78.9	88.5	76.8
Trace Metals												
Antimony (Sb)	μg/dry g	500	150	1.57	2.002	0.925	1.009	0.593	1.198	0.772	0.564	0.893
Arsenic (As)	μg/dry g	500	50	15.17	10.51	7.952	32.51	6.23	12.77	7.998	5.09	8.854
Barium (Ba)	μg/dry g	10,000	1,000	162	140	219.7	194	167.1	183.2	176.3	68.44	209.2
Beryllium (Be)	μg/dry g	75	7.5	0.653	0.398	0.676	0.701	0.559	0.673	0.512	0.416	0.581
Cadmium (Cd)	μg/dry g	100	10	2.842	3.093	0.533	1.217	0.303	0.775	0.673	0.658	0.5
Chromium (Cr)	μg/dry g	2,500	50	66.28	52.11	49.34	56.84	35.75	51.93	37.46	25.27	45.97
Cobalt (Co)	μg/dry g	8,000	800	12.05	8.36	10.14	13.06	8.441	12.79	9.22	9.608	8.775
Copper (Cu)	μg/dry g	2,500	250	157.7	101.9	33.91	39.8	26.09	33.74	31.35	18.06	31.58
Lead (Pb)	μg/dry g	1,000	50	306.3	359.6	5.987	36.16	10.88	13.78	28.49	7.026	30.22
Mercury (Hg)	μg/dry g	20	2	0.37	0.28	0.03	0.07	0.04	0.04	0.06	0.04	0.04
Molybdenum (Mo)	μg/dry g	3,500	3,500	6.367	6.046	1.935	2.215	1.445	2.845	1.761	1.847	3.092
Nickel (Ni)	μg/dry g	2,000	200	39.41	30.26	36.87	39.8	25.59	36.57	25.12	19.31	27.3
Selenium (Se)	μg/dry g	100	10	1.088	0.79	1.807	0.577	1.996	1.768	1.204	1.139	0.37
Silver (Ag)	μg/dry g	500	50	1.978	1.059	0.598	0.52	0.47	0.674	0.668	0.58	0.72
Thallium (Tl)	μg/dry g	700	70	0.329	0.187	0.277	0.288	0.185	0.276	0.198	0.155	0.218
Vanadium (V)	μg/dry g	2,400	240	95.5	60.9	107.2	110.7	74.05	103.7	73.8	51.06	93.29
Zinc (Zn)	μg/dry g	5,000	2,500	481.2	459.2	72.06	107.8	76.65	98	105.1	51.02	86.82
AVS/SEM												
Cadmium (Cd) – SEM	μmol/dry g			<0.0018	0.0022J	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018	<0.0018
Copper (Cu) – SEM	μmol/dry g			<0.0062	<0.0062	0.0102J	<0.0062	0.0085J	0.007J	0.0065J	0.0116J	<0.0062
Lead (Pb) – SEM	μmol/dry g			0.147	0.2691	0.0015	0.0847	0.007	0.0029	0.0121	0.0101	0.0198
Nickel (Ni) – SEM	μmol/dry g			0.0167	0.0325	0.007	0.0142	0.0098	0.013	0.0119	0.015	0.0089
Silver (Ag) – SEM	μmol/dry g			<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047	<0.0047
Zinc (Zn) – SEM	μmol/dry g			0.7977	1.5269	0.008	0.2	0.0884	0.0348	0.106	0.0797	0.0826
ΣSEM[1]	μmol/dry g			0.967	1.835	0.029	0.304	0.116	0.060	0.139	0.118	0.116
AVS	μmol/dry g			0.148	0.157	0.001	0.166	0.001	0.001	0.001	0.001	0.052
ΣSEM:AVS	ratio			6.511	11.72	36.91	1.836	148.5	76.67	177.7	152.0	2.236
Polynuclear Aromatic Hydrocarbons												

Table 4. Summary of Oxford Retention Basin Sediment Chemistry

Parameter	Units	CRITERIA		EXCAVATION LAYER		CONSOLIDATED LAYER						
		TTLC	10x-STLC	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
1-Methylnaphthalene	ng/dry g			2.4J	3.4J	<1	<1	<1	<1	<1	<1	<1
1-Methylphenanthrene	ng/dry g			4.4J	<1	<1	<1	<1	<1	<1	<1	<1
2,3,5-Trimethylnaphthalene	ng/dry g			1.8J	1.9J	<1	<1	<1	<1	<1	<1	<1
2,6-Dimethylnaphthalene	ng/dry g			32.9	21.4	<1	1.1J	<1	<1	<1	<1	<1
2-Methylnaphthalene	ng/dry g			5.9	11.3	<1	<1	<1	<1	<1	<1	<1
Acenaphthene	ng/dry g			2.6J	4J	<1	<1	<1	<1	<1	<1	<1
Acenaphthylene	ng/dry g			3.6J	4.6J	<1	<1	<1	<1	2J	<1	<1
Anthracene	ng/dry g			18.9	30.7	<1	1J	<1	<1	2.8J	<1	1J
Benz[a]anthracene	ng/dry g			105.5	198.5	<1	6.1	1.2J	<1	14	11.1	4.2J
Benzo[a]pyrene	ng/dry g			231	275	32.1	11.6	5.9	1.6J	22.3	11	5.4
Benzo[b]fluoranthene	ng/dry g			254.5	361.3	<1	8.6	<1	<1	14.7	11	4.4J
Benzo[e]pyrene	ng/dry g			215.3	285.6	8.8	9.2	3.2J	<1	13.2	8.8	5
Benzo[g,h,i]perylene	ng/dry g			265.5	353.2	7.5	11.1	3.1J	<1	16.1	10.6	5.8
Benzo[k]fluoranthene	ng/dry g			95.8	148.1	<1	3.6J	<1	<1	4.5J	6	1.9J
Biphenyl	ng/dry g			2.4J	7.5	<1	<1	<1	<1	<1	<1	<1
Chrysene	ng/dry g			154.4	267.1	11.8	8	2.9J	<1	21.1	14.8	5.9
Dibenz[a,h]anthracene	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Dibenzothiophene	ng/dry g			<1	7.6	<1	<1	<1	<1	<1	<1	<1
Fluoranthene	ng/dry g			169.6	493.3	5.2	9.8	2.8J	<1	22.8	25.5	6.7
Fluorene	ng/dry g			4.6J	7.8	<1	<1	<1	<1	<1	<1	<1
Indeno[1,2,3-c,d]pyrene	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	ng/dry g			5.7	10.3	<1	1J	<1	<1	1.8J	<1	<1
Perylene	ng/dry g			113.7	99	59.1	3.8J	4J	3.5J	19.2	3.6J	2.9J
Phenanthrene	ng/dry g			42.7	80.3	<1	3J	1.5J	<1	12.2	5	5.1
Pyrene	ng/dry g			362.9	671.3	12.6	18.6	5.6	1.1J	32.2	27.3	11.9
Total detectable PAHs	ng/dry g			2,096.1	3,343.2	137.1	96.5	30.2	6.2	198.9	134.7	60.2
Base/Neutral-Extractable Compounds												
1,2,4-Trichlorobenzene	ng/dry g			<10	<10	<10	<10	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	ng/dry g			<10	<10	<10	<10	<10	<10	<10	<10	<10
1,3-Dichlorobenzene	ng/dry g			<10	<10	<10	<10	<10	<10	<10	<10	<10
1,4-Dichlorobenzene	ng/dry g			<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
2,6-Dinitrotoluene	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
2-Chloronaphthalene	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
3,3'-dichlorobenzidine	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
4-Bromophenylphenylether	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
4-Chlorophenylphenylether	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
Azobenzene	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
Benzidine	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroethoxy)methane	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroethyl)ether	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroisopropyl)ether	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
Hexachlorobenzene	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 4. Summary of Oxford Retention Basin Sediment Chemistry

Parameter	Units	CRITERIA		EXCAVATION LAYER		CONSOLIDATED LAYER						
		TTLC	10x-STLC	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
Hexachlorobutadiene	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
Hexachlorocyclopentadiene	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
Hexachloroethane	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
Isophorone	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
N-Nitrosodi-n-propylamine (NDPA)	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
N-Nitrosodimethylamine (NDMA)	mg/kg			<0.3	<0.26	<0.33	<0.28	<0.27	<0.3	<0.31	<0.3	<0.29
N-Nitrosodiphenylamine	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
Nitrobenzene	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
Phthalates												
bis(2-Ethylhexyl) phthalate	ng/dry g			4773	6158	<100	168	<100	<100	158	149	<100
Butylbenzyl phthalate	ng/dry g			344	460	<25	<25	<25	<25	<25	<25	<25
Di-n-butyl phthalate	ng/dry g			<75	<75	<75	<75	<75	<75	<75	<75	<75
Di-n-octyl phthalate	ng/dry g			<10	60	<10	<10	<10	<10	<10	<10	<10
Diethyl phthalate	ng/dry g			<100	<100	<100	<100	<100	<100	<100	<100	<100
Dimethyl phthalate	ng/dry g			222	271	<50	<50	<50	<50	<50	<50	<50
Acid-Extractable Compounds												
2,4,6-Trichlorophenol	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
2,4-Dichlorophenol	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
2,4-Dimethylphenol	ng/dry g			<100	<100	<100	<100	<100	<100	<100	<100	<100
2,4-Dinitrophenol	ng/dry g			<100	<100	<100	<100	<100	<100	<100	<100	<100
2-Chlorophenol	ng/dry g			<50	<50	<50	<50	<50	<50	<50	<50	<50
2-Methyl-4,6-dinitrophenol	ng/dry g			<100	<100	<100	<100	<100	<100	<100	<100	<100
2-Nitrophenol	ng/dry g			<100	<100	<100	<100	<100	<100	<100	<100	<100
4-Chloro-3-methylphenol	ng/dry g			<100	<100	<100	<100	<100	<100	<100	<100	<100
4-Nitrophenol	ng/dry g			<100	<100	<100	<100	<100	<100	<100	<100	<100
Pentachlorophenol	ng/dry g	17,000	17,000	<50	<50	<50	<50	<50	<50	<50	<50	<50
Phenol	ng/dry g			<100	<100	<100	<100	<100	<100	<100	<100	<100
Organochlorine Pesticides												
2,4'-DDD	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4'-DDE	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4'-DDT	ng/dry g			9.9	<1	<1	<1	<1	<1	<1	<1	<1
4,4'-DDD	ng/dry g	1,000	1,000	<1	44.8	<1	<1	<1	<1	<1	<1	1J
4,4'-DDE	ng/dry g	1,000	1,000	<1	3.8	<1	2.3	<1	<1	<1	<1	<1
4,4'-DDT	ng/dry g	1,000	1,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total detectable DDTs	ng/dry g			9.9	48.6	<1	2.3	<1	<1	<1	<1	1
Aldrin	ng/dry g	1,400	1,400	<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-alpha	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-beta	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-delta	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-gamma	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlordane-alpha	ng/dry g			17.9	34.3	<1	<1	<1	<1	<1	<1	<1
Chlordane-gamma	ng/dry g			28.5	50	<1	1.6J	<1	<1	1.1J	<1	1J
Total detectable chlordane (a,g)	ng/dry g			46.4	84.3	<1	1.6	<1	<1	1.1	<1	1

Table 4. Summary of Oxford Retention Basin Sediment Chemistry

Parameter	Units	CRITERIA		EXCAVATION LAYER		CONSOLIDATED LAYER						
		TTLC	10x-STLC	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
DCPA (dacthal)	ng/dry g			<5	<5	<5	<5	<5	<5	<5	<5	<5
Dicofol	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Dieldrin	ng/dry g	8,000	8,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan sulfate	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan-I	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan-II	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Endrin	ng/dry g	200	200	<1	<1	<1	<1	<1	<1	<1	<1	<1
Endrin aldehyde	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Endrin ketone	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Heptachlor	ng/dry g	4,700	4,700	<1	<1	<1	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Methoxychlor	ng/dry g	100,000	100,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mirex	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-Nonachlor	ng/dry g			<1	15	<1	<1	<1	<1	<1	<1	<1
trans-Nonachlor	ng/dry g			15.5	24.8	<1	<1	<1	<1	<1	<1	<1
Oxychlordane	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
Perthane	ng/dry g			<5	<5	<5	<5	<5	<5	<5	<5	<5
Toxaphene	ng/dry g	5,000	5,000	61.29	168.71	<10	<10	<10	<10	<10	<10	<10
Aroclor PCBs												
Aroclor 1016	ng/dry g	50,000	50,000	<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1221	ng/dry g	50,000	50,000	<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1232	ng/dry g	50,000	50,000	<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1242	ng/dry g	50,000	50,000	137	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1248	ng/dry g	50,000	50,000	<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1254	ng/dry g	50,000	50,000	110	199	<10	20	<10	<10	<10	<10	16J
Aroclor 1260	ng/dry g	50,000	50,000	<10	148	<10	38	<10	<10	<10	<10	<10
Total Aroclor	ng/dry g			247	347	<10	58	<10	<10	<10	<10	16
PCB Congeners												
PCB003	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB008	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB018	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB028	ng/dry g			11	<1	<1	<1	<1	<1	<1	<1	<1
PCB031	ng/dry g			4.8	<1	<1	<1	<1	<1	<1	<1	<1
PCB033	ng/dry g			10.4	<1	<1	<1	<1	<1	<1	<1	<1
PCB037	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB044	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	1J
PCB049	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	1.1J
PCB052	ng/dry g			<1	11.4	<1	<1	<1	<1	<1	<1	<1
PCB056/060	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB066	ng/dry g			7.1	4.2	<1	<1	<1	<1	<1	<1	<1
PCB070	ng/dry g			5.8	32	<1	<1	<1	<1	<1	<1	1J
PCB074	ng/dry g			<1	11.4	<1	<1	<1	<1	<1	<1	<1
PCB077	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 4. Summary of Oxford Retention Basin Sediment Chemistry

Parameter	Units	CRITERIA		EXCAVATION LAYER		CONSOLIDATED LAYER						
		TTLC	10x-STLC	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
PCB081	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB087	ng/dry g			6.2	4.2	<1	<1	<1	<1	<1	<1	<1
PCB095	ng/dry g			6.9	15.8	<1	1.3J	<1	<1	1.1J	<1	<1
PCB097	ng/dry g			<1	7.4	<1	<1	<1	<1	<1	<1	<1
PCB099	ng/dry g			6.2	8.4	<1	1.1J	<1	<1	<1	<1	<1
PCB101	ng/dry g			18	30.3	<1	2.7	<1	<1	<1	<1	1.5J
PCB105	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB110	ng/dry g			13.5	24.3	<1	2.4	<1	<1	<1	<1	2
PCB114	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB118	ng/dry g			<1	22.1	<1	<1	<1	<1	<1	<1	<1
PCB119	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB123	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB126	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB128	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB138	ng/dry g			<1	13	<1	3	<1	<1	<1	<1	1J
PCB141	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB149	ng/dry g			14.3	16.8	<1	1.6J	<1	<1	<1	<1	<1
PCB151	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB153	ng/dry g			<1	12.2	<1	1.4J	<1	<1	<1	<1	1.3J
PCB156	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB157	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB158	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB167	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB168+132	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB169	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB170	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB174	ng/dry g			<1	4.4	<1	<1	<1	<1	<1	<1	<1
PCB177	ng/dry g			<1	1.1J	<1	<1	<1	<1	<1	<1	<1
PCB180	ng/dry g			8.3	9	<1	3	<1	<1	<1	<1	<1
PCB183	ng/dry g			<1	2.2	<1	<1	<1	<1	<1	<1	<1
PCB187	ng/dry g			4.9	8.3	<1	3	<1	<1	<1	<1	<1
PCB189	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB194	ng/dry g			<1	18.5	<1	4.7	<1	<1	<1	<1	<1
PCB195	ng/dry g			<1	<1	<1	<1	<1	<1	<1	<1	<1
PCB200	ng/dry g			1.3J	<1	<1	1J	<1	<1	<1	<1	<1
PCB201	ng/dry g			<1	6.6	<1	8.2	<1	<1	<1	<1	<1
PCB203	ng/dry g			<1	2.3	<1	6.9	<1	<1	<1	<1	<1
PCB206	ng/dry g			<1	3.9	<1	9.5	<1	<1	1J	<1	<1
PCB209	ng/dry g			<1	<1	<1	2.9	<1	<1	1.7J	<1	<1
Total PCBs	ng/dry g			118.7	269.8	<1	52.7	<1	<1	3.8	<1	8.9
Organophophorus Pesticides												
Azinphos methyl	ng/dry g			<50	<50							
Bolstar (sulprofos)	ng/dry g			<10	<10							

Table 4. Summary of Oxford Retention Basin Sediment Chemistry

Parameter	Units	CRITERIA		EXCAVATION LAYER		CONSOLIDATED LAYER						
		TTLC	10x-STLC	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
Chlorpyrifos	ng/dry g			<5	<5							
Demeton	ng/dry g			<10	<10							
Diazinon	ng/dry g			<5	<5							
Dichlorvos	ng/dry g			<10	<10							
Dimethoate	ng/dry g			<5	<5							
Disulfoton	ng/dry g			<10	<10							
Ethoprop (ethoprofos)	ng/dry g			<10	<10							
Ethyl parathion	ng/dry g			<10	<10							
Fenchlorphos (ronnel)	ng/dry g			<10	<10							
Fenitrothion	ng/dry g			<10	<10							
Fensulfothion	ng/dry g			<10	<10							
Fenthion	ng/dry g			<10	<10							
Malathion	ng/dry g			<5	<5							
Merphos	ng/dry g			<10	<10							
Methamidophos (monitor)	ng/dry g			<50	<50							
Methidathion	ng/dry g			<10	<10							
Methyl parathion	ng/dry g			<10	<10							
Mevinphos (phosdrin)	ng/dry g			<10	<10							
Phorate	ng/dry g			<10	<10							
Phosmet	ng/dry g			<50	<50							
Tetrachlorvinphos (stirofos)	ng/dry g			<10	<10							
Tokuthion	ng/dry g			<10	<10							
Trichloronate	ng/dry g			<10	<10							

<	Less than the method detection limit (MDL).
J	Estimated value less than the reporting limit but greater than the MDL.
1	ΣSEM = sum (Cd + Cu + Pb + Ni + (Ag/2) + Zn); if ND, then 1/2 MDL used.
(yellow shading)	ΣSEM:AVS = >1, indicating potential for metal toxicity due to excess ΣSEM.
BHC	Hexachlorobenzene.
Σ	Sum.
DDD	Dichlorodiphenyldichloroethane.
DDE	Dichlorodiphenyldichloroethylene.
DDT	Dichlorodiphenyltrichloroethane.

The aforementioned data for chromium and lead suggested the potential for leachate from the excavation layer composite samples to exhibit the characteristics of toxicity. Further analyses of these samples (Table 5) using the WET showed that chromium and lead results (4.4 mg/L and 2.4 mg/L, respectively) for sample S-1-5-EL did not exceed STLC criteria (5 mg/L for both metals) and was therefore classified as non-hazardous material. On the other hand, the WET confirmed that chromium and lead results (5.5 mg/L and 5.3 mg/L, respectively) for sample S-6-10-EL, collected from the excavation layer, exceeded STLC criteria for both metals and was therefore classified as hazardous material as defined by the State of California.

Table 5. Oxford Retention Basin Sediment Chemistry – Soluble Threshold Limit Concentration Results

Parameter	Units	Criteria	Excavation Layer	
		STLC	S-1-5-EL	S-6-10-EL
Trace Metals				
Chromium (Cr)	mg/L	**5**	4.4	5.5
Lead (Pb)	mg/L	**5**	2.4	5.3

Simultaneously Extracted Metals / Acid-Volatile Sulfides

The SEM/AVS method was used to determine the potential toxicity of metals in a sediment sample. This method is based on the theory that AVS, comprised primarily of iron monosulfides in sediments, bind to divalent cationic metals and form metal-sulfide complexes. Because these metal-sulfide complexes have low solubility, metal bioavailability and toxicity to benthic organisms is therefore affected by the amount of AVS in sediment. Thus, to determine the potential toxicity of metals in a sediment sample, the ratio of SEM to the concentration of AVS in a sample is evaluated. If SEM is higher than AVS, or SEM:AVS more than 1, then some portion of the metals are not bound up by AVS and therefore are bioavailable and potentially toxic. If SEM is less than AVS, or SEM:AVS is less than 1, then the metals are bound to AVS in the sediment sample are likely not toxic to benthic organisms.

It should be emphasized that this approach works specifically with divalent metals, including cadmium, copper, lead, nickel, and zinc (McGrath et al., 2002). Further research has suggested that silver may also bind with AVS; however, unlike the one to one relationship of the each of the other metals to AVS, one mole of SEM silver reacts with two moles of AVS (Berry et al., 1999; USEPA, 2000).

In addition, results should be interpreted in light of other environmental factors (e.g., DO and salinity), which, at their extremes, may interfere with the determination of this ratio (Long et al., 1988). However, a number of studies have demonstrated the usefulness of this method to predict the toxicity of metals in sediments (Di Toro et al., 1991; Ankley et al., 1991, Casas and Crecelius, 1994).

Table 4 presents the SEM results for the six divalent metals that are likely to bind AVS and the concentration of AVS for each sample. The table also presents the sum (Σ) of the SEM metals and the ratio of the ΣSEM to AVS. Stations with a ΣSEM:AVS ratio greater than one have been highlighted. All of the station samples that were analyzed using the SEM:AVS method had ΣSEM:AVS ratios greater than one. Ratios ranged from 6.511 in the S-1-5-EL sample to 11.72 in the S-6-10-EL sample. This indicates that the concentration of SEM was higher than the concentration of AVS in the sediment sample, suggesting that not all of the metals in the sediment samples were bound up by AVS and therefore may be bioavailable and potentially toxic to benthic organisms. Although the ratios for each station were greater than one, suggesting the potential for metal toxicity from excess ΣSEM to AVS, the calculated ratios for the samples were within a range of 2 to 40, making the prediction of effects uncertain (McGrath et al., 2002). Therefore, these results should be interpreted in the context of toxicity test results and other chemical/physical measurements.

Organic Sediment Constituents

The results of the organic constituents analyses are summarized in Table 4. Several PAH compounds were detected in the sample composites representing the excavation layer. Total detectable PAHs were calculated (low + high molecular weight) at concentrations of 2,096.1 µg/kg and 3,343.2 µg/kg for S-1-5-EL and S-6-10-EL, respectively.

Base/neutral-extractable compounds, acid-extractable compounds, and organophosphorus pesticides were not detected in both excavation layer composite samples. Three phthalates compounds were detected in S-1-5-EL, ranging from 222 ng/g to 4,773 ng/g. Four phthalate compounds were detected in S-6-10-EL, ranging from 60–6,158 ng/g.

Although seven organochlorine pesticide analytes were detected in low concentrations in sample S-1-5-EL and nine organochlorine pesticide analytes were detected in low concentrations in sample S-6-10-EL, none exceeded their respective TTLC or ten times STLC values. The value reported for 4,4'-DDD, in sample S-6-10-EL was 3.8 ng/g, significantly below the ten times STLC value of 1,000 ng/g. The values reported for toxaphene ranged from 61.29 ng/g to 168.71 ng/g for both excavation layer samples, significantly below the ten times STLC value of 50,000 ng/g. Total detectable chlordane ranged from 46.4 ng/g to 84.3 ng/g.

Fourteen individual PCB congeners were detected in sample S-1-5-EL and 21 individual PCB congeners were detected in sample S-6-10-EL. Aroclor 1242 and Aroclor 1254 were the only PCB Aroclors detected in sample S-1-5-EL with a concentration of 137 µg/kg and 110.0 µg/kg, respectively. Aroclor 1254 and Aroclor 1260 were the only PCB Aroclors detected in sample S-1-5-EL with a concentration of 199 µg/kg and 148 µg/kg, respectively. Total detectable PCBs were calculated at a concentration of 247 µg/kg for S-1-5-EL and at a concentration of 347 µg/kg for S-6-10-EL. All reported PCB results for the excavation layer samples were significantly below the ten times STLC criteria value of 50,000 ng/g.

3.1.2.3 Sediment Chemistry using Toxicity Characteristic Leaching Procedure

Results of the TCLP analyses are presented in Table 6. Briefly, the TCLP values are published in the Code of Federal Regulations (40 CFR §261.24) and are the federal benchmark for determining whether the leachate from a solid would be classified as toxic and, therefore, hazardous. Results of TCLP analyses of project sediments from the excavation layer indicated no metals were reported above the TCLP criteria.

All base/neutral-extractable compounds, acid-extractable compounds, and organochlorine pesticides were reported less than the reporting limit, with the exception of N-Nitrosodimethylamine (NDMA). NDMA values ranged from 7,600 ng/L to 24,000 ng/L. As shown in Table 6, all analytes were reported below the TCLP values.

Table 6. Summary of Oxford Retention Basin Sediment Chemistry using TCLP

Parameter	Units	Criteria	Excavation Layer		Consolidated Layer						
		TCLP	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
Trace Metals											
Antimony (Sb)	µg/L		1.3	4.5	1.7	1.1	1	2	1.5	0.9	1
Arsenic (As)	µg/L	5,000	178	94.5	11.7	24.7	10.3	9.5	18.8	8.5	35.2
Barium (Ba)	µg/L	100,000	406.2	393.5	546.4	620.4	586.8	461.2	512.5	628.1	456.2
Beryllium (Be)	µg/L		3.7	2.9	6.8	5.6	5.2	5.3	4.6	3	3.4
Cadmium (Cd)	µg/L	1,000	24.7	17.7	3.8	6.8	7.3	7.5	6	6.7	4.1
Chromium (Cr)	µg/L	5,000	11.6	9	6.6	4.5	1.6	2.2	2.6	1.5	2.6
Cobalt (Co)	µg/L		26.5	37.3	56.8	66.6	67.8	73.2	75.5	78.9	48.6
Copper (Cu)	µg/L		13.2	7.6	8.5	1.7	35	14.9	7	31.9	5.9
Lead (Pb)	µg/L	5,000	942.71	744.51	8.97	36.17	16.53	14.91	12.23	3.93	21.43
Mercury (Hg)	µg/L	200	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum (Mo)	µg/L		0.7	0.8	0.4J	0.3J	<0.2	0.2J	0.2J	<0.2	0.3J
Nickel (Ni)	µg/L		63.3	98.1	107.7	109.8	111.6	110.7	104.6	114.5	77
Selenium (Se)	µg/L	1,000	<0.2	<0.2	0.8	0.4J	3.4	6.5	5.4	19.6	0.3J
Silver (Ag)	µg/L	5,000	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium (Tl)	µg/L		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium (V)	µg/L		128.2	77.4	227.6	190	83.3	106.3	128.6	142.5	111.1
Zinc (Zn)	µg/L		6,187.9	5,215.9	432.3	766.7	879.8	642.6	620.6	301.3	384.2
Base/Neutral-Extractable Compounds											
1,2,4-Trichlorobenzene	ng/L		<10	<10	<10	<10	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	ng/L		<10	<10	<10	<10	<10	<10	<10	<10	<10
1,3-Dichlorobenzene	ng/L		<10	<10	<10	<10	<10	<10	<10	<10	<10
1,4-Dichlorobenzene	ng/L		<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
2,6-Dinitrotoluene	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
2-Chloronaphthalene	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
3,3'-dichlorobenzidine	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
4-Bromophenylphenylether	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
4-Chlorophenylphenylether	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
Azobenzene	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
Benzidine	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
Hexachlorobenzene	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
Hexachlorocyclopentadiene	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
Hexachloroethane	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
Isophorone	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
NDPA	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
NDMA	ng/L		7,600	24,000	4,500	6,800	5,400	7,200	7,300	6,500	8,200
N-Nitrosodiphenylamine	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
Nitrobenzene	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroethoxy)methane	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroethyl)ether	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroisopropyl)ether	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50

Table 6. Summary of Oxford Retention Basin Sediment Chemistry using TCLP

Parameter	Units	Criteria	Excavation Layer		Consolidated Layer						
		TCLP	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
Acid-Extractable Compounds											
2,4,6-Trichlorophenol	ng/L	2,000,000	<50	<50	<50	<50	<50	<50	<50	<50	<50
2,4-Dichlorophenol	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
2,4-Dimethylphenol	ng/L		<100	<100	<100	<100	<100	<100	<100	<100	<100
2,4-Dinitrophenol	ng/L		<100	<100	<100	<100	<100	<100	<100	<100	<100
2-Chlorophenol	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
2-Methyl-4,6-dinitrophenol	ng/L		<100	<100	<100	<100	<100	<100	<100	<100	<100
2-Nitrophenol	ng/L		<100	<100	<100	<100	<100	<100	<100	<100	<100
4-Chloro-3-methylphenol	ng/L		<100	<100	<100	<100	<100	<100	<100	<100	<100
4-Nitrophenol	ng/L		<100	<100	<100	<100	<100	<100	<100	<100	<100
Pentachlorophenol	ng/L	100,000,000	<50	<50	<50	<50	<50	<50	<50	<50	<50
Phenol	ng/L		<100	<100	<100	<100	<100	<100	<100	<100	<100
Organochlorine Pesticides											
2,4'-DDD	ng/L	10,000,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4'-DDE	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4'-DDT	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
4,4'-DDD	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
4,4'-DDE	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
4,4'-DDT	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Total detectable DDTs	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Aldrin	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-alpha	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-beta	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-delta	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-gamma	ng/L	400,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlordane-alpha	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlordane-gamma	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Total detectable chlordane (a,g)	ng/L	30,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
DCPA (dacthal)	ng/L		<5	<5	<5	<5	<5	<5	<5	<5	<5
Dicofol	ng/L		<50	<50	<50	<50	<50	<50	<50	<50	<50
Dieldrin	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan sulfate	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan-I	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan-II	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Endrin	ng/L	20,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
Endrin aldehyde	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Endrin ketone	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Heptachlor	ng/L	8,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	ng/L	8,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methoxychlor	ng/L	10,000,000	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mirex	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-Nonachlor	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-Nonachlor	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 6. Summary of Oxford Retention Basin Sediment Chemistry using TCLP

Parameter	Units	Criteria	Excavation Layer		Consolidated Layer						
		TCLP	S-1-5-EL	S-6-10-EL	S-1-NL	S-2-NL	S-3-NL	S-4-NL	S-5-NL	S-6-NL	S-8-NL
Oxychlordane	ng/L		<1	<1	<1	<1	<1	<1	<1	<1	<1
Perthane	ng/L		<5	<5	<5	<5	<5	<5	<5	<5	<5
Toxaphene	ng/L	500,000	<10	<10	<10	<10	<10	<10	<10	<10	<10

< Less than the MDL.
J Estimated value less than the reporting limit but greater than the MDL.

3.1.2.4 Microbiological Characteristics of Sediment

Results of the sediment bacterial analyses are provided in Table 7. Currently, no sediment quality criteria have been established for indicator bacteria, therefore, these results should be interpreted based on an understanding of the behavior and natural occurrence of these parameters in the environment. Preliminary review of these data suggest the total coliform concentrations were likely indicative of nutrient rich sediment and may be influenced by recent activities in the Oxford Retention Basin to control algae. The fecal coliform, *E. coli*, and enterococcus concentrations are considered indicative of natural sediment background levels. None of the indicator bacteria concentrations suggested anthropogenic sources that required abatement.

Table 7. Indicator Bacterial Concentrations in Oxford Retention Basin Sediment

Parameter	Units	EXCAVATION LAYER									
		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
Total coliforms	MPN/dry gram	218	451	435	278	591	2,174	21,782	14,953	1,110	5,693
Fecal coliforms	MPN/dry gram	10	34	33	18	81	625	554	935	236	436
E. coli	MPN/dry gram	11*	58*	66*	530*	640*	106	146	5851*	140	407
Enterococci	MPN/dry gram	3	58	59	10	81	<5	8	32	32	133

*Although *E. coli* is a subgroup of fecal coliforms, some values may be higher due to differences in methodology, the sample's matrix (sediment), or statistical range.

MPN = most probable number.

3.1.3 Consolidated Layer Results

3.1.3.1 Physical and Conventional Parameters

Results of the physical and conventional parameter analyses for sediments collected within consolidated layer of the Oxford Retention Basin are presented in Table 4. The individuals sediment samples (S-1-NL through S-6-NL, and S-8-NL) ranged from 23.8–50.1% in coarse-grained material (gravel and sand); and 49.9–76.3% in fine-grained material (silt and clay). The ammonia-N concentrations reported for the consolidated layer samples ranged from 3.41 mg/kg to 22.82 mg/kg. TKN results ranged from 182 mg/kg to 345 mg/kg. TOC levels ranged from 0.33–1.15%, and the percent solids ranged from 76.2–88.5%. Total sulfides and AVS ranged from non-detected (value reported under the method detection limit (MDL)) to 5.31 mg/kg. TPH-CC ranged from non-detected to 150 mg/kg, and pH ranged from 8.8 to 9.3 for all individual consolidated layer sediment samples.

3.1.3.2 Chemical Analyses

Results of the bulk chemical analyses for sediments collected within the Oxford Retention Basin are presented in Table 4. Similar to the excavation layer sediment results, these results were compared to the TTLC and ten times the STLC values. The consolidated layer sediment was also subjected to TCLP tests. Results of the TCLP analyses are presented in Table 6.

Trace Metals

Chromium was the only metal to minimally exceed the screening level assessment of ten times STLC value (50 µg/g) in the consolidated layer individual sediment samples. The chromium concentrations reported for S-2-NL and S-4-NL were 56.84 µg/g and 51.93 µg/g, respectively. All metals, including chromium, were reported significantly below their respective TTLC values.

Simultaneously Extracted Metals / Acid-Volatile Sulfides

Table 4 presents the SEM results for the six divalent metals that are likely to bind AVS and the concentration of AVS for each sample. The table also presents the sum (Σ) of the SEM metals and the ratio of the ΣSEM to AVS. Stations with a ΣSEM:AVS ratio greater than one have been highlighted. All of the station samples that were analyzed using the SEM:AVS method had ΣSEM:AVS ratios greater than one. Ratios ranged from 1.836 in the S-2-NL sample to 177.7 in the S-5-NL sample. This indicates that the concentration of SEM was higher than the concentration of AVS in the sediment sample, suggesting that not all of the metals in the sediment samples were bound up by AVS and therefore may be bioavailable and potentially toxic to benthic organisms. It should be noted that although the ratios for each station were greater than one, suggesting the potential for metal toxicity from excess ΣSEM to AVS, the calculated ratios for the samples, S-1-NL, S-2-NL, and S-8-NL were within a range of 2 to 40, making the prediction of effects uncertain (McGrath et al., 2002). Therefore, these results should be interpreted in the context of toxicity test results and other chemical/physical measurements.

Organic Sediment Constituents

The results of the organic constituents analyses are summarized in Table 4. Several PAH compounds were detected in the sample composites representing the excavation layer. Total detectable PAHs were calculated (low + high molecular weight) at concentrations ranging from 6.2 µg/kg and 198.9 µg/kg for consolidated layer samples.

Base/neutral-extractable compounds and acid-extractable compounds were not detected in the individual consolidated layer sediment samples. One phthalate compound (bis[2-Ethylhexyl] phthalate) was detected in S-2-NL, S-5-NL and S-6-NL, ranging from 149 ng/g to 168 ng/g.

Three organochlorine pesticide analytes were detected in low concentrations in sample S-2-NL, one organochlorine pesticide analyte was detected in sample S-5-NL, and two organochlorine pesticide analytes were detected in low concentrations in sample S-8-NL. The value reported for 4,4'-DDE, in sample S-2-NL was 2.3/g, significantly below the ten times STLC value of 1,000 ng/g. Total detectable chlordane ranged from non-detected to 1.6 ng/g. Organophosphorus pesticides were not tested for in the individual consolidated layer sediment samples.

Eleven individual PCB congeners were detected in sample S-2-NL, one individual PCB congener was detected in sample S-5-NL and two individual PCB congeners were detected in sample S-8-NL. Aroclor 1254 and Aroclor 1260 were the only PCB Aroclors detected in sample S-1-5-EL with a concentration of 137 µg/kg and 110.0 µg/kg, respectively. Aroclor 1254 and Aroclor 1260 were the only PCB Aroclors detected in sample S-2-NL with a concentration of 20 µg/kg and 30 µg/kg, respectively. Total detectable PCBs were calculated at a concentration of 58 µg/kg for S-2-NL and at a concentration of 16 µg/kg for S-8-NL. All reported PCB results for the excavation layer samples were significantly below the ten times STLC criteria value of 50,000 ng/g.

3.1.3.3 Sediment Chemistry using Toxicity Characteristic Leaching Procedure

Results of the TCLP analyses are presented in Table 6. All base/neutral-extractable compounds, acid-extractable compounds, and organochlorine pesticides were reported less than the reporting limit, with the exception of NDMA. NDMA values ranged from 4,500 ng/L to 8,200 ng/L. As shown in Table 6, all analytes, including trace metals were reported significantly below the TCLP values.

3.2 Water Sampling Results – Wet Weather

3.2.1 Sample Collection

The wet weather water quality field sampling program was completed on January 12–13, 2010, in accordance with the approved SAP. Four sampling efforts were conducted during the sampling event. Table 8 presents the station locations where samples were collected during each sampling round.

The first sampling effort was conducted prior to the onset of rain (termed ‘pre-storm’) during the low tide. This pre-storm sampling effort was conducted to assess water quality during dry weather conditions. Samples were collected from the Oxford Retention Basin (sample ORB-1), from the Exchange Area between Oxford Retention Basin and Basin E, from the Oxford Retention Basin side of the Exchange, (X-ORB-1), and from Basin E (E-1).

The second sampling effort (termed ‘prior to stormwater release’) was conducted after the storm had passed, and Oxford Retention Basin had filled with stormwater runoff (with the tide gates closed). This sampling effort was collected to assess stormwater quality entering Oxford Retention Basin via the associated storm drain system. During this sampling effort, samples were also collected from within Basin E, and represent water quality within Basin E prior to the release of stormwater runoff from Oxford Retention Basin into Basin E. Samples were also collected during this sampling effort for the additional list of analytes listed at the end of Subsection 2.4.2. These additional analyte samples were collected from Oxford Retention Basin as well as the Exchange water between the two basins.

The third sampling effort (termed ‘during stormwater release’) was conducted after the tide gate between Oxford Retention Basin and Basin E was opened. During this sampling effort, samples were collected from the Exchange water (i.e., discharge from Oxford Retention Basin to Basin E), Basin E, and Boone Olive Pump Station.

The fourth sampling effort was collected after Oxford Retention Basin had completely discharged (termed ‘Oxford Retention Basin drained’). Samples were collected from Basin E only during this sampling effort.

Table 8. Station Identification and Latitude and Longitude Coordinates for Water Samples Collected within the Oxford Retention Basin, Basin E, and Boone Olive Pump Station

Area/Basin	Station ID	Latitude	Longitude
Oxford Retention Basin	**ORB-A**	33.98482°	-118.45650°
	ORB-B	33.98530°	-118.45570°
	ORB-C	33.98524°	-118.45525°
	ORB-D	33.98548°	-118.45505°
	ORB-E	33.98536°	-118.45479°
Exchange Area	**X-ORB**	33.98437°	-118.45632°
	X-Basin E	33.98355°	-118.45609°
Basin E	**Basin E-A**	33.98290°	-118.45499°
	Basin E-B	33.98328°	-118.45547°
	Basin E-C	33.98292°	-118.45600°
Boone Olive Pump Station	**Boone Olive**	33.98461°	-118.45928°

3.2.2 Pre-Storm Results

3.2.2.1 Field Data Results

Physical parameter measurements were taken in the field during the wet weather event of January 12–13, 2010. The following results were taken on January 12, 2010, to represent the pre-storm conditions. The parameters measured were conductivity, pH, turbidity, DO, temperature, color, odor, clarity, and water depth. Measurements were recorded at each designated sample station in conjunction with sample collection. The data collected in the field are summarized in Table 9.

Oxford Retention Basin
Water depth varied between the stations from 0.4 ft at ORB-E to 1.0 ft at ORB-A. Conductivity, a measure of the dissolved solutes in the water, ranged from 20.76 mS (ORB-E) to 28.91 mS (ORB-A). Turbidity ranged from 5.0 nephelometric turbidity units (NTU) (ORB-A) to 31.7 NTU (ORB-E). DO was relatively consistent among the five stations, ranging from 6.6 mg/L to 12.4 mg/L. pH ranged from 8.23 to 8.50. Temperature was consistent among the five stations monitored, ranging from 15.38ºC to 16.59ºC.

Exchange Water
Field observations and measurements were only taken at one station, X-ORB to represent the Exchange Area water. Water depth was measured at 4.16-ft deep, and temperature was reported at 14.64ºC. Conductivity was 54.16 mS and turbidity was measured at 1.0 NTU. DO was measured at 14.60 mg/L, and ph was measured at 7.94 at station X-ORB.

Basin E
Water depth varied between the stations from 12.5 ft at Basin E-B to 18.6 ft at Basin E-C. Conductivity was consistent between the three stations ranging from 50.15 mS to 50.82 mS. Turbidity was also consistent among the stations ranging from -0.3 NTU to -0.5 NTU. DO ranged from 7.96 mg/L to 8.03 mg/L. pH ranged from 8.02 to 8.04. Temperature was consistent among the three stations monitored, ranging from 14.79ºC to 14.82ºC.

3.2.2.2 Analytical Chemistry Results

Results of the wet weather (i.e., pre-storm) water quality sampling are presented in Table 10 (the complete laboratory analytical data report for wet weather water quality samples is included in Appendix D). The results from composite sample ORB-1 represent the Oxford Retention Basin, the results from the composite sample X-ORB-1 represent the Exchange Area, and the results from the composite sample E-1 represents Basin E. These results were compared to the either the COP and/or the CTR as appropriate. In the results discussion below, 'J flag' values (i.e., estimated concentrations below the reporting limit) were considered not detected.

General Chemistry
Several nutrients were monitored as part of the ambient monitoring analyte list, including nitrate, nitrite, TKN, ammonia, and total orthophosphate (Table 10). Of these, a water quality benchmark is available for ammonia. Concentrations of ammonia in all three samples, ORB-1, X-ORB-1, and E-1were significantly less than the COP water quality criteria of 6.0 mg/L. The greatest concentration was observed at ORB-1 (0.34 mg/L). TKN was only detected in the sample, ORB-1, at 2.62 mg/L. Orthophosphate results ranged from 0.02 mg/L (ORB-1) to 0.04 mg/L (X-ORB-1). DOC and TOC were only detected in the ORB-1 sample, reported at 3.0 mg/L and 4.9 mg/L, respectively. TDS ranged from 15,840 mg/L (ORB-1) to 33,380 mg/L (X-ORB-1). TSS were only detected in sample ORB-1, reported at 29.3 mg/L.

Table 9. Field Observations of Water Quality during Wet Weather Monitoring Event at Oxford Retention Basin

Parameter	Unit	Pre Storm										
		Oxford Basin					Exchange Water		Basin E			Boone Olive Pump Station
		ORB-A	ORB-B	ORB-C	ORB-D	ORB-E	X-ORB	X-Basin E	Basin E-A	Basin E-B	Basin E-C	Boone Olive
Date		1.12.10	1.12.10	1.12.10	1.12.10	1.12.10	1.12.10		1.12.10	1.12.10	1.12.10	
Time		2040	2040	2040	2040	2040	2210		2310	2310	2310	
pH		8.31	8.37	8.50	8.38	8.23	7.94		8.03	8.04	8.02	
Conductivity	mS	28.91	27.29	27.34	25.39	20.76	54.16		50.69	50.15	50.82	
Turbidity	NTU	5.0	9.5	5.7	18.3	31.7	1		-0.4	-0.3	-0.5	
Dissolved Oxygen	mg/L	12.4	9.44	11.55	8.36	6.6	7.45		7.96	8.22	8.03	
Temperature	°C	16.48	16.59	15.97	15.46	15.38	14.64		14.8	14.79	14.82	
Color		slight yellow	slight yellow	slight yellow	slight yellow	yellow	None		None	None	None	
Odor		None	None	sulfide	sulfide	sufide	None		None	None	None	
Clarity		Clear	Clear	Clear	Clear	Opaque	Clear		Clear	Clear	Clear	
Water Depth (Total)	feet	1.0	0.9	0.6	0.6	0.4	4.16		14	12.5	18.6	
Fresh Water Lens Depth	feet	0	0	0	0	0	0		0	0	0	
Prior to Stormwater Release												
Date		1.13.10	1.13.10	1.13.10	1.13.10	1.13.10	1.13.10		1.13.10	1.13.10	1.13.10	
Time		1010	1010	1010	1010	1010	1130		1150	1150	1150	
pH		7.9	8.02	7.93	7.94	7.99	7.87		7.94	7.92	7.69	
Conductivity	mS	46.2	36.25	45.55	44.52	42.99	51.06		51.00	50.95	50.81	
Turbidity	NTU	5.6	9.2	5.2	6.4	9.8	1.4		-0.2	-0.2	-0.3	
Dissolved Oxygen	mg/L	7.70	7.77	7.23	7.09	7.12	7.98		7.54	7.53	7.69	
Temperature	°C	14.91	15.0	15.0	15.08	15.15	16.04		14.87	14.96	14.84	
Color		None	None	None	None	None	None		None	None	None	
Odor		None	None	None	None	None	None		None	None	None	
Clarity		Clear	Clear	Clear	Clear	Clear	Clear		Clear	Clear	Clear	
Water Depth (Total)	feet	3.5	2.25	2.4	1.8	2.0	5.8		12.5	11.2	15.5	
Fresh Water Lens Depth	feet	1.3	2.0	1.66	1.5	1.5	0		<0.3	0	0	
During Stormwater Release												
Date								1.13.10	1.13.10	1.13.10	1.13.10	1.13.10
Time								1400	1425	1425	1425	1500
pH								8.02	7.83	7.86	7.81	7.69
Conductivity	mS							32.53	50.04	50.41	50.58	N/A
Turbidity	NTU							12.5	1.1	1.0	1.7	34.8
Dissolved Oxygen	mg/L							7.48	7.62	7.91	7.45	7.36
Temperature	°C							18.36	15.2	15.25	15.04	16.56
Color								slight yellow	None	None	None	slight yellow
Odor								None	None	None	None	None
Clarity								Clear	Clear	Clear	Clear	Clear
Water Depth (Total)	feet							6.75	10.5	9.5	13.0	1.0
Fresh Water Lens Depth	feet							0	<0.3	<0.3	<0.3	N/A
Oxford Basin Drained												
Date									1.13.10	1.13.10	1.13.10	
Time									1600	1600	1600	
pH									7.91	7.93	7.81	
Conductivity	mS								50.7	51.28	50.85	
Turbidity	NTU								1.3	0.3	5.3	
Dissolved Oxygen	mg/L								7.79	7.84	6.33	
Temperature	°C								15.22	15.17	15.14	
Color									None	None	None	
Odor									None	None	None	
Clarity									Clear	Clear	Clear	
Water Depth (Total)	feet								11.3	9.9	13.0	
Fresh Water Lens Depth	feet								<0.3	<0.3	<0.3	

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
General Chemistry													
Ammonia-N	mg/L	6			0.34B	<0.03	0.05B	0.33B	0.05B	0.05B	0.13B	0.08B	0.69B
DOC	mg/L				3	2.9	<0.1	4.6	<0.1	<0.1	2.9	1.4J	11.3
Nitrate-N	mg/L				1.23	0.42	0.07	0.52	0.13	0.21	0.36	0.17	
Nitrate-N by IC	mg/L												1.98
Nitrite-N	mg/L				0.06	0.03J	0.01J	0.05	0.01J	0.01J	0.03J	0.01J	0.08
pH	pH Units				8H	7.4H	7.5H	7.2H	7.4H	7.3H	7.1H	7.2H	7.1H
TDS	mg/L				15,840	24,980	33,380	19,000	31,660	31,320	27,400	29,420	1,106
Total hardness as CaCO3	mg/L				3,097.9	4,688.4	6,035.6	3,676.0	5,856.8	5,735.5	5,075.4	5,616.3	276.9
TKN	mg/L				2.62	1.088	<0.456	1.862	<0.456	<0.456	0.872J	0.586J	2.06
TOC	mg/L				4.9	4.2	0.6J	8.2	0.1J	0.4J	4.3	6.3	15.4
Total orthophosphate as P	mg/L				0.02	0.03	0.04	0.1	0.03	0.06	0.08	0.04	0.69
Total sulfides	mg/L				0.01J,H	0.01J,H	<0.01	0.02J,H	<0.01	0.01J,H	0.01J,H	0.01J,H	0.04J,H
TSS	mg/L				29.3	20.8	3.3J	17.5	2J	5	9.8	5	39.3
Indicator Bacteria													
Enterococci	MPN/100mL	104			10	6,867	10	1,664	10	246	6,131	19,863	>241,960
Fecal coliforms	MPN/100mL	400			130	30,000	40	24,000	70	300	50,000	13,000	17,000
Total coliforms	MPN/100mL	10,000			1,100	50,000	70	50,000	300	2,400	220,000	24,000	240,000
Acid-Extractable Compounds													
2,4,6-Trichlorophenol	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
2,4-Dichlorophenol	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
2,4-Dimethylphenol	ng/L				<100	<100	<100	<100	<100	<100	<100	<100	<100
2,4-Dinitrophenol	ng/L				<100	<100	<100	<100	<100	<100	<100	<100	<100
2-Chlorophenol	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
2-Methyl-4,6-dinitrophenol	ng/L				<100	<100	<100	<100	<100	<100	<100	<100	<100
2-Nitrophenol	ng/L				<100	<100	<100	<100	<100	<100	<100	<100	<100
4-Chloro-3-methylphenol	ng/L				<100	<100	<100	<100	<100	<100	<100	<100	<100
4-Nitrophenol	ng/L				<100	<100	<100	<100	<100	<100	<100	<100	<100
Pentachlorophenol	ng/L		(a)	13,000	988	<50	<50	951	<50	<50	<50	<50	1203
Phenol	ng/L				<100	<100	<100	<100	<100	<100	<100	<100	<100
Total chlorinated phenolics	ng/L	10,000			<100	<100	<100	<100	<100	<100	<100	<100	<100
Total non-chlorinated phenolics	ng/L	300,000			988	<100	<100	951	<100	<100	<100	<100	1203
Base/Neutral-Extractable Compounds													
1,2,4-Trichlorobenzene	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
2,6-Dinitrotoluene	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
2-Chloronaphthalene	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
3,3'-dichlorobenzidine	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
4-Bromophenylphenylether	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
4-Chlorophenylphenylether	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
Azobenzene	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
Benzidine	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
Butylbenzyl Phthalate	ng/L				117	504	<25	593	35J	47J	347	132	450
Di-n-butyl Phthalate	ng/L				340	116	<75	182	84J	<75	274	<75	217
Di-n-octyl Phthalate	ng/L				79	113	<10	151	<10	12J	121	27	267
Diethyl Phthalate	ng/L				144	116J	<100	208	<100	<100	179	<100	234
Dimethyl Phthalate	ng/L				<50	97	<50	179	<50	<50	148	<50	89
Hexachlorobenzene	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
Hexachlorocyclopentadiene	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
Hexachloroethane	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
Isophorone	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
NDPA	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
NDMA	ng/L				<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	2.7
N-Nitrosodiphenylamine	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
Nitrobenzene	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroethoxy)methane	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroethyl)ether	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroisopropyl)ether	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
bis(2-Ethylhexyl) Phthalate	ng/L				860	999	<100	1124	146	237	625	257	1983
Chlorinated Pesticides													
2,4'-DDD	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4'-DDE	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
2,4'-DDT	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
4,4'-DDD	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
4,4'-DDE	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
4,4'-DDT	ng/L		1,100	130	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total detectable DDTs	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Aldrin	ng/L		3,000	1,300	<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-alpha	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-beta	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-delta	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
BHC-gamma	ng/L		950	160	<1	<1	<1	<1	<1	<1	<1	<1	<1
Total detectable BHC	ng/L	12			<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlordane-alpha	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlordane-gamma	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
DCPA (dacthal)	ng/L				<5	<5	<5	<5	<5	<5	<5	<5	<5
Dicofol	ng/L				<50	<50	<50	<50	<50	<50	<50	<50	<50
Dieldrin	ng/L		240	710	<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan sulfate	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan-I	ng/L	27	220	34	<1	<1	<1	<1	<1	<1	<1	<1	<1
Endosulfan-II	ng/L	27	220	34	<1	<1	<1	<1	<1	<1	<1	<1	<1
Endrin	ng/L	6	83	37	<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
Endrin aldehyde	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Endrin ketone	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Heptachlor	ng/L		52	53	<1	<1	<1	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	ng/L		52	53	<1	<1	<1	<1	<1	<1	<1	<1	<1
Methoxychlor	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Mirex	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Oxychlordane	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Perthane	ng/L				<5	<5	<5	<5	<5	<5	<5	<5	<5
Total detectable chlordane	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Toxaphene	ng/L		730	210	<10	<10	<10	<10	<10	<10	<10	<10	<10
cis-Nonachlor	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-Nonachlor	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	<1
Aroclor PCBs													
Aroclor 1016	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1221	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1232	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1242	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1248	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1254	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
Aroclor 1260	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
Total Aroclor	ng/L				<10	<10	<10	<10	<10	<10	<10	<10	<10
PCB Congeners													
PCB1	ng/L				0.0111	0.0071	0.0052	<0.0045	0.0047	<0.0066	<0.0044	<0.0036	<0.0065
PCB2	ng/L				0.0057	<0.0039	<0.0038	<0.0048	<0.0035	<0.0068	<0.0045	<0.0037	<0.0053
PCB3	ng/L				<0.0087	0.0074	0.0043	0.0066	0.0036	<0.0067	0.0066	0.0057	0.0136
PCB4	ng/L				0.038	0.0376	0.0424	0.021	0.035	0.025	0.0273	0.0227	0.0249
PCB5	ng/L				<0.0065	<0.0053	<0.0083	<0.0059	<0.0052	<0.0067	<0.0034	<0.0042	<0.0049
PCB6	ng/L				0.0187	0.0143	<0.015	0.0099	0.0146	<0.0091	0.0091	<0.0084	0.0117
PCB7	ng/L				<0.0064	<0.0053	<0.0082	<0.0067	<0.0051	<0.0076	<0.0038	<0.0048	<0.0056
PCB8	ng/L				0.086	0.0748	0.0753	0.0563	0.0744	0.0545	0.0523	0.0602	0.082
PCB9	ng/L				0.0064	<0.0049	<0.0077	<0.0061	<0.0048	<0.007	<0.0035	<0.0044	<0.0051
PCB10	ng/L				<0.02	<0.013	<0.014	<0.012	<0.014	<0.018	<0.011	<0.012	<0.0053
PCB11	ng/L				0.12	0.13	0.0444	0.141	0.0243	0.0341	0.0857	0.0522	0.248
PCB12+13	ng/L				0.0076	<0.0061	<0.0079	<0.0068	0.0069	<0.0078	<0.0039	<0.0048	0.0063
PCB14	ng/L				<0.0059	<0.0048	<0.0075	<0.0064	<0.0047	<0.0073	<0.0037	<0.0046	<0.0054
PCB15	ng/L				0.045	0.0393	0.041	0.0243	0.0407	0.022	0.0254	0.0242	0.0346
PCB16	ng/L				0.036	0.048	<0.039	0.036	0.037	0.03	<0.031	0.038	0.043
PCB17	ng/L				0.045	0.055	0.049	0.027	0.043	0.024	<0.024	0.0255	0.0267
PCB18+30	ng/L				0.102	0.119	0.102	0.0665	0.083	<0.047	0.0572	0.0556	0.0556
PCB19	ng/L				<0.012	0.0138	<0.012	<0.0086	0.0153	0.0109	0.0098	0.0116	0.0087
PCB20+28	ng/L				0.159	0.14	0.178	0.0883	0.122	0.0853	0.0885	0.091	0.0911
PCB21+33	ng/L				0.0893	0.0837	0.091	0.052	0.069	0.047	0.0471	0.0482	0.0577

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
PCB22	ng/L				0.0533	0.0544	0.056	0.0335	0.0418	0.0291	0.0311	0.0295	0.0381
PCB23	ng/L				<0.0038	<0.0019	<0.0023	<0.0067	<0.0043	<0.0042	<0.0032	<0.003	<0.0035
PCB24	ng/L				<0.016	<0.01	<0.0097	<0.0074	<0.012	<0.0078	<0.0058	<0.0065	<0.0054
PCB25	ng/L				<0.011	0.011	0.0123	0.0076	<0.0085	0.0068	0.0076	<0.0062	0.0067
PCB26+29	ng/L				0.0271	0.0245	0.0251	0.015	0.0204	0.0142	<0.015	0.015	0.0153
PCB27	ng/L				<0.012	0.0088	0.0104	<0.0081	<0.009	<0.0085	<0.0058	<0.0071	<0.0059
PCB31	ng/L				0.138	0.122	0.132	0.0841	0.0912	0.063	0.0722	0.0711	0.0807
PCB32	ng/L				0.03	0.0355	0.0389	0.0206	0.0304	0.0197	0.0205	0.021	<0.016
PCB34	ng/L				<0.0035	<0.0017	<0.0021	<0.006	<0.0039	<0.0037	<0.0029	<0.0027	<0.0031
PCB35	ng/L				0.0055	<0.0058	<0.0022	0.0064	<0.0041	<0.0038	<0.0029	<0.0028	0.0099
PCB36	ng/L				<0.0032	<0.0016	<0.002	<0.0054	<0.0037	<0.0034	<0.0026	<0.0025	<0.0029
PCB37	ng/L				0.0365	0.0372	0.0446	0.0229	0.0254	0.0167	0.0198	0.0181	0.0341
PCB38	ng/L				<0.0036	<0.0018	<0.0022	<0.0062	<0.0041	<0.0039	<0.003	<0.0028	<0.0033
PCB39	ng/L				<0.0034	<0.0017	<0.0021	<0.0058	<0.0039	<0.0037	<0.0028	<0.0026	<0.0031
PCB40+41+71	ng/L				<0.073	0.0925	0.066	0.0854	0.0451	0.0319	0.0563	<0.038	0.045
PCB42	ng/L				0.042	0.0458	0.0414	0.0379	0.026	0.0191	0.0284	0.0243	<0.017
PCB43	ng/L				<0.01	<0.0081	<0.0057	<0.01	<0.0059	<0.011	<0.0065	<0.0092	<0.008
PCB44+47+65	ng/L				0.173	0.301	0.138	0.38	0.093	0.0774	0.191	0.118	0.0801
PCB45+51	ng/L				<0.022	0.0314	0.0229	0.0211	<0.017	<0.012	0.0169	0.0172	<0.013
PCB46	ng/L				<0.011	<0.0091	0.0092	0.0098	0.0071	<0.01	<0.006	<0.0086	<0.0075
PCB48	ng/L				0.0306	0.0364	0.0278	0.0254	0.0197	0.0132	<0.016	0.0159	<0.013
PCB49+69	ng/L				0.104	0.159	0.1	0.175	0.0606	0.0526	0.0992	0.0721	0.0427
PCB50+53	ng/L				0.0259	0.031	0.0226	0.0314	0.0182	<0.014	0.0218	0.021	<0.0092
PCB52	ng/L				0.298	0.558	0.16	0.791	0.103	0.0867	0.363	0.167	0.107
PCB54	ng/L				<0.013	<0.008	<0.008	<0.0088	<0.0089	<0.0097	<0.0077	<0.0097	<0.01
PCB55	ng/L				<0.0041	<0.0031	<0.003	<0.0051	<0.0023	<0.0051	<0.0024	<0.0047	<0.0049
PCB56	ng/L				<0.043	0.0512	0.0391	0.0644	0.0167	0.0175	0.0333	0.0266	0.0386
PCB57	ng/L				<0.0037	<0.0028	<0.0028	<0.0048	<0.0021	<0.0049	<0.0023	<0.0044	<0.0047
PCB58	ng/L				<0.0041	<0.0031	<0.003	0.0262	<0.0023	<0.0049	<0.0087	<0.0044	<0.0047
PCB59+62+75	ng/L				0.012	0.0136	0.0136	0.0115	<0.0076	<0.0067	0.0102	0.0084	0.0068
PCB60	ng/L				0.0257	0.0276	0.0232	0.024	0.0091	<0.0093	0.0163	0.0121	0.0194
PCB61+70+74+76	ng/L				0.256	0.406	0.188	0.552	0.077	0.0817	0.271	0.14	0.141
PCB63	ng/L				0.0051	0.005	0.004	0.0061	0.0021	<0.0046	0.0034	<0.0042	<0.0044
PCB64	ng/L				<0.06	0.0924	0.0523	0.108	0.0315	0.0275	<0.054	0.0371	0.0341
PCB66	ng/L				0.115	0.118	0.105	0.149	0.047	0.0557	0.0936	0.0709	0.071
PCB67	ng/L				<0.0034	<0.0032	0.0029	<0.0046	<0.0019	<0.0047	<0.0022	<0.0043	<0.0045
PCB68	ng/L				<0.0038	<0.0029	<0.0028	<0.0047	<0.0021	<0.0048	<0.0023	<0.0043	<0.0046
PCB72	ng/L				<0.0037	<0.0028	<0.0027	<0.0047	<0.0021	<0.0048	<0.0023	<0.0044	<0.0046
PCB73	ng/L				<0.0075	<0.0059	<0.0042	<0.0065	<0.0043	<0.007	<0.0041	<0.0059	<0.0051
PCB77	ng/L				0.0196	0.0266	0.0084	0.0373	0.0046	<0.0061	0.018	0.0083	0.0293
PCB78	ng/L				<0.0038	<0.0029	<0.0028	<0.0047	<0.0022	<0.0048	<0.0023	<0.0044	<0.0046
PCB79	ng/L				<0.0034	0.0037	<0.0025	<0.0052	<0.0019	<0.0043	0.0037	<0.0039	<0.0042

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
PCB80	ng/L				<0.0034	<0.0026	<0.0026	<0.0043	<0.0019	<0.0043	<0.0021	<0.0039	<0.0042
PCB81	ng/L				<0.0052	<0.0039	<0.0039	<0.006	<0.0029	<0.006	<0.0029	<0.0055	<0.0058
PCB82	ng/L				0.042	0.0697	<0.011	0.102	<0.0048	<0.008	0.0452	0.019	0.0273
PCB83+99	ng/L				0.16	0.319	0.113	0.423	0.0427	0.0476	0.197	0.0947	0.0854
PCB84	ng/L				0.086	0.223	0.0331	0.339	0.0211	0.0185	0.142	0.0532	0.0524
PCB85+116+117	ng/L				0.0516	0.0896	0.0308	0.113	0.0117	<0.007	0.0492	0.0241	0.0291
PCB86+87+97+109+119+125	ng/L				0.23	0.469	0.105	0.649	0.0467	0.0541	0.29	0.119	0.165
PCB88+91	ng/L				0.047	<0.089	0.0229	0.144	0.0123	0.0091	0.0623	0.0269	0.0213
PCB89	ng/L				<0.0097	<0.0074	<0.0053	0.0101	<0.0042	<0.0077	<0.0053	<0.0048	<0.0065
PCB90+101+113	ng/L				0.334	0.722	0.205	0.94	0.0866	0.106	0.439	0.195	0.261
PCB92	ng/L				0.0585	0.119	0.0337	0.168	0.0143	0.0185	0.0746	0.0366	0.0405
PCB93+98+100+102	ng/L				<0.0093	0.0247	0.0083	0.0362	<0.0041	<0.0073	0.0162	0.0066	<0.0062
PCB94	ng/L				<0.0097	<0.0074	<0.0053	<0.0076	<0.0042	<0.0079	<0.0054	<0.0049	<0.0067
PCB95	ng/L				0.25	0.628	0.11	0.979	0.0685	0.0726	0.41	0.163	0.193
PCB96	ng/L				<0.012	<0.013	<0.022	<0.0086	<0.015	<0.014	<0.0073	<0.012	<0.011
PCB103	ng/L				<0.0082	<0.0063	<0.0044	<0.0061	<0.0036	<0.0064	<0.0043	<0.004	<0.0054
PCB104	ng/L				<0.0049	<0.0052	<0.0091	<0.0054	<0.006	<0.0085	<0.0046	<0.0075	<0.0066
PCB105	ng/L				0.126	0.177	0.0445	0.237	0.0196	0.025	0.113	0.0496	0.102
PCB106	ng/L				<0.0033	<0.0025	<0.0022	<0.0048	<0.0028	<0.0056	<0.0024	<0.0031	<0.0026
PCB107	ng/L				0.0181	0.0279	0.0106	0.0376	<0.0025	<0.005	0.0181	0.0104	0.0158
PCB108+124	ng/L				0.0108	0.0189	0.0053	0.0256	<0.0026	<0.0054	0.0115	0.0054	0.0103
PCB110+115	ng/L				0.379	0.742	0.188	1.06	0.0806	0.0944	0.492	0.206	0.305
PCB111	ng/L				<0.0068	<0.0052	<0.0037	<0.0052	<0.003	<0.0054	<0.0037	<0.0034	<0.0046
PCB112	ng/L				<0.0074	<0.0057	<0.004	<0.0053	<0.0032	<0.0056	<0.0038	<0.0035	<0.0047
PCB114	ng/L				0.0052	0.0103	0.0029	0.0125	<0.0032	<0.0061	0.0047	<0.0033	0.0056
PCB118	ng/L				0.282	0.445	0.144	0.583	0.0516	0.0688	0.29	0.132	0.215
PCB120	ng/L				<0.0066	<0.0051	<0.0036	<0.005	<0.0029	<0.0052	<0.0035	<0.0032	<0.0044
PCB121	ng/L				<0.0068	<0.0053	<0.0037	<0.0052	<0.003	<0.0054	<0.0037	<0.0034	<0.0046
PCB122	ng/L				<0.0033	0.0041	<0.0022	<0.0055	<0.0028	<0.0057	<0.0025	<0.0031	<0.0027
PCB123	ng/L				<0.0048	0.0093	0.0032	0.0106	<0.0032	<0.0061	0.0047	<0.0033	<0.0029
PCB126	ng/L				<0.0052	<0.0058	<0.0024	0.0095	<0.0031	<0.006	0.0043	<0.0033	<0.0063
PCB127	ng/L				<0.003	<0.0023	<0.002	<0.0044	<0.0026	<0.0052	<0.0022	<0.0028	<0.0024
PCB128+166	ng/L				<0.07	<0.081	0.0222	0.144	<0.0086	0.015	0.0655	0.0281	0.0654
PCB129+138+163	ng/L				0.467	0.589	0.191	0.816	0.0791	0.11	0.377	0.171	0.458
PCB130	ng/L				0.028	0.037	0.0106	0.061	<0.011	<0.014	0.0245	0.0105	<0.022
PCB131	ng/L				<0.02	<0.013	<0.0078	0.017	<0.011	<0.014	<0.0073	<0.009	<0.01
PCB132	ng/L				0.16	0.233	0.051	0.341	0.024	0.036	0.146	0.058	0.143
PCB133	ng/L				<0.018	<0.012	<0.0072	<0.015	<0.01	<0.013	<0.0067	<0.0082	<0.0095
PCB134+143	ng/L				0.024	0.038	0.0082	0.05	<0.011	<0.014	0.0216	0.0117	0.019
PCB135+151	ng/L				<0.095	0.196	0.067	<0.2	0.03	0.04	0.098	0.053	0.12
PCB136	ng/L				0.052	0.097	0.022	<0.11	<0.016	<0.014	0.0557	0.025	0.0521
PCB137	ng/L				0.023	<0.022	<0.0073	0.046	<0.01	<0.013	0.0175	<0.0082	0.0121

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
PCB139+140	ng/L				<0.017	0.012	<0.0068	0.018	<0.0094	<0.012	0.0086	<0.0078	<0.009
PCB141	ng/L				0.072	0.1	0.0348	0.136	0.0107	0.014	0.0555	0.0298	0.0815
PCB142	ng/L				<0.019	<0.012	<0.0075	<0.016	<0.01	<0.013	<0.007	<0.0086	<0.01
PCB144	ng/L				0.023	<0.025	<0.013	0.032	<0.02	<0.016	0.015	<0.013	0.02
PCB145	ng/L				<0.016	<0.014	<0.011	<0.014	<0.017	<0.013	<0.009	<0.011	<0.01
PCB146	ng/L				<0.05	<0.061	0.0263	0.092	0.011	0.014	0.0468	0.0256	0.0604
PCB147+149	ng/L				0.329	0.464	0.142	0.582	0.0643	0.082	0.265	0.134	0.32
PCB148	ng/L				<0.02	<0.018	<0.014	<0.017	<0.022	<0.016	<0.011	<0.013	<0.012
PCB150	ng/L				<0.015	<0.013	<0.011	<0.013	<0.016	<0.012	<0.0084	<0.01	<0.0094
PCB152	ng/L				<0.015	<0.013	<0.011	<0.013	<0.016	<0.012	<0.0084	<0.01	<0.0094
PCB153+168	ng/L				0.316	0.413	0.186	0.5	0.0657	0.0907	0.247	0.138	0.325
PCB154	ng/L				<0.018	<0.016	<0.012	<0.015	<0.019	<0.015	<0.01	<0.012	<0.011
PCB155	ng/L				<0.007	<0.0061	<0.0049	<0.0087	<0.0074	<0.0085	<0.0058	<0.0069	<0.0065
PCB156+157	ng/L				0.049	0.0624	0.0171	0.087	0.0063	0.0105	<0.04	<0.015	0.0518
PCB158	ng/L				0.043	0.059	<0.013	0.081	<0.007	<0.009	0.0348	0.0156	0.0449
PCB159	ng/L				<0.0069	<0.0038	<0.0034	<0.0091	<0.0037	<0.0066	<0.0033	<0.004	<0.0049
PCB160	ng/L				<0.014	<0.0095	<0.0057	<0.012	<0.0079	<0.01	<0.0053	<0.0065	<0.0076
PCB161	ng/L				<0.013	<0.0088	<0.0053	<0.011	<0.0073	<0.0093	<0.0049	<0.006	<0.007
PCB162	ng/L				<0.0072	<0.0039	<0.0035	<0.0095	<0.0038	<0.0069	<0.0035	<0.0042	<0.0052
PCB164	ng/L				0.029	0.0401	0.0113	0.053	<0.0076	<0.0096	0.0245	0.0123	0.0335
PCB165	ng/L				<0.015	<0.0098	<0.0059	<0.013	<0.0081	<0.01	<0.0055	<0.0067	<0.0078
PCB167	ng/L				0.0171	0.021	0.0062	0.033	<0.0047	<0.008	0.0151	0.007	0.0207
PCB169	ng/L				<0.0089	<0.0049	<0.0043	<0.011	<0.0048	<0.0082	<0.0041	<0.005	<0.0062
PCB170	ng/L				0.066	0.068	0.0346	0.085	0.0125	0.021	0.0445	0.028	0.131
PCB171+173	ng/L				<0.019	0.022	0.013	0.029	<0.0085	<0.018	<0.013	<0.012	<0.031
PCB172	ng/L				<0.019	<0.013	<0.0087	<0.016	<0.0085	<0.018	<0.01	<0.012	0.021
PCB174	ng/L				0.078	0.078	<0.036	0.074	0.019	0.023	0.041	0.026	0.103
PCB175	ng/L				<0.021	<0.011	<0.0096	<0.015	<0.0095	<0.014	<0.0067	<0.0097	<0.012
PCB176	ng/L				<0.016	0.0109	<0.0075	<0.012	<0.0074	<0.011	<0.0053	<0.0077	<0.011
PCB177	ng/L				0.042	0.04	<0.021	0.044	0.0099	<0.018	<0.022	0.015	0.065
PCB178	ng/L				<0.022	<0.015	<0.0099	<0.016	<0.0098	<0.015	0.01	<0.01	<0.022
PCB179	ng/L				0.039	0.0395	0.0206	<0.037	0.0116	0.012	0.022	0.0146	0.0368
PCB180+193	ng/L				0.142	0.125	0.0745	0.148	0.0269	<0.039	0.0802	0.0467	0.247
PCB181	ng/L				<0.019	<0.013	<0.0085	<0.015	<0.0083	<0.017	<0.0096	<0.011	<0.01
PCB182	ng/L				<0.021	<0.011	<0.0098	<0.015	<0.0097	<0.014	<0.0068	<0.0099	<0.012
PCB183	ng/L				0.038	0.038	0.0257	0.048	0.0113	<0.018	<0.022	0.021	0.078
PCB184	ng/L				<0.016	<0.0081	<0.0073	<0.011	<0.0072	<0.011	<0.0051	<0.0073	<0.0088
PCB185	ng/L				<0.02	<0.013	<0.009	<0.015	<0.0087	<0.017	<0.0096	<0.011	<0.01
PCB186	ng/L				<0.017	<0.0086	<0.0078	<0.012	<0.0077	<0.011	<0.0055	<0.0079	<0.0095
PCB187	ng/L				<0.095	0.099	0.0579	0.094	<0.026	0.032	0.0522	<0.034	0.127
PCB188	ng/L				<0.012	<0.0062	<0.0056	<0.011	<0.0055	<0.011	<0.0052	<0.0075	<0.0089
PCB189	ng/L				<0.013	<0.0091	<0.0043	<0.02	<0.0065	<0.0094	<0.012	<0.0078	<0.0081

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
PCB190	ng/L				<0.015	<0.012	0.0077	0.017	<0.0066	<0.014	0.0084	<0.009	<0.019
PCB191	ng/L				<0.014	<0.0093	<0.0063	<0.012	<0.0061	<0.014	<0.0079	<0.009	<0.0086
PCB192	ng/L				<0.015	<0.01	<0.007	<0.013	<0.0068	<0.015	<0.0084	<0.0096	<0.0091
PCB194	ng/L				0.031	<0.018	<0.0088	<0.025	<0.0079	<0.017	<0.014	<0.012	0.061
PCB195	ng/L				<0.024	<0.016	<0.0083	<0.021	<0.0084	<0.018	<0.015	<0.012	<0.02
PCB196	ng/L				<0.03	<0.023	<0.016	<0.027	<0.011	<0.023	<0.018	<0.016	0.035
PCB197	ng/L				<0.024	<0.019	<0.013	<0.02	<0.0088	<0.017	<0.014	<0.012	<0.016
PCB198+199	ng/L				<0.041	0.038	0.016	0.039	<0.011	<0.023	0.022	0.016	0.069
PCB200	ng/L				<0.021	<0.017	<0.011	<0.019	<0.0077	<0.016	<0.013	<0.011	<0.015
PCB201	ng/L				<0.023	<0.018	<0.012	<0.019	<0.0082	<0.017	<0.013	<0.011	<0.016
PCB202	ng/L				<0.021	<0.017	<0.011	<0.021	<0.0077	<0.018	<0.014	<0.012	0.018
PCB203	ng/L				<0.028	<0.022	<0.015	<0.024	<0.01	<0.021	<0.017	<0.014	0.038
PCB204	ng/L				<0.022	<0.017	<0.012	<0.019	<0.0081	<0.016	<0.013	<0.011	<0.016
PCB205	ng/L				<0.023	<0.015	<0.0078	<0.018	<0.008	<0.016	<0.013	<0.011	<0.011
PCB206	ng/L				<0.046	<0.025	<0.014	<0.032	<0.016	<0.023	<0.025	<0.021	0.044
PCB207	ng/L				<0.04	<0.022	<0.012	<0.027	<0.014	<0.02	<0.022	<0.018	<0.012
PCB208	ng/L				<0.047	<0.026	<0.015	<0.033	<0.016	<0.024	<0.026	<0.022	<0.014
PCB209	ng/L				<0.048	<0.028	<0.014	<0.039	<0.017	<0.047	<0.019	<0.029	0.028
Total PCBs	ng/L				6.3154	10.081	4.0823	12.8006	2.1814	1.9604	6.2485	3.3569	5.9616
PAHs													
1-Methylnaphthalene	ng/L				3J	<1	<1	2.6J	<1	<1	1.8J	1.1J	28.7
1-Methylphenanthrene	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	26.5
2,3,5-Trimethylnaphthalene	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	7.2
2,6-Dimethylnaphthalene	ng/L				38.5	5.4	<1	7.3	<1	<1	3.3J	1.5J	21.4
2-Methylnaphthalene	ng/L				3.8J	1.5J	<1	4.1J	<1	<1	3.1J	1.1J	54.8
Acenaphthene	ng/L				<1	<1	<1	<1	<1	<1	3.1J	<1	7.1
Acenaphthylene	ng/L				3.2J	2.7J	<1	1.6J	<1	<1	5	2.6J	5.6
Anthracene	ng/L				4.1J	7.9	<1	6.1	<1	<1	1.9J	3.8J	12.5
Benz[a]anthracene	ng/L				7.4	9.5	<1	6.6	<1	<1	4.6J	2.1J	20.3
Benzo[a]pyrene	ng/L				7.7	9	<1	9.8	<1	<1	6.2	4.1J	26.5
Benzo[b]fluoranthene	ng/L				13.1	11.9	<1	12.3	<1	5.1	8.5	6.1	39
Benzo[e]pyrene	ng/L				13.8	17.2	<1	14.1	<1	3.2J	7.4	4.9J	69.8
Benzo[g,h,i]perylene	ng/L				6.9	3.3J	<1	4.9J	<1	<1	<1	<1	38.5
Benzo[k]fluoranthene	ng/L				6.9	65	<1	8.4	<1	3.1J	6.7	2.6J	18.3
Biphenyl	ng/L				6.3	3.9J	<1	5.5	<1	<1	2.6J	2.8J	11
Chrysene	ng/L				20.2	34.2	<1	27.3	<1	4.1J	16.5	6.9	97.7
Dibenz[a,h]anthracene	ng/L				3.3J	<1	<1	5.5	<1	<1	<1	<1	8.6
Dibenzothiophene	ng/L				<1	<1	<1	<1	<1	<1	<1	<1	18.5
Fluoranthene	ng/L				26.6	40.9	<1	32.6	<1	7.5	17.2	7.4	89.5
Fluorene	ng/L				<1	3J	<1	5.2	<1	<1	3.3J	1.6J	14.8
Indeno[1,2,3-c,d]pyrene	ng/L				12.2	10.6	<1	17.4	<1	<1	2J	<1	19
Perylene	ng/L				2.1J	4.4J	<1	4.3J	<1	<1	4J	6.5	37.4

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
Phenanthrene	ng/L				11	15.7	<1	12.9	<1	5.5	9.8	4.6J	90.4
Pyrene	ng/L				29.7	35.5	<1	32.1	<1	6.8	20.7	7.5	94.7
Total detectable PAHs	ng/L				219.8	281.6	<1	220.6	<1	35.3	127.7	67.2	857.8
TPH-CC													
C6	ug/L				<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4
C7	ug/L				<6.1	<6.1	<6.1	<6.1	<6.1	<6.1	<6.1	<6.1	<6.1
C8	ug/L				<9.9	<9.9	<9.9	<9.9	<9.9	<9.9	<9.9	<9.9	<9.9
C9-C10	ug/L				<13	<13	<13	<13	<13	<13	<13	<13	<13
C11-C12	ug/L				<14	<14	<14	<14	<14	<14	<14	<14	<14
C13-C14	ug/L				<16	<16	<16	16	<16	<16	<16	<16	28
C15-C16	ug/L				<17	<17	<17	18	<17	<17	<17	<17	49
C17-C18	ug/L				<17	<17	<17	24	<17	<17	<17	<17	57
C19-C20	ug/L				<18	<18	<18	23	<18	<18	<18	<18	64
C21-C22	ug/L				<18	<18	<18	28	<18	<18	<18	<18	75
C23-C24	ug/L				<18	<18	<18	32	<18	<18	<18	<18	93
C25-C28	ug/L				<16	<16	<16	34	<16	<16	17	19	130
C29-C32	ug/L				15	20	<8.5	41	<8.5	<8.5	18	18	190
C33-C36	ug/L				<7.9	12	<7.9	21	<7.9	<7.9	8.5	8	140
C37-C40	ug/L				<6.8	<6.8	<6.8	21	<6.8	<6.8	<6.8	<6.8	130
C41-C44	ug/L				9	<6.6	<6.6	11	<6.6	<6.6	<6.6	<6.6	66
C6-C44 Total	ug/L				<47	<47	<47	270	<47	<47	<47	<47	1000
Dissolved Metals													
Antimony (Sb)	µg/L				0.38B	0.4B	0.14B	0.62B	0.23B	0.26B	0.5B	0.34B	<0.1
Arsenic (As)	µg/L		0.34 (b)	69	0.91B	1.45B	2.02B	1.36B	2.17B	2.24B	1.55B	1.59B	<0.2
Barium (Ba)	µg/L				43	21.3	10.6	25.9	12.5	12.9	16.5	12.9	34.4
Beryllium (Be)	µg/L				0.032	0.034	0.025	0.032	0.024	0.038	0.026	0.02	<0.2
Cadmium (Cd)	µg/L		(c)	42	0.015	0.067	0.108	0.048	0.112	0.123	0.105	0.107	<0.2
Chromium (Cr)	µg/L		(c)	1100	1.671B	0.701B	0.198B	0.859B	0.481B	0.256B	0.461B	0.303B	<0.1
Cobalt (Co)	µg/L				0.291B	0.203B	0.189B	0.237B	0.215B	0.198B	0.204B	0.183B	<0.1
Copper (Cu)	µg/L		(c)	4.8	1.46B	3.52B	10.74B	3.88B	12.11B	9.59B	7.02B	9.94B	<0.4
Lead (Pb)	µg/L		(c)	210	0.078	0.158	0.207	0.188	0.147	0.107	0.17	0.144	<0.05
Mercury (Hg)	µg/L				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum (Mo)	µg/L				8.044	7.408	7.995	6.667	8.135	8.598	7.197	7.943	<0.2
Nickel (Ni)	µg/L		(c)	74	1.019B	1.02B	0.572B	1.341B	0.629B	0.667B	0.959B	0.742B	<0.2
Selenium (Se)	µg/L			290	0.01J	0.03	0.02	0.04	0.02	0.03	0.02	0.03	<0.2
Silver (Ag)	µg/L		(c)	1.9	0.09B	0.07B	0.11B	0.06B	0.08B	0.09B	0.07B	0.07B	<0.5
Thallium (Tl)	µg/L				<0.005	<0.005	0.011	<0.005	0.012	0.01	0.007J	0.01	<0.1
Vanadium (V)	µg/L				3.08	2.01	1.89	2.32	2.17	1.97	2.09	1.92	<0.2
Zinc (Zn)	µg/L		(c)	90	10.22B	52.44B	89.5B	48.91B	84.59B	77.79B	66.53B	74.18B	<0.1
Total Metals													
Antimony (Sb)	µg/L				0.5B	0.55B	0.24B	0.76B	0.15B	0.26B	0.47B	0.34B	2.2B
Arsenic (As)	µg/L	80			1.11B	1.52B	2.07B	1.5B	2.24B	1.92B	1.72B	2.16B	3.6B

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
Barium (Ba)	µg/L				49.3	26.3	11.9	37.8	13	15	20.4	15.1	43.9
Beryllium (Be)	µg/L				0.046	0.048	0.033	0.046	0.03	0.04	0.035	0.037	<0.2
Cadmium (Cd)	µg/L	10			0.368	0.132	0.108	0.141	0.107	0.181	0.114	0.105	0.3J
Chromium (Cr)	µg/L	20			4.116B	1.951B	0.347B	2.169B	0.51B	0.463B	1.028B	0.676B	1.9B
Cobalt (Co)	µg/L				0.377B	0.308B	0.2B	0.324B	0.208B	0.204B	0.244B	0.208B	0.5B
Copper (Cu)	µg/L	30			10.6B	14.75B	14.03B	16.51B	14.14B	13.44B	15.04B	14.41B	21.6B
Lead (Pb)	µg/L	20			3.504B	3.255B	0.56B	3.659B	0.332B	0.767B	1.748B	0.92B	7.38B
Mercury (Hg)	µg/L	0.4			0.01J	0.01J	<0.01	0.01J	<0.01	<0.01	<0.01	<0.01	0.01J
Molybdenum (Mo)	µg/L				6.707	5.279	7.423	4.912	8.093	7.072	5.636	6.71	5.3
Nickel (Ni)	µg/L	50			1.596B	1.464B	0.63B	1.861B	0.617B	0.702B	1.284B	0.85B	3.9B
Selenium (Se)	µg/L	150			0.04	0.04	0.02	0.04	0.03	0.03	0.04	0.03	2.3
Silver (Ag)	µg/L	7			0.09B	0.07B	0.11B	0.07B	0.08B	0.08B	0.06B	0.08B	<0.5
Thallium (Tl)	µg/L				<0.005	0.007J	0.012	0.006J	0.012	0.01	0.009J	0.01	<0.1
Vanadium (V)	µg/L				5.01	3.19	2.13	3.45	2.14	2.26	2.55	2.37	5.4
Zinc (Zn)	µg/L	200			50.35B	79.66B	91.85B	80.32B	67.43B	82.14B	77.5B	78.15B	89.7B
VOCs													
1,1,1-Trichloroethane (TCA)	µg/L				<0.0365	<0.0365	<0.0365	<0.0365	<0.0365	<0.0365	<0.0365	<0.0365	<0.0365
1,1,2,2-Tetrachloroethane	µg/L				<0.0228	<0.0228	<0.0228	<0.0228	<0.0228	<0.0228	<0.0228	<0.0228	<0.0228
1,1,2-Trichloroethane	µg/L				<0.031	<0.031	<0.031	<0.031	<0.031	1.2	<0.031	<0.031	<0.031
1,1-Dichloroethane	µg/L				<0.0076	<0.0076	<0.0076	<0.0076	<0.0076	<0.0076	<0.0076	<0.0076	<0.0076
1,1-Dichloroethene	µg/L				<0.0177	<0.0177	<0.0177	<0.0177	<0.0177	<0.0177	<0.0177	<0.0177	<0.0177
1,2-Dichlorobenzene	µg/L				<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
1,2-Dichloroethane (EDC)	µg/L				<0.031	<0.031	<0.031	<0.031	<0.031	<0.031	<0.031	<0.031	<0.031
1,2-Dichloropropane	µg/L				<0.0266	<0.0266	<0.0266	<0.0266	<0.0266	<0.0266	<0.0266	<0.0266	<0.0266
1,3-Dichlorobenzene	µg/L				<0.0283	<0.0283	<0.0283	<0.0283	<0.0283	<0.0283	<0.0283	<0.0283	<0.0283
1,4-Dichlorobenzene	µg/L				0.1J,B	<0.031	<0.031	<0.031	<0.031	<0.031	<0.031	<0.031	<0.031
2-Chloroethyl vinyl ether (2-CVE)	µg/L				<0.0951	<0.0951	<0.0951	<0.0951	<0.0951	<0.0951	<0.0951	<0.0951	<0.0951
Acrolein	µg/L				<0.8217	<0.8217	<0.8217	<0.8217	<0.8217	<0.8217	<0.8217	<0.8217	<0.8217
Acrylonitrile	µg/L				<1.401	<1.401	<1.401	<1.401	<1.401	<1.401	<1.401	<1.401	<1.401
Benzene	µg/L				<0.0118	<0.0118	<0.0118	<0.0118	<0.0118	<0.0118	<0.0118	<0.0118	<0.0118
Bromodichloromethane	µg/L				<0.0281	<0.0281	<0.0281	<0.0281	<0.0281	<0.0281	<0.0281	<0.0281	<0.0281
Bromoform	µg/L				<0.0347	<0.0347	<0.0347	<0.0347	<0.0347	<0.0347	<0.0347	<0.0347	<0.0347
Bromomethane (methyl bromide)	µg/L				0.4J,B	0.3J,B	0.5B	0.3J,B	0.3J,B	0.4J,B	0.3J,B	0.2J	0.2J
Carbon Tetrachloride	µg/L				<0.0323	<0.0323	<0.0323	<0.0323	<0.0323	<0.0323	<0.0323	<0.0323	<0.0323
Chlorobenzene	µg/L				<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Chloroethane (ethyl chloride)	µg/L				<0.0583	<0.0583	<0.0583	<0.0583	<0.0583	<0.0583	<0.0583	<0.0583	<0.0583
Chloroform	µg/L				<0.1795	<0.1795	<0.1795	0.2J	<0.1795	<0.1795	<0.1795	<0.1795	<0.1795
Chloromethane (methyl chloride)	µg/L				0.4J,B	0.3J,B	0.4J,B	0.3J,B	0.4J,B	0.3J,B	0.2J	0.2J	0.2J
Dibromochloromethane	µg/L				<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
Dichlorodifluoromethane (F12)	µg/L				0.3J,B	0.2J,B	0.2J,B	0.2J,B	0.2J,B	0.3J,B	0.2J,B	0.2J,B	0.2J,B
Ethylbenzene	µg/L				0.1J	<0.0156	<0.0156	<0.0156	<0.0156	<0.0156	<0.0156	<0.0156	<0.0156
Methyl-t-butyl ether (MTBE)	µg/L				<0.1318	<0.1318	0.2J	<0.1318	0.2J	0.2J	<0.1318	<0.1318	<0.1318

Table 10. Summary of Oxford Retention Basin Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater								Freshwater
					Oxford Retention Basin		Exchange		Basin E				Boone Olive Pump Station
					ORB-1	ORB-2	X-ORB-1	X-BasinE-3	E-1	E-2	E-3	E-4	BO-3
					01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/12/2010	01/13/2010	01/13/2010	01/13/2010	01/13/2010
Methylene chloride (dichloromethane)	µg/L				1.5B	2.2B	1.3B	2.9B	2B	2.9B	2.3B	1.8B	0.3J,B
Tetrachloroethene (PCE)	µg/L				0.1J	<0.0167	<0.0167	<0.0167	<0.0167	<0.0167	0.1J	0.4J	10.7
Toluene	µg/L				0.2J,B	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Trichloroethene (TCE)	µg/L				0.1J	<0.0277	<0.0277	<0.0277	<0.0277	<0.0277	<0.0277	<0.0277	0.4J
Trichlorofluoromethane (F11)	µg/L				<0.0312	<0.0312	<0.0312	<0.0312	<0.0312	<0.0312	<0.0312	<0.0312	0.1J
Vinyl Chloride	µg/L				0.1J	<0.0983	<0.0983	<0.0983	<0.0983	<0.0983	<0.0983	<0.0983	<0.0983
c-1,2-Dichloroethene	µg/L				<0.0215	<0.0215	<0.0215	<0.0215	<0.0215	<0.0215	<0.0215	<0.0215	0.3J
c-1,3-Dichloropropene	µg/L				<0.0198	<0.0198	<0.0198	<0.0198	<0.0198	<0.0198	<0.0198	<0.0198	<0.0198
o-Xylene	µg/L				<0.0152	<0.0152	<0.0152	<0.0152	<0.0152	<0.0152	<0.0152	<0.0152	<0.0152
p/m-Xylene	µg/L				<0.0201	<0.0201	<0.0201	<0.0201	<0.0201	<0.0201	<0.0201	<0.0201	<0.0201
t-1,2-Dichloroethene	µg/L				<0.0403	<0.0403	<0.0403	<0.0403	<0.0403	<0.0403	<0.0403	<0.0403	<0.0403
t-1,3-Dichloropropene	µg/L				<0.0218	<0.0218	<0.0218	<0.0218	<0.0218	<0.0218	<0.0218	<0.0218	<0.0218

CVE = chloroethyl vinyl ether.
EDC = dichloroethane.
F11 = trichlorofluoromethane.

Organic Constituents Results

Acid-extractable compounds were not detected in samples X-ORB-1 and E-1. Total non-chlorinated phenolics (i.e., pentachlorophenol) were reported at 988 ng/L in sample ORB-1, which is below the CTR value of 13,000 ng/L and the COP value of 300,000 ng/L. Five base/neutral-extractable compounds were detected in sample ORB-1, and one base/neutral-extractable compound was detected in sample E-1.

There were no chlorinated pesticides detected during the pre-storm event in all three composite samples.

Aroclor PCBs were not detected in the three samples. Although, 59 individual PCB congeners were detected in sample ORB-1, 63 individual PCB congeners were detected in sample X-ORB-1, and 52 individual PCB congeners were detected in sample E-1, total detectable PCBs were calculated at low concentrations of 6.32 ng/L for ORB-1, 4.08 ng/L for X-ORB-1, and 2.1814 ng/L for E-1.

Several PAH compounds were detected only in sample ORB-1. Total detectable PAHs were calculated (low + high molecular weight) at a concentration 219.8 µg/L.

Two TPH-CC analytes were detected in sample ORB-1. C29-C32 was reported at 15.0 ug/L, and C41-C44 was reported at 9.0 ug/L.

One VOC (methylene chloride) was detected in sample ORB-1 at 1.5 µg/kg, two VOCs (bromomethane and methylene chloride) were detected in X-ORB-1, at 0.5 µg/kg and 1.3 µg/kg, respectively; and one VOC (methylene chloride) was detected in E-1 at 2.0 µg/kg.

Total and Dissolved Metals

The total and dissolved fractions of 17 metals were tested for in each of the composite samples during the pre-storm event. Only dissolved copper exceeded the CTR saltwater criteria (4.8 µg/L) in samples X-ORB-1 (10.74 µg/L) and E-1 (12.11 µg/L). There were no other exceedances reported for dissolved metals in all three samples. In addition, there were no observed exceedances for total metals in all three composite samples.

3.2.2.3 Microbiology Results

The indicator bacteria monitored during the pre-storm event—representing the Oxford Retention Basin, Exchange Area, and Basin E—included enterococci, fecal coliforms, and total coliforms. Enterococcus concentrations were measured at 10 MPN/100 mL for all three samples, which is significantly below the COP values of 104 MPN/100 mL (Table 10). The fecal coliform concentrations ranged between 40 MPN/100 mL (X-ORB-1) and 130 MPN/100 mL (ORB-1), which is below the COP values of 400 MPN/100 mL. The total coliform concentrations ranged between 70 MPN/100 mL (X-ORB-1) and 1,100 MPN/100 mL (ORB-1), which is also significantly below the COP values of 10,000 MPN/100mL.

3.2.3 Prior to Stormwater Release

3.2.3.1 Field Data Results

Physical parameter measurements were taken in the field during the wet weather event of January 12–13, 2010. The following results were taken on January 13, 2010, to represent conditions prior to stormwater release. The parameters measured were conductivity, pH, turbidity, DO, temperature, color, odor, clarity, and water depth. Measurements were recorded at each designated sample station in conjunction with sample collection. The data collected in the field are summarized in Table 9.

Oxford Retention Basin
Water depth varied between the stations from 1.3 ft at ORB-A to 2.0 ft at ORB-B. Conductivity, a measure of the dissolved solutes in the water, ranged from 36.25 mS (ORB-B) to 46.2 mS (ORB-A). Turbidity ranged from 5.2 NTU (ORB-C) to 9.8 NTU (ORB-E). DO was relatively consistent among the five stations, ranging from 7.09 mg/L to 7.77 mg/L. pH ranged from 7.90 to 8.02. Temperature was consistent among the five stations monitored, ranging from 14.91ºC to 15.15ºC.

Exchange Water
Field observations and measurements were only taken at one station, X-ORB, to represent the Exchange Area water. Water depth was measured at 5.8-ft deep, and temperature was reported at 16.04ºC. Conductivity was 51.06 mS and turbidity was measured at 1.4 NTU. DO was measured at 7.98 mg/L, and ph was measured at 7.87 at station X-ORB.

Basin E
Water depth varied between the stations from 11.2 ft at Basin E-B to 15.5 ft at Basin E-C. Conductivity was consistent between the three stations ranging from 50.81 mS to 51.00 mS. Turbidity was also consistent among the stations ranging from -0.2 NTU to -0.3 NTU. DO ranged from 7.53 mg/L to 7.69 mg/L. pH ranged from 7.69 to 7.94. Temperature was consistent among the three stations monitored, ranging from 14.84ºC to 14.96ºC.

3.2.3.2 Analytical Chemistry Results

Results of the wet weather (i.e., prior to stormwater release) water quality sampling are presented in Table 10. The results from composite sample ORB-2 represent the Oxford Retention Basin, and the results from the composite sample E-2 represents Basin E. These results were compared to the either the COP and/or the CTR as appropriate. In the results discussion below, 'J flag' values (i.e., estimated concentrations below the reporting limit) were considered not detected.

General Chemistry
Several nutrients were monitored as part of the ambient monitoring analyte list, including nitrate, nitrite, TKN, ammonia, and total orthophosphate (Table 10). Of these, a water quality benchmark is available for ammonia. Ammonia was only detected in sample E-2, at 0.05 mg/L; significantly less than the COP water quality criteria of 6.0 mg/L. TKN was only detected in the sample, ORB-2, at 1.088 mg/L. Orthophosphate results ranged from 0.03 mg/L (ORB-2) to 0.06 mg/L (E-2). DOC and TOC were only detected in the ORB-2 sample, reported at 2.9 mg/L and 4.2 mg/L, respectively. TSS ranged from 24,980 mg/L (ORB-2) to 31,320 mg/L (E-2). TSS were ranged from 5.0 mg/L (E-2) to 17.5 mg/L (ORB-2).

Organic Constituents Results
Acid-extractable compounds were not detected in samples X-ORB-2 and E-2. Five base/neutral-extractable compounds were detected in sample ORB-2, and one base/neutral-extractable compound was detected in sample E-2.

There were no chlorinated pesticides detected prior to the stormwater release in both composite samples.

Aroclor PCBs were not detected in both samples. Although 77 individual PCB congeners were detected in sample ORB-2, and 48 individual PCB congeners were detected in sample E-2, total detectable PCBs were calculated at low concentrations of 10.08 ng/L and 1.96 ng/L for E-2.

Several PAH compounds were detected only in both samples. Total detectable PAHs were calculated (low + high molecular weight) at a concentration 281.6 µg/L for ORB-2 and 35.3 µg/L for E-2.

Two TPH-CC analytes were detected in sample ORB-2. C29-C32 was reported at 20 µg/L, and C33-C36 was reported at 12.0 µg/L.

One VOC (methylene chloride) was detected in sample ORB-2 at 2.2 µg/kg, two VOCs (1,1,2-trichloroethane and methylene chloride) were detected in E-2, at 1.2 µg/kg and 2.9 µg/kg, respectively.

Total and Dissolved Metals

The total and dissolved fractions of 17 metals were tested for in each of the composite samples during the pre-storm event. Only dissolved copper exceeded the CTR saltwater criteria (4.8 µg/kg) in sample E-2, reported at 9.59 µg/L. There were no other observed exceedances for dissolved metals in the two composite samples. In addition, there were no observed exceedances for total metals in both composite samples.

3.2.3.3 Microbiology Results

The indicator bacteria monitored prior to the stormwater release—representing the Oxford Retention Basin and Basin E—included enterococci, fecal coliforms, and total coliforms. Enterococcus concentrations were measured at 6,867 for sample ORB-2 and 246 MPN/100 mL for sample E-2, which exceeds the COP values of 104 MPN/100 mL (Table 10). The fecal coliform concentrations ranged between 300 MPN/100 mL (E-2) and 30,000 MPN/100 mL (ORB-2). This concentration reported for ORB-2 exceeds the COP values of 400 MPN/100 mL. The total coliform concentrations ranged between 2,400 MPN/100 mL (E-2) and 50,000 MPN/100 mL. This concentration reported for sample ORB-2 exceeds the COP value of 10,000 MPN/100mL.

3.2.3.4 Additional Analytes Results

Additional analytes were collected prior to the stormwater release for the composite samples ORB-Add-2 and X-ORB-Add-2. General chemistry (i.e., BOD, COD, chloride, cyanide, and oil and grease) and organophosphorus pesticides results are presented in Table 11. These additional analytes will be used for the bioremediation study.

BOD ranged from not-detected (X-ORB-Add-2) to 6.9 mg/L for ORB-Add-2. COD ranged from 119 mg/L (ORB-Add-2) to 161 mg/L (X-ORB-Add-2). Chloride ranged from 15,143.34 mg/L (ORB-Add-2) to 17,594.57 mg/L (X-ORB-Add-2). Cyanide and oil and grease were not detected in both samples. There were no detected organophosphorus pesticides reported in the two composite samples.

Table 11. Summary of Additional Analytes Wet Weather Water Quality Chemistry

Parameter	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater Oxford Retention Basin ORB-Add-2 01/13/2010	Saltwater Exchange X-ORB-Add-2 01/13/2010
General Chemistry						
BOD	mg/L				6.9	<2
COD	mg/L				119	161
Chloride by IC	mg/L				15143.34	17594.57
Cyanide	mg/L	0.01		0.001*	<0.005	<0.005
Oil & grease	mg/L				1.7J	1.6J
Organophosphorus Pesticides						
Azinphos methyl	ng/L				<10	<10
Bolstar (sulprofos)	ng/L				<2	<2
Chlorpyrifos	ng/L				<1	<1
Demeton	ng/L				<1	<1
Diazinon	ng/L				<2	<2
Dichlorvos	ng/L				<3	<3
Dimethoate	ng/L				<3	<3
Disulfoton	ng/L				<1	<1
Ethoprop (ethoprofos)	ng/L				<1	<1
Ethyl parathion	ng/L				<10	<10
Fenchlorphos (ronnel)	ng/L				<2	<2
Fenitrothion	ng/L				<10	<10
Fensulfothion	ng/L				<1	<1
Fenthion	ng/L				<2	<2
Malathion	ng/L				<3	<3
Merphos	ng/L				<1	<1
Methamidophos (monitor)	ng/L				<50	<50
Methidathion	ng/L				<10	<10
Methyl parathion	ng/L				<1	<1
Mevinphos (phosdrin)	ng/L				<8	<8
Phorate	ng/L				<6	<6
Phosmet	ng/L				<50	<50
Tetrachlorvinphos (stirofos)	ng/L				<2	<2
Tokuthion	ng/L				<3	<3
Trichloronate	ng/L				<1	<1

< = Results are less than the MDL.
J = Analyte was detected at a concentration below the reporting limit and above the laboratory MDL. Reported value is estimated.
*MDL is above WQO.

3.2.4 During Stormwater Release

3.2.4.1 Field Data Results

Physical parameter measurements were taken in the field during the wet weather event of January 12–13, 2010. The following results were taken on January 13, 2010, to represent conditions during stormwater release. The parameters measured were conductivity, pH, turbidity, DO, temperature, color, odor, clarity, and water depth. Measurements were recorded at each designated sample station in conjunction with sample collection. The data collected in the field are summarized in Table 9.

Oxford Retention Basin
Physical parameter measurements were not taken in the field during the stormwater release event in the Oxford Retention Basin.

Exchange Water
Field observations and measurements were only taken at one station, X-Basin E, to represent the Exchange Area water. Water depth was measured at 6.75 ft, and temperature was reported at 18.36ºC. Conductivity was 32.53 mS and turbidity was measured at 12.5 NTU. DO was measured at 7.48 mg/L and ph was measured at 8.02 at station X-Basin E.

Basin E
Water depth varied between the stations from 9.5 ft at Basin E-B to 13.0 ft at Basin E-C. Conductivity was consistent between the three stations ranging from 50.04 mS to 50.58 mS. Turbidity was also consistent among the stations ranging from 1.0 NTU to 1.7 NTU. DO ranged from 7.53 mg/L to 7.69 mg/L. pH ranged from 7.45 to 7.91. Temperature was consistent among the three stations monitored, ranging from 15.04ºC to 15.25ºC.

Boone Olive Pump Station
Field observations and measurements were only taken at one station (i.e., Boone Olive) to represent the Boone Olive Pump Station. Water depth was measured at 1.0 ft, and temperature was reported at 16.56ºC. Turbidity was relatively high, measured at 34.8 NTU. DO was measured at 7.36 mg/L, and ph was measured at 7.69 at the Boone Olive Pump Station.

3.2.4.2 Analytical Chemistry Results

Results of the wet weather (i.e., during stormwater release) water quality sampling are presented in Table 10. The results from composite sample X-BasinE-3 represent the Exchange Area, the results from the composite sample E-3 represents Basin E, and the results from the composite sample BO-3 represents Boone Olive Pump Station. These results were compared to the either the COP and/or the CTR as appropriate. In the results discussion below, 'J flag' values (i.e., estimated concentrations below the reporting limit) were considered not detected.

General Chemistry
Several nutrients were monitored as part of the ambient monitoring analyte list, including nitrate, nitrite, TKN, ammonia, and total orthophosphate (Table 10). Of these, a water quality benchmark is available for ammonia. Ammonia ranged from 0.13 mg/L in sample E-3, to 0.69 mg/L in sample BO-3; significantly less than the COP water quality criteria of 6.0 mg/L. TKN ranged from 0.872 mg/L (E-3) to 2.06 mg/L (B)-3). Orthophosphate results ranged from 0.08 mg/L (E-3) to 0.69 mg/L (BO-3). DOC results ranged from 2.9 mg/L (E-3) to 11.3 mg/L (BO-3). TOC results ranged from 4.3 mg/L (E-3) to 15.4 mg/L (BO-3). TDS ranged from 1,106 mg/L (BO-3) to 27,400 mg/L (E-3). TSS were ranged from 9.8 mg/L (E-3) to 39.3 mg/L (BO-3).

Organic Constituents Results

Acid-extractable compounds were not detected in samples E-3. Pentachlorophenol was reported at 951 ng/L in sample X-BasinE-3 and 1203 ng/L in sample BO-3, thus the total non-chlorinated phenolics were calculated at 951 ng/L and 1203 ng/L, respectively. These values are significantly below the COP value of 300,000 ng/L. Six base/neutral-extractable compounds were detected in sample X-Basin E-3, six compounds were detected in sample E-3, and seven compounds were detected in sample BO-3.

There were no chlorinated pesticides detected during the stormwater release in all three composite samples.

Aroclor PCBs were not detected in all three samples. Although 78 individual PCB congeners were detected in sample X-BasinE-3, 72 individual PCB congeners were detected in sample E-3, and 73 individual PCB congeners were detected in sample BO-3, total detectable PCBs were calculated at low concentrations of 12.8006 ng/L for sample X-BasinE-3, 6.2486 ng/L for sample E-3, and 5.9616 ng/L for BO-3.

Several PAH compounds were detected only in both samples. Total detectable PAHs were calculated (low + high molecular weight) at a concentration of 220.6 µg/L for X-Basin-E-3, 127.7 ng/L for sample E-3, and 857.8 µg/L for BO-3.

Eleven TPH-CC analytes were detected in sample X-BasinE-3, and the total C6-C44 TPH-CC was calculated at 270 µg/L. Two TPH-CC analytes were detected in sample E-3, and C29-C32 was reported at 18.0 µg/L and C33-36 was reported at 8.5 µg/L. Eleven TPH-CC analytes were detected in sample BO-3, and the total C6-C44 TPH-CC was calculated at 1,000 µg/L.

One VOC (methylene chloride) was detected in sample X-BasinE-3 at 2.9 µg/kg, one VOC (methylene chloride) was detected in E-3, at 2.3 µg/kg and one VOC (tetrachloroethene (PCE)) was detected 10.7 µg/kg.

Total and Dissolved Metals

The total and dissolved fractions of 17 metals were tested for in each of the composite samples during the stormwater release event. Only dissolved copper exceeded the CTR saltwater criteria (4.8 µg/kg) in sample E-3, reported at 7.02 µg/L. There were no other observed exceedances reported for dissolved metals in the three composite samples. Additionally, there were no observed exceedances reported for total metals in all three composite samples.

3.2.4.3 Microbiology Results

The indicator bacteria monitored during the stormwater release—representing the Exchange Area, and Basin E, and the Boone Olive Pump Station—included enterococci, fecal coliforms, and total coliforms. Enterococcus concentrations were measured at 1,664 MPN/100 mL for sample X-BasinE-3, 6,131 MPN/100 mL for sample E-3, and greater than 241,960 MPN/100 mL for sample BO-3, which exceed the COP values of 104 MPN/100 mL (Table 10). The fecal coliform concentrations ranged between 17,000 MPN/100 mL (BO-3) and 50,000 MPN/100 mL (E-3). All three station results exceed the COP values of 400 MPN/100 mL for fecal coliforms. The total coliform concentrations ranged between 50,000 MPN/100 mL (X-BasinE-3) and 240,000 MPN/100 mL (BO-3). All three station results exceed the COP values of 10,000 MPN/100 mL for total coliforms.

3.2.5 Oxford Retention Basin Drained

3.2.5.1 Field Data Results

Physical parameter measurements were taken in the field during the wet weather event of January 12–13, 2010. The following results were taken on January 13, 2010, to represent conditions while the Oxford Retention Basin was drained. The parameters measured were conductivity, pH, turbidity, DO, temperature, color, odor, clarity, and water depth. Measurements were recorded at each designated sample station in conjunction with sample collection. The data collected in the field are summarized in Table 9.

Oxford Retention Basin
Physical parameter measurements were not taken in the field during the event while the Oxford Retention Basin was drained.

Exchange Water
Physical parameter measurements were not taken in the field in the Exchange Area Water for the event conducted while the Oxford Retention Basin was drained.

Basin E
Water depth varied between the stations from 9.9 ft at Basin E-B to 13.0 ft at Basin E-C. Conductivity was consistent between the three stations ranging from 50.7 mS to 51.28 mS. Turbidity ranged among the stations from 0.3 NTU to 5.3 NTU. DO ranged from 6.33 mg/L to 7.84 mg/L. pH ranged from 7.81 to 7.93. Temperature was consistent among the three stations monitored, ranging from 15.14ºC to 15.22ºC.

Boone Olive Pump Station
Physical parameter measurements were not taken in the field at the Boone Olive Pump Station for the event conducted while the Oxford Retention Basin was drained.

3.2.5.2 Analytical Chemistry Results

Results of the wet weather (i.e., Oxford Retention Basin drained) water quality sampling are presented in Table 10. The results from the composite sample E-4 represent Basin E. These results were compared to the either the COP and/or the CTR as appropriate. In the results discussion below, ‘J flag’ values (i.e., estimated concentrations below the reporting limit) were considered not detected.

General Chemistry
Several nutrients were monitored as part of the ambient monitoring analyte list, including nitrate, nitrite, TKN, ammonia, and total orthophosphate (Table 10). Of these, a water quality benchmark is available for ammonia. Ammonia was reported at 0.08 mg/L in sample E-4, significantly less than the COP water quality criteria of 6.0 mg/L. TKN was reported at 0.586 mg/L. Orthophosphate was reported at 0.04 mg/L. DOC was reported as not detected TOC was 6.3 mg/L. TDS were 29,420 mg/L, and TSS was 5.0 mg/L.

Organic Constituents Results
Acid-extractable compounds were not detected in samples E-4. Three base/neutral-extractable compounds were detected in sample E-4.

There were no chlorinated pesticides detected during the Oxford Retention Basin drainage event in composite sample E-4.

Aroclor PCBs were not detected in all three samples. Although 65 individual PCB congeners were detected in sample E-4, total detectable PCBs were calculated at a low concentration of 5.96 ng/L.

Several PAH compounds were detected only in sample E-4. Total detectable PAHs were calculated (low + high molecular weight) at a concentration of 857.8 µg/L sample E-4.

Three TPH-CC analytes were detected in sample E-4. C25-C28 was reported at 19 µg/L, C29-C32 was reported at 18 µg/L and C33-C36 µg/L in sample E-4. One VOC (methylene chloride) was detected in sample E-4 at 1.8 µg/kg.

Total and Dissolved Metals
The total and dissolved fractions of 17 metals were tested for in each of the composite samples during the stormwater release event. Only dissolved copper exceeded the CTR saltwater criteria (4.8 µg/kg) in sample E-4, reported at 9.94 µg/L. There were no other observed exceedances reported for dissolved metals in the three composite samples. Additionally, there were no observed exceedances reported for total metals in all three composite samples.

3.2.5.3 Microbiology Results

The indicator bacteria monitored while the Oxford Retention Basin was drained—representing Basin E (composite sample E-4)—included enterococci, fecal coliforms, and total coliforms. Enterococcus concentrations were measured at 19,863 MPN/100 mL for sample E-3, which exceeds the COP value of 104 MPN/100 mL (Table 10). The fecal coliform concentrations were 13,000 MPN/100 mL, which exceeds the COP value of 400 MPN/100 mL for fecal coliforms. The total coliform concentrations were measured at 24,000 MPN/100 mL, which exceeds the COP value of 10,000 MPN/100 mL for total coliforms.

3.3 Water Sampling Results – Dry Weather

3.3.1 Sample Collection

The dry weather water quality field sampling program was completed on March 11, 2010, in accordance with the approved SAP. Two rounds of sampling were conducted during the sampling event, once during the ebbing tide and once during flooding tide. Table 8 presents the station locations where samples were collected during each sampling round. Boone Olive Pump Station was only sampled during the ebb tide.

The first round of sampling was conducted after the high tide peak, while the tide was receding (termed ‘ebb tide’). The ebb tide sampling round was conducted to evaluate how water discharged from Oxford Retention Basin and Boone Olive Pump Station may affect water quality in Basin E. Samples were collected from Oxford Retention Basin (with the tide gates closed), the Exchange water from the Oxford Retention Basin side of the tide gate, the Boone Olive Pump Station, and Basin E.

The second round of sampling was conducted after the low tide nadir, while the tide was filling in (termed ‘flood tide’). The flood tide sampling round was conducted to evaluate how flood water from Basin E may affect water quality in Oxford Retention Basin. Samples were collected from Basin E, the Exchange water from the Basin E side of the tide gate, and Oxford Retention Basin. All samples were taken after the tide gate between Oxford Retention Basin and Basin E was opened.

Due to extremely low water levels in Oxford Retention Basin during the flood tide sampling round, samples could not be taken at Station ORB-D or Station ORB-E. A strong current was created in Oxford Retention Basin while the tide gate was open. Water being discharged from Oxford Retention Basin to Basin E had significantly dropped the water level in the east end of the basin, leaving it inaccessible for sampling. Samples ORB-D and ORB-E were collected at Station ORB-C, where water levels were sufficient enough for sampling. These samples were processed following the procedure described in Subsection 2.3.2.

3.3.2 Ebbing Tide

3.3.2.1 Field Data Results

Physical parameter measurements were taken in the field during the dry weather event of March 11, 2010. The following results were taken on March 11, 2010, to represent the ebbing tide conditions. The parameters measured were conductivity, pH, turbidity, DO, temperature, color, odor, clarity, and water depth. Measurements were recorded at each designated sample station in conjunction with sample collection. The data collected in the field are summarized in Table 12.

Oxford Retention Basin
Water depth varied between the stations from 1.5 ft (ORB-C, ORB-D, and ORB-E) to 2.0 ft at ORB-A. Conductivity, a measure of the dissolved solutes in the water, ranged from 43.27 mS (ORB-E) to 45.65 mS (ORB-D). Turbidity ranged from 0.3 NTU (ORB-A) to 2.6 NTU (ORB-D). DO was relatively consistent among the five stations, ranging from 2.65 mg/L to 6.77 mg/L. pH ranged from 7.66 to 7.91. Temperature ranged from 14.59ºC to 17.29ºC among all five stations.

Exchange Water
Field observations and measurements were only taken at one station, X-Basin E to represent the Exchange Area water. Water depth was measured at 5.5-ft deep, and temperature was reported at 17.61ºC. Conductivity was 33.81 mS, and turbidity was measured at 2.9 NTU. DO was measured at 6.33 mg/L, and ph was measured at 7.93 at station X-Basin E.

Basin E
Water depth varied between the stations from 11.1 ft at Basin E-B to 14.7 ft at Basin E-C. Conductivity was consistent between the three stations ranging from 52.45 mS to 52.66 mS. Turbidity was also consistent among the stations ranging from 0.0 NTU to 1.4 NTU. DO ranged from 7.15 mg/L to 7.27 mg/L. pH ranged from 7.91 to 7.92. Temperature was consistent among the three stations monitored, ranging from 16.05ºC to 16.23ºC.

Boone Olive Pump Station
Field observations and measurements were only taken at one station, to represent the Boone Olive Pump Station. Water depth was measured at 2.4-ft deep, and temperature was reported at 18.41ºC. Conductivity was 7.51 mS and turbidity was measured at 0.4 NTU. DO was measured at 7.11 mg/L and ph was measured at 7.62 at the Boone Olive Pump Station.

3.3.2.2 Analytical Chemistry Results

Results of the dry weather (ebbing tide) water quality sampling are presented in Table 13 (the complete laboratory analytical data report for dry weather water quality samples is included in Appendix E). The results from Composite sample Basin E-D-1 represent Basin E, the results from the composite sample ORB-D-1 represent the Oxford Retention Basin, the results from the composite sample X-ORB-D-1 represents the Exchange Area, and the results from the composite sample BO-D-1represents The Boone Olive Pump Station. These results were compared to the either the COP and/or the CTR as appropriate. In the results discussion below, 'J flag' values (i.e., estimated concentrations below the reporting limit) were considered not detected.

General Chemistry
Several nutrients were monitored as part of the ambient monitoring analyte list, including nitrate, nitrite, TKN, ammonia, and total orthophosphate (Table 13). Of these, a water quality benchmark is available for

ammonia. Concentrations of ammonia in all four samples, Basin E-D-1, ORB-D-1, X-ORB-D-2, and BO-D-1 were significantly less than the COP water quality criteria of 6.0 mg/L. The greatest concentration was observed at X-ORB-D-1 (0.07 mg/L). TKN was recorded as not-detected in all four samples. Orthophosphate results ranged from 0.03 mg/L (Basin E-D-1) to 0.18 mg/L (BO-D-1).

DOC carbon results ranged from 2.6 mg/L (BO-D-1) to 7.4 mg/L (Basin E-D-1), and TOC results ranged from 2.0 mg/L (ORB-D-1) to 3.0 mg/L (X-ORB-D-1). DOC was not detected in sample ORB-D-1, and TOC was not detected in sample Basin E-D-1. TDS ranged from 3,944 mg/L (BO-D-1) to 32,760 mg/L (Basin E-D-1). TSS were not-detected in all four samples.

Organic Constituents Results

Acid-extractable compounds were not detected in all four composite samples. Base/neutral-extractable compounds were not detected in sample Basin E-D-1. Two base/neutral-extractable compounds were detected in sample ORB-D-1, three base/neutral-extractable compounds were detected in sample X-ORB-D-1, and one base/neutral-extractable compound was detected in sample BO-D-1.

There were no chlorinated pesticides detected during the dry weather, ebbing tide event in all four composite samples.

Aroclor PCBs were not detected in the four composite samples. No individual PCB congeners were detected in samples Basin E-D-1 and BO-D-1; only two individual PCB congeners were detected in sample ORB-D-1, and four individual PCB congeners were detected in sample X-ORB-D-1. Total detectable PCBs were calculated at a concentration of 2.0599 ng/L for ORB-D-1, and 2.3804 ng/L for X-ORB-D-1.

Total detectable PAHs were calculated (low + high molecular weight) at a concentration of 7.4 µg/L for Basin E-D-1, 90.1 ng/L for sample ORB-D-1, 37.8 ng/L for sample ORB-D-1, and 48.3 µg/L for BO-D-1.

Five TPH-CC analytes were detected in sample ORB-D-1 and the Total C6-C44 was reported at 110 µg/L. Four TPH-CC analytes were detected in sample X-ORB-D-1 and the Total C6-C44 was reported at 96 µg/L.

No VOCs were detected in sample Basin E-D-1 and sample X-ORB-D-1. One VOC (methyl bromide) was detected in sample ORB-D-1 at 0.5 µg/kg, two VOCs (methylene chloride and PCE) were detected in BO-D-1, at 1.0 µg/kg and 8.8 µg/kg, respectively.

Total and Dissolved Metals

The total and dissolved fractions of 17 metals were tested for in each of the composite samples during the pre-storm event. Only dissolved copper exceeded the CTR saltwater criteria (4.8 µg/L) in sample Basin E-D-1 (5.1 µg/L). There were no other exceedances reported for dissolved metals in all four samples. In addition, there were no observed exceedances for total metals in all four composite samples.

Table 12. Field Observations of Water Quality during Dry Weather Event

Parameter	Unit	Oxford Basin					Exchange Water	Basin E			Pump Station
		ORB-A	ORB-B	ORB-C	ORB-D	ORB-E	X-Basin E	Basin E-A	Basin E-B	Basin E-C	Boone Olive
Flood Tide											
Date		3/11/2010	3/11/2010	3/11/2010	Stations ORB-D and ORB-E were inaccessible due to low water levels; physical parameter measurements and samples collected at station ORB-C.		3/11/2010	3/11/2010	3/11/2010	3/11/2010	
Time		1245	1245	1245			1200	1400	1400	1400	
pH		7.77	7.88	7.91			7.70	7.85	7.27	7.82	
Conductivity	mS	37.65	25.42	26.06			46.04	52.37	52.31	53.32	
Turbidity	NTU	2.7	1.3	11.7			0.3	-0.3	0.1	0.0	
Dissolved Oxygen	mg/L	7.79	9.68	10.3			5.87	7.38	7.87	7.3	
Temperature	°C	19.74	20.75	20.87			16.73	16.71	16.46	16.55	
Color		None	None	Light Brown			None	None	None	None	
Odor		None	None	Organic			None	None	None	None	
Clarity		Clear	Clear	Slightly Turbid			Clear	Clear	Clear	Clear	
Water Depth (Total)	feet	1.7	0.41	0.41			7.4	10.8	9.7	12.5	
Fresh Water Lens Depth	feet	1.5	None	None			None	2.5	2.8	2.7	
Ebb Tide											
Date		3/11/2010	3/11/2010	3/11/2010	3/11/2010	3/11/2010	3/11/2010	3/11/2010	3/11/2010	3/11/2010	3/11/2010
Time		0800	0800	0800	0800	0800	1055	1015	1015	1015	0930
pH		7.91	7.83	7.88	7.66	7.87	7.93	7.92	7.91	7.91	7.62
Conductivity	mS	43.48	44.5	45.4	45.65	43.27	33.81	52.66	52.46	52.45	7.52
Turbidity	NTU	0.3	1.7	1.8	2.6	1.4	2.9	1.4	0.0	0.0	0.4
Dissolved Oxygen	mg/L	6.77	4.21	5.23	2.65	4.66	6.33	7.23	7.15	7.27	7.11
Temperature	°C	14.59	16.1	15.8	17.29	15.7	17.61	16.23	16.05	16.08	18.41
Color		None	None	None	None	None	None	None	None	None	None
Odor		Sulfide	None	None	Sulfide	Sulfide	None	None	None	None	Sulfide/ Anaerobic
Clarity		Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Water Depth (Total)	feet	3.3	2.2	1.6	1.7	1.6	5.5	12.5	11.1	14.7	2.4
Fresh Water Lens Depth	feet	2.0	1.9	1.5	1.5	1.5	None	None	None	None	N/A

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
General Chemistry												
pH	SM 4500 H+	pH Units				7.8 H	7.9 H	7.5 H	7.5 H	7.9 H	7.7 H	7 H
Total hardness as CaCO3	SM 2340 B	mg/L				5,778.30	5,050	4,836.50	5,094.20	2,852.50	3,651.60	899.9
TDS	SM 2540 C	mg/L				32,760	28,480	27,780	28,640	15,900	19,800	3,944
TSS	SM 2540 D	mg/L				3.8 J	3.2 J	4.2 J	4.5 J	23	3.5 J	1.3 J
DOC	SM 5310 B	mg/L				7.4	0.9 J	2.2	1.3 J	1.7 J	4	2.6
TOC	SM 5310 B	mg/L				0.8 J	1 J	3.1	2	2.1	3	2.7
Ammonia-N	SM 4500-NH3 F	mg/L	6			<0.03	0.07	0.11	0.16	0.14	0.15	0.03 J
Nitrite-N	SM 4500-NO2 B	mg/L				<0.01	0.02 J	0.03 J	0.04 J	0.05	0.07	0.01 J
Nitrate-N	SM 4500-NO3 E	mg/L				0.09	0.51	0.5	0.46	2.8	1.67	4.73
TKN	SM 4500-N D	mg/L				<0.456	<0.456	0.458 J	0.586 J	0.642 J	0.632 J	<0.456
Total orthophosphate as P	SM 4500-P E	mg/L				0.03	0.05	0.06	0.06	0.14	0.08	0.18
Total sulfides	SM 4500-S2 D	mg/L				<0.01	<0.01	<0.01	<0.01	0.02 J	<0.01	0.01 J
Indicator Bacteria												
E. coli	Colilert	MPN/100mL				30	10	<10	10	63	<10	20
Enterococci	Enterolert	MPN/100mL	104			20	20	<10	30	195	30	63
Fecal coliforms	SM 9221E	MPN/100mL	400			40	<20	<20	<20	230	<20	20
Total coliforms	SM 9221B	MPN/100mL	10,000			220	70	40	220	1400*	220	1,100
Total Metals												
Antimony (Sb)	EPA 1640m/EPA 200.8m	µg/L				0.21 B	0.45 B	0.52 B	0.47 B	0.76 B	0.86 B	0.4 J
Arsenic (As)	EPA 1640m/EPA 200.8m	µg/L	80			2.84	2.08	2.49	1.84	1.7	1.67	11.1
Barium (Ba)	EPA 200.8m	µg/L				11.2	17.6	21	19.8	38.6	32.5	56.3
Beryllium (Be)	EPA 1640m/EPA 200.8m	µg/L				0.042 B	0.031 B	0.041 B	0.036 B	0.052 B	0.04 B	<0.2
Cadmium (Cd)	EPA 1640m/EPA 200.8m	µg/L	10			0.076	0.089	0.066	0.067	0.123	0.06	<0.2
Chromium (Cr)	EPA 1640m/EPA 200.8m	µg/L	20			0.358	1.363	1.684	1.533	9.161	3.728	1.1
Cobalt (Co)	EPA 1640m/EPA 200.8m	µg/L				0.355 B	0.396 B	0.39 B	0.461 B	0.593 B	0.51	0.3 J
Copper (Cu)	EPA 1640m/EPA 200.8m	µg/L	30			6.99 B	5.92 B	3.98 B	4.78 B	8.82 B	3.81 B	0.9
Lead (Pb)	EPA 1640m/EPA 200.8m	µg/L	20			0.689 B	0.944 B	1.122 B	1.508	5.987 B	1.162 B	<0.05
Mercury (Hg)	EPA 245.7m	µg/L	0.4			<0.01	<0.01	<0.01	<0.01	0.01 J	<0.01	0.01 J
Molybdenum (Mo)	EPA 1640m/EPA 200.8m	µg/L				10.33 B	10.83 B	10.14 B	10.2 B	10.4 B	9.732 B	19.6
Nickel (Ni)	EPA 1640m/EPA 200.8m	µg/L	50			0.494 B	0.685 B	0.787 B	0.814 B	1.547 B	1.021 B	2.7
Selenium (Se)	EPA 1640m/EPA 200.8m	µg/L	150			0.02	0.05	0.05	0.04	0.07	0.05	4.4
Silver (Ag)	EPA 1640m/EPA 200.8m	µg/L	7			0.68 B	0.68 B	0.65 B	0.61 B	0.64 B	0.64 B	<0.5
Thallium (Tl)	EPA 1640m/EPA 200.8m	µg/L				0.009 J	0.007 J	<0.005	<0.005	0.005 J	<0.005	<0.1
Vanadium (V)	EPA 1640m/EPA 200.8m	µg/L				2.05	2.3	2.09	1.9	4.22	2.57	3.6
Zinc (Zn)	EPA 1640m/EPA 200.8m	µg/L	200			30.14 B	27.79 B	25.27 B	28.01 B	42.21 B	22.97 B	5.2 B
Dissolved Metals												
Antimony (Sb)	EPA 1640m/EPA 200.8m	µg/L				0.26 B	0.44 B	0.7 B	0.52 B	0.82 B	0.79 B	0.5
Arsenic (As)	EPA 1640m/EPA 200.8m	µg/L		340 (a)	69	2.26 B	1.7 B	1.29 B	1.75 B	1.34 B	1.49 B	12.6
Barium (Ba)	EPA 200.8m	µg/L				9.1	17.5	20.5	19.8	37.4	30.6	53.3
Beryllium (Be)	EPA 1640m/EPA 200.8m	µg/L				0.03 B	0.032 B	0.029 B	0.033 B	0.038 B	0.04 B	<0.2
Cadmium (Cd)	EPA 1640m/EPA 200.8m	µg/L		(b)	42	0.074 B	0.073 B	0.057 B	0.038 B	0.028 B	0.047 B	0.2 J

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
Chromium (Cr)	EPA 1640m/EPA 200.8m	µg/L		(b)	1100	0.17	0.874	0.792	0.578	4.902	2.625	1
Cobalt (Co)	EPA 1640m/EPA 200.8m	µg/L				0.374 B	0.502 B	0.415 B	0.4 B	0.442 B	0.46 B	0.4 J
Copper (Cu)	EPA 1640m/EPA 200.8m	µg/L		(b)	4.8	5.1 B	3.82 B	1.58 B	1.09 B	0.76 B	1.89 B	1.5
Lead (Pb)	EPA 1640m/EPA 200.8m	µg/L		(b)	210	0.131	0.051	0.032	0.025	0.077	0.057	0.12
Mercury (Hg)	EPA 245.7m	µg/L				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Molybdenum (Mo)	EPA 1640m/EPA 200.8m	µg/L				10.1	10.42	10.06	9.914	10.32	9.686	21
Nickel (Ni)	EPA 1640m/EPA 200.8m	µg/L		(b)	74	0.445 B	0.613 B	0.719 B	0.674 B	0.986 B	0.972 B	2.8
Selenium (Se)	EPA 1640m/EPA 200.8m	µg/L			290	0.02	0.04	0.04	0.04	0.07	0.03	5.6
Silver (Ag)	EPA 1640m/EPA 200.8m	µg/L		(b)	1.9	0.63 B	0.66 B	0.63 B	0.58 B	0.64 B	0.64 B	1.2
Thallium (Tl)	EPA 1640m/EPA 200.8m	µg/L				0.012	0.006 J	<0.005	<0.005	<0.005	<0.005	<0.1
Vanadium (V)	EPA 1640m/EPA 200.8m	µg/L				1.75	1.85	1.58	1.32	3.05	2.26	3.4
Zinc (Zn)	EPA 1640m/EPA 200.8m	µg/L		(b)	90	29.26 B	23.73 B	20.33 B	18.79 B	6.111 B	15.48 B	5.5
Acid-Extractable Compounds												
2,3,4,6-Tetrachlorophenol	EPA 625m	ng/L										<50
2,4,5-Trichlorophenol	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
2,4,6-Trichlorophenol	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
2,4-Dichlorophenol	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
2,4-Dimethylphenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
2,4-Dinitrophenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
2,6-Dichlorophenol	EPA 625m	ng/L										<50
2-Chlorophenol	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
2-Methyl-4,6-dinitrophenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
2-Methylphenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
2-Nitrophenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
3+4-Methylphenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
4-Chloro-3-methylphenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
4-Nitrophenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
Benzoic Acid	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
Pentachlorophenol	EPA 625m	ng/L		(c)	13000	<50	<50	<50	<50	<50	<50	<50
Phenol	EPA 625m	ng/L				<100	<100	<100	<100	<100	<100	<100
Total chlorinated phenolics	Calculations	ng/L	10000			<100	<100	<100	<100	<100	<100	<100
Total non-chlorinated phenolics	Calculations	ng/L	300000			<100	<100	<100	<100	<100	<100	<100
Base/Neutral-Extractable Compounds												
1,2,4-Trichlorobenzene	EPA 625m	ng/L				<10	<10	<10	<10	<10	<10	<10
2,4-Dinitrotoluene	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
2,6-Dinitrotoluene	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
2-Chloronaphthalene	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
3,3'-dichlorobenzidine	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
4-Bromophenylphenylether	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
4-Chlorophenylphenylether	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
Azobenzene	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
Benzidine	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
Butylbenzyl phthalate	EPA 625m	ng/L				40 J	44 J	41 J	57	58	58	60
Di-n-butyl phthalate	EPA 625m	ng/L				<75	<75	<75	91 J	98 J	<75	<75
Di-n-octyl phthalate	EPA 625m	ng/L				<10	<10	<10	17 J	58	<10	<10
Diethyl phthalate	EPA 625m	ng/L				<100	<100	<100	<100	115 J	167	<100
Dimethyl phthalate	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
Hexachlorobenzene	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
Hexachlorocyclopentadiene	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
Hexachloroethane	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
Isophorone	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
NDPA	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
N-Nitrosodimethylamine	EPA 1625M	ng/L				<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	2.5
N-Nitrosodiphenylamine	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
Nitrobenzene	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroethoxy)methane	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroethyl)ether	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
bis(2-Chloroisopropyl)ether	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
bis(2-Ethylhexyl) Phthalate	EPA 625m	ng/L				<100	178	<100	276	1118	148	<100
PAHs												
1-Methylnaphthalene	EPA 625m	ng/L				<1	<1	<1	<1	1.7 J	2.3 J	1.2 J
1-Methylphenanthrene	EPA 625m	ng/L				<1	<1	<1	<1	3.1 J	<1	<1
2,3,5-Trimethylnaphthalene	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
2,6-Dimethylnaphthalene	EPA 625m	ng/L				1 J	<1	1.2 J	5.1	15.7	3.3 J	<1
2-Methylnaphthalene	EPA 625m	ng/L				<1	<1	<1	<1	4.7 J	3.3 J	1.9 J
Acenaphthene	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Acenaphthylene	EPA 625m	ng/L				<1	<1	<1	<1	2.4 J	1.1 J	<1
Anthracene	EPA 625m	ng/L				<1	<1	<1	<1	3.5 J	<1	1.7 J
Benz[a]anthracene	EPA 625m	ng/L				<1	<1	<1	4.7 J	9.6	<1	<1
Benzo[a]pyrene	EPA 625m	ng/L				<1	<1	<1	3.3 J	11.9	<1	<1
Benzo[b]fluoranthene	EPA 625m	ng/L				<1	<1	<1	6.3	23.7	<1	<1
Benzo[e]pyrene	EPA 625m	ng/L				<1	<1	<1	3.4 J	21.2	<1	<1
Benzo[g,h,i]perylene	EPA 625m	ng/L				<1	<1	<1	13.3	21.2	<1	<1
Benzo[k]fluoranthene	EPA 625m	ng/L				<1	<1	<1	1.6 J	6.5	<1	<1
Biphenyl	EPA 625m	ng/L				1.6 J	1.6 J	2.1 J	2.3 J	5.1	3.6 J	2.2 J
Chrysene	EPA 625m	ng/L				<1	<1	3.8 J	11	28.2	1.8 J	5.7
Dibenz[a,h]anthracene	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Dibenzothiophene	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Fluoranthene	EPA 625m	ng/L				1.2 J	4.2 J	5.5	16.4	46.6	5.5	9.6
Fluorene	EPA 625m	ng/L				<1	<1	<1	<1	4.9 J	2.9 J	1.7 J
Indeno[1,2,3-c,d]pyrene	EPA 625m	ng/L				<1	<1	<1	<1	14.3	<1	<1
Naphthalene	EPA 625m	ng/L				2.2 J, B	3 J, B	3.1 J, B	3.4 J, B	9.7 B	5.1 B	6.8 B
Perylene	EPA 625m	ng/L				<1	<1	<1	<1	5.8	<1	<1

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
Phenanthrene	EPA 625m	ng/L				<1	2 J	3 J	4.6 J	20.1	5.1	10.2
Pyrene	EPA 625m	ng/L				1.4 J	3.4 J	4 J	14.7	38.7	3.8 J	7.3
Total detectable PAHs	Calculations	ng/L				7.4	14.2	22.7	90.1	298.6	37.8	48.3
TPH-CC												
C6	EPA 8015B (M)	ug/L				<1.4	<1.4	<1.4	<1.4	<2.8	<1.4	<1.4
C7	EPA 8015B (M)	ug/L				<6.1	<6.1	<6.1	<6.1	<12	<6.1	<6.1
C8	EPA 8015B (M)	ug/L				<9.9	<9.9	<9.9	<9.9	<20	<9.9	<9.9
C9-C10	EPA 8015B (M)	ug/L				<13	<13	<13	<13	<26	<13	<13
C11-C12	EPA 8015B (M)	ug/L				<14	<14	<14	<14	<29	<14	<14
C13-C14	EPA 8015B (M)	ug/L				<16	<16	<16	<16	<31	<16	<16
C15-C16	EPA 8015B (M)	ug/L				<17	<17	<17	<17	<34	<17	<17
C17-C18	EPA 8015B (M)	ug/L				<17	<17	<17	<17	<35	<17	<17
C19-C20	EPA 8015B (M)	ug/L				<18	<18	<18	<18	<35	<18	<18
C21-C22	EPA 8015B (M)	ug/L				<18	<18	<18	<18	<35	<18	<18
C23-C24	EPA 8015B (M)	ug/L				<18	<18	<18	<18	<35	<18	<18
C25-C28	EPA 8015B (M)	ug/L				<16	<16	<16	21	<31	24	<16
C29-C32	EPA 8015B (M)	ug/L				<8.5	<8.5	16	29	37	31	<8.5
C33-C36	EPA 8015B (M)	ug/L				<7.9	<7.9	14	25	30	25	<7.9
C37-C40	EPA 8015B (M)	ug/L				<6.8	8.2	14	20	28	16	<6.8
C41-C44	EPA 8015B (M)	ug/L				<6.6	<6.6	<6.6	20	19	<6.6	<6.6
C6-C44 Total	EPA 8015B (M)	ug/L				<47	<47	<47	110	110	96	<47
Chlorinated Pesticides												
2,4'-DDD	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
2,4'-DDE	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
2,4'-DDT	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
4,4'-DDD	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
4,4'-DDE	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
4,4'-DDT	EPA 625m	ng/L		1100	130	<1	<1	<1	<1	<1	<1	<1
Aldrin	EPA 625m	ng/L		3000	1300	<1	<1	<1	<1	<1	<1	<1
BHC-alpha	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
BHC-beta	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
BHC-delta	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
BHC-gamma	EPA 625m	ng/L		950	160	<1	<1	<1	<1	<1	<1	<1
Chlordane-alpha	EPA 625m	ng/L				<1	<1	<1	<1	3.3 J	<1	<1
Chlordane-gamma	EPA 625m	ng/L				<1	<1	<1	1.6 J	2.1 J	<1	<1
DCPA (dacthal)	EPA 625m	ng/L				<5	<5	<5	<5	<5	<5	<5
Dicofol	EPA 625m	ng/L				<50	<50	<50	<50	<50	<50	<50
Dieldrin	EPA 625m	ng/L		240	710	<1	<1	<1	<1	<1	<1	<1
Endosulfan sulfate	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Endosulfan-I	EPA 625m	ng/L	27	220	34	<1	<1	<1	<1	<1	<1	<1
Endosulfan-II	EPA 625m	ng/L	27	220	34	<1	<1	<1	<1	<1	<1	<1
Endrin	EPA 625m	ng/L	6	83	37	<1	<1	<1	<1	<1	<1	<1

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
Endrin aldehyde	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Endrin ketone	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Heptachlor	EPA 625m	ng/L		52	53	<1	<1	<1	<1	<1	<1	<1
Heptachlor epoxide	EPA 625m	ng/L		52	53	<1	<1	<1	<1	<1	<1	<1
Methoxychlor	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Mirex	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Oxychlordane	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Perthane	EPA 625m	ng/L				<5	<5	<5	<5	<5	<5	<5
cis-Nonachlor	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
trans-Nonachlor	EPA 625m	ng/L				<1	<1	<1	<1	1.1 J	<1	<1
Toxaphene	EPA 625mNCI	ng/L		730	210	<10	<10	<10	<10	<10	<10	<10
Total detectable BHC	Calculations	ng/L	12			<1	<1	<1	<1	<1	<1	<1
Total detectable chlordane	Calculations	ng/L				<1	<1	<1	1.6	6.5	<1	<1
Total detectable DDTs	Calculations	ng/L				<1	<1	<1	<1	<1	<1	<1
Aroclor PCBs												
Aroclor 1016	EPA 625m	ng/L				<10	<10	<10	<10	<10	<10	<10
Aroclor 1221	EPA 625m	ng/L				<10	<10	<10	<10	<10	<10	<10
Aroclor 1232	EPA 625m	ng/L				<10	<10	<10	<10	<10	<10	<10
Aroclor 1242	EPA 625m	ng/L				<10	<10	<10	<10	<10	<10	<10
Aroclor 1248	EPA 625m	ng/L				<10	<10	<10	<10	<10	<10	<10
Aroclor 1254	EPA 625m	ng/L				<10	<10	<10	<10	<10	<10	<10
Aroclor 1260	EPA 625m	ng/L				<10	<10	<10	<10	<10	<10	<10
Total aroclor	Calculations	ng/L				<10	<10	<10	<10	<10	<10	<10
PCB Congeners												
PCB003	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB008	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB018	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB028	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB031	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB033	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB037	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB044	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB049	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB052	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB056/060	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB066	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB070	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB074	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB077	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB081	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB087	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB095	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
PCB097	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB099	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB101	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB105	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB110	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB114	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB118	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB119	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB123	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB126	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB128	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB138	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB141	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB149	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB151	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB153	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB156	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB157	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB158	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB167	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB168+132	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB169	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB170	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB174	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB177	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB180	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB183	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB187	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB189	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB194	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB195	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB200	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB201	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB203	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB206	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB209	EPA 625m	ng/L				<1	<1	<1	<1	<1	<1	<1
Total PCBs for EPA 625m	Calculations	ng/L				<1	<1	<1	<1	<1	<1	<1
PCB1	EPA 1668A	ng/L				<0.019	<0.056	<0.03	<0.0082	<0.017	<0.017	<0.014
PCB10	EPA 1668A	ng/L				<0.042	<0.074	<0.028	<0.022	<0.016	<0.019	<0.024
PCB103	EPA 1668A	ng/L				<0.0066	<0.006	<0.0075	<0.0075	<0.0069	<0.0068	<0.0043
PCB104	EPA 1668A	ng/L				<0.0055	<0.012	<0.0074	<0.0093	<0.01	<0.0076	<0.005
PCB105	EPA 1668A	ng/L				0.0151 J	<0.024	0.0371 J	0.0492 J	0.26	0.0463 J	<0.0066

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
PCB106	EPA 1668A	ng/L				<0.0041	<0.0063	<0.0051	<0.0065	<0.0074	<0.0064	<0.0041
PCB107	EPA 1668A	ng/L				<0.0044	<0.0068	0.0084 J	0.0079 J	0.0484 J	0.0099 J	<0.0044
PCB108+124	EPA 1668A	ng/L				<0.0044	<0.0067	<0.0054	<0.0068	0.0228 J	<0.0067	<0.0043
PCB11	EPA 1668A	ng/L				0.057 J	0.1	0.1 J	0.1	0.21	0.13	<0.06
PCB110+115	EPA 1668A	ng/L				0.0696 J	0.105 J	0.143 J	0.178 J	1	0.18 J	0.0336 J
PCB111	EPA 1668A	ng/L				<0.0059	<0.0054	<0.0067	<0.0067	<0.0062	<0.0061	<0.0038
PCB112	EPA 1668A	ng/L				<0.0057	<0.0052	<0.0065	<0.0064	<0.0059	<0.0059	<0.0037
PCB114	EPA 1668A	ng/L				<0.005	<0.0076	<0.0061	<0.0077	0.0137 J	<0.0077	<0.0049
PCB118	EPA 1668A	ng/L				0.0473 J	0.068 J	0.0994 J	0.11	0.6	0.12	0.0218 J
PCB12+13	EPA 1668A	ng/L				<0.019	<0.02	<0.019	<0.0059	<0.015	<0.012	<0.0093
PCB120	EPA 1668A	ng/L				<0.0057	<0.0052	<0.0065	<0.0065	<0.006	<0.0059	<0.0037
PCB121	EPA 1668A	ng/L				<0.0059	<0.0054	<0.0067	<0.0067	<0.0062	<0.0061	<0.0038
PCB122	EPA 1668A	ng/L				<0.0048	<0.0073	<0.0059	<0.0075	<0.0086	<0.0074	<0.0047
PCB123	EPA 1668A	ng/L				<0.005	<0.0077	<0.0062	<0.0079	0.0129 J	<0.0078	<0.005
PCB126	EPA 1668A	ng/L				<0.0049	<0.0075	<0.006	<0.0077	0.0112 J	<0.0076	<0.0048
PCB127	EPA 1668A	ng/L				<0.0042	<0.0065	<0.0052	<0.0066	<0.0076	<0.0065	<0.0042
PCB128+166	EPA 1668A	ng/L				<0.011	<0.013	0.02 J	<0.023	0.153 J	0.027 J	<0.0082
PCB129+138+163	EPA 1668A	ng/L				0.066 J	0.099 J	0.13 J	0.162 J	0.85	0.161 J	0.041 J
PCB130	EPA 1668A	ng/L				<0.013	<0.014	<0.015	<0.012	0.053 J	<0.02	<0.0097
PCB131	EPA 1668A	ng/L				<0.013	<0.014	<0.015	<0.012	<0.013	<0.019	<0.0095
PCB132	EPA 1668A	ng/L				0.017 J	0.027 J	0.036 J	0.05 J	0.27	0.05 J	0.0113 J
PCB133	EPA 1668A	ng/L				<0.012	<0.013	<0.014	<0.011	<0.012	<0.018	<0.0089
PCB134+143	EPA 1668A	ng/L				<0.013	<0.014	<0.015	<0.012	0.033 J	<0.02	<0.0096
PCB135+151	EPA 1668A	ng/L				<0.017	0.022 J	0.028 J	<0.027	0.146 J	0.042 J	<0.012
PCB136	EPA 1668A	ng/L				<0.0077	<0.015	<0.011	<0.014	0.066 J	0.0151 J	<0.0085
PCB137	EPA 1668A	ng/L				<0.014	<0.015	<0.016	<0.013	<0.035	<0.021	<0.01
PCB139+140	EPA 1668A	ng/L				<0.012	<0.012	<0.013	<0.011	0.014 J	<0.018	<0.0086
PCB14	EPA 1668A	ng/L				<0.018	<0.018	<0.018	<0.0055	<0.014	<0.011	<0.0087
PCB141	EPA 1668A	ng/L				<0.012	<0.013	<0.015	0.024 J	0.13	0.023 J	<0.0087
PCB142	EPA 1668A	ng/L				<0.013	<0.014	<0.015	<0.012	<0.013	<0.02	<0.0097
PCB144	EPA 1668A	ng/L				<0.0096	<0.018	<0.013	<0.018	0.021 J	<0.012	<0.011
PCB145	EPA 1668A	ng/L				<0.008	<0.015	<0.011	<0.015	<0.013	<0.01	<0.0088
PCB146	EPA 1668A	ng/L				<0.011	<0.012	<0.014	0.018 J	0.095 J	0.02 J	<0.0083
PCB147+149	EPA 1668A	ng/L				0.044 J	0.063 J	0.079 J	0.095 J	0.46	0.104 J	0.0312 J
PCB148	EPA 1668A	ng/L				<0.0095	<0.018	<0.013	<0.017	<0.015	<0.012	<0.01
PCB15	EPA 1668A	ng/L				<0.026	<0.027	<0.026	<0.0082	<0.021	<0.016	<0.013
PCB150	EPA 1668A	ng/L				<0.008	<0.015	<0.011	<0.015	<0.013	<0.01	<0.0088
PCB152	EPA 1668A	ng/L				<0.0065	<0.012	<0.009	<0.012	<0.01	<0.0081	<0.0071
PCB153+168	EPA 1668A	ng/L				0.054 J	0.075 J	<0.086	0.111 J	0.54	0.128 J	0.0342 J
PCB154	EPA 1668A	ng/L				<0.0088	<0.017	<0.012	<0.016	<0.014	<0.011	<0.0097
PCB155	EPA 1668A	ng/L				<0.0065	<0.012	<0.009	<0.012	<0.01	<0.0081	<0.0071
PCB156+157	EPA 1668A	ng/L				0.0062 J	<0.01	0.0141 J	0.015 J	0.093 J	0.017 J	<0.0087

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
PCB158	EPA 1668A	ng/L				<0.0094	<0.01	<0.011	<0.015	0.0889 J	<0.014	<0.0069
PCB159	EPA 1668A	ng/L				<0.0054	<0.0093	<0.0088	<0.009	<0.0089	<0.0097	<0.0077
PCB16	EPA 1668A	ng/L				<0.018	<0.056	<0.025	<0.019	<0.022	<0.019	<0.02
PCB160	EPA 1668A	ng/L				<0.011	<0.011	<0.012	<0.0097	<0.01	<0.016	<0.0077
PCB161	EPA 1668A	ng/L				<0.0097	<0.01	<0.011	<0.009	<0.0095	<0.015	<0.0071
PCB162	EPA 1668A	ng/L				<0.0055	<0.0094	<0.009	<0.0092	<0.0091	<0.0099	<0.0078
PCB164	EPA 1668A	ng/L				<0.0094	<0.01	<0.011	0.0148 J	0.0652 J	<0.014	<0.0069
PCB165	EPA 1668A	ng/L				<0.011	<0.011	<0.012	<0.0098	<0.01	<0.016	<0.0078
PCB167	EPA 1668A	ng/L				<0.0059	<0.01	<0.0097	<0.01	0.033 J	<0.011	<0.0085
PCB169	EPA 1668A	ng/L				<0.0062	<0.011	<0.01	<0.01	<0.01	<0.011	<0.0088
PCB17	EPA 1668A	ng/L				<0.015	<0.048	<0.021	<0.017	<0.019	<0.016	<0.017
PCB170	EPA 1668A	ng/L				0.0127 J	0.013 J	0.0199 J	0.028 J	0.13	0.032 J	0.0126 J
PCB171+173	EPA 1668A	ng/L				<0.009	<0.01	<0.0094	<0.013	0.038 J	<0.014	<0.0096
PCB172	EPA 1668A	ng/L				<0.0092	<0.01	<0.0096	<0.013	<0.021	<0.014	<0.0098
PCB174	EPA 1668A	ng/L				<0.0086	<0.0096	0.0162 J	<0.023	0.12	0.028 J	<0.0092
PCB175	EPA 1668A	ng/L				<0.008	<0.013	<0.01	<0.013	<0.011	<0.015	<0.0065
PCB176	EPA 1668A	ng/L				<0.0064	<0.01	<0.008	<0.01	0.0103 J	<0.012	<0.0052
PCB177	EPA 1668A	ng/L				<0.0088	<0.0099	<0.0093	<0.012	0.067 J	0.017 J	<0.0094
PCB178	EPA 1668A	ng/L				<0.008	<0.013	<0.01	<0.013	0.019 J	<0.015	<0.0065
PCB179	EPA 1668A	ng/L				0.0069 J	<0.01	<0.0077	<0.0099	<0.032	0.013 J	0.0059 J
PCB18+30	EPA 1668A	ng/L				0.014 J	<0.039	<0.018	<0.014	0.042 J	0.027 J	<0.014
PCB180+193	EPA 1668A	ng/L				0.0235 J	0.0263 J	0.0445 J	0.049 J	0.24	0.065 J	<0.02
PCB181	EPA 1668A	ng/L				<0.0087	<0.0097	<0.0091	<0.012	<0.011	<0.013	<0.0093
PCB182	EPA 1668A	ng/L				<0.0084	<0.014	<0.01	<0.014	<0.011	<0.015	<0.0068
PCB183	EPA 1668A	ng/L				0.0085 J	0.0092 J	0.0121 J	0.017 J	0.0668 J	0.02 J	<0.0081
PCB184	EPA 1668A	ng/L				<0.0062	<0.01	<0.0077	<0.0099	<0.0082	<0.011	<0.005
PCB185	EPA 1668A	ng/L				<0.009	<0.01	<0.0095	<0.013	<0.011	<0.014	<0.0097
PCB186	EPA 1668A	ng/L				<0.0062	<0.0099	<0.0077	<0.0099	<0.0082	<0.011	<0.005
PCB187	EPA 1668A	ng/L				0.0147 J	0.019 J	0.027 J	0.031 J	0.12	0.032 J	<0.011
PCB188	EPA 1668A	ng/L				<0.007	<0.011	<0.0087	<0.011	<0.0093	<0.013	<0.0057
PCB189	EPA 1668A	ng/L				<0.0068	<0.0079	<0.01	<0.01	<0.012	<0.0077	<0.0085
PCB19	EPA 1668A	ng/L				<0.014	<0.043	<0.019	<0.015	<0.017	<0.015	<0.016
PCB190	EPA 1668A	ng/L				<0.0072	<0.008	<0.0076	<0.01	0.0261 J	<0.011	<0.0077
PCB191	EPA 1668A	ng/L				<0.0072	<0.0081	<0.0076	<0.01	<0.0089	<0.011	<0.0077
PCB192	EPA 1668A	ng/L				<0.0077	<0.0085	<0.008	<0.011	<0.0094	<0.012	<0.0082
PCB194	EPA 1668A	ng/L				<0.012	<0.012	<0.015	<0.015	0.058 J	<0.019	<0.01
PCB195	EPA 1668A	ng/L				<0.013	<0.012	<0.015	<0.016	0.023 J	<0.02	<0.011
PCB196	EPA 1668A	ng/L				<0.012	<0.013	<0.015	<0.016	<0.024	<0.015	<0.0074
PCB197	EPA 1668A	ng/L				<0.01	<0.011	<0.013	<0.013	<0.013	<0.013	<0.0061
PCB198+199	EPA 1668A	ng/L				<0.012	<0.013	<0.016	0.016 J	0.067 J	<0.015	<0.0074
PCB2	EPA 1668A	ng/L				<0.019	<0.058	<0.031	<0.0086	<0.018	<0.018	<0.015
PCB20+28	EPA 1668A	ng/L				0.0261 J	0.03 J	0.0278 J	0.0286 J	0.0724 J	0.0386 J	0.0126 J

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
PCB200	EPA 1668A	ng/L				<0.0093	<0.0096	<0.012	<0.012	<0.012	<0.012	<0.0056
PCB201	EPA 1668A	ng/L				<0.0096	<0.0099	<0.012	<0.012	<0.012	<0.012	<0.0057
PCB202	EPA 1668A	ng/L				<0.011	<0.011	<0.014	<0.014	<0.015	<0.014	<0.0066
PCB203	EPA 1668A	ng/L				<0.012	<0.012	<0.015	<0.015	0.038 J	<0.015	<0.007
PCB204	EPA 1668A	ng/L				<0.0099	<0.01	<0.012	<0.013	<0.013	<0.012	<0.0059
PCB205	EPA 1668A	ng/L				<0.011	<0.01	<0.013	<0.013	<0.013	<0.017	<0.0092
PCB206	EPA 1668A	ng/L				<0.012	<0.018	<0.013	<0.017	<0.042	<0.017	<0.013
PCB207	EPA 1668A	ng/L				<0.011	<0.015	<0.011	<0.014	<0.023	<0.015	<0.011
PCB208	EPA 1668A	ng/L				<0.013	<0.019	<0.014	<0.017	<0.028	<0.018	<0.014
PCB209	EPA 1668A	ng/L				<0.013	<0.04	<0.021	<0.032	0.042 J	<0.023	<0.01
PCB21+33	EPA 1668A	ng/L				<0.0075	<0.012	0.0085 J	0.009 J	0.0253 J	0.0162 J	<0.0047
PCB22	EPA 1668A	ng/L				<0.0055	<0.013	0.0071 J	0.007 J	0.0225 J	0.0113 J	<0.005
PCB23	EPA 1668A	ng/L				<0.0052	<0.013	<0.0067	<0.0061	<0.0062	<0.007	<0.0049
PCB24	EPA 1668A	ng/L				<0.012	<0.038	<0.017	<0.013	<0.015	<0.013	<0.014
PCB25	EPA 1668A	ng/L				<0.0046	<0.011	<0.0059	<0.0054	<0.0055	<0.0062	<0.0043
PCB26+29	EPA 1668A	ng/L				<0.0048	<0.012	<0.0062	<0.0056	0.0114 J	<0.0065	<0.0046
PCB27	EPA 1668A	ng/L				<0.012	<0.036	<0.016	<0.012	<0.014	<0.012	<0.013
PCB3	EPA 1668A	ng/L				<0.019	<0.056	<0.03	<0.0083	<0.017	<0.017	<0.014
PCB31	EPA 1668A	ng/L				0.0157 J	0.017 J	0.0201 J	<0.02	0.0667 J	0.0309 J	0.0127 J
PCB32	EPA 1668A	ng/L				<0.011	<0.033	<0.015	<0.011	0.016 J	<0.011	<0.012
PCB34	EPA 1668A	ng/L				<0.0049	<0.012	<0.0063	<0.0057	<0.0059	<0.0066	<0.0046
PCB35	EPA 1668A	ng/L				<0.0049	<0.012	<0.0063	<0.0058	<0.0059	<0.0066	<0.0047
PCB36	EPA 1668A	ng/L				<0.0044	<0.011	<0.0057	<0.0052	<0.0053	<0.0059	<0.0042
PCB37	EPA 1668A	ng/L				<0.0062	<0.015	<0.008	<0.0073	0.0218 J	0.0118 J	<0.0059
PCB38	EPA 1668A	ng/L				<0.005	<0.012	<0.0064	<0.0058	<0.006	<0.0067	<0.0047
PCB39	EPA 1668A	ng/L				<0.0047	<0.012	<0.0061	<0.0056	<0.0057	<0.0064	<0.0045
PCB4	EPA 1668A	ng/L				<0.04	<0.071	<0.026	<0.021	<0.027	<0.018	<0.023
PCB40+41+71	EPA 1668A	ng/L				0.0159 J	<0.015	0.0165 J	0.02 J	<0.065	<0.022	<0.0086
PCB42	EPA 1668A	ng/L				0.0079 J	<0.012	<0.0093	<0.011	<0.032	0.0128 J	<0.0089
PCB43	EPA 1668A	ng/L				<0.0086	<0.013	<0.011	<0.013	<0.011	<0.01	<0.01
PCB44+47+65	EPA 1668A	ng/L				0.0432 J	0.042 J	0.051 J	0.0821 J	0.263 J	0.07 J	0.012 J
PCB45+51	EPA 1668A	ng/L				<0.0068	<0.011	<0.0085	<0.01	<0.016	<0.0081	<0.0082
PCB46	EPA 1668A	ng/L				<0.0078	<0.012	<0.0098	<0.012	<0.01	<0.0093	<0.0094
PCB48	EPA 1668A	ng/L				<0.007	<0.011	<0.0088	<0.01	<0.018	0.0095 J	<0.0084
PCB49+69	EPA 1668A	ng/L				<0.025	0.0266 J	0.0338 J	0.0402 J	0.146 J	<0.036	<0.0072
PCB5	EPA 1668A	ng/L				<0.02	<0.021	<0.02	<0.0062	<0.016	<0.012	<0.0098
PCB50+53	EPA 1668A	ng/L				0.0084 J	<0.01	<0.0082	<0.0098	0.0239 J	0.0082 J	<0.0079
PCB52	EPA 1668A	ng/L				0.0515 J	0.068 J	0.0953 J	0.12	0.57	0.14	0.0156 J
PCB54	EPA 1668A	ng/L				<0.012	<0.039	<0.015	<0.02	<0.021	<0.019	<0.0095
PCB55	EPA 1668A	ng/L				<0.0063	<0.0095	<0.0094	<0.0096	<0.0073	<0.01	<0.011
PCB56	EPA 1668A	ng/L				0.0113 J	0.0156 J	0.0121 J	<0.013	0.0568 J	0.0194 J	<0.01
PCB57	EPA 1668A	ng/L				<0.0054	<0.0082	<0.0081	<0.0083	<0.0063	<0.0088	<0.0093

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
PCB58	EPA 1668A	ng/L				<0.0056	<0.0085	<0.0084	<0.0085	<0.0065	<0.0091	<0.0096
PCB59+62+75	EPA 1668A	ng/L				<0.0056	<0.0086	<0.007	<0.0083	<0.0071	<0.0066	<0.0067
PCB6	EPA 1668A	ng/L				<0.018	<0.019	<0.018	<0.0056	<0.015	<0.011	<0.0089
PCB60	EPA 1668A	ng/L				<0.006	<0.0091	<0.009	<0.0092	0.0312 J	<0.011	<0.01
PCB61+70+74+76	EPA 1668A	ng/L				0.0388 J	0.059 J	0.0707 J	0.0839 J	0.399 J	0.0951 J	0.019 J
PCB63	EPA 1668A	ng/L				<0.0052	<0.0079	<0.0078	<0.008	<0.0061	<0.0085	<0.009
PCB64	EPA 1668A	ng/L				0.0136 J	0.0142 J	0.0176 J	0.0207 J	0.0896 J	0.0231 J	<0.0066
PCB66	EPA 1668A	ng/L				0.0296 J	0.0425 J	0.0353 J	0.0433 J	0.14	0.0414 J	<0.0094
PCB67	EPA 1668A	ng/L				<0.0051	<0.0078	<0.0077	<0.0079	<0.006	<0.0084	<0.0088
PCB68	EPA 1668A	ng/L				<0.0051	<0.0078	<0.0077	<0.0079	<0.006	<0.0084	<0.0088
PCB7	EPA 1668A	ng/L				<0.018	<0.019	<0.018	<0.0057	<0.015	<0.011	<0.009
PCB72	EPA 1668A	ng/L				<0.0052	<0.0079	<0.0078	<0.008	<0.0061	<0.0085	<0.009
PCB73	EPA 1668A	ng/L				<0.0055	<0.0085	<0.0068	<0.0082	<0.007	<0.0065	<0.0066
PCB77	EPA 1668A	ng/L				<0.0074	<0.011	<0.011	<0.011	0.0385 J	<0.012	<0.013
PCB78	EPA 1668A	ng/L				<0.0056	<0.0085	<0.0084	<0.0086	<0.0065	<0.0091	<0.0096
PCB79	EPA 1668A	ng/L				<0.0048	<0.0073	<0.0072	<0.0074	0.007 J	<0.0078	<0.0083
PCB8	EPA 1668A	ng/L				<0.017	<0.018	<0.017	<0.0053	0.02 J	<0.011	<0.0084
PCB80	EPA 1668A	ng/L				<0.005	<0.0075	<0.0074	<0.0076	<0.0058	<0.0081	<0.0085
PCB81	EPA 1668A	ng/L				<0.0074	<0.011	<0.011	<0.011	<0.0086	<0.012	<0.013
PCB82	EPA 1668A	ng/L				<0.0084	<0.0076	<0.0095	0.0161 J	0.0839 J	0.0172 J	<0.0054
PCB83+99	EPA 1668A	ng/L				0.0424 J	0.0502 J	0.0669 J	0.0767 J	0.38	0.0676 J	0.0206 J
PCB84	EPA 1668A	ng/L				0.0137 J	<0.017	0.0286 J	0.0353 J	0.2	0.0407 J	<0.0054
PCB85+116+117	EPA 1668A	ng/L				0.0073 J	0.007 J	0.015 J	0.0194 J	0.0923 J	0.0201 J	<0.0039
PCB86+87+97+109+119+125	EPA 1668A	ng/L				0.0435 J	0.0578 J	0.0816 J	0.1 J	0.498 J	0.0984 J	0.0281 J
PCB88+91	EPA 1668A	ng/L				<0.0073	<0.0087	0.0147 J	0.0175 J	0.0932 J	0.0164 J	<0.0047
PCB89	EPA 1668A	ng/L				<0.0078	<0.0071	<0.0088	<0.0088	<0.0081	<0.0081	<0.005
PCB9	EPA 1668A	ng/L				<0.018	<0.019	<0.018	<0.0057	<0.015	<0.011	<0.009
PCB90+101+113	EPA 1668A	ng/L				0.0666 J	0.0887 J	0.124 J	0.127 J	0.66	0.138 J	0.0329 J
PCB92	EPA 1668A	ng/L				<0.011	<0.017	0.0231 J	0.0272 J	0.12	0.0264 J	<0.0052
PCB93+98+100+102	EPA 1668A	ng/L				<0.0074	<0.0067	<0.0084	<0.0083	0.0243 J	<0.0076	<0.0048
PCB94	EPA 1668A	ng/L				<0.008	<0.0073	<0.0091	<0.009	<0.0083	<0.0083	<0.0052
PCB95	EPA 1668A	ng/L				0.0513 J	0.063 J	0.0866 J	0.11	0.58	0.12	0.0235 J
PCB96	EPA 1668A	ng/L				<0.0071	<0.016	<0.0097	<0.012	<0.014	<0.0098	<0.0065
Total PCBs for EPA1668A	Calculation	ng/L				0.9433	1.2081	1.651	2.0599	11.1501	2.3804	0.3686
VOCs												
1,1,1-TCA	EPA 624	µg/L				<0.0365	<0.0365	<0.0365	<0.0365	<0.0365	<0.0365	<0.0365
1,1,2,2-Tetrachloroethane	EPA 624	µg/L				<0.0228	<0.0228	<0.0228	<0.0228	<0.0228	<0.0228	<0.0228
1,1,2-Trichloroethane	EPA 624	µg/L				<0.031	<0.031	<0.031	<0.031	<0.031	<0.031	<0.031
1,1-Dichloroethane	EPA 624	µg/L				<0.0076	<0.0076	<0.0076	<0.0076	<0.0076	<0.0076	<0.0076
1,1-Dichloroethene	EPA 624	µg/L				<0.0177	<0.0177	<0.0177	<0.0177	<0.0177	<0.0177	<0.0177
1,2-Dichlorobenzene	EPA 624	µg/L				<0.019	<0.019	<0.019	0.1 J	<0.019	<0.019	<0.019
1,2-Dichloroethane (EDC)	EPA 624	µg/L				<0.031	<0.031	<0.031	<0.031	<0.031	<0.031	<0.031

Table 13. Summary of Oxford Retention Basin Dry Weather Water Quality Chemistry

Parameter	Method	Units	COP	CTR Freshwater	CTR Saltwater	Saltwater						Freshwater
						Basin E	Basin E	Basin E Exchange	Oxford Retention Basin	Oxford Retention Basin	Oxford Exchange Area	Boone Olive Pump Station
						BASIN E -D -1	BASIN E -D -2	X -BASIN E -D -2	ORB -D -1	ORB -D -2	X -ORB -D -1	BO -D -1
1,2-Dichloropropane	EPA 624	µg/L				<0.0266	<0.0266	<0.0266	<0.0266	<0.0266	<0.0266	<0.0266
1,3-Dichlorobenzene	EPA 624	µg/L				<0.0283	<0.0283	<0.0283	0.1 J	<0.0283	<0.0283	<0.0283
1,4-Dichlorobenzene	EPA 624	µg/L				<0.031	<0.031	<0.031	0.2 J	<0.031	<0.031	<0.031
2-Chloroethyl vinyl ether (2-CVE)	EPA 624	µg/L				<0.0951	<0.0951	<0.0951	<0.0951	<0.0951	<0.0951	<0.0951
Acrolein	EPA 624	µg/L				<0.8217	<0.8217	<0.8217	<0.8217	<0.8217	<0.8217	<0.8217
Acrylonitrile	EPA 624	µg/L				<1.401	<1.401	<1.401	<1.401	<1.401	<1.401	<1.401
Benzene	EPA 624	µg/L				<0.0118	<0.0118	<0.0118	<0.0118	<0.0118	<0.0118	<0.0118
Bromodichloromethane	EPA 624	µg/L				<0.0281	<0.0281	<0.0281	<0.0281	<0.0281	<0.0281	<0.0281
Bromoform	EPA 624	µg/L				<0.0347	<0.0347	<0.0347	<0.0347	<0.0347	<0.0347	<0.0347
Bromomethane (methyl bromide)	EPA 624	µg/L				0.3 J, B	0.2 J, B	0.3 J, B	0.5 B	0.2 J, B	0.4 J, B	0.4 J, B
Carbon Tetrachloride	EPA 624	µg/L				<0.0323	<0.0323	<0.0323	<0.0323	<0.0323	<0.0323	<0.0323
Chlorobenzene	EPA 624	µg/L				<0.019	<0.019	<0.019	<0.019	<0.019	<0.019	<0.019
Chloroethane (ethyl chloride)	EPA 624	µg/L				<0.0583	<0.0583	<0.0583	<0.0583	<0.0583	<0.0583	<0.0583
Chloroform	EPA 624	µg/L				<0.1795	<0.1795	<0.1795	<0.1795	0.2 J	<0.1795	<0.1795
Chloromethane (methyl chloride)	EPA 624	µg/L				<0.0763 J	<0.0763	<0.0763	<0.0763 J	<0.0763	<0.0763 J	<0.0763 J
Dibromochloromethane	EPA 624	µg/L				<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
Dichlorodifluoromethane (F12)	EPA 624	µg/L				<0.0654	<0.0654	<0.0654	<0.0654	<0.0654	<0.0654	<0.0654
Ethylbenzene	EPA 624	µg/L				<0.0156	<0.0156	<0.0156	<0.0156	<0.0156	<0.0156	<0.0156
MTBE	EPA 624	µg/L				<0.1318	<0.1318	<0.1318	<0.1318	<0.1318	<0.1318	<0.1318
Methylene chloride	EPA 624	µg/L				0.6 J	0.4 J	0.6 J	0.6 J	0.5 J	0.5 J	1
PCE	EPA 624	µg/L				<0.0167	0.3 J	<0.0167	<0.0167	0.2 J	0.1 J	8.8
Toluene	EPA 624	µg/L				<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
TCE	EPA 624	µg/L				<0.0277	<0.0277	<0.0277	<0.0277	0.2 J	0.1 J	0.3 J
Trichlorofluoromethane (F11)	EPA 624	µg/L				<0.0312	<0.0312	<0.0312	<0.0312	<0.0312	<0.0312	<0.0312
Vinyl chloride	EPA 624	µg/L				<0.0983	<0.0983	<0.0983	<0.0983	<0.0983	<0.0983	<0.0983
c-1,2-Dichloroethene	EPA 624	µg/L				<0.0215	<0.0215	<0.0215	<0.0215	<0.0215	<0.0215	0.3 J
c-1,3-Dichloropropene	EPA 624	µg/L				<0.0198	<0.0198	<0.0198	<0.0198	<0.0198	<0.0198	<0.0198
o-Xylene	EPA 624	µg/L				<0.0152	<0.0152	<0.0152	<0.0152	<0.0152	<0.0152	<0.0152
p/m-Xylene	EPA 624	µg/L				<0.0201	<0.0201	<0.0201	0.1 J	<0.0201	<0.0201	<0.0201
t-1,2-Dichloroethene	EPA 624	µg/L				<0.0403	<0.0403	<0.0403	<0.0403	<0.0403	<0.0403	<0.0403
t-1,3-Dichloropropene	EPA 624	µg/L				<0.0218	<0.0218	<0.0218	<0.0218	<0.0218	<0.0218	<0.0218

< = Results less than the MDL.
B = Analyte was detected in the associated method blank.
H = Samples received and/or analyzed past the recommended holding time.
J = Analyte was detected at a concentration below the reporting limit and above the MDL. Reported value is an estimate.
*Fecal coliforms : total coliforms ratio exceeds 0.1, therefore total coliform criterion becomes 1,000 MPN/100 mL.
(a) = Water quality benchmark for dissolved metal fractions are based on a default water effects ratios (WER) value of 1 and are calculated as described by the USEPA Federal Register Doc. 40 CFR Part 131, May 18, 2000.
(b) = Water quality benchmark for dissolved metal fractions are based on total hardness and are calculated as described by the USEPA Federal Register Doc. 40 CFR Part 131, May 18, 2000. The criterion maximum concentration (CMC) was used.
(c) = Water quality benchmark for Pentachlorophenol is based on pH as described by the USEPA Federal Register Doc. 40 CFR Part 131, May 18, 2000. The CMC was used.

3.3.2.3 Microbiology Results

A total of seven samples were collected from the Oxford Retention Basin, Basin E, and Boone Olive Pump Station. The indicator bacteria monitored during the dry weather, ebbing tide event—representing the Basin E, Oxford Retention Basin, Oxford Retention Basin Exchange Area, and Boone Olive Pump Station—included *E. coli*, enterococci, fecal coliforms, and total coliforms.

E. coli was not detected in the X-ORB-D-1 sample, and ranged from 10 MPN/100 mL (ORB-D-1) to 30 MPN/100 mL (Basin E-D-1) for the other three samples. Enterococcus concentrations ranged from at 20 MPN/100 mL (Basin E-D-1) to 63 MPN/100 mL (BO-D-1), which is significantly below the COP values of 104 MPN/100 mL (Table 13). The fecal coliform concentrations ranged between 20 MPN/100 mL (BO-D-1) and 40 MPN/100 mL (Basin E-D-1), which is significantly below the COP values of 400 MPN/100 mL. Fecal coliforms were not detected in samples ORB-D-1 and X-ORB-D-1. The total coliform concentrations ranged between 220 MPN/100 mL (basins E-D-1, ORB-D-1, and X-ORB-D-1) and 1,100 MPN/100 mL (BO-D-1), which is also significantly below the COP values of 10,000 MPN/100mL.

3.3.3 Flooding Tide

3.3.3.1 Field Data Results

Physical parameter measurements were taken in the field during the dry weather event of March 11, 2010. The following results were taken on March 11, 2010, to represent the flooding tide conditions. The parameters measured were conductivity, pH, turbidity, DO, temperature, color, odor, clarity, and water depth. Measurements were recorded at each designated sample station in conjunction with sample collection. The data collected in the field are summarized in Table 12.

Oxford Retention Basin
Water depth varied between the stations from 0.41 ft at ORB-B and ORB-C to 1.7 ft at ORB-A. Conductivity, a measure of the dissolved solutes in the water, ranged from 25.42 mS (ORB-B) to 37.65 mS (ORB-A). Turbidity ranged from 2.7 NTU (ORB-A) to 11.7 NTU (ORB-C). DO was relatively consistent among the three stations, ranging from 7.79 mg/L to 10.3 mg/L. pH ranged from 7.77 to 7.91. Temperature was consistent among the three stations monitored, ranging from 19.74ºC to 20.87ºC.

Exchange Water
Field observations and measurements were only taken at one station, X-Basin E to represent the Exchange Area water. Water depth was measured at 7.4-ft deep, and temperature was reported at 16.73ºC. Conductivity was 46.04 mS, and turbidity was measured at 0.3 NTU. DO was measured at 5.87 mg/L and ph was measured at 7.70 at station X-Basin E.

Basin E
Water depth varied between the stations from 9.7 ft at Basin E-B to 12.5 ft at Basin E-C. Conductivity was consistent between the three stations ranging from 52.31 mS to 53.32 mS. Turbidity was also consistent among the stations ranging from -0.3 NTU to 0.1 NTU. DO ranged from 7.30 mg/L to 7.87 mg/L. pH ranged from 7.27 to 7.85. Temperature was consistent among the three stations monitored, ranging from 16.46ºC to 16.71ºC.

Boone Olive Pump Station
Field observations and measurements were not taken at the Boone Olive Pump Station during the flooding tide event.

3.3.3.2 Analytical Chemistry Results

Results of the dry weather (i.e., flooding tide) water quality sampling are presented in Table 13. The results from the composite sample Basin E-D-2 represent the Basin E, the results from the composite sample X-Basin E-D-2 represent the Basin E Exchange Area, and the results from the composite sample ORB-D-2 represent Oxford Retention Basin. These results were compared to the either the COP and/or the CTR as appropriate. In the results discussion below, 'J flag' values (i.e., estimated concentrations below the reporting limit) were considered not detected.

General Chemistry

Several nutrients were monitored as part of the ambient monitoring analyte list, including nitrate, nitrite, TKN, ammonia, and total orthophosphate (Table 13). Of these, a water quality benchmark is available for ammonia. Concentrations of ammonia in all three samples, Basin E-D-2, X-Basin E-D-2, and ORB-D-2 were significantly less than the COP water quality criteria of 6.0 mg/L. The greatest concentration was observed at ORB-D-2 (0.14 mg/L). TKN was recorded as not-detected in all three samples. Orthophosphate results ranged from 0.05 mg/L (Basin E-D-2) to 0.14 mg/L (ORB-D-2). DOC was only detected in sample X-Basin E-D-2 at 2.2 mg/L, and TOC results ranged from 2.1 mg/L (ORB-D-2) to 3.1 mg/L (X-Basin E-D-2). TOC was not detected in sample Basin E-D-2. TDS ranged from 15,900 mg/L (ORB-D-2) to 28,480 mg/L (Basin E-D-2). TSS were not-detected in samples Basin E-D-2 and X-Basin E-D-2. TSS was reported as 23.0 mg/L for sample ORB-D-2.

Organic Constituents Results

Acid-extractable compounds were not detected in all three composite samples. Base/neutral-extractable compounds were not detected in sample Basin E-D-1. One base/neutral-extractable compound was detected in sample Basin E-D-2, no base/neutral-extractable compounds were detected in sample X-Basin E-D-2, and three base/neutral-extractable compounds were detected in sample ORB-D-2. Bis(2-Ethylhexyl) Phthalate was recorded at 1,118 ng/L in sample ORB-D-2.

There were no chlorinated pesticides detected during the dry weather, flooding tide event in all three composite samples.

Aroclor PCBs were not detected in the three composite samples. No individual PCB congeners were detected in sample X-Basin E-D-2; only one individual PCB congener was detected in sample Basin E-D-2 and 29 individual PCB congeners were detected in sample ORB-D-2. Total detectable PCBs were calculated at a concentration of 1.2081 ng/L for Basin E-D-2 and at a concentration of 11.1501 ng/L for ORB-D-2.

Total detectable PAHs were calculated (low + high molecular weight) at a concentration of 7.4 µg/L for Basin E-D-1, 90.1 ng/L for sample ORB-D-1, 37.8 ng/L for sample ORB-D-1, and 48.3 µg/L for BO-D-1.

One TPH-CC analyte (C37-C40) was detected in sample Basin E-D-2 and reported at 8.2 µg/L. Three TPH-CC analytes (C29-C32, C33-C36, C37-C40) were detected in sample X-Basin E-D-2 and reported at 16.0 µg/L, 14.0 µg/L, and 14.0 µg/L, respectively. Four TPH-CC analytes were detected in Sample ORB-D-1 and the total C6-C44 was reported at 110.0 µg/L.

No VOCs were detected in all three composite samples.

Total and Dissolved Metals

The total and dissolved fractions of 17 metals were tested for in each of the composite samples during the pre-storm event. There were no exceedances reported for dissolved metals in all three composite samples. In addition, there were no observed exceedances for total metals in all three composite samples.

3.3.3.3 Microbiology Results

A total of seven samples were collected from the Oxford Retention Basin, Basin E, and Boone Olive Pump Station. The indicator bacteria monitored during the dry weather, ebbing tide event—representing the Basin E, Oxford Retention Basin, Oxford Retention Basin Exchange Area, and Boone Olive Pump Station—included *E. coli*, enterococci, fecal coliforms, and total coliforms.

E. coli was not detected in the sample X-Basin-D-2 and ranged from 10 MPN/100 mL (Basin E-D-2) to 63 MPN/100 mL (ORB-D-2). Enterococcus concentrations were not detected in sample X-Basin E-D-2 and ranged from 20 MPN/100 mL (Basin E-D-2) to 195 MPN/100 mL (ORB-D-2). The results for ORB-D-2 exceed the COP values of 104 MPN/100 mL (Table 13). Fecal coliform concentrations were not detected in sample Basin E-D-2 and X-Basin E-D-2. The fecal coliform concentrations for sample ORB-D-2 were reported at 230 MPN/100 mL, which is below the COP values of 400 MPN/100 mL. The total coliform concentrations ranged between 40 MPN/100 mL (X-Basin E-D-2) and 1,400 MPN/100 mL (ORB-D-2). The fecal coliform : total coliform ratio exceeded 0.1, thus the total coliform criterion became 1,000 MPN/100 mL, and the sample ORB-D-2 exceeded the COP criteria.

3.4 Quality Assurance / Quality Control

A complete review of analytical results is provided in Appendix F.

4.0 DISCUSSION AND CONCLUSIONS

As stated in the study objectives, water and sediment samples were collected from Oxford Retention Basin and Basin E in MdRH to characterize existing contaminant levels and to assess available options for water quality improvements and sediment disposal. Specifically, sediment and water quality characterizations were performed for the LADPW for the following purposes:

- Characterize sediments that have been deposited in the Oxford Retention Basin so that informed management decisions can be made in the future regarding excavation and water quality management.
- Determine the spatial extent of bacterial and chemical contamination in the sediments and in the water column within Oxford Retention Basin.
- Determine the organic composition of the sediment to examine evaluate the feasibility of bioremediation.
- Characterize water quality conditions in Oxford Retention Basin in relation to the compliance requirements of the Bacteria and Toxics TMDLs for Basin E within MdRH.
- Satisfy the necessary requirements to evaluate the disposal options for sediment removal from Oxford Retention Basin.

This section reviews each of these five main project objectives and discusses the data collected in this study relative to these objectives.

4.1 Objective 1

Characterize sediments that have been deposited in the Oxford Retention Basin so that informed management decisions can be made in the future regarding excavation and water quality management.

Subsection 3.1 (Sediment Sampling Results) presented a detailed characterization of sediments contained with Oxford Retention Basin. In summary, sediments in Oxford Retention Basin are comprised of the following two distinct layers:

- Unconsolidated sediments made up of recently deposited sediments, generally higher in organics and nutrients.
- Consolidated sediments made up of an artificial cap placed over an historical landfill that lies beneath the Oxford Retention Basin.

Sediments within Oxford Retention Basin are generally finer grained towards the discharge into Basin E and are generally coarser grained in the areas closer to the storm drain input. This characterization suggests that any management of sediments should focus on finer-grained sediments that pose the potential to transport constituents out into the MdRH.

Sediment characterization of unconsolidated layers suggests that Oxford Retention Basin contains sediments that exceed the Toxics TMDL compliance targets for metals and PCBs (Objective 4). If left undisturbed, these sediments may not impact compliance in Basin E. However, disturbance or flushing of these sediments has the potential to impact Basin E. Analysis of sediments suggests that excavation could be done in compliance with disposal regulations under the classification of hazardous material (per the State of California), specifically for chromium and lead (Objective 5). However, under federal guidelines, this material would not be classified as hazardous.

With regard to bacteria concentrations, sediments were not found to be a reservoir for bacteria and therefore removal and disposal of sediments would not appear to provide a management solution for compliance with the Bacteria TMDL targets.

Sediment management can therefore be approached in the following four ways:

1. Excavation can be implemented to remove unconsolidated sediments that may contribute to non-compliance with Toxics TMDL targets at the risk of disturbing finer grains and allowing further transport out into Basin E. Excavation of the consolidated layer is not recommended.
2. Unconsolidated sediments can be left undisturbed, and improved circulation can be implemented to reduce environmental fluctuations (which may cause bacterial growth) at the risk of allowing sediments to be resuspended and transported into Basin E.
3. Bioremediation (i.e., uptake of contaminants into bacteria, algae, or emergent vegetation) can be investigated (Subsection 4.3).
4. Leave the system as it is and allow sediments to remain undisturbed while assuming a risk of increased bacterial concentrations from a fluctuating environment.

4.2 Objective 2

Determine the spatial extent of bacterial and chemical contamination in the sediments and in the water column within Oxford Retention Basin.

A number of water quality and sediment quality studies have been undertaken in both Oxford Retention Basin and Marina del Rey's Back Basins providing directly comparable data for this study.

The studies used in comparison include the following:

- *Mother's Beach and Back Basins' Bacteria TMDL Non-Point Source Study* (WESTON, 2007).
- *Marina del Rey Harbor Sediment Characterization Study* (WESTON, 2008a).
- *Marina del Rey Annual Reports* (LADPW, 2008).

In this section, results of those previous studies are compared to the results of this study to address the objective stated above.

4.2.1 Sediment Conditions

Sediment collected with Oxford Retention Basin became increasingly finer-grained closer to the Exchange with Basin E, whereas the eastern portion of Oxford Retention Basin contained coarser-grained material. These results are consistent with the sediment grain-size data collected in the Marina del Rey Annual Reports, which found increasing grain size towards the centre of the main channels and finer grains sizes in those area of the MdRH with low flows and longer retention times. The grain-size analysis in the Oxford Retention Basin, comprising predominantly silts and clays, is consistent with these findings and suggest that deposition of finer grains towards the Exchange with Basin E is attributable to lower flows and longer retention times from the storm drain inputs.

Total metals were detected in all samples, with chromium and lead exceeding the STLC criteria in the excavation layer in the eastern portion of Oxford Retention Basin (Table 14). These results are consistent with the *Marina del Rey Sediment Characterization Study* (WESTON, 2008a), which used Isopleth mapping to assess pollutant distribution in sediments. The results showed that copper concentrations were higher in the main channel and Mother's Beach than in Basin E, suggesting that Oxford Retention Basin was not a source of copper. Analysis of lead in MdRH sediments found that the highest concentrations were at the mouths of the main channel and each Back Basin, with concentrations decreasing towards the further reaches of the basins. Basin E was found to have lower lead concentrations in comparison to other basins in this study, which was undertaken in 2007–2008. These results suggest that, while Oxford

Retention Basin may be a reservoir for some metals (e.g., chromium and lead), concentrations of most metals are higher outside of the Oxford Retention Basin and suggest an external source. previous studies have hypothesized that those sources may include maritime activities such as boat hull paints, storm drain discharges and inputs from outside the MdRH. Ballona Creek has been identified as a potentially significant external source for metal contamination.

Table 14. Summary of Results

	Sediment Quality	Wet Weather Water Quality	Dry Weather Water Quality
Boone Olive Pump Station	Not Applicable	Appears to be a source of total metals though dissolved metals were not detected. All dissolved values below the CTR. Appears to be a contributing source of bacteria at the Exchange and in Basin E. This site exceeded the WQO for bacteria stated in the TMDL	Boone Olive Pump station does not pump to Basin E during dry weather and concentrations of total and dissolved metals were below WQOs. Boone Olive Pump Station does not pump to Basin E during dry weather and concentrations of bacteria in the pump station were below WQOs.
Oxford Retention Basin	Total metals detected throughout Oxford Retention Basin; only chromium and lead exceeded STLC. No TTLC or TCLP exceedances. Trace amounts of semivolatile compounds, chlorinated pesticides and PCBs at some locations. Bacteria indicative of nutrient rich sediments.	Both total and dissolved metals were detected though all dissolved values below CTR. Appears to receive bacterial pollution from tributary storm drains and contribute bacteria to the Exchange and Basin E. Stormwater within Oxford Retention Basin exceeded the WQO for bacteria stated in the TMDL.	Both total and dissolved metals were detected though all dissolved values were below the CTR. Dry weather flows are diverted from Oxford Retention Basin. May be a reservoir for bacteria. One exceedance at ORB D-2 for total coliform and enterococcus exceeded the WQO for bacteria stated in the TMDL.
Exchange	Not Applicable	Both total and dissolved metals were detected and dissolved copper values were above the CTR. Appears to receive bacterial pollution from Oxford Retention Basin and contribute bacteria to Basin E. These sites exceed the WQO for bacteria stated in the TMDL.	Both total and dissolved metals were detected though all dissolved values were below the CTR. May receive bacterial pollution from the Oxford Retention Basin if conditions for bacteria regrowth in Oxford Retention Basin are optimal; though concentrations of bacteria in the exchange were below WQOs.
Basin E	Not Applicable	Both total and dissolved metals were detected and dissolved copper values were above the CTR. Appears to receive bacteria from the Exchange. These sites	Both total and dissolved metals were detected though all dissolved values were below the CTR with exception of dissolved copper at E-D-1. May receive bacterial

Table 14. Summary of Results

	Sediment Quality	Wet Weather Water Quality	Dry Weather Water Quality
		exceed the WQO for bacteria stated in the TMDL.	pollution from the Exchange if conditions for bacteria regrowth in the Oxford Retention Basin are optimal; though concentrations of bacteria in the Basin E were below WQOs.

Trace amounts of SVOCs (i.e., PAHs, base/neutrals, phthalates, and acid extractables), and chlorinated pesticides were found in the unconsolidated layer in the Oxford Retention Basin. Again, these results are consistent with those of the Marina del Rey Sediment Characterization Study, which found that concentrations of chlordane and PCBs were highest at the mouth of the Main Channel and were found only in very low concentrations in Basin E. Again, it has been postulated that a key source (e.g., Ballona Creek) is responsible for the majority of chlordane and PCBs in the main channel of the MdRH.

Indicator bacteria concentrations found in Oxford Retention Basin sediments in this study were comparable to those found in sediments at Mother's Beach during the *Mother's Beach and Back Basins' Bacteria TMDL Non-Point Source Study* (WESTON, 2007). This study showed that enterococcus concentrations in sediments within Mother's Beach were generally low (the majority of samples were at the MDLs) and were not a significant source of contamination to the receiving water. However, at the deeper sediment depths, where nutrients and organics are higher and sediment is constantly below the water line, concentrations of enterococci were found to increase at Mother's Beach. These results are consistent with the results found within the Excavation Layer of the Oxford Retention Basin sediments where enterococcus concentrations were between 3 MPN/gram and 133 MPN/gram. The results suggest that sediments within the Oxford Retention Basin are not a significant source of indicator bacteria.

4.2.2 Water Column Conditions

4.2.2.1 Wet Weather Monitoring Conditions

During wet weather monitoring, four conditions were monitored within Oxford Retention Basin, including 1) pre-storm, 2) post-storm but immediately prior to stormwater discharges from Oxford Retention Basin, 3) during stormwater discharges from Oxford Retention Basin, and 4) after Oxford Retention Basin had been completely drained of stormwater (Table 14). Prior to the storm, physical observations and measurements indicated a freshwater lens was not present in either Oxford Retention Basin or Basin E. After the storm, a freshwater lens appeared in Oxford Retention Basin, but Basin E still appeared well mixed. A shallow freshwater lens developed in Basin E during the discharge of stormwater from Oxford Retention Basin and persisted for at least two hours post-discharge.

Prior to the storm event, all indicator bacteria were below TMDL WQOs (Table 14**)**. However, during the storm events, all indicator bacteria were detected at levels that exceeded WQOs within Oxford Retention Basin and at the tidal Exchange. Although bacterial concentrations were elevated, there was no difference between the concentrations observed at each of the monitoring locations, with the exception of enterococcus concentrations at the Boone Olive Pump Station. Enterococcus concentrations at this site were one to two orders of magnitude higher than those observed within the Oxford Retention Basin, Exchange and Basin E. These results suggest that Boone Olive Pump Station may be a contributing source of fecal indicator bacteria during wet weather. These results are consistent with observations from the Mother's Beach and Back Basins' Bacteria TMDL Non-Point Source Study, which identified the Boone Olive Pump Station as a potential source of bacteria.

Nutrients and general chemistry were within expected ranges with no exceedances of COP objectives. As noted in the subsection below, the low nutrient concentrations may have been a causal link to the low bacterial concentrations observed in the water column.

There were detections for nearly all total and dissolved metals. There were exceedances of the WQO for one metal (i.e., dissolved copper at the tidal Exchange and in Basin E), which could contribute to concentrations of dissolved copper in Oxford Retention Basin.

PAHs, PCBs, TPH, VOCs, and base/neutral-extractable compounds (phthalates) were detected at low levels below WQO. Acid-extractable compounds and chlorinated pesticides were not detected in stormwater samples.

4.2.2.2 Dry Weather Monitoring Conditions

During dry weather monitoring, two conditions were monitored within Oxford Retention Basin (i.e., 1) ebbing tide and 2) flooding tide). During the ebbing tide, a freshwater lens was present within Oxford Retention Basin, but this lens was not apparent in Basin E. During the flooding tide, a freshwater lens was only apparent in the western portion of Oxford Retention Basin (Station ORB-A); a freshwater lens had also developed in Basin E. In both cases (i.e., Oxford Retention Basin during ebbing tide and Basin E during flooding tide), it was assumed the freshwater lens was from nuisance flow, but this study's results regarding nuisance flow origin (i.e., either from Oxford Retention Basin or Basin E) and potential transport mechanisms were inconclusive. Note that construction of the Washington/Thatcher low flow diversion and Marina del Rey low flow diversion systems was completed at the two primary stormwater conveyances in Oxford Retention Basin in January 2007 and January 2010, respectively. The Marina del Rey low flow diversion system was completed prior to the wet weather and dry weather monitoring events conducted as part of this study.

During both ebbing and flooding tide sampling events, all indicator bacterial concentrations during dry weather were low relative to the wet weather event and were near detection limits with the exception of one sample in Oxford Retention Basin during the flooding tide (Table 14). Total coliforms and enterococci in this sample exceeded WQOs. Analysis results of the Exchange water and Boone Olive Pump Station water quality showed bacteria concentrations below WQOs. These results are not consistent with observations from the Mother's Beach and Back Basins' Bacteria TMDL Non-Point Source Study, which showed dry weather indicator bacteria concentrations consistently exceeding WQOs. Although it is difficult to draw conclusions from only one monitoring event, this may due to the completion of the dry weather diversion in Oxford Retention Basin.

Nutrients and general chemistry were within expected ranges with no exceedances of COP objectives. As noted in the subsection below, the low nutrient concentrations may have been a causal link to the low bacterial concentrations observed in the water column.

With the exception of one sample, all total and dissolved metals were detected at concentrations below COP WQOs. There were no exceedances of WQOs for total and dissolved metals within the Oxford Retention Basin. Dissolved copper exceeded WQOs in one sample collected from Basin E at concentrations five times higher than those from the Oxford Retention Basin. These results suggest that Oxford Retention Basin is not a contributing source of metals during dry weather.

PAHs, PCBs, TPH, VOCs, base/neutral-extractable compounds (phthalates), and chlorinated pesticides were detected at low levels below WQO. Acid-extractable compounds were not detected in dry weather samples.

4.2.2.3 Overall Summary of Water Quality Conditions

With the exception of fecal indicator bacteria, sediment and water quality results are comparable to other studies conducted in MdRH, and demonstrate that Oxford Retention Basin and the Boone Olive Pump Station are not contributors of metals and toxics during dry weather and wet weather.

Contrary to the Mother's Beach and Back Basins' Bacteria TMDL Non-Point Source Study conducted in 2007, this study did not find higher concentrations of fecal indicator bacteria in the Oxford Retention Basin compared to concentrations in Basin E during wet weather. The 2007 study was conducted with temporally and spatially intensive sampling during dry weather and wet weather and provides a robust dataset for comparison. The study concluded that, due to low flushing, bacterial contamination was site specific within MdRH, and each basin was found to have its own local sources of bacteria. Basin E was identified as having the most complex contamination issues with both direct and in-direct sources, including birds, irrigation, the influence of Oxford Retention Basin and the Boone Olive Pump Station. A significant emphasis was placed on the impact of the Oxford Retention Basin and Boone Olive Pump Station with most bacterial exceedances occurring in direct proximity to the discharge point from Oxford Retention Basin. In addition, a rudimentary Excel-based model was prepared, which calculated potential bacterial load transfer between Oxford Retention Basin and Basin E. Overall, the 2007 study identified Oxford Retention Basin as a key contributing source of bacteria.

In contrast, this present study found lower than expected bacterial concentrations in the water column and sediments as well as unconsolidated sediments and low nutrients. These conditions suggest that bacterial survival and growth in Oxford Retention Basin was nutrient-limited at the time of sampling. The impact of nutrients, freshwater inputs and circulation can have significant repercussions on bacterial survival. The discrepancy in results may be explained in part by the temporal and spatial characteristics impacting indicator bacteria growth. Conditions within the Oxford Retention Basin on the day of sampling do not suggest the presence of a large reservoir within the water column. However, seasonal and spatial effects can change very rapidly with increases in nutrients, algae and decreases in UV penetration causing increases in bacterial growth. In addition, the completion of the Washington/Thatcher low flow diversion system and Marina del Rey low flow diversion system may assist in reducing inputs of indicator bacteria during dry weather.

To better control season and spatial fluctuations in bacterial growth, a increased circulation within the Oxford Retention Basin may be implemented. Increased circulation has the benefit of introducing more oxygen into the water column, maintaining an aerobic sediment structure and reducing algal growth. All these factors can assist in providing a steady state, rather than a fluctuating, environment that would reduce the risk of bacterial proliferation.

4.3 Objective 3

Determine the organic composition of sediment to examine and evaluate the feasibility of bioremediation.

Samples collected from the unconsolidated layer of sediment contained 58–66% solids, 4.1–5.6% TOC, and 724–1,110 mg/kg total organic nitrogen (TON) (calculated as TKN – ammonia-N).

There are several operational parameters that need to be considered with use of bioremediation as a treatment strategy for decreasing the organic carbon load of the Oxford Retention Basin. After discussions regarding the goodness-of-fit of microbial augmentation with Pro-Act Biotech (Warren, Rhode Island) and AquaBio Environmental Technologies, Inc. (Marina del Rey, California), TOC, DO, BOD, nutrients (i.e., ammonia, nitrate, phosphorus, etc.), vertical depth of the targeted sediments, overlying water depth, and operation of flow-control structures must be considered during an evaluation of this technology as a treatment option. If bioremediation successfully decreased all the available carbon within the excavatable layers, only a 3% decrease in mass would be realized. In other words, as a technology to solely decrease sediment mass in this basin, there would not be much 'bang for the buck.' However, addition of the right microorganism blend to this system would out-compete resident algae and bacteria populations for available nutrients in the sediments and stormwater influent and subsequently decrease their potential to be a nuisance to water quality in Oxford Retention Basin and Basin E.

Additional benefits to this system from bioaugmentation include but are not limited to decreased nutrient loads, increased oxygen concentrations in overlying waters, decreased odors, and a small increase in storage capacity. Algae fix carbon, using available oxygen to respire carbon dioxide into the water column and during eutrophic conditions can deplete oxygen concentrations below potentially harmful thresholds to resident biota within a confined basin. Introduction of microorganisms (that do not fix carbon dioxide) to the basin twice a year would suppress potential algae blooms and decrease the potential of oxygen depletion in the system. Additionally, without a large die-off of algae biomass in the fall/winter providing a pulse of carbon for decay, associated odors (due to ammonia, hydrogen sulfide, and methane) would decrease. If microorganisms were used for algae control in this system, chlorophyll concentrations could be monitored over time to measure treatment performance. Addition of this type of microorganism blend does not require additional supplements and or operational changes (e.g., discharge gate closure, and aeration) to the system and could be applied by current personnel with minimal training and health and safety concerns.

Stormwater contaminants (i.e., PCBs, chlordane, copper, lead, zinc, and nutrients) transported to the Oxford Retention Basin may be sequestered within the basin's sediments via sedimentation, precipitation, adsorption, and absorption and other transfers and transformations. Within a natural engineered treatment system, these contaminants may be simultaneously transferred to basin sediments and vegetation and/or transformed to less mobile chemical species. Adsorption to natural organic matter (NOM) and organic carbon is expected to be the primary transfer pathway of PCBs, organochlorine pesticides, and metals from the stormwater to sediments of this treatment system. Metals (e.g., copper, lead, and zinc) have a lithic biogeochemical cycle and have a predisposition to return to freshwater and marine sediments, especially when organic material is available for adsorption. Metals may also be absorbed by resident biota (e.g., hyperaccumulaters) and/or precipitate from the water to sediments depending on the hydrodynamics and ionic strength of the engineered system. If not utilized, sedimentation will also facilitate transfer of nutrients (N and P) to basin sediments. However, low concentrations of nitrogen and phosphorus flushing into this system should be quickly used by algae, bacteria, and floating vegetation in the system.

Speciation or a change in the oxidation state of dissolved metals is the primary transformation facilitated in a potential treatment system designed for stormwater mitigation. PCBs and organochlorine pesticides will biodegrade, but typically this transformation process occurs over the course of several years. Overall, several characteristics (i.e., pH, hardness, redox, and alkalinity) within the basin must be stabilized and maintained in order for these transfers and transformations to initially occur and be sustainable over time.

As previously discussed in Section 3 (Results), the SEM:AVS method is often used to determine the potential toxicity and speciation of divalent metals (i.e., copper, lead, and zinc) in a sediment sample. This method is based on the theory that AVS binds to divalent cationic metals and forms metal-sulfide complexes. Because these metal-sulfide complexes have low water solubility, they will subsequently precipitate to the sediments of the treatment system. Therefore, the ratio of SEM to the concentration of AVS in a sample may be measured to determine the metal speciation occurring within the basin's sediments. If SEM is higher than AVS (SEM:AVS ratio greater than 1), then some portion of the metals are not bound by AVS and probably in their ionic (i.e., dissolved) form. If SEM is less than AVS (i.e., SEM:AVS ratio is less than 1), then metal concentrations are bound to AVS within the sediments and in their precipitated form (i.e., salt or chelation).

The results from this study indicate that the current basin system is not engineered to maintain the chemical characteristics necessary to facilitate these desired transfers and transformations for the stormwater contaminants of concern. Neither the Oxford Retention Basin (excavated and consolidated sediments) nor Basin E had organic carbon (i.e., DOC and TOC) concentrations required for both adsorption and sufficient bacterial activity to decrease the system's redox for subsequent AVS production.

Confirmation of these results were indicated by SEM:AVS ratios greater than one in both excavation and consolidated sediment layers throughout the basin system. Remember, ratios greater than one indicate that AVS concentrations are insufficient for chelation of total metal concentrations and thus dissolved metal species are likely within the engineered system. Additionally, a significant increase in metals, PAHs, organochlorine pesticides, PCBs, and other hydrophobic contaminants concentrations were measured in the excavated layers of these basin sediments compared to consolidated sediments due to significantly higher organic material loads.

There are several factors to consider in the design of a natural engineered treatment system for these potential stormwater contaminants, as follows:

- Redox within the Oxford Retention Basin is probably positive due to tidal flushing and unpredictable stormwater events, thus a consistent overlying water depth is not maintained.
- Inputs of organic material are lost from the basin during daily, tidal flushing events.
- Hydraulic retention time and other hydrodynamic characteristics of these stormwater events have not been sufficiently modeled and correlated with the desired fate processes of these contaminants.
- The contaminants of concern have a predisposition to adsorb to organic matter, thus are transported with the organic materials out of the retention basin during these tidal events.
- Although native biota are present within the basin, these species may be antagonistic to the desired sediment characteristics required for this treatment system and its fate processes. Additionally, vegetation absorbs nutrients and other contaminants at varying rates depending on life-stage of the population. An appropriate operation and maintenance program should be designed and implemented to maintain optimal removal performance.

Recommendations to be considered include:

- Perform a cost–benefit analysis of bioaugmentation for algae control compared to other chemical treatment options and request proposals from qualified vendors.
- Review the literature for natural engineered treatment systems located in tidally influenced areas that mitigate comparable contaminants.
- Model the potential fate processes (i.e., transfers and transformations) of the contaminants of concern and prioritize those processes that are synergistic for this system.
- Quantify and model the treatment system for mass loading of organic material compared to contaminants.
- Review the hydrodynamics of the treatment system compared to the desired water and sediment quality characteristics.
- Inventory native vegetation species and perform a literature review for species that will facilitate desired water and sediment quality characteristics as well as potential hyperaccumulaters.

4.4 Objective 4

Characterize water quality conditions in Oxford Retention Basin in relation to the compliance requirements of the Bacteria and Toxics TMDLs for Basin E within MdRH.

4.4.1 Bacteria Total Maximum Daily Load

The MdRH Marina Beach and Back Basins' Bacteria TMDL established bacterial compliance targets and waste load allocations (WLAs) based on the numeric targets set under the Assembly Bill 411 health standards. The TMDL WLAs are expressed as allowable exceedance days or the maximum number of days where sampling results can surpass the established Assembly Bill 411 standards without exceeding the limits in the Bacteria TMDL. The indicator bacteria standards for the TMDL are presented in Table 15.

Table 15. Total Maximum Daily Load Compliance Limits

	Rolling 30-Day Geometric Mean Limit*	Single Sample Limit
Total coliforms	1,000 MPN/ 100 mL	1,000 MPN/ 100 mL if fecal > 10% of total, or 10,000 MPN/100 mL**
Fecal coliforms	200 MPN/100 mL	400 MPN/100 mL
Enterococci	35 MPN/100 mL	104 MPN/100 mL

*30-day limit is based on the geometric mean of 30 sample days. For days without sampling, the result for that day is applied to the remaining days of the week until the next sample event (excluding wet weather days).
**The total coliform single sample limit of 10,000 MPN decreases to 1,000 when the fecal coliform value is greater than 10% of total coliform value.

The Bacteria TMDL is divided into the following three defined seasons:

- *Summer Dry* – April 1 to October 3.
- *Winter Dry* – November 1 to March 31.
- *Wet Weather* – Year-round wet weather (defined as days of 0.1 inch of rain or more plus three days following the rain event).

Each season has its own compliance dates, requirements, and limits as provided in Table 16.

Table 16. Total Maximum Daily Load Compliance Targets

Compliance Categories	Compliance Dates	Compliance Days/Year
Summer dry weather	April 1–October 31	0 days per year (daily and weekly sampling)
Winter dry weather	November 1–March 31	3 days per year (daily sampling) 0 days per year (weekly sampling)
Wet weather	Rain event ≥ 0.1 inch at LAX rain gage, and three days following the end of the rain event	17 days per year (daily sampling) 3 days per year (weekly sampling)

In this study, bacteria samples were collected during both winter dry conditions (March 2010) and wet conditions (January 2010).

During wet weather, six of the nine bacterial water samples collected exceeded the Bacteria TMDL compliance targets. Compliance points for the TMDL are located in Basin E, where four samples were collected during wet weather. Of these, three of the four enterococcus samples exceeded the TMDL compliance targets while two of the four exceeded the fecal coliform and total coliform targets set out in the TMDL. Given these data, the discharges from Oxford Retention Basin and the Boone Olive Pump Station have an influence on TMDL compliance in Basin E.

During dry weather, one sample within Basin E, out of a total of seven sample locations, exceeded the Bacteria TMDL compliance targets for enterococci and total coliforms. Due to the limited temporal and spatial sampling undertaken in this study these results are inconclusive. However, analysis of the historical data collected in Marina del Rey, undertaken in the *Marina del Rey Harbor Mother's Beach and Back Basins' Indicator Bacteria TMDL Compliance Study* (WESTON, 2008b) indicated the following:

- TMDL compliance targets were mostly met with the exception of compliance monitoring stations during summer dry weather sampling events.

Station Type	% within TMDL Compliance Targets		
	Summer Dry Weather	Winter Dry Weather	Wet Weather
Compliance Monitoring	22%	89%	78%
Ambient Monitoring	80%	100%	100%

- Analysis of historical data showed that all stations exceeded the TMDL single sample compliance targets, although only four stations would have met the criteria for SWRCB §303(d) listing. Due to this difference in assessment methodology, the TMDL compliance targets are expected to be more difficult to achieve than meeting the SWRCB §303(d) listing policy.

4.4.2 Toxics Total Maximum Daily Load

Numeric targets for the Toxics TMDL were used to calculate WLAs for the impairing metals and organic compounds, and/or to indicate attainment of numeric limits (Table 17).

Table 17. Numeric Targets for Sediment Quality in the Marina del Rey Back Basins

Organics	Numeric Target for Sediment
Chlordane	0.5 µg/kg
Total PCBs	22.7 µg/kg
Copper	34 mg/kg
Lead	46.7 mg/kg
Zinc	150 mg/kg

The CTR criterion for the protection of human health from the consumption of aquatic organisms was selected as the final numeric target for total PCBs in the water column (Table 18). The interim numeric target is applied until advances in technology allow for the ultra-low detection of PCBs.

Table 18. Numeric Targets for Total Polychlorinated Biphenyls in the Water Column

	Numeric Target (µg/L)
Interim	0.03
Final	0.00017

Sediment
Data collected from Oxford Retention Basin showed that sediment Toxics TMDL compliance targets were not met for copper (101.9 mg/kg and 157.7 mg/kg), lead (306.3 mg/kg and 359.6 mg/kg), or zinc (459.2 mg/kg and 481.2 mg/kg) in the unconsolidated sediments. Total PCB concentrations were also higher than Toxics TMDL compliance targets in the unconsolidated sediments. The two sediment samples collected in the unconsolidated sediments had total PCB concentrations of 118.7 µg/kg and 269.8 µg/kg.

The implications for compliance with the Toxics TMDL are that Oxford Retention Basin may present a source of metals if those sediments were to be transferred into Basin E.

Water
Data collected from the Oxford Retention Basin during wet weather showed that concentrations of total PCBs ranged from 1.9 ng/L through 12.8 ng/L. The interim compliance target is 30 ng/L. Therefore, PCB concentrations in the water column during wet weather comply with Toxics TMDL compliance targets. During dry weather, total PCBs ranged from 0.3 ng/L to 11.1 ng/L again in compliance with Toxics TMDL targets.

4.4.3 Summary

Water and sediment quality, as it related to the Toxics TMDL, does not indicate that Oxford Retention Basin is a key contributor to exceedances in Basin E. However, during wet weather, the impact of Oxford Retention Basin, when all historical data are viewed as a whole, does have an impact on Basin E in terms of compliance with the Bacteria TMDL. In addition, while the bacteria results of dry weather monitoring in this study were low, data collected historically indicate that dry weather flows from Oxford Retention Basin will impact Basin E and will cause compliance issues in terms of the Bacteria TMDL. However, with the recent completion of the Washington/Thatcher low flow diversion system and Marina del Rey low flow diversion system in Oxford Retention Basin, further monitoring to be considered to determine if dry weather flows into Oxford Retention Basin may still impact Basin E or if the system will benefit (i.e., reduce indicator bacteria concentrations) the water quality within the Basin.

4.5 Objective 5

Satisfy the necessary requirements to evaluate the disposal options for sediment removal from Oxford Retention Basin.

4.5.1 Classification of Sediments

Sediment chemistry results were compared to the TTLC and ten times the STLC values. Briefly, TTLC and STLC values are published in Title 22 of the State of California Code of Regulations and are the benchmark for determining whether a solid, or its leachate, respectively, exhibits the characteristics of toxicity, thereby causing it to be classified as hazardous. If bulk chemistry values exceed ten times the STLC, it does not definitively classify the material as hazardous; rather, it suggests those analytes have the potential to exceed the STLC after conducting the WET. None of the analytes exceeded TTLC criteria; however, two analytes did exceed the ten times STLC criteria. These were chromium and lead. These data suggested the potential for leachate from these samples to exhibit the characteristics of toxicity, specifically from chromium and lead. Chromium exceeded in four samples (both composite samples representing the unconsolidated layer, and two individual station samples (S2 and S4) representing the consolidated layer). Lead only exceeded in two samples (both composite samples representing the non-unconsolidated layer).

Further analyses of these samples using the WET showed that chromium and lead results (4.4 mg/L and 2.4 mg/L, respectively) for sample S-1-5-EL, collected from the excavation layer, did not exceed STLC criteria (5 mg/L for both metals) and is therefore classified as non-hazardous material. On the other hand, the WET confirmed that chromium and lead results (5.5 mg/L and 5.3 mg/L, respectively) for sample S-6-10-EL, collected from the excavation layer, exceeded STLC criteria for both metals and is therefore classified as hazardous material as defined by the State of California. Material classified as (California) hazardous must be disposed of at approved facilities such as Clean Harbors Facility in Buttonwillow, California; Chemical Waste Management Facility in Kettleman City, California; or United States Ecology Facility in Beatty, Nevada. Material classified as non-hazardous may be disposed of at approved facilities such as Otay Landfill in Chula Vista, California.

Sediment was also subjected to TCLP tests. Briefly, the TCLP values are published in the Code of Federal Regulations (40 CFR §261.24) and are the federal benchmark for determining whether the leachate from a solid would be classified as toxic and, therefore, hazardous. None of the analytes exceeded published TCLP criteria. Therefore, the material would not be classified as hazardous under federal guidelines.

4.5.2 Volume of Material to be Excavated

Using the descriptions from our core logs, the unconsolidated layer depth for each station location was input into the geographic information system (GIS) project file and excavation volumes were calculated. Since multiple cores were collected at each station, a minimum volume (based on the thinnest layer of unconsolidated material observed in cores taken from each station), a maximum volume (based on the thickest layer of unconsolidated material observed in cores taken from each station), and an average volume (based on the average thickness of unconsolidated material observed in cores taken from each station) was calculated using the method described below.

Data from the ten core sample locations within the Oxford Retention Basin were used in an interpolation procedure to create a surface for the Oxford Retention Basin area that represented the unconsolidated layer depth. Three different surfaces were created that represented the minimum, maximum and mean depth of the unconsolidated layer based on the sediment data collection. The interpolation method used was Inverse Distance Weighted (IDW). The IDW interpolation implements the assumption that points that are close to one another are more alike than those that are farther apart. Therefore, to predict a value for any unmeasured location, IDW used the measured values surrounding the prediction location. Those measured values closest to the prediction location had more influence on the predicted value than those farther away. Cell values in the grid were determined using a linearly weighted combination of a set of sample points in which weight is a function of inverse distance. IDW is an exact interpolator meaning that the predictions will be exactly equal to the data value at locations where data has been input, and predicted values will not fall outside the range of the data input values.

For each of these depth estimates, a volume was calculated using the 3D Analyst Surface Analysis function, which calculates area and volume for a surface above or below a reference plane at a specified height. The height of the reference plane was set to zero, and statistics were calculated for the area above the plane.

There were no assumptions required of the data for IDW. Therefore, the measured values rather than a transformation of the data were used for this set of interpolations. The resulting grid values were then classified by multipliers of the effects range–low (ER-L) threshold. It should be noted that with IDW, there was no assessment of prediction errors, and IDW can produce bull's eyes around data locations as noted in some of the maps.

Based on this GIS exercise, the following estimated volume of material is to be removed:

- The minimum volume of material to be removed is 5,281 cy (142,600 ft^3).
- The maximum volume of material to be removed is 10,896 cy (294,200 ft^3).
- The average volume of material to be removed is 7,982 cy (215,500 ft^3).

4.5.3 Estimated Disposal Costs

Cost estimates associated with the transportation and disposal of hazardous unconsolidated sediments from Oxford Retention Basin to the Clean Harbors Facility in Buttonwillow, California are based on the following assumptions:

- Approximately 4,000 cy (108,000 ft^3) of hazardous material. Since composite sample S-6-10-EL exceeded STLC criteria for both chromium and lead, approximately half of the proposed volume of unconsolidated sediments to be removed from Oxford Retention Basin (4,000 cy) can be assumed to be comprised of hazardous material.
- A transportation and disposal cost of $85/ton (2,000 pounds) of material.
- A conservative weight estimate of 100 pounds/ft^3 for the excavated material.

The estimated total cost to dispose of 4,000 cy of hazardous sediment at the Clean Harbors Facility is $459,000. Costs to excavate the material are not included in this estimate.

Cost estimates associated with the transportation and disposal of non-hazardous dredged material from Oxford Retention Basin to the Otay Landfill in Chula Vista, California are based on the following assumptions:

- Approximately 4,000 cy (108,000 ft^3) of non-hazardous material. Since composite sample S-1-5-EL did not exceed STLC criteria for either chromium or lead, approximately half of the proposed volume of unconsolidated sediments to be removed from Oxford Retention Basin (4,000 cy) can be assumed to be comprised of non-hazardous material.
- A transportation and disposal cost of $45/ton (2,000 pounds) of material
- A conservative weight estimate of 100 pounds/ft^3 for the excavated material.

The estimated total cost to dispose of 4,000 cy of non-hazardous sediment at the Otay Landfill is $243,000. Costs to excavate the material are not included in this estimate.

The total estimated cost to dispose of approximately 8,000 cy of sediment from Oxford Retention Basin (4,000 cy of hazardous material + 4,000 cy of non-hazardous material) is $702,000.

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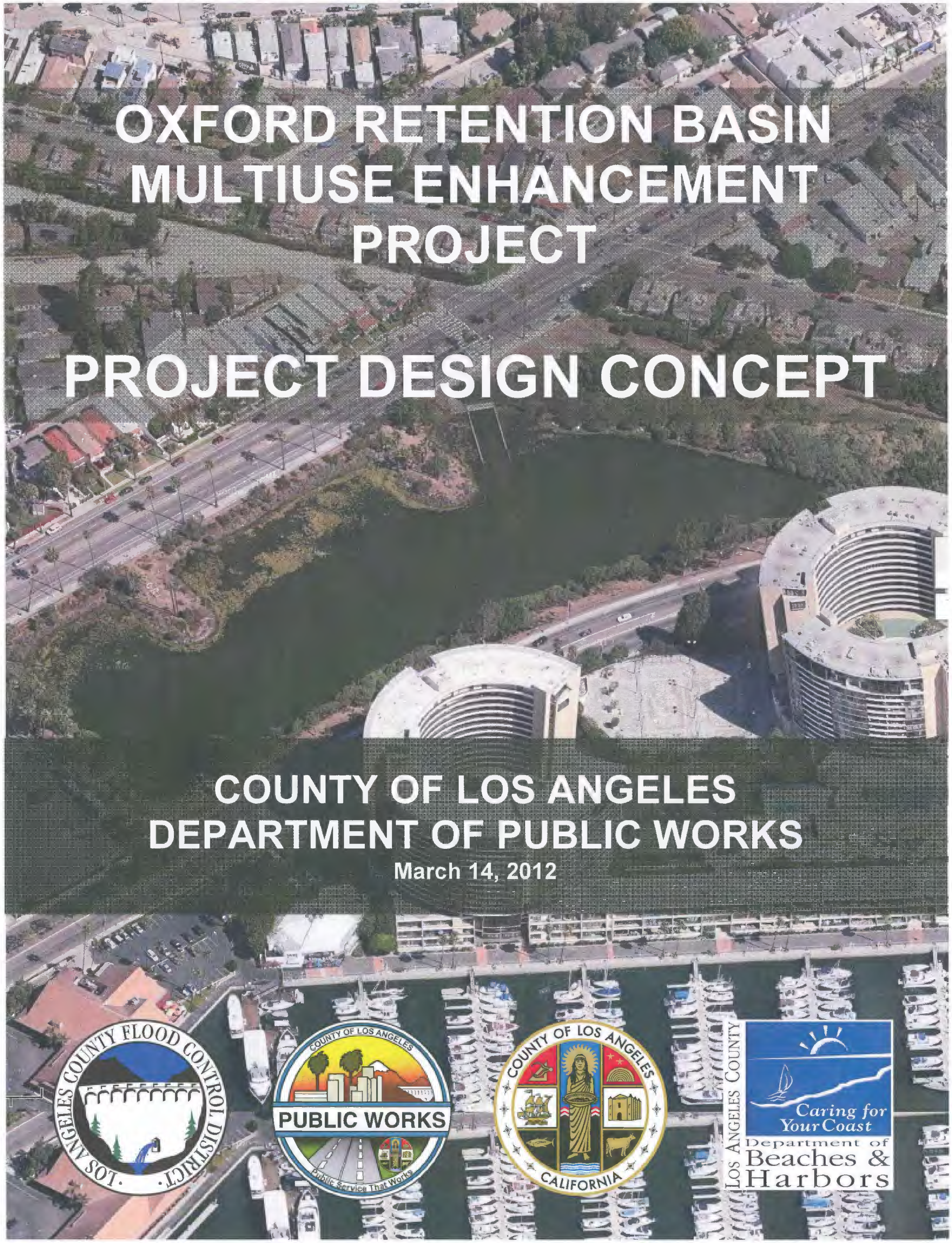
OXFORD RETENTION BASIN MULTIUSE ENHANCEMENT PROJECT

PROJECT DESIGN CONCEPT



COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

March 14, 2012

LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

COUNTY OF LOS ANGELES PUBLIC WORKS Public Service That Works

COUNTY OF LOS ANGELES CALIFORNIA

LOS ANGELES COUNTY Caring for Your Coast Department of Beaches & Harbors

Approved Patrick V. DeChellis 3.16.2012
Patrick V. DeChellis

Approved Diego Cadena
Diego Cadena

March 14, 2012

TO: Patrick V. DeChellis
Diego Cadena

FROM: Sree Kumar
Design Division

Gary Hildebrand
Watershed Management Division

PROJECT DESIGN CONCEPT
OXFORD RETENTION BASIN MULTIUSE ENHANCEMENT PROJECT
PROJECT ID FCC0001176, PCA JX0039

RECOMMENDATIONS

1. Approve the Project Design Concept (PDC) for the Oxford Retention Basin Multiuse Enhancement Project (Project) as described herein.

2. Approve a Project budget of $10,190,000 and request Watershed Management Division (WMD) to arrange for necessary financing over Fiscal Years (FY) 2012-15 as described in this PDC.

BACKGROUND

The Project is located at Oxford Retention Basin (Oxford Basin), a flood control facility operated by the Los Angeles County Flood Control District (LACFCD), one block north of Marina Del Rey Harbor Basin E (Basin E) in the unincorporated community of Marina Del Rey (Thomas Guide 671-J6).

The Project will mitigate localized flooding, address water quality deficiencies, enhance native habitat, improve the site's aesthetics, and provide passive recreation features.

WMD completed a Project Concept Report for the Project dated December 31, 2008. Design Division (DES) has studied and evaluated the alternatives for the Project and has refined the project scope and schedule.

PROJECT DESCRIPTION

The Project's scope of work is as follows:

LACFCD FUNDED WORK:

- Excavation of approximately 2,700 cubic yards (CY) of accumulated sediment along the bottom of Oxford Basin to restore basin capacity. The sediment will be disposed at a Class III landfill.

- Construction of a parapet wall along the northwestern and southern boundaries of Oxford Basin. The reinforced concrete wall will be approximately 1,050 linear feet long and a maximum of 2 feet in height. The wall will provide enhanced protection from flooding along Washington Avenue.

- Construction of a berm between the two existing tide gates and reprogramming the opening cycle of the existing tide gates to improve water circulation in Oxford Basin.

- Mitigation of localized flooding by modifying the existing 7-foot-wide catch basin on the south side of Oxford Avenue at the intersection of Oxford Avenue and Olive Street. The catch basin will be modified and a Tideflex "Check-mate" flap-gate will be installed at the connection to Project 5243. Local drainage will be further improved by the removal and replacement of existing Tideflex G-37 valves in four catch basins on Oxford Avenue and Olive Street with more efficient Tideflex "Check-mate" flap-gates.

- Installation of trash BMPs at the outlets of Storm Drain Project Nos. 5243 and 3872 to remove gross solids in urban and storm water runoff.

- Construction of a maintenance vehicle access ramp from Admiralty Way adjacent to the tide gate control house.

- Installation of a steel-grated landing above the two tide gate inlet structures in the basin to provide safer access for trash rack maintenance.

- Construction of a permanent boat ramp near the outlet of Project No. 3872 to allow Flood Maintenance Division (FMD) and the Department of Beaches and Harbors (DBH) access to Oxford Basin for routine maintenance, trash removal, and water quality monitoring.

COUNTY FUNDED WORK:

- Construction of an 8-foot-wide walking trail with wildlife-friendly lighting around the perimeter of Oxford Basin. The sidewalk along Admiralty Way will be replaced with landscaped parkway and integrated with the new walking trail.
- Reconstruct approximately 400 linear feet of slope along Admiralty Way near Project 3872 with geogrid or an approved equal to stabilize the underlying soils.
- Installation of approximately 3,550 linear feet of 4-foot-high ornamental steel fence around the perimeter of Oxford Basin.
- Removal of existing vegetation and approximately 6,200 CY of contaminated soils along the perimeter of Oxford Basin (3,200 CY and 3,000 CY to be disposed at Class I and Class III landfills, respectively) and replacement with clean imported fill and attractive, drought-tolerant native plants to provide aesthetic enhancement, which will also serve to enhance the habitat surrounding Oxford Basin.
- Installation of an irrigation system to establish the new native plants.
- Construction of six observation areas with park benches overlooking Oxford Basin: two along Washington Boulevard and four along Admiralty Way.
- Installation of interpretative signage at the observation decks and along the walking trail to educate users about stormwater pollution prevention measures, native plants, and area wildlife.

The project scope is also shown on Attachment A, artistic rendering of completed project, and Attachment B, Preliminary Design Plans.

DISCUSSION

The Oxford Basin site occupies an area of approximately 10.7 acres and currently has a large retention pond that is inundated year-round with urban and stormwater runoff, high groundwater, and tidal inflows from Basin E. A 10-foot-high chainlink fence encloses the facility, and there are a variety of trees and shrubs along the basin's steep banks. The facility lacks recreational amenities and has little aesthetic appeal. Oxford Basin is primarily a flood control facility, detaining urban and stormwater runoff from the surrounding area (approximately 700 acres) of the Marina Del Rey Watershed. There are automatically controlled tide gates, which allow Oxford Basin to drain to the Marina when the water surface elevation in the Marina is lower than that in Oxford Basin. On occasion, water in Basin E is allowed to enter the Oxford Basin through the gates for water recirculation purposes.

The Los Angeles Regional Water Quality Control Board (RWQCB) has identified Marina Beach ("Mother's Beach") and the Marina Del Rey Harbor Back Basins (Basins D, E, and F) as impaired water bodies. The jurisdictions within Oxford Basin's tributary drainage area are the Cities of Culver City and Los Angeles, the County of Los Angeles (County), and California Department of Transportation. Current Bacteria and Toxics Total Maximum Daily Load (TMDL) regulations call for an improvement to water quality in the Marina Del Rey Harbor back basins.

Basin Hydraulic Analysis

Two LACFCD storm drains discharge into Oxford Basin. Project No. 5243, constructed in 1969, was designed for the 10-year flow of 235 cubic feet per second (CFS), and Project No. 3872, constructed in 1972, was designed for the 10-year storm flows of 235 CFS. A new hydrology and storm routing analysis for Oxford Basin for a 50-year storm was conducted in August 2010, (Attachment D). The 50-year storm flow collected at Oxford Basin using the Watershed Modeling System and the Modified Rational Method was found to be 750 CFS. Based on initial water surface of 1.5 feet MSL in Oxford Basin and 2.7 feet MSL high tide water surface in the marina, routing the 50-year capital storm through the basin indicated that the maximum water surface in Oxford Basin would reach 4.9 feet MSL. While at this level, the discharge to the marina through the existing tide gates of 6-foot-by-6-foot reinforced concrete box and 81-inch diameter reinforced concrete pipe will be limited to 561 CFS. At an elevation of 4.9 feet MSL, the basin will have adequate storage capacity for 13.75 acre-feet. Under the 50-year capital storm event, the southerly and westerly perimeters of Oxford Basin will require a new parapet wall with the top-of-wall elevation at 8.0 feet MSL. This wall will provide the necessary freeboard to prevent flooding to the adjacent Parcel "OT" and along Washington Boulevard.

According to the hydraulic analysis conducted in 2010, when Oxford Basin reaches its maximum of 4.9 feet MSL, the low-lying subarea at the intersection of Oxford Avenue and Olive Street does not adequately drain into the Project 5243 Line "C" storm drain. This could lead to possible flooding above the property line within this reach for approximately 60 minutes before the basin water level recedes back to 3.8 feet MSL. In 2003, to address this flood hazard, check valves (Tideflex G-37) were installed on the connector pipes within the surrounding catch basins. However, one 7-foot-wide catch basin along Oxford Avenue could not be retrofitted with a check valve because it has a direct opening to the existing 6-foot-wide by 4-foot-high reinforced concrete box storm drain (Project 5243 Line "C").

The Project involves modification of the existing 7-foot-wide catch basin by separating the catch basin from Project No. 5243 and installing a check valve to isolate the potential backflow from the drain (See Attachment B, Sheet 3). Prior to forecasted storms, the basin is drained down to the lowest elevation possible, typically between -3.0 and -1.0 feet MSL. Any adverse affect on the lateral storm drain such as storm backflow along Oxford Avenue will be reduced. Therefore, based on the hydrology and reservoir routing analysis, the proposed improvements will alleviate flooding at the intersection of Olive Street and Oxford Avenue and no additional improvements are required on Oxford Avenue.

Water Circulation Operation

The Project will improve the water quality in Oxford Basin by increasing circulation and dissolved oxygen levels of the water within Oxford Basin. This will be accomplished by constructing a berm to direct flows around the basin and by revising the operation program of the tide gates to vary the water elevation between -2.0 and 1.5 feet MSL. This will facilitate better exchange of water between the Marina and the basin during high and low tides. Because the circulation will be powered by tidal action, the berm will have significantly lower maintenance requirements accomplishing the same goal as the mechanical circulation device included in the Project Concept Report.

The proposed berm structure will extend into the middle of Oxford Basin, separating incoming and outgoing flows and increasing circulation of water within Oxford Basin. The berm's function will be enhanced by strategic operation of the tide gates. For example, the west tide gate will be programmed to open during rising tides, sending water from Basin E into Oxford Basin, traveling upstream of the dividing berm. The east tide gate will be programmed to open during falling tides, forcing the water to circulate around the end of the berm and out of Oxford Basin into Basin E.

The top of the berm will be at 2.0 feet MSL and will be 2 feet wide. The berm will be planted with pockets of vegetation at an intermediate water elevation. The vegetation on the berm will potentially help to capture some of the pollutants in the water. See Attachment A for artistic renderings of the completed project.

Water Quality Enhancement

The proposed berm, modifications to the tide gate program, planting along the berm, landscaping on the embankment, and removal of deposited sediment will enhance circulation, increase oxygen levels in the water, remove pollutants, and improve the quality of water discharging from Oxford Basin.

To keep track of the improvements to the water quality, WMD will utilize data collected from the existing water quality monitoring system at station MdRH-5 in front of the tide gates, as well as the toxic monitoring station MdRH-B-2 in the middle of Basin E. Data collected from both stations will be used to evaluate the effectiveness of this Project.

Sediment Excavation

Removal of the contaminated sediment from Oxford Basin will ensure that this sediment is not contributing to concentrations of toxics, metals, or other pollutants of concern in the water within Oxford Basin prior to discharge to Basin E. A sediment and geotechnical study completed at Oxford Basin by URS Corporation in December 2011 identified evidence of elevated levels of hydrocarbons in sediment samples from the bottom of the basin. The report also identified the basin's perimeter to have levels of heavy metals above the thresholds for federal Resource Conservation and Recovery Act (RCRA) and California regulated (non-RCRA) hazardous material. Sediment removed from within the basin between elevation -3.0 MSL and elevation 1.0 MSL (approximately 2,700 CY) will be disposed at a Class III landfill and excavation material for retaining wall, access ramps and landscaping (approximately 300 CY) will need to be disposed at a Class I landfill. Staging, drying, and hauling of the excavated materials in the basin will be done as part of the contractor's soil management plan.

The landscaping work will require the excavation of approximately 6,200 CY of contaminated soil. Approximately 3,200 CY will be directed to a Class I landfill and 3,000 CY to a Class III landfill. This soil exceeds recommended agronomic thresholds, cannot be amended, and will need to be replaced for any type of planting to flourish. Biological assessments of the site have also recommended that approximately 150 non-native mature trees be removed to restore native habitat.

Based on the results and previous removal of material in the project area, the estimated total cost to remove the clean and hazardous soils is approximately $1.4 million, $300,000 for LACFCD funded work and $1.1 million for County funded work.

Recreational and Aesthetic Improvements

The community neighboring Oxford Basin has expressed a strong desire to add recreational and aesthetically pleasing amenities to the area surrounding the basin.

Replacement of the sidewalk along Admiralty Way with a landscaped parkway/bio-swale and construction of an 8-foot-wide decomposed granite walking trail around Oxford Basin will significantly improve the recreational appeal of Oxford Basin. In addition, replacement of existing vegetation with attractive, drought-tolerant native plants, installation of a 4-foot tall ornamental steel fence, construction of observation areas, interpretive signage, and improved wildlife friendly lighting will provide significant improvements to the site's aesthetics. See Attachment A for artistic renderings of the completed project.

The Oceana Del Rey retirement facility, a proposed multi-story housing development on Parcel OT (on the west side of Oxford Basin), is currently scheduled to begin construction in 2012. As part of their lease requirements, the developer has agreed to construct a walking trail and install landscaping in the adjacent space between the new complex and Oxford Basin. The trail and landscaping will be built to the same standard plans and architectural specifications as this Project. See Attachment C for plans of this proposed trail.

The Admiralty Way Settlement Repair Project is scheduled to begin in late 2012 and proposes a new temporary asphalt sidewalk, fencing, and grading into Oxford Basin. This sidewalk will be removed and replaced with a walking path as part of the Oxford Retention Basin Multiuse Enhancement Project.

RIGHT OF WAY AND MAINTENANCE

A construction easement from the City of Los Angeles will be required for the catch basin modification on Oxford Avenue and for construction of the walking trail along Washington Boulevard. No permanent easement or right-of-way acquisitions are required.

The County owns the Oxford Basin site, and the LACFCD, by agreement with the County, has unrestricted access to the site to maintain and operate its facilities thereon. This agreement stipulates that any construction projects initiated by the LACFCD on the Oxford Basin site must first be reviewed and approved by the DBH.

The maintenance responsibility of the non-flood control facilities on the Oxford Basin site, including the walking trail, landscaping, lighting, and other enhancements, has not been finalized. Watershed Management Division will facilitate the establishment of a Memorandum of Understanding (MOU) to be agreed upon by the County DBH, LACFCD, and/or the Department of Public Works for the maintenance of these improvements.

ENVIRONMENTAL DOCUMENT AND PERMIT REQUIREMENTS

Programs Development Division (PDD) has secured the services of Chambers Group as environmental consultant to prepare all required environmental documents. The consultant has determined the Project will require at least a Mitigated Negative Declaration, and that it may be necessary to prepare an Environmental Impact Report depending comments from the public review period from the constituents, regulatory agencies, and the general public. The Initial study will include Biological Resources, Cultural Resources, Hazards, and Hazardous Materials.

The Project is located within the coastal zone and must comply with the County-certified Local Coastal Program (LCP) for Marina Del Rey pursuant to Section 30519.5 of the Coastal Act. In addition, a Clean Water Act Permit for Section 401 from RWQCB and a Nationwide Permit from the United States Army Corps of Engineers will be required. The California Department of Fish and Game will require compliance with Section 1602 for any modifications made to Oxford Basin.

PROJECT CONSTRUCTABILITY AND ISSUES

High groundwater is expected during high tide. Dewatering will be required during excavation within the basin and will be subject to RWQCB regulations. Noise levels may need to be addressed due to construction activities that impact the bird nesting season.

All excavation and sediment disposal included in this Project will be required to comply with hazardous waste discharge requirements and the South Coast Air Quality Management District Rule 1166, Contaminated Soil Mitigation Plan. The trucking of material will be constant during grading and excavation, a truck route plan will need to be approved by the City of Los Angeles.

COMMUNITY OUTREACH

Public Works has been in contact with several stakeholders during the planning of this project. A chronological history of meetings with stakeholders can be seen on Attachment E.

TRAFFIC

A traffic detour plan will be required in order to allow the ingress and egress of heavy equipment to perform excavation operations at Oxford Basin. Detour and/or traffic control measures will also be required during perimeter construction activities.

UTILITIES

No utility relocations are anticipated for this Project.

DIVISION INVOLVEMENT FROM FISCAL YEAR 2009- FEB 2012

DES	Prepare PDC and preliminary design plans,	$	300,000
AED	Prepare preliminary design plans	$	34,000
SPM	Collect field data and create CADD file for DES	$	42,000
GMED	Preliminary Environmental Assessment & Geotechnical Report	$	325,000
CON	Preliminary utility notification	$	3,000
FMD	Review Project plan	$	2,000
PDD	Prepare Environmental report	$	60,000
PMD	Manage Project	$	180,000
TNL	Plan review	$	9,000
WMD	Oversee Project and coordinate with stakeholders	$	428,000
	Engineering Costs from 2009-2012	**$**	**1,383,000**

DIVISION INVOLVEMENT FROM FISCAL YEAR FEB 2012-14

DES	Prepare and complete final design plans, specifications, and engineer's estimate	$	175,000
AED	Prepare and complete final design plans, specifications, and estimate	$	86,000
SPM	Collect additional field data and review project plans.	$	33,000
GMED	Final Environmental Assessment & Geotechnical Report and review project	$	170,000
CON	Coordinate utility notification, prepare construction contract documents including all special monitoring for dewatering and disposal of contaminated material, provide construction contract administration,	$	77,000
FMD	Review Project plans.	$	3,000
PDD	Perform environmental study, prepare MND, obtain regulatory permits for environmental drilling and project construction, and prepare maintenance agreement with DBH	$	75,000
PMD	Manage Project	$	175,000
TNL	Prepare detour plans	$	11,000
WMD	Oversee Project and coordinate with stakeholders	$	112,000
	Estimated Engineering Costs 2012-2014	**$**	**917,000**

CONSTRUCTION ENGINEERING JANUARY 2014-2015

CON & OTHER SUPPORT DIVISIONS	Construction support – provide construction contract administration and inspection services.	$ 1,400,000

CONSTRUCTION COSTS

Drainage Improvements	$	1,000,000
Landscaping	$	1,200,000
Aesthetic Enhancements	$	1,500,000
Water Quality Enhancements	$	800,000
Excavation and disposal of sediment	$	1,400,000
Construction Contingency (10%)	$	590,000
Total Estimated Construction Costs	**$**	**6,490,000**

FUNDING BREAKDOWN

The LACFCD will provide funding for the parapet wall, modification to the catch basins on Oxford Ave, access ramps, removal of accumulated sediment within Oxford Basin, grading, and berm construction. The County of Los Angeles Supervisorial District 4 (SD4) has agreed to provide funding for landscaping and associated excavation, fencing, walking path, lighting, signage, and other aesthetic and recreational enhancements through their discretionary fund. Maintenance of the new access road and the berm will be funded by the LACFCD. Funding for maintenance of all proposed aesthetic and recreational improvements, including the fencing, lighting, walking path, and landscaping, will be arranged when establishing the MOU.

LACFCD Funded Work		
Engineering Expenditures in FY 2009-2012:	$	1,383,000
Engineering in FY 2012-2013 through FY 2014-2015:	$	917,000
Construction Engineering FY 2014-2015:	$	1,400,000
LACFCD Improvements (excavation, berm, etc)	$	2,300,000
Removal and Disposal of Accumulated Sediment	$	300,000
Construction Contingency (10%)	$	260,000
Total Estimated LACFCD Costs	**$**	**6,560,000**

SD4 Funded Work		
Fencing, Landscaping, Walking Path, Observation Deck/Areas, Aesthetic improvements	$	2,200,000
Excavation and Disposal of Contaminated Soil	$	1,100,000
Construction Contingency (10%)	$	330,000
Total Estimated Aesthetic Enhancement Costs	**$**	**3,630,000**
Total Estimated Project Costs	**$**	**10,190,000**

ISI RATING

Using the Institute for Sustainable Infrastructure's (ISI) Envision 2.0 draft sustainability rating tool released in January 2012, this project scored 438 points out of a possible 768 points (see Attachment F for summary).

PROJECT SCHEDULE

Milestone	Estimated Start (actual in **Bold**)	Estimated Finish (actual in **Bold**)
Project Design Concept	**April 2010**	**March 2012**
30% Plan	**June 2010**	**August 2010**
30% Plan Review	**September 2010**	**October 2010**
PDD - MND Report / Board approval	March 2012	October 2012
PDD – Drilling permits	**July 2011**	**September 2011**
GMED Environmental Assessment	**September 2011**	March 2012
60% Plan	**October 2010**	**March 2012**
60% Plan Review	March 2012	April 2012
First Utility Notice	March 2012	May 2012
Prepare and submit permit applications	August 2012	September 2012
Secure regulatory permits		September 2013
90% Plans, Specs, & Estimate	March 2012	May 2012
90% Plans, Specs, & Estimate Review	May 2012	June 2012
Final utility clearance	July 2012	September 2012
Final Plans, Specs, & Estimate	September 2012	September 2013
Signed Plans		September 2013
Advertise	September 2013	November 2013
Award		February 2014
Construction	March 2014	March 2015

PREPARED BY:

Charles Chen, Design Division
Drainage Section II

3/14/12
Date

Joshua Svensson, Watershed Management Division
Santa Monica Bay Watershed

3/14/12
Date

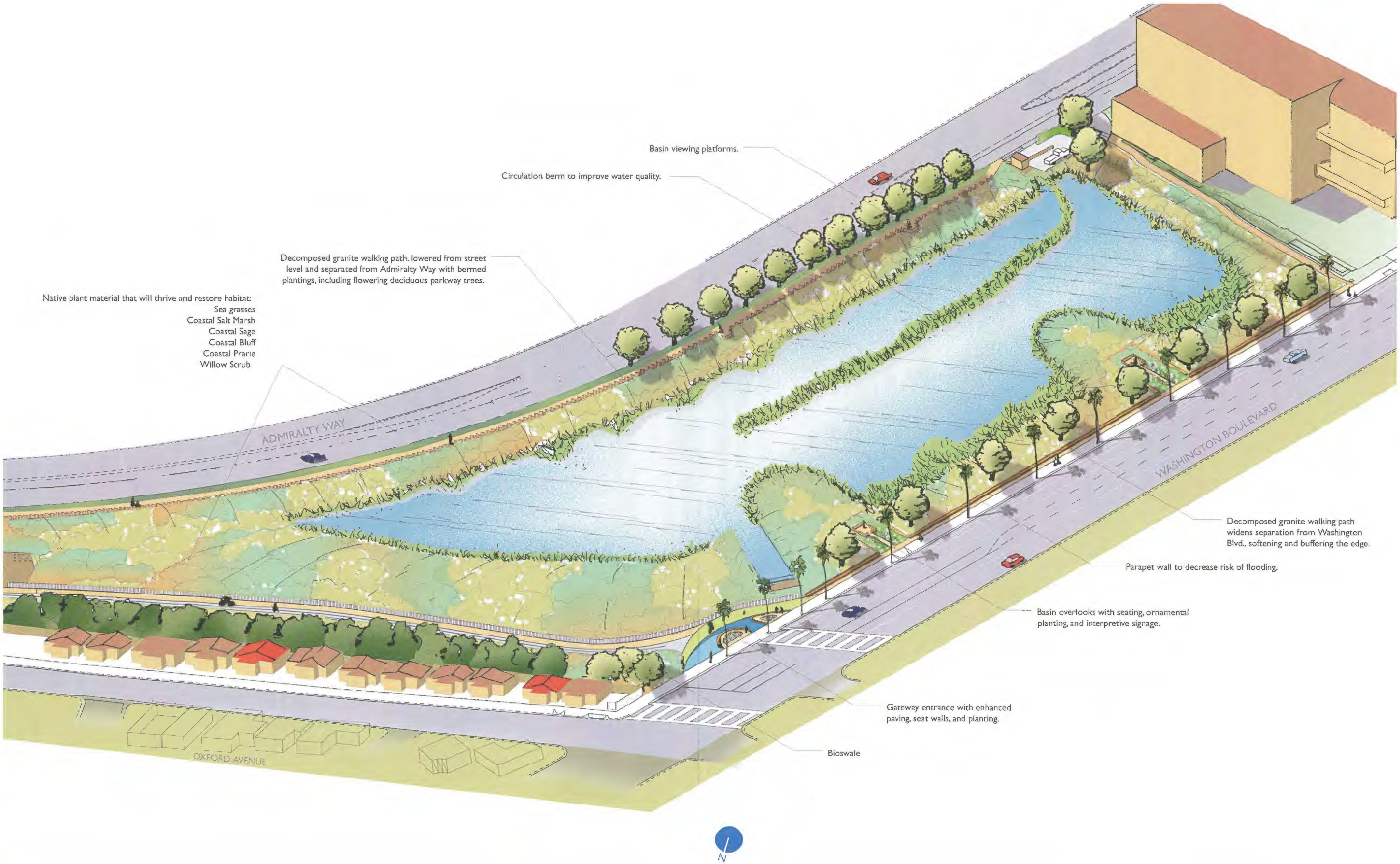
JTS:
CC:
P:\ddpub\Structures\Projects\Oxford Retention Basin PDC v6.4.docx

Attach.

cc: Construction (Sparks, Updyke, Dunn)
Flood Maintenance (Lee, South)
Geotechnical & Materials Engineering (Montgomery, Goodman)
Programs Development (Dingman)
Road Maintenance (MacGregor, MD 4)
Survey/Mapping & Property (Steinhoff, Jeffers)
Watershed Management (Hamamoto)
Project Management (Kearns, E-Nunu)
Design (Atashzay, Grindle)

ATTACHMENT A

PERSPECTIVE RENDERINGS OF
PROPOSED BASIN



OXFORD RETENTION BASIN MULTIUSE ENHANCEMENT PROJECT

Admiralty Way: Parkway planting and path elevation change buffers pedestrian path from traffic.

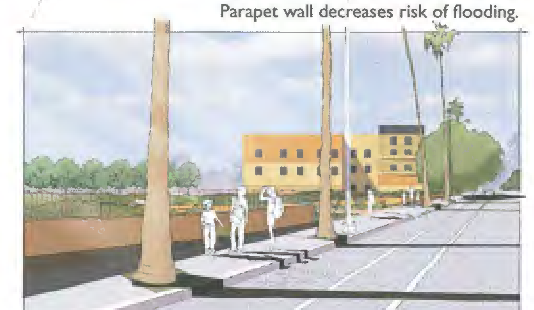
Basin Overlook: Ornamental planting, seating and interpretive signage at lookouts.

Bike path and decomposed granite walking path, ornamental fencing and native planting

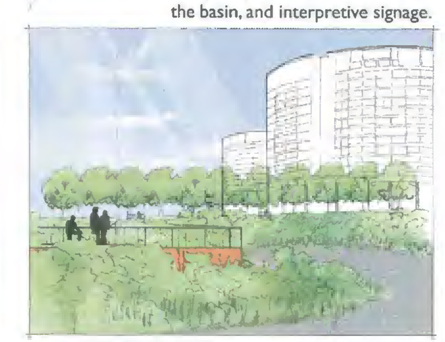
Washington Boulevard: View to the street with bike path, new Gateway paving, seatwalls, and bioswale planting

Gateway at Washington Boulevard: bike path, seatwalls, enhanced paving, bioswale planting.

Washington Boulevard: Sidewalk, decomposed granite parkway, and basin overlooks. Parapet wall decreases risk of flooding.



Admiralty Way Overlooks: Views into the basin, and interpretive signage.



OXFORD RETENTION BASIN MULTIUSE ENHANCEMENT PROJECT

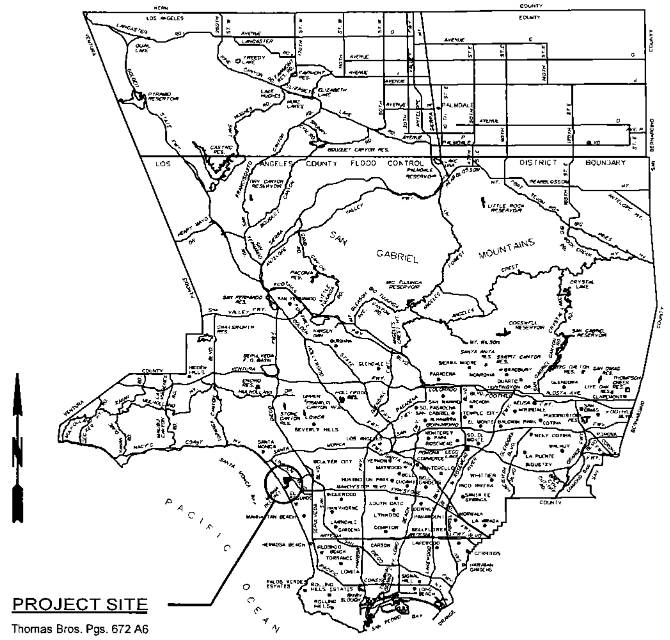
COUNTY OF LOS ANGELES · CALIFORNIA | PUBLIC WORKS | LOS ANGELES COUNTY FLOOD CONTROL DISTRICT

ATTACHMENT B

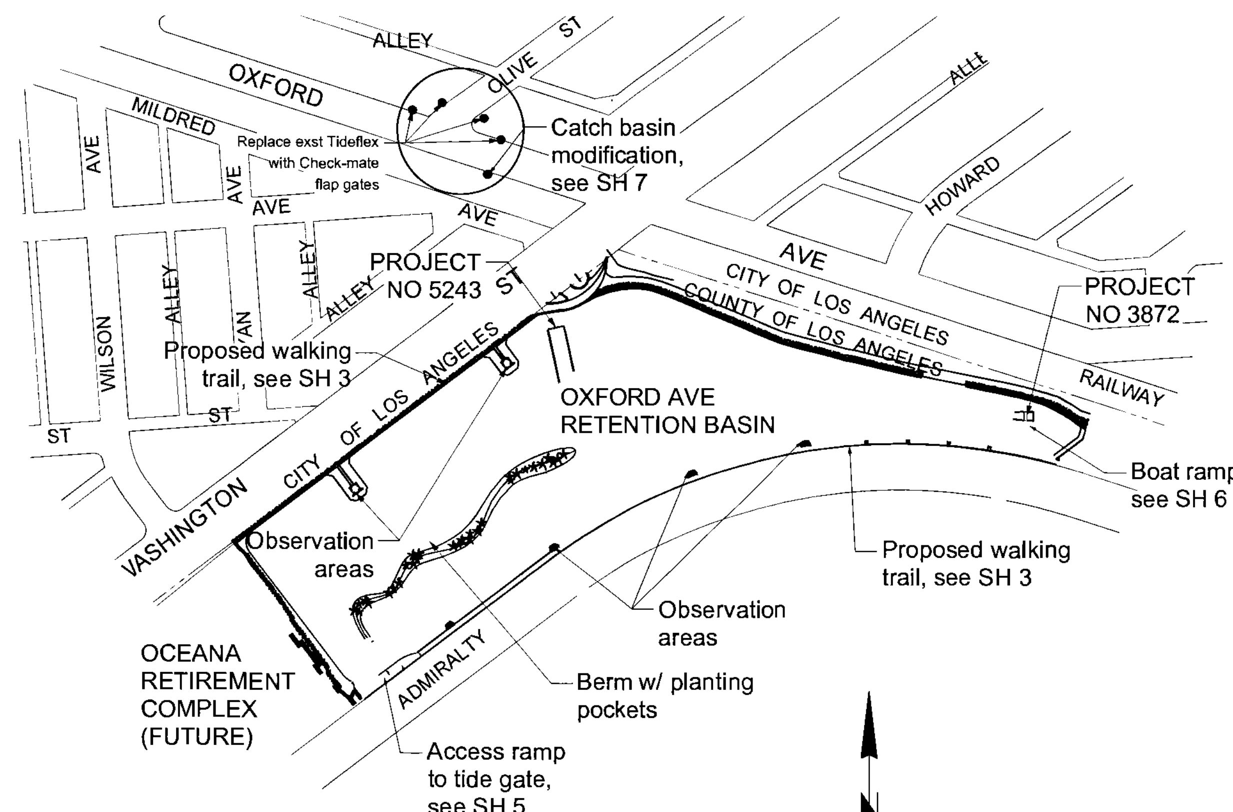
PRELIMINARY CONCEPT
PROJECT PLANS

COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS

OXFORD RETENTION BASIN
MULTI-USE ENHANCEMENT PROJECT



LOCATION MAP



GENERAL PLAN

NOT TO SCALE

INDEX TO PROJECT PLANS

UTILITIES

WATER	CITY OF LOS ANGELES DEPT OF WATER & POWER
GAS	THE GAS CO.
ELECTRIC	SO. CALIF. EDISON
TELEPHONE	AT&T
SEWER	CITY OF LOS ANGELES BUREAU OF SANITATION

REFERENCES

PROJECT NO. 3872, UNIT 1	DWG. NO.470-3872-D3.1-13
PROJECT NO. 3872, UNIT 1, AUTOMATIC FLAPGATES	DWG.NO.470-3872-D8.1-3
PROJECT NO. 5243	DWG.NO. 364-5243-D2.1-25
OXFORD RETENTION BASIN AND PUMP STATION	DWG.NO.507 D1.1-22
OXFORD RETENTION BASIN AND OUTLET SYSTEM IMPROVEMENT	DWG.NO.507 D3.1-15
PROJECT NO 3872 MARINA DEL RAY LOW FLOW DIVERSION	DWG.NO. 364-5243-D10.1-11
SURVEY NOTES	PWFB 1015-654, 764, 1099 to 1102 PWLB 1015-996 to 1001
ADMIRALTY WAY SETTLEMENT REPAIR PROJECT	PROJ ID NO. RDC0015061

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TWO DAYS BEFORE YOU DIG
CALL USA TOLL FREE
1-800-227-2600

APPROVED GAIL FARBER DIRECTOR OF PUBLIC WORKS
BY ______ DEPUTY DIRECTOR DATE
RECOMMENDED
BY ______ ASSISTANT DEPUTY DIRECTOR DATE
SUBMITTED
BY ______ DATE

DATE	MK	DESCRIPTION

REVISIONS

REGISTERED PROFESSIONAL ENGINEER
CHARLES C. CHEN
NO. C63209
EXP. 06/30/12
CIVIL
STATE OF CALIFORNIA

PROJECT ENGINEER ______ DATE

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
OXFORD RETENTION BASIN
MULTI-USE ENHANCEMENT PROJECT
TITLE SHEET

FCC0001176	JOB JX0039	DWG 507-D4.1	SHEET 1 OF 11

TS-DF 07/05

DRAFTER C. CHEN
DESIGNER C. CHEN
CHECKER J. LI
CADD PROJECT FILE NAME

GENERAL NOTES

1. ELEVATIONS SHOWN ARE IN FEET BASED ON L.A. CITY 1980 ELEV. PER TRIG LEVELS
2. STATIONS SHOWN ON THE PLANS ARE ALONG CENTER LINE OF CONDUIT OR ON A LINE NORMAL TO CENTER LINE OF CONDUIT.
3. STATIONS AND INVERT ELEVATIONS OF PIPE INLETS SHOWN ON THE PROFILES ARE AT THE INSIDE FACE OF THE CONDUIT, UNLESS OTHERWISE SHOWN.
4. ALL PIPE IN OPEN TRENCH SHALL BE BEDDED ACCORDING TO LACDPW STANDARD PLAN 3080, CASE III, EXCEPT BELL AND SPIGOT PIPE WHICH SHALL BE CASE II BEDDING, UNLESS OTHERWISE SHOWN. "W" VALUES SHALL BE AS SPECIFIED ON STANDARD PLAN 3080 FOR CASE III BEDDING, NOTES (a), (b), AND (c). IF THE "W" VALUE AT THE TOP OF THE PIPE IS EXCEEDED, THE BEDDING SHALL BE MODIFIED, AND/OR PIPE OF ADDITIONAL STRENGTH SHALL BE PROVIDED. THE PROPOSED MODIFICATION SHALL BE APPROVED BY THE DEPARTMENT.
5. CONCRETE BACKFILL SHALL BE PROVIDED AROUND PIPE 21 INCHES IN DIAMETER OR LESS WHERE THE COVER IS EQUAL TO OR LESS THAN 2'-0", AROUND PIPE GREATER THAN 21 INCHES IN DIAMETER BUT LESS THAN 39 INCHES WHERE THE COVER IS LESS THAN 1'-3", AND FOR PIPE 39 INCHES OR GREATER WHERE THE COVER IS LESS THAN 1'-0". THE CONCRETE BACKFILL SHALL BE AS SPECIFIED ON LACDPW STANDARD PLAN 3080, NOTE 7.
6. ALL EXISTING UTILITIES SHOWN ON THE PLANS ARE THE PROPERTY OF THE OWNERS LISTED ON SHEET 1, UNLESS OTHERWISE NOTED.
7. EXISTING UTILITIES SHALL BE MAINTAINED IN PLACE BY THE CONTRACTOR, UNLESS OTHERWISE NOTED, AND ALL UTILITIES CROSSING THE TRENCH SHALL BE TEMPORARILY SUPPORTED TO THE SATISFACTION OF THE OWNER.
8. THE CONTRACTOR SHALL MAKE EXPLORATORY EXCAVATIONS TO DETERMINE THE DEPTH AND LOCATION OF EXISTING UTILITIES WHERE SO INDICATED BY THE SYMBOL "△".
9. ALL RESURFACING, CURBS, GUTTERS, SIDEWALKS, DRIVEWAYS AND OTHER EXISTING IMPROVEMENTS TO BE RECONSTRUCTED SHALL BE CONSTRUCTED AT THE SAME ELEVATION AND LOCATION AS THE EXISTING IMPROVEMENTS, UNLESS OTHERWISE NOTED.
10. THE WORK SHOWN ON THESE DRAWINGS REQUIRES THE PRIME CONTRACTOR TO HAVE A VALID CLASS A OR C42 LICENSE ISSUED BY THE STATE OF CALIFORNIA.
11. ALL FIELD BOOK REFERENCES ARE TO LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS FIELD BOOKS, UNLESS OTHERWISE NOTED.

STRUCTURAL NOTES

1. DIMENSIONS FROM FACE OF CONCRETE TO STEEL ARE TO CENTER OF BAR, UNLESS OTHERWISE SHOWN.
2. CONCRETE DIMENSIONS SHALL BE MEASURED HORIZONTALLY OR VERTICALLY ON THE PROFILE, AND PARALLEL TO OR AT RIGHT ANGELS (OR RADIALLY) TO CENTER LINE OF CONDUIT ON THE PLAN EXCEPT AS OTHERWISE SHOWN.
3. ALL BAR BENDS AND HOOKS SHALL CONFORM TO THE AMERICAN CONCRETE INSTITUTE'S "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE", LATEST EDITION, SECTION 7.2.
4. PLACING OF REINFORCEMENT SHALL CONFORM TO THE AMERICAN CONCRETE INSTITUTE'S "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE", LATEST EDITION, SECTION 7.3
5. TRANSVERSE CONSTRUCTION JOINTS SHALL NOT BE PLACED WITHIN 30 INCHES OF MANHOLE OR JUNCTION STRUCTURE OPENINGS.
6. TRANSVERSE CONSTRUCTION JOINTS IN WALLS AND SLABS SHALL BE IN THE SAME PLANE. NO STAGGERING OF JOINTS WILL BE PERMITTED. TRANSVERSE CONSTRUCTION JOINTS SHALL BE NORMAL OR RADIAL TO THE CENTER LINE OF CONSTRUCTION.
7. THE TRANSVERSE REINFORCING BARS SHALL TERMINATE ONE AND ONE-HALF INCHES FROM THE CONCRETE SURFACES UNLESS OTHERWISE SHOWN ON THE STRUCTURAL DETAILS.
8. EXPOSED SURFACES OF CONCRETE MEMBERS SHALL BE ROUNDED OR BEVELED.
9. NO SPLICES IN TRANSVERSE BARS REINFORCEMENT WILL BE PERMITTED OTHER THAN SHOWN ON THE STRUCTURAL DETAILS WITHOUT APPROVAL OF THE ENGINEER. NO MORE THAN TWO SPLICES WILL BE PERMITTED IN ANY LONGITUDINAL BAR BETWEEN TRANSVERSE JOINTS. SPLICES SHALL BE STAGGERED.
10. LONGITUDINAL BARS SHALL BE LAPPED 20 BAR DIAMETERS AT SPLICES. TRANSVERSE BARS SHALL BE LAPPED 30 BAR DIAMETERS AT SPLICES.
11. LONGITUDINAL STEEL SHALL TERMINATE TWO INCHES FROM TRANSVERSE CONSTRUCTION JOINTS.
12. TRANSVERSE JOINTS SHALL BE SPACED NOT TO EXCEED 50 FEET NOR BE LESS THAN 10 FEET, MEASURED ALONG THE CENTERLINE OF CONSTRUCTION, EXCEPT AS OTHERWISE SHOWN ON THE PLANS.
13. AT THE BEGINNING AND ENDING OF ALL POURS, A COMPLETE CURTAIN OF MAIN REINFORCEMENTS SHALL SHALL BE PLACED THREE INCHES FROM THE TRANSVERSE CONSTRUCTION JOINTS.
14. ALL REBAR USED IN CONSTRUCTION SHALL BE EPOXEY COATED IN CONFORMANCE WITH ASTM SPECIFICATION A775M AND FIELD INSTALLED IN CONFORMANCE WITH ASTM SPECIFICATION D3963/D3963M

INDEX TO STANDARD PLANS

STD. PLAN	LACDPW TITLE
3080-2	AUTOMATIC FLAP GATE INLET
3080-2	PIPE BEDDING IN TRENCHES
3090-1	CRITERIA FOR THE DESIGN OF SHORING FOR EXCAVATIONS
3091-1	SAMPLE SHEET FOR USE AS A GUIDE IN PREPARING CALCULATIONS FOR SHORING OF EXCAVATIONS
3093-1	UNIFIED SOIL CLASSIFICATION SYSTEM
6002-1	PORTABLE SECURITY FENCE FOR OPEN TRENCHES
6008-1	MINIMUM PUBLIC SAFETY REQUIREMENT FOR OPEN EXCAVATIONS

STD. PLAN	SPPWC TITLE
314-2	MODIFICATIONS FOR SIDE OPENING CATCH BASIN
600-2	CHAIN LINK FENCE AND GATES
606-2	METAL HAND RAILING
610-2	REINFORCED CONCRETE RETAINING WALL TYPE 1

CONCRETE REMOVAL NOTES

CONCRETE REMOVAL SHALL BE DONE IN THE FOLLOWING SEQUENCE:

A. WHERE THE PLAN INDICATE THE EXISTING CONCRETE IS TO BE REMOVED AND THE EXISTING REINFORCEMENT IS REQUIRED TO EXTEND THROUGH THE NEW JOINT, CONCRETE SHALL BE REMOVED IN THE FOLLOWING SEQUENCE:

1. THE CONTRACTOR SHALL MAKE A SUFFICIENT NUMBER OF EXPLORATORY HOLES IN THE EXISTING SLAB TO VERIFY HORIZONTAL SPACING AND CONCRETE COVER OVER EXISTING REINFORCEMENT. THE DEPTH OR EXACT LOCATION OF SAW CUTS MAY VARY AS DETERMINED BY THE ENGINEER IN THE FIELD BASED ON INFORMATION OBTAINED FROM EXPLORATORY HOLES.

2. A SAW CUT SHALL BE MADE ONE AND ONE-HALF INCHES DEEP AT THE REMOVAL LIMITS. CARE SHALL BE EXERCISED IN SAWING AT THE REMOVAL LIMITS SO AS NOT TO CUT THE REINFORCING STEEL IN THE REMAINING SLAB. THE EXISTING REINFORCING STEEL SHALL BE RETAINED AND EXTENDED INTO THE NEW CONSTRUCTION AS INDICATED ON THE PLANS. ANY STEEL INADVERTENTLY CUT OR DAMAGED SHALL BE REPLACED WITH DOWELING AT CONTRACTORS EXPENSE.

3. USING HAND-HELD EQUIPMENT, CAREFULLY REMOVE THE CONCRETE FOR THE FULL DEPTH OF THE SLAB AND FOR A MINIMUM DISTANCE FROM THE SAW CUT EQUAL TO THE LONGEST EXTENSION OF THE EXISTING BARS TO BE EXTENDED INTO THE NEW CONSTRUCTION. THIS EXTENSION SHALL BE 30 BAR DIAMETERS, UNLESS OTHERWISE NOTED.

4. EXISTING REINFORCEMENT SHALL BE CUT TO THE REQUIRED BAR EXTENSIONS.

5. THE REMAINING CONCRETE MAY BE REMOVED BY ANY SUITABLE METHOD UPON APPROVAL OF THE ENGINEER, WHO SHALL BE THE SOLE JUDGE OF THE USE OF ANY CONCRETE REMOVAL EQUIPMENT, EXPLOSIVE, WRECKING BALL, OR OTHER SIMILAR DEVICES. METHODS AND EQUIPMENT WHICH ARE LIKELY TO DAMAGE THE CONCRETE TO BE LEFT IN PLACE SHALL NOT BE USED.

STRUCTURAL DESIGN CRITERIA

L.A.C.F.C.D. STRUCTURAL DESIGN MANUAL
DATED APRIL 1982

LIVE LOAD

HS 20-44 unless otherwise noted.

DEAD LOAD

Earth load per Marston's formula: w= 130 pcf
Ku=Ku' =0.150
Bd=Outside width of box plus 3 feet
Side earth:
Rubber dam EFP = 60 pcf
Internal water pressure: 62.4 psf per foot of depth
Weight of concrete: 150 pcf

ALLOWABLE STRESSES

f'c=4000 psi at 28 days
fc =1800 psi
fs =24,000 psi
n =8
Shear and bond stresses per A.C.I. 318-63

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DATE	MK	DESCRIPTION

REVISIONS

REGISTERED PROFESSIONAL ENGINEER — CHARLES C. CHEN — NO. C63209 — EXP. 06/30/12 — CIVIL — STATE OF CALIFORNIA

PROJECT ENGINEER — DATE

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

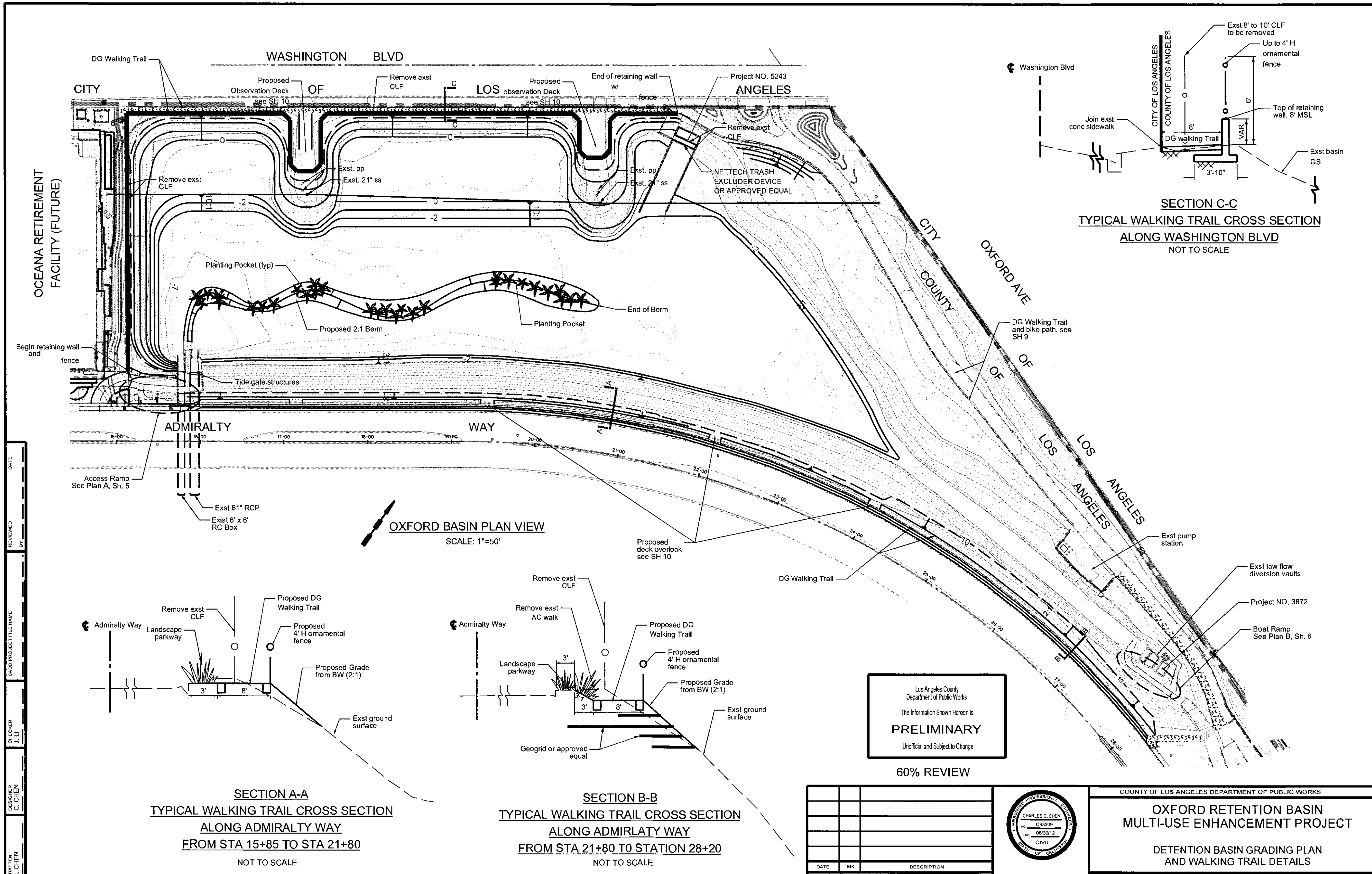
OXFORD RETENTION BASIN
MULTI-USE ENHANCEMENT PROJECT

GENERAL NOTES, STRUCTURAL NOTES, STRUCTURAL DESIGN CRITERIA AND INDEX TO STANDARD PLANS

FCC0001176 | JOB JX0039 | DWG 507-D4.2 | SHEET 2 OF 11

PS-NOTES-DF 08/03

DATE | REVIEWED BY | CADD PROJECT FILE NAME | CHECKER | DESIGNER C. CHEN | DRAFTER C. CHEN



WASHINGTON BLVD
CITY OF LOS ANGELES
DG Walking Trail
Proposed Observation Deck see SH 10
Remove exst CLF
Proposed observation Deck see SH 10
End of retaining wall w/ fence
Project NO. 5243
Remove exst CLF
NETTECH TRASH EXCLUDER DEVICE OR APPROVED EQUAL
Exst. pp
Exst. 21" ss
Remove exst CLF
OCEANA RETIREMENT FACILITY (FUTURE)
Planting Pocket (typ)
Proposed 2:1 Berm
Planting Pocket
End of Berm
Begin retaining wall and fence
Tide gate structures
ADMIRALTY WAY
Access Ramp See Plan A, Sh. 5
Exst 81" RCP
Exst 6' x 6' RC Box
OXFORD BASIN PLAN VIEW
SCALE: 1"=50'
Proposed deck overlook see SH 10
DG Walking Trail
CITY COUNTY OF LOS ANGELES
OXFORD AVE
CITY OF LOS ANGELES
DG Walking Trail and bike path, see SH 9
Exst pump station
Exst low flow diversion vaults
Project NO. 3872
Boat Ramp See Plan B, Sh. 6
Washington Blvd
Join exst conc sidewalk
CITY OF LOS ANGELES
COUNTY OF LOS ANGELES
Exst 8' to 10' CLF to be removed
Up to 4' H ornamental fence
Top of retaining wall, 8' MSL
DG walking Trail
VAR
3'-10"
Exst basin GS
SECTION C-C
TYPICAL WALKING TRAIL CROSS SECTION ALONG WASHINGTON BLVD
NOT TO SCALE
Admiralty Way
Remove exst CLF
Landscape parkway
Proposed DG Walking Trail
Proposed 4' H ornamental fence
Proposed Grade from BW (2:1)
Exst ground surface
SECTION A-A
TYPICAL WALKING TRAIL CROSS SECTION
ALONG ADMIRALTY WAY
FROM STA 15+85 TO STA 21+80
NOT TO SCALE
Admiralty Way
Remove exst CLF
Remove exst AC walk
Landscape parkway
Proposed DG Walking Trail
Proposed 4' H ornamental fence
Proposed Grade from BW (2:1)
Exst ground surface
Geogrid or approved equal
SECTION B-B
TYPICAL WALKING TRAIL CROSS SECTION
ALONG ADMIRLATY WAY
FROM STA 21+80 T0 STATION 28+20
NOT TO SCALE
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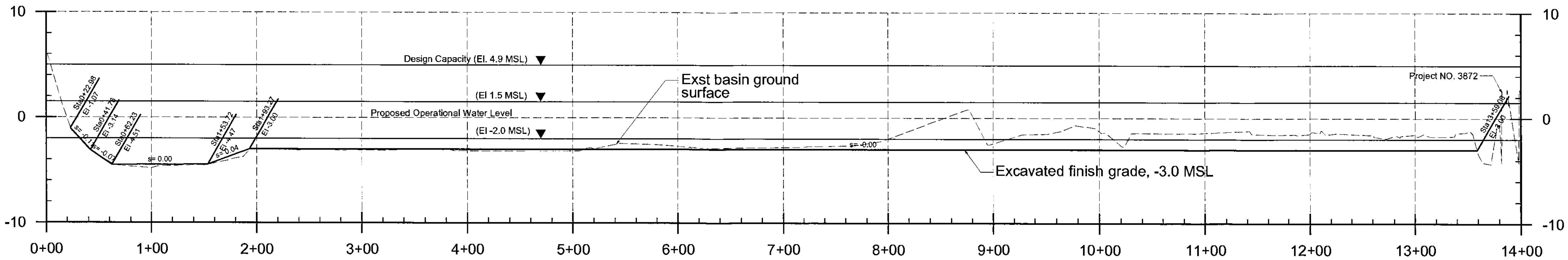
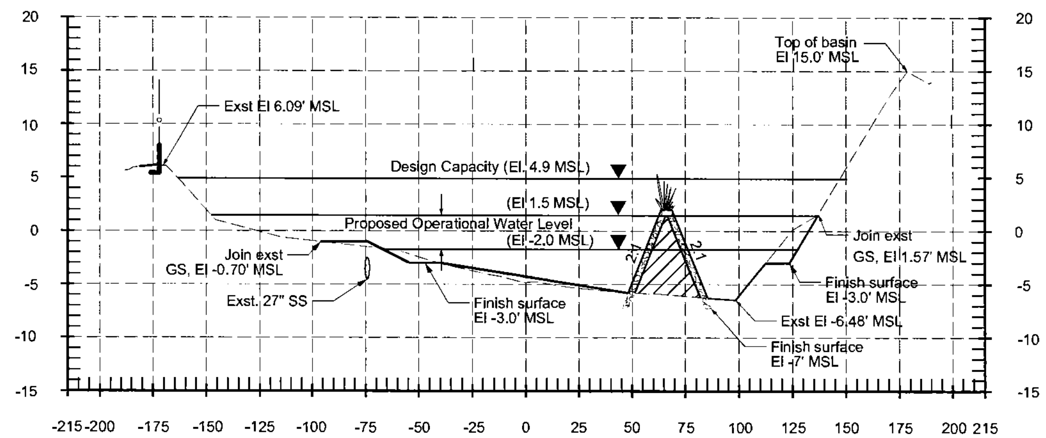
OXFORD RETENTION BASIN
MULTI-USE ENHANCEMENT PROJECT
DETENTION BASIN GRADING PLAN
AND WALKING TRAIL DETAILS
CHARLES C. CHEN
C63209
06/30/12
CIVIL
DATE MK DESCRIPTION
REVISIONS
PROJECT ENGINEER DATE
FCC0001176 JOB JX0039 DWG 507-D4.3 SHEET 3 OF 11
DRAFTER C. CHEN
DESIGNER C. CHEN
CHECKER J. LI



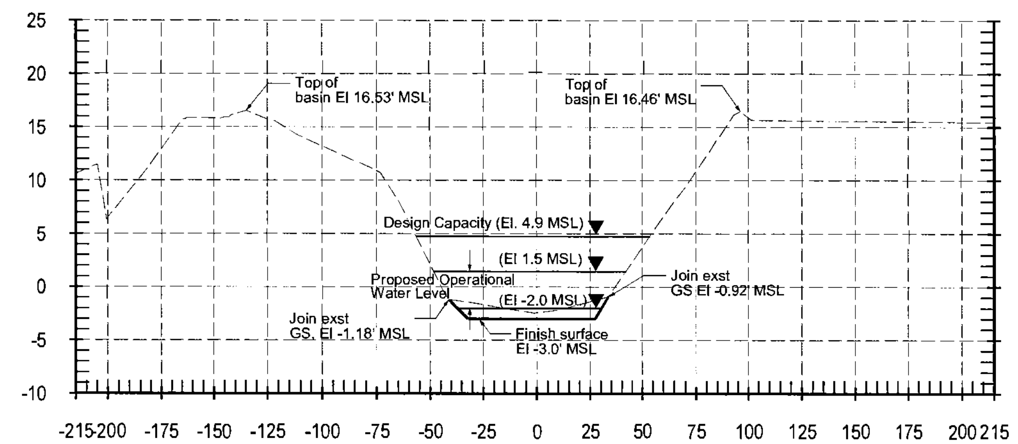
OXFORD BASIN PROFILE ALONG ℄(SH 3)

SCALE: HORZ 1"=50'
VERT 1"=5'



CROSS SECTION AT STATION 1+00 (SH 3)

SCALE: Horiz 1"=40'
Vert 1"=8'



CROSS SECTION AT STATION 9+00 (SH 3)

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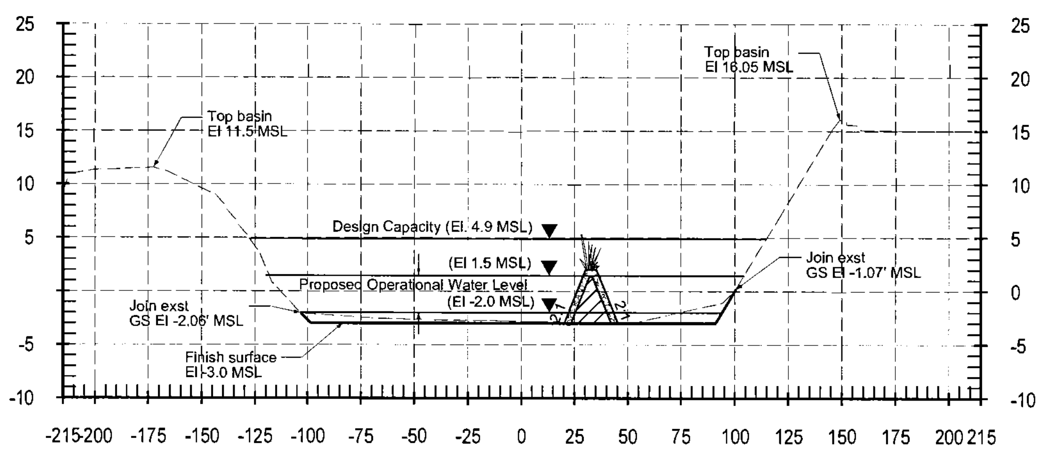
Vert 1"=8'



CROSS SECTION AT STATION 7+00 (SH 3)

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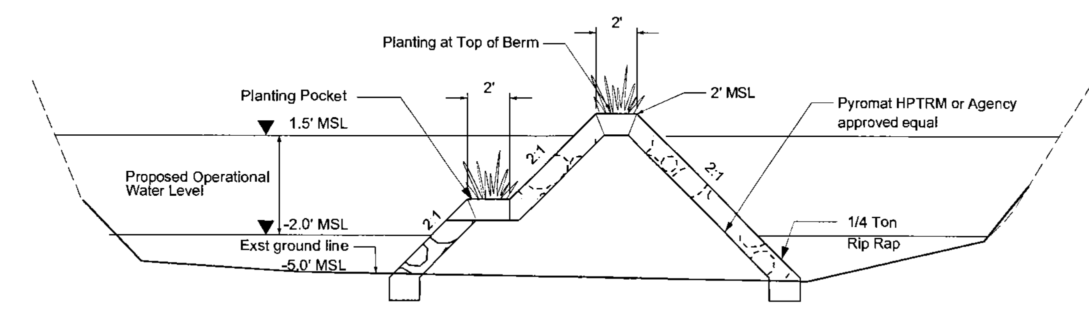
Vert 1"=8'



TYPICAL SECTION
BASIN DIVERSION BERM

NOT TO SCALE

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CHARLES C. CHEN
NO. C63209
EXP. 06/30/12
CIVIL
STATE OF CALIFORNIA

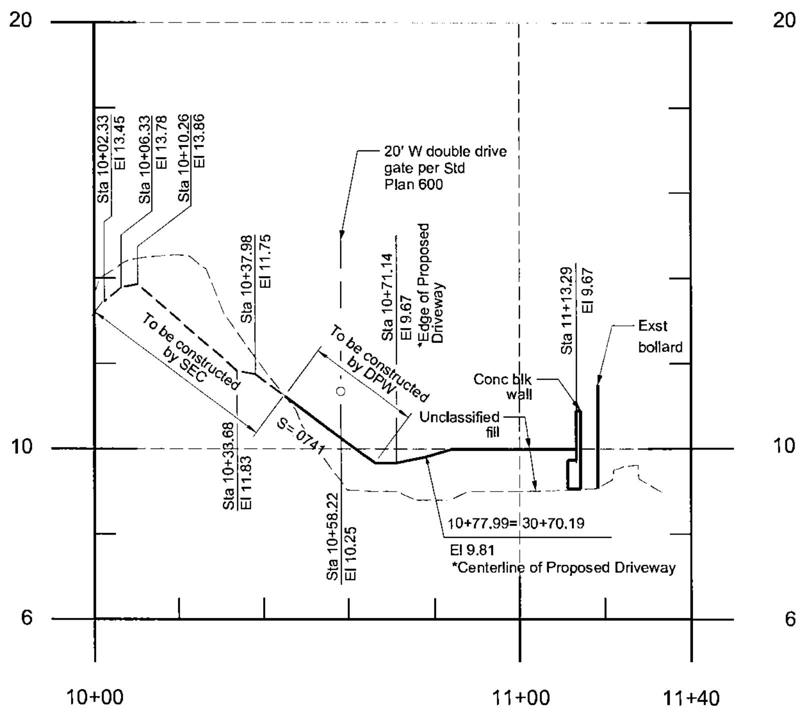
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

OXFORD RETENTION BASIN
MULTI-USE ENHANCEMENT PROJECT

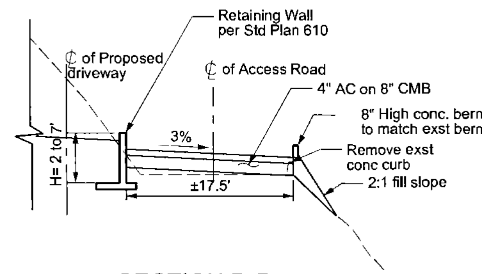
PROFILE AND CROSS SECTION DETAILS

PROJECT ENGINEER	DATE	FCC0001176	JOB JX0039	DWG 507-D4.3	SHEET 4 OF 9

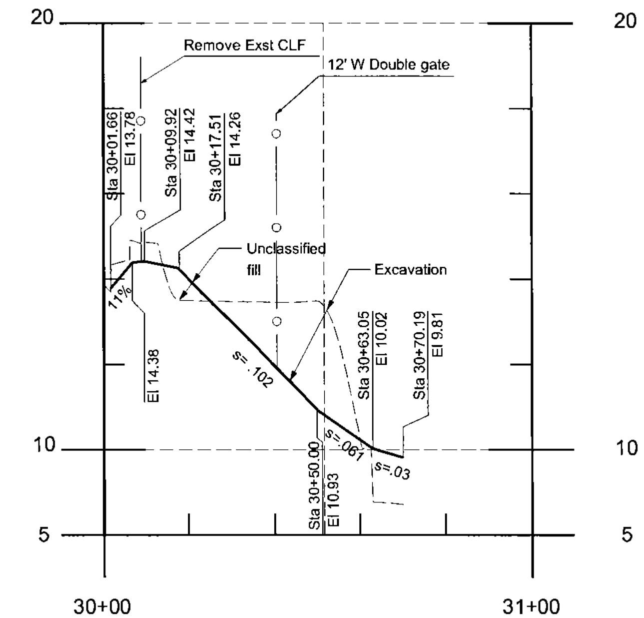
DRAFTER C. CHEN
DESIGNER C. CHEN
CHECKER J. LI
CADD PROJECT FILE NAME
REVIEWED BY
DATE



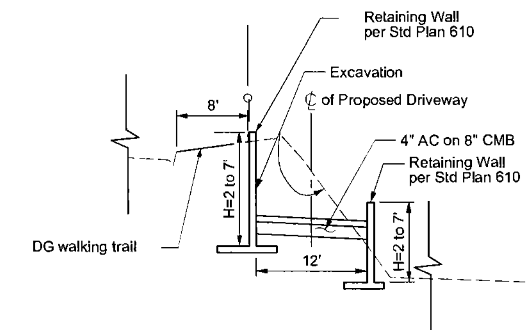
PROFILE FOR
EXISTING ACCESS RAMP
SCALE: HORIZ 1"=20'
VERT 1"=2'



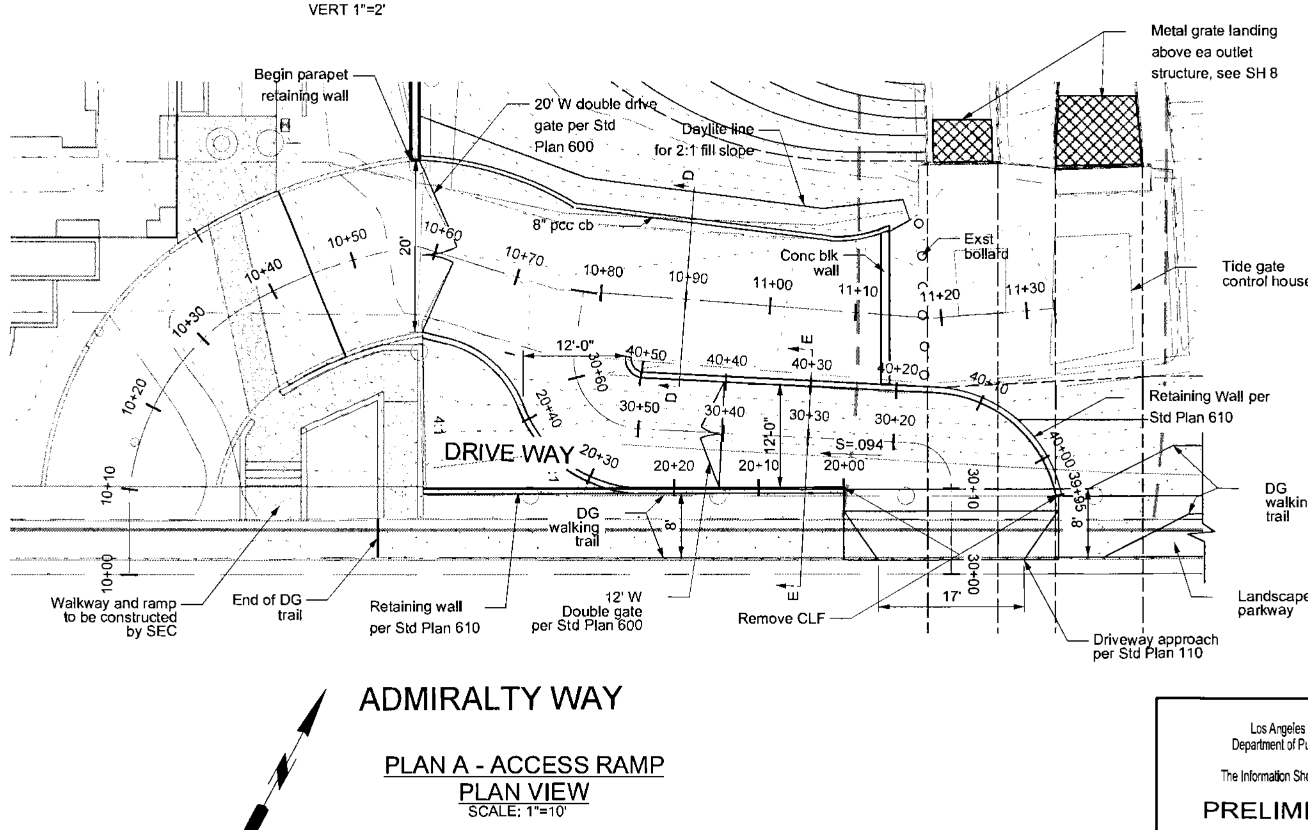
SECTION D-D
EXISTING ACCESS RAMP
CROSS SECTION
NOT TO SCALE



PROFILE FOR
PROPOSED DRIVEWAY
SCALE: HORIZ 1"=20'
VERT 1"=2'

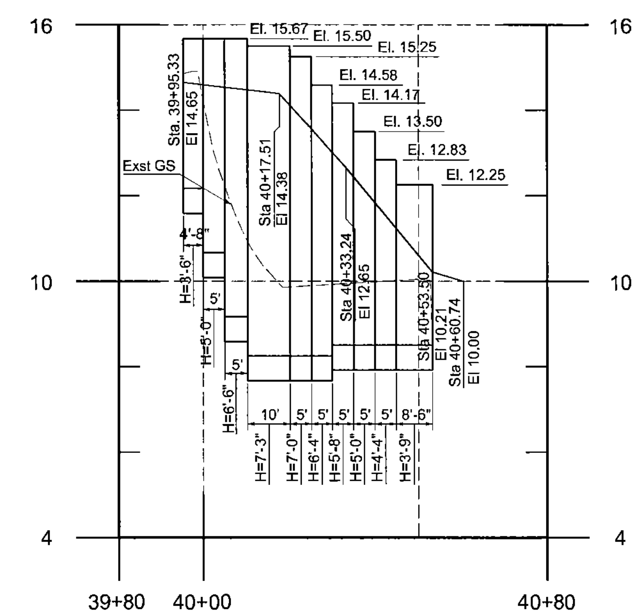


SECTION F-F
PROPOSED DRIVEWAY
CROSS SECTION
NOT TO SCALE

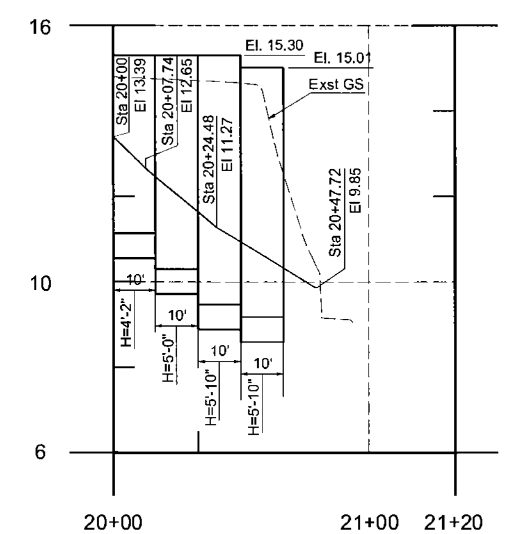


ADMIRALTY WAY

PLAN A - ACCESS RAMP
PLAN VIEW
SCALE: 1"=10'



PROFILE FOR
DRIVEWAY RETAINING WALL (RIGHT SIDE)
SCALE: HORIZ 1"=20'
VERT 1"=2'



PROFILE FOR
DRIVEWAY RETAINING WALL (LEFT SIDE)
SCALE: HORIZ 1"=20'
VERT 1"=2'

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DATE	MK	DESCRIPTION
REVISIONS		

CHARLES C. CHEN
C63209
EXP. 06/30/12
CIVIL
STATE OF CALIFORNIA
REGISTERED PROFESSIONAL ENGINEER

PROJECT ENGINEER DATE

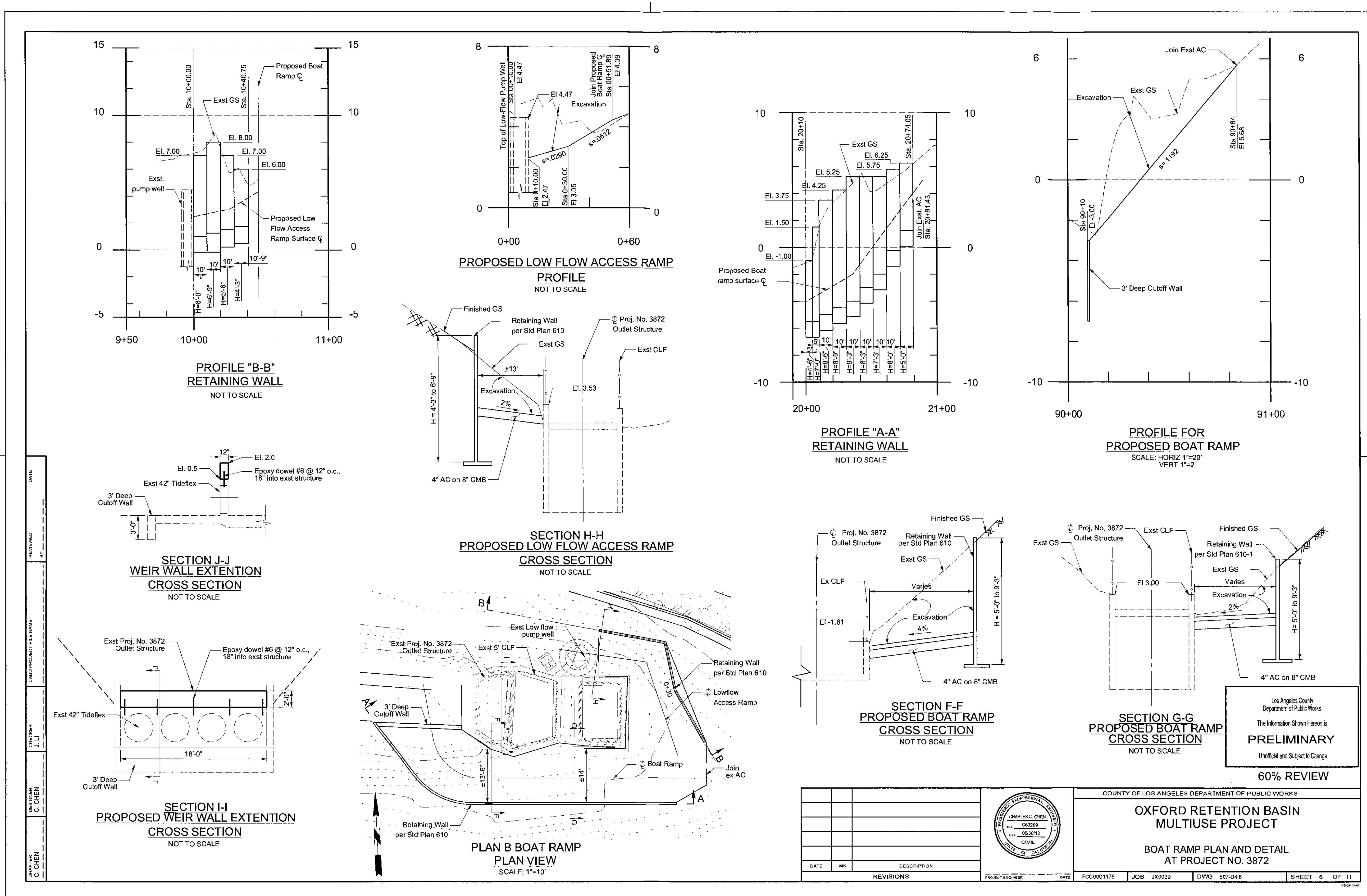
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

OXFORD RETENTION BASIN
MULTI-USE PROJECT

TIDE GATE ACCESS RAMP
PROFILE AND DETAILS

FCC0001176 JOB EF21507000 DWG SHEET 5 OF 11

DRAFTER C. CHEN
DESIGNER C. CHEN
CHECKER J. LI
CADD PROJECT FILE NAME
REVIEWED BY
DATE


PROFILE "B-B"
RETAINING WALL
NOT TO SCALE
Proposed Boat Ramp ℄
Exst GS
Sta. 10+00.00
Sta. 10+40.75
El. 8.00
El. 7.00
El. 6.00
Exst. pump well
Proposed Low Flow Access Ramp Surface ℄
H=6'-0"
H=6'-9"
H=5'-6"
H=4'-3"
PROPOSED LOW FLOW ACCESS RAMP
PROFILE
NOT TO SCALE
Top of Low-Flow Pump Well
Join Proposed Boat Ramp ℄
El 4.47
Excavation
s=.0290
s=.0612
Sta 0+10.00
El 2.47
Sta 0+30.00
El 3.05
PROFILE "A-A"
RETAINING WALL
NOT TO SCALE
Exst GS
El. 6.25
El. 5.75
El. 5.25
El. 4.25
El. 3.75
El. 1.50
El. -1.00
Proposed Boat ramp surface ℄
Join Exst. AC
Sta. 20+10
Sta. 20+74.05
Sta. 20+81.43
PROFILE FOR
PROPOSED BOAT RAMP
SCALE: HORIZ 1"=20'
VERT 1"=2'
Join Exst AC
Excavation
Exst GS
s=.1192
Sta 90+84
El 5.68
Sta 90+10
El -3.00
3' Deep Cutoff Wall
SECTION J-J
WEIR WALL EXTENTION
CROSS SECTION
NOT TO SCALE
El. 2.0
El. 0.5
Epoxy dowel #6 @ 12" o.c., 18" into exst structure
Exst 42" Tideflex
3' Deep Cutoff Wall
SECTION H-H
PROPOSED LOW FLOW ACCESS RAMP
CROSS SECTION
NOT TO SCALE
Finished GS
Retaining Wall per Std Plan 610
℄ Proj. No. 3872 Outlet Structure
Exst GS
Exst CLF
Excavation
El. 3.53
H = 4'-3" to 6'-9"
4" AC on 8" CMB
SECTION I-I
PROPOSED WEIR WALL EXTENTION
CROSS SECTION
NOT TO SCALE
Exst Proj. No. 3872 Outlet Structure
Epoxy dowel #6 @ 12" o.c., 18" into exst structure
Exst 42" Tideflex
18'-0"
3' Deep Cutoff Wall
PLAN B BOAT RAMP
PLAN VIEW
SCALE: 1"=10'
Exst Low flow pump well
Exst Proj. No. 3872 Outlet Structure
Exst 5' CLF
3' Deep Cutoff Wall
Retaining Wall per Std Plan 610
℄ Lowflow Access Ramp
℄ Boat Ramp
Join ex AC
SECTION F-F
PROPOSED BOAT RAMP
CROSS SECTION
NOT TO SCALE
Finished GS
℄ Proj. No. 3872 Outlet Structure
Retaining Wall per Std Plan 610
Exst GS
Ex CLF
El -1.81
Varies
Excavation
4%
H = 5'-0" to 9'-3"
4" AC on 8" CMB
SECTION G-G
PROPOSED BOAT RAMP
CROSS SECTION
NOT TO SCALE
℄ Proj. No. 3872 Outlet Structure
Exst CLF
Finished GS
Exst GS
Retaining Wall per Std Plan 610-1
El 3.00
Varies
Excavation
2%
H= 5'-0" to 9'-3"
4" AC on 8" CMB
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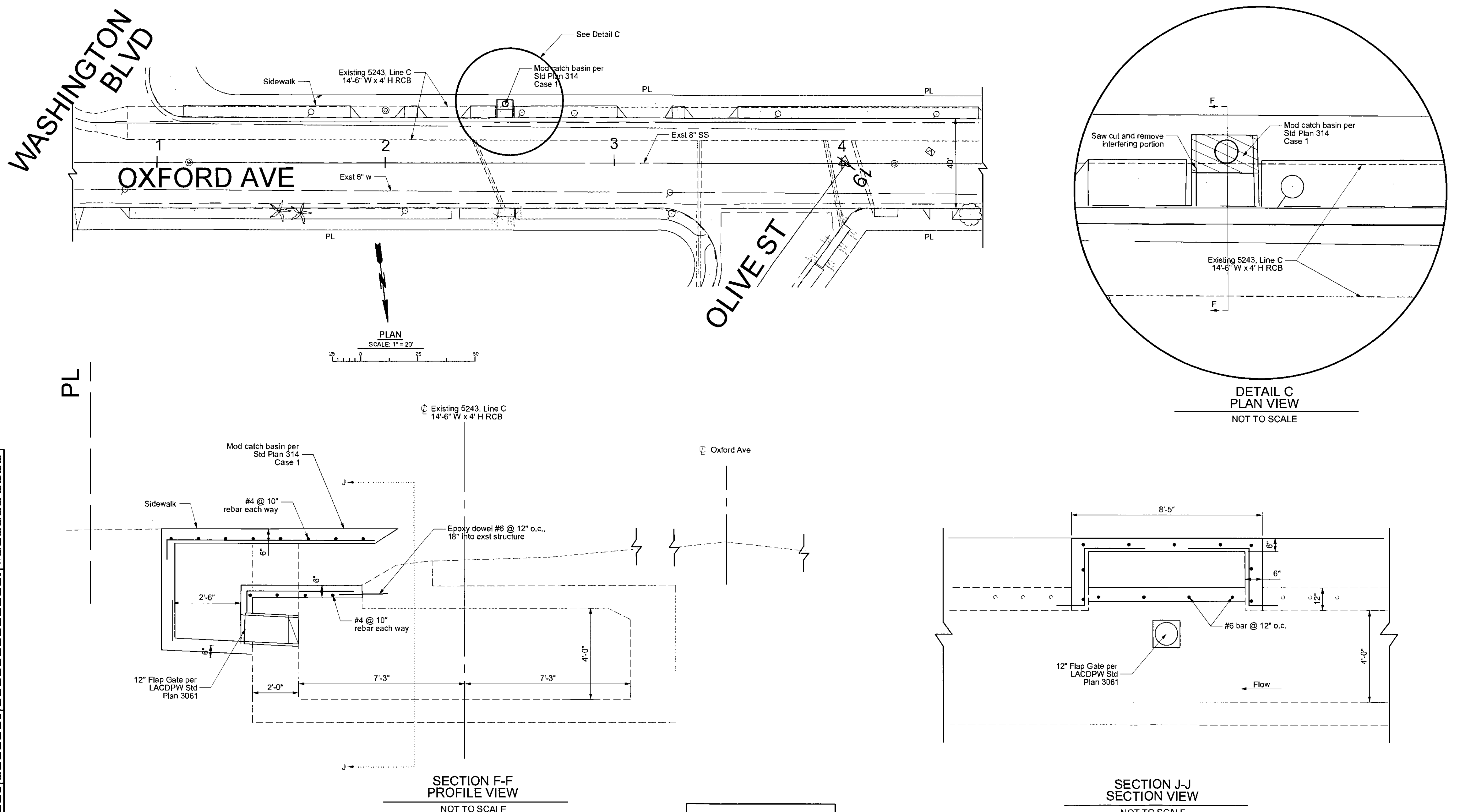
60% REVIEW
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
OXFORD RETENTION BASIN
MULTIUSE PROJECT
BOAT RAMP PLAN AND DETAIL
AT PROJECT NO. 3872
CHARLES C. CHEN
C63209
06/30/12
CIVIL
DATE
MK
DESCRIPTION
REVISIONS
PROJECT ENGINEER
FCC0001176
JOB JX0039
DWG 507-D4.6
SHEET 6 OF 11
DRAFTER C. CHEN
DESIGNER C. CHEN
CHECKER J. LI
CADD PROJECT FILE NAME
REVIEWED BY
DATE



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Department of Public Works
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DATE	MK	DESCRIPTION
REVISIONS		

CHARLES C. CHEN
C63209
06/30/12
CIVIL
STATE OF CALIFORNIA

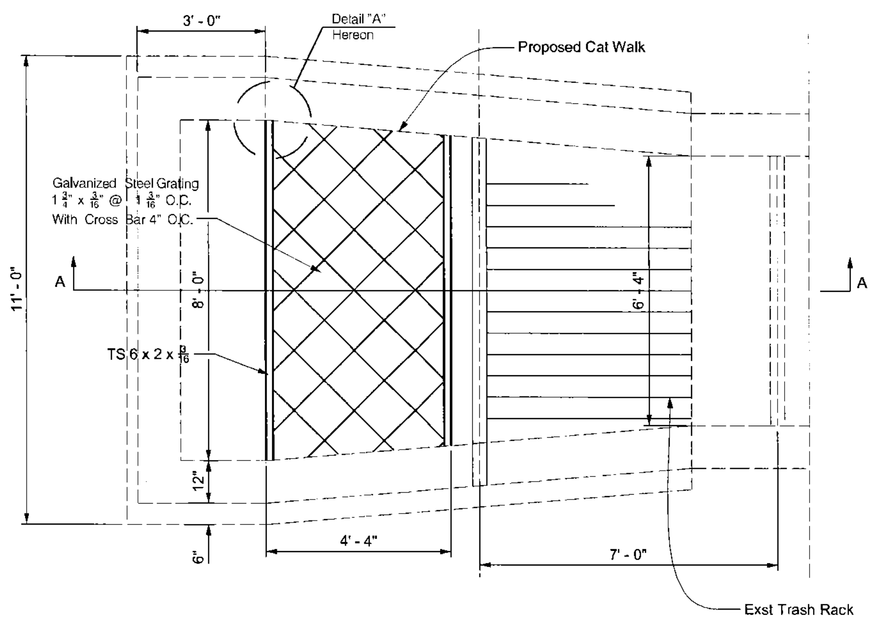
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

OXFORD RETENTION BASIN MULTI-USE PROJECT

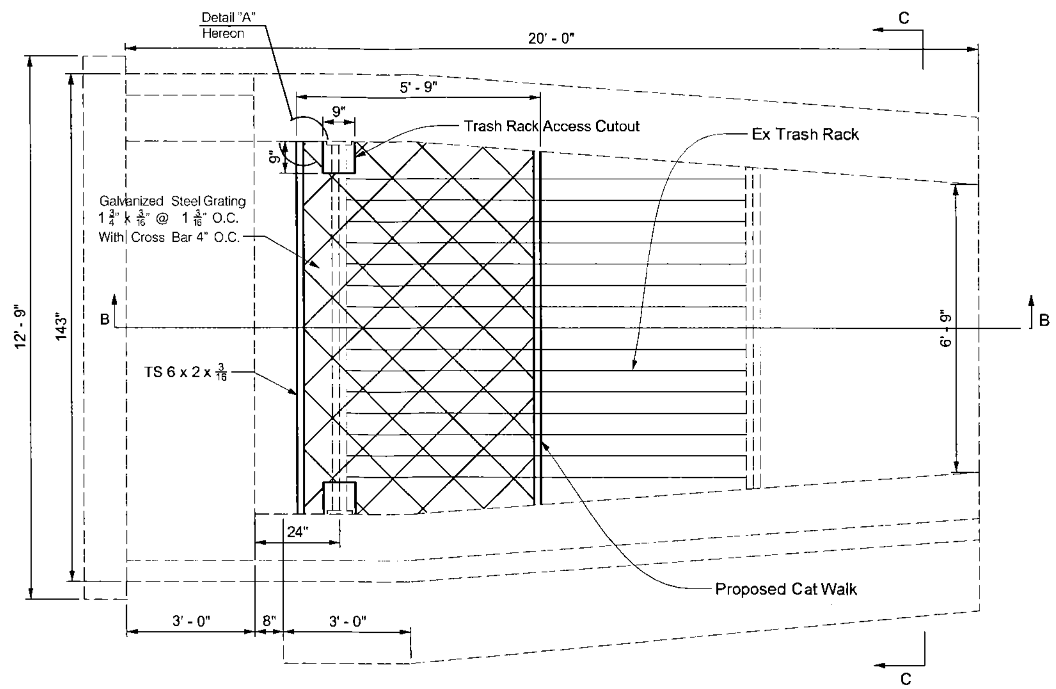
OXFORD AVE CATCH BASIN MODIFICATION AND DETAILS

FCC0001176 | JOB JX0039 | DWG 507-D4.7 | SHEET 7 OF 11

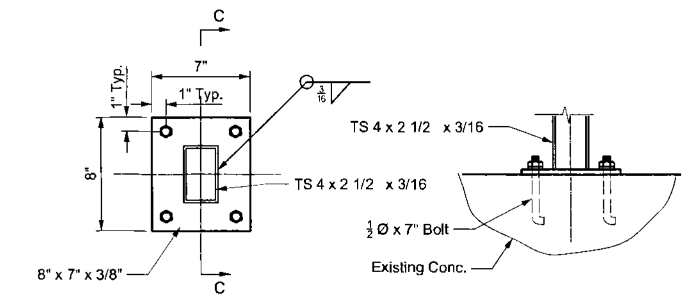
DRAFTER C. CHEN | DESIGNER C. CHEN | CHECKER J. LI | REVIEWED BY | DATE | CADD PROJECT FILE NAME



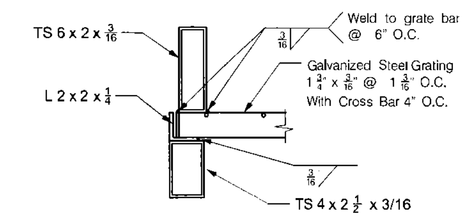
6' X 6' INLET PLAN VIEW
SCALE: 1/2" = 1'-0"



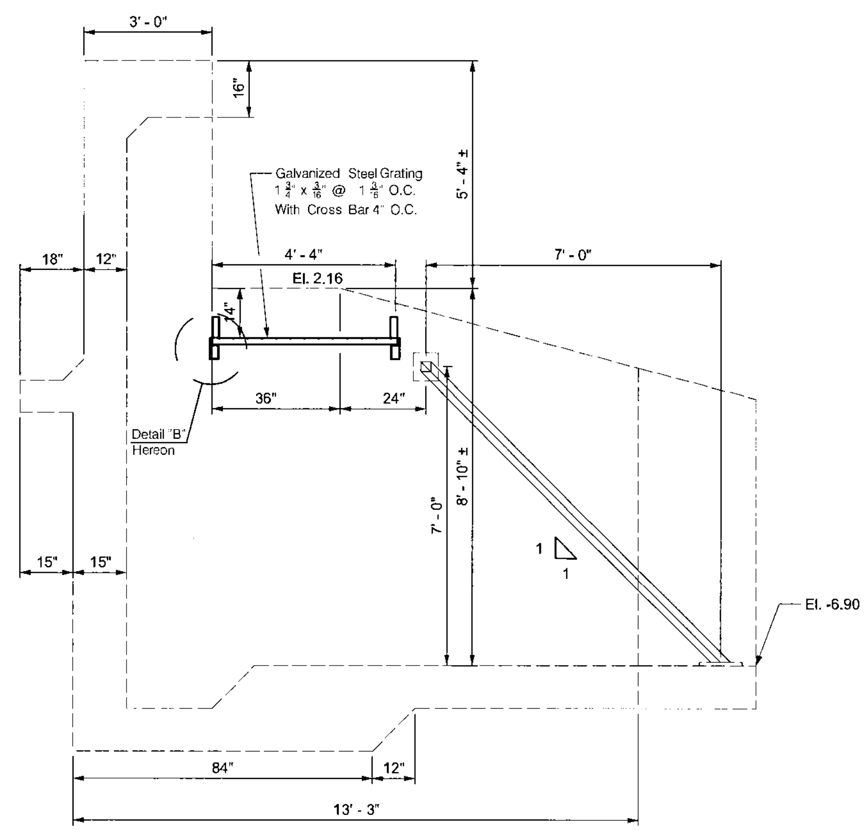
81" INLET PLAN VIEW
SCALE: 1/2" = 1'-0"



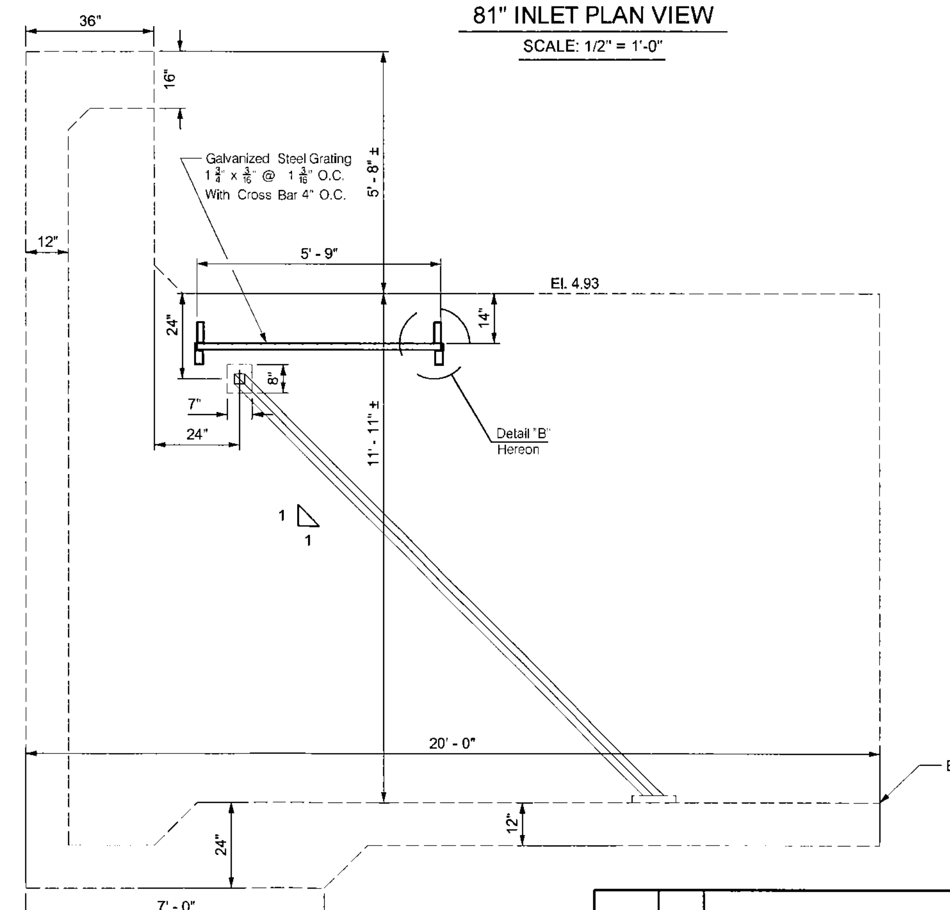
DETAIL "A", TYPICAL
WALL ANCHORAGE
SCALE: 1/2" = 1'-0"



DETAIL "B", TYPICAL
GRATING ANCHORAGE
SCALE: 1/2" = 1'-0"



6' X 6' INLET SECTION A-A
SCALE: 1/2" = 1'-0"



81" INLET SECTION B-B
SCALE: 1/2" = 1'-0"

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60% REVIEW

DATE	MK	DESCRIPTION
REVISIONS		

CHARLES C. CHEN — C53209 — EXP. 06/30/10 — CIVIL — STATE OF CALIFORNIA

PROJECT ENGINEER — DATE

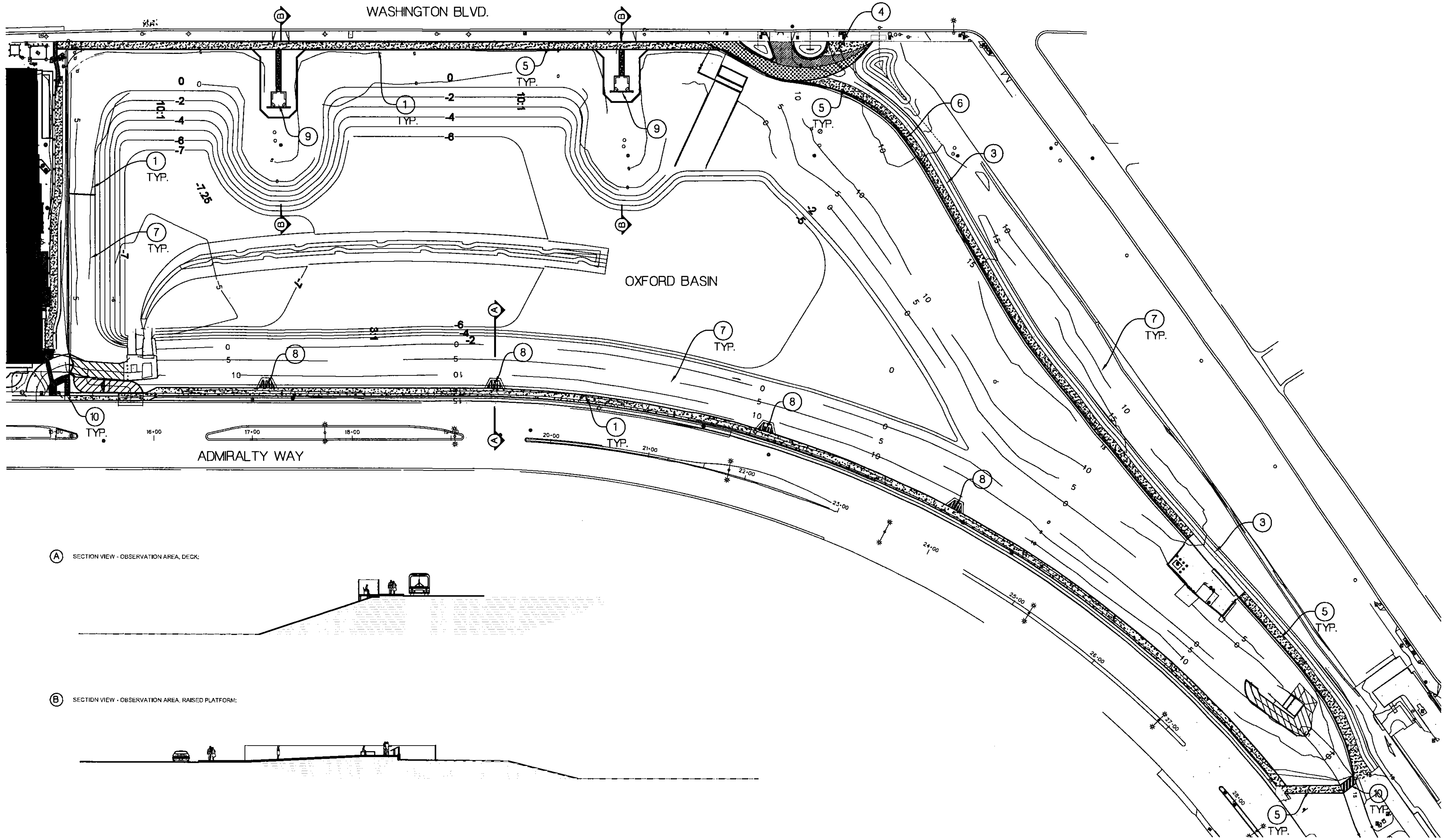
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

OXFORD RETENTION BASIN MULTIUSE PROJECT

STRUCTURAL CATWALK DETAIL FOR TIDE GATE CONTROL HOUSE

FCC0001176 | JOB JX0039 | DWG 507-D4.8 | SHEET 8 OF 11

DATE | REVIEWED BY | CADD PROJECT FILE NAME | CHECKER J. LI | DESIGNER C. CHEN | DRAFTER C. CHEN



(A) SECTION VIEW - OBSERVATION AREA, DECK:

(B) SECTION VIEW - OBSERVATION AREA, RAISED PLATFORM:

CONSTRUCTION LEGEND:

1. FENCING, 8' HIGH WELDED WIRE MESH, TYPICAL
2. POROUS CONCRETE WALK
3. EXISTING ASPHALT DRIVE (TO REMAIN, SLURRY SEAL)
4. PCC WALK, 6" THICK, INTEGRAL COLOR
5. DECOMPOSED GRANITE PATH
6. BOLLARD LIGHT (ADJACENT TO D.G. PATH)
7. LANDSCAPE AREA
8. OBSERVATION AREA, DECK
9. OBSERVATION AREA, RAISED PLATFORM
10. ADA UPGRADES AND IMPROVEMENTS, TYPICAL

NORTH

0 25' 50' 100' 150'

GRAPHIC SCALE: 1"=50'

30% PLAN

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

OXFORD RETENTION BASIN
MULTIUSE ENHANCEMENT PROJECT

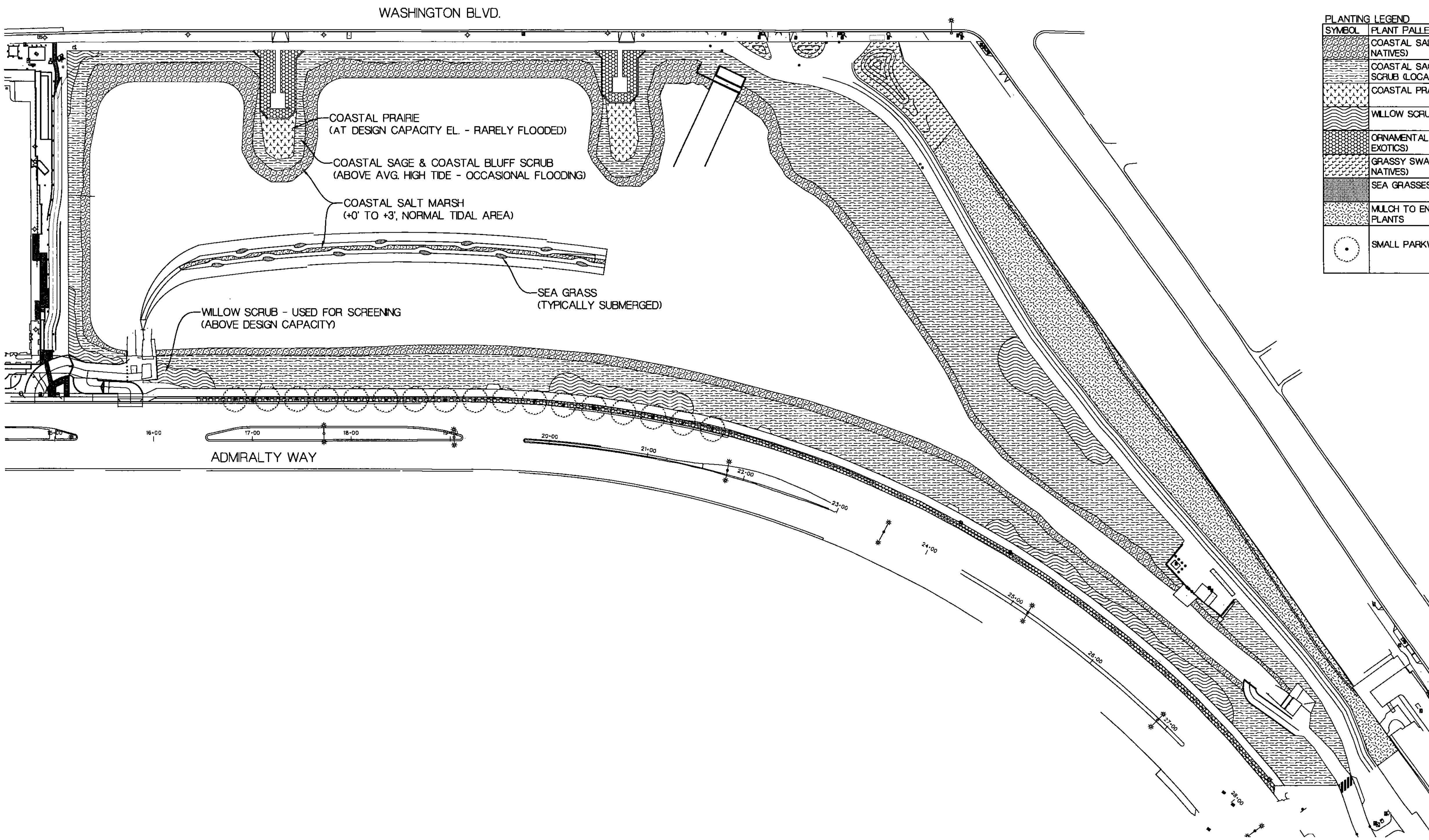
CONSTRUCTION LAYOUT PLAN

DATE	MK	DESCRIPTION

REVISIONS

PROJECT LANDSCAPE ARCHITECT DATE 8/05/10 PCA X0000000 RDC0000000 SHEET 7 OF 9

DRAFTER | DESIGNER | CHECKER | CAD PROJECT FILE NAME | REVIEWED BY | DATE



PLANTING LEGEND

SYMBOL	PLANT PALLETTE/COMMUNITY
	COASTAL SALT MARSH (LOCAL NATIVES)
	COASTAL SAGE & COASTAL BLUFF SCRUB (LOCAL NATIVES)
	COASTAL PRAIRIE (LOCAL NATIVES)
	WILLOW SCRUB (LOCAL NATIVES)
	ORNAMENTAL (NATIVES AND EXOTICS)
	GRASSY SWALE (CALIFORNIA NATIVES)
	SEA GRASSES (NATIVES)
	MULCH TO ENHANCE EXISTING PLANTS
	SMALL PARKWAY TREE

NORTH

0 25' 50' 100' 150'

GRAPHIC SCALE: 1"=50'

30% PLAN

DATE	MK	DESCRIPTION
REVISIONS		

PROJECT LANDSCAPE ARCHITECT DATE

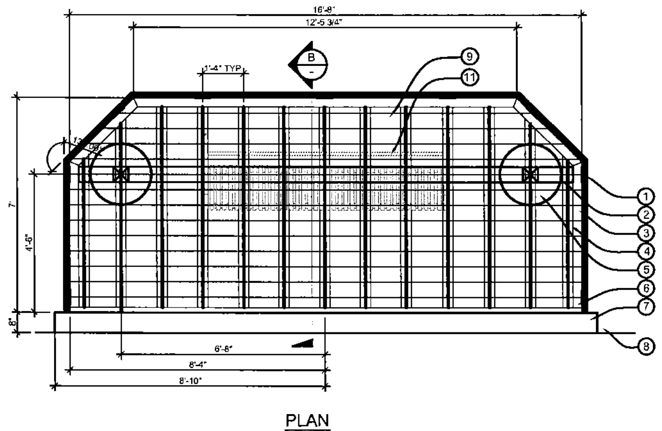
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

OXFORD RETENTION BASIN
MULTIUSE ENHANCEMENT PROJECT

PLANTING PLAN

8/05/10 | PCA X0000000 | RDC0000000 | SHEET 9 OF 9

DRAFTER | DESIGNER | CHECKER | CAD PROJECT FILE NAME | REVIEWED BY | DATE



PLAN

LEGEND:

1. TUBE STEEL GUARDRAIL, SEE DETAIL J, THIS SHEET
2. 6X10 PTDF BEAM
3. 4X8 PTDF FASCIA
4. 4X6 PTDF JOIST
5. 24"Ø CONCRETE FOOTING W/ REINFORCEMENT (520-C-2500)
6. 2X8 PTDF HEADER ANCHORED TO CONCRETE CURB WALL WITH ANCHOR BOLTS @ 32" OC
7. CONCRETE CURB WALL, SEE DETAIL H, THIS SHEET
8. SAWCUT EXISTING AC PAVEMENT, PATCH WITH AC (PG 64-10)
9. 2X6 COMPOSITE WOOD DECKING: ACCENT: FIRE DEFENSE MANUFACTURED BY TREX OR AGENCY APPROVED EQUAL. COLOR: SADDLE
10. FINISH GRADE (90% COMPACTION)
11. VANDAL PROOF ANCHOR BOLT SUPPLIED BY BENCH MANUFACTURER OR AGENCY APPROVED EQUAL
12. 8' BENCH MANUFACTURED BY:
    A. RB-28 BENCH BY VICTOR STANLEY. MODEL # RB-28 8' W/ INTERMEDIATE ARM, POWDER COATED. COLOR: BRONZE

    OR

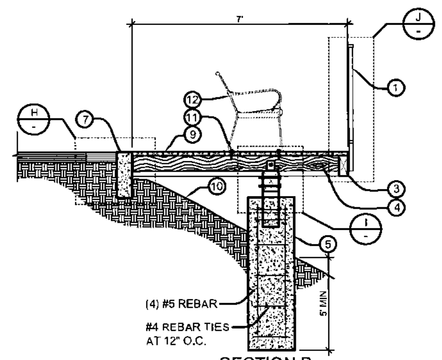
    B. CARNIVAL BENCH BY THOMAS STEELE. MODEL # CRB-8-CA-VS-P. COLOR: BRONZE

    OR

    C. CITY VIEW BENCH BY SITESCAPES. MODEL # CV-1-2001-PF. COLOR: BRONZE

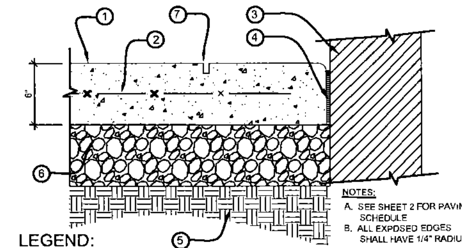
NOTES:

A. ALL STRUCTURAL LUMBER SHALL BE PTDF (PRESSURE TREATED DOUGLAS FIR)
B. PROVIDE 1/4" GAP BETWEEN EACH DECK PLANKS AND 3/8" AT BUTT JOINT OR AGAINST CURB WALL



SECTION B

(K) DECK OVERLOOK NTS



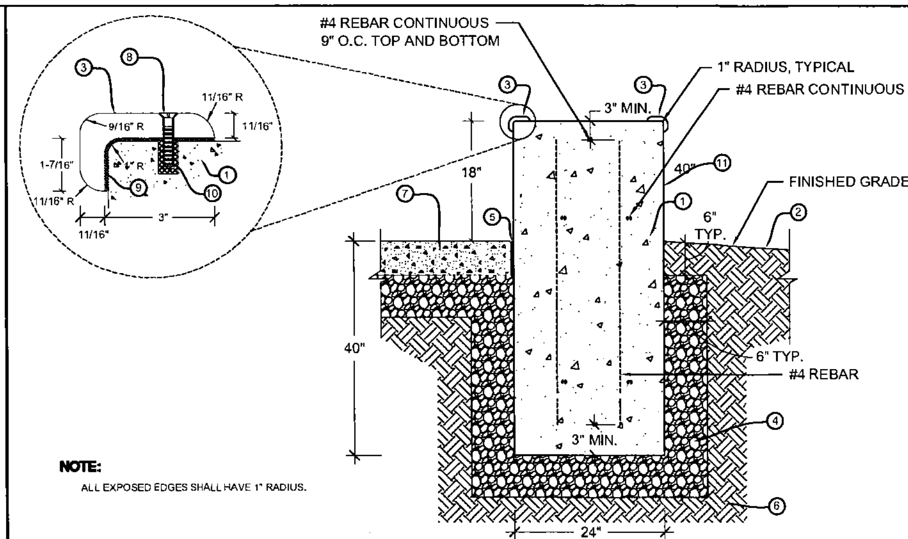
NOTES:

A. SEE SHEET 2 FOR PAVING SCHEDULE
B. ALL EXPOSED EDGES SHALL HAVE 1/4" RADIUS.

LEGEND:

1. PCC, POURED IN PLACE CONCRETE. MIX 520-C-2500. REFER TO CONCRETE & MATERIALS FINISH LEGEND.
2. #3 REBAR @ 18" O.C. BOTH WAYS. CENTERED IN CONCRETE.
3. CONCRETE WALL, SEE PLAN.
4. EXPANSION JOINT (EJ), 1/2" THICK ASPHALT IMPREGNATED FIBERBOARD WITH BACKER ROD AND JOINT SEALANT. EJ AS SHOWN ON PLANS AND/OR BETWEEN ADJACENT WALLS/CONCRETE.
5. SUBGRADE, 90% RELATIVE COMPACTION.
6. 6" CRUSHED MISC. BASE, 95% RELATIVE COMPACTION.
7. 1/4" DEEP TOOLED SCORE JOINT WHERE SHOWN ON PLANS.
8. ADJACENT LANDSCAPE AREAS SHALL BE 3" BELOW FINISHED SURFACE, TYPICAL.

(B) CONCRETE PAVING NTS

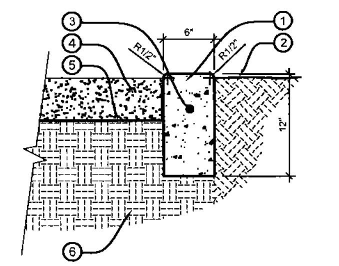


NOTE:
ALL EXPOSED EDGES SHALL HAVE 1" RADIUS.

LEGEND:

1. POURED IN PLACE CONCRETE WALL:
   A. CONCRETE SHALL BE 560-C-3250
   B. STANDARD INTEGRAL COLOR: PORCELAIN GRAY (3987) CHROMIX ADMIXTURE, BY L.M. SCOFIELD COMPANY OR APPROVED EQUAL.
   C. LIGHT SANDBLAST FINISH.
   D. APPLY A WATERBORNE, LOW VOC, ENVIRONMENTALLY SOUND, CLEAR CURING COMPOUND AND SEALER SUCH AS SCOFIELD CURESEAL-W, BY L.M. SCOFIELD COMPANY OR APPROVED EQUAL.
2. LANDSCAPE AREA.
3. SKATEBOARD DETERRENT, STAINLESS STEEL, FLAT BAR 1" RADIUS CORNER (FB1.0R), BY RAVENSFORGE CONEG LLC., (888) 743-3490, OR APPROVED EQUAL. INSTALL 38" ON CENTER AND CENTERED ON THE ENDS OF EACH WALL.
4. CRUSHED MISCELLANEOUS BASE, 95% RELATIVE DENSITY.
5. EXPANSION JOINT (EJ), 1/2" THICK ASPHALT IMPREGNATED FIBERBOARD. EJ AS SHOWN ON PLANS OR AT EVERY 20' ON CENTER AND AT EVERY CHANGE IN DIRECTION.
6. SUBGRADE, 90% RELATIVE COMPACTION.
7. CONCRETE SURFACE, SEE SHEET 7, DETAIL B..
8. TAMPER PROOF SCREW
9. EPOXY, TYPICAL
10. EXPANSION ANCHOR
11. APPLY GRAFFITI PREVENTION MATERIAL CONTAINING TWO PARTS EPOXY ON ALL EXPOSED SURFACES. KRYSTALKOAT GRAFFITI PREVENTION MATERIAL OR APPROVED EQUAL.

(A) CONCRETE SEAT WALL NTS

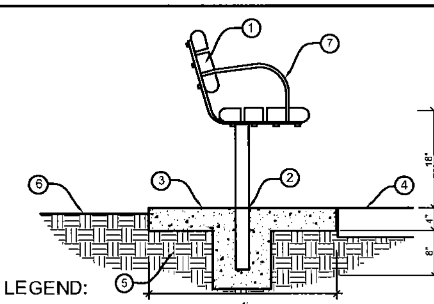


LEGEND:

1. PCC HEADER (520-C-2500)
2. FINISH GRADE TO BE 1/2" BELOW TOP OF HEADER
3. #4 REBAR
4. DECOMPOSED GRANITE PAVING. SEE DETAIL I, SHEET 14
5. NON-WOVEN GEOTEXTILE
6. 90% RELATIVE COMPACTION SUBGRADE

NOTE:
PROVIDE EXPANSION JOINT EVERY 15' AND WEAKENED PLANE JOINT EVERY 7.5'

(C) D.G. AND HEADER NTS

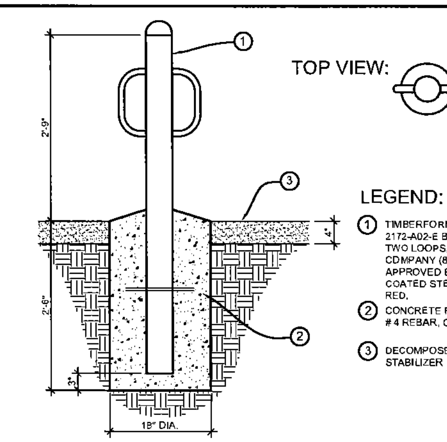


LEGEND:

1. CONTOURED RECYCLED PLASTIC 6' BENCH WITH BACK, MODEL RP6WB-I, BY BELSON OUTDOORS INC., OR APPROVED EQUAL. COLOR OF FRAME: BLACK. COLORS OF SLATS: CEDAR. INSTALL PER MANUFACTURER'S RECOMMENDATIONS.
2. IN-GROUND MOUNTING, POST 2-⅛" WIDTH, CENTERED ON SLAB. INSTALL PER MANUFACTURER'S RECOMMENDATIONS.
3. CONCRETE SLAB. REFER TO PLAN AND CONCRETE AND MATERIALS FINISH LEGEND.
4. ADJACENT FINISH GRADE
5. SUBGRADE, 90% RELATIVE COMPACTION
6. FINISH GRADE OF ADJACENT PLANTING AREA
7. FOR THE ADA COMPLIANT BENCH AREAS (4 TOTAL), ONLY INSTALL ONE OF THE ARMRESTS. THE REMAINING FOUR BENCHES SHALL RECEIVE BOTH ARMRESTS.

(D) BENCH NTS

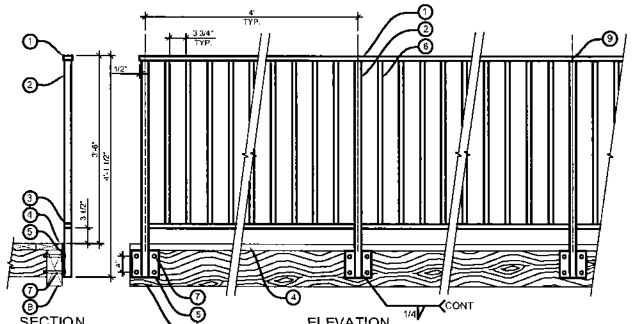
TOP VIEW:



LEGEND:

1. TIMBERFORM CYCLOOPS: MODEL 2172-A02-E BOLLARD ASSEMBLY WITH TWO LOOPS, BY COLUMBIA CASCADE COMPANY (800) 547-1940, OR APPROVED EQUAL. POWDER COATED STEEL VERSION, COLOR: RED.
2. CONCRETE FOOTING WITH # 4 REBAR, CONCRETE (560-C-3250)
3. DECOMPOSED GRANITE WITH STABILIZER

(E) BIKE BOLLARD NTS



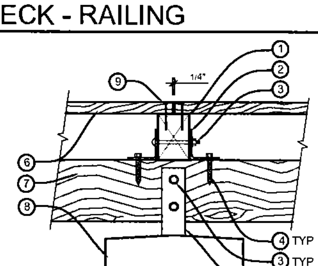
LEGEND:

1. 2"WX1"H TUBE STEEL TOPRAIL, CAP ALL ENDS
2. 1-1/2"X1-1/2" TUBE STEEL POST
3. 1-1/2"WX1"H TUBE STEEL BOTTOM RAIL
4. COMPOSITE WOOD DECKING - SEE DETAIL E, SHT. 7
5. 6"X6"X1/4" THICK STEEL PLATE
6. 1"X1" TUBE STEEL PICKETS
7. 1/2"X5" GALVANIZED CARRIAGE BOLTS AND WASHER, 4 PER PLATE
8. 4X8 PTDF FASCIA BOARD
9. WELD SHUT MITRE JOINT

NOTES:

A. ALL TUBE STEEL SHALL HAVE A MINIMUM WALL GAUGE OF 11
B. ALL STEEL MEMBERS SHALL RECEIVE TWO COATS OF PRIMER AND TWO COATS OF PAINT. COLOR AND FINISH SHALL MATCH EXISTING FENCE RAILING

(J) DECK - RAILING NTS



LEGEND:

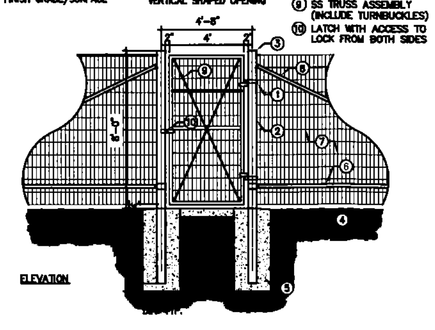
1. 4X6 PTDF JOIST
2. 4"X4" ANGLE STEEL GALVANIZED, TYP
3. 1/2" Ø CARRIAGE BOLT GALVANIZED
4. 1/2" X 4" GALVANIZED LAG BOLT W/ WASHER
5. GALVANIZED STEEL BEAM SUPPORT - SIMPSON CB66 OR AGENCY APPROVED EQUAL
6. 2X6 COMPOSITE WOOD DECKING
7. 8X8 PTDF BEAM
8. 24" Ø CONCRETE FOOTING, SLOPE TOP TO DRAIN
9. 3" STAINLESS STEEL SQUARE HEAD DECK SCREW, 2 SCREWS PER ATTACHMENT POINT

(I) DECK - POST TO BEAM CONNECTION NTS

NOTES:

1. WELDED WIRE MESH SHALL BE TYPHOON, HOT DIPPED GALVANIZED, BY SECURE TECHNOLOGY, INC. (949) 633-9624 OR APPROVED EQUAL. GATE & FENCE SHALL BE CONSTRUCTED PER MANUFACTURER'S SPECIFICATIONS
2. SIZE & TYPE OF FASTENERS, JUNCTION CLIPS & TOUCH CLIPS SHALL BE AS PER THE MANUFACTURER'S RECOMMENDATIONS. QUANTITY PER PANEL OF FASTENERS, JUNCTION CLIPS & TOUCH CLIPS SHALL BE PER MANUFACTURER'S RECOMMENDATION.
3. ALL FENCE MATERIAL, TUBULAR STEEL METAL MEMBERS & HARDWARE SHALL RECEIVE POWDER COAT PAINT – COLOR GREEN
4. EXPOSED PORTION OF FOOTING TO RECEIVE A SMOOTH TROWEL FINISH & SLOPE TO DRAIN
5. CONTRACTOR SHALL INCLUDE CHAIN & COUNTY APPROVED LOCK & KEY WITH EACH SET OF GATES

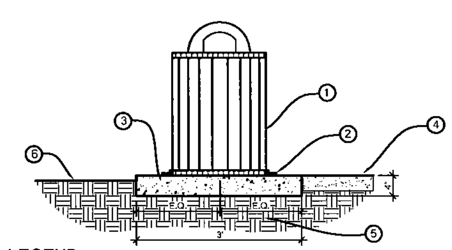
1. GATE HINGE
2. 4"X4" SQUARE FENCE POST BOTH SIDES OF GATE
3. FLAT & FORMED CAP ON EACH POST (TYP)
4. FINISH GRADE/SURFACE
5. PCC FOOTING (TYP)
6. TUBULAR STEEL 1-½" X 2-¾" AT BOTTOM (EVERY PANEL)
7. 6' HIGH WELDED WIRE MESH WITH 2" HORIZONTAL BY 6" VERTICAL SHAPED OPENING
8. 1-½" X 2-¾" RECTANGULAR TUBING CROSS MEMBER USED EVERY 5TH PANEL & AT CORNERS ON BOTH SIDES OF GATE
9. SS TRUSS ASSEMBLY (INCLUDE TURNBUCKLES)
10. LATCH WITH ACCESS TO LOCK FROM BOTH SIDES



ELEVATION

NOT TO SCALE

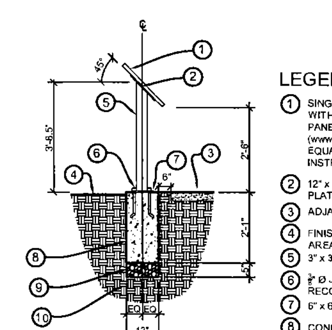
(H) W.W.M. FENCING NTS



LEGEND:

1. ROUND RECYCLED PLASTIC LITTER RECEPTACLE, MODEL RB32-R-DT, BY BELSON OR APPROVED EQUAL. COLOR OF FRAME: BLACK. COLOR OF SLATS: CEDAR. INSTALL PER MANUFACTURER'S INSTRUCTIONS.
2. ATTACH TO SLAB PER MANUFACTURER'S INSTRUCTIONS.
3. CONCRETE SLAB. REFER TO PLAN AND CONCRETE AND MATERIALS FINISH LEGEND.
4. ADJACENT FINISH GRADE
5. SUBGRADE, 90% RELATIVE COMPACTION
6. FINISH GRADE OF ADJACENT PLANTING AREA

(G) TRASH RECEPTACLE NTS



LEGEND:

1. SINGLE POST PEDESTAL: PART # SP121B WITH 2' x 3' EXTERIOR dHPL 1/2" GRAPHIC PANEL, BY FOSSIL INDUSTRIES (www.fossilgraphics.com), OR APPROVED EQUAL. INSTALL PER MANUFACTURER'S INSTRUCTIONS.
2. 12" x 18" x $\frac{3}{16}$" STANDARD MOUNTING PLATE
3. ADJACENT FINISH SURFACE
4. FINISH GRADE OF ADJACENT PLANTING AREA
5. 3" x 3" STEEL POST, COLOR: BLACK
6. $\frac{3}{8}$" Ø J-BOLT, INSTALL PER MANUFACTURER'S RECOMMENDATIONS.
7. 6" x 6" x $\frac{3}{8}$" STEEL PLAT
8. CONCRETE (520-C-5200)
9. 6" CRUSHED MISC. BASE, 95% RELATIVE COMPACTION
10. COMPACT SUBGRADE, 90% RELATIVE COMPACTION

NOTES:

1. ARTWORK SHALL BE PROVIDED BY THE COUNTY. SIGN AND GRAPHICS SHALL BE FABRICATED AND INSTALLED BY THE CONTRACTOR.

(F) INTERPRETIVE SIGN NTS

DATE	MK	DESCRIPTION

REVISIONS

PROJECT LANDSCAPE ARCHITECT | DATE

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS

OXFORD RETENTION BASIN
MULTIUSE ENHANCEMENT PROJECT
CONSTRUCTION DETAILS

4/1/10 | PCA EF21507000 | WMD | SHEET 8 OF 9

ATTACHMENT C

MCR OCEANA WALKING TRAIL PLAN
FOR PARCEL OT

PLANT LEGEND: TREES

SYMBOL	BOTANICAL NAME "COMMON NAME"	SIZE HTxSPR	REMARKS	COMMENTS
	PLATANUS RACEMOSA "CALIFORNIA SYCAMORE"	24" BOX	X X	A
	PHOENIX DACTYLIFERA "DATE PALM"	20' BTH	X X	B

PLANT LEGEND: SHRUBS & GROUNDCOVERS

SYMBOL	BOTANICAL NAME "COMMON NAME"	SIZE	REMARKS	COMMENTS
	ANIGOZANTHOS FLAVIDUS "KANGAROO PAW"	5 GAL	X X	X X C
	CAREX TUMILICOLA "BERKELEY SEDGE"	1 GAL 9" O.C.	X X	X X D
	MISCANTHUS 'ADAGIO' "DWARF MAIDEN GRASS"	5 GAL	X X	X X E
	ELYMUS GLAUCUS "GLUE WILDRYE"	1 GAL	X X	X X F
	CYPERUS PAPYRUS "PAPYRUS"	15 GAL	X X	X X G
	DENDROMENCON HARFORDII "CHANNEL ISLAND TREE POPPY"	5 GAL	X X	X X H
	JUNCUS PATENS "CALIFORNIA RUSH"	1 GAL 24" O.C.	X X	X X I
	CHONDROPETALUM TECTORUM "CAPE RUSH"	5 GAL	X X	X X J
	ARTEMISIA PYCNOCEPHALA 'DAVID'S CHOICE'	1 GAL	X X	X X K
	IRIS 'FREQUENT FLYER' "IRIS"	5 GAL 24" O.C.	X X	X X L
	BOUGAINVILLEA 'ROSENKA' "ROSENKA BOUGAINVILLEA"	5 GAL 30" O.C.	X X	X X M
	BACCHARIS PILULARIS 'PIGEON POINT' "DWARF COYOTE BUSH"	1 GAL 36" O.C.	X X	X X N
	SENECIO MANDRALISCAE "KLEINIA"	FLATS 8" O.C.	X X	X X O
	ANIGOZANTHOS FLAVIDUS "KANGAROO PAW"	5 GAL		X X
	SENECIO MANDRALISCAE "KLEINIA"	1 GAL		X X

SCALE: 1/16" = 1'-0"

0 8' 16' 32' 64'

LANDSCAPE PLANTING PLAN

DCB HEARING 02.17.2010

ahbé landscape architects

8729 washington boulevard | culver city, california 90232
t 310.838.0448 | f 310.204.2664 | www.ahbe.com

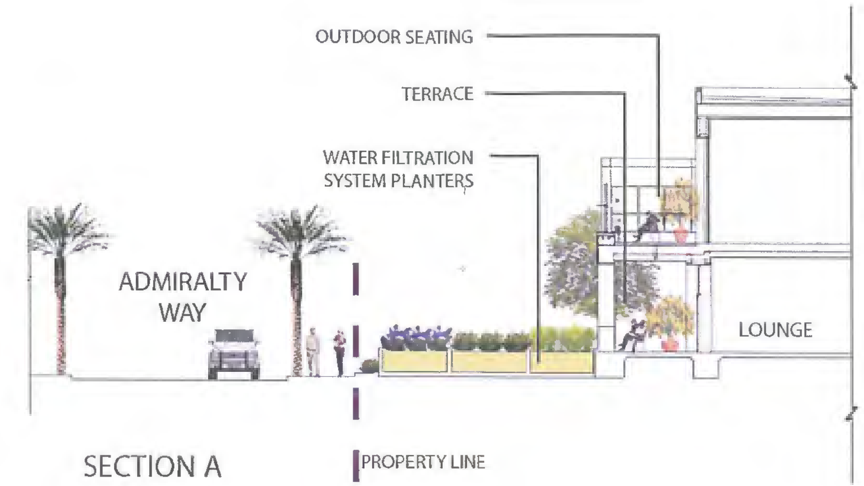
GMPA ARCHITECTS

1631 16th Street, Santa Monica, CA 90404
T. 310.450.0200 F. 310.450.0225
www.gmpaArchitects.com

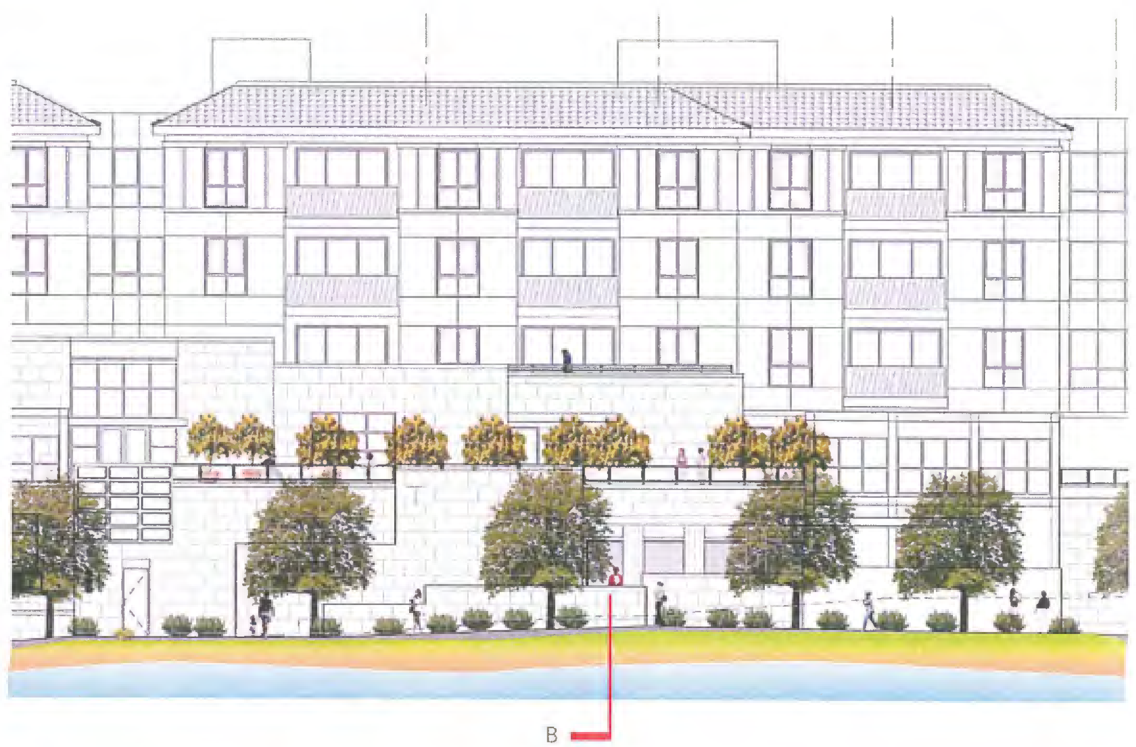
marina del rey PARCEL OT - OCEANA RETIREMENT FACILITY (MDR OCEANA, LLC)

GOLDRICH & KEST INDUSTRIES, LLC

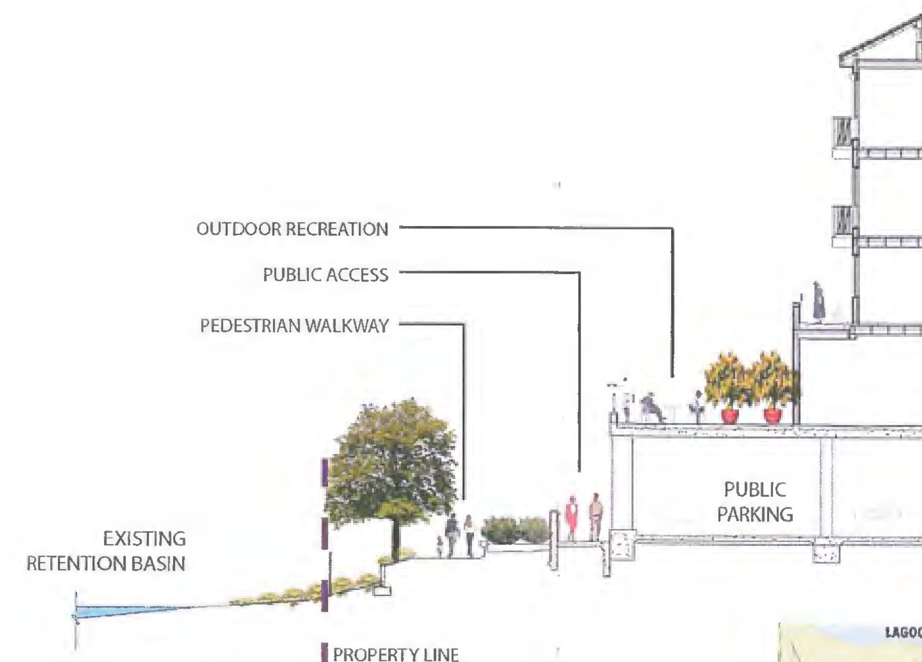
ENLARGED EAST ELEVATION (ALONG ADMIRALITY WAY)



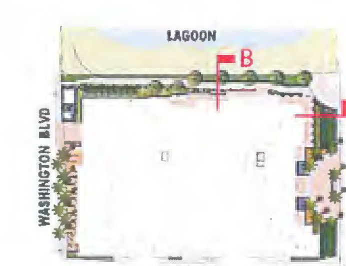
SECTION A



ENLARGED NORTH ELEVATION (ALONG RETENTION BASIN)



SECTION B



KEY PLAN

DCB HEARING 02.17.2010

GMPA ARCHITECTS
1631 16th Street, Santa Monica, CA 90404
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www.gmpaArchitects.com

marina del rey PARCEL OT - OCEANA RETIREMENT FACILITY (MDR OCEANA, LLC)

GOLDRICH & KEST INDUSTRIES, LLC

ATTACHMENT D

OXFORD RETENTION BASIN
HYDROLOGY STUDY
AUGUST 4, 2010

August 4, 2010

TO: Sree Kumar
Design Division

Attention Zahid Atashzay

FROM: for Christopher Stone *Steve Sheridan*
Water Resources Division

OXFORD RETENTION BASIN
HYDROLOGY STUDY

In response to your request, a revised hydrologic analysis for Oxford Retention Basin including Project Nos. 3872 and 5243 has been completed. The information in this report will assist in evaluating the feasibility of constructing a relief line with linear detention and pump station at Oxford Retention Basin.

As requested, the hydrologic information provided is for the Capital Flood, based on a 50-year frequency 4-day design storm. The total watershed area tributary to Oxford Retention Basin is 687.4 acres.

Additionally, a reservoir routing analysis was performed for the basin using the 4-day design storm with an initial water surface elevation of 2.7 feet MSL and also 3.4 feet MSL. As requested by your staff, the elevation-storage-discharge rating curve from the previous August 15, 1994, study was used to perform these analyses.

The subarea hydrograph for the sump located at Oxford Avenue is provided to determine the volume and depth of ponding that could result when the water surface elevation at Oxford Retention Basin exceeds the existing Project 5243 catch basin's invert.

The hydrology was performed using the Watershed Modeling System and the Modified Rational Method. The hydrologic analysis is based on the standards and procedures described in the 2006 Hydrology Manual.

<u>Attachments</u>

A-1. Hydrologic map with aerial photograph showing existing drain alignment and drainage boundaries.

A-2. Hydrologic map with Thomas Brothers streets showing existing drain alignment and drainage boundaries.

B. Hydrologic data sheets listing subarea sizes, subarea, and reach peak flow rates from an adequately collected system based on a 50-year frequency design storm.

C-1. Reservoir routing analysis results assuming initial water surface elevation of 2.7 feet MSL.

C-2. Reservoir routing analysis results assuming initial water surface elevation of 3.4 feet MSL.

D. Capital Flood hydrograph for Subarea 33F.

E. Supporting information, including design parameters.

F. Comparison with previous hydrology study.

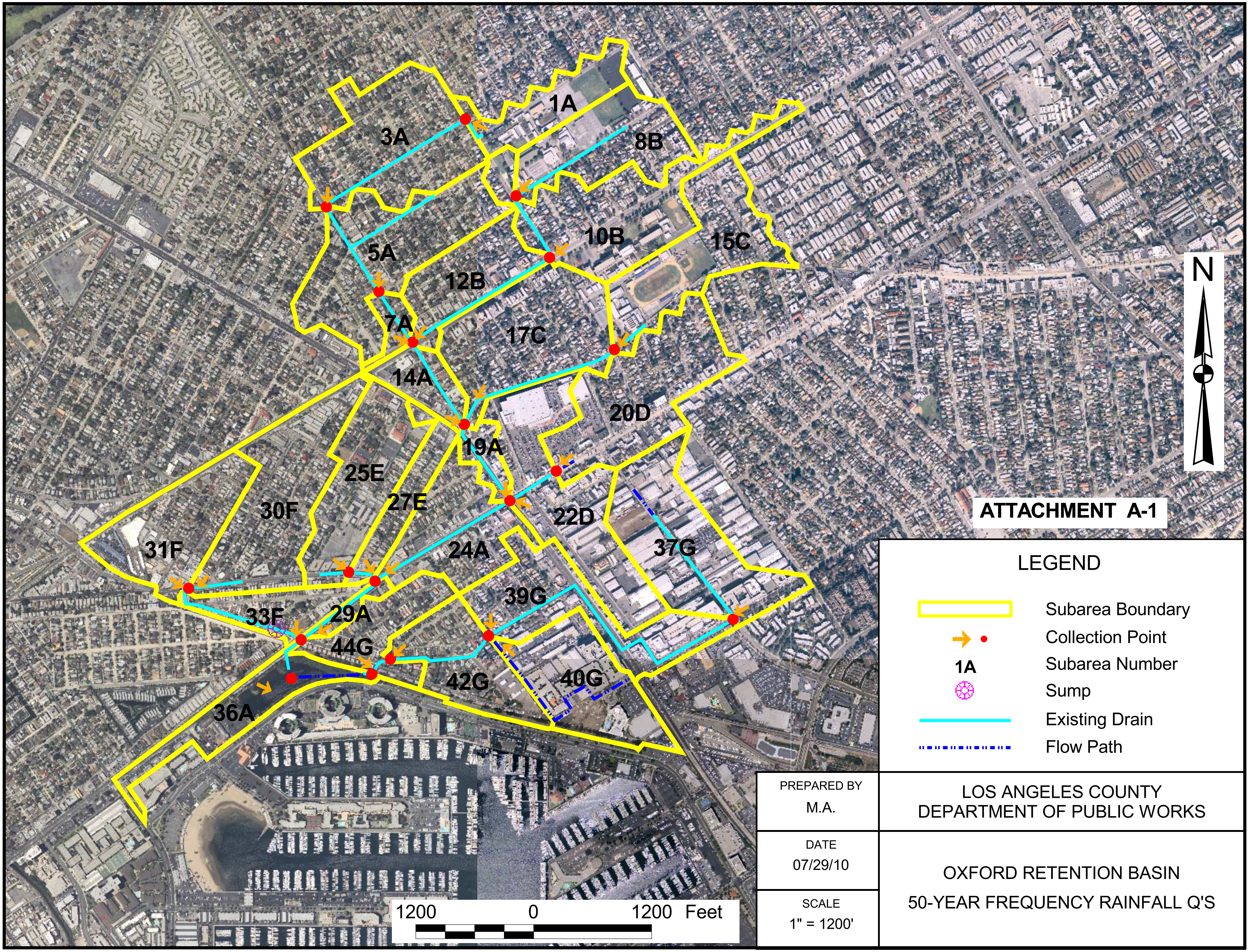
Summary of Findings

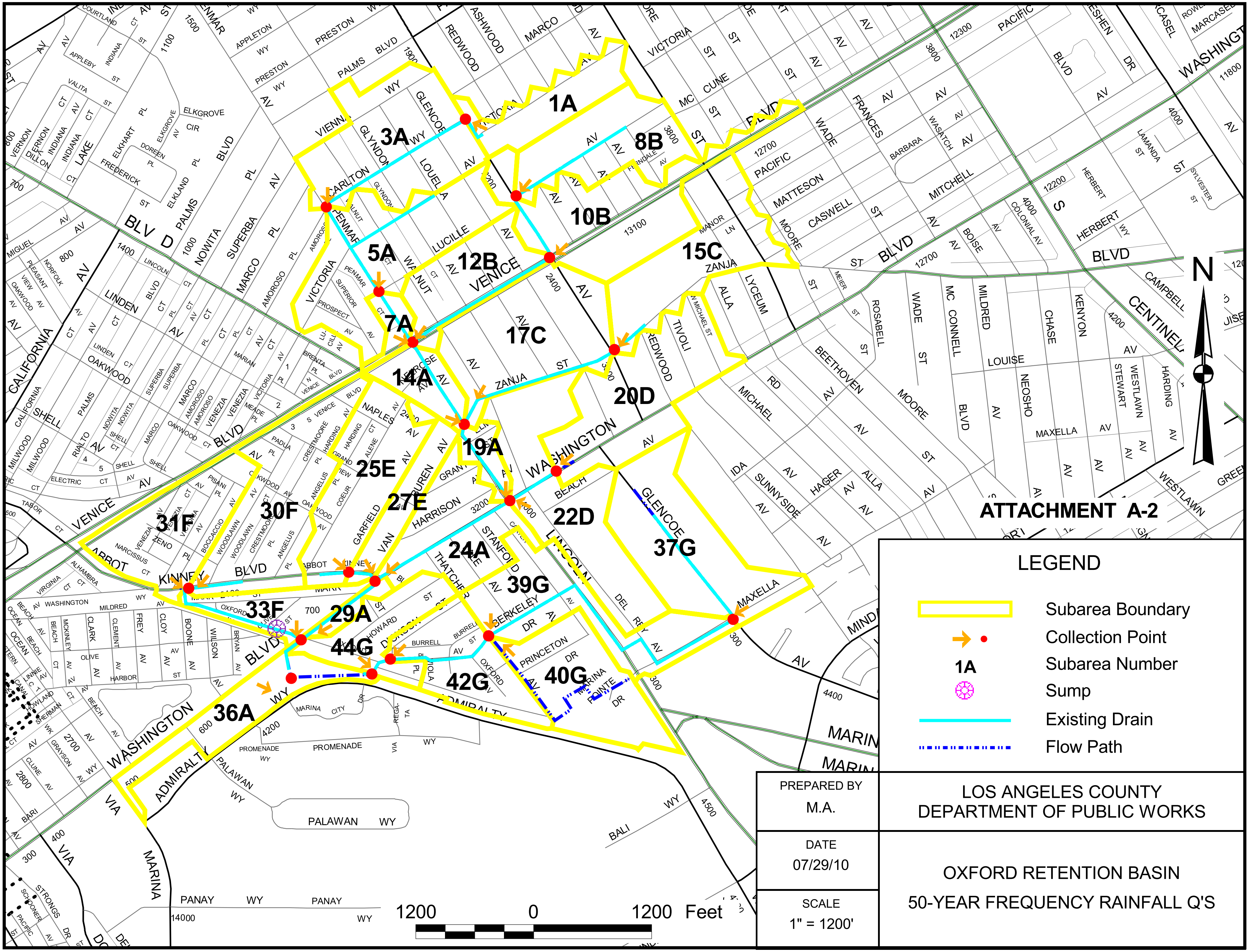
The Capital Flood for Oxford Retention Basin is 751 cfs. A reservoir routing analysis of Oxford Retention Basin using the calculated 4-day inflow hydrographs along with the existing elevation-storage-discharge relationship used in the 1994 study showed that for on an initial water surface elevation of 2.7 feet MSL, the basin will reach a maximum elevation of 4.90 feet MSL. A second analysis showed that based on an initial water surface elevation of 3.4 feet MSL, the basin will reach a maximum elevation of 5.60 feet MSL.

If you have any questions, please contact Martin Araiza at Extension 6152.

MA:yg
P:\wrd\Hyddev\Users\Martin\memos\Oxford Memo.doc

Attach.


1A
3A
8B
5A
10B
15C
12B
7A
17C
14A
20D
19A
25E
30F
27E
22D
31F
24A
37G
39G
33F
29A
44G
42G
40G
36A
N
ATTACHMENT A-1
LEGEND
Subarea Boundary
Collection Point
1A Subarea Number
Sump
Existing Drain
Flow Path
1200 0 1200 Feet
PREPARED BY
M.A.
DATE
07/29/10
SCALE
1" = 1200'
LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
OXFORD RETENTION BASIN
50-YEAR FREQUENCY RAINFALL Q'S


ATTACHMENT A-2
N
1A
3A
5A
7A
8B
10B
12B
14A
15C
17C
19A
20D
22D
24A
25E
27E
29A
30F
31F
33F
36A
37G
39G
40G
42G
44G
LEGEND
Subarea Boundary
Collection Point
1A Subarea Number
Sump
Existing Drain
Flow Path
1200 0 1200 Feet
PREPARED BY
M.A.
DATE
07/29/10
SCALE
1" = 1200'
LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
OXFORD RETENTION BASIN
50-YEAR FREQUENCY RAINFALL Q'S

County of Los Angeles Department of Public Works
ATTACHMENT B
HYDROLOGIC DATA

Project: OXFORD RETENTION BASIN

Conveyance Types:

1. Natural Mountain
2. Natural Valley
3. Street
4. Pipe
5. Rectangular Channel
6. Trapezoidal Channel

50 -Year Frequency Design Storm

Reach or Subarea	Preliminary Conveyance			Slope	Area (acres)		Peak Q (cfs)	
	Length (feet)	Type	Size (feet)		Subarea	Total	Subarea[1]	Reach[2]
Line A								
1A					16.9		25	
1A - 3A	1,684	4	2.00	0.01671		16.9		25
3A					41.0		67	
3A - 5A	1,016	4	5.25	0.00100		57.9		90
5A					42.1		58	
5A - 7A	620	4	4.25	0.00838		100.0		143
7A					4.7		11	
7A - Line B	-	-	-	-		104.7		145
Line B					89.0		120	
Line B - 14A	988	4	7.75	0.00100		193.7		265
14A					10.3		16	
14A - Line C	-	-	-	-		204.0		272
Line C					73.4		84	
Line C - 19A	933	4	6.00	0.00644		277.4		355
19A					5.7		11	
19A - Line D	-	-	-	-		283.1		357
Line D					81.7		108	
Line D - 24A	1,597	5	12.00	0.00100		364.8		454
24A					27.7		36	

[1]Peak flow rate from the subarea that can be proportioned (Q/A) for catch basin design within the subarea (see the Department's "Hydraulic Design Manual").

[2]Peak flow rate at the top of the reach for design of the conveyance.

County of Los Angeles Department of Public Works
ATTACHMENT B
HYDROLOGIC DATA

Project: OXFORD RETENTION BASIN

Conveyance Types:

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Reach or Subarea	Preliminary Conveyance			Slope	Area (acres)		Peak Q (cfs)	
	Length (feet)	Type	Size (feet)		Subarea	Total	Subarea[1]	Reach[2]
24A - Line E	-	-	-	-		392.5		474
Line E					43.3		50	
Line E - 29A	973	5	13.00	0.00100		435.8		519
29A					3.3		5	
29A - Line F	-	-	-	-		439.1		519
Line F					83.4		94	
Line F - 36A	279	5	13.00	0.00100		522.5		601
36A					19.7		26	
36A - Line G	-	-	-	-		542.2		620
Line G					145.2		140	
Line G - Oxford Ret Basin	-	-	-	-		687.7		751
Line B								
8B					27.1		40	
8B - 10B	764	4	2.50	0.00831		27.1		40
10B					40.9		53	
10B - 12B	1,640	4	3.75	0.00689		68.0		92
12B					21.0		32	

[1]Peak flow rate from the subarea that can be proportioned (Q/A) for catch basin design within the subarea (see the Department's "Hydraulic Design Manual").

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County of Los Angeles Department of Public Works
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50 -Year Frequency Design Storm

Reach or Subarea	Preliminary Conveyance			Slope	Area (acres)		Peak Q (cfs)	
	Length (feet)	Type	Size (feet)		Subarea	Total	Subarea[1]	Reach[2]
12B - Line A	-	-	-	-		89.0		120
Line C								
15C					33.5		46	
15C - 17C	1,776	4	4.00	0.00100		33.5		46
17C					39.9		46	
17C - Line A	-	-	-	-		73.4		84
Line D								
20D					39.8		51	
20D - 22D	561	4	4.25	0.00100		39.8		51
22D					41.9		59	
22D - Line A	-	-	-	-		81.7		108
Line E								
25E					30.8		36	
25E - 27E	309	4	3.75	0.00100		30.8		36

[1]Peak flow rate from the subarea that can be proportioned (Q/A) for catch basin design within the subarea (see the Department's "Hydraulic Design Manual").

[2]Peak flow rate at the top of the reach for design of the conveyance.

County of Los Angeles Department of Public Works
ATTACHMENT B
HYDROLOGIC DATA

Project: OXFORD RETENTION BASIN

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50 -Year Frequency Design Storm

Reach or Subarea	Preliminary Conveyance			Slope	Area (acres)		Peak Q (cfs)	
	Length (feet)	Type	Size (feet)		Subarea	Total	Subarea[1]	Reach[2]
27E					12.5		14	
27E - Line A	-	-	-	-		43.3		50
Line F								
30F					40.8		47	
31F					28.9		34	
31F - 33F	1,428	4	5.00	0.00100		69.7		81
33F					13.7		19	
33F - Line A	-	-	-	-		83.4		94
Line G								
37G					40.5		49	
37G - 39G	3,251	4	4.25	0.00100		40.5		49
39G					33.5		39	
40G					29.4		34	
40G - 42G	1,111	4	5.50	0.00100		103.4		104
42G					24.0		25	
42G - 44G	260	4	5.75	0.00100		127.4		124

[1]Peak flow rate from the subarea that can be proportioned (Q/A) for catch basin design within the subarea (see the Department's "Hydraulic Design Manual").

[2]Peak flow rate at the top of the reach for design of the conveyance.

County of Los Angeles Department of Public Works
ATTACHMENT B
HYDROLOGIC DATA

Project: OXFORD RETENTION BASIN

Conveyance Types:

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3. Street
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5. Rectangular Channel
6. Trapezoidal Channel

50 -Year Frequency Design Storm

Reach or Subarea	Preliminary Conveyance			Slope	Area (acres)		Peak Q (cfs)	
	Length (feet)	Type	Size (feet)		Subarea	Total	Subarea[1]	Reach[2]
44G					17.8		23	
44G - Line A	-	-	-	-		145.2		140

[1]Peak flow rate from the subarea that can be proportioned (Q/A) for catch basin design within the subarea (see the Department's "Hydraulic Design Manual").

[2]Peak flow rate at the top of the reach for design of the conveyance.

ATTACHMENT E

CHRONOLOGICAL HISTORY OF COMMUNITY OUTREACH

Community Outreach & Support

Date	Audience
Early 2012	*Additional Community Meeting(s)*
March 2012	Marina Del Rey Lessee's Association
January 2012	Ballona Creek Task Force
August 2011	MdR Convention & Visitor's Bureau
August 2010	MdR Design Control Board
August 2010	Small Craft Harbors Committee
September 2009	Public Meeting
November 2007	Santa Monica Bay Restoration Commission
November 2007	Ballon Creek Task Force
July 2007	Small Craft Harbors Committee
July 2007	MdR Design Control Board

ATTACHMENT F

ISI RATING SUMMARY

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Project Application

Envision™ Sustainable Infrastructure Rating System

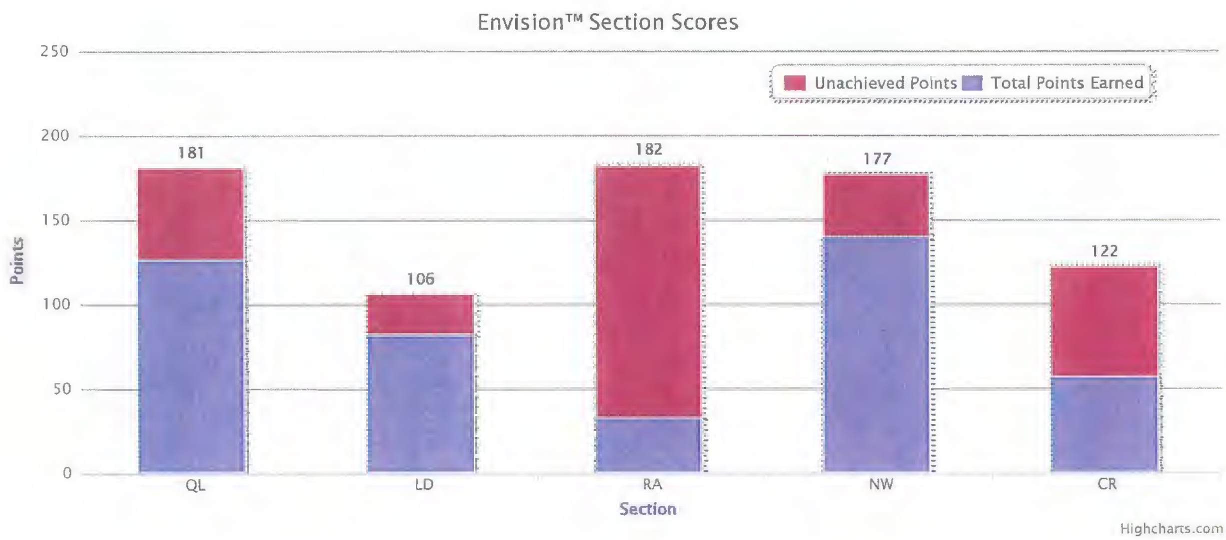
Instructions | Projects | Section Menu | QL | LD | RA | NW | CR | Section Totals Summary | Report

Section 5 choices updated.

"Oxford Retention basin Multi-Use Project"

Section Totals Summary

Section	Maximum Possible Score	Section Points	Innovation Points	Total Points Earned
QL	181	121	5	126
LD	106	79	3	82
RA	182	30	3	33
NW	177	135	5	140
CR	122	54	3	57
Total Project Points	**768**	**419**	**19**	438



< Previous Page   Next Page >

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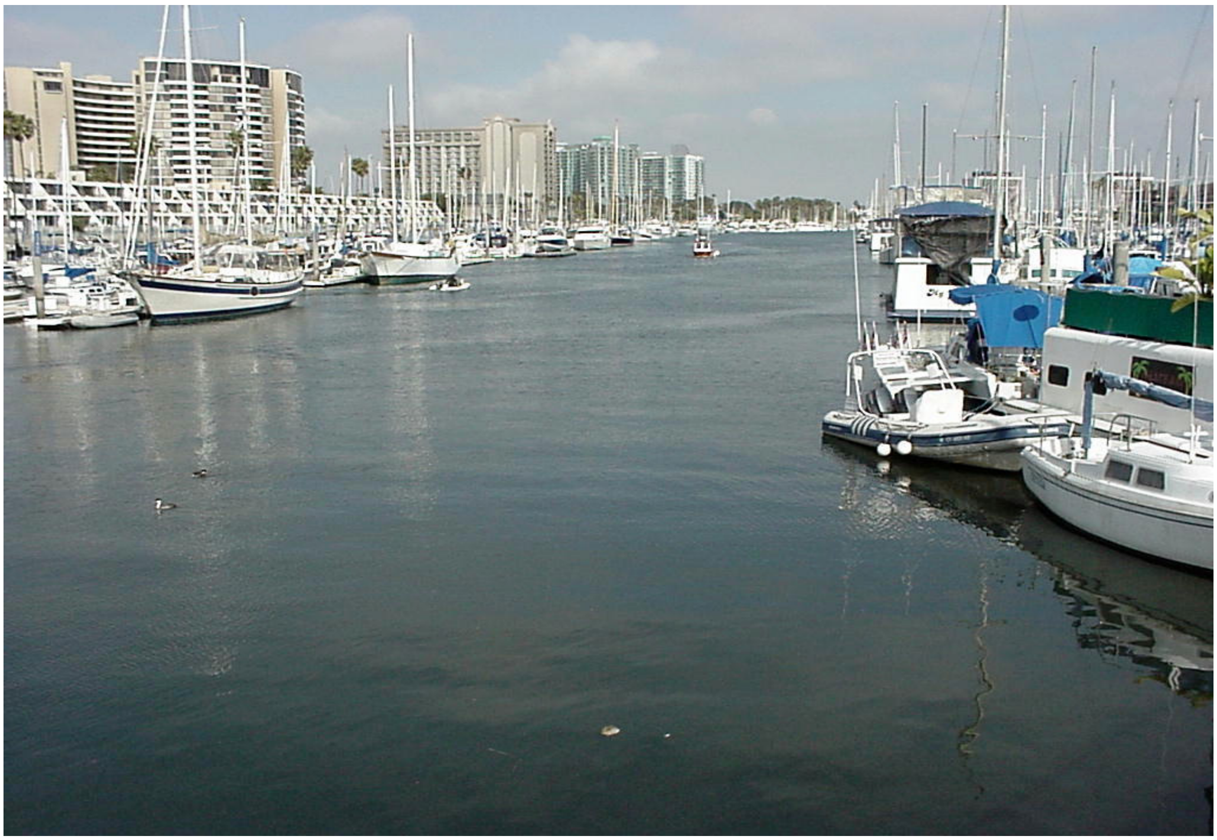
Email: info@sustainableinfrastructure.org
www.sustainableinfrastructure.org

TOTAL MAXIMUM DAILY LOAD FOR TOXIC POLLUTANTS IN MARINA DEL REY HARBOR



PREPARED BY
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION
AND

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 9

FINAL REPORT: OCTOBER 6, 2005

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

µg/g	Micrograms per Gram
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
BMPs	Best Management Practices
BPTCP	Bay Protection and Toxic Cleanup Program
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
COMM	Commercial and Sport Fishing
CTR	California Toxics Rule
CWA	Clean Water Act
DL	Detection Limit
EMCs	Event Mean Concentrations
ERL	Effects Range-Low
+ERM	Effects Range-Median
EST	Estuarine Habitat
FHWA	Federal Highway Administration
FR	Federal Register
kg	Kilograms
LACDPW	Los Angeles County Department of Public Works
LARWQCB	Los Angeles Regional Water Quality Control Board
LACDBH	Los Angeles County Department OF Beaches and Harbors
MAR	Marine Habitat
MdRH	Marina del Rey Harbor
MGD	Million Gallons per Day
mg/kg	Milligrams per Kilogram
MS4	Municipal Separate Storm Sewer System
MTRL	Maximum Tissue Residue Level
NAV	Navigation
ng/L	Nanograms per Liter
NPDES	National Pollutant Discharge Elimination System
NPTN	National Pesticide Telecommunications Network
O&M	Operation and Maintenance
OEHHA	Office of Environmental Heath Hazard Assessment
PCBs	Polychlorinated biphenyls
PEL	Probable Effects Level
pg/L	Picograms per Liter
ppb	Parts per Billion
ppt	Parts per Thousand
RARE	Rare, Threatened, or Endangered Species
REC1	Water Contact Recreation
REC2	Non-Contact Water Recreation
SHELL	Shellfish Harvesting

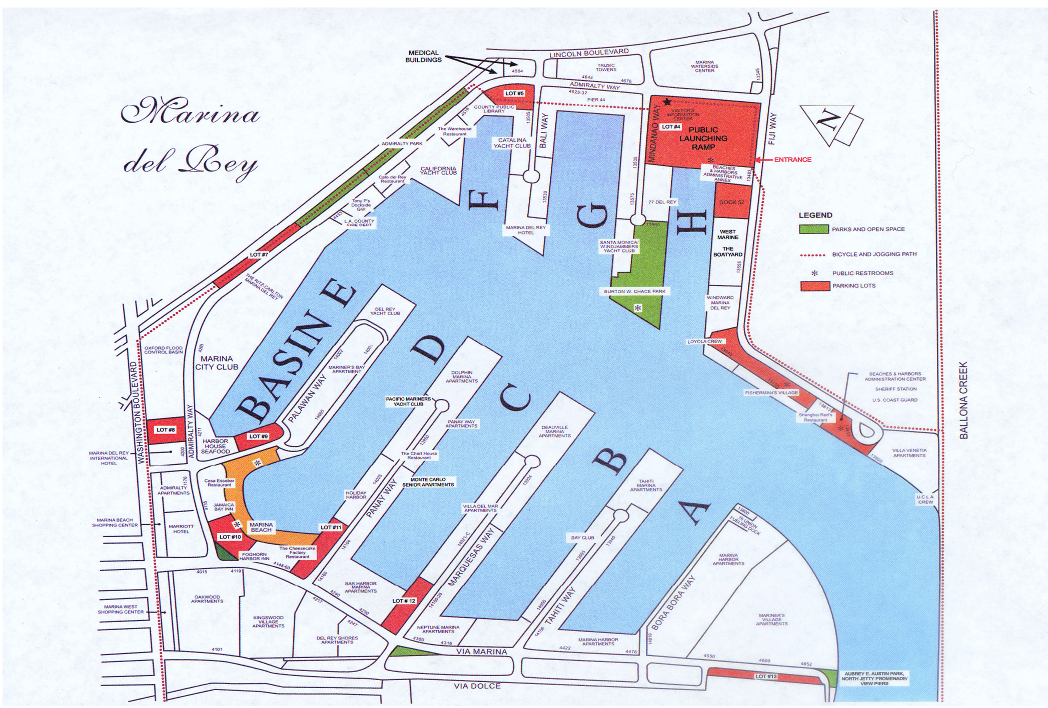
SIYB	Shelter Island Yatch Basin
SQGs	Sediment Quality Guidelines
SQOs	Sediment Quality Objectives
TEL	Threshold Effects Level
TMDL	Total Maximum Daily Load
TSMP	Toxic Substances Monitoring Program
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WDRs	Waste Discharge Requirements
WILD	Wildlife Habitat
WLAs	Waste Load Allocations
WQA	Water Quality Assessment
WQOs	Water Quality Objectives

1. INTRODUCTION

This report presents the required elements of the Total Maximum Daily Load (TMDL) for toxic pollutants in Marina del Rey's Back Basins (Basins D, E and F), and summarizes the technical analyses performed by the California Regional Water Quality Control Board, Los Angeles Region (Regional Board) and the United States Environmental Protection Agency, Region 9 (USEPA) to develop this TMDL.

The back basins of the Marina are listed for a variety of toxic pollutants, including metals, organic compounds and sediment toxicity (Table 1-1). These sections of Marina del Rey Harbor were included on the 1996, 1998 and 2002 California 303(d) list of impaired waterbodies (LARWQCB, 1996, 1998, 2002). The Clean Water Act (CWA) requires a TMDL be developed to restore the impaired waterbodies to their full beneficial uses.

Figure 1: Marina del Rey Harbor



This TMDL complies with 40 CFR 130.2 and 130.7, Section 303(d) of the CWA and USEPA guidance for developing TMDLs in California (USEPA, 2000a). In addition to the summary of the information used in its development, the TMDL includes an implementation plan and cost estimate to achieve the WLAs and attain water quality objectives (WQOs) in Marina del Rey's back basins. The California Water Code (Porter-Cologne Water Quality Control Act) requires that an implementation plan be developed to achieve water quality objectives. This TMDL addresses the impairments in Basins D, E, and F of Marina del Rey Harbor (Figure 1).

1.1 Regulatory Background

Section 303(d) of the CWA requires that each State "shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality objective applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters. The elements of a TMDL are described in 40 CFR 130.2 and 130.7 and Section 303(d) of the CWA, as well as in the USEPA guidance (USEPA, 2000a). A TMDL is defined as the "sum of the individual waste load allocations for point sources and load allocations for non-point sources and natural background" (40 CFR 130.2) such that the capacity of the waterbody to assimilate pollutant loads (the loading capacity) is not exceeded. A TMDL is also required to account for seasonal variations and include a margin of safety to address uncertainty in the analysis (USEPA, 2000a).

States must develop water quality management plans to implement the TMDL (40 CFR 130.6). The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (State Board) and the nine Regional Water Quality Control Boards are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If USEPA does not approve a TMDL submitted by a state, USEPA is required to establish a TMDL for that waterbody. The Regional Boards also hold regulatory authority for many of the instruments used to implement the TMDLs, such as the National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs).

As part of its 1996 and 1998 regional water quality assessments (WQAs), the Regional Board identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWQCB, 1996, 1998). These are referred to as "listed" or "303(d) listed" waterbodies or waterbody segments. A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree that was approved on March 22, 1999 (Heal the Bay Inc., et al. v. Browner, et al. C 98-4825 SBA).

For the purpose of scheduling TMDL development, the consent decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units. Analytical Unit 54 addresses the impairments in Marina del Rey back basins associated with organic pollutants (chlordane, dieldrin, DDT, PCBs, benthic community effects, fish consumption advisory and sediment toxicity) and Analytical Unit 56 addresses the impairments associated with metals (lead, copper, and zinc). In addition, the Tributyltin impairment is addressed under Analytical Unit 70. Table 1-1 presents the 1998 303(d) list of toxic impairments in the Marina del Rey back basins The consent decree also prescribed schedules for certain TMDLs, and according to this schedule, USEPA must either approve a state TMDL for Analytical Units 54 and 56 or establish its own, by March 22, 2006

Table 1-1: 1998 303(d) list of metal and organic compound impairments for Marina del Rey's back basins

Media	Pollutant		
	Analytical Unit 54	**Analytical Unit 56**	**Analytical Unit 70**
Sediment	DDT Chlordane Sediment toxicity	Lead (Pb) Copper (Cu) Zinc (Zn)	
Fish Tissue	DDT Chlordane PCBs Dieldrin Fish consumption advisory	Lead (Pb) Copper (Cu) Zinc (Zn)	Tributyltin (TBT)
Benthic infauna	Benthic community effects		

Paragraph 8 of the consent decree provides that TMDLs need not be completed for specific waterbody by pollutant combinations if the State or EPA determines that TMDLs are not needed for these combinations, consistent with the requirements of Section 303(d). The consent decree provides that this determination may be made either through a formal decision to remove a combination from the State Section 303(d) list or through a separate determination that the specific TMDLs are not needed. Paragraph 9 of the consent decree describes procedures for giving notice that TMDLs are not needed.

On the 2002 303(d) list, the Regional Board de-listed copper, lead, zinc and tributyltin in fish tissue. The tissue listings for these pollutants were removed because the elevated data levels upon which the 1998 listings were based no longer reflect valid assessment guidelines. DDT in sediment was de-listed since sediment concentrations have dropped below sediment quality guidelines. The benthic community degradation impairment was also de-listed since the benthic infauna was determined to be only moderately degraded. In addition, the Regional Board added a new listing for PCBs in sediment for the Marina del Rey back basins. Current listings are presented in Table 1-2.

Table 1-2. 2002 303(d) List of metal and organic compound impairments for Marina del Rey's back basins

Media	**Pollutant**
Sediment	Copper (Cu) Lead (Pb) Zinc (Zn) Chlordane PCBs Sediment toxicity
Fish Tissue	DDT Dieldrin Chlordane PCBs Fish consumption advisory

Pursuant to paragraph 8, the Regional Board determined that TMDLs are not required for chlordane, total DDT, and dieldrin in fish tissue. More recent data shows these pollutants to be below screening values. A more detailed discussion on these findings is provided in Section 2.2 Data Review. This constitutes the notice as provided for in paragraph 9 of the consent decree.

On May 6, 2003, the Regional Board held a California Environmental Quality Act (CEQA) scoping meeting to solicit input from the public and interested stakeholders in determining the scope, content and implementation options of the proposed TMDL for toxic pollutants in Marina del Rey's back basins. At the scoping meeting, the CEQA checklist of significant environmental issues and mitigation measures were discussed. This meeting fulfilled the requirements under CEQA (Public Resources Code, Section 21083.9).

This TMDL will address impairment of beneficial uses due to elevated concentrations of chlordane, copper, lead, and zinc in Marina del Rey Harbor sediments, and total PCBs in fish tissue. The sediment toxicity and fish advisory listing will be addressed by the TMDLs waste load allocations (WLAs) and load allocations (LAs) for these toxic pollutants. The TMDLs for nearby Ballona Creek required under Analytical Units # 55 and 57 have been addressed in a separate TMDL.

1.2 Environmental Setting

The MdR watershed is approximately 2.9 square miles located in the Santa Monica Bay, California. It is south of Venice and north of Playa del Rey, and approximately 15 miles southwest of downtown Los Angeles. The watershed includes the City of Los Angeles, Culver City and unincorporated areas of Los Angeles County. The climate is warm and dry most of the year with intermittent wet weather events typically between November and March.

MdR Harbor (MdRH) was developed in the early 1960s on degraded wetlands that formed part of the estuary of Ballona Creek Wetlands. MdRH, which opens into Santa Monica Bay, was constructed by the Army Corps of Engineers and is the largest artificial small-craft harbor in the United States. MdRH harbors more than 6,000 wet berthed slips for privately owned pleasure craft, dry storage of approximately 3,000 boats, and launch facilities, which can accommodate approximately 240 trailered boats. The back basins (Basins D, E and F) house approximately 2,000 slips (Joseph Chesler, Los Angeles County Department of Beaches and Harbors, personal communication).

The Corps of Engineers maintains the harbor entrance channel and main channel for navigation by dredging. Since the late 1980's, the Corps of Engineers has not been able to use open water disposal for sediments dredged from the entrance channel due to the elevated levels of contaminants deposited from adjacent Ballona Creek. Based on Corps of Engineers' hydrodynamic numerical modeling (RMA4 model) results, the contaminant influence from Ballona Creek does not travel to nor affect the back basins (USACE 1999). Therefore, the back basins of the MdRH are assumed to be outside any significant influence from Ballona Creek.

The MdR watershed is highly developed with high-density single family residence (HDSFR), multiple family residence (MFR), and mixed residential comprising the primary land use in the watershed (46.6%) followed by retail, commercial, and general office representing the second largest land use (12.2%). The receiving waters of MdRH constitute 11.6% of the land area and marina facilities cover 9.2% of the land use. Open space and recreation represents 4.8% of the land use in the watershed. Light industrial and vacant/urban vacant each represent 4.7% of the land use. The remaining 6% of land area is covered by educational institutions (3.8%), under construction (1.2%), institutional and military installations (0.6%), transportation (0.3%), and mixed urban (0.2%).

For the purposes of this TMDL, the Regional Board has divided the watershed into five sub-watersheds based on the drainage patterns provided by the Los Angeles County Department of Public Works (LACDPW). Area 1A drains into the back basins (Basins D, E and F) of MdRH and Area 1B drains into the rest of the MdRH area (all other basins). Area 2 drains into Ballona Lagoon and then to the harbor entrance. Area 3 drains into the back basins via storm drains and Area 4 drains into the Oxford Flood Control Basin (OFCB) via storm drains and then into Basin E through a tidal gate. The sub-watersheds of the harbor are shown in Figure 1-2. See Table 1-3 for land use breakdowns by sub-watersheds.

Figure 1-2: Marina del Rey sub-watershed areas

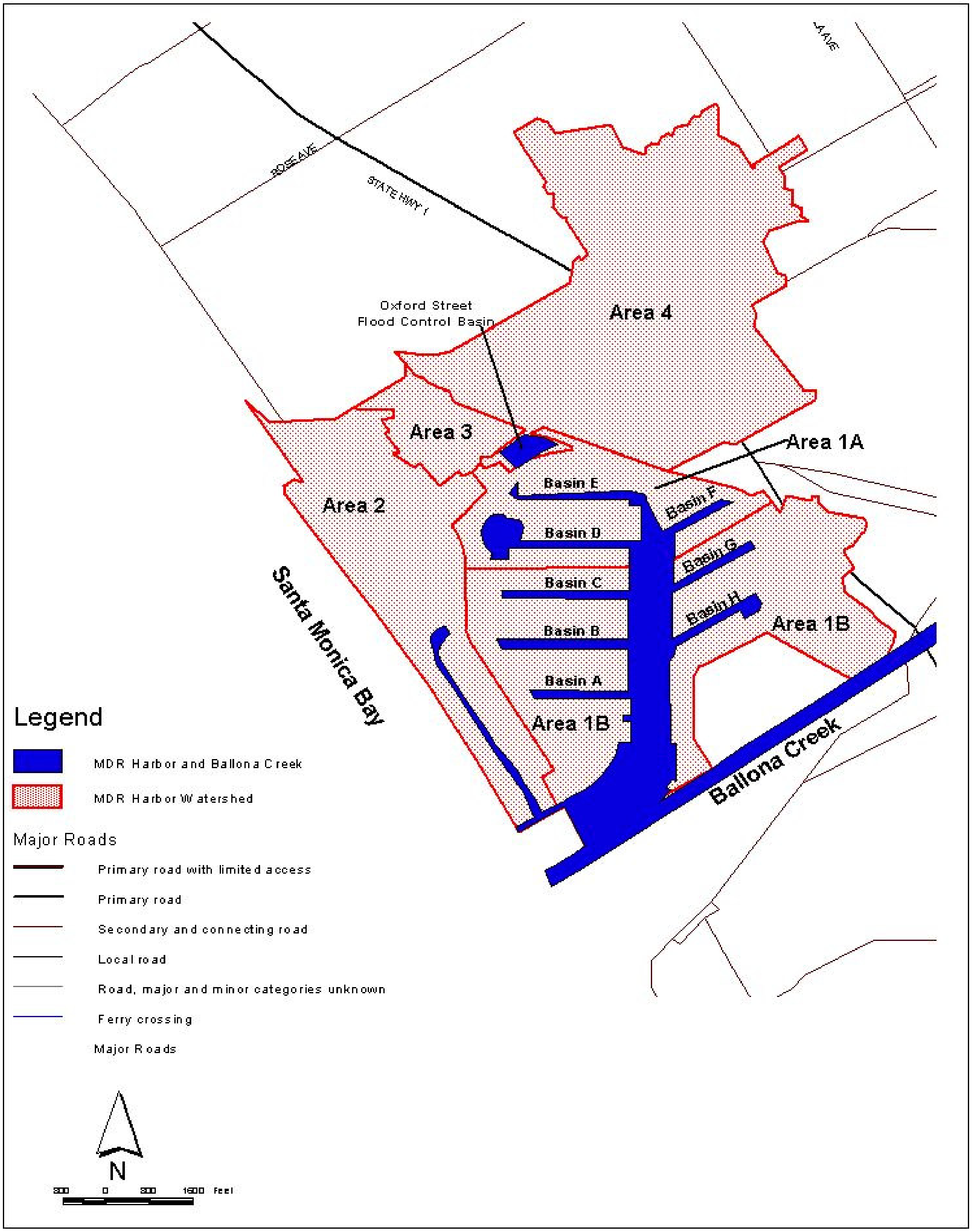


Table 1-3. Land Use by Sub-watershed Area for Marina del Rey Watershed

Land Use Type*	Marina del Rey Watershed (acres)				
	Area 1A	Area 1B**	Area 2**	Area 3	Area 4
Education			**3**		67
General Office	2	**17**			
HDSFR			**65**	38	304
Institutional	1	**9**			
Light Industrial				2	86
Marina Facilities	65	**106**			
MFR	32	**128**	**201**	14	50
Military Installations		**1**			
Mixed Residential			**1**	13	18
Mixed Urban					3
Open Space/Recreation	19	**65**	**2**		3
Other Commercial	16	**3**	**9**		2
Receiving Waters	44	**151**	**13**		8
Retail/Commercial	32	**30**	**21**		94
Transportation	4				2
Under Construction		**2**	**11**	4	6
Urban Vacant	2	**4**			29
Vacant		**53**			
Total	217	**569**	**326**	71	672

* Land use data was provided by the LACDPW on May 20, 2002 by Dr. T.J. Kim
** These sub-watershed areas do not drain to the back basins

1.3 Organization of this Document

Guidance from USEPA (1991) identifies seven elements of a TMDL. Sections 2 through 7 of this document present these elements, with the analysis and findings of this TMDL for that element. The required elements are as follows:

- **Section 2: Problem Identification.** This section describes the nature of the impairments addressed by this TMDL, and presents data to demonstrate the extent of impairment. Beneficial uses of the impaired water bodies and the relevant water quality objectives are also presented.
- **Section 3: Numeric Targets.** This section identifies the numeric targets established for the TMDLs and representing attainment of water quality objectives (WQOs) and beneficial uses.
- **Section 4: Source Assessment.** This section identifies the potential point sources and nonpoint sources of organic pollutants and metals to Marina del Rey Harbor
- **Section 5: Linkage Analysis, TMDL and Pollutant Allocations.** This section presents the analysis to evaluate the link between sources of toxic pollutants and the resulting conditions in the impaired waterbody. Each identifiable source is allocated a quantitative load or waste load allocations for the listed pollutants, representing the load that it can discharge while still ensuring that the receiving water meets the WQOs. Allocations are designed to protect the waterbody from conditions that exceed the applicable numeric target.
- **Section 6: Implementation.** This section describes the regulatory tools, plans and other mechanisms available to achieve the WLAs. The TMDL provides cost estimates to implement best management practices (BMPs) required throughout the Marina del Rey watershed to meet water quality objectives in the back basins of the harbor.
- **Section 7: Monitoring.** This TMDL describes the monitoring to ensure that the WQOs are attained. If the monitoring results demonstrate the TMDL has not resulted in attainment of WQOs, then revised allocations will be developed While the TMDL identifies the goals for a monitoring program, the Executive Officer will issue subsequent orders to identify the specific requirements and the specific entities that will develop and implement a monitoring program and submit technical reports.

2. PROBLEM IDENTIFICATION

The listings for Marina del Rey's back basins are based on concentrations of chlordane, dieldrin, DDT and PCBs in fish tissue and concentrations of copper, lead, zinc, chlordane, and PCBs in sediments. This section provides an overview of water quality criteria and guidelines applicable to Marina del Rey and reviews the fish tissue, and sediment and water quality data compiled for the purpose of this TMDL.

As a result of the data review conducted to prepare this section, the Regional Board concluded that some of the 303(d) listing decisions were no longer valid. Section 2.2 describes the basis for these conclusions. Pursuant to the consent decree, TMDLs are not required to address these listings and are therefore not developed.

2.1 Water Quality Standards

California state water quality standards consist of the following elements: 1) beneficial uses; 2) narrative and/or numeric WQOs; and 3) an anti-degradation policy. In California, the Regional Boards define beneficial uses in the Water Quality Control Plans (Basin Plans). Numeric and narrative objectives are specified in each region's Basin Plan. The objectives are set to be protective of the beneficial uses in each waterbody in the region and/or to protect against degradation. Numeric objectives for toxics can be found in the California Toxics Rule (40 CFR §131.38).

2.1.1 Beneficial Uses

The Basin Plan for the Los Angeles Regional Board (CRWQCB, 1994) defines 7 existing (E), beneficial uses for Marina del Rey Harbor (Table 2-1).

Table 2-1. Beneficial Uses of Marina del Rey Harbor (LARWQCB, 1994)

Coastal Feature	Hydro Unit #	NAV	REC1	REC2	COMM	MAR	WILD	SHELL
Marina del Rey Harbor	405.13	E	E	E	E	E	E	E

Beneficial use designations apply to all tributaries to the indicated waterbody, if not listed separately.
E: Existing beneficial use

There are existing designated uses to protect aquatic life that use the marine, and wildlife habitat (MAR and WILD). There are also beneficial uses associated with human use of the habor including recreational use for water contact (REC1), non-contact water recreation (REC2), navigation (NAV), commercial and sport fishing (COMM), and shellfish harvesting (SHELL).

Discharges of toxic pollutants to the harbor back basins may result in impairments of beneficial uses associated with aquatic life (MAR and WILD), and human use of these resources (COMM, SHELL, and REC-1).

2.1.2 Water Quality Objectives (WQOs)

As stated in the Basin Plan, water quality objectives (WQOs) are intended to protect the public health and welfare and to maintain or enhance water quality in relation to the designated existing and potential beneficial uses of the water. The Basin Plan specifies both narrative and numeric water quality objectives. The following narrative water quality objectives are the most pertinent to this TMDL. These narrative WQOs may be applied to both the water column and the sediments.

> Chemical Constituents: *Surface waters shall not contain concentrations of chemical constituents in amounts that adversely affect any designated beneficial use.*
>
> Bioaccumulation: *Toxic pollutants shall not be present at levels that will bioaccumulate in aquatic life to levels, which are harmful to aquatic life or human health.*
>
> Pesticides: *No individual pesticide or combination of pesticides shall be present in concentrations that adversely affect beneficial uses. There shall be no increase in pesticide concentrations found in bottom sediments or aquatic life.*
>
> Toxicity: *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life.*

The Regional Board's narrative toxicity objective reflects and implements national policy set by Congress. The Clean Water Act states that, "it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited." (33 U.S.C. 1251(a)(3).) In 2000, USEPA established numeric water quality objectives for several pollutants addressed in this TMDL in the California Toxics Rule (CTR) (USEPA, 2000b). The CTR establishes numeric aquatic life criteria for 23 priority toxic pollutants and numeric human health criteria for 92 priority toxic pollutants. These criteria are established to protect human health and the environment and are applicable to inland surface waters enclosed bays and estuaries.

For the protection of aquatic life, the CTR establishes short-term (acute) and long-term (chronic) criteria in both freshwater and saltwater. The acute criterion equals the highest concentration of a pollutant to which aquatic life can be exposed, for a short period of time, without deleterious effects. The chronic criterion equals the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. Freshwater criteria apply to waters in which the salinity is equal to or less than 1 part per thousand (ppt) 95 percent or more of the time. Saltwater criteria apply to waters in which salinity is equal to or greater than 10 ppt 95 percent or more of the time. For waters in which the salinity is between 1 and 10 ppt, the more stringent of the two criteria apply.

In the CTR, freshwater and saltwater criteria for metals are expressed in terms of the dissolved fraction of the metal in the water column. These criteria were calculated based on methods in USEPA's *Summary of Revisions to Guidelines for Deriving Numerical*

National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses (50 FR 30792, July 29, 1985), developed under Section 304(a) of the CWA. This methodology is used to calculate the total recoverable fraction of metals in the water column and then appropriate conversion factors, included in the CTR are applied, to calculate the dissolved criteria for metals in the water column.

The human health criteria are established to protect the general population from priority toxic pollutants regulated as carcinogens (cancer-causing substances) and are based on the consumption of water and aquatic organisms or aquatic organisms only, assuming a typical consumption of 6.5 grams per day of fish and shellfish and drinking 2.0 liters per day of water. Table 2-2 summarizes the aquatic life, and human health criteria for metals and organic constituents, covered under this TMDL.

Table 2-2. Water quality objectives established in the CTR for metals and organic compounds

Pollutant	Criteria for the Protection of Aquatic Life		Criteria for the Protection of Human Health	
	Saltwater			
	Acute (µg/L)	Chronic (µg/L)	Water & Organisms (µg/L)	Organisms only (µg/L)
Chlordane	0.09	0.004	0.00057	0.00059
Total PCBs[1]	-	0.03	0.00017	0.00017
Copper (dissolved)	4.8	3.1	1300	-
Lead (dissolved)	210	8.1	-	-
Zinc (dissolved)	90	81	-	-

[1]Based on total PCBs, the sum of all congener or isomer or homolog or aroclor analyses.

For PCBs, the Basin Plan states that, "*Pass-through or uncontrollable discharges to waters of the Region, or at locations where the waste can subsequently reach water of the Region, are limited to 70 picograms per liter (pg/L) measured as a 30 day average for protection of human health and 14 nanograms per liter (ng/L) measured as a daily average and 30 ng/L measured as a daily average to protect aquatic life in inland fresh water and estuarine waters, respectively*." The 30-day average aquatic life value for PCBs in the Basin is the same as the 4-day average value in the CTR. However, the human health 30-day average value in the Basin Plan of 70 pg/L is more stringent the CTR value of 170 pg/L, which is also a 30-day average.

There are no numeric standards for fish tissue in the Basin Plan. The human health criteria in the CTR were developed to ensure that bioaccumulative substances do not concentrate in fish tissue at levels that could impact human health.

There are no water quality objectives for sediment in the Basin Plan. The Regional Board applied best professional judgment to define elevated values for metals in sediment during the water quality assessments conducted in 1996, 1998, and 2002. The State Board is in the process of developing sediment quality objectives (SQOs) for enclosed bays and estuaries, and expects to adopt these objectives and an implementation policy by February 28, 2007. The final objectives and implementation policy would be subject to review by the Office of Administrative Law before becoming effective. The Regional

Board will review the numeric targets in this TMDL for consistency with the final sediment quality objectives within six months after the effective date.

2.1.3 Antidegradation

State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water" in California, known as the "Anti-degradation Policy," protects surface and ground waters from degradation. Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the federal Anti-degradation Policy (40 CFR 131.12).

2.2 Data Review

This section summarizes the data for Marina del Rey back basins for the listed toxic pollutants in water, fish and sediments. The summary includes water quality, fish tissue, and sediment quality data from different sources, for the period of 1993 to 2003.

2.2.1 Water Column

Although no water column impairments for Marina del Rey back basins were listed in the current CWA 303(d) list, this was due to a lack of data rather than an indication of no impairment. Some assessment of water quality is useful as sediment and fish tissue concentrations are ultimately impacted by water-borne inputs of contaminants. Conversely, high concentrations of contaminants in sediment have the potential to impact water quality through de-sorption of chemicals into water.

No data were available for assessing water column concentrations of metals and organic pollutants in Marina del Rey harbor at the onset of developing this TMDL. In order to bridge this data gap, the Los Angeles County Public Works (LACDPW) collected water column data for the listed contaminants in the summer of 2002 (June to July). The data collected represents the results of four sampling episodes during this period (see Table 2-3).

Table 2-3 Water column data for Basin E in Marina del Rey Harbor

Pollutant	Detection Limit	CTR chronic Target	6/6//02[1]	6/18/05[1]	7/1/02[1]	7/16/02	Average
Copper* (μg/L)	0.5	3.1	53	58	12.7	16.4	35
Lead* (μg/L)	0.5	8.1	n.d	n.d	n.d	0.52	-
Zinc* (μg/L)	1.0	81	55.2	39.4	96	43	58.4
Chlordane (μg/L)	0.05	0.004	n.d	n.d	n.d	n.d	n.d
DDT (μg/L)	0.1	0.001	n.d	n.d	n.d	n.d	n.d
Dieldrin (μg/L)	0.1	0.0019	n.d	n.d	n.d	n.d	n.d
PCB (μg/L)	0.5	0.03	n.d	n.d	n.d	n.d	n.d

*Values presented are dissolved metal concentrations, n.d: not detected.
[1]Uncertainty exists with respect to the analytical method used in obtaining this data.

Dissolved copper concentrations in Basin E ranged from 12.7 µg/L to 58 µg/L, exceeding both the CTR chronic criterion values of 3.1 µg/L, and the 4.8 µg/L acute criterion for salt water. Lead was not detected in three samples out of four and the only detectable concentration was below the acute and chronic criteria for saltwater. Only one sample exceeded the acute and chronic limits for zinc. Uncertainty exists with regard to the validity of the analytical methods with which results for the metals were obtained - the analytes were not removed from their salt matrix prior to analysis. Therefore, a finding of impairment for copper in the water column cannot be made at present. Further sample collection and analysis, using appropriate methods, will be required to make a final determination.

There is no indication that CTR standards are exceeded for any of the organic pollutants in Marina del Rey. However, this may be as a result of the use of analytical methods with detection limits that are above CTR standards. Further monitoring will be necessary to make a final determination of no impairment.

2.2.2 Fish and Shellfish Tissue

As discussed in section 2.2.1, there is limited data on water column concentrations to address the potential for bioaccumulation in fish. Analysis of fish tissue for chemical contaminants provides a more direct means for assessing impacts.

Maximum tissue residue levels (MTRLs) were developed by State Board by multiplying the human health CTR water quality objectives by the bioconcentration factor for each substance as recommended by USEPA (USEPA, 1991). These objectives represent levels that protect human health from consumption of fish and shellfish. The MTRLs are an assessment tool and do not constitute enforceable regulatory limits. MTRLs have value as alert levels indicating water bodies with potential human health concerns. However, the MTRLs are no longer used by the State to evaluate fish or shellfish tissue data for 303(d) listing purposes. Screening values have been developed by the Office of Environmental Health Hazard Assessment (OEHHA). These screening values relate human health endpoints to contaminant concentrations in fish based on an average consumption rate for fish and shellfish (California EPA OEHHA 1999).

To assess potential impairments associated with contaminant concentrations in fish tissue, we reviewed the 1996 WQA worksheets, which formed the basis for the 1998 303(d) list. Tissue data used in the assessment were data collected as part of the Toxic Substances Monitoring Program (TSMP) in 1993 and 1995 (Table 2-4).

Table 2-4. Fish tissue listing data from Toxic Substances Monitoring Program (ppb, wet weight).

Program	TSMP				SWRCB	OEHHA
Date	1993	1995	1995	1995	Maximum Tissue Residue Level (MTRL)	Screening Value (µg/kg)
Species	White Croaker	Round Stingray	Sargo	Yellow Croaker		
Number of individuals	1	1	1	1		
Chlordane	128		30.7		8.3	30
Dieldrin	5.6		5.3		0.7	2.0
Total DDTs	230		101	60	--	100
Total PCBs	490	255	59		5.3	20

The TSMP data represents the results from a single sample (White Croaker) in 1993, and three samples (Round Stingray, Sargo, and Yellow Croaker) in 1995 that were collected in Marina del Rey Harbor. The TSMP data indicate concentrations of chlordane, dieldrin, DDT, and PCBs that are above the MTRLs or OEHHA screening values.

More recent fish data was obtained for the Marina del Rey back basins during the Southern California Bight Regional Monitoring Project. Fish tissue samples were analyzed for chlordane, total DDTs, and total PCBs. In addition, the Los Angeles County Department of Beaches and Harbors (LACDBH) conducted fish tissue analyses at EPA's request in 2002. Chlordane, total DDTs, and dieldrin in whole fish were analyzed. Data from both sources are presented in Table 2-4.

Table 2-5. Fish tissue listing data from Toxic Substances Monitoring Program (ppb, wet weight).

Source/Date	**Bight 98**				**LACDBH 2002**	**OEHHA**
Location	MdR Basin D/E	MdR Basin H	MdR Main Channel - Entrance	MdR Main Channel - Center	MdR back basins	Screening Value (µg/kg)
Species	California Halibut	California Halibut	California Halibut	California Halibut	White Croaker	
Number of individuals	1	1	1	1	6	
Chlordane	0	0	0	2.4	<1	30
Dieldrin	n.a	n.a	n.a	n.a	<1	2.0
Total DDTs	7.4	8.8	18.6	35.2	74.4	100
Total PCBs	7	10.8	23	50.2	n.a	20

* 6 fish merged into one composite sample

The (Bight 98) data indicates that total DDT and chlordane are below the fish screening values at all locations in the harbor. Total PCB concentration in fish tissue exceeded the fish target in 2 of 4 samples in the harbor. Dieldrin was not measured for the Bight 98 studies. Additional data from the LACDBH 2002 analyses showed chlordane and dieldrin to be undetectable and total DDTs to be below screening values. These more recent data indicate that total PCBs are currently the only fish tissue impairment.

2.2.3 Sediment

Assessment of the extent of sediment impairment was based on data from the following sources:

Bay Protection and Toxic Cleanup Program Data (BPTCP): Sampling was conducted in January 93, February 94, June 96 and February 97 at different locations in the Marina del Rey Harbor. This assessment included three sampling locations in the back harbor (1 in Basin D and 2 in Basin E). The samples were analyzed for sediment chemistry and toxicity.

Los Angeles County Department of Beaches and Harbors (LACDBH 1996 –2004): This annual Marina del Rey Harbor sampling program is conducted by the Los Angeles County Department of Beaches and Harbors. The samples were taken from different locations throughout the harbor, including 4 stations in the back basins (1 in Basin D, 2 in Basin E, and 1 in Basin F). The samples were analyzed for sediment chemistry, benthic community index, water column general chemistry and physical parameters, and bacteria.

Southern California Bight Regional Monitoring Project (Bight 98): provides an integrated assessment of Southern California coastal estuaries. The samples were collected in summer of 1998 and were analyzed for sediment chemistry, toxicity (solid phase, elutriate test and enzyme induced), bioaccumulation in whole fish (juvenile California Halibut) and AVS/SEM for metals. The samples included three stations in the Marina del Rey back basin (Basin D and Basin E).

Data from these sources are presented and evaluated in Table 2-6 through 2-9.

Table 2.6: Summary of Sediment Quality Data for Marina del Rey's back basins (96-03).

Date	Location	Pollutants of Concern (metals in mg/Kg and organics in µg/Kg)				
	Basin D	**Cu**	**Pb**	**Zn**	**Chlordane**	**Total PCBs**
Jun-96	BPTCP (#48002)	320	52.2	520	11.15	130.2
Oct-95	LACDBH (#8)	367	81	387	<20	
Oct-96		210	57.2	213	<0.3	<20
Oct-97		300	92	320	<0.4	<20
Oct-98		242	62	238	<0.4	<20
Oct-99		312	91	320	<0.4	<20
Oct-00		307	76	320	<0.4	<20
Oct-01		354	79	293	<2	22.66
Oct-02		330	105	322	<2	<1
Oct-03		351	72	445	<2	<1
	Basin E					
Jan-93	BPTCP (#44014)	550	240	620	22.1	308.9
Feb-94		427	171	636	38.1	391.5
Jun-96		321	149	400	24.9	237.9
Jun-96	BPTCP (#48001)	266	206	496	14.87	165.3
Oct-95	LACDBH (#10)	299	177	455	110	
Oct-96		314	292	440	2	<20
Oct-97		380	210	480	3	<20
Oct-98		172	106	320	<1.4	<20
Oct-99		108	51	157	<0.3	<20
Oct-00		147	88	252	<0.4	<20
Oct-01		122	45	155	<2	50.06
Oct-02		241	89	335	<1	59.7
Oct-03		362	109	648	<2	<1
Oct-95	LACDBH (#11)	373	95	423	<20	
Oct-96		346	114	426	0.5	<20
Oct-97		390	120	390	<0.5	<20
Oct-98		312	113	390	<1.1	<20
Oct-99		450	128	450	<0.4	<20
Oct-00		420	103	390	<0.5	<20
Oct-01		359	106	339	<2	58.82
Oct-02		433	109	451	5.3	93.3
Oct-03		403	96	523	<2	<1
1998	Bight 98 (2443)	146.5	117.5			177.31
1998	Bight 98 (2444)	263	98.6			20.1
	Basin F					
Oct-95	LACDBH (#9)	380	115	419	<20	
Oct-96		346	141	382	0.6	<20
Oct-97		360	140	370	<0.5	<20
Oct-98		320	116	360	<1.2	<20
Oct-99		390	149	410	<0.5	<20
Oct-00		167	105	245	<0.5	<30
Oct-01		333	143	324	<2	137.12
Oct-02		368	187	396	<2.15	101.6
Oct-03		294	95	371	<2	<1

No. of samples	**43**	**43**	**41**	**41**	**39**
Average	**318**	**118**	**386**		
Min.	**108**	**45**	**155**	**<0.3**	**<1**
Max.	**550**	**292**	**648**	**110**	**391.5**

The sediment contaminants were evaluated relative to sediment quality guidelines (SQGs), specifically the values for Effects Range-Low (ERL), Effects Range-Median (ERM) (Long et al., 1995), Threshold Effects Level (TEL), and Probable Effects Level (PEL) (MacDonald, 1994). These SQGs are based on empirical data compiled from numerous field and laboratory studies performed in North America.

The National Oceanic Atmospheric Administration (Long et al., 1995) assembled data from throughout the country that correlated chemical concentrations in sediments with effects. These data included spiked bioassay results and field data of matched biological effects and chemistry. The product of the analysis is the identification of two concentrations for each substance evaluated. The ERL values were set at the 10th percentile of the ranked data and represent the point below which adverse biological effects are not expected to occur. The ERM values were set at the 50th percentile and are interpreted as the point above which adverse effects are expected.

The TEL and PEL values were developed by the State of Florida and were based on a biological effects empirical approach similar to the ERLs/ERMs. The development of the TELs and PELs differ from the development of the ERLs and ERMs in that data showing no effects were incorporated into the analysis. In the Florida weight-of-evidence approach, two databases were assembled: a "no-effects" database and an "effects" database. Taking the geometric mean of the 15th percentile value in the effects database and the 50th percentile value of the no-effects database generated the TEL values. The PEL values were generated by taking the geometric mean of the 50th percentile value in the effects database and the 85th percentile value of the no-effects database. By including the no-effect data in the analysis, a clearer picture of the chemical concentrations associated with the three ranges of concern (no effects, possible effects, and probable effects) can be established.

The ERLs and TELs are presumed to be non-toxic levels with a high degree of confidence of no potential threat. The ERMs and PELs identify pollutant concentrations that are more probably elevated due to toxic levels. In the "*Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) Lis*t," ERMs for copper, zinc, and chlordane, and the PEL value for lead, are identified as the guidelines most predictive of biological effects (SWRCB, 2004). The listing policy also identifies a consensus-based SQG for total PCBs as most predictive of biological effects. Table 2-7.summarizes these guidelines.

Table 2-7. Summary of marine sediment quality guidelines used in assessment of TMDL pollutants

Organics	ERL (µg/kg)	ERM (µg/kg)	TEL (µg/kg)	PEL (µg/kg)	Consensus-based SQG (µg/kg)
Chlordane	0.5	6*	2.26	4.79	
Total PCBs	22.7	180	21.6	189	400*
Metals	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Copper	34	270*	18.7	108	
Lead	46.7	218	30.2	112*	
Zinc	150	410*	124	271	

*SQGs most predictive of biological effects (CSWRCB, 2004).

As shown in Table 2-6, several sediment samples had chlordane and total PCBs in concentrations at or below detection limits; and, in some cases, the detection limits were greater than the SQG. In Table 2-8, the detection limits were treated as the actual concentration when evaluating the sediment data.

Table 2-8. Evaluation of sediment data relative to sediment quality guidelines

Pollutant	Number of samples	# >DL	# > ERL	# > ERM	# > TEL	# > PEL	# > Other SQG
Copper	**43**	**43**	**43**	**32**	**43**	**42**	**n.a**
Lead	**43**	**43**	**42**	**2**	**40**	**19**	**n.a**
Zinc	**41**	**41**	**41**	**15**	**41**	**35**	**n.a**
Chlordane	**41**	**11**	**27**	**9**	**11**	**10**	**n.a**
PCBs	**39**	**14**	**13**	**3**	**14**	**3**	**0**

n.a not applicable

Organics in Sediments

Chlordane was detected in 11 out of 41 sediment samples used for this assessment. In 16 of the 41 samples the detection limit was above the SQGs. Based on the assumption that the detection limit is the actual concentration, 9 of 41 samples exceeded the ERM value. This number of exceedances of the ERM value indicates that chlordane remains an impairment in the harbor sediment.

Total PCBs were detected 14 out of 39 sediment samples. Concentrations ranged from <1 to 391.5 µg/kg (calculated as the sum of the congeners). Treating detection limits as true values, 3 out of the 39 samples had concentrations greater than ERM and no samples were greater than the consensus-based SQG value of 400 µg/Kg. While there are no exceedances of the SQG value for total PCBs, the elevated levels of this pollutant in fish tissue would make a determination of no impairment premature.

Metals in Sediments

Copper was detected in all sediment samples from Basins D, E, and F of Marina del Rey Harbor. Sediment concentrations ranged from 108 to 550 mg/kg. All 43 samples were above ERL guidelines, and 32 of 43 exceeded the ERM value. Copper remains at elevated concentrations within Marina del Rey's back basins.

All sediment samples had detectable lead concentrations. Lead in the sediments of Marina del Rey's back basins ranged from 45 to 292 mg/kg. Samples from Basins E and F exhibited higher lead levels than those from Basin D. The PEL guideline was exceeded in 19 of 43 samples, which indicates a continuing impairment in the sediments of the back basin.

Zinc concentrations in the sediment samples ranged from 155 to 648 mg/kg in Marina del Rey's back basins. All 41 samples exceeded the ERL values, and 15 of 41 samples exceeded the ERM guideline, confirming the zinc impairment.

Sediment Toxicity

Sediment toxicity data for the Marina del Rey back basins is presented in Table 2-9. These data were compiled from the Bay Protection and Toxic Cleanup Program (BPTCP) from 1993 to 1997 and the Southern California Bight 1998 Regional Monitoring Program (Bight 98). The reported data shows sediment toxicity in seven of nine samples.

Table 2-9 Sediment Toxicity Data for Marina del Rey's Back Basins – Amphipod Survival Rates

Source	Date	Location	Specie	Survival
BPTCP	1/14/93	Basin E (#44014)	Rhepoxynius	53% (T)
	2/15/94	Basin E (#48001)	Rhepoxynius	32% (T)
	2/15/94	Basin E (#48001)	Rhepoxynius	42% (T)
	2/15/94	Basin E (#48001)	Rhepoxynius	35% (T)
	6/19/96	Basin E (#44014)	Eohaustorius	92% (NT)
	2/5/97	Basin E (#48001)	Eohaustorius	49% (T)
	2/5/97	Basin D (#48002)	Eohaustorius	65% (T)
Bight 98	Summer 1998	Basin E (#2443)	Eohaustorius	66% (T)
	Summer 1998	Basin E (#2444)	Eohaustorius	79% (NT)

T – toxic, NT = non toxic

2.3 Summary and Findings concerning TMDLs Required

There is indication of water column impairment by dissolved copper in Marina del Rey Harbor. However due to the uncertainty involved with the method used for sample analysis, further monitoring is necessary to make a final determination. Sediment concentrations of copper, lead, zinc, and chlordane remain elevated, while total PCBs meet the State's de-listing criteria. However, more recent fish tissue data indicates that total PCB concentrations are above fish tissue targets; while fish tissue levels of chlordane, dieldrin and total DDTs are below the fish tissue targets.

This TMDL will be developed to reduce sediment impairment by copper, lead, zinc, and chlordane. In addition, the fish tissue impairment by total PCBs will be addressed. Based on the above assessment of available data, fish tissue impairment by chlordane, dieldrin and DDTs, do not require a TMDL. Sediment toxicity and the fish consumption advisory impairments will be mitigated through implementing TMDLs for the listed pollutants.

3 NUMERIC TARGETS

Numeric Targets for this TMDL are used to calculate waste load allocations for the impairing metals and organic compounds, and/or to indicate attainment of water quality objectives. Sediment quality guidelines are used to calculate the TMDLs for the copper, lead, zinc, and chlordane impairments in sediments. Water criteria, fish tissue and sediment quality guidelines are selected as numeric targets for the total PCB fish tissue impairment. The sediment target for total PCBs is the primary numeric target, which is used to calculate the TMDL and allocations. Water quality objectives and fish tissue guidelines for total PCBs are secondary targets that will provide additional means of assessing success in attaining water quality standards, including the narrative toxicity objective.

3.1 Sediment Numeric Targets

Numeric targets that are protective of aquatic life beneficial uses are developed for copper, lead, zinc, total PCBs and chlordane in sediments. While the PCB impairment occurs in fish tissue only, a sediment target is necessary as PCBs are directly associated with sediments which are the transport mechanism of these compounds from the Marina del Rey watershed to the harbor. As discussed in Section 2, the Basin Plan provides narrative objectives that can be applied to sediments but does not provide numeric WQOs for sediment quality. To develop the TMDLs, it is necessary to translate the narrative objectives into numeric targets that identify the measurable endpoint or goal of the TMDL and represent attainment of applicable numeric and narrative water quality standards.

Sediment quality guidelines compiled by National Oceanic and Atmospheric Administration (NOAA) are used in evaluating waterbodies within the Los Angeles Region for development of the 303(d) list. The sediment quality guidelines are applicable numeric targets because the impairments and the 303(d) listings are primarily based on sediment quality data. In addition, the pollutants being addressed have a high affinity for particles and the delivery of these pollutants is generally associated with the transport of suspended solids from the watershed or from sediments within the harbor.

The ERLs (Long et al., 1995) guidelines are established as the numeric targets for sediments in Marina del Rey's back basins, as summarized in Table 3-2. The State Board listing policy recommends the use of ERMs, PELs, and other SQGs as a threshold for listing. ERM and PEL values are interpreted as levels above which the adverse biological effects are expected, which makes them applicable in the determination of impairment. The ERL values, on the other hand, represent the levels below which adverse biological effects are not expected to occur, and are more applicable to the prevention of impairment. These SQGs are discussed in greater detail in Section 2.2.3. The goal of the TMDL is to remove impairment and restore beneficial uses; therefore, the ERLs are selected as numeric targets over the ERMs to limit adverse effects to aquatic life. The selection of the ERLs, which are lower than ERMs, provides an implicit margin of safety.

Table 3-1. Numeric targets for sediment quality in Marina del Rey's back basins

Organics	Numeric Target for Sediment
Chlordane	0.5 µg/kg
Total PCBs	22.7 µg/kg
Copper	34 mg/kg
Lead	46.7 mg/kg
Zinc	150 mg/kg

3.2 Water Quality Criteria

The California Toxics Rule (CTR) Criterion for the protection of human health from the consumption of aquatic organisms is selected as the final numeric target for total PCBs in the water column. However, given the inability of current analytical methods to detect concentrations at this low level, an interim numeric target will be applied. The CTR Chronic Criterion for the protection of aquatic life in saltwater is selected as the interim numeric target for the fish tissue impairment by PCBs. This numeric target will remain in effect until advances in technology allow for analysis of PCBs at lower detection limits. The interim and final numeric targets for total PCBs in the water column are provided in Table 3-2. As discussed in Section 3, this secondary target will serve as a means of gauging improvements in water quality, and not as a basis for calculating TMDL allocations.

Table 3-2: Numeric Targets for total PCBs in the water column

	Numeric Targets (µg/L)
Interim	0.03
Final	0.00017

3.3 Fish Tissue Target

The fish tissue target of 5.3 µg/Kg for total PCBs is derived from CTR human health criteria, which are adopted criteria for water designated to protect humans from consumption of contaminated fish or other aquatic organisms. The derived fish tissue target is referred to as the Threshold Tissue Residue Level (TTRL), in this document. Use of a fish tissue target is appropriate to account for uncertainties in the relationship between pollutant loadings and beneficial use effects (EPA, Newport Bay TMDL, 2002) and directly addresses human health impacts from consumption of contaminated fish or other aquatic organisms. While the detection limit for total PCBs in water is currently higher than the CTR criteria for the protection of human health, the TTRL numeric target is detectable with current technology; making compliance monitoring feasible. Thus, the TTRL provides an effective method for accurately quantifying achievement of the water quality objectives.

3.3.1. Deriviation of the Treshold Tissue Residue Level (TTRL)

The TTRL value of 5.3 µg/Kg for total PCBs is derived from the CTR human health criteria for consumption of organisms only (i.e. 0.00017 µg/L). CTR criteria were developed by determining pollutant concentrations in edible fish tissue that would pose a health risk to humans consuming 6.5 grams of fish per day. These fish tissue concentrations were converted to water column concentrations using a bioconcentration factor (BCF), which is the ratio of the chemical concentration in fish to the chemical concentration in water. The TTRL was derived by reverting back to the original fish tissue concentration upon which the human health criteria are based (see equation 3-1). This was the same approach used in the Calleguas Creek OC Pesticides and PCBs TMDL (LARWQCB, 2005a).

$$\text{TTRL} = \text{CTR criterion} \times \text{BCF} \qquad \text{(equation 3-1)}$$

TTRL = Threshold Tissue Residue Level µg/Kg
CTR criterion = 0.00017 µg/L
BCF = Bioconcentration Factor = 31200 L/Kg

4 SOURCE ASSESSMENT

This section identifies the potential sources of metals and organochlorine compounds to Marina del Rey's back basins. The toxic pollutants can enter surface waters from both point and non-point sources. Point sources typically include discharges from a discrete human-engineered point. These types of discharges are regulated through the federal National Pollutant Discharge Elimination System (NPDES) program, which the Regional Boards have been delegated to implement through the issuance of Waste Discharge Requirements (WDRs). In Los Angeles County urban runoff to Marina del Rey is regulated under storm water NPDES permits, which are regulated as a point source discharge. Non-point sources, by definition, include pollutants that reach surface waters from a number of diffuse land uses and activities that are not regulated through NPDES permits. Examples of non-point sources in the Marina del Rey Watershed include atmospheric deposition and boat discharges.

4.1 Background on Toxic Pollutants

The following sections provide background information on the toxic pollutants addressed in this TMDL, including their properties and uses.

4.1.1 Organic Pollutants

Chlordane was used as a pesticide to control insects on agricultural crops, residential lawns and gardens, and in buildings, particularly for termite control. In 1988, all chlordane uses, except for fire ant control, were voluntarily cancelled in the United States (NPTN, [undated]). Chlordane can still be legally manufactured in the United States for sale or use by foreign countries. Although it is no longer used in the US, chlordane persists in the environment, adhering strongly to soil particles. It is assumed that the only source of chlordane in the watershed is storm water runoff carrying historically deposited chlordane most likely attached to eroded sediment particles.

Polychlorinated biphenyls (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). They were used in a wide variety of applications, including dielectric fluids in transformers and capacitors, heat transfer fluids, and lubricants. In 1976, the manufacture of PCBs was prohibited because of evidence they build up in the environment and can cause harmful health effects. Although it is now illegal to manufacture, distribute, or use PCBs, these synthetic oils were used for many years as insulating fluids in electrical transformers and in other products such as cutting oils. Products made before 1977, which may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils. Historically, PCBs have been introduced into the environment through discharges from point sources and through spills and accidental releases. Although point source contributions are now controlled, non-point sources may still exist, for example, refuse sites and abandoned facilities may still contribute PCBs to the environment. Once in a waterbody, PCBs become associated with solid particles and typically enter sediments (USEPA, 2002).

4.1.2 Metals

Potential anthropogenic sources of copper include corrosion of brass and copper pipe be acidic waters, copper brake pads, the use of copper compounds as aquatic algaecides, sewage treatment plant effluents, runoff and groundwater contamination for agricultural uses of copper as fungicides and pesticides, and effluents from industrial sources. Major industrial sources include mining, smelting and refining industries, copper wire mills, coal burning industries and iron and steel producing industries (MacDonald, 1994). Boats are another source of copper in the in Marina del Rey harbor. Copper is leached constantly from the anti-fouling paints used on boats to effectively reduce fouling organisms. Underwater hull cleaning also contributes copper to the harbor.

The single largest use of lead is in the production of lead-zinc batteries. Lead and its compounds are used in electroplating, metallurgy, construction materials, coating and dyes, electronic equipment, plastics, veterinary medicines, fuels and radiation shielding. Lead is also used for ammunition, corrosive-liquid containers, paints, glassware, fabricating storage tank linings, transporting radioactive materials, solder, piping, cable sheathing, and roofing (MacDonald, 1994). Prior, to the phasing out of leaded gasoline, lead additives in gasoline was a significant source of lead in the environment. Since the phasing out of leaded gasoline, there has been a gradual decline of lead concentrations in the environment.

Zinc is primarily used as a coating on iron and steel to protect against corrosion, in alloys for die-casting, in brass, in dry batteries, in roofing and exterior fittings for buildings, and in some printing processes. The principal sources of zinc in the environment include smelting and refining activities, wood combustion, waste incineration, iron and steel production, and tire wear (MacDonald, 1994). A tire contains about half a pound of zinc, which is needed to cure the rubber (America Zinc Association). In Marina del Rey harbor, the use of sacrificial zinc anodes to prevent corrosion on boats, is a potential source of zinc.

4.2 Point Sources

A point source, according to 40 CFR 122.3, is defined as "any discernable, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged." The NPDES Program, under CWA sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources.

The NPDES permits in the Marina del Rey Watershed include the MS4 and Caltrans Storm Water Permits, general construction storm water permits, general industrial storm water permits, and general NPDES permits (Table 4-1).

Table 4-1. NPDES Permits in the Marina del Rey Watershed

Type of NPDES Permit	Number of Permits
Municipal Storm Water	1
California Department of Transportation Storm Water	1
General Construction Storm Water Tradewind Apartments Marina Point III Apartments Marina Waterside	3
General Industrial Storm Water Fed Ex Windward Yatch & Repair Seamark Boatyard	3
Total	**8**

4.2.1 Stormwater Runofff

Storm water runoff in the Marina del Rey watershed is regulated through a number of permits. The first is the municipal separate storm sewer system (MS4) permit issued to the County of Los Angeles and its co-permittees. The second is a separate statewide storm water permit specifically for the California Department of Transportation (Caltrans). The third is the statewide Construction Activities Storm Water General Permit and the fourth is the statewide Industrial Activities Storm Water General Permit. The permitting process defines these discharges as point sources because the storm water discharges from the end of a storm water conveyance system. Since the industrial and construction storm water discharges are enrolled under NPDES permits, these discharges are treated as point sources in this TMDL.

The Oxford Street Flood Control Basin (OSFCB) and the Washington Street (Palawan Way) drain are two major stormwater conduits with direct drainage into the back basin E. OSFCB is a sump for street drainage, from the community north and east of the marina, draining into Basin E through a tide gate. The Washington Street conduit drains an area north west of the Marina. The runoff carries relatively high contaminant concentration into sheltered, low energy areas such as Basin E and F. The OSFCB serves as a settling basin and detention basin for the major stormwater inflows to the back harbor. Many studies suggested that the OSFCB may be a significant contributor of contaminants in the back basins based on the high contamination levels in the drainage basin and the correlation between back harbor and OSFCB concentrations during storm events (Soule et al. studies 1977, 1984, Los Angeles County Department of Beaches and Harbors 1996-2004).

A GIS based Pollutant Loading Model (PLOAD) was used to calculate stormwater pollutant loads for total recoverable and dissolved copper, lead and zinc for Marina del Rey's sub-watersheds (Table 4-2). The detailed calculations are included in Appendix A The loadings for metals were calculated based on the stormwater event mean concentrations (EMCs) analyzed by the Los Angeles County Department Public Works

(LADPW) from 1994 to 2000 for eight land use types. EMCs values for organochlorine pesticides and PCBs were not available due to non-detectable levels in stormwater.

Table 4-2. Annual Loading from Stormwater Water Runoff for Metals (lb/year)

Sub-watershed	Total Suspended Solids	Total Copper	Dissolved Copper	Total Lead	Dissolved Lead	Total Zinc	Dissolved Zinc
Average Rain Year							
Area 1A	21,933	9.9	4.4	3.3	0.0	71	47.9
Area 3	7,788	1.4	0.8	0.8	0	13	7.6
Area 4	111,742	23	12.4	9.8	0	218	153.7
TOTAL	**141,463**	**34.3**	**17.6**	**13.9**	**0**	**302**	**209**
Dry Rain Year							
Area 1A	10,231	4.6	2.0	1.5	0.0	33.2	22.4
Area 3	3,633.	0.7	0.4	0.4	0	5.8	3.6
Area 4	52,127	10.7	5.8	4.6	0	101.8	71.7
TOTAL	**65,992**	**16**	**11.5**	**9.2**	**0**	**199**	**136**
Wet Rain Year							
Area 1A	38,153	17.3	7.6	5.8	0.0	124.0	83.4
Area 3	13,547	2.4	1.4	1.3	0	21.7	13.3
Area 4	194,378	39.9	21.5	17	0	379.6	267.4
TOTAL	**246,078**	**59.6**	**30.5**	**24.1**	**0**	**525**	**364**

4.2.2 Summary Point Sources

Urban storm water has been recognized as a substantial source of metals (Characklis and Wiesner 1997, Davis et al. 2001, Buffleben et al. 2002) and organic pollutants (Suffet and Stenstrom, 1997). This is reflected in routine storm water monitoring performed by LACDPW under the MS4 permit (LACDPW, 2002). Studies have also shown that dry-weather pollutant loadings are not insignificant (McPherson et al., 2002).

The Oxford Street Flood Control Basin (OSFCB) and the Washington Street (Palawan way) drain are two major stormwater conduits with direct drainage into the back basin E. In the Marina del Rey Watershed storm water discharges are regulated under the MS4 permit, the Caltrans permit, the general industrial storm water permit and the general construction storm water permit. There are also two non-storm water general permits with low potential to contribute significant loadings to the system.

The most prevalent metals in urban storm water (i.e., copper, lead and zinc) are consistently associated with the suspended solids (Sansalone and Buchberger 1997, Davis et al. 2001). These metals are typically associated with fine particles in storm water runoff (Characklis and Wiesner 1997, Liebens 2001), and have the potential to accumulate in estuarine sediments posing a risk of toxicity (Williamson and Morrisey, 2000). The organic contaminants in storm water are also associated with suspended solids and the particulate fraction.

A major contributor of associated metals, and organic compounds to Marina del Rey Harbor is assumed to be wet-weather runoff discharged from the storm water conveyance system. While the loadings of metals are attributable to ongoing activities in the watershed, the loadings of chlordane and PCBs, reflect historic uses. Although the uses of these compounds are banned, these legacy pollutants continue to be detected in sediments at elevated levels.

4.3 Nonpoint Sources

Marina activities and atmospheric deposition are the major non-point sources of contaminants in the Marina del Rey watershed.

4.3.1. Marina Activities

Elevated metal concentrations occur in the middle and back basins of Marina del Rey Harbor. The numerous boats that utilize the Marina are a likely contributor to the metals impairment in this area. Boats have metal components and engines that constantly corrode from salt water and air. Anti-fouling paints contain heavy metals such as copper that are designed to constantly ablate or leach out (passive leaching) to effectively reduce fouling organisms. Lead and zinc concentrations were also found in high amounts in the back harbor sediments. These metals might have originated from the historical industrial land uses of the Marina or have been derived from boating activity, including copper and lead in the boat paints, and zinc in the anodes of boat engines.

4.3.1.1 Copper Loading from Recreational Boats

Copper inputs from recreational boats to Marina del Rey back basins were estimated based on information obtained from the Dissolved Copper TMDL for Shelter Island Yacht Basin (SIYB), which was developed by the San Diego Regional Water Quality Control Board (SDRWQCB, 2005). The San Diego TMDL, adopted on March 9, 2005 , provides dissolved copper loading equations for both passive leaching from wetted hull surfaces, and from underwater hull cleaning (i.e. wiping down the wetted surface to remove marine growth). Local conditions (number of moored boats) were applied for Marina del Rey. Parameters such as mean boat length and wetted surface area were assumed to be the same as in the SIYB. Passive leaching and hull cleaning were estimated to contribute approximately 3,693-lb/year and 47.6 lbs lb/year of dissolved copper, respectively to the Marina del Rey back harbor. Details of these calculations are provided in the Appendix B.

Copper in the water column can accumulate in sediment through adsorption or by partitioning in pore water. In this way, sediment acts as a “sink” for copper in the water column, and concentration levels can build up and persist over time. The rate of contamination of sediment is dependent on a variety of factors including sediment type and quality, organic matter content and the degree of contamination in the water column and associated sediment (SIYB TMDL, 2005). The poor flushing in the harbor’s back basins increases the likelihood of dissolved copper partitioning to the sediment. However, there is insufficient information available to quantify copper loading to the sediment from boat discharges. This TMDL will require a study designed to estimate copper partitioning between the water column and sediment.

4.3.2 Atmospheric Deposition

Direct deposition of airborne particles to the water surface may be responsible for contributing copper, lead and zinc to the Marina del Rey back basins. Indirect deposition from air to land and subsequent wash into the back basins is accounted for in the stormwater runoff estimates. Indirect and direct deposition of metals to surface water was estimated from dry deposition fluxes in the Los Angeles coastal region presented in Sabin et al., (2004). Table 4-3 shows that the direct air deposition is a relatively small source for the metals impairment.

Table 4-3. Estimate of Atmospheric Deposition of Metals to Surface Water

Metals	Direct Deposition (kg/yr)	Indirect Deposition (kg/yr)
Copper	0.14	29
Lead	0.09	22
Zinc	0.46	144

5 LINKAGE ANALYSIS, TMDL AND POLLUTANT ALLOCATION

The linkage analysis is used to identify the assimilative capacity of the receiving water for the pollutant of concern by linking the source loading information to the water quality target. The TMDL is then divided among existing pollutant sources through the calculation of load and waste load allocations. This section discusses the linkage analysis used for Marina del Rey's back basins and identifies the resulting pollutant allocations.

The goals of the Marina del Rey Toxics TMDL is to reduce pollutant loads of copper, lead, zinc, chlordane, and PCBs from the Marina del Rey watershed to the sediments back basins of its harbor. The TMDL is also intended to reduce elevated levels PCBs in fish tissue.

The impairing contaminants in sediment are associated with fine-grained particles that are delivered to the sediments through suspended solids in stormwater. It is expected that reductions in loadings of these pollutants will lead to reductions in sediment concentrations over time. The existing contaminants in surface sediments will be removed over time as sediments are scoured during storms or removed in dredging operations. For the legacy pollutants (chlordane and PCBs), some loss will also occur through the slow decay and breakdown of these organic compounds. Concentrations in surface sediments will be reduced through mixing with cleaner sediments. Attenuation of pollutant concentration levels in sediment is expected to translate to reductions in fish tissue contaminant levels. Also see Section 3.1 herein.

5.1 Loading Capacity

The loading capacity of the sediments was estimated from the annual average total suspended solids (TSS) loading to the back basins of Marina del Rey Harbor, as estimated from the PLOAD model (Table 5-1). While the TSS load may not represent the total sediment loading to the harbor, it represents the finer material with which pollutants are more readily associated.

Table 5-1. Average Annual Total Suspended Solids (TSS) Loading to Marina del Rey

Subwatershed	TSS (lbs/year)	TSS (kg/year)
Area 1A	21933	9,948
Area 3	7,788	3,533
Area 4	111,742	50,685
Total	**141,463**	**64166**

Assuming fine sediments carried by stormwater to be the main source of contaminated sediments to the back basins, pollutant specific loading capacity was calculated by multiplying the average annual total suspended solids load 64,166 kg/yr discharged to the harbor by the numeric sediment targets (Table 3-2). The resultant numbers are presented in Table 5-2. The TMDL for sediment is set equal to the loading capacity.

Table 5-2. Sediment Loading Capacity Expressed as Mass per Year

Metals	Numeric Target ERL (mg/kg)	TMDL (kg/year)
Copper	34	2.18
Lead	46.7	3.0
Zinc	150	9.6
Organics	**ERL (µg/kg)**	**TMDL(g/year)**
Chlordane	0.5	0.03
PCBs	22.7	1.46

5.1.1 Critical Conditions

The amount of total suspended solids in stormwater run-off is a function of the storms, which are highly variable between years. The TMDL is based on a TSS load derived from long-term average rainfall over a 52-year period from 1948 to 2000. This time period contains a wide range of storms in the Marina del Rey watershed. Use of the average condition for the TMDL is appropriate because issues of sediment effects on benthic communities and potential for bioaccumulation to higher trophic levels occurs over long time periods.

5.1.2 Margin of Safety

TMDLs must include a margin of safety to account for any uncertainty concerning the relationships between sources, and water and sediment quality. An implicit margin of safety is applied through the use of more protective SQG values. The ERLs were selected over the higher ERMs as the numeric targets.

5.2 Allocations

Contaminated sediment generated in the watershed is transported to Marina del Rey's back basins through the storm water conveyance system. These are regulated directly in the NPDES process through storm water permits or indirectly through the issuance of NPDES permits for discharges to the storm water system. A mass-based load allocation was developed for direct atmospheric deposition. A grouped mass-based waste load allocation was developed for storm water permittees (Los Angeles County MS4, Caltrans, General Industrial and General Construction) by subtracting the mass-based load allocations from the total loading capacity according to the following equation:

TMDL = Direct Atmospheric Deposition + Combined Storm Water Sources (5-1)

Concentration-based sediment waste load allocations are developed for other point sources in the watershed. These other point sources have intermittent flows and should discharge little to no sediment. These sources will have a minor impact on sediment loading if they are limited by concentration to the applicable ERL-based waste load allocations.

5.2.1 Load Allocations

A mass-based load allocation is developed for direct atmospheric deposition. An estimate of direct atmospheric deposition was developed based on the percent area of surface water, within the watershed area of the back basins, which is approximately 52 acres or 5.4% of the total watershed area. The load allocation for atmospheric deposition is calculated by multiplying this percentage by the total loading capacity, according to the following equation:

Direct Atmospheric Deposition = 0.054 x TMDL (5-2)

The loadings associated with indirect atmospheric deposition are included in the stormwater waste load allocations.

There will be no load allocations assigned to boat discharges at this time, as contribution from water column concentrations to sediment loading cannot be quantified. Upon completion of a study designed to obtain such information, the TMDL will be revised as necessary.

5.2.2 Waste Load Allocation for Storm Water

A mass-based waste load allocation, for the impairing pollutants in sediment, is developed for the storm water permittees according to the following equation:

Combined Storm Water Sources = TMDL - Direct Atmospheric Deposition (5-3)

Since, the direct atmospheric deposition is calculated as a percentage of the total loading capacity equation 5-3 becomes:

Combined Storm Water Sources = TMDL – 0. 054 TMDL (5-4)

Combined Storm Water Sources = 0.946 x TMDL (5-5)

For accounting purposes, it is assumed that Caltrans and the general stormwater permittees discharge entirely to the MS4 system. This assumption has been supported though review of the permits. The resulting allocations are presented in Table 5-3.

Table 5-3. Mass-based Allocations

Metals	**Direct Air (kg/yr)**	**Stormwater (kg/yr)**
Copper	0.12	2.06
Lead	0.16	2.83
Zinc	0.52	9.11
Organics	**Direct Air (g/yr)**	**Stormwater (g/yr)**
Chlordane	0.002	0.03
PCBs	0.079	1.38

USEPA requires that waste load allocations be developed for NPDES-regulated storm water discharges. Allocations for NPDES-regulated storm water discharges from multiple point sources may be expressed as a single categorical waste load allocation when data and information are insufficient to assign each source or outfall individual allocations. The combined storm water waste load allocation is divided among the four storm water permittees (MS4, Caltrans, general industrial and general construction) based on an estimate of the percentage of land area covered under each permit (Table 5-4).

Table 5-4. Areal extent of watershed and percent area covered under storm water permits

Category	**Area in acres**	**Percent area**
MS4 Permit	880	91.9
Caltrans Storm Water Permit	9.58	1
General Construction Storm Water Permit	14.5	1.5
General Industrial Storm Water Permit	2	0.2
Water (LA for direct atmospheric deposition)	52	5.4
Total	**958**	**100**

Based on these areas, the waste load allocations for each storm water permittee are presented in Table 5-5. In the storm water permits, permit writers may translate the numeric waste load allocations to BMPs, based on BMP performance data. It is anticipated that reductions will be achieved either through pollutant control measures or sediment control measures.

Table 5-5. Combined storm water allocation apportioned based on percent of watershed.

Metals	**General Construction permittees (kg/yr)**	**General Industrial permittees (kg/yr)**	**Caltrans (kg/yr)**	**MS4 Permittees (kg/yr)**
Copper	0.033	0.004	0.022	2.01
Lead	0.045	0.006	0.030	2.75
Zinc	0.144	0.018	0.096	8.85
Organics	**General Construction permittees (g/yr)**	**General Industrial permittees (g/yr)**	**Caltrans (g/yr)**	**MS4 Permittees (g/yr)**
Chlordane	0.0005	0.0001	0.0003	0.0295
PCBs	0.0219	0.0029	0.015	1.34

Each storm water permittee enrolled under the general construction or industrial storm water permits will receive individual waste load allocations on a per acre basis, based on the acreage of their facility as presented in Table 5-6.

Table 5-6. Per acre waste load allocation for an individual general construction or industrial storm water permittee (g/day/ac).

Metals	Individual General Construction or Individual General Industrial Permittee (g/yr/ac)
Copper	2.3
Lead	3.1
Zinc	10
Organics	**(mg/yr/ac)**
Chlordane	0.03
PCBs	1.5

5.2.3 Waste Load Allocation for other NPDES Permits

Concentration-based sediment waste load allocations have been developed for the minor NPDES permits and general non-storm water NPDES permits that discharge to Marina del Rey Harbor to ensure that these do not contribute significant loadings to the system. The concentration-based waste load allocations are equal to the sediment numeric targets. All minor NPDES permittees and general non-storm water NPDES permittees shall not discharge sediments with concentrations greater than the ERLs as listed in Table 5-7. Monitoring requirements will be placed on these discharges as appropriate in their respective NPDES permits. Any future minor NPDES permits or enrollees under a general non-storm water NPDES permit will also be subject to the concentration-based waste load allocations.

Table 5-7. Concentration-based waste load allocation for sediment discharged to Marina del Rey Harbor.

Metals	Waste Load Allocation for Sediment
Copper	34 mg/kg
Lead	46.7 mg/kg
Zinc	150 mg/kg
Organics	**Waste Load Allocation for Sediment**
Chlordane	0.5 µg/kg
Total PCBs	22.7 µg/kg

5.2.4 Contaminated Inplace Sediment

The waste load allocations and load allocations have been developed to achieve the numeric targets in the back basins of Marina del Rey Harbor by the end of the compliance period. However, the Regional Board is aware of toxic pollutants bound up in *insitu* sediment. To the extent that the Regional Board or another responsible jurisdiction or agency determines that toxic pollutants bound in *insitu* sediments are ~~still~~ preventing the attainment of numeric targets, the Regional Board will issue appropriate investigatory orders or cleanup and abatement orders to achieve attainment of the numeric targets.

5.3 Summary of TMDL

The TMDL is based on pollutant loadings to the sediments of Marina del Rey's back basins. The sediment loading capacity is based on an estimate of the annual pollutant loads that can be delivered to the sediments and still meet the sediment targets. A margin of safety is provided through the use of ERLs. A grouped waste load allocation for sediment has been developed for the storm water permittees (MS4, Caltrans, general industrial and construction storm water permittees). Load allocations have been developed for direct atmospheric deposition. Concentration-based waste load allocations apply to all other non-storm water NPDES permittees. It is anticipated that implementation will be based on BMPs which address pollution prevention and/or sediment reduction. Compliance with the TMDL will be determined through the sediment and water quality monitoring program.

6 IMPLEMENTATION

Because of the high value of the Marina del Rey for commercial and recreational uses and its important biological function as a shallow coastal water habitat, it should be targeted for an intensive, marina specific, contaminant management effort designed to reduce the amount of pollution in urban runoff, and other discharges to the harbor The County of Los Angeles, City of Los Angeles, and Culver City are jointly responsible for meeting the mass-based waste load allocations for the MS4 permittees. Caltrans is responsible for meeting their mass-based waste load allocations, however, they may choose to work with the MS4 permittees. Since, MdRH is located in an unincorporated area of the County of Los Angeles, the County of Los Angeles is the primary jurisdiction. Additional studies and monitoring should assist municipalities in focusing their implementation efforts on key land uses, critical sources and/or storm periods.

The City of Los Angeles, County of Los Angeles, Culver City, and Caltrans may jointly decide how to achieve the necessary reductions in organics and metals loading by employing one or more of the implementation strategies discussed below or any other viable strategy. The Porter Cologne Water Quality Control Act prohibits the Regional Board from prescribing the method of achieving compliance with water quality standards, and likewise TMDLs. Below staff have identified some potential implementation strategies; however, there is no requirement to follow the particular strategies proposed herein as long as the allowable organics and metals loading are not exceeded.

6.1 Regulation by the Regional Board

The Porter-Cologne Water Quality Control Act provides that "All discharges of waste into the waters of the State are privileges, not rights."[1] Furthermore, all discharges are subject to regulation under the Porter-Cologne Act including both point and non-point source discharges.[2] In obligating the State Board and Regional Boards to address all discharges of waste that can affect water quality, the legislature provided the State Board and Regional Boards with authority in the form of administrative tools (waste discharge requirements (WDRs), waivers of WDRs, and Basin Plan waste discharge prohibitions) to address ongoing and proposed waste discharges. Hence, all current and proposed discharges must be regulated under WDRs, waivers of WDRs, or a prohibition, or some combination of these administrative tools. Since the USEPA delegated responsibility to the State and Regional Boards for implementation of the National Pollutant Discharge Elimination System (NPDES) program, WDRs for discharges to surface waters also serve as NPDES permits.

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[1] See CWC section 13263(g).

[2] See CWC sections 13260 and 13376.

6.1.1 Stormwater Discharges

As required by the federal Clean Water Act, discharges of pollutants to Marina del Rey Harbor from municipal storm water conveyances are prohibited, unless the discharges are in compliance with a NPDES permit. In December 2001, the Los Angeles County Municipal NPDES Storm Water Permit was re-issued jointly to Los Angeles County and 84 cities as co-permittees. The regulatory mechanisms used to implement the TMDL will include the Los Angeles County MS4 storm water permit, the Caltrans storm water permit, general industrial storm water permits, general construction storm water permits, minor NPDES permits, and general NPDES permits. Each NPDES permit assigned a WLA shall be reopened or amended at re-issuance, in accordance with applicable laws, to address implementation and monitoring of this TMDL and to be consistent with the waste load allocations of this TMDL.

The concentration-based waste load allocations for the minor NPDES permits and general non-storm water NPDES permits will be implemented through NPDES permit conditions. Permit writers for the non-storm water permits may translate applicable waste load allocations into effluent limits for the minor and general NPDES permits by applying applicable engineering practices. The minor and existing general non-storm water NPDES permittees are allowed up to seven years from the effective date of the TMDL to achieve the waste load allocations.

The mass-based waste load allocations for the general construction and industrial storm water permittees (Table 5-6) will be incorporated into watershed specific general permits. Concentration-based permit limits may be set to achieve the mass-based waste load allocations. These concentration-based limits would be equal to the concentration-based waste load allocations assigned to the other NPDES permits (Table 5-7). It is expected that permit writers will translate the waste load allocations into BMPs, based on BMP performance data. However, the permit writers must provide adequate justification and documentation to demonstrate that specified BMPs are expected to result in attainment of the numeric waste load allocations.

Within seven years of the effective date of the TMDL, the construction industry will submit the results of BMP effectiveness studies to determine BMPs that will achieve compliance with the waste load allocations assigned to construction storm water permittees. Regional Board staff will bring the recommended BMPs before the Regional Board for consideration within eight years of the effective date of the TMDL. General construction storm water permittees will be considered in compliance with waste load allocations if they implement these Regional Board approved BMPs. All general construction permittees must implement the approved BMPs within seven years of the effective date of the TMDL. If no effectiveness studies are conducted and no BMPs are approved by the Regional Board within eight years of the effective date of the TMDL, each general construction and industrial storm water permit holder will be subject to site-specific BMPs and monitoring requirements to demonstrate compliance with waste load allocations.

The general industrial storm water permit shall contain a model monitoring and reporting program to evaluate BMP effectiveness. A permittee enrolled under the general industrial stormwater permit shall have the choice of conducting individual monitoring based on the model program or participating in a group monitoring effort. A group monitoring effort will not only assess individual compliance, but will also assess the effectiveness of chosen BMPs to reduce pollutant loading on an industry-wide or permit category basis. MS4 permittees are encouraged to take the lead in group monitoring efforts for industrial facilities within their jurisdiction because compliance with waste load allocations by these facilities will translate to reductions in contaminate loads to the MS4 system.

The MS4 and Caltrans permittees shall be allowed a phased implementation schedule to achieve the waste load allocations. A phased implementation approach, using a combination of non-structural and structural BMPs could be used to achieve compliance with the waste load allocations. The administrative record and the fact sheets for the MS4 and Caltrans storm water permits must provide reasonable assurance that the BMPs selected will be sufficient to implement the WLAs in the TMDL.

We expect that reductions to be achieved by each BMP will be documented and that sufficient monitoring will be put in place to verify that the desired reductions are achieved. The permits should also provide a mechanism to make adjustments to the required BMPs as necessary to ensure their adequate performance. If non-structural BMPs alone adequately implement the waste load allocations then additional controls are not necessary. Alternatively, if the non-structural BMPs selected prove to be inadequate then structural BMPs or additional controls may be required.

Each municipality and permittee will be required to meet the WLAs at the designated assessment locations as defined in the TMDL effectiveness monitoring plan, not necessarily an allocation for their jurisdiction or for specific land uses. Therefore, the focus should be on developed areas where the contribution of metals, historic pesticides, and PCBs are highest and areas where activities occur that contribute significant loading of these toxic pollutants (e.g., high-density residential, industrial areas, boating, and highways). Flexibility will be allowed in determining how to reduce these toxic pollutants as long as the WLAs are achieved.

To achieve the necessary reductions to meet the allowable waste load allocations, permittees will need to balance short-term capital investments directed to addressing this and other TMDLs in the Marina del Rey watershed with long-term planning activities for storm water management in the region as a whole. It should be emphasized that the potential implementation strategies discussed below may contribute to the implementation of other TMDLs for Marina del Rey. Likewise, implementation of other TMDLs in the Marina del Rey Watershed may contribute to the implementation of this TMDL.

6.2 Potential Implementation Strategies

The implementation strategy selected will need to control the loading of contaminated sediments to Marina del Rey Harbor during wet weather, since, metals, historic pesticides, and PCBs are predominately bound to sediment, which are transported with storm runoff. Municipalities may employ a variety of implementation strategies to meet the required waste load allocations such as non-structural and structural best management practices (BMPs). The implementation strategies discussed below incorporate implementation approaches presented in the Ballona Creek Metals and Toxics TMDLs, which focus on source control and sediment control (LARWQCB, 2005b). Specific projects, which may have a significant impact, would be subject to a separate environmental review. The lead agency for subsequent projects would be obligated to mitigate any impacts they identify, for example by mitigating potential flooding impacts by designing the BMPs with adequate margins of safety.

6.2.1 Non-Structural Best Management Practices

The non-structural BMPs are based on the premise that specific land uses or critical sources can be targeted to achieve the TMDL waste load allocations. Non-structural BMPs provide several advantages over structural BMPs. Non-structural BMPs can typically be implemented in a relatively short period of time. The capital investment required to implement non-structural BMPs is generally less than for structural BMPs. However, the labor costs associated with non-structural BMPs may be higher, therefore, in the long-term the non-structural BMPs may be more costly. Examples of non-structural controls include better sediment control at construction sites and improved street cleaning by upgrading to vacuum type sweepers.

6.2.2 Structural Best Management Practices

Structural BMPs may include placement of storm water treatment devices specifically designed to reduce sediment loading such as infiltration trenches or filters at critical points in the storm water conveyance system. During storm events, when flow rates are high these types of filters may require surge control, such as underground storage vaults or detention basins to avoid bypassing of the treatment unit.

6.3 Implementation Cost Analysis and CEQA considerations

This section takes into account a reasonable range of economic factors in estimating potential costs associated with this TMDL. This analysis, together with the other sections of this staff report, CEQA checklist, response to comments Basin Plan amendment and supporting documents, were completed in fulfillment of the applicable provisions of the California Environmental Quality Act (Public Resources Code Section 21159.) [3]

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[3] Because this TMDL implements existing water quality objectives it does not "establish" water quality objectives and no further analysis of the factors identified in Water Code section 13241 is required. However, the staff notes that its CEQA analysis provides the necessary information to properly "consider" the factors specified in Water Code section 13241. As a result, the section 13241 analysis would at best be redundant.

6.3.1 Implementation Cost Analysis

This cost analysis focuses on achieving the grouped waste load allocation by the MS4 and Caltrans storm water permittees in the urbanized portion of the watershed[4]. The BMPs and potential compliance approaches analyzed here could apply to the general industrial and construction storm water permittees as well. An evaluation of the costs of implementing this TMDL amounts to evaluating the costs of preventing contaminated sediments from entering storm drains and/or reaching the Marina del Rey Harbor. Most permittees would likely implement a combination of the structural and non-structural BMPs to achieve their waste load allocations. This analysis considers a potential strategy combining structural and non-structural BMPs through a phased implementation approach and estimates the costs for this strategy. It will also be important to document any possible reductions in sediment loading that may concurrently be achieved via BMPs implemented under the Bacteria TMDL.

6.3.1.1 Phased Implementation

Under a phased implementation approach, it is assumed that compliance with the grouped waste load allocation could be achieved in 30% of the urbanized portion of the watershed through various iterations of non-structural BMPs. Compliance with the remaining 70% of the urbanized portion of the watershed could be achieved through structural BMPs.

The first step of the potential phased approach would include the implementation of non-structural BMPs by permittees, such as increasing the frequency and efficiency of street sweeping. In their National Menu of Best Management Practices for Stormwater – Phase II, USEPA reports that conventional mechanical street sweepers can reduce non-point source pollution by 5 to 30% (USEPA, 1999a). The removal efficiencies of sediment for conventional sweepers are dependent on the size of particles. Conventional sweepers, including mechanical broom sweepers and vacuum-assisted wet sweepers, have removal efficiencies of approximately 15 to 50% for particles less than 500 micrometers and up to approximately 65% for larger particles (Walker and Wong, 1999). USEPA reports that vacuum-assisted dry street sweeping can remove significantly more pollution, including fine sediment and metals, before the pollutants are mobilized by rainwater. USEPA reports a 50 to 88% overall reduction in annual sediment loading for residential areas by vacuum-assisted dry street sweepers. As reported by Walker and Wong in a 1999 study of the effectiveness of street sweeping for stormwater pollution control, Sutherland and Jelen (1997) showed a total removal efficiency of 70% for fine particles and up to 96% for larger particles by vacuum – assisted dry sweepers (also known as small-micron surface sweepers). Upgrading to vacuum-assisted dry sweeping would translate to a significant reduction of sediments. In their 1999 Preliminary Data Summary of Urban

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[4] This TMDL only addresses 1.5 square miles of the 2.9 square mile Marina del Rey watershed. Water comprises 0.08 square miles of the area. It is not expected that the MS4 and Caltrans permittees will need to address areas of open water to meet the waste load allocations. Therefore, areas of water are not considered in the calculation of the cost analysis. The remaining 1.42 square miles is considered the portion of the watershed that may require BMPs and therefore, used in the cost analysis for the purposes of this TMDL.

Stormwater Best Management Practices, USEPA estimated cost data for both standard mechanical and vacuum-assisted dry sweepers as shown in Table 6-1.

Table 6-1. Estimated costs for two types of street sweepers. (Source: USEPA, 1999b.)

Sweeper Type	Life (Years)	Purchase Price ($)	Annual O&M Cost ($/curb mile)
Mechanical	5	75,000	30
Vacuum-assisted	8	150,000	15

Table 6-1 illustrates that while the purchase price of vacuum-assisted dry sweepers is higher, the operation and maintenance costs are lower than for standard sweepers. Based on this information, USEPA determined the total annualized cost of operating street sweepers per curb mile, for a variety of frequencies (Table 6-2). In their estimates, USEPA assumed that one sweeper serves 8,160 curb miles during a year and assumed an annual interest rate of 8 percent (USEPA, 1999b). According to Table 6-2, permittees would save money in the long-term by switching to vacuum-assisted dry sweepers.

Table 6-2. Annualized sweeper costs, including purchase price and operation and maintenance costs ($/curb mile/year).

Sweeper Type	Sweeping Frequency					
	Weekly	**Bi-weekly**	**Monthly**	**Quarterly**	**Twice per year**	**Annually**
Mechanical	1,680	840	388	129	65	32
Vacuum-Assisted	946	473	218	73	36	18

Under a phased implementation approach, the permittees could monitor effectiveness using flow-weighted composite sampling of runoff throughout representative storms to determine the effectiveness of this first step of implementing non-structural BMPs. If monitoring showed ineffectiveness, permittees could adapt their approach by increasing frequency of street sweeping or incorporating other non-structural BMPs.

If the WLAs can not be achieved through non-structural BMPs, permittees could incorporate structural BMPs. Two potential structural BMPs were analyzed in this cost analysis:

1. Infiltration trenches
2. Sand filters

These approaches are specifically designed to treat urban runoff and to accommodate high-density areas. They were chosen for this analysis because in addition to addressing sediment loadings to the creek, they have the additional positive impact of addressing the effects of development and increased impervious surfaces in the watershed. Both approaches can be designed to capture and treat 0.5 to 1 inch of runoff. When flow exceeds the design capacity of each device, untreated runoff is allowed to bypass the device and enter the storm drain.

Both infiltration trenches and sand filters must be used in conjunction with some type of pretreatment device such as a biofiltration strip or gross solids removal system to remove sediment and trash in order to increase their efficiency and service life. This analysis provides an estimate of the costs associated with installing sand filters or infiltration trenches.

In addition, both infiltration trenches and sand filters are efficient in removing bacteria and could be used to achieve the WLAs in the adopted bacteria TMDL for Marina del Rey Harbor. USEPA reports that sand filters have a 76% removal rate and infiltration trenches have a 90% removal rate for fecal coliform (USEPA, 1999c).

As stated previously, it is assumed that 70% of the urbanized portion of the watershed would need to be treated by structural BMPs. In this cost analysis, it was assumed that infiltration trenches would treat 35% of the watershed and sand filters would treat the other 35%. Costs were estimated using data provided by USEPA (USEPA, 1999a and 1999c) and the Federal Highway Administration (FHWA, 2003). USEPA cost data were reported in 1997 dollars. FHWA costs were reported in 1996 dollars for infiltration trenches and 1994 dollars for sand filters. Where costs were reported as ranges, the highest reported cost was assumed. These costs were then compared to costs determined by Caltrans in their BMP Retrofit Pilot Program (Caltrans, 2004). Caltrans costs were reported in 1999 dollars. To estimate land acquisition cots for individual projects in this cost analysis would be purely speculative.

Infiltration trenches. Infiltration trenches store and slowly filter runoff through the bottom of rock-filled trenches and then through the soil. Infiltration trenches can be designed to treat any amount of runoff, but are ideal for treating small urban drainage areas less than five to ten acres. Soils and topography are limiting factors in design and siting, as soils must have high percolation rates and groundwater must be of adequate depth. Potential impacts to groundwater by infiltration trenches could be avoided by proper design and siting. Infiltration trenches are reported to achieve 75 to 90% suspended solids removal and 75 to 90% metals removal by USEPA and FHWA. In their BMP Retrofit Pilot Program, Caltrans assumed that constituent removal was 100 percent for storm events less than the design storm, because all runoff would be infiltrated.

Table 6-3 presents estimated costs for infiltration trenches designed to treat 0.5 inches of runoff over a five-acre drainage area with a runoff coefficient equal to one. Staff determined that 130 devices, designed to treat five acres each, would be required to treat 35% of the land area of the watershed.

Table 6-3. Estimated Costs for Infiltration Trenches.

	Construction Costs ($ million)	Maintenance Costs ($ million/year)
Based on USEPA estimate (1997 dollars)	2.88	0.58
Based on FHWA estimate (1996 dollars)	2.75	Not reported

Sand Filters. Sand filters work by a combination of sedimentation and filtration. Runoff is temporarily stored in a pretreatment chamber or sedimentation basin, and then flows by gravity or is pumped into a sand filter chamber. The filtered runoff is then discharged to a storm drain or natural channel. The costs of two types of sand filters were analyzed: 1) the Delaware sand filter, which is installed underground and suited to treat drainage areas of approximately one acre and 2) the Austin sand filter, which is installed at-grade and suited to larger drainage areas up to 50 acres. The underground sand filter is especially well adapted for applications with limited land area and is independent of soil conditions and depth to groundwater. However, both types of sand filters must consider the imperviousness of the drainage areas in their design.

USEPA estimated a 70% removal of total suspended solids and 45% removal of lead and zinc for both types of sand filters. FHWA reported high sediment, zinc and lead removal, but low copper removal for Austin sand filters and high sediment and moderate to high metals removal for Delaware sand filters. Caltrans reported a 50% reduction in total copper, a 7% reduction in dissolved copper, an 87% reduction in total lead, a 40% reduction in dissolved lead, an 80% reduction in total zinc and a 61% reduction in dissolved zinc by the Austin sand filters they tested. Caltrans reported a 66% reduction in total copper, a 40% reduction in dissolved copper, an 85% reduction in total lead, a 31% reduction in dissolved lead, a 92% reduction in total zinc and a 94% reduction in dissolved zinc by the Delaware sand filter they tested.

USEPA and FHWA reported costs per acre for 0.5 inches of runoff. Total costs were calculated by multiplying the per-acre cost by the total acreage of the urbanized portion of the watershed not addressed through an integrated resources plan or non-structural BMPs. Estimated costs are presented in Table 6-4. There are significant economies of scale for Austin filters. USEPA reported that costs per acre decrease with increasing drainage area. FHWA reported two separate costs based on drainage area served. Economies of scale are not a factor for Delaware filters, as they are limited to drainage areas of about one acre.

Table 6-4. Estimated Costs for Austin and Delaware Sand Filters

	Austin Sand Filter Construction Costs ($ million)	Austin Sand Filter Maintenance Costs ($ million/year)	Delaware Sand Filter Construction Costs ($ million)	Delaware Sand Filter Maintenance Costs ($ million/year)
Based on USEPA estimate (1997 dollars)	2.93	0.15	1.74	0.09
Based on FHWA estimate* (1994 dollars)	0.54	Not reported	2.22	Not reported

*FHWA cost estimate for Austin filter was calculated assuming a drainage area greater than five acres. The costs would be $4.6 million for Austin filters designed for a drainage area of less than two acres.

Based on the adaptive management approach, and some assumptions about the efficiencies of each stage of the approach, the cost analysis arrived at the total costs for achieving the WLAs in the Toxic Pollutants TMDL as shown in Table 6-5. The total costs do not include the cost savings associated with switching to vacuum-assisted street sweepers. As stated previously, the costs associated with this adaptive management approach could be applied towards the cost of achieving the WLAs in the Metals TMDLs and the adopted Bacteria TMDL.

Table 6-5. Total Estimated costs of structural BMP approach for stormwater discharges.

	Total Construction ($ million)	Total Maintenance ($ million/year)
Based on USEPA estimate(1997 dollars)	7.6	0.8
Based on FHWA estimate(1994/1996 dollars)	5.5	Not reported

6.3.1.2 Comparison of Costs Estimates with Caltrans Reported Costs

Estimated costs for structural BMPs were compared to costs reported by Caltrans in their BMP Retrofit Pilot Program (Caltrans, 2004). Caltrans sited five Austin sand filters and one Delaware sand filter as part of their study. The five Austin sand filters served an average area of 2 acres and the Delaware sand filter served an area of 0.7 acres. Caltrans sited two infiltration trench/biofiltration strip combinations as part of their study. Each trench and biofiltration strip used in combination served an area of 1.7 acres. Based on these drainage areas, the average adjusted cost of the Austin sand filters in the Caltrans study was $156,600 per acre, the adjusted cost of the Delaware filter was $310,455 per acre and the average adjusted cost of the infiltration trench/biofiltration strips was $84,495 per acre. These costs are approximately an order of magnitude greater than the costs determined using estimates provided by USEPA and FHWA. It should be noted that costs calculated using EPA and FHWA estimates were based on infiltration trench and sand filter designs that would treat 0.5 inches of runoff, while the Caltrans study costs were based on an infiltration trench design that would treat 1 inch of runoff and sand filter designs that would treat 0.56 to 1 inches of runoff. This could explain some of the differences in costs.

The differences in costs can also be explained by a third party review of the Caltrans study, conducted by Holmes & Narver, Inc. and Glenrose Engineering (Caltrans, 2001). Holmes & Narver, Inc. and Glenrose Engineering (Caltrans, 2001). The review compared adjusted Caltrans costs with costs of implementing BMPs by other state transportation agencies and public entities. The adjusted costs exclude costs associated with the unique pilot program and ancillary costs such as improvements to access roads, landscaping or erosion control, and non-BMP related facilities. For the comparison, all costs were adjusted for differences in regional economies. The third party review determined that the median costs reported by Caltrans were higher than the median costs reported by the other agencies for almost every BMP considered, including sand filters and infiltration BMPs. The review attributed the higher Caltrans costs to the small scale and accelerated nature of the pilot program. The third party review then gave recommendations for construction cost reductions based on input from other state agencies. These included simplifying design and material components, combining retrofit work with ongoing construction projects, changing methods used to select and work with construction contractors, allowing for a longer planing horizon, constructing a larger number of BMPs at once, and implementing BMPs over a larger drainage area.

6.3.2 Results of a Region-wide Cost Study

In their report entitled "Alternative Approaches to Storm Water Quality Control, Prepared for the Los Angeles Regional Water Quality Board," Devinny et al. estimated the total costs for compliance with Regional Board storm water quality regulations as ranging from $2.8 billion, using entirely non-structural systems, to between $5.7 billion and $7.4 billion, using regional treatment or infiltration systems. The report stated that final costs would likely fall somewhere within this range. Table 6-6 presents the report's estimated costs for the various types of structural and non-structural systems that could be used to achieve compliance with municipal storm water requirements throughout the Region.

Table 6-6. Estimated costs of structural and non-structural compliance measures for the entire Los Angeles Region. (Source: Devinny et al.)

Compliance Approach	Estimated Costs
Enforcement of litter ordinances	$9 million/year
Public Education	$5 million/year
Increased storm drain cleaning	$27 million/year
Installation of catch basin screens, enforcing litter laws, improving street cleaning	$600 million
Low –flow diversion	$28 million
Improved street cleaning	$7.5 million/year
On-site BMPs for individual facilities	$240 million
Structural BMPs – 1st estimation method	$5.7 billion
Structural BMPs – 2nd estimation method	$4.0 billion

The Devinny et al. study calculates costs for the entire Los Angeles Region, which is 3,100 square miles, while the Marina del Rey watershed is 2.9 square miles. When compared on a per square mile basis, the costs estimated in section 6.5.1 are within the range calculated by Devinny et al. (Table 6-7).

Table 6-7. Comparison of costs for storm water compliance on a per square mile basis.

	Construction Costs ($ million/square mile)
Based on U.S. EPA estimate	2.62
Based on FHWA estimate	1.91
Maximum cost calculated by Devinny et al.	1.84 –2.39

The Devinny et al. study also estimated benefits associated with storm water compliance. It was determined that the Region-wide benefits of a non-structural compliance program would equal approximately $5.6 billion while the benefits of non-structural and regional measures would equal approximately $18 billion. Region-wide estimated benefits included:

- Flood control savings due to increased pervious surfaces of about $400 million,
- Property value increase due to additional green space of about $5 billion,
- Additional groundwater supplies due to increased infiltration worth about $7.2 billion,
- Willingness to pay to avoid storm water pollution worth about $2.5 billion,

- Cleaner streets worth about $950 million,
- Improved beach tourism worth about $100 million
- Improved nutrient recycling and atmospheric maintenance in coastal zones worth about $2 billion,
- Savings from reduction of sedimentation in Regional harbors equal to about $330 million, and
- Unquantifiable health benefits of reducing exposure to fine particles from streets.

7 MONITORING

There are three objectives of monitoring associated with the TMDL. The first is to collect additional water, and fish tissue quality data to evaluate the extent of impairment in these media. The second is to assess the effectiveness of the TMDL and ultimately achieving the waste load allocations. The third is to conduct special studies to address the uncertainties in the TMDL and to assist in the design and sizing of BMPs. To achieve these objectives, a monitoring program will need to be developed for the TMDL that consists of three components: (1) ambient monitoring, (2) effectiveness monitoring and (3) special studies.

The monitoring program and any required technical reports will be established pursuant to a subsequent order issued by the Executive Officer. As a planning document, the TMDL identifies the type of information necessary to refine and update it, and to assess its effectiveness. The Executive Officer will comply with any necessary legal requirements in developing the monitoring program, requiring technical reports, and establishing special studies.

7.1 Ambient Component

A monitoring program is necessary to assess water quality throughout Marina del Rey Harbor and to assess fish tissue and sediment quality in the harbor's back basins. Data on background water quality for copper will help refine the numeric targets and waste load allocations and assist in the effective placement of BMPs. In addition, fish tissue data is required in Marina del Rey's back basins to confirm continued impairment.

Water quality samples shall be collected monthly from the back basins and analyzed for chlordane and total PCBs at detection limits that are at or below the minimum levels until the TMDL is reconsidered in the sixth year. The minimum levels are those published by the State Water Resources Control Board in Appendix 4 of the Policy for the Implementation of Toxic Standards for Inland Surface Water, Enclosed Bays, and Estuaries of California, March 2, 2000. Special emphasis should be placed on achieving detection limits that will allow evaluation relative to the CTR standards. If these can not be achieved with conventional techniques, then a special study should be proposed to evaluate concentrations of organics.

Water quality samples shall also be collected monthly from the back basins and analyzed for total recoverable and dissolved copper, lead, and zinc until the TMDL is reconsidered in the sixth year. For total recoverable and dissolved copper analyses, monthly samples will be collected throughout the harbor. For metals water column analysis, methods that allow for (1) the removal of salt matrix to reduce interference and avoid inaccurate results prior to the analysis; and (2) the use of trace metal clean sampling techniques, should be applied. Examples of such methods include EPA Method 1669 for sample collection and handling, and EPA Method 1640 for sample preparation and analysis.

Storm water monitoring shall be conducted for total recoverable and dissolved metals (copper, lead, and zinc) and organics (chlordane and total PCBs) to provide assessment of water quality during wet-weather conditions and loading estimates from the watershed to the harbor. Special emphasis should be placed on achieving lower detection limits for organochlorine compounds.

The MS4 and Caltrans storm water permittees are jointly responsible for conducting bioaccumulation testing of fish within the harbor. The permittees are required to submit, for approval of the Executive Officer, a monitoring plan that will provide the data needed to confirm or challenge continued impairment of the 303(d) listed pollutants.

Representative sediment sampling shall be conducted quarterly within the back basins of the harbor for copper, lead, zinc, chlordane, and total PCBs at detection limits that are lower than the ERLs. Sediment samples shall also be analyzed for total organic carbon, grain size and sediment toxicity. Initial sediment toxicity monitoring should be conducted quarterly in the first year of the TMDL to define the baseline and semi-annually, thereafter, to evaluate effectiveness of the BMPs until the TMDL is reconsidered in the sixth year. The sediment toxicity testing shall include testing of multiple species, a minimum of three, for lethal and non-lethal endpoints. Toxicity testing may include: the 28-day and 10-day amphipod mortality test; the sea urchin fertilization testing of sediment pore water; and the bivalve embryo testing of the sediment/water interface. The chronic 28-day and shorter-term 10-day amphipod tests may be conducted in the initial year of quarterly testing and the results compared. If there is no significant difference in the tests, then the less expensive 10-day test can be used throughout the rest of the monitoring, with some periodic 28-day testing.

7.2 Effectiveness Component

The water quality samples collected during wet weather, shall be analyzed for total dissolved solids, settleable solids and total suspended solids if not already part of the sampling program. Sampling shall be designed to collect sufficient volumes of settleable and suspended solids to allow for analysis of copper, lead, zinc, chlordane, total PCBs, and total organic carbon in the sediment.

Monthly representative sediment sampling shall be conducted at existing monitoring locations within the back basins of the harbor, and analyzed for copper, lead, zinc, chlordane, and total PCBs at detection limits that are lower than the ERLs. The, sediment samples shall also be analyzed for total organic carbon and grain size. Sediment toxicity testing shall be conducted semi-annually, and shall include testing of multiple species (a minimum of three) for lethal and non-lethal endpoints. Toxicity testing may include: the 28-day or 10-day amphipod mortality test; the sea urchin fertilization testing of sediment pore water; and the bivalve embryo testing of the sediment/water interface.

Toxicity shall be indicated by an amphipod survival rate of 70% or less in a single test, in conjunction with a statistically significant decrease in amphipod survival relative to control organisms (significance determined by T-test, a=0.05). Accelerated monitoring may be conducted to confirm toxicity at stations identified as toxic. Accelerated monitoring shall consist of six additional tests, approximately every two weeks, over a 12-week period. If the results of any two of the six accelerated tests are less than 90% survival, then the MS4 and Caltrans permittees shall conduct a Toxicity Identification Evaluation (TIE). Alternatively, responsible parties have the option of foregoing accelerated toxicity testing and conducting a TIE directly following an indication of toxicity. The TIE shall include reasonable steps to identify the sources of toxicity and steps to reduce the toxicity The Phase I TIE shall include the following treatments and corresponding blanks: baseline toxicity; particle removal by centrifugation; solid phase extraction of the centrifuged sample using C8, C18, or another approved media; complexation of metals using ethylenediaminetetraacetic acid (EDTA) addition to the raw sample; neutralization of oxidants/metals using sodium thiosulfate addition to the raw sample; and inhibition of organo-phosphate (OP) pesticide activation using piperonyl butoxide addition to the raw sample (crustacean toxicity tests only).

Bioaccumulation monitoring of fish and mussel tissue within the harbor shall be conducted annually. The permittees are required to submit for approval of the Executive Officer a monitoring plan that will provide the data needed to assess the effectiveness of the TMDL The general industrial storm water permit shall contain a model monitoring and reporting program to evaluate BMP effectiveness. A permittee enrolled under the general industrial permit shall have the choice of conducting individual monitoring based on the model program or participating in a group monitoring effort. MS4 permittees are encouraged to take the lead in group monitoring efforts for industrial facilities within their jurisdiction because compliance with waste load allocations by these facilities will in many cases translate to reductions in contaminate loads to the MS4 system.

7.3 Special Studies

Special studies are necessary to refine source assessments, to provide better estimates of loading capacity, and to optimize implementation efforts. The Regional Board will re-consider the TMDL in the sixth year after the effective date in light of the findings of these studies.

Studies required for this TMDL include:

- Evaluate partitioning coefficients between water column and sediment to assess the contribution of water column discharges to sediment concentrations in the harbor, and
- Evaluate the use of low detection level techniques to determine water quality concentrations for those contaminants where standard detection limits cannot be used to assess compliance for CTR standards or are not sufficient for estimating source loadings from tributaries and storm water.

Studies recommended for this TMDL include:

- Develop and implement a monitoring program to collect the data necessary to apply a multiple lines of evidence approach;
- Refine the relationship between pollutants and suspended solids aimed at better understanding of the delivery of pollutants to the watershed, and
- Evaluate the effectiveness of BMPs to address pollutants and/or sediments.

8. FINAL TMDL MILESTONES AND IMPLEMENTATION SCHEDULE

The TMDL milestones and implementation schedule are summarized in Table 8-1. The schedule allows time for dischargers to perform special studies and to develop implementation plans before any waste load reductions are required.

8.1 Final TMDL Milestones

The Regional Board intends to reconsider this TMDL six years after the effective date of the TMDL to re-evaluate the waste load allocations and the implementation schedule based on the additional data obtained from the special studies. The Regional Board will consider extending the implementation schedule from 10 years up to 15 years if an IRP approach is pursued. Until the TMDL is revised, the waste load allocations will remain as presented in Section 5. Revising the TMDL will not create a conflict, since the total contaminated sediment reductions are not required until 10-15 years after the effective date.

8.2 Implementation Schedule

The implementation schedule for all NPDES permittees is summarized in Table 8-1. The municipalities and Caltrans are encourage to work together to meet the waste load allocations. For the MS4 and Caltrans storm water permittees the proposed implementation schedule consists of a phased approach, with compliance to be achieved in incremental percentages of the watershed, with total compliance achieved within 10 years. This schedule is based on a combination of structural and non-structural strategies designed specifically to reduce toxic pollutant loading to Marina del Rey Harbor. However, should the responsible jurisdictions and agencies pursue an integrated water resources approach that includes beneficial re-use of storm water, the Regional Board will consider extending the allowable time to 15 years, in recognition of the additional planning and time needed for this approach (see Table 8.1).

Table 8-1. Implementation Schedule

Date	Action
Effective date of the TMDL	Regional Board permit writers shall incorporate the waste load allocations for sediment into the NPDES permits. Waste load allocations will be implemented through NPDES permit limits in accordance with the implementation schedule contained herein, at the time of permit issuance, renewal or re-opener.
On-going	The Executive Officer shall promptly issue appropriate investigatory and clean up and abatement orders to address any toxicity hotspots within sediments identified as a result of data submitted pursuant to this TMDL, any U.S. Army Corps of Engineer dredging activity, or any other investigation.
Within 6 months after the effective date of the State Board adopted sediment quality objectives and implementation policy	The Regional Board will re-assess the numeric targets and waste load allocations for consistency with the State Board adopted sediment quality objectives.
5 years after effective date of the TMDL	Responsible jurisdictions and agencies shall provide to the Regional Board result of any special studies.
6 years after effective date of the TMDL	The Regional Board shall reconsider this TMDL to re-evaluate the waste load allocations and the implementation schedule.
NON-STORM WATER NPDES PERMITS (INCLUDING MINOR AND GENERAL PERMITS)	
7 years after effective date of the TMDL	The non-storm water NPDES permittees shall achieve the concentration-based waste load allocations for sediment per provisions allowed for in NPDES permits.
GENERAL INDUSTRIAL STORM WATER PERMITS	
7 years after effective date of the TMDL	The general industrial storm water permittees shall achieve the mass-based waste load allocations for sediment per provisions allowed for in NPDES permits. Permits shall allow an iterative BMP process including BMP effectiveness monitoring to achieve compliance with permit requirements.
GENERAL CONSTRUCTION STORM WATER PERMITS	
7 years from the effective date of the TMDL	The construction industry will submit the results of the BMP effectiveness studies to the Regional Board for consideration. In the event that no effectiveness studies are conducted and no BMPs are approved, permittees shall be subject to site-specific BMPs and monitoring to demonstrate BMP effectiveness.

Date	Action
8 years from the effective date of the TMDL	The Regional Board will consider results of the BMP effectiveness studies and consider approval of BMPs no later than eight years from the effective date of the TMDL.
9 years from the effective date of the TMDL	All general construction storm water permittees shall implement Regional Board-approved BMPs.
MS4 AND CALTRANS STORM WATER PERMITS	
12 months after the effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees must submit a coordinated monitoring plan, to be approved by the Executive Officer, which includes both ambient monitoring and TMDL effectiveness monitoring. Once the coordinated monitoring plan is approved by the Executive Officer, monitoring shall commence within 6 months. The draft monitoring report shall be made available for public comment and the Executive Officer shall accept public comments for at least 30 days.
5 years after effective date of TMDL (Draft Report) 5 ½ years after effective date of TMDL (Final Report)	The MS4 and Caltrans storm water NPDES permittees shall provide a written report to the Regional Board outlining how they will achieve the waste load allocations for sediment to Marina del Rey Harbor. The report shall include implementation methods, an implementation schedule, proposed milestones, and any applicable revisions to the TMDL effectiveness monitoring plan. The draft report shall be made available for public comment and the Executive Officer shall accept public comments for at least 30 days.
Schedule for MS4 and Caltrans Permittees if Pursuing a TMDL Specific Implementation Plan	
8 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 50% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.
10 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 100% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.
Schedule for MS4 and Caltrans Permittees if Pursuing an Integrated Resources Approach, per Regional Board Approval	
7 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 25% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.
9 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 50% of the total drainage area served by the MS4 system is effectively meeting the waste load

Date	Action
	allocations for sediment.
11 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 75% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.
15 years after effective date of the TMDL	The MS4 and Caltrans storm water NPDES permittees shall demonstrate that 100% of the total drainage area served by the MS4 system is effectively meeting the waste load allocations for sediment.

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November 29, 2012

Hannah Koo
County of Los Angeles
Department of Public Works
900 South Fremont Avenue
Alhambra, CA 91803

SUBJECT: REVIEW OF EXISTING BIOLOGICAL CONDITIONS AT OXFORD BASIN MARINA DEL REY, LOS ANGELES COUNTY, CALIFORNIA

Dear Hannah,

At the request of the Department of Public Works (Department), Hamilton Biological has conducted a biological reconnaissance survey to evaluate whether conditions at Oxford Basin remain consistent with those described in the *Biological Evaluation of Oxford Basin, Marina del Rey, Los Angeles County, California* (Hamilton Biological, Inc., plan dated November 22, 2010). The Department has requested this evaluation as part of planning of the Oxford Retention Basin Multi-Use Enhancement Project.

METHODS

Prior to conducting the survey, I reviewed the above-referenced biological report. I conducted the reconnaissance survey on November 15, 2012, from 8:00 to 10:25 a.m. Skies were 100% overcast, winds were light, and temperatures ranged from 55 to 62° F. During the first 90 minutes of the survey, I was joined by Stephen Zurek of the Department and Rick Ware of Coastal Resources Management. During the survey, I recorded all terrestrial vertebrate wildlife species detected (by sight, sound, tracks, scat, or other sign). I compared the limits of vegetation communities around Oxford Basin with those mapped by Hamilton Biological in 2010.

RESULTS

Road construction was taking place along Admiralty Way, directly south of Oxford Basin, at the time of the survey; this did not affect my ability to conduct the survey, and the road work did not extend into the survey area.

Vegetation

I observed no substantial change in the extent, species composition, or vigor of native wetland vegetation along the edge of the open water of the Basin.

At the southwestern end of the Basin, much of the non-native landscaping that had been present in 2010 had been removed or thinned out.

On the upland slopes surrounding the Basin, scattered non-native plants had died and/or been removed, but this did not change the limits of any plant communities or seem likely to affect their value as habitat for wildlife.

In 2010, much of the non-native Small-flowered Myoporum (*Myoporum laetum*) planted around the Basin was in very poor condition, likely due to an infestation of the Myoporum Thrip (*Klambothrips myopori*)[1], but during the current survey most of these plants appeared to be healthier. Whether healthy or not, a near-monoculture of myoporum with understory of non-native grasses and weeds, as found at Oxford Basin, provides habitat of marginal value for wildlife.

None of the differences observed in the non-native upland vegetation around Oxford Basin in 2012 versus 2009/2010 represents a substantial change in the plant resources of Oxford Basin.

Wildlife

I observed the tracks of one mammal species – either a Raccoon (*Procyon lotor*) or Striped Skunk (*Mephitis mephitis*) – and detected 22 bird species. All of these birds and mammals were recorded at Oxford Basin by Dan Cooper and Robert Hamilton during a series of more than 20 surveys conducted in 2009 and 2010 (*Biological Evaluation of Oxford Basin, Marina del Rey, Los Angeles County, California*). Table A, below, shows the status of these 22 bird species in 2009/2010 and specifies the number of each species detected during my survey in 2012.

Table A. Bird Species at Oxford Basin in 2009/2010 and on November 15, 2012

Family	Species	2009/2010 Study	Nov. 15, 2012
Waterfowl	Mallard *Anas platyrhynchos*	Up to 23 during fall/winter; <5 during spring; pair with 5 young on 28 May 2010.	2
	American Wigeon *Anas Americana*	Up to 89 in winter (Nov. - Mar.)	2
	Gadwall *Anas strepera*	Up to 6 in winter (Dec. - Feb.)	2
Grebes	Pied-billed Grebe *Podilymbus podiceps*	Five in fall (23 Oct.), 1 through winter	1

[1] Hamilton Biological, Inc. 2010. Conservation and Management Plan for Marina del Rey, Los Angeles County, California. Report dated September 16, 2010, prepared for the Department of Beaches & Harbors and Department of Public Works.

Family	Species	2009/2010 Study	Nov. 15, 2012
Pelicans/ Cormorants	Double-crested Cormorant *Phalacrocorax auritus*	Up to 3 in fall	3
Large waders	Great Blue Heron *Ardea Herodias*	1 on 3 dates	1
	Great Egret *Ardea alba*	1-2 through early winter	1
	Snowy Egret *Egretta thula*	Up to 3 year-round	1
Shorebirds	Killdeer *Charadrius vociferus*	1-2 in spring	4
Gulls/Terns	Ring-billed Gull *Larus delawarensis*	2 on 12 Jan.	1
Doves	Rock Pigeon *Columba livia*	3-4 in spring	5
	Mourning Dove *Zenaida macroura*	Up to 27 in late fall; single-digits rest of year	3
Hummingbirds	Anna's Hummingbird *Calypte anna*	Up to 11, with juveniles heard in myoporum grove (24 Feb.)	9
	Allen's Hummingbird *Selasphorus sasin*	2 on 27 Apr.	2
Kingfisher	Belted Kingfisher *Megaceryle alcyon*	1 on three dates in fall/winter	1
Flycatchers	Black Phoebe *Sayornis nigricans*	Up to 3 year-round	1
Jays/Crows	American Crow *Corvus brachyrhynchos*	Up to 5; nesting observed in myoporum (25 Mar.) and in surrounding residential area	4
Misc. songbirds	Ruby-crowned Kinglet *Regulus calendula*	Up to 4 in winter	2
	Northern Mockingbird *Mimus polyglottos*	1 on 3 dates	2
Wood-warblers	Orange-crowned Warbler *Vermivora celata*	1 on 3 dates	2

Family	Species	2009/2010 Study	Nov. 15, 2012
	Yellow-rumped Warbler *Dendroica coronata*	Up to 15 in winter (all but 1 were "Audubon's")	13
	Townsend's Warbler *Dendroica townsendi*	Up to 3 in winter/spring	2

Cooper and Hamilton recorded a total of 51 bird species over the course of 20+ surveys, but only a subset of this number was observed during any single survey; and the numbers of most species vary considerably from visit to visit as birds fly between the Basin and surrounding areas, and as flocks of certain species stop over for short periods during their migrations. The diversity and quantities of birds detected on November 15, 2012, were consistent with results obtained during our previous fall surveys of Oxford Basin.

Conclusion

For the reasons discussed in this report, I conclude that the vegetation and terrestrial vertebrate fauna observed at Oxford Basin on November 15, 2012, were comparable to those documented in the *Biological Evaluation of Oxford Basin, Marina del Rey, Los Angeles County, California* (Hamilton Biological, Inc., 2010). I do not identify any steps that would be warranted to update the biological baseline as the County continues its planning and eventual implementation of the Oxford Retention Basin Multi-Use Enhancement Project.

I appreciate the opportunity to continue biological investigations of Oxford Basin. If you have questions, please send e-mail to robb@hamiltonbiological.com or call me at 562-477-2181.

Sincerely,

Robert A. Hamilton

Robert A. Hamilton
President, Hamilton Biological, Inc.
http://hamiltonbiological.com

Biological Evaluation of Oxford Basin
Marina del Rey,
Los Angeles County, California
November 22, 2010

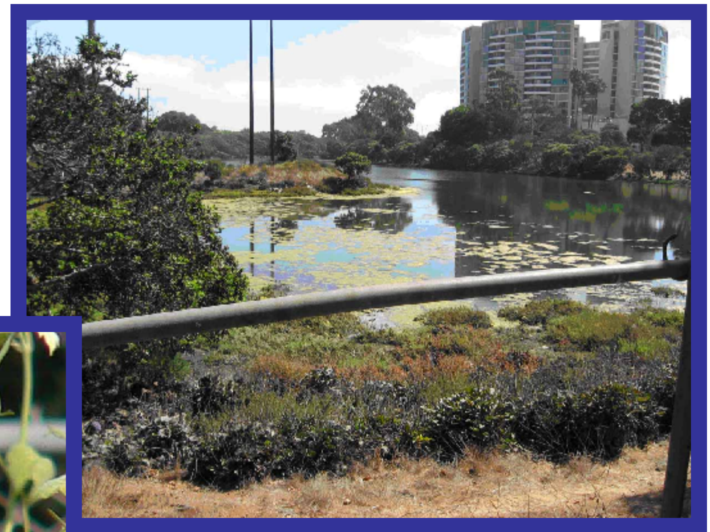

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Table of Contents

TABLES

ATTACHMENTS

EXECUTIVE SUMMARY

Completed in the early 1960s in conjunction with the creation of Marina del Rey, the Oxford Storm Water Retention Basin (hereafter "Oxford Basin" or the "Basin") was designed to receive storm runoff from the surrounding urban landscape and to release that water into Marina del Rey, thereby avoiding inundation of low-lying neighborhoods in the Venice area. During the past decade, various species of herons and egrets have become increasingly common as breeders in Marina del Rey's non-native landscaping, and a recent marina-wide review of biological resources (Hamilton and Cooper 2010) identified Oxford Basin as the most important foraging and roosting habitat in the local area for Great Egrets (*Ardea alba*), Snowy Egrets (*Egretta thula*), and Black-crowned Night-Herons (*Nycticorax nycticorax*).

The current biological evaluation is being undertaken as part of ongoing planning by the County Department of Public Works to increase the Basin's effectiveness as a flood control facility, to improve its ecological functions and values, and to increase the area's aesthetic and recreational values. This is the first in-depth investigation of Oxford Basin since 1980, and the first such effort undertaken by a multidisciplinary team of specialists:

- David E. Bramlet: Botany, Plant Community Descriptions and Mapping; Wetland Delineation.
- Emile Fiesler: Entomology.
- Camm C. Swift and Joel Mulder: Ichthyology/Estuarine Biology.
- Daniel S. Cooper and Robert A. Hamilton: Ornithology/Terrestrial Vertebrates.

As Oxford Basin serves a critical flood protection role for the surrounding community, all proposed enhancements and policies for the Basin must be consistent with the operation and maintenance needs of the Los Angeles County Flood Control District (LACFCD). Although the flood-control imperative imposes certain constraints upon any effort to increase the Basin's ecological values, this report identifies numerous conservation strategies that could potentially be undertaken within those constraints that would be expected to improve the Basin's ecological functions and values.

1.0 INTRODUCTION & PURPOSE

1.1 Introduction

The County of Los Angeles (County) commissioned Robert A. Hamilton, president of Hamilton Biological, Inc., to prepare this biological evaluation of the Oxford Storm Water Retention Basin (hereafter "Oxford Basin" or the "Basin"; Figures 1-1, 1-2). The Basin was built during the late 1950s and early 1960s. It was designed to receive storm runoff from the surrounding urban landscape and to release that water into Marina del Rey, thereby avoiding inundation of low-lying neighborhoods in the Venice area. In June 1973, the Board adopted an agreement providing for the Los Angeles County Flood Control District (LACFCD) to assume the responsibility for the operation and maintenance of Oxford Basin as a flood control facility.

Historical information on Oxford Basin (also known as "Parcel P") was provided in a Draft Environmental Impact Report prepared for a then-proposed Japanese garden at the Basin (County of Los Angeles 1976:2; see Attachment D, appendix):

> At the time the Oxford Drainage Basin was constructed, various naturalist organizations requested that the Board of Supervisors set aside this parcel as a wildlife sanctuary, particularly for birds. In January, 1963, the Board designated Parcel P as the Bird Conservation Area. Plant materials were selected and planted to afford nesting, roosting and feeding capabilities. A band of dense shrubbery was planted along the periphery fence to afford privacy and minimize the impact of nearby streets and activity areas. A few years later, about 1965, fill was imported to construct a mound along the northeasterly property line and the area replanted and irrigated in an effort to further improve the habitat.

The "Bird Conservation Area" designation was not based on any study or plan, or in conformance to an existing land-use policy, and was unaccompanied by a formal management plan or other guidelines for ecological restoration (such plans generally did not exist for these types of "urban habitat areas" during that era). The above-described efforts toward creating bird habitat are not consistent with modern understandings of conservation biology principles.

The most thorough study of Oxford Basin's ecology prior to the current study was completed in 1980 by D. W. Schreiber and C. F. Dock, and their report is reproduced here in the appendix to Attachment D. Those authors concluded:

> . . . this area is not important as habitat for wild birds in the Los Angeles basin. While it serves as "green belt" space and as an area for a limited but important number of people to enjoy seeing and enjoying domestic ducks, the area serves little or no purpose as a conservation area for a viable population of migratory or resident wild species. Because of its limited size and relative isolation, we believe that any efforts at habitat modification would have little or no effect at increasing the wild avian populations in the region.

> Certain modifications could make it more conducive for the domestic animals and as green space (Schreiber and Dock 1980:2).

They recommended two potential options for management of the Basin. Option 1, "Leave the area essentially unchanged," reflects a common line of thinking among biologists and land managers 30 years ago, when small parks and other wildlife habitat areas surrounded by urbanization were routinely considered to have little potential conservation value (unlike today, when such areas are more highly valued for the habitat values they can provide to adaptable native species in a region where nearly all natural habitats are developed or highly disturbed). Schreiber and Dock noted:

> The domestic waterfowl currently present in the area are of interest to many people who live in the surrounding community. These birds subsist largely on "handouts" from interested citizens who regularly visit the site. In this regard, the Bird Conservation Area is of some recreational value to the human community. A regular schedule of maintenance which would improve the aesthetic appeal of the area would undoubtedly be appreciated. This has been suggested by some of the local citizenry encountered during the study. In addition, stations might be created that would allow more efficient feeding of the birds and would allow better observation of the birds (Schreiber and Dock (1980:25).

It is impossible to know the exact circumstances that led these biologists to recommend the establishment of feeding stations for domestic waterfowl, but it may be that they were attempting to make the best of a situation in which a more costly, ambitious, and controversial habitat restoration alternative was unlikely to be pursued. Nevertheless, their report did include Option 2, which was recommended "if a substantial effort is to be made to improve the current Bird Conservation Area in terms of its use by wild birds . . ." Option 2 involved the following:

> 1) Clear the area of introduced vegetation and replant with native species. This would mean an attempt to essentially reestablish a coastal scrub community on the grounds of the Bird Conservation Area. Such a program would improve the aesthetic appeal of the conservation area and could have an important educational value to the human community if information concerning the vegetation were made available to the public. Signs could be erected providing the names of the plants and historical and ecological facts pertaining to the species and coastal scrub communities in general. Such restoration measures concerning the vegetation would be likely to attract larger numbers of migrating and wintering songbirds.
>
> 2) Remove the resident domestic waterfowl and gallinaceous birds that currently inhabit the area in large numbers. Such a move might lessen the competition for space and food resources and lead to an increase in the number of wild birds. Removing domestics would also decrease the degradation of ground cover currently seen at the area. Benefits of such action must, however, be weighed against potential costs. As previously mentioned, there is considerable interest in the resident waterfowl populations among local people, many of whom would be displeased by any efforts to eliminate these "pets." Removal of the chickens and other domestic fowl would probably not be opposed and should lead to an

> increase in ground cover which could improve the habitat for terrestrial migrants.
>
> 3) Increase the extent of available mudflat habitat. This would have the potential of increasing the number of shorebirds, gulls and terns using the Bird Conservation Area. Such change could be accomplished by grading the intertidal zone to create a more gradual shoreline around the pond. Any such effort would probably have to be accompanied by dredging of the deeper regions of the pond to maintain the potential water volume of the area for flood control purposes. An alternative, or additional step, would be to create a series of small mudflat islands within the pond itself. This could be preferable to the aforementioned approach, as it would provide greater isolation from human disturbance for any birds using this habitat, and might actually make them easier to observe by interested bird watchers.
>
> 4) Regulate water quality within the pond. Pollution levels within the pond should be monitored and controlled, and the variability of salinity should be regulated to permit further development of the invertebrate community of the mudflats. The invertebrates provide food for most of the shorebirds and some of the duck species found on the area.
>
> We must emphasize that the suggestions given above are a brief outline, and we are more than willing to discuss these factors further. However, we firmly believe that it is a real gamble whether or not this "Bird Conservation Area" can actually be improved as a wild bird habitat, no matter how much funds are expanded [*sic*]. No question exists that it can be improved as a "green belt" and as an area for people to enjoy the presence of and feeding of domestic ducks, but schemes to attract a large wild bird population probably will be fruitless.

Ultimately, the County chose to eliminate the domestic waterfowl and chickens, and to continue operating Oxford Basin as a flood control facility (without attempting to improve the area for human recreational use or as a habitat for native birds or other wildlife). As discussed herein, use of Oxford Basin by wild birds has shifted considerably during the past 30 years, with some species dropping out entirely and others becoming newly established. Although it is still fair to conclude, as Schreiber and Dock did, that the Basin does not provide wildlife habitat of regional importance, it is one of very few areas with open water, mudflat, and brackish marsh in the west Los Angeles area, and Oxford Basin has come to serve as an important foraging area for herons and egrets that now maintain sizable nesting colonies along Admiralty Way (Hamilton and Cooper 2010). In this respect, the Basin provides habitat of much greater value to native bird populations than had been envisioned by Schreiber and Dock three decades ago.

This is the first in-depth biological investigation of Oxford Basin since 1980, and the first such effort undertaken by a multidisciplinary team of specialists:

- David E. Bramlet: Botany, Plant Community Descriptions and Mapping; Wetland Delineation.
- Emile Fiesler: Entomology.

- Camm C. Swift and Joel Mulder: Ichthyology/Estuarine Biology.
- Daniel S. Cooper and Robert A. Hamilton: Ornithology/Terrestrial Vertebrates.

Attachments A–E to this report provide stand-alone technical reports representing each of these disciplines. Please refer to these reports for more detailed discussions of the biological resources present, or potentially present, at Oxford Basin. Attachment F provides Curricula Vitae for each of the specialists named above.

1.2 Purpose

This biological evaluation is being undertaken as part of ongoing planning by the County Department of Public Works to increase the Basin's effectiveness as a flood control facility, to improve its ecological functions and values, and to increase the area's aesthetic and recreational values. Oxford Basin serves a critical flood protection role for the surrounding community, and so all proposed enhancements and policies must be consistent with the operation and maintenance needs of the LACFCD. The primary purpose of this study was to develop a baseline inventory of the plant and wildlife resources present at Oxford Basin prior to developing final plans for the area's renovation. The surveys were therefore designed to sample at different times of year, as necessary to capture seasonal variation in plant and wildlife detectability.

The surveys were also designed to detect any listed or otherwise "special status" species that might be present. This summary report includes a section on the special status species observed at Oxford Basin, or that have moderate or high potential to occur there; the technical reports cover some additional special status species that are deemed absent from the site, or that have only low potential to occur there.

Finally, the specialists in each discipline identified restoration and conservation strategies that may be pursued (within the constraints posed by flood-control imperatives) to improve Oxford Basin's ecological functions and values.

Figure 1-1. Oxford Basin is located along the northern boundary of Marina del Rey, on the central coast of Los Angeles County. The Basin is surrounded by urban areas, but has relative proximity to a few natural areas. The site is approximately 1.5 miles northwest of the Ballona Wetlands, three miles northwest of the El Segundo Dunes remnant, west of Los Angeles International Airport, six miles southeast of the Santa Monica Mountains, and 13 miles north of the Palos Verdes Peninsula.

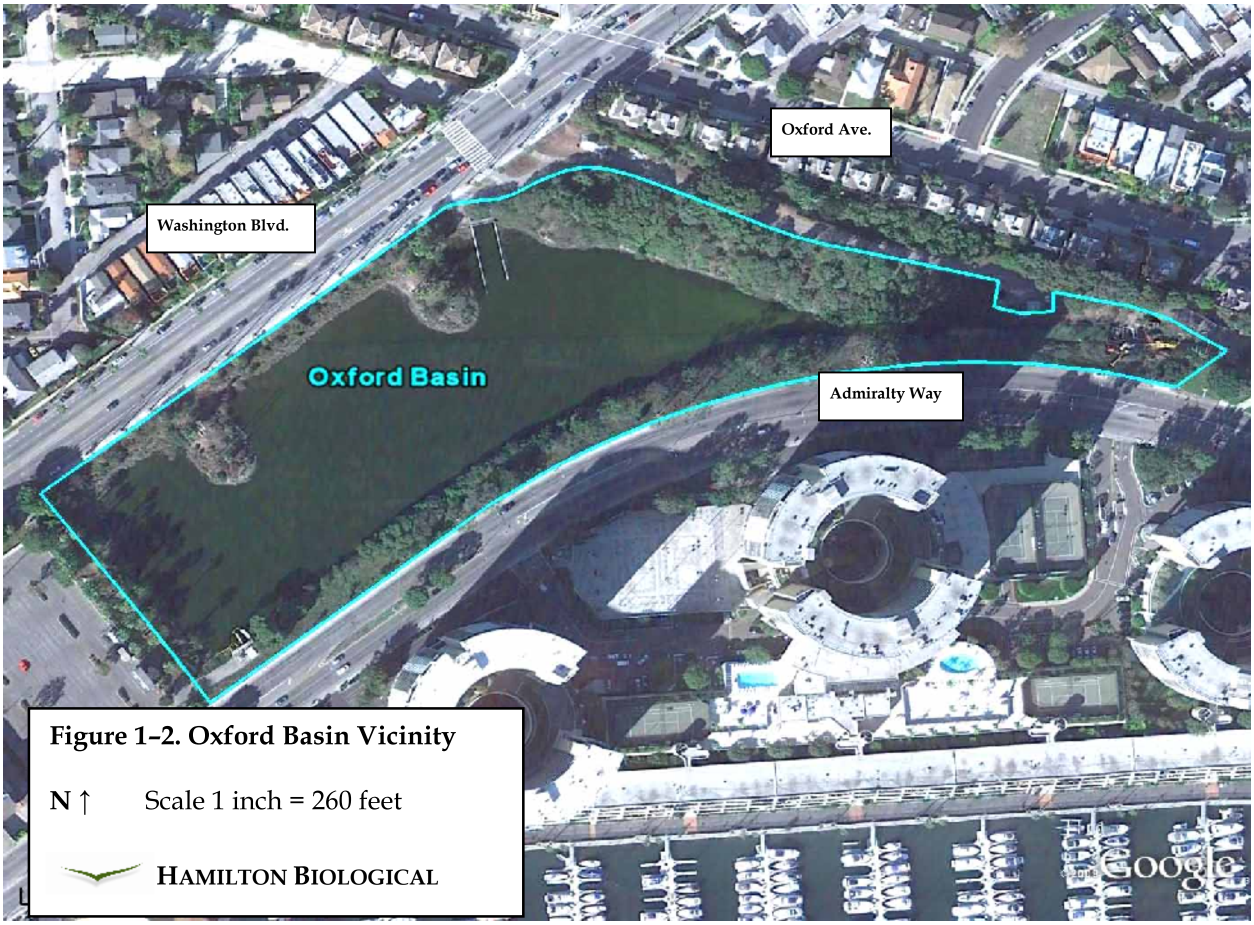


Figure 1–2. Oxford Basin Vicinity. The study area for this project, including the Basin and surrounding uplands within the blue line, covers approximately 9.0 acres. This area is bounded on the north by Washington Boulevard and Oxford Avenue and on the south by Admiralty Way. A County parking lot borders on the west and Yvonne B. Burke Park lies to the east.

2.0 METHODS

Each specialist was tasked with developing a scope of work necessary to adequately characterize the biological resources of Oxford Basin within their respective fields of study, and to search for any "special status" with potential to occur in the habitats present at the Basin. Another goal of the studies was to develop recommendations for ways to increase the Basin's ecological values (as feasible, given flood control requirements). As summarized in Table A, below, field work was completed between September 23, 2009, and June 12, 2010.

TABLE 2–1: SUMMARY OF FIELD SURVEYS

	Survey Type				
Date	Wetland Delineation	Botanical; Vegetation Mapping	Insects	Fish and Estuarine	Birds and Terrestrial Vertebrates
September 23, 2009			√		√
September 24, 2009			√		
October 23, 2009					√
November 20, 2009					√
December 23, 2009					√
January 12, 2010		√	√	√	√
February 24, 2010					√
March 25, 2010					√
March 29, 2010		√			
April 22, 2010		√			
April 27, 2010				√	√
May 7, 2010			√		
May 13, 2010		√			
May 24, 2010			√		
June 12, 2010	√				

For the study of birds and terrestrial vertebrates, Daniel S. Cooper developed the scope of work, served as lead investigator, and authored the technical report, with assistance from Robert A. Hamilton. During 2009 and 2010, Hamilton and Cooper collaborated on preparation of a Conservation and Management Plan for Marina del Rey (current draft dated September 16, 2010), a project that involved 19 visits to Oxford Basin during spring and summer 2009, primarily to document use of the Basin by foraging herons and egrets.

Please refer to the individual technical reports (Attachments A–E) for details of the dates, times, and methods used to conduct each survey undertaken by the different specialists.

3.0 SETTING

Figures 3–1 and 3–2, below, are representative views of Oxford Basin during periods of low and high water levels.

Figure 3–1. Photo showing Oxford Basin during a draw-down period on May 28, 2010. The view is to the southwest, from the northern shore, with the tide-gate visible on the far side of the open water. *Daniel S. Cooper.*

Figure 3–2. Photo showing Oxford Basin during a period of high water on September 23, 2009. The view is to the west, from the northern shore of the Basin. *Robert A. Hamilton*.

3.1 Overview

Oxford Basin, a relict of the larger Ballona/Venice marshes, was constructed in the late 1950s and early 1960s. The Basin is surrounded by elevated roadways, a parking lot, and trees along the roadway edges. Together, these extend upward to 10-15 m above the water level and shield the water's surface from wind action. Surrounding high rise buildings and apartments along the northeast border also shelter the area from wind. Oxford Basin's purpose is to "receive storm runoff at such times as the state of the tide within the [Marina del Rey] harbor precluded its discharge causing inundation of the low-lying lands adjacent to the north section of the harbor" (County of Los Angeles 1976). The Basin's slopes were landscaped extensively with non-native trees and shrubs, and the area has never been formally managed for wildlife. By the early 1970s Oxford Basin had become a popular dumping ground for unwanted pets, including rabbits and chickens. This situation was partially remedied in the 1990s by the construction of a taller fence surrounding the site, making it more difficult to toss pets inside. Public access has since been restricted, and the area has been managed strictly for flood-control and water quality purposes.

3.2 Hydrology

Oxford Basin is fed by two (freshwater) storm drain inlets along the northeastern and southeastern ends, as well as a tidal gate at the western end that provides limited flushing. The Basin was not designed to drain completely. Water depths within the Basin fluctuate with natural tidal fluctuations in Marina del Rey, but the inflow and outflow to the Basin is controlled by a set of tide-gates at the southwestern corner of the Basin. The elevation of high tide is currently allowed to rise by no more than approximately 1.5 m (4.8 feet) above mean low water (Mike Stephenson, Los Angeles Department of Public Works, January 12, 2010, pers. comm. to Camm Swift). As a result, water depths in the Basin during 2009 and 2010 were greatest at or shortly after high tide, with a maximum depth of approximately 2 m (6.6 feet) in a localized area near the tide-gate. Depths are generally shallower throughout the remainder of the Basin. Approximately one-half of the Basin bottom substrate became exposed at low tide. The tide-gates are occasionally shut to prevent any tidal fluctuation, such as following low tides before predicted rain storms, in order to increase the Basin's capacity for storm runoff.

As of April 27, 2010, a low flow diversion structure had been installed at the north-eastern inlet. This structure consists of a concrete box that collects street runoff and periodically pumps it into the sewer system rather than allowing the potentially contaminated water to flow into the Basin. The structure includes overflow inlets to allow high storm flows to pass in the Basin.

Camm Swift and Joel Mulder (Entrix 2010; see Attachment C) described patterns of water movement in the Basin during their two field surveys:

> At high and low tides, very little flow was present in most of the Basin although some surge was observed coming through the mouth of the tide-gates. This caused a slow back and forth flow near the mouth and within about 30 m of either side of the gates, as well as some small wave action against the opposite shore. When the gates were opened with a strong difference in tidal levels between Oxford Basin and the Basin E of Marina del Rey, stronger flows occurred. During strong incoming flows on April 27, a circular

> current existed in the western portion of the Basin which caused masses of green algae to float in a broad circular track across the water surface. This current, however, is likely an infrequent event and typically the tidal flow would be much slower over the 4–6 hour duration between high and low tides. These observed currents were with one tide-gate open and possibly even stronger flows can occur under certain circumstances with both tide-gates open.

3.3 Soils

The Natural Resources Conservation Service did not prepare a published soil survey for this area of Los Angeles County, and no information on the soils in the study area was located in the literature review for this study. A study by Glenn Lukos Associates (2006) mentioned a published soil map for the region, but this could not be located in the material examined for this project.

Swift and Mulder (Entrix 2010; see Attachment C) described the soils in the inundated portion of the Basin as follows:

> Substrate within the Basin on both survey dates was predominately comprised of firm to soft mud/silt. Some small areas of fine sand existed near the tide gates where the strength of the inflowing and outflowing tidal currents presumably prevents deposition of finer substrate. The majority of the Basin banks were steep to gentle earthen slopes . . . At lower tides, bare, firm to soft mud/silt was exposed between the water's edge and the [lower edge of marsh vegetation]. The steeper south side of the Basin and eastern one third or so of the north side had approximately 1-3 m of bottom substrate exposed at low tide. The western two-thirds of the north side became much more exposed at low tide, with 5 to 20 m of gently sloping mudflats becoming exposed. Near the tide-gates and the eastern inlet, patches of concrete debris and boulders were present. A few logs were also observed floating in the water. These hard substrates supported barnacles and a small number of mussels existed near and on the tide-gate structures.

David Bramlet (2010b; see Attachment E) described the soils higher up, on the slopes above the Basin:

> Overall, the soils in the areas above the Basin tend to be sandy loams, commonly observed in southern California. The Basin itself has been filled with a silty clay and areas of loamy sands.
>
> The observations from the soil pits, conducted at each sample point, noted strong indicators of hydric soils within the tidal zone. These included extensive mottling, low chroma, stratified layers, and gleyed matrix within these soils. Depleted matrix conditions with oxidized rhizospheres or less extensive mottling, along with some low chroma soils, were observed in the soils found near the margin of the mean high tide elevation. Hydric soils were not found in areas that apparently are inundated by occasional very high tides or winter flooding events, as evidenced by drift deposits.

3.4 Plant Communities

As described by Bramlet (2010a; see Attachment A), Oxford Basin is generally characterized by open water, with wetland and upland communities occurring along the margins of this Basin. Plant communities/mapping units include open water, mud flats, saltmarsh, annual grassland, ornamental plantings and ruderal areas (Figures 3–3a, 3–3b). Plant species observed on the project site are specified in Attachment A.

OPEN WATER

Oxford Basin is characterized by open water that generally has a high salinity. This open water characteristically has blooms of dense mats of algae, but no vascular plants occur in the fluctuating waters of the Basin.

MUD FLATS

Mud flats are exposed during normal tidal fluctuations, and are generally unvegetated, although some of the higher areas do support common woody pickleweed (*Salicornia virginica*) during the summer months. The total area of exposed mud flats can fluctuate greatly depending on management actions. In particular, Oxford Basin can be pumped out in anticipation of winter storms, exposing additional areas within the Basin, and the Basin can be allowed to fill with storm waters when the tidal gates are closed, leaving no mud flats exposed.

BEACH

These unvegetated areas of Oxford Basin have a similar substrate to the mud flats but are dry and generally unvegetated, as they are inundated only by the highest tides or during heavy rainfall. However, some beach areas may develop stands of common woody pickleweed during the summer months.

SALICORNIA MARSH

Except near the inlet area at the east end, Oxford Basin supports a "ring" of saltmarsh-like vegetation along the upper tidal edge. This vegetation generally consists of a lower stratum dominated by common woody pickleweed; other commonly found species consisted of spearscale (*Atriplex prostrata*), rabbit's foot grass (*Polypogon monspeliensis*), saltmarsh sand spurry (*Spergularia marina*), toad rush (*Juncus bufonius*), alkali heliotrope (*Heliotropium curassavicum*), scarlet pimpernel (*Anagallis arvensis*), alkali weed (*Cressa truxillensis*), slender-leaved cat-tail (*Typha domingensis*), and lesser wart-cress (*Lepidium didymum*). This marsh area also included some localities with dense stands of spearscale, along with some scattered common woody pickleweed.

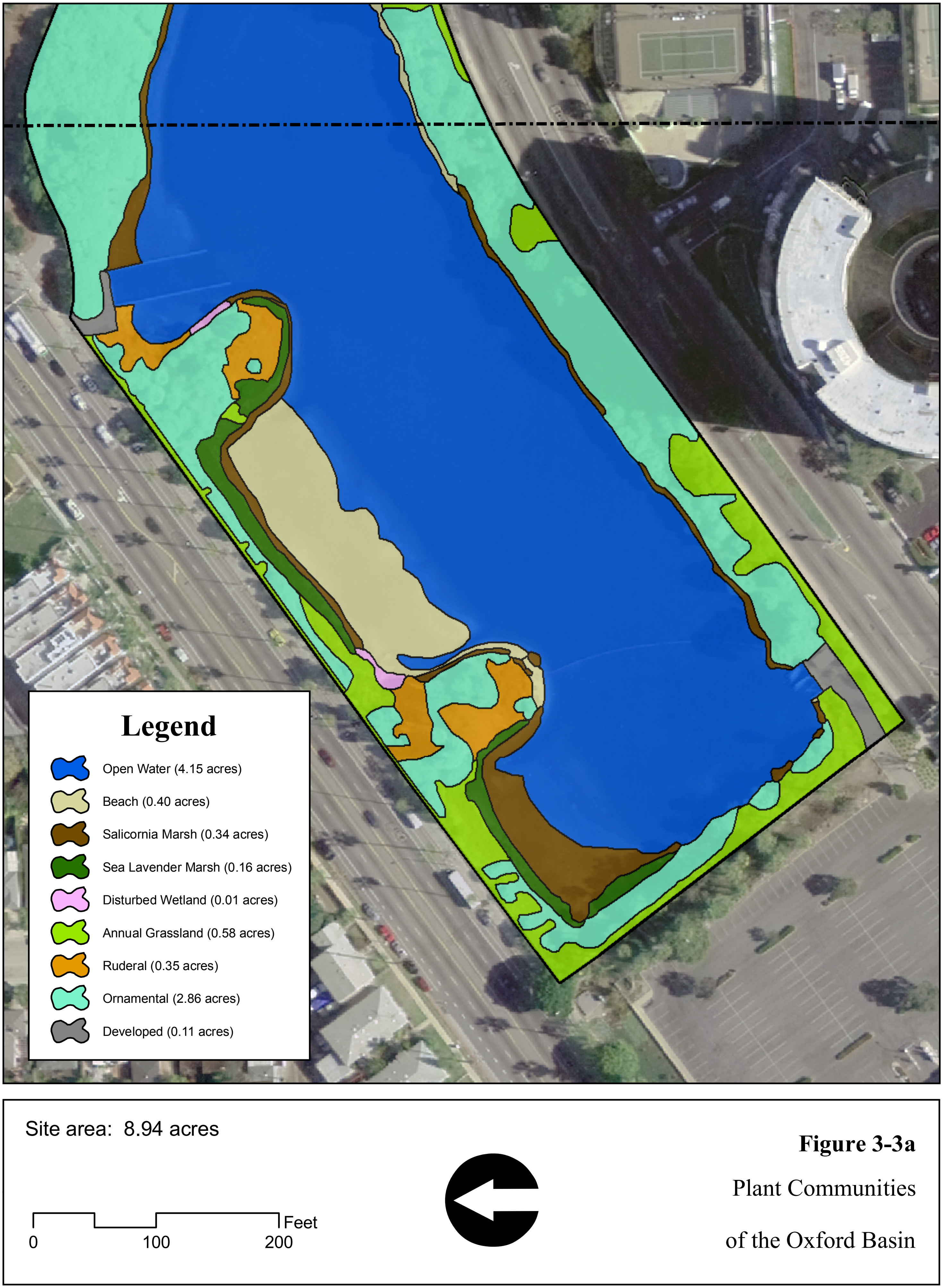
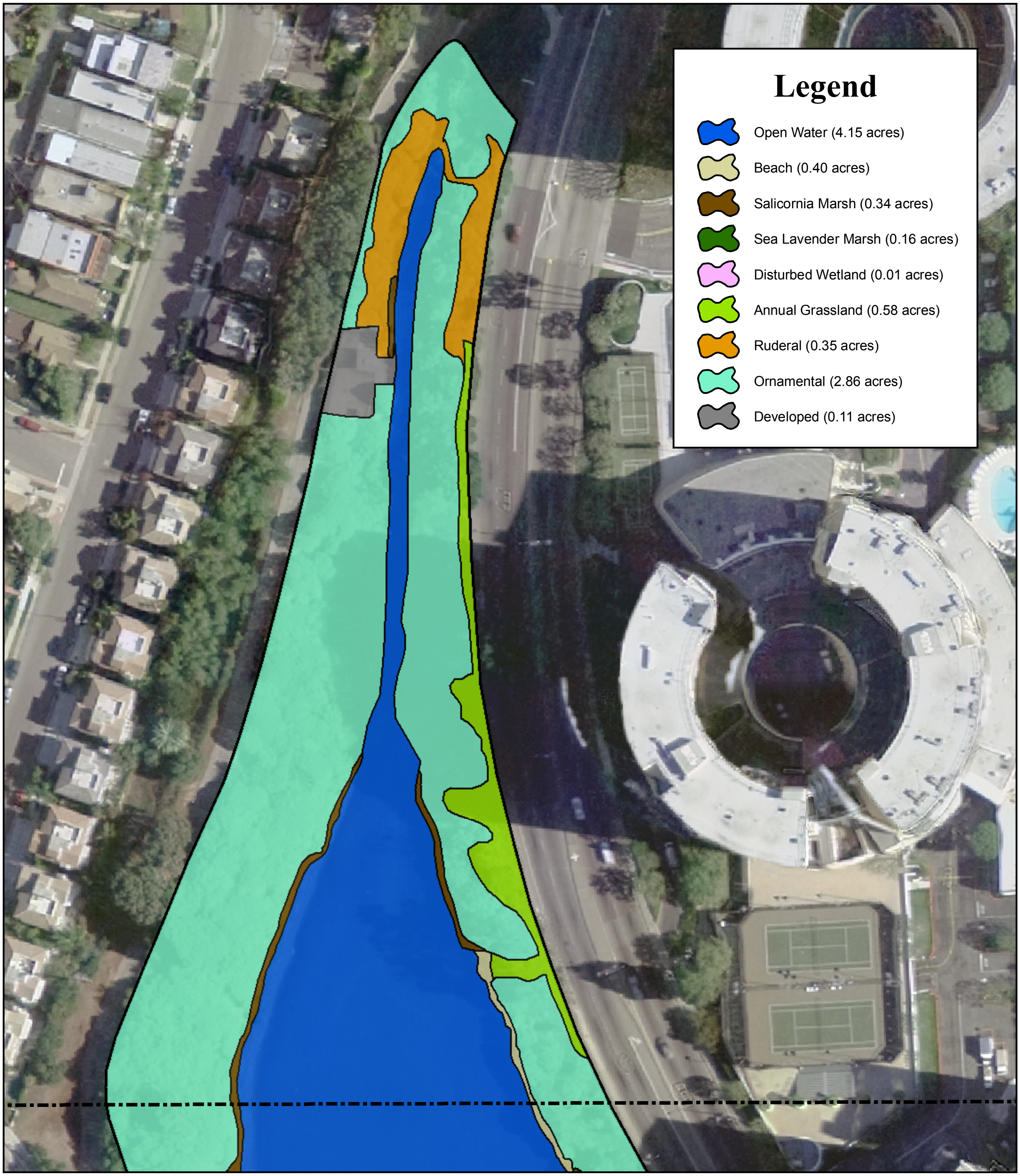


Figure 3-3a

Plant Communities of the Oxford Basin



Site area: 8.94 acres

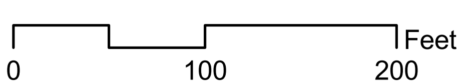


Figure 3-3b

Plant Communities

of the Oxford Basin

Sea Lavender Marsh

At Oxford Basin, this community occurs at a slightly higher elevation than does Salicornia Marsh. Sea Lavender Marsh is characterized by dense mounds of Perez's sea lavender (*Limonium perezii*), and on the south side of the Basin this species occurs together with tall limonium (*Limonium arborescens*). Other species found in this community include saltmarsh sand spurry, alkali heliotrope, curly dock (*Rumex crispus*), yellow sweet clover (*Melilotus indicus*), garden beet (*Beta vulgaris*), kikuyu grass (*Pennisetum clandestinum*), prickly lettuce (*Lactuca serriola*), and Australian saltbush (*Atriplex semibaccata*).

Disturbed Wetland

Some small areas along the margins of Oxford Basin that did not appear to be part of the saltmarsh community were classified as "disturbed wetland." These small areas consisted of stands of rabbit's foot grass, spearscale, Mexican tea (*Dysphania ambrosioides*), crab grass (*Digitaria sanguinalis*), Boccone's sand spurry (*Spergularia bocconei*), Mexican fan palm (*Washingtonia robusta*) seedlings, annual blue grass (*Poa annua*), common purslane (*Portulaca oleracea*), goose grass (*Eleusine indica*), lesser wart cress, and common stink grass (*Eragrostis cilianensis*).

Annual Grassland

Much of the upland areas around Oxford Basin consist of an annual grassland, often interspersed with ornamental shrubs and trees planted on the site. Commonly found grasses in this community consisted of ripgut brome (*Bromus diandrus*), slender wild oat (*Avena barbata*), red brome (*Bromus madritensis* ssp. *rubens*), foxtail barley (*Hordeum murinum* ssp. *leporinum*), and panic veldt grass (*Ehrharta erecta*). Moist sites contained Bermuda grass (*Cynodon dactylon*), smilo grass (*Piptatherum miliaceum*), rabbit's foot grass, water bentgrass (*Agrostis viridis*), rescue grass (*Bromus catharticus*), and Dallis grass (*Paspalum dilatatum*). Commonly found forb species included summer mustard (*Hirschfeldia incana*), common horseweed (*Conyza canadensis*), London rocket (*Sisymbrium irio*), scarlet pimpernel, Mexican tea, lesser wart cress, Australian saltbush, cheese weed (*Malva parviflora*), white-stemmed filaree (*Erodium moschatum*), common sow thistle (*Sonchus oleraceus*), yellow sweet clover, nettle-leaved goosefoot (*Chenopodium murale*), red-stemmed filaree (*Erodium cicutarium*), and dwarf nettle (*Urtica urens*).

Ruderal

Some parts of the study area contain plant species consistent with disturbed localities. Common species in the ruderal habitat consisted of foxtail barley, panic veldt grass, red brome, ripgut brome, Russian thistle (*Salsola tragus*), bull mallow (*Malva nicaeensis*), London rocket, serrate-leaved saltbush (*Atriplex suberecta*), garden beet, summer mustard, bristly ox-tongue (*Picris echioides*), redscale (*Atriplex rosea*), puncture vine (*Tribulus terrestris*), petty spurge (*Euphorbia peplus*), dwarf nettle, four-leaved polycarp (*Polycarpon tetraphyllum*), kikuyu grass, black mustard (*Brassica nigra*), prickly lettuce, common purslane, castor bean (*Ricinus communis*), tree tobacco (*Nicotiana glauca*), pampas grass (*Cortaderia selloana*), and sweet fennel (*Foeniculum vulgare*).

ORNAMENTAL

Ornamental tree, shrub and vine plantings generally dominate the upland areas of the Oxford Basin study area. In the eastern part of the property a myoporum "woodland" is found, characterized by dense stands of myoporum (*Myoporum laetum*), along with some planted pines (*Pinus* sp.). Other areas of the site contained scattered stands of myoporum, with Mexican fan palm, melaleuca (*Melaleuca* sp.), Brazilian pepper tree (*Schinus terebinthifolius*), crimson bottle bush (*Melaleuca citrina*), Peruvian pepper tree (*Schinus molle*), Indian laurel fig (*Ficus microcarpa*), oleander (*Nerium oleander*), and grape vines (*Vitis* sp.). The south side of the Basin has a more open cover of myoporum and a greater diversity of ornamental plantings. Planted trees and shrubs in this locality included, pines, lemon gum (*Eucalyptus citriodora*), Catalina cherry (*Prunus lyonii*), creeping fig (*Ficus pumila*), Brazilian pepper tree, red gum (*Eucalyptus camaldulensis*), Canary Island palm (*Phoenix canariensis*). Shrubs consisted of crimson bottle bush, oleander, melaleuca, firethorn (*Pyracantha coccinea*), and dwarf myoporum (*Myoporum parvifolium*).

DEVELOPED

The pump stations, low flow diversion structure, paved roads and concrete inflow structures were mapped as developed.

3.5 Invertebrates

As described by Fiesler (2010; see Attachment B), a high-level baseline invertebrate survey was conducted that covered both upland and aquatic habitats at Oxford Basin.

The terrestrial fauna is dominated by non-native species, in particular the Argentine ant (*Linepithema humile*), which is discussed below. Another important non-native is the European paper wasp (*Polistes dominula*), which often outcompetes and then replaces native paper wasp species. Two out of three adult hemipteran species encountered are non-native to the United States. They are bagrada bug, also known as the painted bug (*Bagrada hilaris*), native to Africa, Southern Asia, and Southern Europe, and the torpedo bug (*Siphanta acuta*), native to Australia. The third adult hemipteran encountered was one exemplar of a plant bug (*Phytocoris* sp.), which is not commonly found in metropolitan Los Angeles. Some native species were also found in relative abundance, like the brine fly (*Ephydra niveiceps*), which is associated with aquatic habitats, and the sinuous bee fly (*Hemipenthes sinuosa*), as well as the Jumping Spider (*Habronattus pyrithrix*) and the margined spurthroated grasshopper (*Melanoplus marginatus*). The latter two are discussed in the next section.

Aquatic invertebrates found in the Basin itself included the California mud snail (*Cerithidea californica*; Phylum Mollusca), found in large quantities below the high-tide line, some straight horsemussels (*Modiolus rectus*), and a few other small-to-microscopic bivalves in the benthos. In the Phylum Arthropoda, sampling revealed large numbers of gammarid amphipod (Suborder Gammaridae; Order Amphipoda) adults and immaures, as well as some copepods (Class Maxillopoda) and the remains of one shrimp, which is apparently an ocean (smooth) pink, also known as pink Shrimp (*Pandalus jorani*; Order Decapoda; Class Malacostraca). Dr. Fiesler also recorded relatively large numbers of nematodes (Phylum Nematoda), some flatworms (Phylum Platyhelminthes), rotifers (Phylum Rotifera), and seed shrimp (Phylum Ostracoda), and various microscopic protozoans (Phylum Protozoa), including some collared flagellates. Within each taxon, relatively little diversity was seen. The relatively low quantity of protozoa and other micro-invertebrates is due to the relatively large (1-mm) mesh size of the sieve that was used for sampling, and, to a lesser extent, the 500-micron mesh size of the net. The smaller organisms were still collected, however, as they were trapped in the algae collected by the net.

The surveys by Swift and Mulder (Entrix 2010; see Attachment C) also included some sampling for aquatic invertebrates. They found these organisms to be uncommon in January, except for the broken-backed shrimp (*Palaemon macrodatylus*), a non-native species from Asia. This species was very common in January but fewer than 10 were captured in April, when they were much less abundant. *P. macrodatylus* is well adapted for brackish or low salinity environments (Kuris et al. 2007). Possibly this species becomes abundant in Oxford Basin during the winter with the increase in freshwater influence that provides lower salinities and decreases the number of predatory fish present as well. The California horn shell (*Cerithidia californica*), a typical invertebrate in southern California estuaries, was uncommon; only a few were observed during both surveys despite the presence of considerable amounts of green algae, their primary food source, in April. Barnacles were present on hard substrates around most of the Basin while mussels seemed restricted to the area around the tide gates. Other than an abundance of amphipods observed under the intertidal rocks, the only other aquatic invertebrate noted was the bubble shell (*Bulla gouldiana*). Several of these were observed near the mouth of the tide gate among the algae being dislodged by the strong incoming tidal currents and several were also captured by seining. Surprisingly, no crabs were encountered during the surveys. Seining and baited traps frequently take species of marsh crabs when sampling coastal salt marshes and estuaries. These crabs also have long pelagic larval stages which should enable them to colonize Oxford Basin.

NARRATIVES FOR SELECTED INVERTEBRATE SPECIES

This section discusses certain species present at Oxford Basin considered to be of special interest.

The most unexpected species found at the site was a signal fly (Family Platystomatidae), which is a beetle-like insect with a long, aardvark like snout. This appears to represent a first state record for California. Robert Hamilton found one exemplar of this Signal Fly that apparently belongs in genus *Amphicnephes*. There are only three species of *Amphicnephes* described in the world, all from America, and the specimen is likely *Amphicnephes fasciola*, given (a) that its distribution range, which includes Arizona, is the closest to southern California of the three described species, and (b) the original description of *A. fasciola* (Coquillett 1900) matches reasonably well. On subsequent visits Dr. Fiesler surveyed the area where the specimen was seen but did not find another exemplar as potential voucher specimen. It is likely that the restricted public access has contributed to the survival of this rarity at Oxford Basin. Signal flies have no state or federal listing status, or other "special status," and the occurrence of one of these flies at Oxford Basin does not appear to represent a potential regulatory constraint to the proposed renovation project.

The only species of grasshopper found during the survey is the short-winged form of the margined spurthroated grasshopper (*Melanoplus marginatus*), which was fairly common at the site. This species is endemic to California. The southern edge of its range includes part of the Santa Monica Mountains (Capinera et al. 2005). The Oxford Basin population may therefore represent its southernmost recorded occurrence. It is not clear if it is found in the Ballona Region, as only "*Melanopus species?*" is listed in the 1980-1981 entomology survey report (Schreiber 1981), and there are a number of other *Melanoplus* species present in the Los Angeles Basin. These grasshoppers have difficulty dispersing to colonize new areas due to their short wings, which render them incapable of sustained flight. Their local gene pool is therefore in danger of becoming impoverished.

The jumping spider (Family Salticidae) most often encountered during the survey is *Habronattus pyrrithrix*. This a common spider of the Los Angeles area, whose prime habitat includes wetlands. There seems to be a healthy population of these small jumping spiders at the site.

A good-sized population of small, gray-and-black spider wasps (*Aporinellus* sp.) was present at the Basin. Despite a cosmopolitan distribution across the United States and beyond, they are uncommonly found in the Los Angeles metropolitan area. Their main prey is Jumping Spiders (see previous species account), which are food for their offspring. This renders these spider wasps secondary predators in the Oxford Basin ecosystem.

The non-native Argentine ant (*Linepithema humile*) is abundant on the site, across much of Los Angeles County, and far beyond. It is a non-native species that outcompetes native ant species and other invertebrates. In Los Angeles County, Argentine Ants have decimated the native California harvester ant (*Pogonomyrmex californicus*) and hence, indirectly their predator, the coast horned lizard (*Phrynosoma blainvillii*), which primarily feeds on native ant species like the California harvester ant. No native ants were found at the site.

DISCUSSION

The predominantly non-native vegetation at the Basin constitutes a degraded fundament for terrestrial faunal ecosystem, and the native and non-native terrestrial invertebrate fauna consists, for the most part, of species typically found in urban environments. Despite the relative abundance of non-native plant and invertebrate species, the ecosystem is functional for terrestrial invertebrates, and includes primary consumers as well as primary predators (e.g., spiders) and secondary predators (e.g., spider wasps).

The broad variety of aquatic invertebrates found at Oxford Basin, as well as the overall abundance of amphipods, indicate the relative health of the Basin's water, which provides ample feeding grounds for various wildlife. In specific, gammarid amphipods are a prime food source for fish and birds (McCurdy et al. 2005, Schneider 1981). They also have a high sensitivity to environmental changes (Conlan 1994, Zajac et al. 2003), and monitoring their abundance can provide one useful measure of the quality of the ecosystem.

3.6 Fish and Estuarine Biology

Camm C. Swift and Joel Mulder of Entrix (2010; see Attachment C) evaluated this aspect of the Basin's biology, as summarized here.

SALINITY MEASUREMENTS AND TURBIDITY

On January 12, 2010 the salinity at the surface at two sites in the lower Basin ranged between 15–18 parts per thousand (‰), and salinity at the inflow at the east inlet was 3 ‰. The water temperature ranged from 15-18° Celsius (C) at several locations in the Basin.

On April 27, 2010 several salinity measurements throughout the Basin, including at the eastern inlet, ranged from 33–34 ‰. Water temperatures were 17-18° C. During both surveys the water was moderately turbid; estimated visibility was approximately 1 m.

ALGAE

During the first survey on January 12, 2010, no aquatic vegetation was observed in the Basin. During the second survey, on April 27, 2010, filamentous green algae (possibly *Enteromorpha* sp.) were present along 50–80% of the wetted margins at low tide. Approximately 10% of the Basin's surface had floating mats of this same algae present.

FISH

Attachment C provides a table showing the numbers of each species trapped, seined, and observed during each survey. A total of 14 seine hauls around the perimeter of the Basin on January 12, 2010 captured hundreds of mosquitofish (*Gambusia affinis*) and one or two small juvenile shadow gobies (*Quietula y-cauda*) just west of the tide gates. In addition one large longjaw mudsucker (*Gillichthys mirabilis*) was observed in the rocks near the upper end but was not captured. The seining (5 hauls) and trapping on April 27, 2010 captured large numbers of native gobies, such as arrow gobies (*Clevelandia ios*) and cheekspot gobies (*Ilypnus gilberti*). Also captured were a small number of native shadow gobies and longjaw mudsuckers. Topsmelt (*Atherinops affinis*) were abundant and hundreds were observed and captured ranging in size from small juveniles to adults (up to about 15 centimeters total length). In addition a few small, juvenile, non-native, yellowfin gobies (*Acanthogobius flavimanus*) were taken. The majority of fish were captured by seining rather than in the traps. Fish were found to be relatively scarce as distance form the tide-gates increased, with the exception of mosquitofish. For this reason, seining during the second survey was focused around the tide-gate. During both surveys, the majority of the Basin was observed 1–10 m from shore and fishes were rarely detected with the exception of the abundant mosquitofish in January.

The species captured during the surveys are typical of coastal estuaries of southern California and indicate that Oxford Basin contains habitat that can support estuarine species for at least part of the year. The results of the January survey suggest the Basin supported very few estuarine fish in January. Mosquitofish were present in the tens of thousands while only two or three larval or small juvenile shadow gobies were captured near the tide-gate where they had apparently recently arrived and one large mudsucker was observed. By the April 27, 2010 survey, large numbers of gobies were detected. These were comprised of four native and one non-native species, all of which are typical of coastal estuaries in southern California. In addition, large numbers of topsmelt were present and only a few mosquitofish were captured. Fish were encountered both in seine hauls near the mouth and in traps set around the perimeter of the Basin indicating fish were dispersed throughout the Basin in late April. However, fish were most abundant near the tide gates. It is likely that the difference in fish abundance between the two surveys was due to the changes in freshwater influence and salinity in the Basin. In January, when freshwater input from numerous winter storm events had presumably repeatedly washed out the Basin, salinity in the Basin ranged from almost fresh to approximately half that of seawater. The salinity was considerably higher and at near seawater salinities in April, allowing colonization of the Basin by estuarine species dependent on higher salinity.

Also of interest are the species not encountered in the Basin during the surveys, but which would be expected to occur in southern California estuarine systems at this time of year. Because these species are typically very abundant following the springtime breeding periods, they are frequently easy to detect and would likely have been encountered if present in Oxford Basin. These species include staghorn sculpin (*Leptocottus armatus*), California killifish (*Fundulus parvipinnis*), diamond turbot (*Pleuronichthys guttatus*), bay anchovy (*Anchoa delicatissima*), deepbody anchovy (*A. compressa*), bay pipefish (*Syngnathus leptorhynchus*), barred pipefish (*S. auliscus*), California halibut (*Paralichthys californicus*), striped mullet (*Mugil cephalus*), and shiner perch (*Cymatogaster aggregata*). A few other species that are less common or are more prevalent in larger estuaries but which might be expected to occur in the Basin include bay blenny (*Hypsoblennius gentilis*), spotted sand bass (*Paralabrax maculofasciatus*), and several species of elasmobranchs (sharks and rays). Many of these are species are known to occur in adjacent Marina del Rey.

Most of the estuarine species detected during the two surveys in Oxford Basin are pelagic midwater species (such as topsmelt) or have larvae that are pelagic in the water column for a few weeks (such as the goby species encountered). Other species that could be expected in Oxford Basin that produce pelagic larvae include anchovies, staghorn sculpin, diamond turbot, striped mullet, and California halibut. The larvae of these species typically arrive in estuaries in late winter and spring. Because these larvae colonize estuaries by being swept in by water currents, Oxford Basin should have the potential to be colonized by these species.

Fish species that do not have a pelagic larval phase, as well as adult fish of any estuarine species, would only be able to colonize Oxford Basin by swimming in through the subterranean passageway and tide-gate system that connects Oxford Basin to Basin E in Marina del Rey. This connection is at least 100 m long and is unlit. It is unknown if this connection would present a barrier or deterrent to passage of fish into the Basin. County workers present at Oxford Basin on January 12 mentioned having observed "sting rays" in Oxford Basin in the past, and several other species known from Marina del Rey (Allen et al. 2006) certainly have the potential to invade. The available composition of fish species available to colonize Oxford Basin is probably largely determined by the community present in Basin E of Marina del Rey. The fauna of Marina del Rey has been studied for over 30 years and is well known to fluctuate considerably due to periodic fish kills in the summer when the lack of circulation and excess nutrients combines to lower oxygen concentrations. These effects are most extreme in the uppermost reaches of the harbor, such as at Oxford Basin or Basin E (Aquatic BioAssay and Consulting 2009). Thus, the marina may not consistently be a reliable source of fish colonization into Oxford Basin.

One species of fish not encountered in the Basin but which is extremely common in other parts of the Ballona Wetlands and Marina del Rey is the California killifish. California killifish lay large eggs on hard substrates or vegetation and the young hatch out at an advanced stage as small juveniles with little or no pelagic or drifting dispersal phase. Therefore, California killifish may be limited in their ability to colonize Oxford Basin since it does not have a pelagic phase and may not occur close enough for adults to disperse into the Basin. It is possible that the habitat between the nearest known population at Mother's Beach in the marina may be in inhospitable to killifish thereby limiting their dispersal. The long, dark passage from the tide-gates to Basin E may also deter them. In addition, Basin E has deep water (2 or more meters deep) with vertical concrete walls which may not be conducive to movement of the California killifish. The presence of larger predators in deep-water areas might also prevent significant migration through the marina and Basin E. It is possible that if California killifish were introduced into Oxford Basin they would succeed in the area since the habitat appears appropriate for them. California killifish typically inhabit gently sloping, sandy, beaches and tidal sloughs. They often inhabit vegetated margins of salt marshes and adjoining shallow marine waters and are tolerant of fresh water (Moyle 2002). They are a prevalent part of the fish fauna of most southern California tidal salt marshes, bays and estuaries and would be a valuable addition to Oxford Basin.

Two other species which lack pelagic life stages, which were not encountered in Oxford Basin, and which are common in other parts of Ballona Wetlands are pipefish and shiner perch. Pipefish reproduce through male brooding of large eggs and the young juveniles are released directly into the habitat without a distinct dispersal stage. However, pipefish are often associated with drifting seaweed and other sea grasses and may disperse via this mechanism. Shiner perch are live bearing and young are born throughout most of the summer. It is uncertain how readily the young or adults would disperse into Oxford Basin. If water quality conditions were improved in the Basin, artificial introduction of these species may be possible since appropriate habitat is present in the Basin.

The California halibut is an important commercial and sport fish species and is reliant on coastal bays and estuaries as nurseries for the first two or three years of life. Any increase is such habitat would be valuable for this species. Its preferred diet early in life, estuarine gobies, is already common in the Basin as identified in our surveys.

Additionally, there are several species of brackish, freshwater, or anadromous fish that undoubtedly occurred in the Ballona Lagoon and Ballona Wetlands historically but which have been extirpated from the area for at least 70 years or more. These species still occur to the north and south of the area and have special conservation status. The federally endangered tidewater goby (*Eucyclogobius newberryi*) occurs in Malibu and Topanga creeks to the north and in San Diego County to the south and there are historical records for artesian springs in Santa Monica (U. S. Fish and Wildlife Service

2005). The federally endangered southern California steelhead (*Oncorhynchus mykiss*) also still migrates from the ocean into Malibu and Topanga Creeks and was observed in San Mateo Creek in northern San Diego County in 1998-99 (NMFS 2009). After the adult steelhead spawned upstream in freshwater, the juveniles would have used the Basin as a nursery area for a year or so before the juveniles left for the ocean (Swift et al. 1993; Moyle 2002). Finally the federally endangered unarmored threespine stickleback (*Gasterosteus aculeatur williamsoni*) occurred in the Los Angeles River and presumably occurred in or near the Ballona wetlands. The tidewater goby and stickleback would have been permanent residents of the estuarine area of the wider Ballona Marsh. All of these species rely on relatively stable, low salinity or brackish conditions and such conditions are unlikely to develop for any extended length of time in Oxford Basin, particularly since there appears to be an effort to divert freshwater street runoff into the sewer system, as was observed at the eastern inlet, rather than allowing it to flow into the Basin. Thus it would take exceptional effort to re-establish these species. In addition steelhead and stickleback require relatively cool and well oxygenated water which will also be difficult to maintain in Oxford Basin under current conditions. If these species are ever to be seriously considered for return to this area, it would probably be best to utilize other areas of Ballona Wetlands where the appropriate habitat conditions can be developed more easily.

WATER QUALITY, WATER TEMPERATURE, DISSOLVED OXYGEN

A study conducted by Aquatic BioAssay and Consulting (2009) noted that Basin E and Oxford Basin have some of the highest levels of pollutants and lowest oxygen values in the Marina del Rey area. The study found that the number and diversity of invertebrate species dropped from the mouth of the Marina inland towards the most inland sites such as Oxford Basin. These water quality issues may explain some of the absence of species in Oxford Basin. In addition, Oxford Basin has only minimal circulation of water with the marina and is therefore more likely to suffer longer spans of poor water conditions that may arise. A good starting point for a restoration effort for fauna would be to improve the water circulation through the Basin, to reduce the level of pollutants, and to increase the dissolved oxygen levels in the Basin water in order to establish the water quality conditions necessary for successful colonization of estuarine aquatic species.

Dissolved oxygen concentration in water is related to water temperature such that the warmer the water the lower the amount of oxygen the water is able to hold in solution. Thus, excessive warming of the water will contribute to lower the availability of oxygen in the water. Other conditions such as the lack of circulation, excessive enrichment of the water, or the overnight lack of photosynthesis by aquatic plants to supply oxygen to the system can result in low dissolved oxygen levels. Excess plant material such as large algal blooms can supply oxygen in the day time but also use up the available oxygen rapidly at night as the plants respire resulting in low oxygen levels for the other organisms.

During the surveys by Entrix, water temperatures were below 20° C which is within the preferred range for most estuarine fish and is cool enough to maintain adequate dissolved oxygen concentrations. Often, areas near the coast stay cooler because the summer fog coverage can insulate coastal marshes and wetlands from the usual summer warming more prevalent farther inland (Swift and Frantz 1981). However, it is possible that the water temperature gets considerably higher in Oxford Basin during the late summer and fall due to the lack of water circulation, relatively shallow depths in the Basin, and as the cooler marine layer is less prevalent. If the water temperature increases beyond the mid-twenties Celsius then temperatures and dissolved oxygen concentrations may become intolerable to many fish species. Estuarine fish species can generally be divided into two categories relative to oxygen tolerance. Gobies, killifish, and mosquitofish are relatively tolerant of low oxygen conditions and can utilize aerial oxygen and other strategies to survive periods of low oxygen in the water. Other fishes are relatively intolerant of low oxygen conditions and include anchovies, topsmelt, flatfishes (diamond turbot, California halibut), and shiner perch. These fish are unable to tolerate lower oxygen levels for any period of time and are the fish frequently seen during morning fish kills in coastal estuaries. Any attempt to restore habitat conditions that would support these species would have to include provisions for maintenance of relatively high oxygen concentrations (above approximately 4 milligrams per liter). Dissolved oxygen levels in the waters of Basin E and Oxford Basin often fall below this value according to the study by Aquatic BioAssay and Consulting (2009). It is less well known how these fish species are affected by the other pollutants noted by Aquatic BioAssay and Consulting (2009) such as DDT and heavy metals.

DISCUSSION

It appears that the current state of Oxford Basin is of a system whose habitat and health is compromised by its distance from the ocean mouth and restricted access to Marina del Rey. It has been documented to have relatively poor values of several indicators of aquatic health, most recently by the study of Aquatic BioAssay and Consulting (2009). These factors make the development and sustainability of typical estuarine or bay fish fauna populations difficult. The Entrix study indicates that several typical species can and do colonize and inhabit the area but have difficulty maintaining a year-round population. In addition, several species that would be expected to be present are absent, and in some cases the reasons for their absence are not readily apparent.

Some uncertainty exists in the sampling results regarding the presence of fish in the Basin throughout the year since the sampling by Entrix was limited to two visits. More sampling throughout the season could better define the extent of fish population variation in the area. However, the faunal composition of nearby Marina del Rey is well understood and aquatic species composition in Oxford Basin is likely closely tied to conditions in the marina, as well.

Increasing the diversity and abundance of fish species living in Oxford Basin on a permanent basis would require management of water quality issues and the identification and removal of colonization barriers. Monitoring the fish populations in the Basin as such restoration actions are implemented would be beneficial in assessing the success of these actions as related to creating favorable habitat for estuarine fish.

3.7 Birds and Terrestrial Vertebrates

Daniel S. Cooper of Cooper Ecological Monitoring (2010; see Attachment D) evaluated the Basin's avian and terrestrial vertebrate communities, as summarized here. This included consideration of previous biological reports that were completed on the Basin during the 1970s and in 1980 (Schleicher 1974, Schreiber and Dock 1980). As noted by Cooper, these early reports were not peer-reviewed and both included some questionable information. His current study focuses upon current uses of the Basin by reptiles, birds, and mammals, but includes some comparisons with the species reliably observed during the older survey efforts completed (see Attachment D).

AMPHIBIANS, REPTILES, AND MAMMALS

Non-avian terrestrial vertebrates were scarce during the 2009/10 surveys. No lizards or amphibians were observed during the 2009/10 survey, although Schleicher (1974) recorded the southern alligator lizard (*Elgaria multicarinata*), and this species likely still occurs.

On May 28, 2010 at least ten California ground-squirrels (*Spermophilus beecheyi*) were detected, with presumed burrows scattered across the entire site; one squirrel was seen on May 7, 2010, but they were not detected during the preceding fall/winter. Two non-native eastern fox squirrels (*Sciurus niger*) were observed in the myoporum grove on February 24, 2010 and evidence of their presence (including pine cone "shavings") was easily observed.

Numerous large burrows present toward the far eastern end of the site, within the myoporum grove, likely belong to striped skunk (*Mephitis mephitis*). This evaluation is based on their size and the habitat (this mammal is now common and highly urban-adapted in the region). Tracks in mud seen on several visits were made by skunk or raccoon (*Procyon lotor*), another ubiquitous, urban-adapted animal in Los Angeles.

The earlier studies noted the presence of feral dogs, chickens, and domestic ducks, but these are no longer present, although several hybrid/feral Mallard × domestic ducks were present on most visits. Native rabbits (*Sylvilagus* sp.) that were present in the 1970s have apparently been extirpated from the site.

BIRDS

As of July 2010, 84 species of birds have been credibly recorded at Oxford Basin. Of these species, 33 were not detected during our recent monthly visits since September 2009, which suggests that approximately 50 species may be expected to occur regularly at the site each year. Table A in Attachment D provides results for 2009/2010 and compares them with results obtained in the earlier studies, mainly Schreiber and Dock (1980). Attachment D includes the scientific names of bird species recorded during the current study, or previous studies.

Three species have been observed nesting at Oxford Basin in 2010: the Mallard, Anna's hummingbird, and American crow. Several other species were observed using the site during the breeding season, but were breeding off-site in the surrounding residential area and ornamental landscaping, notably several species of herons and egrets.

The rest of this section focuses on birds, because (a) birds are, by far, the most numerous and diverse terrestrial vertebrates at Oxford Basin, and (b) several species of special interest occur, or have potential to occur, at the Basin.

Patterns of Bird Usage

The patterns of usage documented in this report provide baseline data against which the effects of future habitat enhancements may be compared. The fact that native birds are using non-native vegetation at the site does not imply that these exotic plants are especially "important" for birds at Oxford Basin. All of the birds recorded in the myoporum and other landscaping at the site are commonly encountered in urban habitats throughout Los Angeles. Nearby areas with native vegetation, either naturally-occurring or restored, such as Ballona Freshwater Marsh and the Playa Vista Riparian Corridor, see much higher usage by native bird species, including regular, successful breeding by more than a dozen species.

Seasonal Patterns

As found in previous studies, bird usage of Oxford Basin is highly seasonal. Overall numbers are lowest in late summer and fall (July to October), before wintering waterfowl have arrived, and after the locally-nesting herons have raised young and dispersed. By November, small rafts of waterfowl are present that include American wigeon, lesser scaup, and American coot, joined by lower numbers of other species of ducks and grebes. Migrant songbirds, typically in limited numbers, can occur from late July through the fall months. Wintering songbirds, such as ruby-crowned kinglets, yellow-rumped and Townsend's warblers, generally arrive by late October and remain into April. Bird activity dips in spring, after wintering waterfowl and wintering songbirds have departed (April). Only a small number of ubiquitous resident species, such as the American crow and bushtit, remain to nest in the dense myoporum grove at the far eastern edge of the site. However, on certain days in April and May, a diversity of spring transient songbirds (e.g., Wilson's warbler) may occur, typically forming small foraging flocks in the myoporum grove (but generally using any tree or shrub habitat available throughout the Marina). During summer, waterfowl are mostly absent (aside from a handful of locally-breeding mallards and hybrids), but herons and egrets from local colonies forage in the Basin, their numbers augmented by locally-raised young that remain into July and August.

By Area

Though data on usage by area of Oxford Basin was not collected during our study in 2009/10, a few broad patterns are clear. Most waterfowl were observed either resting on open water or near overhanging vegetation along the shoreline, or foraging on the wet mud exposed during a drawdown. Fish-eating species, such as the pied-billed grebe, were observed actively feeding in open water. Herons and egrets foraged around the entire shoreline, but seemed concentrated at either inflow (especially the inflow emerging from under Washington Boulevard) or at the outflow to the Marina, where they would catch fish. Several species of large waders were observed roosting in the trees surrounding the open water, particularly black-crowned night-herons in myoporum and other landscaping trees at the far eastern end. Songbirds (tree-dwelling) were found throughout the site, but were most consistently found in and around the myoporum grove at the eastern end, especially in the area where dense vegetation approached the freshwater at the eastern inlet.

Songbirds (other than the ubiquitous, non-native European starling) were almost never seen on the ground during the surveys in 2009/2010, suggesting that foraging opportunities for birds like sparrows and towhees are limited, and have become even more degraded over time (see the next discussion).

Faunal Change at Oxford Basin

Birds

The historical avifauna of the Oxford Basin area *per se* is not known, since it was part of a much larger wetland system and its current configuration dates back only to the 1960s. Historically, the inland mudflats and tidal channels of the "Venice Marshes" would have supported flocks of shorebirds nearly year-round, and rafts of waterfowl in winter ("Lake Los Angeles," situated near present-day Oxford Basin, was a popular duck-hunting spot through the 1950s; see, e.g., Cooper 2005). Species found in extensive, often wet grassland, such as the northern harrier (*Circus cyaneus*) and the long-billed curlew (*Numenius americanus*) were common in the Venice/Ballona area into the mid-1900s, as were dune and coastal strand specialists such as the horned lark (*Eremophila alpestris*) and large-billed savannah sparrow (*Passerculus sandwichensis rostratus*). Many of these coastal marsh, dune, and open-country species were effectively extirpated by the construction of Marina del Rey, though some – notably Belding's savannah sparrow (*P. s. beldingi*) and a variety of waterfowl and shorebirds – maintain remnant populations at the nearby Ballona Wetlands/Ballona Creek.

As Marina del Rey has lost certain species, others have colonized novel habitats, nesting in trees near water (herons/egrets, Family: Ardeidae), or on built structures such as culverts (swallows, Family: Hirundinidae), or have simply "invaded" from the surrounding residential area. These population changes are discussed below.

Of the species that are known only from 1970s surveys, several were apparently common then and are best considered extirpated from the site at this time, a determination that is supported by recent research on bird status and distribution in the Ballona area (Cooper 2006b). Recent years have seen the apparent extirpation of three resident or year-round species from Oxford Basin: two raptors/predators (American kestrel and loggerhead shrike) and a woodpecker (northern flicker). Two species, the green heron and western scrub-jay, might be considered a part of this extirpated group, as well, although only 1–3 birds each were detected during the 1970s and both species remain fairly common in the greater Marina/Ballona area year-round. Two species of sparrow, the white-crowned (formerly a winter resident) and the song (formerly occurred in fall migration), have apparently been extirpated in their local roles at the Basin.

Shorebirds, apparently present, if irregular, during the 1970s, seem to have essentially abandoned the site. Schreiber and Dock (1980) wrote, "most of the shorebirds recorded here are dependent on the mudflats for their occurrence, both to feed and rest." Only one or two individual killdeer were seen during the recent surveys. Other species that have apparently declined or stopped using the site include gulls and terns (gulls were apparently common at Oxford Basin in winter 30 years ago and are now rare) and possibly the northern mockingbird and the non-native rock pigeon. These species remain common along lower Ballona Creek and/or in Marina del Rey, so it is likely that local changes in vegetation, food supply, and/or water regime are to blame.

With declines have come inevitable increases; several species have apparently established new populations at Oxford Basin that weren't present during the 1970s. Most importantly, large waders have increased dramatically. The great egret, snowy egret, and black-crowned night-heron now breed at various locations along Admiralty Way and forage at the Basin year-round, whereas during the 1970s they were only sporadic visitors to the Basin. Two species of waterfowl should be considered new "colonists," the American wigeon (high double-digits in winter) and the gadwall; interestingly, no species of waterfowl has dramatically declined at the Basin. The black phoebe, a resident and possible breeder, appears to have recently colonized the Basin. Three species were confirmed as breeders in 2009/2010, whereas before they occurred only in the non-breeding season: Mallard, Anna's hummingbird and American crow. The ruby-crowned kinglet, black-throated gray warbler, and Townsend's warbler, all regionally common during both migration and winter, were first recorded at the Basin during 2009/2010.

Finally, the non-native spotted dove was considered common in residential areas near Oxford Basin in the 1970s, but this species has declined greatly locally and across the Los Angeles Basin. The Eurasian collared-dove, a recent arrival to California that is starting to fill a similar niche today, was detected in the neighborhood north of Oxford Basin during this study.

The avifauna of Oxford Basin is constrained by several factors, including the area's small size (9.0 acres in the study area for this enhancement project; 10.7 acres for the entire parcel), isolation from other wetland habitats by urban development (including numerous tall trees and two high-rise towers just to the south), current lack of regular tidal flushing, and dominance of invasive, non-native vegetation. Other factors such as litter and water quality were emphasized in earlier studies but are probably only minimally impacting the birdlife of the Basin; Ballona Creek, for example, easily as polluted a water body as Oxford, sees very high usage from a much greater variety of waterbirds than does Oxford. Also, it is worth noting that the nearby (restored) Ballona Lagoon just west of Marina del Rey is also small in extent (and linear in configuration), but nonetheless supports an exceptionally high species diversity of shorebirds compared with present-day Oxford Basin (records of 10+ species per year. C. Almdale, unpubl. data; vs. 1 species at Oxford during the 2009/10 survey).

DISCUSSION

Relatively simple steps could be taken to enhance Oxford Basin for birds that have been extirpated since the 1970s, and possibly even for species that existed in the pre-Marina del Rey wetlands. Replacing the thicket of myoporum with low-profile, native vegetation would likely result in the re-colonization of the site by the white-crowned sparrow, which no longer winters there. The American kestrel might use the site with such vegetation restored, as could (migrant) northern flickers and song sparrows. These species remain common in their respective roles in the larger Ballona ecosystem where native vegetation persists or has been restored. Other migrant songbirds recorded regularly at Ballona Lagoon that could use a restored Oxford Basin could include the house wren, blue-gray gnatcatcher (*Polioptila caerulea*), common yellowthroat (*Geothlypis trichas*), and Lincoln's sparrow (*Melospiza lincolnii*). None of these currently occur at the site or in typical urban/residential vegetation, and all have responded positively to restoration at Ballona Lagoon and other nearby natural areas.

With increased tidal flushing, the mudflats of Oxford Basin could once again support numbers and a diversity of shorebirds, and possibly a wider variety of waterfowl than is currently represented (just four duck species and one shorebird species were detected during surveys in 2009/2010, contrasting with five species of waterfowl and at least nine species of shorebirds in 1980). With most of the historical tidal mudflat habitat lost permanently in the Marina/Ballona area (and essentially absent from the rest of the Santa Monica Bay/Los Angeles Basin south of Malibu), restoration of this habitat could have a positive impact on waterbirds in the region. It is also possible that such sensitive species as the California least tern could once again use Oxford Basin as an alternate foraging site during its breeding season.

4.0 SPECIES AND COMMUNITIES OF SPECIAL INTEREST

Biological resources of special interest include species and natural communities that are of limited distribution, or that are potentially regulated under federal, state, or local laws or ordinances. The investigators conducting this study identified those special status plant and wildlife species that have at least some potential to occur at Oxford Basin, and additional species that are worthy of concern in the local area or wider region. David Bramlet completed a jurisdictional delineation that identifies those portions of the site that are under the jurisdiction of the U. S. Army Corps of Engineers, California Department of Fish and Game, and California Coastal Commission.

4.1 Species of Special Interest

Species of special interest, or "special status" species, are plants and animals occurring or potentially occurring in the Project Area that are endangered or rare, as those terms are used in CEQA and its Guidelines, or that are otherwise of concern in the local area or wider region. Legal protection for special status species varies widely, from the relatively comprehensive protection extended to listed threatened/endangered species to no legal status at present. The California Department of Fish & Game's Natural Diversity Data Base (CNDDB) periodically publishes its lists of "Special Vascular Plants, Bryophytes, and Lichens" (CNDDB 2010) and "Special Animals" (CNDDB 2009). The Special Plants list incorporates continually updated information from the California Native Plant Society (CNPS), an independent organization that maintains an online inventory of taxa that its botanists regard as rare, declining, or insufficiently known.

Table 4–1 lists each special-status species known to occur at Oxford Basin, or that has at least moderate potential to occur there (either at present, or with the Basin in a modestly "restored" state). Attachments A–D discuss these species in greater detail, and also identify and discuss some additional species that have no or low potential to occur at the Basin.

TABLE 4–1: SPECIAL STATUS SPECIES

Species	Status (Federal/State)	Known or Potential Status at Oxford Basin
Listed Species		
Birds		
California brown pelican *Pelecanus occidentalis californicus*	FE/ –	One record of a bird photographed as it foraged at Oxford Basin on October 13, 2009 (Cooper 2010; see Attachment D, Figure 6). Although a rarity at Oxford Basin, hundreds of brown pelicans roost on the Marina del Rey breakwater daily, and birds regularly forage and roost in the marina, often near bait tanks. Given the small size of Oxford Basin, it is unlikely that this area would ever provide important foraging or roosting habitat for the California brown pelican.

Species	Status (Federal/State)	Known or Potential Status at Oxford Basin
California least tern *Sternula antillarum browni*	FE/SE	This tern maintains a large nesting colony at south Venice Beach, a few hundred meters from Oxford Basin. Schreiber and Dock (1980) recorded this species at the Basin, but provided only sparse details about the nature of its occurrence: "Of particular interest are California Least Terns, an endangered species that nests on nearby Venice Beach and the Ballona Wetlands, and occasionally forages on small fish in the Bird Conservation Area." Also, "Observed foraging in the pond at the Bird Conservation Area in Spring and Summer, 1980." The number of individuals observed is illegible in the table of the report. The California least tern could possibly use Oxford Basin, at least irregularly, as a foraging site for birds nesting in the Venice Beach colony, as birds are regularly seen foraging for mosquitofish at Ballona Freshwater Marsh and elsewhere in the Ballona area (Cooper 2006b). Having been fenced for decades, Oxford Basin receives very little coverage by birders, and since the least tern is present locally for only a brief time window (May to early July), any foraging here – particularly the occasional brief visit by a bird bringing food to young – could go unobserved. It is not likely that the California least tern would ever nest at Oxford Basin, as the site does not support the broad, sandy beach and sandbar habitat favored by this species. Oxford Basin could possibly serve as an alternative foraging site for the species during its late spring/early summer nesting season.
Non-Listed Species		
Invertebrates		
monarch butterfly *Danaus plexippus*	–/CSA	Species is of concern due to its limited number of remaining overwintering sites, which are covered by statues of the California Public Resources Code and the California Fish and Game Code. Numbers have been fluctuating over the years, with a downward trend during the recent past (Xerces Society 2010). Species is migratory and frequently seen in coastal Los Angeles County; occurs at Oxford Basin only as a migrant. Recorded during all invertebrate sampling visits, passing by the site in an approximately east to west direction. Each specimen stayed only briefly near the site and visited a few flowers before continuing in westerly direction. In southern California, Monarchs usually overwinter in groves of *Eucalyptus*, in a zone between a half mile and one mile from the coast. Although Oxford Basin is on the migratory path of the Monarchs, is located approximately one mile from the coast, and has both blue gum and red gum *Eucalyptus* trees, it does not feature a grove of mixed height and diameter, with an understory of brush and sapling trees. It also lacks food plants for adult Monarchs. For these reasons, Monarchs are unlikely to choose the site in its present condition for overwintering.

Species	Status (Federal/State)	Known or Potential Status at Oxford Basin
Birds		
great egret *Ardea alba*	—/CSA (rookery site)	Unrecorded by earlier surveyors (1970s), small numbers of this large wader were found during 2009/10, including young-of-the-year during summer 2009 surveys (Hamilton and Cooper 2010). Great egrets maintain a limited nesting colony adjacent to Oxford Basin at Yvonne B. Burke Park. Additional nesting sites documented at Marina del Rey in 2009, with an estimated Marina-wide breeding population of approximately five pairs. Great egrets could potentially breed in the taller trees at Oxford Basin, but the species does not appear to be limited in the local area by a shortage of suitable nesting trees.
snowy egret *Egretta thula*	—/CSA (rookery site)	Since around 2005 snowy egrets have nested in tall eucalyptus, ficus, and coral trees in and around the parking lot of Yvonne B. Burke Park, just east of Oxford Basin (Cooper 2006b). This area held an estimated 69 nests of snowy egrets and black-crowned night-herons in July 2009, and Oxford Basin provides important breeding-season foraging area for snowy egrets, particularly for young-of-the-year (Hamilton and Cooper 2010). Up to 19 individuals per day were recorded during July 2009, likely from nearby nests at Burke Park. Snowy egrets could potentially breed in the taller trees at Oxford Basin, but the species does not appear to be limited in the local area by a shortage of suitable nesting trees.
black-crowned night-heron *Nycticorax nycticorax*	—/CSA (rookery site)	Long recorded at Oxford Basin during the non-breeding season (see Cooper 2006a), this medium-sized wader initiated nesting at Marina del Rey during the late 1990s. Several dozen pairs currently breed at the Marina, with one of the largest colonies located just east of Oxford Basin, at Yvonne B. Burke Park, where it co-occurs with snowy egrets (see preceding account). Although black-crowned night-herons were found in relatively small numbers at Oxford Basin during fall-spring (<10 birds), up to 14 birds per day were found during July 2009, when young birds were regularly seen foraging there with adults in apparent family groups (Hamilton and Cooper 2010).
great egret *Ardea alba*	—/CSA (rookery site)	Unrecorded by earlier surveyors (1970s), small numbers of this large wader were found during 2009/10, including young-of-the-year during summer 2009 surveys (Hamilton and Cooper 2010). Great egrets maintain a limited nesting colony adjacent to Oxford Basin at Yvonne B. Burke Park. Additional nesting sites documented at Marina del Rey in 2009, with an estimated Marina-wide breeding population of approximately five pairs. The species could potentially breed in one of the taller trees at Oxford Basin, but the species does not appear to be limited in the local area by a shortage of suitable nesting trees.
American kestrel *Falco sparverius*	—/—	This small raptor was found to be resident at Oxford Basin during the 1970s, but we know of no modern (post-1980) records from the site. As of 2010, the American kestrel no longer breeds at the Ballona Wetlands, where it was once a common year-round resident. In coastal portions of the Los

Species	Status (Federal/State)	Known or Potential Status at Oxford Basin
		Angeles Basin, large vacant lots that formerly supported American Kestrels year-round have all but disappeared. At Oxford Basin, such habitat modifications as removal of myoporum and trees and maintenance of low-profile vegetation, with patches of bare ground, could possibly facilitate the kestrel's re-establishment, at least in fall and early winter.
loggerhead shrike *Lanius ludovicianus*	–/–	This species, like the American kestrel, was recorded at Oxford Basin during the 1970s, but it is now best considered totally extirpated. Up to three loggerhead shrikes have been recorded in winter at the nearby Ballona Wetlands (including at Area A adjacent to Marina del Rey), and it is possible that this species could occur at Oxford Basin during migration if the site included bare ground and the establishment of a population of small mammals and/or macro-invertebrates (e.g., large grasshoppers) to provide a prey base.
western meadowlark *Sturnella neglecta*	–/–	This species has declined sharply throughout the Los Angeles area and, as of 2010, no longer breeds in the Ballona area (D. S. Cooper, unpublished data), or possibly anywhere else in coastal Los Angeles County. Two birds were photographed on October 13, 2009 along the north end of Oxford Basin (Cooper 2010; see Attachment D, Figure 9). Although these were fall migrants, small numbers of wintering birds could possibly occur if several acres of low-profile forbs/grasses and open ground were maintained at the site, rather than the dense, non-native trees and shrubs currently present.

Definitions

Federal
FE Listed as endangered under the federal Endangered Species Act.

State
SE State-listed as endangered under the California Endangered Species Act.

CSA California Special Animal. A general term that refers to all of the taxa the CNDDB is interested in tracking, regardless of their legal or protection status. This list is also referred to as the list of "species at risk" or "special status species". The Department of Fish and Game considers the taxa on this list to be those of greatest conservation need.

4.2 Communities of Special Interest

As described in this section, field surveys by David Bramlet (2010b; see Attachment E), delineated jurisdictional areas (wetlands and of Waters of the U.S.) at Oxford Basin that fall under the jurisdiction of the U.S. Army Corps of Engineers (Corps), California Coastal Commission (CCC), and California Department of Fish and Game (CDFG). Figures 4–1a and 4–1b show the extent of these jurisdictional areas. Please refer to Attachment E for documentation of the historical wetland conditions at Oxford Basin and for current photos of some of the jurisdictional areas found there. The following standard terms describe the wetland/non-wetland indicator status of plant species (see Reed 1988):

- Obligate wetland plants (Obl) – Plants that occur almost always in wetlands (>99%), under natural conditions.
- Facultative wetland plants (FacW) – Plants that usually occur in wetlands (67-99%), but also occur in nonwetlands.
- Facultative plants (Fac) – plants with a similar likely hood of occurring (33-67%) in wetlands as nonwetlands.
- Facultative Upland plants (FacUp) – Plants that sometimes occur in wetlands (1-33%), but occur more often in uplands.
- Upland plants (Up) – Plants that occur almost never in wetlands (< 1%).

AREAS UNDER CORPS JURISDICTION

The Corps regulates discharges of dredged or fill material into Waters of the United States under the provisions of Section 404 of the Clean Water Act. Waters of the United States include wetlands and nonwetland habitats, including oceans, bays, ponds, lakes, rivers, and streams, which may be used for interstate commerce. It also includes tidal areas, mudflats, sandflats, tributaries of Waters, along with wetland and adjacent wetland areas.

Wetlands are a type of the Waters of the United States, and are defined as those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, under normal circumstances, a prevalence of vegetation adapted to saturated soil conditions. The determination of those wetland sites under the Corps jurisdiction is determined by the presence of wetland vegetation, hydric soils, and suitable hydrology, using the methodology defined in the arid west region supplement to the 1987 Corps wetland delineation manual (Wetland Training Institute 1991, U. S. Army Corps of Engineers 2008).

The Corps also regulates any obstruction or alteration to Navigable Waters of the U.S. The jurisdiction for these Waters extends to the high tide line, including spring high tides or other high tides that occur with regular frequency, and to the ordinary high water mark in non tidal waters. Navigable Waters are typically within the same boundaries as the Waters of the U.S., but wetlands are not typically found within Navigable Waters, with the exception of some tidal marshes.

A total of 5.18 acres of Waters of the United States were delineated at Oxford Basin, of which 0.48 acre satisfied the Corps' criteria for vegetation, soils, and hydrology.

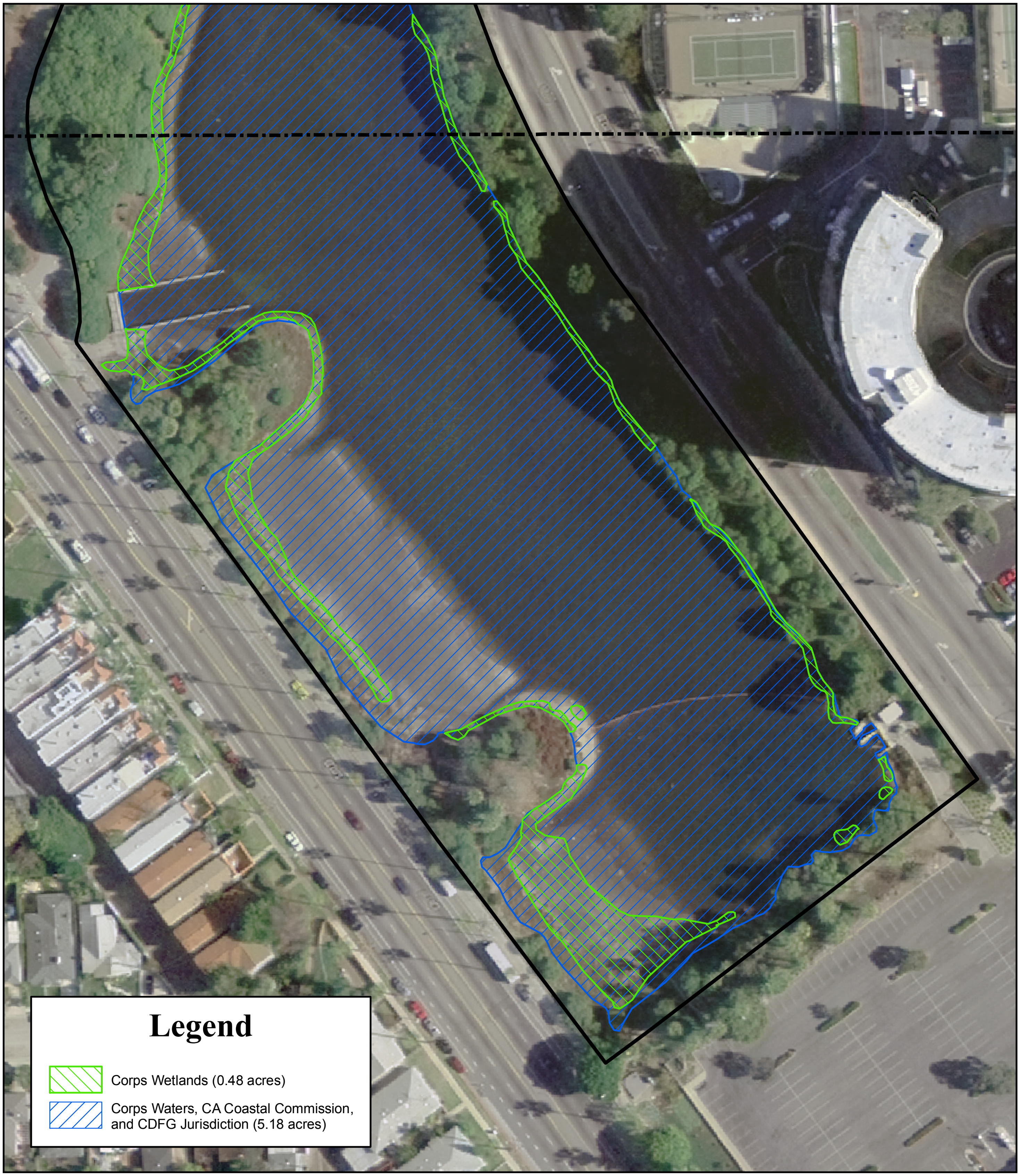
Areas Under California Coastal Commission Jurisdiction

Wetlands meeting the California Coastal Commission's one-parameter wetland criteria extend to the mean high tide within the Basin. These wetland areas had hydric soils and wetland hydrology, but were generally dominated by Perez's sea lavender (*Limonium perezii*). Since this species was considered a FacUp species, these localities were not considered to have hydrophytic vegetation. Therefore these areas were not considered as jurisdictional wetlands under the Corps delineation procedures, but would be classified as wetlands under the Coastal Commission's one-parameter methodology. Other species found in these wetlands included rabbit's foot grass (FacW); salt marsh sand spurry (Obl); spearscale (FacW); alkali heliotrope (*Heliotropium curassavicum*) Obl; Boccone's sand spurry (Fac), Mexican tea (*Dysphania ambrosioides*) Fac; yellow sweet clover (Fac); garden beet (*Beta vulgaris*) FacUp; and myoporum (*Myoporum laetum*) FacUp. The CCC wetland areas would also included those poorly vegetation or non vegetated "beach" areas that are infrequently tidally inundated, and the tidal flat areas that are inundated on a daily basis.

Depending on the slope of the Basin, the CCC wetlands extended from zero to 16 feet above the delineated Corps wetland areas. Along much of the north shore of the Basin, CCC wetlands extended from 6 to 8 feet above the Corps delineated wetland areas. A total of 5.18 acres was determined to meet CCC wetlands criteria at Oxford Basin.

Areas Under California Department of Fish & Game Jurisdiction

As with the CCC wetlands, the area under California Department of Fish & Game (CDFG) jurisdiction extends to the mean high tide line. No other riparian or isolated wetland habitat occurs within the Basin and the inlet channels are all developed storm drains. Therefore, it is determined that any CDFG jurisdiction is limited to the area in the Basin up to and including the high tide boundary. A total of 5.18 acres was determined to be under the jurisdiction of CDFG at Oxford Basin.



Site area: 8.94 acres

0 100 200 Feet

Figure 4-1a

Jurisdictional Wetlands

in the Oxford Basin

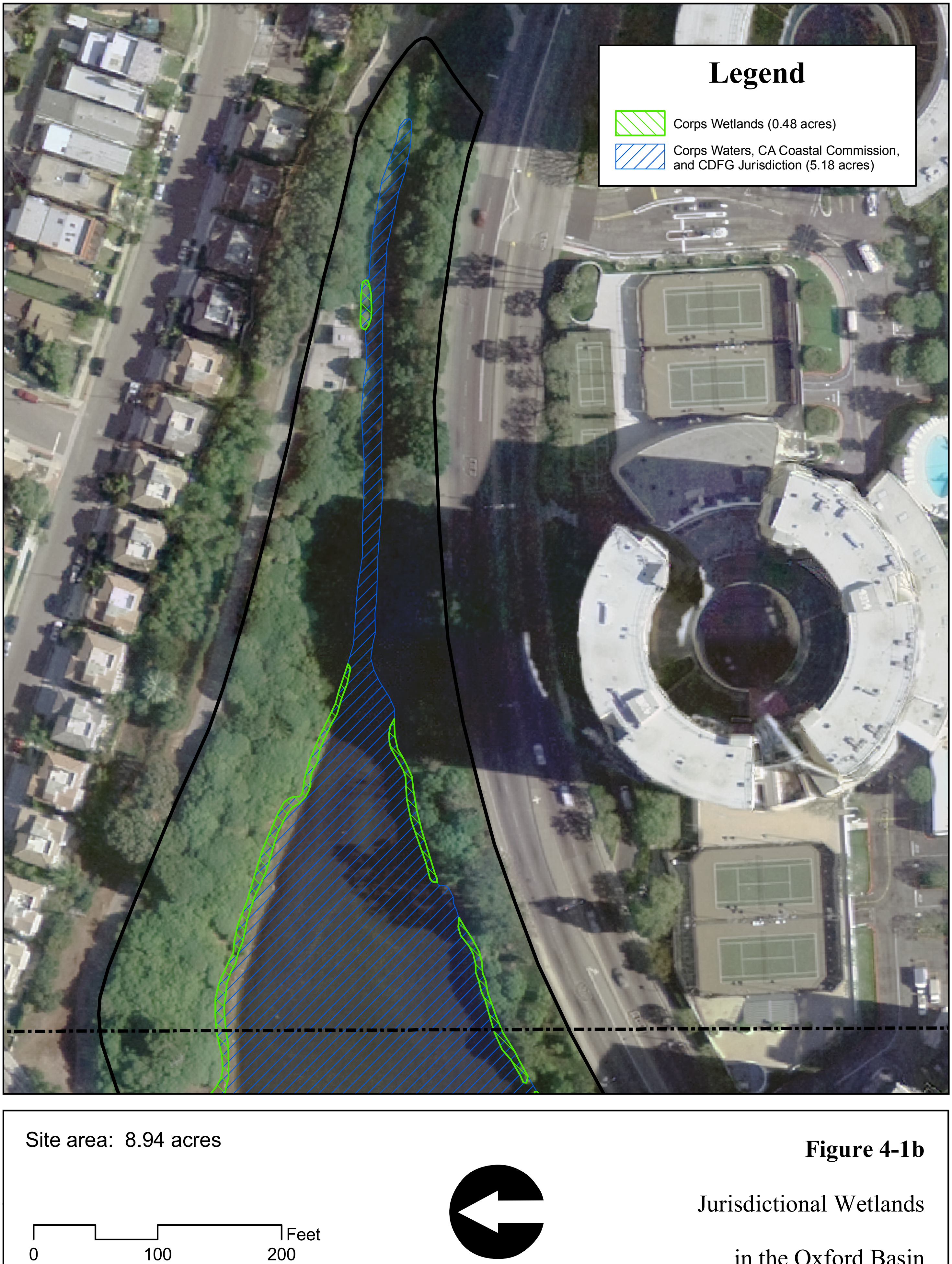


Figure 4-1b

Jurisdictional Wetlands

in the Oxford Basin

5.0 RECOMMENDATIONS FOR CONSERVATION

Opportunities exist to increase habitat values of Oxford Basin for various native plant and wildlife species, and to promote its enjoyment by residents and visitors to Marina del Rey. This section summarizes (and in some cases paraphrases) the specialists' conservation recommendations and those contained in the draft Marina del Rey Conservation & Management Plan (Hamilton and Cooper 2010). The objective at this early planning stage, before a specific direction has been decided upon, was to set forth all potentially relevant recommendations for further consideration as planning of the renovation project progresses.

Oxford Basin's primary role is to receive storm runoff from and to provide flood control for the Marina and surrounding communities. The Basin must be regularly maintained, including periodic removal of sediments. As noted elsewhere in this report, all efforts to enhance habitat at Oxford Basin must be coordinated with the relevant County agencies, including the Department of Public Works, Department of Beaches and Harbors, and Flood Control District, and shall not in any way compromise the operation of the Basin as a flood control facility.

5.1 Recommendations of David Bramlet (Vegetation/Wetlands)

1. Investigate the feasibility of increasing the total area of the tidal prism at differing elevational levels. The principal function of Oxford Basin is to maintain maximum flood control capacity, and this may require a uniform upper elevational level. However, if sediment is to be removed from the Basin, the potential of having differing elevational levels within the Basin should be evaluated. This would allow for a greater diversity of native salt marsh "habitats" (e.g. mid-marsh, high marsh) and species that could potentially be introduced into the Basin.

2. Investigate the feasibility of establishing vascular aquatic plant species, such as eel grass (*Zostera marina*) within the mud flats of Oxford Basin. These could be placed in artificial submerged structures, that would allow "harvesting" of the eel grass. These plants would be grown more to enhance water quality and reduce the algal blooms, than to enhance the habitat found within the mudflats. Another alternative would be to create areas of sandy habitat within the Basin, to provide substrate for this or other suitable species.

3. Consider the feasibility of enhancing the salt marsh community found at Oxford Basin. This would include plans for the removal of non-native Perez's sea lavender (*Limonium perezii*), which has low habitat value for native wildlife, and replacing it with a more diverse group of native salt marsh species. Some of these species could include California marsh rosemary (*Limonium californicum*), alkali heath (*Frankenia salina*), saltgrass (*Distichlis spicata*), jaumea (*Jaumea carnosa*),

shore grass (*Monanthochole littoralis*), and American saltwort (*Batis maritima*). The plan would need to determine the suitability of the existing habitats for these species, and potential procedures that could allow for develop different marsh habitats within the Basin. Planting plans would then need to be developed with the different palettes for the salt marsh plantings, along with detailed procedures for preparing the sites for planting/seeding and long term maintenance of the marsh enhancement areas.

4. Consider the development of a native plant enhancement plan for Oxford Basin. This would include a plan for the removal of the myoporum, melaleuca, and other non-native trees and shrubs from the Basin. A planting palette of suitable native trees, shrubs and grasses could then be developed for the project site. These could include laurel sumac (*Malosma laurina*), Mexican elderberry (*Sambucus mexicana*), lemonadeberry (*Rhus integrifolia*), California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), coyote bush (*Baccharis pilularis*), bladder pod (*Cleome isomeris*) and other suitable shrubs or trees for the project site. Perennial grasses, such as purple needle grass (*Nassella pulchra*) or giant wild rye (*Elymus condensatus*), could also be planted in the understory. The planting plan would need to include procedures for testing the soils for excess salts, and preparing these soils before planting, determining the suitable planting procedures, detailing any provisions for erosion control, such as mulches on the exposed soils, and determining the potential need for supplemental irrigation. A detailed long-term maintenance plan would also have to be developed. This would develop provisions for maintaining any irrigation systems, repairing erosion, weeding the site, and replacing dead or damaged plantings in the enhancement areas.

5. Determine the native plants within Oxford Basin and a listing of non-native plant species that should be removed from the area surrounding the Basin. The botanical survey conducted for this report could not identify all of the species present within the study area, typically because the available plant materials lacked certain characters required for positive identification. Further studies would be necessary to more completely define the Basin's existing flora.

6. Determine the invasive non-native plants that occur within Oxford Basin and the development of a plan to remove these species. Such a plan would note the invasive plant species that are likely to cause continual problems in any native plant enhancement plantings, such as panic veldt grass (*Ehrharta erecta*). Procedures for the initial removal of the existing infestations and long-term maintenance measures to prevent further infestations of these species within the Basin would need to be developed in such a plan.

5.2 Recommendations of Emile Fiesler (Invertebrates)

Oxford Basin has great potential as a habitat for native invertebrates. Even though the site is currently in a relatively degraded state, with predominantly non-native vegetation, the Basin provides an important breeding ground for many aquatic species. The upland areas still have some native vegetation and can be restored to become a more vibrant coastal ecosystem. Specific recommendations for conservation, restoration, and overall site improvement are:

1. Remove exotic plants, ideally by hand, without the use of toxic pesticides.

2. Plant a broad diversity of native plants, specifically plants native to the local coastal area of Los Angeles County.

3. Eradicate/control Argentine ants, which displace native ant species as well as other arthropods, resulting in an impoverished biotope. A critical part of restoration efforts on the site should include the abatement of Argentine Ants. If desired, BioVeyda can assist in this effort.

4. Remove unnecessary concrete and other construction debris. Some monolithic rocks can be left or intentionally placed, as they would provide habitat for various vertebrate and invertebrate animals.

5. Possible introduction of non-listed native fauna, or at least introduction of their food-plants; for example:

   a. Pygmy blue (*Brephidium exilis*): Chenopodiaceae, including Atriplex and Chenopodium.

   b. Wandering skipper (*Panoquina errans*): saltgrass (*Distichlis spicata var. spicata*) and cordgrass (*Spartina foliosa*).

6. Invertebrates, being typically much more abundant and often more vulnerable than vertebrates, are prime indicators for ecosystem health. It would be beneficial to perform periodic surveys in the future, whose results can be compared to those obtained during this project. These future surveys would add valuable information toward completeness of the list and toward measuring changes in biodiversity over time. Ideally, monitoring should occur before, during, and after planned habitat modifications. In addition to performing qualitative surveys to compile and compare species lists, it would be of great value if quantitative data could be gathered on the relative abundance of the species present. This data would provide a detailed view on the health of the ecosystem in general.

5.3 Recommendations of Camm C. Swift and Joel Mulder of Entrix (Fish and Estuarine Biology)

1. Perform a water quality study to determine conditions present to provide a basis for predicting what fish species can be supported by the system and what changes might be made to accommodate others less likely to be currently supported.

2. Improve water circulation with Marina del Rey in order to improve water quality which is currently compromised both in Oxford Basin and its adjacent water supply, Basin E of Marina del Rey.

3. If water quality is or becomes appropriate, consider introduction of aquatic vegetation like eelgrass, ditch grass, and other species of marine algae to provide habitat for faunal elements more dependent on such vegetation (i.e. pipefishes and shiner perch).

4. Consider introducing some fish species such as California killifish which may currently be prevented from colonizing by inhospitable habitat between current populations in Marina del Rey, Ballona Marsh, and Oxford Basin.

5. Investigate options for increasing the number of algae eating snails or fish present in the Basin in order to biologically control the proliferation of algae in the summer. If the freshwater conditions present in the winter decimate the populations of such grazers, possibly they could be artificially augmented in the spring from elsewhere in the marsh area. For example, the non-native fish, the sailfin molly (*Poecilia latipinna*), has become established and is common in Ballona Marsh. Stocks of sailfin molly could be transferred to Oxford Basin as a possible way to control algae. Sailfin mollies are a fecund species producing live bearing young and are tolerant of low oxygen conditions such as those found in the Basin. Striped mullet also feed on algae and detritus, reach large size, and could potentially be artificially introduced. Striped mullet achieve much larger sizes but are more sensitive to oxygen requirements.

6. Investigate options for converting the Basin bottom substrate to more sand and less mud/fine silt. Possibly a layer of sand could be added when or after the system is dredged out periodically. If the fine sediment is determined to be primarily composed of decomposing organic matter, and water quality conditions can be stabilized, an increase in the diversity and abundance of bottom dwelling fish and invertebrate fauna may utilize and thus reduce the thickness of this silt/organic layer.

7. Explore exposing Oxford Basin to more wind, which would facilitate mixing and oxygenation of the water; this could be effective in a wide shallow system like this one, thereby reducing the need for increased water quality in the marina.

As discussed in Attachment C, the long, dark culvert between Oxford Basin and Basin E of the marina likely inhibits dispersal of fish into the Basin. This condition could be improved by replacing some of the paving above the culvert with metal grating or comparable material. However, taken by itself, such a step would not be likely to improve fish stocks in Oxford Basin due to (1) the need to limit the range of tidal fluctuations in Oxford Basin in order to maintain its flood-protection capacity, and (2) the compromised water quality of Basin E, which limits the fish populations capable of surviving there. Given the inability to change these two items, increasing the amount of light in the culvert probably would not result in significant improvement of fish stocks in Oxford Basin (without simultaneous improvement for fish in these two additional items), and so this measure is not recommended as part of the current plan.

5.4 Recommendations of Daniel S. Cooper and Robert A. Hamilton (Birds and Terrestrial Vertebrates)

Relatively simple steps could be taken to enhance habitat quality in Oxford Basin for some birds that have been extirpated since the 1970s, and possibly even for species that existed in the pre-Marina del Rey wetlands.

1. Replace the thicket of myoporum with low-profile, native vegetation would likely result in the re-colonization of the site by the white-crowned sparrow, which no longer winters there. The American kestrel might use the site with such vegetation restored, as could (migrant) northern flickers and song sparrows. These species remain common in their respective roles in the larger Ballona ecosystem where native vegetation persists or has been restored. Other migrant songbirds recorded regularly at Ballona Lagoon that could use a restored Oxford Basin could include the house wren, blue-gray gnatcatcher (*Polioptila caerulea*), common yellowthroat (*Geothlypis trichas*), and Lincoln's sparrow (*Melospiza lincolnii*). None of these currently occur at the site or in typical urban/residential vegetation, and all have responded positively to restoration at Ballona Lagoon and other nearby natural areas.

2. With increased tidal flushing, the mudflats of Oxford Basin could once again support numbers and a diversity of shorebirds, and possibly a wider variety of waterfowl than is currently represented (just four ducks and one shorebird were detected during surveys in 2009/2010, contrasting with five species of waterfowl and at least nine species of shorebirds in 1980). With most of the historical tidal mudflat habitat lost permanently in the Marina/Ballona area (and essentially

absent from the rest of the Santa Monica Bay/Los Angeles Basin south of Malibu), restoration of this habitat could have a wide-reaching, positive impact on waterbirds in the region. It is also possible that such sensitive species as the California least tern could once again use Oxford Basin as an alternate fishing site during its breeding season.

5.6 Recommendations from the Marina del Rey Conservation and Management Plan (Hamilton and Cooper 2010)

Section 6.2.1 of the plan contains the following policy recommendations for Oxford Basin.

1. Restore functional saltmash habitat. Most of the intertidal zone at Oxford Basin is currently vegetated with such native saltmarsh plants as pickleweed, sandmarsh sand-spurry (*Spergularia marina*), and salt grass (*Distichlis spicata*). Because these plants were not mentioned in earlier assessments (e.g., Schreiber and Dock 1980), it appears that they are naturally occurring here, temporarily displaced by the construction of Marina del Rey, and now regenerating within the Basin. Therefore, we recommend that this vegetation be preserved in place or stock-piled for later replanting during any reworking of the Basin's sides. The term "functional saltmarsh habitat" implies regular and, if possible, natural tidal flushing (corresponding to timing and magnitude of natural tidal cycles). A functional saltmarsh at Oxford Basin would, ideally, support a healthy sedimentary invertebrate fauna, to provide habitat for ducks and shorebirds, and a predictable population of small fish during the May–July nesting season for the California Least Tern, a listed species that maintains a large nesting colony on Venice Beach and that has been documented foraging at Oxford Basin in past years. Many other migratory and resident waterbirds would also benefit from the enhancement of this habitat, including those that currently utilize the nearby restored Ballona Lagoon.

2. To the extent possible, the Oxford Retention Basin Flood Protection Multiuse Enhancement Project (currently in design) should maintain the natural characteristics of the site. Once the final contours are established, habitat should be established to include areas of emergent native marsh vegetation exposed during high tide, to serve as refugia for animals, and areas of exposed mud ("mudflats") at low tide, to serve as foraging areas for migratory and resident birds. Although the extent of mudflats may be limited by engineering constraints, including at least a band of this habitat at low tide would be valuable, considering how much mudflat habitat was lost during construction of Marina del Rey, and how vital such areas are for a wide variety of native wildlife, including birds, mollusks, and other intertidal invertebrates.

3. Subsurface debris, including chunks of concrete and asphalt, and sections of pipe, should be removed from the Basin where possible, as these would interfere with ecological functions of the mudflat.

4. Establish the primacy of habitat values over recreation as part of restoration. Removing non-native landscaping and increasing passive recreation potential along the margins of Oxford Basin are worthwhile improvements, but the existing dense vegetation and fencing currently provide considerable security for the herons and egrets that use the Basin's existing habitats in large numbers. Improving public access to the Basin and replacing the tall myoporum with low-growing scrub will be of little or no practical value (for wildlife or the public) if increased human activity causes the herons, egrets, and other wildlife species to stay away from Oxford Basin. Therefore, the Basin must be managed carefully for its wildlife habitat values, along with providing for flood protection and water quality improvement. Levels of passive recreation and other non-essential human uses should not conflict with these main purposes.

5. With plans for new fencing and increased public access to the Basin, care must be given to ensure that the old pattern of dumping of pets or other feral animals into the Basin does not recur, perhaps by the creation and support of a local stewardship organization (including a volunteer ranger/docent program) and clear, vandal-resistant (and easily-replaced/repaired) signage.

6. Any new development at Oxford Basin should be evaluated for its role in promoting natural wildlife habitat, vs. degrading or hindering this habitat. As the site is restored and public access improves, the County may receive proposals from groups to make various uses of the area (e.g., filming, special events, trash clean-up). The County should establish a mechanism for handling such requests, or should include appropriate provisions in a contract with an outside resource management group or a local Audubon chapter.

7. Following renovation, care should be taken to communicate effectively with all relevant users and managers that Oxford Basin, although first and foremost a flood-control facility, can be managed simultaneously as a habitat for native plants and wildlife without affecting flood-control capabilities. Therefore, activities like dumping compost or construction material, planting inappropriate vegetation, and feeding wildlife or domesticated birds, should not be tolerated.

8. Non-native vegetation should be removed from all parts of Oxford Basin on a regular, continuing basis under the supervision of a qualified professional, except where demonstrated to be critical to fulfilling an important natural process (e.g., retention of a small number of eucalyptus, ficus, or other non-native trees with regularly-nesting herons/egrets), consistent with the operation and maintenance requirements of the LACFCD. However, no new non-native

vegetation, or even "California native" (but not locally-native) vegetation inappropriate for the Ballona Wetlands, should be introduced.

9. The establishment of appropriate native landscaping will probably require a complete removal of all existing ground cover and weeds, and could also require eradication of the weed seedbank (e.g., through "solarization" or appropriate means).[1]

10. All vegetation above the high-tide line to be preserved, promoted, and restored/re-created should consist only of the two habitat types native to the historical Ballona Wetlands area (from Cooper 2008): 1) coastal scrub (a low-profile, summer-deciduous community dominated by such species as California sagebrush *Artemisia californica*, California sunflower *Encelia californica*, and coast goldenbush *Isocoma menziesii*), and 2) willow scrub (a low thicket-like community dominated by narrow-leaved willow *Salix exigua*). A professional firm, or firms, specializing in southern California native plant restoration, installation, and maintenance is recommended to prepare the site for planting, and to achieve successful establishment of these native communities.

11. Unnecessary and derelict concrete structures currently on the site (such as old wildlife watering troughs) and redundant fencing should be removed from the upper slopes where feasible.

12. Telephone lines that currently cut across the northern part of Oxford Basin may be re-routed along Washington Boulevard or Admiralty Way, as they could conflict with future wildlife use of the site (and lead to collisions with flying birds, including the listed California Brown Pelican, especially on foggy days).

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[1] The term solarization refers to sterilization of soil by covering it with plastic sheeting for roughly six weeks during warm weather. The sun's radiation is converted to heat by absorption, heating the material above 60°C, hot enough to kill seeds and pathogens in the soil.

6.0 LITERATURE CITED

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ATTACHMENT A: BOTANY REPORT

Botanical Resources of the Oxford Basin Marina del Rey, Los Angeles County, California

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1.0 INTRODUCTION

Oxford Retention Basin (Oxford Basin or Basin) is located in the Marina del Rey Harbor, Los Angeles County, California. It is located approximately 1 mile east of Venice Beach, and 600 feet north of the Marina del Rey Harbor (Figure 1-1). It is south of Washington Boulevard, north of Admiralty Way, east of an existing public parking lot, and west of Yvonne B. Burke park (Figure 1-2). The property occurs on the Venice 7.5' U.S.G.S. topographic quadrangle map and is generally located at the following UTM coordinates: 11S 03 65 584m E × 37 61 458mN. Oxford Basin occurs in an area that was historically part of the Venice Marshes (Figure 1-3).

The County of Los Angeles has proposed an enhancement project for Oxford Basin (County of Los Angeles 2009), to improve flood control, water quality, aesthetics, and passive recreation at this facility.

To characterize and document the existing botanical resources at Oxford Basin, a series of botanical surveys was conducted during the spring of 2010 in a study area, consisting of the Basin and a surrounding fenced-in area, which covers approximately 8.94 acres. The objectives of this study were to describe and determine the extent of each plant community and to note the plant species within this study area.

Figure 1-1. Oxford Basin is located on the northern boundary of Marina del Rey, Los Angeles County, California.

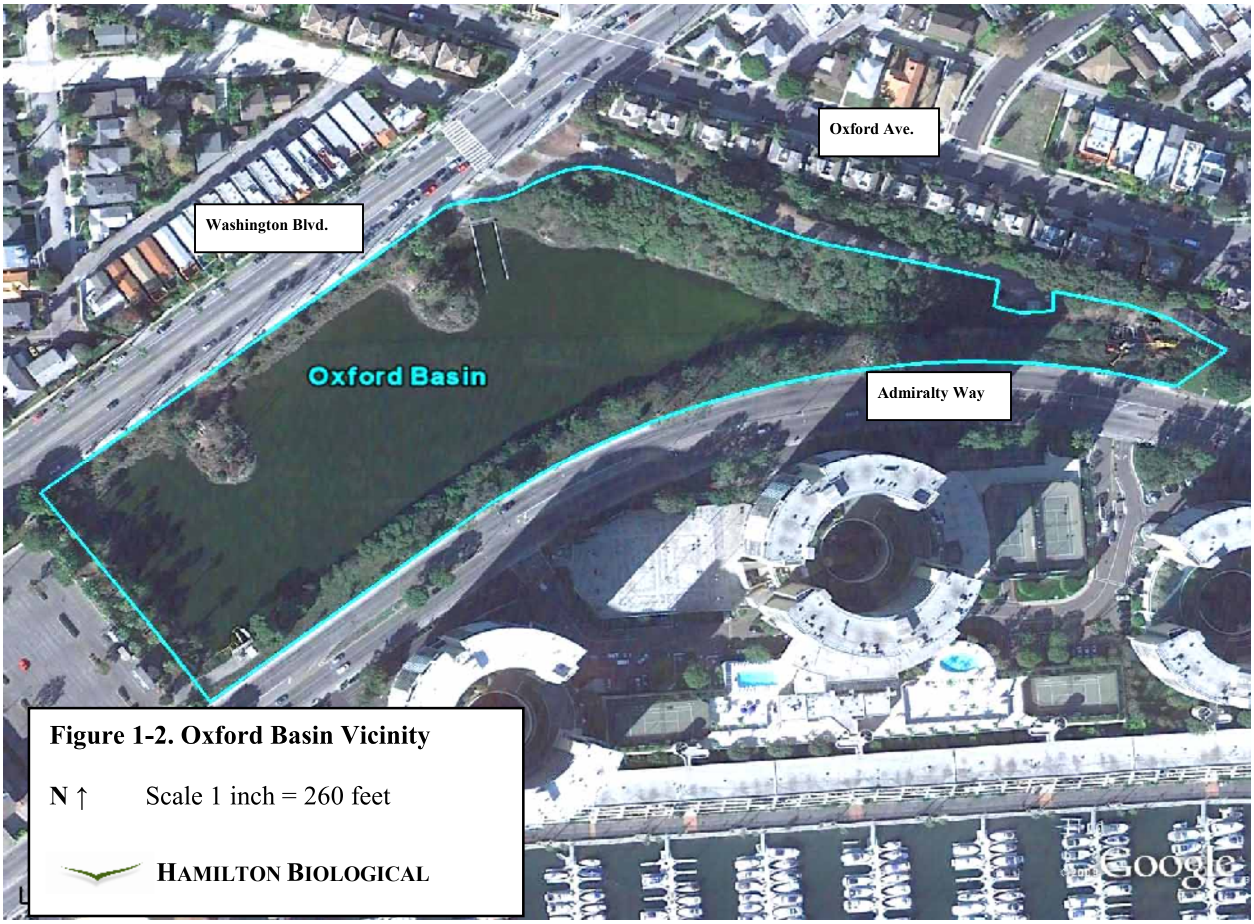

Figure 1-2. Oxford Basin is bounded on the north by Washington Boulevard and Oxford Avenue, and on the south by Admiralty Way.

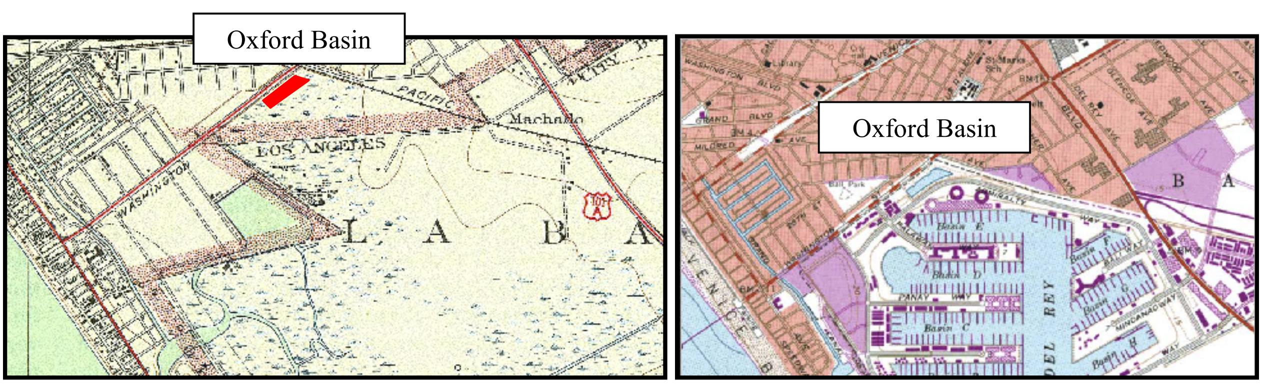

Figure 1-3. Historical topography showing in red the future location of Oxford Basin in 1942 (left) and the Basin as it existed (and still exists) in 1964 (right). Source: USGS Venice 7.5' topographic quadrangles.

2.0 METHODS

A literature review was conducted to determine the known information on the plant communities and botanical resources in the Marina del Rey region, and to determine the known plant species of special interest documented from this area. Literature reviewed included various species lists (Frankel 2006a, 2006b, 2006c, 2007; Mattoni 1997), environmental studies (Glenn Lukos Associates 2006), and information on plant communities (Zedler 1982). To determine the potential "special status" plant species known from the region, the California Natural Diversity Data Base (CNDDB 2010b), CNPS Inventory (2010), and the Consortium of California Herbaria (2010) were examined to note the species and when these plants had last been collected or observed.

A general tour of the project site was conducted with Robert Hamilton and other biologists evaluating Oxford Basin on 12 January 2010. Generally, only limited observations were conducted during this brief examination of the study area. Three botanical surveys were conducted during the spring of 2010. The surveys were conducted by David Bramlet, botanist, and generally consisted of walking over the project site for four or five hours. Surveys were conducted on 29 March, 22 April, and 13 May 2010. Field notes were taken on the plant species present in each community, and notes on the distribution of the communities were made on copies of an aerial photo of Oxford Basin at scale 1 inch equals 100 feet.

A wetland delineation was conducted on 12 June 2010 by D. Bramlet and R. Riefner, using the Arid West supplement (U.S. Army Corps of Engineers 2008) to the Corps' 1987 wetland delineation manual (Wetland Training Institute 1991). The examination included a review of hydrology, soils and vegetation at selected areas around the Basin and determinations were made of those areas that would qualify as Corps jurisdictional wetlands and those that would qualify as wetlands under the criteria of the California Coastal Commission.

The scientific names provided in the text generally follow Roberts (2008) for native plant species and Brenzel (2007) for ornamental plant species.

3.0 EXISTING ENVIRONMENT

3.1 PLANT COMMUNITIES

Oxford Basin is generally characterized by open water, with wetland and upland communities occurring along the margins of this Basin. Mapping units or plant communities found within the Oxford Basin study area include open water, mud flats, saltmarsh, annual grassland, ornamental plantings and ruderal areas (Figures 3-1a, 3-1b). The following paragraphs describe the characteristic species in each community. Plant species observed on the project site are specified in Appendix A.

Open Water (OW)

Oxford Basin is characterized by open water that generally has a high salinity. This open water characteristically has blooms of dense mats of algae, but no vascular plants occur in the fluctuating waters of the Basin.

Mud Flats (MF)

Mud flats are exposed during normal tidal fluctuations, and are generally unvegetated, although some of the higher areas do support common woody pickleweed (*Salicornia virginica*) during the summer months. The total area of exposed mud flats can fluctuate greatly depending on management actions. In particular, Oxford Basin can be drained in anticipation of winter storms, exposing additional areas within the Basin, and the Basin can be allowed to fill with storm waters when the tidal gates are closed, leaving no mud flats exposed.

Beach (Bch)

These unvegetated areas of Oxford Basin have a similar substrate to the mud flats but are dry and generally unvegetated, as they are inundated only by the highest tides or during heavy rainfall. However, some beach areas may develop stands of common woody pickleweed during the summer months.

Salicornia Marsh (SM)

Except near the inlet area at the east end, Oxford Basin supports a "ring" of saltmarsh-like vegetation along the upper tidal edge. This vegetation generally consists of a lower stratum dominated by common woody pickleweed; other commonly found species consisted of spearscale (*Atriplex prostrata*), rabbit's foot grass (*Polypogon monspeliensis*), saltmarsh sand spurry (*Spergularia marina*), toad rush (*Juncus bufonius*), alkali heliotrope (*Heliotropium curassavicum*), scarlet pimpernel (*Anagallis arvensis*), alkali weed (*Cressa truxillensis*), slender-leaved cat-tail (*Typha domingensis*), and lesser wart-cress (*Lepidium didymum*). This marsh area also included some localities with dense stands of spearscale, along with some scattered common woody pickleweed.

Sea Lavender Marsh (SLM)

At Oxford Basin, this community occurs at a slightly higher elevation than does Salicornia Marsh. Sea Lavender Marsh is characterized by dense mounds of Perez's sea lavender (*Limonium perezii*), and on the south side of the Basin this species occurs together with tall limonium (*Limonium arborescens*). Other species found in this community include saltmarsh sand spurry, alkali heliotrope, curly dock (*Rumex crispus*), yellow sweet clover (*Melilotus indicus*), garden beet (*Beta vulgaris*), kikuyu grass (*Pennisetum clandestinum*), prickly lettuce (*Lactuca serriola*), and Australian saltbush (*Atriplex semibaccata*).

Disturbed Wetland (DW)

Some small areas along the margins of Oxford Basin that did not appear to be part of the saltmarsh community were classified as "disturbed wetland." These small areas consisted of stands of rabbit's foot grass, spearscale, Mexican tea (*Dysphania ambrosioides*), crab grass (*Digitaria sanguinalis*), Boccone's sand spurry (*Spergularia bocconei*), Mexican fan palm (*Washingtonia robusta*) seedlings, annual blue grass (*Poa annua*), common purslane (*Portulaca oleracea*), goose grass (*Eleusine indica*), lesser wart cress, and common stink grass (*Eragrostis cilianensis*).

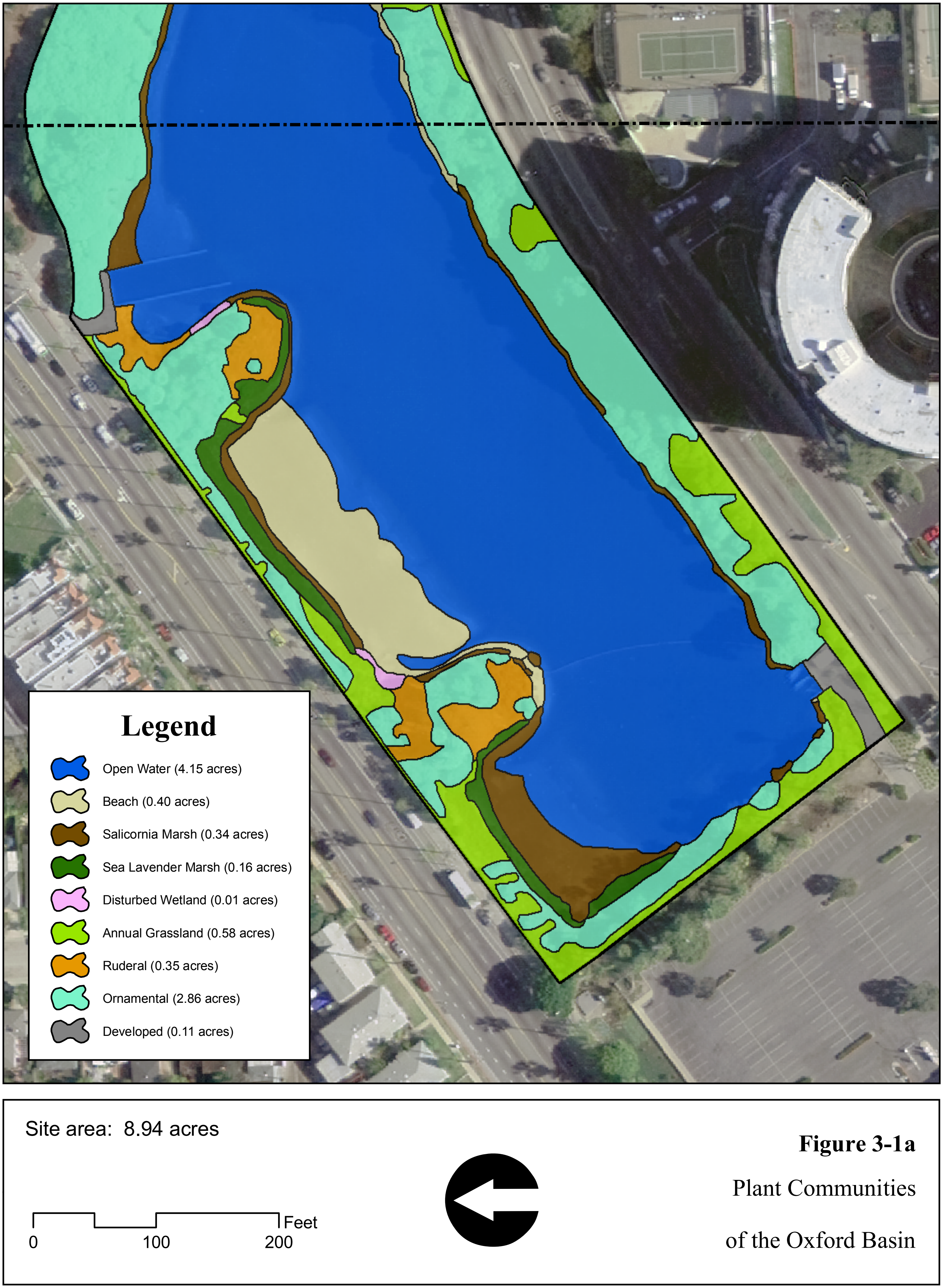

Figure 3-1a

Plant Communities

of the Oxford Basin

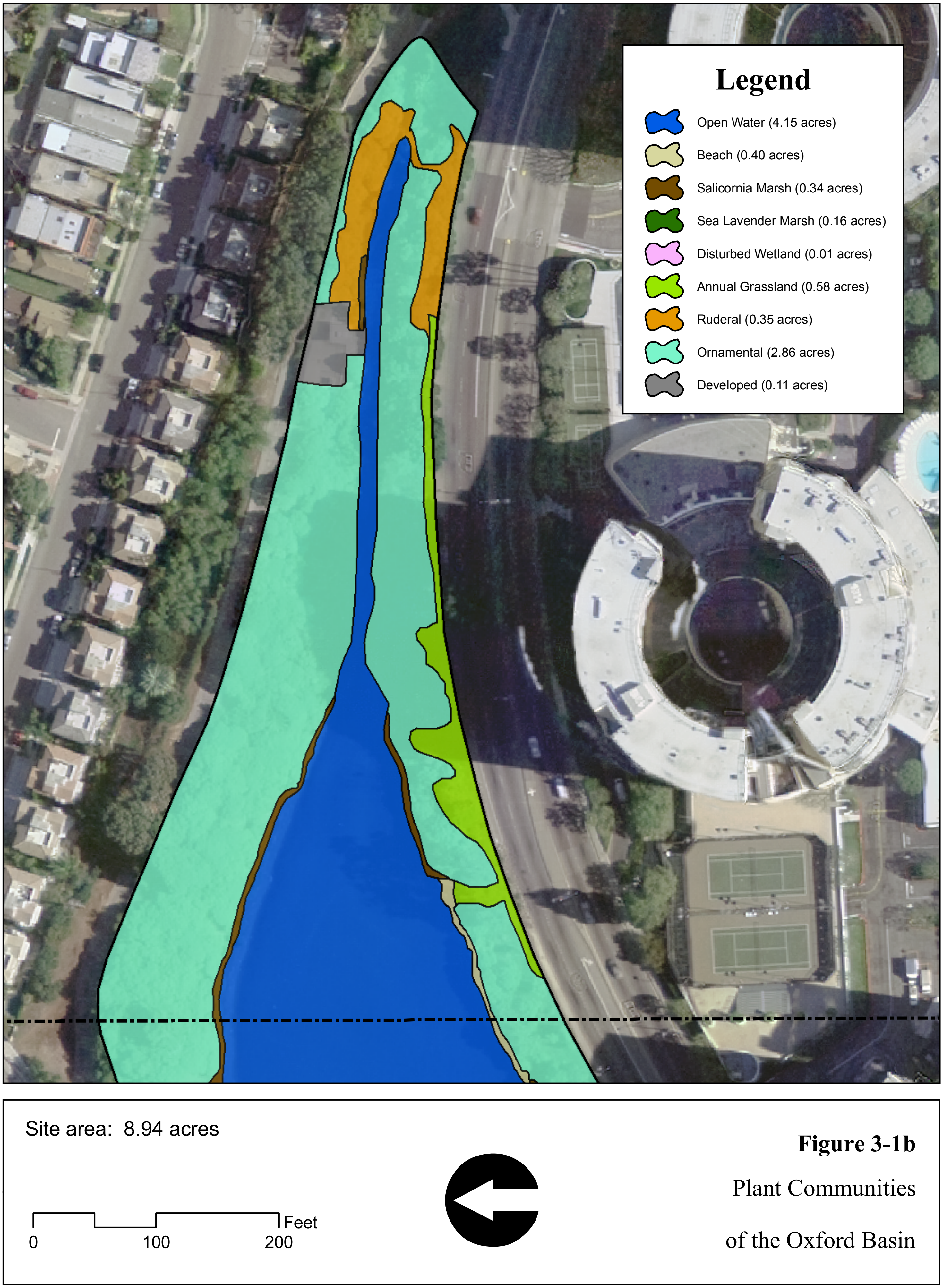

Figure 3-1b

Plant Communities

of the Oxford Basin

Annual grassland (Agr)

Much of the upland areas around Oxford Basin consist of an annual grassland, often interspersed with ornamental shrubs and trees planted on the site. Commonly found grasses in this community consisted of ripgut brome (*Bromus diandrus*), slender wild oat (*Avena barbata*), red brome (*Bromus madritensis* ssp. *rubens*), foxtail barley (*Hordeum murinum* ssp. *leporinum*), and panic veldt grass (*Ehrharta erecta*). Moist sites contained Bermuda grass (*Cynodon dactylon*), smilo grass (*Piptatherum miliaceum*), rabbit's foot grass, water bentgrass (*Agrostis viridis*), rescue grass (*Bromus catharticus*), and Dallis grass (*Paspalum dilatatum*). Commonly found forb species included summer mustard (*Hirschfeldia incana*), common horseweed (*Conyza canadensis*), London rocket (*Sisymbrium irio*), scarlet pimpernel, Mexican tea, lesser wart cress, Australian saltbush, cheese weed (*Malva parviflora*), white-stemmed filaree (*Erodium moschatum*), common sow thistle (*Sonchus oleraceus*), yellow sweet clover, nettle-leaved goosefoot (*Chenopodium murale*), red-stemmed filaree (*Erodium cicutarium*), and dwarf nettle (*Urtica urens*).

Ruderal (Ru)

Some parts of the study area contain plant species consistent with disturbed localities. Common species in the ruderal habitat consisted of foxtail barley, panic veldt grass, red brome, ripgut brome, Russian thistle (*Salsola tragus*), bull mallow (*Malva nicaeensis*), London rocket, serrate-leaved saltbush (*Atriplex suberecta*), garden beet, summer mustard, bristly ox-tongue (*Picris echioides*), redscale (*Atriplex rosea*), puncture vine (*Tribulus terrestris*), petty spurge (*Euphorbia peplus*), dwarf nettle, four-leaved polycarp (*Polycarpon tetraphyllum*), kikuyu grass, black mustard (*Brassica nigra*), prickly lettuce, common purslane, castor bean (*Ricinus communis*), tree tobacco (*Nicotiana glauca*), pampas grass (*Cortaderia selloana*), and sweet fennel (*Foeniculum vulgare*).

Ornamental

Ornamental tree, shrub and vine plantings generally dominate the upland areas of the Oxford Basin study area. In the eastern part of the property a myoporum "woodland" is found, characterized by dense stands of myoporum (*Myoporum laetum*), along with some planted pines (*Pinus* sp.). Other areas of the site contained scattered stands of myoporum, with Mexican fan palm, melaleuca (*Melaleuca* sp.), Brazilian pepper tree (*Schinus terebinthifolius*), crimson bottle bush (*Melaleuca citrina*), Peruvian pepper tree (*Schinus molle*), Indian laurel fig (*Ficus microcarpa*), oleander (*Nerium oleander*), and grape vines (*Vitis* sp.). The south side of the Basin has a more open cover of myoporum and a greater diversity of ornamental plantings. Planted trees and shrubs in this locality included, pines, lemon gum (*Eucalyptus citriodora*), Catalina cherry (*Prunus lyonii*), creeping fig (*Ficus pumila*), Brazilian pepper tree, red gum (*Eucalyptus camaldulensis*), Canary Island palm (*Phoenix canariensis*). Shrubs consisted of crimson bottle bush, oleander, melaleuca, firethorn (*Pyracantha coccinea*), and dwarf myoporum (*Myoporum parvifolium*).

Developed (Dev)

The pump stations, low flow bypass structure, paved roads and concrete inflow structures were mapped as developed.

4.0 SPECIES AND COMMUNITIES OF SPECIAL INTEREST

Species of special interest, or "special status" species, are defined as those plant species of concern to the California Department of Fish and Game, Natural Diversity Database (CNDDB 2010a), California Native Plant Society (2010), and the U.S. Fish and Wildlife Service (USFWS). The literature review was described previously, in the Methods section. The results of this review are provided in Table 4-1. Many of these species were historically documented, but few have any recent observations. Some of the exceptions include the recent finding of an occurrence of the Orcutt's pincushion (*Chaenactis glabriuscula* var. *orcuttiana*), and it is assumed that other historically known sensitive plant species still occur in this region.

Oxford Basin has very limited habitat for any of the special status plant species potentially occurring in the region. The only species with some potential for occurrence is the southern tarplant (*Centromadia parryi* ssp. *australis*), since this species often occurs in disturbed habitats. However, this species was not observed during the field surveys and the potential for occurrence appears to be low in the highly modified habitats surrounding the Basin.

TABLE 4-1

PLANT SPECIES OF SPECIAL INTEREST IN THE OXFORD BASIN STUDY AREA

Species	Status		Habitat	Known Localities
	Federal, State	CNPS		
Astragalus pycnostachyus var. *lanosissimus* Ventura marsh milk vetch	FE, CE	List 1B.1	Coastal salt marshes	Currently known from a single locality in Ventura County, other historical localities are considered extirpated. Historically recorded from the Ballona marshes.
Astragalus tener var. *titi* Coastal dunes milkvetch		List 1B.1	Coastal dunes	Known in the region only from historic localities, including Santa Monica & Hyde Park
Atriplex pacifica South coast saltbush		List 1B.2	Grassland, Sage scrub, Alkali meadow	Historically recorded from Redondo & San Pedro, no recent documentation from the region
Atriplex serenana var. *davidsonii* Davidson's saltscale		List 1B.2	Alkali meadow	Historically recorded from Los Angeles, Cienega, no recent documentation from the region.
Camissonia lewisii Lewis's evening primrose		List 3	Coastal dunes & scrub	Historically recorded from Ballona, El Segundo Dunes, Ingelwood, no recent documentation from the region.
Centromadia parryi ssp. *australis* Southern tarplant		List 1B.1	Alkali meadows, grasslands	Ballona marshes, Marina del Rey, Marina del Rey Hills.
Chaenactis glabriuscula var. *orcuttiana* Orcutt's pincushion		List 1B.1	Coastal dunes, Coastal bluff scrub	Ballona wetlands, coastal strand, recently documented from the study region.

Species	Status		Habitat	Known Localities
	Federal, State	CNPS		
Cordylanthus maritimus ssp. *maritimus* Salt marsh bird's beak	FE, CE	List 1B.2	Salt marsh	Historically recorded for "Santa Monica", considered to be extirpated from this area.
Hordeum intercedens Vernal barley		List 3.2	Moist grasslands and alkali meadows	Historically recorded from the Ballona wetlands.
Juncus acutus ssp. *leopoldii* Southwestern spiny rush		List 4.2	Salt marsh, brackish marsh	No formal documentation for the occurrence of this species within the study region. However, it does occur on some complied lists (Frankel 2006).??
Lasthenia glabrata ssp. *coulteri* Coulter's goldfields		List 1B.1	Alkali meadows salt marshes	Historically recorded from the Ballona wetlands, del Rey and El Segundo, no recent documentation.
Nemacaulis denudata var. *denudata* Coast woolly-heads		List 1B.2	Coastal dunes, margins of salt marshes	Historically reported from Los Angeles and Long Beach, no recent documentation from the region.
Phacelia stellaris Brand's star phacelia		List 1B.1	coastal dunes	Historically recorded from Playa del Rey, considered extirpated from this region.
Potentilla multijuga Ballona cinquefoil		List 1A	Salt marsh	Considered extirpated.
Suaeda esteroa Estuary seablite		List 1B.1	Salt marsh	Long Beach, Seal Beach, no records from the study area.
Suaeda taxifolia Woolly seablite		List 4.2	Salt marsh, coastal bluff	Historically reported from Playa del Rey

STATUS CATEGORIES

Federal Status:
FE - Listed as federally endangered.
FT - Listed as federally threatened.

State Status:
CE - Listed as endangered by the state of California.
CT - Listed as threatened by the state of California.

California Native Plant Society:
CNPS 1A- Plants presumed extinct in California.
CNPS 1B - Plants considered rare, threatened or endangered in California and elsewhere.
CNPS 2 - Plants rare, threatened or endangered in California but more common elsewhere.
CNPS 3 - Plants about which we need more information - A review list.
CNPS 4 - Plants of limited distribution - A watch list.

CNPS Threat Extensions
0.1 Seriously endangered in California.
0.2 Fairly endangered in California.
0.3 Not very endangered in California.

4.2 COMMUNITIES OF SPECIAL INTEREST

Plant communities of special interest are those depleted habitats of concern to local, state and federal agencies or that are within the jurisdiction of federal state or local acts ordinances or other regulations. These include coastal wetlands, Environmentally Sensitive Habitat Areas (ESHA), or other habitats designated as of special interest in the region. In the Oxford Basin area, sensitive habitats include waters or wetlands under jurisdiction to the U. S. Army Corps of Engineers, California Coastal Commission, and the California Department of Fish and Game. It also includes those areas designated by the County of Los Angeles as Significant Ecological Areas, including SEA No. 5 (Old SEA 29) at Ballona Creek (England and Nelson 1976, County of Los Angeles 2008), approximately 1.25 miles south of Oxford Basin. There are no designated ESHAs within Marina del Rey.

A wetland delineation was conducted within Oxford Basin (Bramlet 2010) to determine the extent of (a) Corps jurisdictional wetlands and waters of the United States and (b) wetland habitats as defined by the California Coastal Commission. Please refer to the wetland delineation report for maps and descriptions of these wetland areas.

5.0 RECOMMENDATIONS

The following recommendations are provided for improving the ecological functions and values of Oxford Basin's plant communities:

- Investigate the feasibility of increasing the total area of the tidal prism at differing elevational levels. The principal function of Oxford Basin is to maintain maximum flood control capacity, and this may require a uniform upper elevational level. However, if sediment is to be removed from the Basin, the potential of having differing elevational levels within the Basin should be evaluated. This would allow for a greater diversity of native salt marsh "habitats" (e.g. mid-marsh, high marsh) and species that could potentially be introduced into the Basin.

- Investigate the feasibility of establishing vascular aquatic plant species, such as eel grass (*Zostera marina*) within the mud flats of Oxford Basin. These could be placed in artificial submerged structures, that would allow "harvesting" of the eel grass. These plants would be grown more to enhance water quality and reduce the algal blooms, than to enhance the habitat found within the mudflats. Another alternative would be to create areas of sandy habitat within the Basin, to provide substrate for this or other suitable species.

- Consider the feasibility of enhancing the salt marsh community found at Oxford Basin. This would include plans for the removal of the non-native Perez's sea lavender (*Limonium perezii*), which has low habitat value for native wildlife, and replacement with a more diverse group of native salt marsh species. Some of these species could include California marsh rosemary (*Limonium californicum*), alkali heath (*Frankenia salina*), saltgrass (*Distichlis spicata*), jaumea (*Jaumea carnosa*), shore grass (*Monanthochole littoralis*), and American saltwort (*Batis maritima*). The plan would need to determine the suitability of the existing habitats for these species, and potential procedures that could allow for develop different marsh habitats within the Basin. Planting plans would then need to be developed with the different palettes for the salt marsh plantings, along with detailed procedures for preparing the sites for planting/seeding and long term maintenance of the marsh enhancement areas.

- Consider the development of a native plant enhancement plan for Oxford Basin. This would include a plan for the removal of the myoporum, melaleuca, and other non-native trees and shrubs from the Basin. A planting palette of suitable native trees, shrubs and grasses could then be developed for the project site. These could include laurel sumac (*Malosma laurina*), Mexican elderberry (*Sambucus mexicana*), lemonadeberry (*Rhus integrifolia*), California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), coyote bush (*Baccharis pilularis*), bladder pod (*Cleome isomeris*) and other suitable shrubs or trees for the project site. Perennial grasses, such as purple needle grass (*Nassella pulchra*) or giant wild rye (*Elymus condensatus*), could also be planted in the understory. The planting plan would need to include procedures for testing the soils for excess salts, and preparing these soils before planting, determining the suitable planting procedures, detailing any provisions for erosion control, such as mulches on the exposed soils, and determining the potential need for supplemental irrigation. A detailed long-term maintenance plan would also have to be developed. This would develop provisions for maintaining any irrigation systems, repairing erosion, weeding the site, and replacing dead or damaged plantings in the enhancement areas.

- Determine the native plants within Oxford Basin and a listing of non-native plant species that should be removed from the area surrounding the Basin. The botanical survey conducted for this report could not identify all of the species present within the study area, typically because the available plant materials lacked certain characters required for positive identification. Further studies would be necessary to more completely define the Basin's existing flora.

- Determine the invasive non-native plants that occur within Oxford Basin and develop a plan to remove these species. Such a plan would note the invasive plant species that are likely to cause continual problems in any native plant enhancement plantings, such as panic veldt grass (*Ehrharta erecta*). Procedures for the initial removal of the existing infestations and long-term maintenance measures to prevent further infestations of these species within the Basin would need to be developed in such a plan.

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ATTACHMENT B: ENTOMOLOGY REPORT

Final Report

Oxford Basin Invertebrate Study

Report number OBIS-2010-1-F

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September 7th, 2010

Executive summary

Marina del Rey's Oxford Basin is one of the few remaining areas in Los Angeles County with intertidal mud flat habitat. Mud flats provide essential feeding grounds for numerous animal species.

Invertebrates, because of their omnipresence and pivotal role in the food chain, are key indicators of the health of an ecosystem. The aquatic invertebrate fauna of Oxford Basin, albeit somewhat impoverished, is not atypical for a Southern Californian coastal wetland. A broad selection of phyla was encountered from sieved, netted, benthic and non-benthic samples, indicating a functional ecosystem. Most abundant among the aquatic macro-invertebrates were the native California Mud Snail (*Cerithidea californica*), and Gammarid Amphipods, which are a primary food source and an important link in healthy lagunal ecosystems.

The Oxford Basin flora is predominantly non-native, and constitutes a degraded fundament for a terrestrial faunal ecosystem. The native and non-native terrestrial invertebrate fauna at Oxford Basin consists, for the most part, of species found in urban environments. Despite the relative abundance of non-native plant and invertebrate species, the ecosystem is functional, with primary consumers, and both primary and secondary predators, present. A few remarkable species were found at the site, including a Signal Fly (Platystomatidae), see figure 1, that appears to be a first record for California.

Besides Monarch Butterflies, and the Signal Fly mentioned above, no species of potential biological sensitivity were found. The Basin in its current state does not offer a suitable overwintering site for Monarch Butterflies. Recommendations for conservation are provided toward the end of the report.

This project had the following three goals:

- to provide a high-level baseline inventory of the invertebrates of Oxford Basin;
- to survey and document invertebrate species of potential conservation concern; and
- to establish recommendations for conservation.

These goals have been successfully completed.

Figure 1: **Signal Fly** (*Amphicnephes sp.*)

1 Introduction

This report describes the methods and provides the results of the Oxford Basin Invertebrate Study that took place between September 18, 2009 and May 24, 2010. The study concerns the Oxford Retention Basin in Marina del Rey, Los Angeles County, California (the Basin or simply "the site"). The site is located approximately one mile inland from the coast and is predominantly bounded by Washington Boulevard, Admiralty Way, and Oxford Avenue. Its approximate Global Positioning System (GPS) coordinates are: 33**d** 59' 07" North; 118**d** 27' 18" West, where boldface '**d**' stands for degrees, a single quote for minutes, and a double quote for seconds.

The approximately 10.7-acre site consists of a large retention basin covering approximately three to five acres, depending on the water level. The basin is under tidal influence and can be isolated from the Marina waters by closing a gate.

The site is surrounded by urban areas, but has relative proximity to a few natural areas. The site is approximately 1.5 mile northwest of the Ballona Wetlands, three miles northwest of the El Segundo Dunes remnant west of LAX International Airport, six miles southeast of the Santa Monica Mountains, and 13 miles north of the Palos Verdes Peninsula. These four areas harbor a relatively high biodiversity, including a number of endemics, threatened species, and various other species of concern.

This study involved a high-level baseline invertebrate survey of both the upland and aquatic habitats. A key focus of the project was in determining if any species of conservation concern might be present at the site. Another goal was to provide recommendations for invertebrate conservation. The following sections contain the results obtained toward these goals.

Figure 2: **Fiery Skipper** (*Hylephita phyleus*) female on **Sea-lavender** (*Limonium perezii*)

2 Invertebrate surveys

The following two subsections contain details on the methodologies used for the terrestrial and aquatic surveys, as well as a discussion of the data obtained.

2.1 Terrestrial invertebrates data collection

Common terrestrial invertebrates are mostly comprised of insects and arachnids (spiders and kin). Other, less abundant taxa include: isopods (sow bugs and kin), land snails, and earthworms. Terrestrial invertebrates can be divided into (1) herbivores and detrivores, which are the primary consumers, and (2) predators and parasites. The herbivores and detrivores comprise the lower levels of the food chain; they are an essential cornerstone of ecosystems. Terrestrial herbivores are usually associated with certain host- or food-plants, which are predominantly plants native to the area. Native plants are therefore the base for a healthy terrestrial ecosystem.

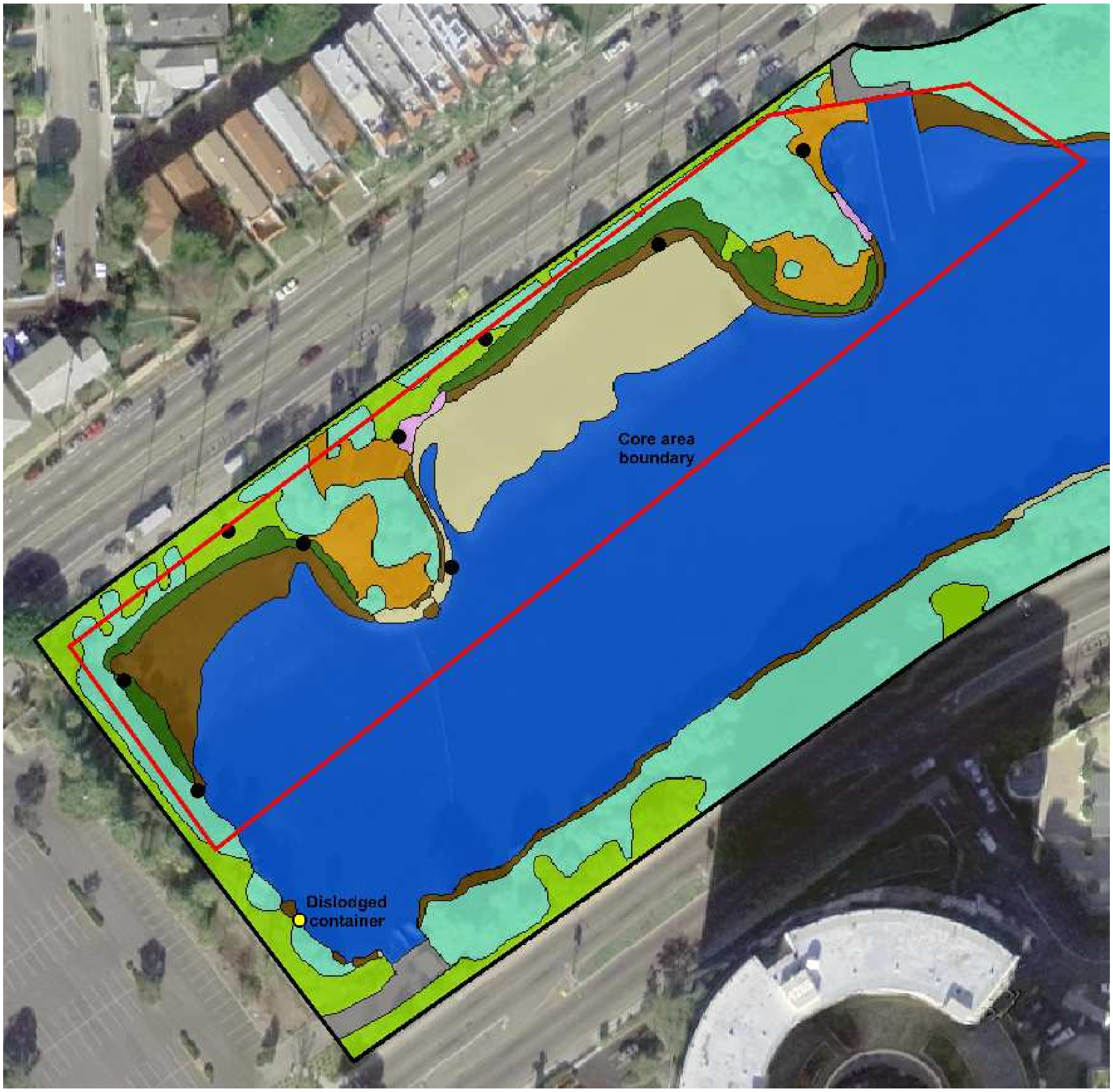
The majority of the upland area of the site is currently dominated by ruderal, non-native plant species, as documented in David Bramlet's accompanying botanical report. The biodiversity of the site is therefore expected to be compromised. The uplands of the site can be divided into "core" and "non-core" areas. The core areas include most of the basin's northwest and southwest banks, where native vegetation, such as Wild Heliotrope (*Heliotropium curassavicum*) and Common Woody Pickleweed (*Salicornia virginica*), is found. The rest of the site's uplands are non-core areas that harbor little to no native vegetation. Map 1 shows the core area delineated by a red line.

2.1.1 Methodology

The minimal impact terrestrial invertebrate survey was performed in stages, using the following methodologies:

- visual detection and photo-documenting salient organisms, as well as evidence of their presence;
- overnight pitfall trapping focused on flightless invertebrates; and
- beat-sheet collection.

Five field trips were conducted during the course of this project. The field trip dates were: September 23rd and 24th, 2009, October 5th, 2009, January 12th, 2010, and May 7th, 2010. Visual detection took place during all five visits of the site, with the bulk recorded on September 23 and 24, 2009, during unseasonably warm weather with high temperatures of approximately 85ºF. Ten pitfall traps, consisting of 1.75-liter white polypropylene containers with smooth, near-vertical walls, were placed on September 23, 2009 at various well-spaced locations between the waterline and the higher parts of the core upland areas. The locations of the pitfall traps are indicated by circles on Map 1. The next morning they were collected, and their content documented.



Map 1: Map of western part of Oxford Basin (adapted from vegetation map by David Bramlet). The red margined area delineates the core area. Pitfall trap locations are depicted by circles. The yellow circle indicates location of the pitfall trap container dislocated by the rising tide.

One container, which was placed closest to the waterline, was dislocated by the still rising water and only contained one terrestrial mite. The location of this contained is marked with a yellow circle on Map 1. The beat sheet collection took place on January 12, 2010. This technique involves beating vegetation with a stick to dislodge invertebrates that are caught on a large, white sheet placed below.

The organisms encountered were photographically recorded and the photos archived. Approximately 1,500 photos of specimens were taken during the project.

2.1.2 Terrestrial invertebrate data collected

The combined results from the three data collection methodologies are listed in Appendix A. Specimens in families already represented in the table, which were not yet identified to genus level, have been omitted.

2.1.3 Discussion

The Oxford Basin flora is predominantly non-native, and constitutes a degraded fundament for terrestrial faunal ecosystem. The native and non-native terrestrial invertebrate fauna at Oxford Basin consists, for the most part, of species typically found in urban environments. Despite the relative abundance of non-native plant and invertebrate species, the Basin's ecosystem is functional, including primary consumers and both primary predators (e.g., spiders) and secondary predators (e.g., spider wasps).

The terrestrial fauna is dominated by non-native species, in particular the Argentine Ant (*Linepithema humile*), which is discussed below. Another important non-native is the European Paper Wasp (*Polistes dominula*), which often outcompetes and then replaces native paper wasp species. Two out of three adult hemipteran species encountered are non-native to the United States. They are Bagrada Bug, also known as the Painted Bug (*Bagrada hilaris*), native to Africa, Southern Asia, and Southern Europe, and the Torpedo Bug (*Siphanta acuta*), see figure 7, native to Australia. The third adult hemipteran encountered was one exemplar of a plant bug (*Phytocoris* sp.), which is not commonly found in metropolitan Los Angeles.

Some native species were also found in relative abundance, like the Brine Fly (*Ephydra niveiceps*), which is associated with aquatic habitats, and the Sinuous Bee Fly (*Hemipenthes sinuosa*), as well as the Jumping Spider (*Habronattus pyrrithrix*) and the Margined Spurthroated Grasshopper (*Melanoplus marginatus*). The latter two are discussed below.

The most remarkable species found at the site was a beetle-like insect with a long aardvark like snout. It is a Signal Fly (Platystomatidae), see figure 1, and seems to be a new record for California. Robb Hamilton found one exemplar of this Signal Fly that looks like it belongs in genus *Amphicnephes*. There are only three species of *Amphicnephes* described in the world, all from America:

1. *A. fasciola*, with records from Kansas and Arizona,
2. *A. pullus*, which is relatively common and widespread in the Eastern Nearctic region, (west to Texas), and
3. *A. stellatus*, with records from southern and eastern Mexico.

The specimen is likely *Amphicnephes fasciola*, given that its distribution range, which includes Arizona, is the closest to Southern California of the three described species, and Coquillett's original description of *A. fasciola* [Coquillett 1900] matches reasonably well. On subsequent visits the principal investigator surveyed the area where the specimen was seen but did not find another exemplar as potential voucher specimen. It is likely that the restricted public access has contributed to the survival of this rarity at Oxford Basin.

A few species of special interest are discussed in some detail here:

Argentine Ant (*Linepithema humile*)

A species of special concern in terms of its abundance is the Argentine Ant (*Linepithema humile*). This small ant is abundant on the site, across much of Los Angeles County, and far beyond. It is an introduced, i.e. non-native, species that outcompetes native ant species [Nygard 2008] [Holway 1999] [Kennedy 1998] [Erickson 1971] [Human 1996] [Human 1998] and other invertebrates [Cole 1992] [Holway 1995] [Grover 2008]. In Los Angeles County, Argentine Ants have decimated the native California Harvester Ant (*Pogonomyrmex californicus*) and hence, indirectly their predator, the Coast Horned Lizard (*Phrynosoma blainvillii*), which primarily feeds on native ant species like the California Harvester Ant. No native ants were found at the site.

Margined Spurthroated Grasshopper (*Melanoplus marginatus*)

Only one species of grasshopper was found during the survey. This is the short-winged form of the Margined Spurthroated Grasshopper (*Melanoplus marginatus*), see figure 5, which was fairly common at the site. This species is endemic to California. The southern edge of its range includes part of the Santa Monica Mountains [Capinera 2004]. The Oxford Basin population may therefore represent its southernmost recorded occurrence. It is not clear if it is found in the Ballona Region, as only "*Melanopus species?*" is listed in the 1980-1981 entomology survey report [Schreiber 1981], and there are a number of other *Melanoplus* species present in the Los Angeles Basin. Increasing their distribution area is hampered by their short wings, which render them incapable of sustained flight and limits their dispersal, especially when surrounded by urban areas. Their local gene pool is therefore in danger of becoming impoverished.

Jumping Spider (*Habronattus pyrrithrix*)

The Jumping Spider (Salticidae) most often encountered during the survey is *Habronattus pyrrithrix*. This a common spider of the Los Angeles area, whose prime habitat includes wetlands. There seems to be a healthy population of these small jumping spiders at the site.

Spider Wasp (*Aporinellus sp.*)

A good-sized population of small, gray-and-black spider wasps (*Aporinellus sp.*) was present at the site. Despite a cosmopolitan distribution across the United States and beyond, they are uncommonly found in the Los Angeles metropolitan area. Their main prey is Jumping Spiders (see previous species account), which are food for their offspring. This renders these spider wasps secondary predators in this slender ecosystem.

2.2 Aquatic invertebrates

2.2.1 Methodology

The aquatic data collection was performed using a 500 micron D-frame net (BioQuip # 7412D). Sampling took place on Monday October 5th, 2009 near high-tide at various locations on the north and west side of the basin. These areas have the lowest bottom gradient, and consequently more extensive shallow areas, which usually have a higher invertebrate biodiversity. Before stepping into the water, we sampled the shallowest water depths, to minimize disturbance of potentially fast species. Next, we entered the water wearing waders and sampled up to deepest reachable areas, while standing in about 3 feet of water and using the 5-foot-long aquatic net handle. We first sampled the water column, followed by sweeps along the benthos, both with long, swift sweeps. The collected material was deposited into a wide white bucket. Next, the content of the bucket was transferred into collection jars using a 1-mm sieve for later examination in the lab.

2.2.2 Aquatic data

Our aquatic data collection, as described in section 2.2.1, resulted in specimens from a spectrum of phyla, as expected. We encountered large schools of juvenile fish, which were predominantly Mosquito Fish (*Gambusia affinis,* Phylum Chordata). This, and other fish species encountered at the site, are discussed in the accompanying fish report by Camm Swift of Entrix, Inc. We found the California Mud Snail (*Cerithidea californica*; Phylum Mollusca) in large quantities below the high-tide line, some Straight Horsemussels (*Modiolus rectus*), and a few other small to microscopic bivalves in the benthos. In the Phylum Arthropoda we found large numbers of Gammarid Amphipod (Suborder Gammaridae; Order Amphipoda) adults and immatures, as well as some Copepods (Class Maxillopoda) and the remains of one shrimp, which is apparently an Ocean (Smooth) Pink, also known as Pink Shrimp (*Pandalus jordani*; Order Decapoda; Class Malacostraca). We furthermore recorded relatively large numbers of Nematodes (Phylum Nematoda), some Flatworms (Phylum Platyhelminthes), Rotifers (Phylum Rotifera), and Seed Shrimp (Phylum Ostracoda), and various microscopic Protozoans (Phylum Protozoa), including some collared flagellates. Within each taxon we observed relatively little diversity.

This broad variety of organisms, plus the overall abundance of amphipods, indicates the relative health of the basin's water, and provides ample feeding grounds for various wildlife. Specifically, gammarid amphipods are a prime food source for fish and birds [McCurdy 2005] [Schneider 1981]. They also have a high sensitivity to environmental changes [Conlan 1994] [Zajac 2003], and monitoring their abundance can provide one useful measure of the quality of the ecosystem.

For completeness, we report collecting a wide spectrum of minute pieces of polymers (plastics) of all colors of the rainbow, as well as extruded polystyrene foam (Styrofoam) pellets, in our net. These ubiquitous particles typically become an undesired and unhealthy part of the food chain.

3 Species of potential concern

Species of concern range from those whose population survival is critically endangered and are formally protected by law, to rare, endemic, and other species whose populations may be declining due to urbanization, environmental pollution, or other threats. Invertebrate species of concern whose range includes, or potentially includes, the site, are discussed in the following subsections, grouped by information source.

3.1 Venice area species listed in the California Natural Diversity Database

The list of key species of concern for a certain area is usually obtained from the California Natural Diversity Database (CNDDB), which includes endangered species that are protected by law. The database contains the status and locations of rare plants and animals in California. The CNDDB data is linked to global status information, which is listed in the Global Natural Diversity Database (NDDB). The land area units used by the CNDDB correspond to Topographic Quadrangles (Quads), as defined by the United States Geological Survey (USGS). The standardized Quad map scale is 1:24,000 and the map covers an area measuring 7.5 minutes of latitude (approximately 8.5 miles) and 7.5 minutes of longitude (approximately 7 miles). The Oxford Basin is situated on the Venice Quad map. The CNDDB lists twelve species for the area covered by the Venice Quad map.

Table 1 contains the following information for each of these twelve species:

- scientific name (genus, species, and, where applicable, subspecies),
- common name,
- conservation status for the following five entities:
  - NDDB [CNDDB 2010]: “NDDB-rarity, Global”
  - CNDDB [CNDDB 2010]: “NDDB-rarity, CA”
  - Federal Endangered Species Act (ESA): “Fed.”
  - California Endangered Species Act (CESA): “(C)ESA, CA”
  - International Union for Conservation of Nature (IUCN) [IUCN 2010],
- whether the species was encountered during our surveys, and
- likelihood of presence at Oxford Basin.

Figure 3: **Plant Bug** (*Phytocoris sp.*)

Genus	Species	Sub-species	Common Name	Conservation Status					observed	Likelihood of presence at Oxford Lagoon
				NDDB-rarity		(C)ESA		IUCN		
				Global	CA	Fed.	CA			
Brennania	belkini		Belkin's Dune Tabanid Fly	G1G2	S1S2	0	SC		no	low; lack of suitable sand dune habitat
Carolella	busckana		Busck's Gall Moth	G1G3	SH	0	SC	NE	no	very low; extirpated in L.A. County [LADoT 2009]
Cicindela	hirticollis	gravida	Sandy Beach Tiger Beetle	G5T2	S1	0	SC		no	very low; lack of suitable habitat.
Cicindela	senilis	frosti	Senile Tiger Beetle	G2G3 T1T3	S1	0	0		no	very low; possibly extirpated in L.A. Co.
Coelus	globosus		Globose Dune Beetle	G1	S1	0	SC	VU	no	very low; >50m from high-tide line; no fore-dune habitat.
Danaus	plexippus		Monarch Butterfly	G5	S3	0	SC		yes	present as migratory species
Eucosma	hennei		Henne's Eucosman Moth	G1	S1	0	SC		no	low; no host plant
Euphilotes	battoides	allyni	El Segundo Blue Butterfly	G5T1	S1	FE	0		no	low; no host plant
Onychobaris	langei		Lange's El Segundo Dune Weevil	G1	S1	0	SC	NE	no	low; lack of suitable sand dune habitat
Panoquina	errans		Wandering Skipper (Butterfly)	G4G5	S1	0	SC	NT	no	low; no host plant
Trigonoscuta	dorothea	dorothea	Dorothy's El Segundo Dune Weevil	G1T1	S1	0	SC		no	low; lack of suitable sand dune habitat
Tryonia	imitator		Mimic Tryonia (Brackish Water Snail)	G2G3	S2S3	0	SC	DD	no	very low; lack of suitable habitat; assumed extirpated in L.A. Co.

Table 1: Species listed in CNDDB for the area covered by the Venice Quad map
Abbreviations used: DD = Data Deficient; FE = Federally Endangered; NE = Not Evaluated; NT = Near Threatened; SC = Species of Concern; VU = Vulnerable; for (C)NDDB codes see [CNDDB 2010].

Some of the data in Table 1 is color coded. The conservation status data is color coded from red, representing the highest conservation level, via pinkish and brown, to beige-brown, representing the lowest level. If a species was observed during the survey, it is color coded green, otherwise brownish.

3.2 Notes on selected species

This section contains additional information on selected species listed in Table 1.

3.2.1 El Segundo Blue (*Euphilotes battoides allyni*)

The El Segundo Blue butterfly (*Euphilotes battoides allyni*) is the only taxon in Table 1 that is placed on the federal list of endangered species. It is endemic to the coastal sand dunes of southwestern Los Angeles County, which historically ranged from Westchester, which is situated southeast of Marina del Rey, southward to the Palos Verdes Peninsula [USFWS 1998]. Urbanization has drastically reduced their range to a few small disjunct populations. The site, being on the north side of Marina del Rey, is at least two miles northwest of Westchester. It is however located within the Ballona Recovery Unit for the El Segundo Blue butterfly

[USFWS 1998]. The larval food plant for the El Segundo Blue is Seacliff Buckwheat, also known as Dune Erigonium, (*Eriogonum parvifolium*), which is not found at the site. This, plus the fact that they do not stray far from their food plant, renders it quite unlikely that the El Segundo Blue will be found at the site.

3.2.2 Immitator Tryonia Snail (*Tryonia imitator*)

All but one of the 23 extant species of *Tryonia* snails live in fresh water habitats; most live in springs, some in lakes. The Immitator Tryonia (*Tryonia imitator*) is the only exception, having its habitat in brackish coastal water [Kellogg 1985]. When present, they are usually one of the more abundant among the macro-invertebrate benthos [Meffe 1983] with typical densities of 20,000 or more animals per meter square [Kellogg-1985], and hence unlikely to be missed. They have historically been found at two locations in Los Angeles County: San Pedro (extirpated) and Ballona Creek (1974) [Kellogg-1985]. Since the Basin receives an irregular influx of “fresh” water from the urban drains, mostly during the rainy season, it has a relatively high salinity and no permanent areas of brackish water. This, combined with the fact that we did not encounter any evidence of the presence of Immitator Tryonia during this survey, renders it highly unlikely that this rare species is present at the site.

3.2.3 Monarch Butterfly (*Danaus plexippus*)

During all of our site visits we recorded Monarch (*Danaus plexippus*) specimens passing by the site in an approximately east to west direction. Each specimen stayed only briefly near the site and visited a few flowers before continuing in westerly direction.

Monarch butterflies are migratory and are frequently seen in coastal Los Angeles County and beyond. Their numbers have been fluctuating over the years, with a distressing downward trend during the recent past [Xerces 2010]. They are a species of concern as they have a limited number of remaining overwintering sites. Their overwintering sites are covered by statues of the California Public Resources Code and the California Fish and Game Code.

Overwintering sites usually consist of groves of trees of mixed height and diameter, with an understory of brush and sapling trees [Calvert 1986], often adjacent to a clearing, to maximize protection from the wind, as well as avail from the winter season sun. The larger the grove, the more choices the butterflies have for relocation to areas with more optimal conditions. The vegetation moderates weather conditions and overall temperatures [Calvert 1981]. The Monarchs tend to avoid the tops of the trees to minimize exposure [Brower-2008], and favor the zone 15 to 50 feet above the ground. Availability of winter-blooming food-plants is also an important selection criterion for their overwintering sites.

Monarch butterflies feed on nectar from Milkweeds (*Asclepias* spp.) and Butterfly Mint (*Monardella* spp.) flowers. Other flowers that are used by the Monarch butterfly are: Black Sage (*Salvia mellifera*), Woolly Blue Curls (*Trichostema lanatum*), California Licorice Mint (*Agastache urticifolia*), Desert Willow (*Chilopsis linearis*), Dwarf Sunflower (*Helianthus gracilentus*), Brittlebush or California Bush Sunflower (*Encelia californica*), Nevin's Barberry

(*Mahonia nevinii*), Golden Currant (*Ribes aureum* var. *gracillimum*), Wild Hyacinth (*Dichelostemma capitatum*), Bladder Pod (*Isomeris arborea*), Blue Lobelia (*Lobelia dunnii*), and Venus Thistle (*Cirsium occidentale var. venustum*).

Some of the most important Monarch overwintering sites are along the coast of Central and Southern California. In Southern California, Monarchs usually overwinter in groves of Blue Gum (*Eucalyptus globulus*) or (River) Red Gum (*E. camaldulensis*) [Lane 1993], in a zone between a half mile and one mile from the coast. Even though the Oxford Basin is on the migratory path of the Monarchs, is located approximately one mile from the coast, and has both Blue Gum and Red Gum trees, it does not feature a grove of mixed height and diameter, with an understory of brush and sapling trees. It also lacks food plants for adult Monarchs. Hence it is unlikely that Monarchs will choose the site in its present condition for overwintering.

3.2.4 Sand Dune Tiger Beetle (*Cicindela hirticollis gravida*)

Sand Dune Tiger Beetles, also known as Sandy Beach Tiger Beetles (*Cicindela hirticollis gravida*), have been recorded from Playa del Rey in 1906. Their habitat is light-colored sand at the mouths of estuaries or barrier islands, which is not present at the site. This species of tiger beetle is very sensitive to contact with humans [Nagano 1980] and likely sensitive to human alteration of waterways [Brust 2006]. It is now apparently extinct from the mouth of Ballona Creek, which was the only remaining suitable habitat of the area [Schreiber 1981].

3.2.5 Wandering Skipper (*Panoquina errans*)

The Wandering Skipper butterfly (*Panoquina errans*) is found in a few locations in a narrow coastal strip between Santa Barbara and the cape region of Baja California [MacNeill 1962]. Its habitat is coastal salt marshes and estuaries near ocean bluffs and other open areas, and its host plants are Saltgrass (*Distichlis spicata* var. *spicata*) and Cordgrass (*Spartina foliosa*). Historically, Wandering Skippers were found in the Ballona region, but they were not found there during surveys performed between 1996 and 1998 [FHA 1998]. There is still a viable population at Malibu Lagoon in the Santa Monica Mountains area. Since the host plants are absent and no specimens were recorded during our survey, it is highly unlikely that the Oxford Basin supports a population of the Wandering Skipper.

Figure 4: **Sweat Bee** (*Halictus tripartitus*) female on **Alkali Heliotrope** (*Heliotropium curassavicum*)

3.3 Other CNDDB species

There are other invertebrates listed in the CNDDB with a historical distribution range that includes coastal Los Angeles County. These are three tiger beetle species and one freshwater mussel. The three tiger beetles, which are not listed in table 1, inhabit tidal flats and salt marshes:

- *Cicindela gabbi*, the **Western Tidal Flat Tiger Beetle**, also known as **Gabb's Tiger Beetle**;
- *Cicindela latesignata latesignata*, the **Western Beach Tiger Beetle**; and
- *Cicindela trifasciata sigmoidea*, the **Western S-banded Tiger Beetle**, also known as the **Mudflat Tiger Beetle**.

Tiger beetles are active on warm sunny days on open mud or sand. Their larvae inhabit burrows in the soils of the same habitats. Tiger beetles are severely threatened by urban expansion, insecticide use, and recreational use of coastal habitats.

The first tiger beetle listed above, *C. gabbi*, is a rare species that inhabits dark colored mud of upper mudflats and salt-pannes of coastal salt marshes. Its historic range stretched from Wilmington in southern Los Angeles County southward to northwestern Mexico. There exist three specimens labeled “Pt. Mugu, California,” but Christopher Nagano feels these have been mis-labeled [Nagano 1980]. This tiger beetle species is very sensitive to urbanization pressure, and has been considered extirpated from Los Angeles County [Nagano 1980].

The second, *C. latesignata latesignata*, which inhabits coastal dunes and mudflats, is also very sensitive to urbanization pressure [Zedler 1982] [Pearson 2006]. It is historically known from San Pedro in southern Los Angeles County south to Baja California in Mexico. Its U.S. range has shrunk from three Southern California counties to one location in San Diego County [Nagano 1980] [Pearson 2006].

The third, *C. trifasciata sigmoidea*, inhabits mudflats and other areas with dark-colored, moist-to-wet sands, has been exterminated from the historic Venice Salt Marsh area, which is now Marina del Rey, except the Ballona Creek Region [Schreiber 1981]. Given the history of Oxford Basin, and it being surrounded by intense urbanization, plus the fact that we found no evidence of these tiger beetles during our survey studies — some of which took place in warm, sunny weather within their annual adult activity period — it is highly unlikely that this beetle is present at the site.

The last of the four species mentioned above is *Anodonta nuttalliana*, the **Winged Floater**. This is a freshwater mussel found on muddy and sandy bottoms in rivers and lakes [Clarke 1981], which is habitat that does not occur on the site.

For completeness we list a few species, listed in the CNDDB, whose historical range is in relative proximity of the site:

- *Coelus pacificus*, the **Channel Islands Dune Beetle**, is considered endemic to the California Channel Islands [Miller-1985].
- *Glaucopsyche lygdamus palosverdesensis*, the federally endangered **Palos Verdes Blue Butterfly**, whose larval foodplants, Rattlepod (*Astragalus trichopodus lonchus*) and Deervetch (*Lotus scoparius*) are not present on the site. This species is restricted to the Palos Verdes Peninsula area, more than twelve miles from the site.
- *Gonidea angulata*, the **Western Ridged Mussel**, is restricted to freshwater habitat, which is not (permanently) available on the site.
- *Haplotrema caelatum*, the **Slotted Lancetooth Snail**, is a little-known terrestrial snail with a distribution from coastal Central California south to northwestern Baja California, Mexico. No Slotted Lancetooth snails were found during this study.
- *Helminthoglypta traski coelata*, also known as *Helminthoglypta coelata*, the **Peninsular Range Shoulderband**, is another little-known land snail. This two centimeter diameter crepuscular snail has been found in rock slides beneath bark and rotten logs, and in coastal vegetation [SD-DPLU 2009]. The holotype is from Pacific Beach, in San Diego County, California.
- *Rhaphiomidas terminatus terminatus*, the **El Segundo Flower-loving Fly**, has historically been described from the El Segundo Dunes, and is now considered extirpated at that location [Mattoni 1994]; a small population survives on the Palos Verdes Peninsula. Its dune habitat, as well as its apparent preferred vegetation, California Croton (*Croton californicus*), are absent from Oxford Basin.

Figure 5: **Margined Spurthroated Grasshopper** (*Melanoplus marginatus*)

3.4 NatureServe

NatureServe is a non-profit conservation organization whose mission is to provide the scientific basis for effective conservation action. The NatureServe database is a leading source for information about rare and endangered species and threatened ecosystems. It contains the species included in the CNDDB. It also lists a species, with a historical range encompassing coastal Los Angeles County whose vulnerability has not yet been ranked by NDDB or CNDDB. This unranked species is *Psammobotys fordi*, **Ford's Sand Dune Moth**. The adults of this snout moth in the Crambidae family nectar at *Gnaphalium*, which is not present at the site. The moth is endemic to the El Segundo dunes and is suspected to be extinct [Mattoni 2000].

3.5 Other sources

For completeness, we list species of potential concern from the undisturbed remnant of the El Segundo Dunes west of Los Angeles International Airport and from the Ballona Wetlands and surrounding areas in Playa del Rey. A number of these species are rare, and some have not been formally described and do not yet have a scientific species name. None of these species have been recorded from the site during this project.

- *Aegialia convexa*, the **Dune Scarab Beetle** is a 4.5 millimeter long, black to dark-brown scarab beetle, found on ocean beaches;
- *Aptostichus simus*, the **Dune Trapdoor Spider**, which has been reported from the El Segundo Dunes, in Los Angeles County, north to Monterey County. Its habitat is fairly steep, undisturbed, south-facing slopes of packed sand, which are not present at the site;
- *Comadia intrusa*, the **El Segundo Goat Moth**, uses **Dune Lupine** (*Lupinus chamissonis*) as host plant, which does not occur on the site;
- *Copablepharon sanctaemonicae*, the **Santa Monica Dunes Moth**, is restricted to sand dune habitats, and primarily found in foredunes. Its host plant is Sand Verbena (*Abronia* sp.) [Mattoni 1990], which does not occur on the site;
- *Cophura clausa*, the **Seashore Robber Fly** [Schreiber 1981], a little-known, 7 to 9 millimeter long fast-flying predatory fly, originally described from Orange County. It has a large distribution range that includes the Mojave desert;
- *Cylindrocopturus new sp.*, an undescribed weevil, which isendemic to the El Segundo Dunes;
- *Ebo new sp.*, an undescribed crab spider, was reported to be present in encouraging numbers in the El Segundo dunes in 1993 [Mattoni-1993];
- *Eremobates new sp.*, **Coastal Dune Whip Scorpion**, is a solifugid. Solifugids, also known as sun spiders, are in a taxonomic order different from both the spiders and the scorpions. This solifugid species is not endemic to the Ballona Creek Region [Schreiber 1981];
- *Euxoa riversii*, **River's Dune Moth**, is a rare noctuid moth found in sand dune habitat;

- *Nebritus powelli*, a recently described stiletto fly without a common name, is possibly associated with coastal dunes and willows (*Salix* spp.) [Webb 1991]; it could become recognized as a species of concern because its distribution range is limited to a few coastal locations between Los Angeles County (Ballona Wetlands) and San Luis Obispo County, and such areas are prone to urbanization pressure;
- *Psammodius mcclayi*, the **South Coast Dune Beetle**, is a detritus-feeding scarab beetle found among the roots of grasses on sand dunes of the Californian sea coast. The holotype is from Playa del Rey;
- *Scythris new sp. 1*, the **El Segundo Scythrid Moth**, was reported to be present in encouraging numbers in the El Segundo dunes in 1993 [Mattoni 1993];
- *Scythris new sp. 2*, the **Lesser Dunes Scythrid Moth**, is reported to be rare and restricted to the El Segundo dunes [Mattoni 1993];
- *Stenopelmatus new sp.*, the **El Segundo Jerusalem Cricket**, is endemic to the El Segundo Dunes, whose northern limits are south of Marina del Rey [Mattoni 1993].

None of these species have been recorded during the course of this project. Due to the site not being a dune habitat, not being pristine, and not having salt flats or other wetland niche habitats, is it unlikely that these species are present at the site. It is, however, possible that some of the flying species are capable of reaching the site, especially during accommodating weather conditions; and if proper habitat is present at the site, they might take up residence.

3.6 Conclusions

The site in its present state is unlikely to harbor healthy populations of any invertebrate species of concern, with possible exception of the Signal Fly discussed in section 2.1.3 above. This is especially due to the scarcity of native vegetation, minimal habitat diversity, presence of non-native fauna, especially Argentine Ants, and the absence of soft sand dune habitat and presence of concrete and other rubble in the soil. Other intrinsic factors are the site's relatively small area and it being surrounded by urbanization, without explicit migration corridors, like adjacent urban parkland or backyards.

Figure 6: **Robber Fly** (*Nicocles sp.*) female

4 Recommendations

4.1 Recommendations for conservation

The Oxford Basin has great potential as a habitat for native invertebrates. Even though the site is currently in a relatively degraded state, with predominantly non-native vegetation, the basin provides an important breeding ground for many aquatic species. The upland areas still have some native vegetation and can be restored to become a more vibrant coastal ecosystem. Specific recommendations for conservation, restoration, and overall site improvement are:

- Removal of exotic plants, ideally by hand, without the use of toxic pesticides.
- Planting a broad diversity of native plants, specifically plants native to the local coastal area of Los Angeles County.
- Abatement of Argentine Ants, which displace native ant species as well as other arthropods, resulting in an impoverished biotope. A critical part of restoration efforts on the site should include the abatement of Argentine Ants. If desired, BioVeyda can assist in this effort.
- Removal of unnecessary concrete and other construction debris. Some monolithic rocks can be left or intentionally placed, as they will provide habitat for various vertebrate and invertebrate animals.

Possible introduction of native fauna, or at least introduction of their food-plants; for example:

- Pygmy Blue (*Brephidium exilis*): Chenopodiaceae, including Atriplex and Chenopodium.
- Wandering Skipper (*Panoquina errans*): Saltgrass (*Distichlis spicata* var. *spicata*) and Cordgrass (*Spartina foliosa*), which are common native plants in Southern Californian salt marshes.

4.2 Recommendations for future invertebrate surveys

The list of invertebrates encountered on the site is rudimentary, as the scope and duration of the project was limited to obtaining a high-level baseline. It would be beneficial to perform periodic surveys in the future, whose results can be compared to those obtained during this project. These future surveys would add valuable information toward completeness of the list and toward measuring changes in biodiversity over time. It would be of value to monitor before, during, and after a potential restoration effort, or other planned habitat modification.

It would be ideal to continue performing minimal impact surveys, based on visual inspection, including the use of close-focusing binoculars, photography, and capture and release. During minimal impact surveys, a minimal number of specimens are killed and curated for future study. For most common species it is not necessary to examine captured specimens in detail for identification. For uncommon taxa, it is often helpful to examine a specimen in microscopic detail, and occasionally by dissection, in order to arrive at a solid taxonomic identification.

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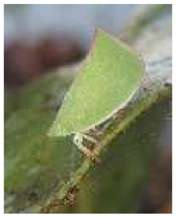

Figure 7: **Torpedo Bug** (*Siphanta acuta*)

Appendix A Invertebrates recorded

The invertebrates recorded during the project are listed in the following table. The table contains the combined results of the terrestrial invertebrate data collection methodologies, as well as the recorded aquatic macro-invertebrates.

Family	Genus	Species	Subspecies	Common Name(s)
Phylum: Arthropoda				**Arthropods**
Class: Arachnida				**Arachnids = Spiders, Mites, & kin**
Order: Aranea				**Spiders**
Agelenidae				Funnel-web Spiders
Dysderidae	Dysdera	crocata		Woodlouse Spider
Gnaphosidae				Ground Spiders
Lycosidae				Wolf Spiders
Miturgidae	Cheiracanthium	mildei		Longlegged Sac Spider
Oecobiidae	Oecobius	sp.		Baseboard Spider
Salticidae	Habronattus	pyrrithrix		Jumping Spider
Theridiidae	Steatoda	grossa		False Black Widow (Spider)
Class: Collembola				**Springtails**
Order: Entomobryomorpha				**Elongate-bodied Springtails**
Entomobryidae				Elongate-bodied Springtails
Class: Diplura				**Two-pronged Bristletails**
Order: Rhabdura				**Rhabdurans**
Campodeidae	Campodea	kelloggi		Two-pronged Bristletail
Class: Insecta				**Insects**
Order: Coleoptera				**Beetles**
Anobiidae	Ozognathus	cornutus		Death-watch Beetle
Carabidae	Bembidion	sp.		Minute Ground Beetle
Carabidae	Calathus	ruficollis	ruficollis	Redneck Woodland Ground Beetle
Coccinellidae	Cryptolaemus	montrouzieri		Mealybug Destroyer
Dermestidae	Cryptorhopalum	sp.		Carpet Beetle
Hydrophilidae	Enochrus	sp.		Water Scavenger Beetle
Staphylinidae				Rove Beetles
Order: Dermaptera				**Earwigs**
Anisolabididae	Euborellia	annulipes		Ring-legged Earwig
Order: Diptera				**Flies, Mosquitos, & kin**
Asilidae	Nicocles	sp.		Robber Fly (see figure 6)
Bombyliidae	Hemipenthes	sinuosa		Sinuous Bee Fly
Bombyliidae	Villa	lateralis		Bee Fly
Calliphoridae	Lucilia	sp.		Common Green Bottle Fly
Chironomidae				Midges
Ephydridae	Ephydra	niveiceps		Brine Fly (see figure 8)
Ephydridae	Mosillus	sp.		Shore Fly
Limoniidae	Erioptera	pilipes		Limoniid Crane Fly
Muscidae	Coenosia	sp.		Tiger Fly
Platystomatidae	Amphicnephes	sp.		Signal Fly (see figure 1)
Sarcophagidae	Sarcophaga	sp.		Flesh Fly
Syrphidae	Eristalinus	aeneus		Hover Fly
Syrphidae	Eupeodes	volucris		Bird Hover Fly
Syrphidae	Palpada	sp.		Drone Fly
Syrphidae	Paragus	haemorrhous		black+red Hover Fly
Syrphidae	Sphaerophoria	sp.		cylinder Hover Fly
Tachinidae				Tachinid Flies

	Family	Genus	Species	Subspecies	Common Name(s)
Phylum: Arthropoda					**Arthropods**
Class: Insecta					**Insects**
Order: Hemiptera					**True Bugs, Hoppers, Aphids, & kin**
	Cicadellidae				Leafhoppers
	Flatidae	Siphanta	acuta		Torpedo Bug (see figure 7)
	Miridae	Phytocoris	sp.		Plant Bug (see figure 3)
	Pentatomidae	Bagrada	hilaris		Bagrada Bug = Painted Bug
	Psyllidae				Psyllids
	Saldidae				Shore Bugs
Order: Hymenoptera					**Wasps, Ants, Bees, Sawflies, & kin**
	Apidae	Apis	mellifera		European Honey Bee
	Apidae	Xylocopa	varipuncta		Valley Carpenter Bee
	Colletidae	Hylaeus	sp.		Yellow-masked Bee
	Formicidae	Linepithema	humile		Argentine Ant
	Halictidae	Halictus	tripartitus		Sweat Bee (see figure 4)
	Ichneumonidae				Ichneumon Wasps
	Pompilidae	Aporinellus	sp.		Spider Wasp
	Pompilidae	Episyron	conterminus	posterus	Spider Wasp
	Sphecidae	Ammophila	sp.		Thread-waisted Wasp
	Sphecidae	Sceliphron	caementarium		Black and Yellow Mud Dauber
	Vespidae	Eumenes	sp.		petioled Potter Wasp
	Vespidae	Polistes	dominula		European Paper Wasp
Order: Isoptera					**Termites**
	Kalotermitidae	Incisitermes	minor		Western Drywood Termite
Order: Lepidoptera					**Butterflies & Moths**
	Crambidae	Dicymolomia	metalliferalis		Crambid Snout Moth
	Geometridae	Perizoma	sp.		Geometrid Moth
	Hesperiidae	Hylephila	phyleus		Fiery Skipper (see figure 2)
	Hesperiidae	Poanes	melane		Umber Skipper
	Noctuidae	Autographa	californica		Alfalfa Looper (Moth)
	Nymphalidae	Danaus	plexippus		Monarch
	Nymphalidae	Vanessa	atalanta		Red Admiral
	Nymphalidae	Vanessa	cardui		Painted Lady
	Papilionidae	Papilio	rutulus		Western Tiger Swallowtail
	Pieridae	Pieris	rapae		Cabbage White
	Pyralidae	Ephestiodes	gilvescentella		Dusky Raisin Moth
	Sphingidae	Hyles	lineata		White-lined Sphinx (Moth)
	Tineidae	Oinophila	v-flavum		Yellow V Moth
Order: Microcoryphia					**Bristletails**
	Machilidae				Bristletail
Order: Odonata					**Dragonflies & Damselflies**
	Coenagrionidae	Ischnura	cervula		Pacific Forktail
	Libellulidae	Libellula	saturata		Flame Skimmer
	Libellulidae	Pachydiplax	longipennis		Blue Dasher
	Libellulidae	Sympetrum	corruptum		Variegated Meadowhawk
	Libellulidae	Tramea	lacerata		Black Saddlebag

	Family	Genus	Species	Subspecies	Common Name(s)
Phylum: Arthropoda					**Arthropods**
Class: Insecta					**Insects**
Order: Orthoptera					**Grasshoppers, Crickets, & kin**
	Acrididae	Melanoplus	marginatus	(see fig. 5)	Margined Spurthroated Grasshopper
	Myrmecophilidae	Myrmecophilus	sp.		Ant (Loving) Cricket
Order: Psocoptera					**Booklice & Barklice**
	Ectopsocidae				Outer Barklice
Order: Thysanoptera					**Thrips**
	Phlaeothripidae				Tube-tailed Thrips
Class: Malacostraca					**Amphipods & Isopods**
Order: Amphipoda					**Scuds & Sideswimmers**
	Gammaridae				Gammarid Scud
Order: Decapoda					**Crabs, Lobsters, Shrimp, & kin**
	Pandalidae				Shrimp
Order: Isopoda					**Isopods**
	Porcellionidae	Porcellionides	pruinosus		Woodlouse
Class: Maxillopoda					**Barnacles, Copopods, & kin**
Order: Sessilia					**Acorn Barnacles**
	Balanidae	Balanus	sp.		Acorn Barnacle
Phylum: Mollusca					**Molluscs**
Class: Gastropoda					**Snails & Slugs**
Order: Neotaenioglossa					
	Bullidae	Bulla	gouldiana		California Bubble Shell
	Potamididae	Cerithidea	californica		California Mud Snail
Class: Bivalvia					**Bivalves**
Order: Mytiloida					**Saltwater Mussels**
	Mytilidae	Modiolus	rectus		Straight Horsemussel
	Veneridae	Protothaca	laciniata		Rough-sided Littleneck Clam

Figure 8: **Brine Fly** (*Ephydra niveiceps*) female + male

End of Final Report

ATTACHMENT C: FISH & ESTUARINE BIOLOGY REPORT

MEMORANDUM

To: Robert A. Hamilton
Hamilton Biological, Inc.
316 Monrovia Avenue
Long Beach, CA 90803

From: Camm C. Swift, Ph.D.
Joel Mulder

Re: Results of Fish surveys at Oxford Basin on January 12 and April 27, 2010 and recommendations for restoration potential for fishes and other estuarine and marine life.

Date: August 27, 2010

Introduction

Oxford Basin (Basin) is a storm-water flood control basin connected by tide-gates and a subterranean concrete conduit to Marina del Rey. The Basin is located along Washington Avenue between Oxford Avenue and Palawan Way in the City of Venice, Los Angeles County, California (33°59'6.77"N, 118°27'19.93"W). It is a remnant of the much larger Ballona Wetlands that formerly occupied this area prior to development of the harbor (Swift and Frantz 1981) and which constituted the mouth of the Los Angeles River in the early 1800s. The Los Angeles County Department of Public Works (LADPW) requested a study of the fish population in the Basin from Hamilton Biological in order to provide a basis for the formulation of a restoration plan for the area and to examine the possible alternatives for improvements to the area. ENTRIX, Inc. (ENTRIX) conducted two fish surveys at Oxford Basin (January 12 and April 27, 2010) and performed a review of historical documents on the fishes and other biological aspects of the area. The results of this study are presented here and provide data on the current fish fauna. Also provided is a discussion and analysis of potential restoration actions to benefit and improve the estuarine habitat for fish and other aquatic estuarine species.

Description of the Project Area

Oxford Basin is designed to catch storm and street water runoff from the surrounding urban areas of the City of Venice and Marine del Rey. The main body of the Basin is approximately 465 meters (m) long and 56 m wide at its widest point. The Basin is generally rectangular shaped and runs in a northeast to southwest direction, with one long, narrow arm leading east approximately 120 m to a storm-water inlet (Figures 1 and 2). During the first survey on January 12, 2010, a small amount of street runoff flow was being pumped into the Basin around a construction project taking place at the eastern inlet. On the second survey occurring April 27, 2010, a permanent concrete diversion barrier had been completed at this inlet which collected street runoff and periodically pumped it into the sewer system rather than allowing this flow into the Basin. However, overflow inlets were present to allow high storm flows to pass in the Basin. A second inlet entered the Basin along the northern side via a concrete lined channel with a concrete apron (approximately 8.5 m wide) extending out into the Basin (Figures 1 and 2). Less than an estimated 0.02 cubic meters per second of flow was observed entering the Basin from this inlet on both survey dates. Additionally, two small trickles of street drainage or seepage were observed on the west and east sides of a southward extending point of land on the northern shore, directly across the Basin from the tide gates.

Water depths within the Basin fluctuate with natural tidal fluctuations in Marina del Rey, however, the inflow and outflow to the Basin is controlled by a set of tide-gates at the southwestern corner of the Basin. The elevation of high tide allowed to rise by no more than approximately 1.5 m (4.8 feet) above mean low water (Mike Stephenson, LADPW, January 12, 2010, personal communication). As a result, water depths in the Basin were greatest at or shortly after high tide, with a maximum depth of approximately 2 m in a localized area near the tide-gate. Depths are generally shallower throughout the remainder of the Basin. Approximately one-half of the Basin bottom substrate became exposed at low tide. The tide-gates are reported to be occasionally shut to prevent any tidal fluctuation, such as following low tides before predicted rain storms in order to increase the capacity of the Basin to hold storm runoff.

On January 12, 2010 the salinity at the surface at two sites in the lower Basin ranged between 15-18 parts per thousand (‰), Salinity at the inflow at the east inlet it was 3 ‰. The water temperature ranged from 15-18° Celsius (C) at several locations in the Basin. On April 27, 2010 several salinity measurements throughout the Basin, including at the eastern inlet, ranged from 33 to 34 ‰. Water temperatures were 17-18° C. During both surveys the water was moderately turbid with visibility estimated to approximately 1 m.

Substrate within the Basin on both survey dates was predominately comprised of firm to soft mud/silt. Some small areas of fine sand existed near the tide gates where the strength of the in-flowing and out-flowing tidal currents presumably prevents deposition of finer substrate. The majority of the Basin banks were steep to gentle earthen slopes densely inundated with pickleweed (*Salicornia sp.*) at the higher, intertidal, edges but the eastern one-third of the northern and southern shores were more shaded and only terrestrial grasses and herbaceous vegetation occupied the shore just above the high tide line. At lower tides, bare, firm to soft mud/silt was exposed between the waters edge and the pickleweed edges. The steeper south side of the Basin and eastern one third or so of the north side had approximately 1-3 m of bottom substrate exposed at low tide. The western two thirds of the north side became much more exposed at low tide, with 5 to 20 m of gently sloping mudflats becoming exposed. Near the tide-gates and the eastern inlet, patches of concrete debris and boulders were present. A few logs were also observed floating in the water. These hard substrates supported barnacles and a small number of mussels existed near and on the tide-gate structures.

During the first survey, no aquatic vegetation was observed in the Basin. On the second survey, filamentous green algae (possibly *Enteromorpha sp.)* were present along 50-80% of the wetted margins at low tide. Approximately 10% of the Basin surface had floating mats of this same algae present.

At high and low tides, very little flow was present in most of the Basin although some surge was observed coming through the mouth of the tide-gates. This caused a slow back and forth flow near the mouth and within about 30 m of either side of the gates, as well as some small wave action against the opposite shore. When the gates were opened with a strong difference in tidal levels between the Oxford Basin and the Basin E of Marina del Rey, stronger flows occurred. During strong incoming flows on April 27, a circular current existed in the western portion of the Basin which caused masses of green algae to float in a broad circular track across the water surface. This current, however, is likely an infrequent event and typically the tidal flow would be much slower over the 4-6 hour duration between high and low tides. These observed currents were with one tide-gate open and possibly even stronger flows can occur under certain circumstances with both tide-gates open.

The Basin is surrounded by elevated roadways, a parking lot, and trees along the roadway edges. Together, these extend upward to 10-15 m above the water level and shield the Basin from wind action. Surrounding high rise buildings and apartments along the northeast border also shelter the area from the wind even more.

Methods

The fish surveys were conducted by visual observation and by beach seining on January 12, 2010 and by visual observation, beach seining, and trapping on April 27, 2010. The seine net utilized measured 5 X 1.8 m with 3 millimeter (mm) mesh. The traps utilized consisted of 4 crayfish traps (Gee's) with 6 mm mesh and 25 minnow traps (Gee's) with 3 mm or 6 mm mesh. The crayfish traps were 70 centimeters (cm) long and 23 cm in diameter with double 5.7 cm openings and the minnow traps were 45 cm long and 23 cm in diameter with double 2.5 cm openings. All traps were baited with cut pieces of fresh mackerel. Traps were set around the perimeter of the Basin on the incoming high tide. Four crayfish traps were placed near the tide gates and the twenty minnow traps distributed around the Basin (Figure 2). The traps fished for 6 to 8 hours after being set in a west to east direction from 06:45 to 08:45 hrs and checked twice, once at approximately 11:30 and again at 14:30 when the traps were removed.

Results

Table 1 presents the results of the surveys. A total of 14 seine hauls around the perimeter of the Basin on January 12, 2010 captured hundreds of mosquitofish, *Gambusia affinis*, and one or two small juvenile shadow gobies, *Quietula y-cauda*, just west of the tide gates. In addition one large longjaw mudsucker, *Gillichthys mirabilis*, was observed in the rocks near the upper end but was not captured. The seining (5 hauls) and trapping on April 27, 2010 captured large numbers of native gobies, such as arrow gobies, *Clevelandia ios*, cheekspot gobies, *Ilypnus gilberti*. Also captured were a small number of native shadow gobies and longjaw mudsuckers. Topsmelt, *Atherinops affinis*, were abundant and hundreds were observed and captured ranging in size from small juveniles to adults (up to about 15 centimeters total length). In addition a few small, juvenile, non-native, yellowfin gobies, *Acanthogobius flavimanus*, were taken. The majority of fish were captured by seining rather than in the traps. Fish were found to be relatively scarce as distance form the tide-gates increased, with the exception of mosquitofish. For this reason, seining during the second survey was focused around the tide-gate. During both surveys, the majority of the Basin was observed from1-10 m from shore and fishes were rarely detected with the exception of the abundant mosquitofish in January.

Table 1 Results of fish surveys occurring on January 12 and April 27, 2010 at Oxford Basin.

		January 12, 2010		April 27, 2010		
Common Name	Scientific Name	Seine	Observed	Trap	Seine	Observed
mosquitofish	*Gambusia affinis*	>1000	>10,000	302	2	40
shadow goby	*Quietula y-cauda*	1	2	2	2	0
longjaw mudsucker	*Gillichthys mirabilis*	0	1	24	1	0
arrow goby	*Clevelandia ios*	0	0	0	25	0
cheekspot goby	*Ilypnus gilberti*	0	0	0	25	0
yellowfin goby	*Acanthogobius flavimanus*	0	0	0	7	0
topsmelt	*Atherinops affinis*	0	0	24	>300	150

Discussion

The species captured during the surveys are typical of coastal estuaries of southern California and indicate that Oxford Basin contains habitat that can support estuarine species for at least part of the year. The results of the January survey suggest the Basin supported very few estuarine fish in January. Mosquitofish were present in the tens of thousands while only two or three larval or small juvenile shadow gobies were captured near the tide-gate where they had apparently recently arrived and one large mudsucker was observed. By the April 27, 2010 survey, large numbers of gobies were detected. These were comprised of four native and one non-native species, all of which are typical of coastal estuaries in southern California. In addition, large numbers of topsmelt were present and only a few mosquitofish were captured. Fish were encountered both in seine hauls near the mouth and in traps set around the perimeter of the Basin indicating fish were dispersed throughout the Basin in late April. However, fish were most abundant near the tide gates. It is likely that the difference in fish abundance between the two surveys was due to the changes in freshwater influence and salinity in the Basin. In January, when freshwater input from numerous winter storm events had presumably repeatedly washed out the Basin, salinity in the Basin ranged from almost fresh to approximately half that of seawater. The salinity was considerably higher and at near seawater salinities in April, allowing colonization of the Basin by estuarine species dependent on higher salinity.

Invertebrates were uncommon in January except for “broken-backed shrimp” or *Palaemon macrodatylus*, a non-native species from Asia. This species was very common in January but fewer than 10 were captured in April when they were much les abundant. *P. macrodatylus* is well adapted for brackish or low salinity environments (Kuris et al. 2007). Possibly this species becomes abundant in Oxford Basin during the winter with the increase in freshwater influence that provides lower salinities and decreases the number of predatory fish present as well. California horn shells, *Cerithidia californica*, a typical invertebrate in southern California estuaries, were uncommon with only a few observed during both surveys despite the presence of considerable amounts of green algae, their primary food source, in April. As noted in the description of the area, barnacles were present on hard substrates around most of the Basin while mussels seemed restricted to the area around the tide gates. Other than an abundance of amphipods observed under the intertidal rocks, the only other aquatic invertebrate noted was the bubble shell, *Bulla gouldiana*. Several of these were observed near the mouth of the tide gate among the algae being dislodged by the strong incoming tidal currents and several were also captured by seining. Surprisingly, no crabs were encountered during the surveys. Seining and baited traps frequently take species of marsh crabs when sampling coastal salt marshes and estuaries. These crabs also have long pelagic larval stages which should enable them to colonize the Oxford Basin.

Also of interest are the species not encountered in the Basin during the surveys, but which would be expected to occur in southern California estuarine systems at this time of year. Because these species are typically very abundant following the springtime breeding periods, they are frequently easy to detect and would likely have been encountered if present in the Basin. These species include staghorn sculpin, *Leptocottus armatus*, California killifish, *Fundulus parvipinnis*, diamond turbot, *Pleuronichthys guttatus*, bay anchovy, *Anchoa delicatissima*, deepbody anchovy, *A. compressa*, bay pipefish, *Syngnathus leptorhynchus*, barred pipefish, *S. auliscus*, California halibut, *Paralichthys californicus*, striped mullet, *Mugil cephalus*, and shiner perch, *Cymatogaster aggregata*. A few other species that are less common or are more prevalent in larger estuaries but which might be expected to occur in the Basin include bay blenny, *Hypsoblennius gentilis*, spotted sand bass, *Paralabrax maculofasciatus*, and several species of elasmobranches (sharks and rays). Many of these are species are known to occur in adjacent Marina del Rey. The LADPW personnel present during the surveys related anecdotal observations of “sting rays” in the Oxford Basin in the past. Some of these fish are discussed in further detail below.

Additionally, there are several species of brackish, freshwater, or anadromous fish that undoubtedly occurred in the Ballona Lagoon and Ballona Wetlands historically but which have been extirpated from the area for at least 70 years or more. These species still occur to the north and south of the area and have special conservation status. The federally endangered tidewater goby, *Eucyclogobius newberryi*, occurs in Malibu and Topanga creeks to the north and in San Diego County to the south and there are historical records for artesian springs in Santa Monica (U. S. Fish and Wildlife Service 2005). The federally endangered southern California steelhead, *Oncorhynchus mykiss*, also still migrates from the ocean into Malibu and Topanga Creeks and was observed in San Mateo Creek in northern San Diego County in 1998-99 (NMFS 2009). After the adult steelhead spawned upstream in freshwater, the juveniles would have used the lagoon as a nursery area for a year or so before the juveniles left for the ocean (Swift et al. 1993; Moyle 2002). Finally the federally endangered unarmored threespine stickleback, *Gasterosteus aculeatus williamsoni*, occurred in the Los Angeles River and presumably occurred in or near the Ballona wetlands. The tidewater goby and stickleback would have been permanent residents of the estuarine area of the wider Ballona Marsh. All of these species rely on relatively stable, low salinity or brackish conditions and such conditions are unlikely to develop for any extended length of time in Oxford Basin, particularly since there appears to be an effort to divert freshwater street runoff into the sewer system, as was observed at the eastern inlet, rather than allowing it to flow into the Basin. Thus it would take exceptional effort to re-establish these species. In addition steelhead and stickleback require relatively cool and well oxygenated water which will also be difficult to maintain in the Oxford Basin under current conditions. If these species are ever to be seriously considered for return to this area, it would probably be best to utilize other areas of Ballona Wetlands where the appropriate habitat conditions can be developed more easily.

Most of the estuarine species detected during the two surveys in Oxford Basin are pelagic mid-water species (such as topsmelt) or have larvae that are pelagic in the water column for a few weeks (such as the goby species encountered). Other species that could be expected in Oxford Basin that produce pelagic larvae include anchovies, staghorn sculpin, diamond turbot, striped mullet, and California halibut. The larvae of these species typically arrive in estuaries in late winter and spring. Because these larvae colonize estuaries by being swept in by water currents, Oxford Basin should have the potential to be colonized by these species.

Fish species that do not have a pelagic larval phase, as well as adult fish of any estuarine species, would only be able to colonize the Basin by swimming in through the subterranean passageway and tide-gate system that connects Oxford Basin to Basin E in Marina del Rey. This connection is at least 100 m long and is unlit. It is unknown if this connection would present a barrier or deterrent to passage of fish into the Basin. As noted above the LADPW workers at the site on January 12 noted observations of “sting rays” in the Basin in the past and several other species known from Marina del Rey (Allen et al. 2006) certainly have the potential to invade. The available composition of fish species available to colonize Oxford Basin is probably largely determined by the community present in Basin E of Marina del Rey. The fauna of Marina del Rey have been studied for over 30 years and is well known to fluctuate considerably due to periodic fish kills in the summer when the lack of circulation and excess nutrients combines to lower oxygen concentrations. These effects are most extreme in the uppermost reaches of the harbor, such as at Oxford Basin or Basin E. (Aquatic BioAssay and Consulting 2009). Thus, the marina may not consistently be a reliable source of fish colonization into Oxford Basin.

One species of fish not encountered in the Basin but which is extremely common in other parts of the Ballona Wetlands and Marina del Rey is the California killifish. California killifish lay large eggs on hard substrates or vegetation and the young hatch out at an advanced stage as small juveniles with little or no pelagic or drifting dispersal phase. Therefore, California killifish may be limited in their ability to colonize Oxford Basin since it does not have a pelagic phase and may not occur close enough for adults to disperse into the Basin. It is possible that the habitat between the nearest known population at Mother’s Beach in the marina may be in inhospitable to killifish thereby limiting their dispersal. The long, dark passage from the tide-gates to Basin E may also deter them. In addition, Basin E has deep water (2 or more meters deep) with vertical concrete walls which may not be conducive to movement of the California killifish. The presence of larger predators in deep-water areas might also prevent significant migration through the marina and Basin E. It is possible that if California killifish were introduced into the Oxford Basin they would succeed in the area since the habitat appears appropriate for them. California killifish typically inhabit gently sloping, sandy, beaches and tidal sloughs. They often inhabit vegetated margins of salt marshes and adjoining shallow marine waters and are tolerant of fresh water (Moyle 2002). They are a prevalent part of the fish fauna of most southern California tidal salt marshes, bays and estuaries and would be a valuable addition to Oxford Basin.

Two other species which lack pelagic life stages, which were not encountered in Oxford Basin, and which are common in other parts of Ballona Wetlands are pipefish and shiner perch. Pipefish reproduce through male brooding of large eggs and the young juveniles are released directly into the habitat without a distinct dispersal stage. However, pipefish are often associated with drifting seaweed and other sea grasses and may disperse via this mechanism. Shiner perch are live bearing and young are born throughout most of the summer. It is uncertain how readily the young or adults would disperse into the Oxford Basin. If water quality conditions were improved in the Basin, artificial introduction of these species may be possible since appropriate habitat is present in the Basin.

The California halibut is an important commercial and sport fish species and is reliant on coastal bays and estuaries as nurseries for the first two or three years of life. Any increase is such habitat would be valuable for this species. Its preferred diet early in life, estuarine gobies, is already common in the Basin as identified in our surveys.

A study conducted by Aquatic BioAssay and Consulting (2009) noted that Basin E and Oxford Basin have some of the highest levels of pollutants and lowest oxygen values in the Marina del Rey area. The study found that the number and diversity of invertebrate species dropped from the mouth of the Marina inland towards the most inland sites such as Oxford Basin. These water quality issues may explain some of the absence of species in Oxford Basin. In addition, the Oxford Basin has only minimal circulation of water with the marina and is therefore more likely to suffer longer spans of poor water conditions that may arise. A good starting point for a restoration effort for fauna would be to improve the water circulation through the Basin, to reduce the level of pollutants, and to increase the dissolved oxygen levels in the Basin water in order to establish the water quality conditions necessary for successful colonization of estuarine aquatic species.

Dissolved oxygen concentration in water is related to water temperature such that the warmer the water the lower the amount of oxygen the water is able to hold in solution. Thus, excessive warming of the water will contribute to lower the availability of oxygen in the water. Other conditions such as the lack of circulation, excessive enrichment of the water, or the overnight lack of photosynthesis by aquatic plants to supply oxygen to the system can result in low dissolved oxygen levels. Excess plant material such as large algal blooms can supply oxygen in the day time but also use up the available oxygen rapidly at night as the plants respire resulting in low oxygen levels for the other organisms. During our surveys, the water was below 20° C which is within the preferred range for most estuarine fish and is cool enough to maintain adequate dissolved oxygen concentrations. Often, areas near the coast stay cooler because the summer fog coverage can insulate coastal marshes and wetlands from the usual summer warming more prevalent farther inland (Swift and Frantz 1981). However, it is possible that the water temperature gets considerably higher in the Basin in the late summer and fall due to the lack of water circulation, relatively shallow depths in the Basin, and as the cooler marine layer is less prevalent. If the water temperature increases beyond the mid-twenties Celsius then temperatures and dissolved oxygen concentrations may become intolerable to many fish species.

Estuarine fish species can generally be divided into two categories relative to oxygen tolerance. Gobies, killifish, and mosquitofish are relatively tolerant of low oxygen conditions and can utilize aerial oxygen and other strategies to survive periods of low oxygen in the water. Other fishes are relatively intolerant of low oxygen conditions and include anchovies, topsmelt, flatfishes (diamond turbot, California halibut), and shiner perch. These fish are unable to tolerate lower oxygen levels for any period of time and are the fish frequently seen during morning fish kills in coastal estuaries. Any attempt to restore habitat conditions that would support these species would have to include provisions for maintenance of relatively high oxygen concentrations (above approximately 4 milligrams per liter). Dissolved oxygen levels in the waters of Basin E and Oxford Basin often fall below this value according to the study by Aquatic BioAssay and Consulting (2009). It is less well known how these fish species are affected by the other pollutants noted by Aquatic BioAssay and Consulting (2009) such as DDT and heavy metals.

It appears that the current state of the Oxford Basin is of a system whose habitat and health is compromised by its distance from the ocean mouth and restricted access to Marina del Rey. It has been documented to have relatively poor values of several indicators of aquatic health, most recently by the study of Aquatic BioAssay and Consulting (2009). These factors make the development and sustainability of typical estuarine or bay fish fauna populations difficult. Our study indicates that several typical species can and do colonize and inhabit the area but have difficulty maintaining a year-round population. In addition, several species that would be expected to be present are absent and in some cases the reasons for their absence are not readily apparent. Some uncertainty exists in our sampling results regarding the presence of fish in the Basin throughout the year since our sampling was limited to two visits. More sampling throughout the season could better define the extent of fish population variation in the area. However, the faunal composition of nearby Marina del Rey is well understood and the Oxford Basin aquatic species composition is likely closely tied to conditions in the marina as well. Increasing the diversity and abundance of fish species living in Oxford Basin on a permanent basis will require management of water quality issues and the identification and removal of colonization barriers. Monitoring the fish populations in the Basin as such restoration actions are implemented would be beneficial in assessing the success of these actions as related to creating favorable habitat for estuarine fish.

Recommendations

1. Perform a water quality study to determine conditions present to provide a basis for predicting what fish species can be supported by the system and what changes might be made to accommodate others less likely to be currently supported.

2. Improve water circulation with Marina del Rey in order to improve water quality which is currently compromised both in Oxford Basin and its adjacent water supply, Basin E of Marina del Rey.

3. If water quality is or becomes appropriate, consider introduction of aquatic vegetation like eelgrass, ditch grass, and other species of marine algae to provide habitat for faunal elements more dependent on such vegetation (i.e. pipefishes and shiner perch).

4. Consider introducing some fish species such as California killifish which may currently be prevented from colonizing by inhospitable habitat between current populations in Marina del Rey, Ballona Marsh, and the Oxford Basin.

5. Investigate options for increasing the number of algae eating snails or fish present in the Basin in order to biologically control the proliferation of algae in the summer. If the freshwater conditions present in the winter decimate the populations of such grazers, possibly they could be artificially augmented in the spring from elsewhere in the marsh area. For example, the non-native fish, the sailfin molly, *Poecilia latipinna*, has become established and is common in Ballona Marsh. Stocks of sailfin molly could be transferred to Oxford Basin as a possible way to control algae. Sailfin mollies are a fecund species producing live bearing young and are tolerant of low oxygen conditions such as those found in the Basin. Striped mullet also feed on algae and detritus, reach large size, and could potentially be artificially introduced also. Striped mullet achieve much larger sizes but are more sensitive to oxygen requirements.

6. Investigate options for converting the Basin bottom substrate to more sand and less mud/fine silt. Possibly a layer of sand could be added when or after the system is dredged out periodically. If the fine sediment is determined to be primarily composed of decomposing organic matter, and water quality conditions can be stabilized, an increase in the diversity and abundance of bottom dwelling fish and invertebrate fauna may utilize and thus reduce the thickness of this silt/organic layer.

7. Explore exposing the Basin to more wind which would facilitate mixing and oxygenation of the water which could be effective in a wide shallow system like Oxford Basin, thereby reducing the need for increased water quality in the marina.

As discussed in the report, the long, dark culvert between Oxford Basin and Basin E of the marina likely inhibits dispersal of fish into the Basin. This condition could be improved by replacing some of the paving above the culvert with metal grating or comparable material. However, such a step would not likely improve fish stocks in Oxford Basin due to (1) the need to limit the range of tidal fluctuations in Oxford Basin in order to maintain its flood-protection capacity, and (2) the compromised water quality of Basin E, which limits the fish populations capable of surviving there. Given the inability to change these two items, increasing the amount of light in the culvert probably would not result in significant improvement of fish stocks in Oxford Basin (without simultaneous improvement for fish in these two additional items), and so this measure is not recommended as part of the current plan.

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Photo 1 – Yellowfin goby (top), longjaw mudsucker (bottom left), and arrow goby (middle right)

Photo 2 -Topsmelt

Photo 3 – Western mosquitofish

100 m

1-14 = Seine Haul Locations

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Figure 1 – Oxford Basin Survey Area
Fish Survey #1; January 12, 2010
City of Venice, Los Angeles County

100 m

1-9 = Seine Haul Locations ◆ = Trap Location

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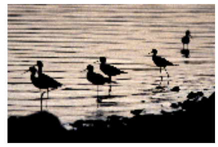
Figure 2 – Oxford Basin Survey Area
Fish Survey #2; April 27, 2010
City of Venice, Los Angeles County

Attachment D: Bird & Terrestrial Vertebrate Report



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Birds and Wildlife of Oxford Basin

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November 17, 2010

Introduction

In late 2009, Cooper Ecological Monitoring, Inc. was contracted by Robert A. Hamilton (RAH) of Hamilton Biological, Inc., and the County of Los Angeles to assess the biological community of Oxford Basin (Basin). The study area for this enhancement project includes 9.0 acres of a 10.7-acre parcel within Marina del Rey in Los Angeles County. In 2009, just prior to and concurrent with this work, I had teamed with RAH to produce a Conservation & Management Plan for Marina del Rey (now in draft form), which will assess the current and historical status of colonial waterbirds and other sensitive species of Marina del Rey, including Oxford Basin.

Background

Oxford Basin (Figure 1) was constructed in 1960 to "receive storm runoff at such times as the state of the tide within the [Marina del Rey] harbor precluded its discharge causing inundation of the low-lying lands adjacent to the north section of the harbor" (County of Los Angeles 1976). The Basin's water is roughly half as saline as seawater (C. Swift, pers. comm.). The Basin is fed by two (freshwater) storm drain inlets along the northeastern and southeastern ends, and a tidal gate at the western end provides limited flushing (the Basin was not designed to drain completely; as of the 1970s, the daily tidal range was "on the order of 5 feet", County of Los Angeles 1976; see Appendix).

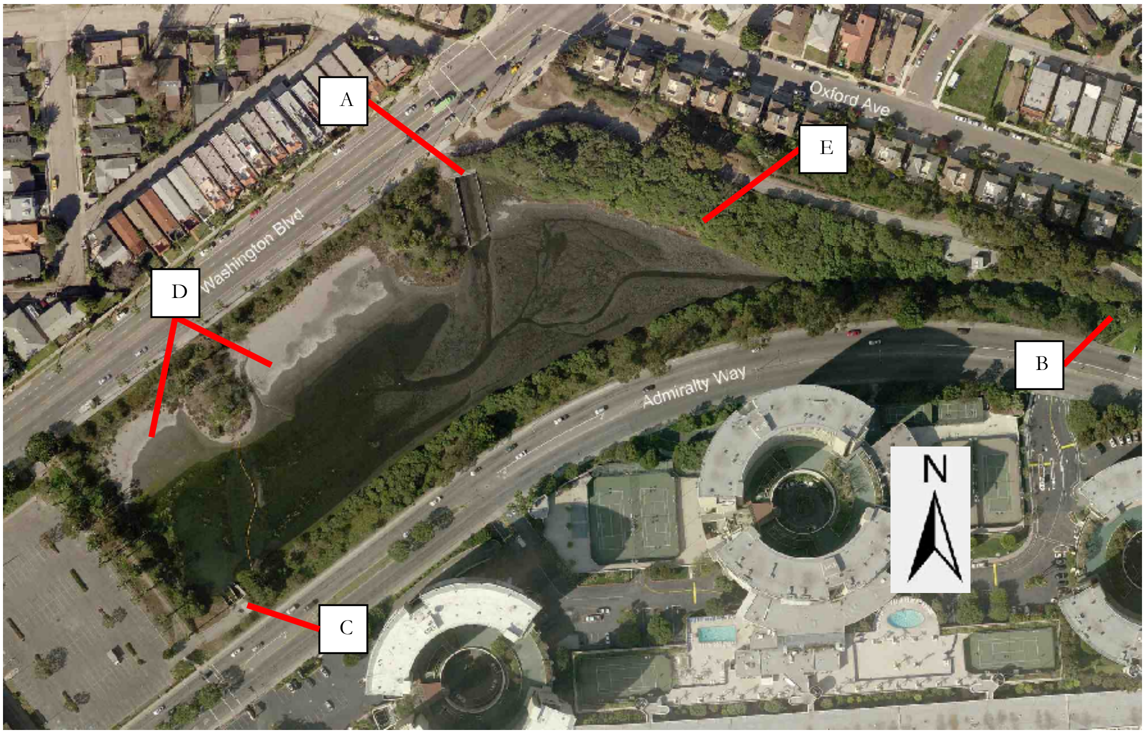

Figure 1. Oxford Basin (at low tide), showing inlet under Washington Blvd. (A), "eastern" inlet (B), main outlet to Marina del Rey harbor (C), mudlfat/drawdown area (D), and myoporum grove (E).

Figures 2 and 3 show Oxford Basin at low and high tide, respectively. This site now represents the largest remnant of open space, and the only area of tidal wetland habitat, within Marina del Rey. Today, the Los Angeles County Department of Public Works is looking into improving the function and natural features of Oxford Basin, and evaluating the biotic resources of the site, which have not been studied in decades. In the intervening years, wetland habitat, including that of small sites like Oxford Basin, have only become rarer and more highly valued in the region.

Figure 2. Oxford Basin, view west, during draw-down (28 May 2010, DSC).

Figure 3. Oxford Basin, view west, when full (23 September 2009, RAH).

To ensure that future work is done in a manner sensitive to the natural environment, and complementary of the ecological integrity of the nearby Ballona Wetlands, Cooper Ecological Monitoring was asked to:

- Develop baseline species lists for terrestrial vertebrates on the site.
- Assess the constraints on the current usage of the site by native bird species.
- Provide recommendations to the County for ecological improvements that could be made to the site, while still allowing for its primary use as a flood-control structure.

History of Site

Following its construction in 1963, the entire site, including approximately five acres of open water and surrounding landscaped "upland", was designated as a "Bird Conservation Area" by the Los Angeles County Board of Supervisors. In 1965, fill dirt was imported and placed along the northeastern edge of the site, and (irrigated) plantings were made here "to further improve the habitat", with additional plantings continuing to 1968 (County of Los Angeles 1976). Despite the moniker of "Bird Conservation Area", the site has never been formally managed for wildlife[1], and by the early 1970s it had become a popular dumping ground for unwanted pets, including rabbits and chickens. This situation was partially remedied in the 1990s by the construction of a taller fence surrounding the site, making it more difficult to toss pets inside. Still, other management issues remain, most significantly, the lack of full tidal flushing, which during summer months results in the formation of thick mats of algae

[1] Some actions ran counter to current ecological practices; a flock of domestic ducks was introduced from Alondra Park in 1965, reportedly prompted by "the apparent lack of bird life" at the site (County of Los Angeles 1976, p. 4). Descendents of these birds, as well as domestic ducks from the nearby Venice Canals, may still occur today.

covering the surface of the lagoon, as well as unpleasant odors from decomposing vegetation[2].

Designed and still used exclusively as a storm water catchment facility, Oxford Basin has been the subject of several proposals to improve its appearance and provide amenities for visitors to and residents of Marina del Rey since the 1960s. The most significant was a proposed 1.3-million-dollar "Japanese-American Cultural Garden" (1976), which led to the first attempt to study the birds of the site, consisting of a series of visits between 14 June to 30 November 1973 by an undergraduate student at California State University, Humboldt (then Humboldt State College; Schleicher 1974; see Appendix). It should be noted, however, that this study was not done by a trained observer (e.g., gulls were not identified to species), and it entirely missed the primary local nesting season for birds (March - May). In addition, many of the management recommendations in the report are unsophisticated, and read as the (unsupported) opinions of a young student (e.g., "We have for all practical purposes 100% cover on the land of which 90% is usable for the birds"; Schleicher 1974:9). Perhaps most jarringly, the author suggested planting non-native cotoneaster (*Pyracantha* sp.) widely, and removing native marsh plant species such as pickleweed (*Salicornia virginica*).

A second attempt to survey the birds of the Oxford Basin was done five years later, consisting of weekly surveys from 11 August 1979 to 08 August 1980 (with a "preliminary investigation" conducted from 07 October 1978 to 14 April 1979) by staff from the Los Angeles County Museum of Natural History (Schreiber and Dock 1980:2; see Appendix). In addition to producing a more professional report, the authors went into more detail on the habitat conditions and avian usage (including observations of flocks of white-crowned sparrows [*Zonotrichia leucophrys*] – now essentially extirpated from the site – feeding under shrubs in winter). However, this study, too, was similarly not peer-reviewed, and includes some questionable information. For example, under the account for belted kingfisher (*Megaceryle alcyon*), the authors state that a pair "probably nests at the Bird Conservation Area"; the species was and still is virtually unknown as a breeder in southern California, confined to a handful of remote, unchannelized streams in the backcountry. Even less helpful, the report recommended that the site be modified "to make it more conducive for the domestic animals", and included many normative statements that serve to downplay the importance of the site as a natural area, e.g., "the area serves little or no purpose as a conservation area for a viable population of migratory or resident wild species" and "any efforts at habitat modification would have little or no effect at increasing the wild avian populations in the region." These pejorative statements are still quoted in environmental documentation (e.g., California Coastal Commission 2007), if only because the site has not been re-studied in more than 30 years.

Other sources of information on the birds of the area deserve mention, including a database of bird counts from monthly visits to nearby Ballona Lagoon (i.e., the southernmost extension of the main Venice Canal, so-named in 1996 following an extensive habitat restoration project), compiled by local birder Charles Almdale between 1996 and 2006. Ballona Lagoon, a linear wetland of approximately 16 acres located a short distance west/coastward of Oxford Basin, receives tidal flushing from the Marina del Rey harbor

[2] During summer, maintenance staff from Los Angeles County Department of Beaches and Harbors rake piles of algae from the basin at low tide (DSC pers. obs.).

mouth at its southern end (CERES 1997). While not directly applicable to Oxford Basin in its current state, Ballona Lagoon may serve as a model of what restoration of a similar-sized wetland can achieve. For example, Ballona Lagoon is regularly visited by the State- and federally-endangered California least tern (*Sternula antillarum brownii*) and supports a much wider diversity of waterfowl, shorebirds, large waders (herons/egrets) and migrant landbirds year-round than does Oxford Basin.

Methods

For this report, DSC conducted a thorough review of existing literature on the historical Ballona Wetlands and Marina del Rey, including obtaining copies of both prior bird surveys (see above) during the 1970s. DSC and/or RAH conducted brief (1-2 hour) monthly visits to Oxford Basin on eight mornings between September 2009 and April 2010 (23 September 2009 - morning and afternoon visit, 23 October 2009, 20 November 2009, 23 December 2009, 12 January 2010, 24 February 2010, 25 March 2010, and 27 April 2010), recording numbers of all birds seen at the site (including the "upland"/planted areas adjacent to the lagoon itself). Prior to this, we made a combined 19 visits to Oxford Basin during summer 2009 to census heron and egret usage for the Marina del Rey Conservation & Management Plan (Hamilton and Cooper 2010).

Results

Birds

As of July 2010, 84 species of birds have been credibly recorded at Oxford Basin (Schleicher 1974; Schreiber and Dock 1980; this study). A handful of species reported in previous studies are not credible, and should not be considered part of the avifauna of the site. For example, Schreiber and Dock (1980:21) reported multiple olive-sided flycatchers (*Contopus cooperi*) in January, but the species is virtually unknown in winter in North America. Of the 84 species credibly reported, 33 species were not detected during our recent monthly visits since September 2009, which suggests that roughly 50 species may be expected to occur regularly at the site each year. The following Table A provides the results for 2009/2010 and compares them with results obtained 30 years ago, mainly by Schreiber and Dock (1980). Apparent changes in bird species composition at the Basin are discussed in subsequent sections of this report (see especially "Faunal Change at Oxford Basin" on page 13).

Table A. Status of bird species at Oxford Basin, 1980 vs. 2009/2010

Family	Species	1980	Present	Change
Waterfowl	Mallard *Anas platyrhynchos*	50+ year-round, incl. domestics	Up to 23 during fall/winter; <5 during spring; pair with 5 young on 28 May 2010.	N/A
	American wigeon *Anas americana*	Vagrant (1 on 18 Nov.)	Up to 89 in winter (Nov. - Mar.)	Colonization
	Gadwall *Anas strepera*	No record	Up to 6 in winter (Dec. - Feb.)	Colonization
	Cinnamon teal *Anas cyanoptera*	Vagrant (1 in early May)	No records	N/A
	Bufflehead *Bucephala albeola*	Vagrant (1 in late Oct.)	No records	N/A
	Lesser scaup *Aythya affinis*	Up to 20 in winter (Nov. - Mar.)	Up to 14 in winter (Nov. - Mar.)	N/A
Quails	California quail *Callipepla californica*	1 in spring	No records	N/A

Family	Species	1980	Present	Change
Grebes	Pied-billed grebe *Podilymbus podiceps*	Singles in winter	Five in fall (23 Oct.), 1 through winter	N/A
	Eared grebe *Podiceps nigricollis*	Up to 3 in winter	1 in winter	N/A
	Western grebe *Aechmophorus occidentalis*	Single in winter	1 on 20 Nov.	N/A
Pelicans/ Cormorants	California brown pelican *Pelecanus occidentalis californicus*	No record	1 imm. in fall/winter	N/A
	Double-crested cormorant *Phalacrocorax auritus*	Vagrant (1 on 26 Nov.)	Up to 3 in fall	N/A
Large waders	Great blue heron *Ardea herodias*	No records	1 on 3 dates	Colonization?
	Great egret *Ardea alba*	No records	1-2 through early winter	Colonization
	Snowy egret *Egretta thula*	Singles on 2 dates	Up to 3 year-round	Colonization
	Green heron *Butorides virescens*	Up to 3 in winter	No records	Extirpation?
	Black-crowned night-heron *Nycticorax nycticorax*	2 in late winter/spring	Up to 8	N/A
Raptors	Red-shouldered hawk *Buteo lineatus*	Listed by Schleicher (1974)	Single on several dates	N/A
	Red-tailed hawk *Buteo jamaicensis*	No records	1 on 23 Dec.	N/A
	American kestrel *Falco sparverius*	Resident ("observed commonly")	No records	Extirpation
Rails	American coot *Fulica americana*	20-50 birds in fall/winter	Up to 45 birds fall/winter	N/A
Shorebirds	Black-bellied plover *Pluvialis squatarola*	1 on two dates in fall	No records	N/A
	Semipalmated plover *Charadrius semipalmatus*	3 on 14 Oct.	No records	N/A
	Killdeer *Charadrius vociferus*	Up to 6 in fall, then 1 through winter	1-2 in spring	Slight decline
	Greater yellowlegs *Tringa melanoleuca*	2 on 26 Nov.	No records	N/A
	Spotted sandpiper *Actitis macularia*	Sporadic Sept. – May	No records	Decline
	Marbled godwit *Limosa fedoa*	1 in fall	No records	N/A
	Western sandpiper *Calidris mauri*	"sporadically on mudflats" in winter	No records	Extirpation?
	Sanderling* *Calidris alba*	150 on 26 Nov.*	No records	N/A
	Red knot *Calidris canutus*	2 on 9 Dec.	No records	N/A
	Long-billed dowitcher *Limnodromus scolopaceus*	1 in Jan.	No records	N/A
Gulls/Terns	Bonaparte's gull *Larus philadelphia*	1 on 2 Dec.	No records	N/A
	Heermann's gull *Larus heermanni*	"Occ." in fall/winter	No records	Decline
	Ring-billed/California gull *Larus delawarensis/L. californicus*	Up to 37 Oct. - Apr.	2 RBGU on 12 Jan.	Decline
	Herring gull *Larus argentatus*	3 on 13 Jan.	No records	N/A
	Western gull *Larus occidentalis*	Irregular throughout year	Singles on 4 dates	N/A
	Forster's tern *Sterna forsteri*	"Occ." on mudflats in fall/winter	No records	Decline
	California least tern *Sternula antillarum brownii*	"Observed foraging in the pond...spring and summer, 1980"	No records	Extirpation?
Doves	Rock pigeon *Columba livia*	Up to 41 year-round	3-4 in spring	Decline
	Eurasian collared-dove *Streptopelia decaocto*	No records	Resident in surrounding urban area (to north)	(Colonization)
	Spotted dove *Streptopelia chinensis*	Resident in surrounding urban area	No records	Extirpation

Family	Species	1980	Present	Change
	Mourning dove *Zenaida macroura*	25+ in Nov.; otherwise up to 4 year-round	Up to 27 in late fall; single-digits rest of year	N/A
Swift	White-throated swift *Streptoprocne zonaris*	Listed by Schleicher (1974)	No records	N/A
Hummingbirds	Anna's hummingbird *Calypte anna*	Up to 3 in winter	Up to 11, with juveniles heard in myoporum grove (24 Feb.)	Increase/ Colonization as breeder
	Allen's hummingbird *Selasphorus sasin*	No records	2 on 27 Apr.	N/A
Kingfisher	Belted kingfisher *Megaceryle alcyon*	Up to 3 in winter	1 on three dates in fall/winter	N/A
Woodpecker	Northern flicker *Colaptes auratus*	Irr. throughout year in "wooded portion"	No records	Extirpation
Flycatchers	Western wood-pewee *Contopus sordidulus*	1 in May 1980	No records	N/A
	Pacific-slope flycatcher *Empidonax difficilis*	Listed by Schleicher (1974)	No records	N/A
	Black phoebe *Sayornis nigricans*	No records	Up to three year-round	Colonization
	Ash-throated flycatcher *Myiarchus cinerascens*	Listed by Schleicher (1974)	No records	N/A
Vireo	Hutton's vireo *Vireo huttonii*	No records	1 wintered 14 Dec. 2007 - 27 Jan. 2008 (DSC unpubl. data)	N/A
Shrike	Loggerhead shrike *Lanius ludovicianus*	Resident ("commonly observed")	No records	Extirpation
Crows/Jays	Western scrub-jay *Aphelocoma californica*	1-2 year-round	1 on 23 Sept.	Extirpation?
	American crow *Corvus brachyrhynchos*	Up to 4 in Oct.; otherwise irr.	Up to 5; nesting observed in myoporum (25 Mar.) and in surrounding residential area	Colonization as a breeder
	Common raven *Corvus corax*	1 overhead Apr.	No records	N/A
Swallows	No. rough-winged swallow *Stelgidopteryx serripennis*	No records	Singles in spring	N/A
	Barn swallow *Hirundo rustica*	Small #s late spring/summer	Small #s in spring and summer	N/A
Misc. songbirds	Bushtit *Psaltriparus minimus*	Up to 20 in fall/winter	Up to 20 year-round?	N/A
	House wren *Troglodytes aedon*	1-2 in spring	No records	N/A
	Ruby-crowned kinglet *Regulus calendula*	No records	Up to 4 in winter	Colonization
	Hermit thrush *Catharus guttatus*	Singles late fall/winter	No records	N/A
	Northern mockingbird *Mimus polyglottos*	Up to 4 year-round	1 on 3 dates	Decline?
	European starling *Sturnus vulgaris*	Common resident	Irr.; up to 10	N/A
	Cedar waxwing *Bombycilla cedrorum*	No records	30 on 27 Apr.	N/A
	Phainopepla *Phainopepla nitens*	Vagrant (1 on 7 Oct.)	No records	N/A
Wood-warblers	Orange-crowned warbler *Vermivora celata*	2 on 8 Jan.	1 on 3 dates	N/A
	Yellow-rumped warbler *Dendroica coronata*	"regularly observed" in winter	Up to 15 in winter (all but 1 were "Audubon's")	N/A
	Black-throated gray warbler *Dendroica nigricans*	No records	Up to 2 in winter/spring	Colonization
	Townsend's warbler *Dendroica townsendi*	No records	Up to 3 in winter/spring	Colonization
	Hermit warbler *Dendroica occidentalis*	No records	1 on 27 Apr.	N/A
	Wilson's warbler *Wilsonia pusilla*	1 in late Apr.	1 on 27 Apr.	N/A
	Western tanager *Piranga ludoviciana*	Singles (2) in fall	No records	N/A
Sparrows	Green-tailed towhee *Pipilo chlorurus*	Vagrant (1 in late Jan.)	No records	N/A

Family	Species	1980	Present	Change
	Song sparrow *Melospiza melodia*	"Frequent" in fall	No records	Extirpation
	White-crowned sparrow *Zonotrichia leucophrys*	Up to 60 in winter	2-3 on 2 dates	Extirpation
Blackbirds/ Orioles	Western meadowlark *Sturnella neglecta*	No records	2 on 23 Sept.	N/A
	Bullock's oriole *Icterus bullockii*	Vagrant (1 in late Aug.)	No records	N/A
Finches	House finch *Carpodacus mexicanus*	Up to 20+ year-round	Up to 3 in fall/winter, then 10 on 27 Apr.	N/A
	Lesser goldfinch *Spinus psaltria*	"Small #s late winter"	2 on 24 Feb., 27 Apr.	N/A
Weaver	House sparrow *Passer domesticus*	Common resident	15 on 27 Apr.	N/A

* A generally coastal species reported by Schreiber and Dock (1980) almost certainly in error (150 individuals); however, this species regularly forages well up Ballona Creek as far as Centinela Ave. (DSC pers. obs.), so it is possible that it occurred and may again.

Three species have been observed nesting at Oxford Basin in 2010: the mallard (*Anas platyrhynchos*; pair with five young on 28 May), Anna's hummingbird (*Calypte anna*; two juveniles in the myoporum grove on 24 February), and the American crow (*Corvus brachyrhynchos*; pair nest-building in the myoporum grove on 25 March). Several other species were observed using the site during the breeding season, but were breeding off-site in the surrounding residential area and ornamental landscaping, notably several species of herons and egrets (see Hamilton and Cooper 2010 for discussion).

Figure 4. California ground-squirrel at Oxford Basin, 7 May 2010 (Emile Fiesler).

Non-bird Wildlife

Mammals, reptiles, and amphibians were scarce during our surveys. On 28 May 2010, at least 10 California ground-squirrels (*Spermophilus beecheyi*) were detected (DSC), with presumed burrows scattered across the entire site; one squirrel was seen on 7 May 2010 (E. Fiesler; Figure 4) but they were not detected during the preceding fall/winter. Two non-native eastern fox squirrels (*Sciurus niger*) were observed in the myoporum grove on 24 February 2010, and evidence of their presence (including pine cone "shavings") are easily observed.

Figure 5. Track (hind foot), likely of a striped skunk or possibly a raccoon, at Oxford Basin, 13 October 2009 (DSC).

Numerous large burrows are present toward the far eastern end of the site, within the myoporum grove (Figure 1), that likely belong to striped skunk (*Mephitis mephitis*) based on their size and the habitat (this mammal is now common and highly urban-adapted in the region). Tracks in mud seen on several visits (Figure 5) indicate the presence of either skunk or raccoon (*Procyon lotor*), another ubiquitous, urban-adapted animal in Los Angeles. The feral dogs, chickens, and domestic ducks mentioned in previous studies are no longer present (raising the height of the fence apparently helped), although several obvious hybrid/feral mallard × domestic ducks were present on most visits. Native rabbits (*Sylvilagus* sp.) that were present in the 1970s have apparently been extirpated from the site.

No lizards or amphibians were observed during the 2009/10 survey, although Schleicher (1974) lists southern alligator lizard (*Elgaria multicarinata*) as occurring, and it likely still does.

<u>Vegetation Notes</u>

In a concurrent study, botanist David Bramlet is documenting and mapping the plants and plant communities of Oxford Basin; this section provides a brief overview of the existing vegetation. The Basin currently supports three main habitats: open water; saltmarsh/mudflat; and ornamental vegetation/thicket. Since the vegetation of site was last assessed (in 1980), the amount of open water has remained more or less constant, the myoporum thicket that surrounds the lagoon has matured, and the extent of saltmarsh – dominated by pickleweed (*Salicornia virginica*) – formerly limited to the southern shore and eastern inlet (Gustafson 1980; see Appendix), now extends around the entire shoreline. Currently (2010), the entire northern edge of the Basin is dominated by shrubby, non-native Perez's sea-lavender (*Limonium perezii*), forming a low, purple hedge between the northern fenceline and the waterline.

In addition to pickleweed, only one other native plant species noted in the 1970s still occurs at the site, wild heliotrope (*Heliotropium curassavicum*); at least one native plant species has been lost at the site, mugwort (*Artemisia douglasiana*), which was formerly found growing with weedy, non-native species at the eastern inlet (Gustafson 1980). Other native species noted by Gustafson (1980) were apparently planted during the original landscaping (see list in County of Los Angeles 1976, in Appendix), including coyote brush (*Baccharis pilularis*) and laurel sumac (*Malosma laurina*).

Sensitive Bird Species of Oxford Basin

Compared to the nearby Ballona Wetlands, Oxford Basin supports few sensitive species. However, some deserve mention, either because they are considered noteworthy by regulatory agencies (generally the California Department of Fish and Game), or because they are particularly dependent on coastal wetland, open-country, and other scarce habitat in the region. As a note, the (draft) Marina del Rey Conservation & Management Plan includes a comprehensive discussion of all sensitive bird species known from the Marina area; this is an abbreviated list of species that appear to be using Oxford Basin, based on our surveys, and those that could potentially use a restored Oxford Basin.

California Brown Pelican (*Pelecanus occidentalis californicus*) (State Endangered)

One individual was observed on several visits during the 2009/10 surveys (Figure 6). Earlier (1970s) visits did not record this large bird, but this was likely due to its extreme rarity in the region during the 1970s, when DDT-caused eggshell-thinning infamously drove it to the endangered species list. Since then, the species has rebounded, and it is now a regular sight along the coast and well upstream along Ballona Creek (DSC unpubl. data). Because of its rarity at Oxford Basin, and the fact that it has so much (occupied) habitat nearby (hundreds roost nearly year-round on the breakwater at the mouth of Marina del Rey harbor), and due to the small size of the site, it is unlikely that Oxford Basin will ever be particularly important for the California brown pelican.

Figure 6. California brown pelican foraging at Oxford Basin, 13 October 2009 (DSC).

Snowy Egret (*Egretta thula*) (no special status)
This species recently (c. 2005) established a breeding colony ("rookery") in tall eucalyptus, ficus, and coral trees in and around the parking lot of Yvonne B. Burke Park just east of Oxford Lagoon (Cooper 2006b), which held an estimated 69 nests of snowy egrets and black-crowned night-herons in July 2009 (Hamilton and Cooper 2010). During more than a dozen visits by DSC and RAH during July 2009, we confirmed that Oxford Basin provides important breeding-season foraging area for snowy egrets, particularly for young-of-the-year. Up to 19 individuals per day were recorded during July 2009, likely from nearby nests at Burke Park (Figure 7).

Great Egret (*Ardea alba*) (no special status)
Unrecorded by earlier surveyors (1970s), small numbers of this large wader were found during 2009/10, including young-of-the-year during summer 2009 surveys (Hamilton and Cooper 2010). Like the snowy egret, the great egret maintains a nesting colony adjacent to Oxford Basin at Yvonne B. Burke Park, albeit in much smaller numbers; additional nesting sites at Marina del Rey were documented in 2009, with an estimated Marina-wide breeding population of around five pairs.

Figure 7. Typical scene of egrets (snowy and great) foraging on the north side of Oxford Basin on 23 July 2009, near the main inlet at Washington Boulevard. These birds were probably from the nearby breeding colony along Admiralty Way (RAH).

Black-crowned Night-Heron (*Nycticorax nycticorax*) (no special status)
Long recorded at Oxford Basin during the non-breeding season (see Cooper 2006a), this medium-sized wader initiated nesting at Marina del Rey during the late 1990s. Today, several dozen pairs breed at the Marina, with a particularly large colony located just east of Oxford Basin, at Yvonne B. Burke Park. Although only relatively small numbers were observed at Oxford Basin during fall-spring (fewer than 10 birds per day), daily counts of up to 14 birds were made during July 2009 (see Figure 8), at a time of year when parents likely lead young birds to the Basin to forage in family groups (Hamilton and Cooper 2010).

Figure 8. Black-crowned night-herons – juvenile on the left, adult on the right – at Oxford Basin on 7 May 2010 (Emile Fiesler).

American Kestrel (*Falco sparverius*) (no special status)
This small raptor was found to be resident at Oxford Basin during the 1970s, but we know of no modern (post-1980) records from the site (DSC unpubl. data). As of 2010, it no longer breeds at the Ballona Wetlands, where it was once a common year-round resident. In coastal portions of the Los Angeles Basin, large vacant lots that formerly supported American Kestrels year-round have all but disappeared. At Oxford Basin, such habitat modifications as removal of myoporum and trees and maintenance of low-profile vegetation, with patches of bare ground, could possibly facilitate the kestrel's re-establishment, at least in fall and early winter.

California Least Tern (*Sternula antillarum brownii*) (State/Fed. Endangered)
The least tern maintains one of its largest known nesting sites at south Venice Beach, just a few hundred meters from Oxford Basin. Schreiber and Dock (1980) recorded this species at the Basin, but provided only sparse details about the nature of its occurrence: "Of particular interest are California Least Terns, an endangered species that nests on nearby Venice Beach and the Ballona Wetlands, and occasionally forages on small fish in the Bird Conservation Area" (p. 4); "Observed foraging in the pond at the Bird Conservation Area in Spring and Summer, 1980" (p. 20). Unfortunately, the number of individuals observed is illegible in the table of the report.

It is possible that the California least tern currently uses Oxford Basin at least irregularly as a foraging site for birds nesting in the Venice Beach colony, as birds are regularly seen foraging for mosquitofish (*Gambusia affinis*) at Ballona Freshwater Marsh and elsewhere in the Ballona area (Cooper 2006b). Having been fenced for decades, Oxford Basin receives very little coverage by birders, and since the least tern is present locally for only a brief time window (May to early July), it is likely that any foraging here – particularly the occasional brief visit by a bird bringing food to young – would simply be unobserved. It is not likely that the California least tern would ever nest at Oxford Basin, as the site does not support the broad, sandy beach and sandbar habitat favored by this species. Rather, Oxford Basin should be seen as a potential alternative foraging site for the species during its brief late spring/early summer nesting season.

Loggerhead Shrike (*Lanius ludovicianus*) (California Species of Special Concern)
Like the American kestrel, the shrike was formerly (1970s) present at Oxford Basin but is now best considered totally extirpated. It, too, still winters (1-3 individuals per year) at the

nearby Ballona Wetlands (including at Area A adjacent to Marina del Rey), and it is possible that the shrike could occur at Oxford Basin during migration, given the establishment of bare ground and the establishment of a macroinvertebrate/small mammal fauna (e.g., large grasshoppers, Order: Orthoptera) for foraging.

Western Meadowlark (*Sturnella neglecta*) (no special status)
This species has declined sharply throughout the Los Angeles area and, as of 2010, no longer breeds in the Ballona area (DSC unpubl. data), or possibly anywhere else in coastal Los Angeles County. Two birds were observed on a grassy promontory along the north end on 13 Oct. 2009 (Figure 9). Though these were fall migrants, it is possible that small numbers of wintering birds could occur if several acres of low-profile forbs/grasses and open ground were maintained at the site, rather than the dense (non-native) trees and shrubs currently present.

Figure 9. One of two western meadowlarks observed at Oxford Basin on 23 October 2009 (DSC).

Patterns of Bird Usage
The patterns of usage documented in this report provide baseline data against which the effects of future habitat enhancements may be compared. The fact that native birds are using non-native vegetation at the site does not imply that these exotic plants are especially "important" for birds at Oxford Lagoon. All of the birds recorded in the myoporum and other landscaping at the site are commonly encountered in urban habitats throughout Los Angeles. Nearby areas with native vegetation, either naturally-occurring or restored, such as Ballona Freshwater Marsh and the Playa Vista Riparian Corridor, see much higher usage by native bird species, including regular, successful breeding by more than a dozen species.

Scientific names of bird species recorded at Oxford Basin are omitted from the rest of this report but can be found in Table A.

By Season
As found in previous studies, bird usage of Oxford Basin is highly seasonal. Overall numbers are lowest in late summer and fall (July - October), before wintering waterfowl have arrived,

and after the locally-nesting herons have raised young and dispersed. By November, small rafts of waterfowl are present that include American wigeon, lesser scaup, and American coot, joined by lower numbers of other species of ducks and grebes (Figure 10).

Figure 10. Gadwall (at far left) and American wigeon foraging on and near an exposed mudflat during draw-down of the Basin's water level in advance of anticipated rain on 23 February 2010 (DSC).

While a smattering of fall migrant songbirds can occur from late July on, the first flights of wintering songbirds, such as ruby-crowned kinglets, yellow-rumped and Townsend's warblers, appear by late October, and remain through winter into April. Bird activity dips in spring, after wintering waterfowl and wintering songbirds have departed (April), and when only a small number of ubiquitous resident species, such as the American crow and bushtit, nest in the dense myoporum grove at the far eastern edge of the site. However, on certain days from mid-April to late May, a diversity of spring transient songbirds (e.g., Wilson's warbler) may occur, typically forming small foraging flocks in the myoporum grove (but generally using any tree or shrub habitat available throughout the Marina). During summer, waterfowl are mostly absent (aside from a handful of locally-breeding mallard), but herons and egrets from local colonies forage in the Basin, their numbers augmented by locally-raised young that remain into July and August.

<u>By Area</u>

Though data on usage by area of the Basin was not collected during our study in 2009/10, a few broad patterns are clear. Most waterfowl were observed either resting on open water or near overhanging vegetation along the shoreline, or foraging on the wet mud exposed during a drawdown. Fish-eating species, such as the pied-billed grebe, were observed actively feeding in open water. Herons and egrets foraged around the entire shoreline, but seemed concentrated at either inflow (especially the inflow emerging from under Washington Boulevard) or at the outflow to the Marina, where they would catch fish. Several species of large waders were observed roosting in the trees surrounding the open water, particularly black-crowned night-herons in myoporum and other landscaping trees at the far eastern end. Songbirds (tree-dwelling) were found throughout the site, but were most consistently found in and around the myoporum grove at the eastern end, especially the area where dense vegetation approached the freshwater at the eastern inlet.

Songbirds (other than the ubiquitous, non-native European starling) were almost never seen on the ground at the site, suggesting that foraging opportunities for birds like sparrows and towhees are limited, and have become even more degraded over time (see the subsequent discussion of "Faunal Change at Oxford Basin").

Faunal Change at Oxford Basin

Birds

The historical avifauna of the Oxford Basin area *per se* is not known, since it was part of a much larger wetland system and its current configuration dates back only to the 1960s. Historically, the inland mudflats and tidal channels of the "Venice Marshes" would have supported flocks of shorebirds nearly year-round, and rafts of waterfowl in winter ("Lake Los Angeles," situated near present-day Oxford Lagoon, was a popular duck-hunting spot through the 1950s; see, e.g., Cooper 2005). Species found in extensive, often wet grassland, such as the northern harrier (*Circus cyaneus*) and the long-billed curlew (*Numenius americanus*) were common in the Venice/Ballona area into the mid-1900s, as were dune and coastal strand specialists such as the horned lark (*Eremophila alpestris*) and large-billed savannah sparrow (*Passerculus sandwichensis rostratus*). Many of these coastal marsh, dune, and open-country species were effectively extirpated by the construction of Marina del Rey, though some – notably Belding's savannah sparrow (*P. s. beldingi*) and a variety of waterfowl and shorebirds – maintain remnant populations at the nearby Ballona Wetlands/Ballona Creek.

As Marina del Rey has lost certain species, others have colonized novel habitats, nesting in trees near water (herons/egrets, Family: Ardeidae), or on built structures such as culverts (swallows, Family: Hirundinidae), or have simply "invaded" from the surrounding residential area. These population changes are discussed below.

Of the species that are known only from 1970s surveys, several were apparently common then and are best considered extirpated from the site at this time, a determination that is supported by recent research on bird status and distribution in the Ballona area (Cooper 2006b). Recent years have seen the apparent extirpation of three resident or year-round species from Oxford Basin: two raptors/predators (American kestrel and loggerhead shrike) and a woodpecker (northern flicker). Two species, the green heron and western scrub-jay, might be considered a part of this extirpated group as well, though only 1-3 birds each were detected during the 1970s and both species remain fairly common in the greater Marina/Ballona area year-round (Cooper 2006b). Two species of sparrows have apparently been extirpated in their local roles from the site as well – the white-crowned (formerly a winter resident) and the song (formerly occurred in fall migration).

Shorebirds appear to have been at least irregularly present at Oxford Basin during the 1970s, but seem to have essentially abandoned the site. Schreiber and Dock (1980:6) wrote, "most of the shorebirds recorded here are dependent on the mudflats for their occurrence, both to feed and rest". Only one or two individual killdeer were seen during the recent surveys (Figure 11).

Figure 11. Killdeer on exposed mudflat at Oxford Basin on 23 February 2010 (DSC).

Other species that have apparently declined or stopped using the site include gulls and terns (gulls were apparently common at Oxford Basin in winter 30 years ago and are now rare) and possibly the northern mockingbird and the non-native rock pigeon. All of these species remain common at Marina del Rey and the surrounding urban area, so it is likely that their absence from the Basin stems from localized changes in vegetation, food supply and/or water regime.

With declines have come inevitable increases; several species have apparently established new populations at Oxford Basin that weren't present during the 1970s. Most importantly, large waders have increased dramatically. The great egret, snowy egret, and black-crowned night-heron now breed at various locations along Admiralty Way and forage at the Basin year-round, whereas during the 1970s they were only sporadic visitors to the Basin. Two species of waterfowl should be considered new "colonists," the American wigeon (high double-digits in winter) and the gadwall; interestingly, no species of waterfowl has dramatically declined at the Basin. The black phoebe, a resident and possible breeder, appears to have recently colonized the Basin. Three species were confirmed as breeders in 2009/2010, when before they occurred only in the non-breeding season: the mallard, Anna's hummingbird and the American crow. The ruby-crowned kinglet, black-throated gray warbler, and Townsend's warbler are regionally common during both migration and winter, though they were recorded at the Basin for the first time during 2009/2010.

Finally, the non-native spotted dove was considered common in residential areas Oxford Basin in the 1970s, but this species has declined greatly locally and across the Los Angeles Basin. The Eurasian collared-dove, a recent arrival to California that is starting to fill a similar niche today, was detected in the neighborhood north of Oxford Basin during this study.

[Addendum: An inactive nest high detected on 30 June 2010 in a large ficus tree along the Basin's southern border, near Admiralty Way, may have belonged to an American crow, a heron, or a raptor (see Figure 12). When discovered by DSC, there was no bird activity in the area, and no obvious whitewash on the ground below. Given that American crows were active in this area during previous visits, including birds carrying nesting material, this was probably a crow's nest. However, it is probably best left unidentified.]

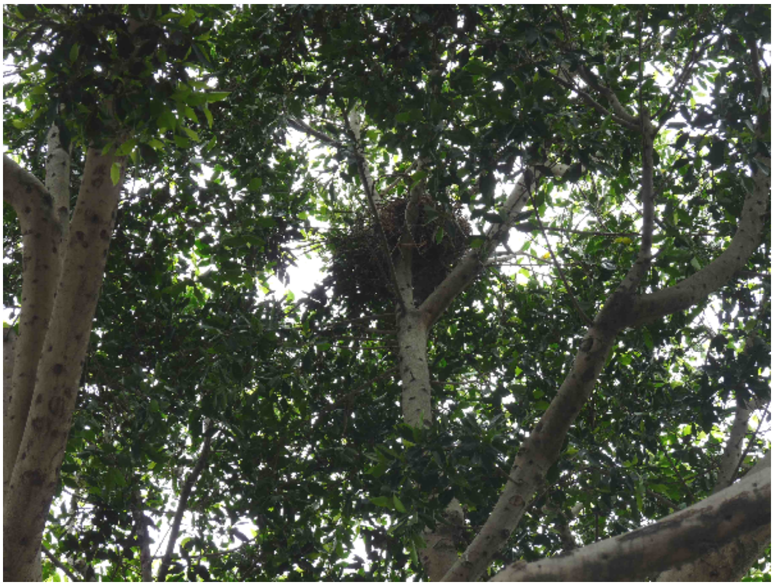

Figure 12. Unknown nest on south side of Oxford Basin, 30 June 2010; DSC).

Other Wildlife

Populations of non-avian terrestrial vertebrates have also come and gone from Oxford Basin during recent decades. Schleicher (1974:14) recorded one native reptile, the southern alligator-lizard (*Gerrhonotus* [now *Elgaria*] *multicarinatus*) and a native rabbit that was listed as "Brush rabbit" (*Sylvilagus bachmani*) but was almost certainly the desert cottontail (*S. audubonii*), a species widespread in the Los Angeles area. A 1976 EIR by the Los Angeles County Department of Small Craft Harbors also mentioned rabbits ("Other than a few rabbits...", p. 4). The desert cottontail is still common over much of the Ballona Wetlands (including "Area A" adjacent to Marina del Rey) but no longer occurs at Marina del Rey proper, nor elsewhere in the Venice/Mar Vista area (DSC pers. obs.). We consider it extirpated from Oxford Basin. Schleicher (1974) also recorded a non-native turtle, the red-eared slider (recorded as "*Pseudemys* sp."), a commonly released pet found widely in urban Los Angeles that will probably occur again at Oxford Basin. The Basin's population of the California ground-squirrel was not mentioned by Schleicher, and it may be fairly recent, perhaps the result of animals displaced by ongoing development of vacant lots nearby.

Opportunities for Restoration

The avifauna of Oxford Basin is constrained by several factors, including the parcel's small size, isolation from other wetland habitats by urban development (including numerous tall trees and two high-rise towers just to the south), current lack of regular tidal flushing, and dominance of invasive, non-native vegetation. Other factors, such as a litter and water quality, were emphasized in earlier studies but are probably only minimally impacting the birdlife of the Basin. Ballona Creek, for example, easily as polluted a water body as Oxford, sees very high usage from a much greater variety of waterbirds than does Oxford. Also, it is worth noting that the nearby (restored) Ballona Lagoon just west of Marina del Rey is also small in extent (and linear in configuration), but nonetheless supports an exceptionally high species diversity of shorebirds compared with present-day Oxford Basin (records of 10+ species per year [C. Almdale unpubl. data] vs. 1 species at Oxford Basin during the 2009/10 survey).

Relatively simple steps could be taken to enhance Oxford Basin for birds that have been extirpated since the 1970s, and possibly even for certain species that existed in the pre-Marina del Rey wetlands. Replacing the thicket of myoporum with low-profile, native vegetation would likely result in the re-colonization of the site by white-crowned sparrows, which no longer winter there. The American kestrel might use the site with such vegetation restored, as could (migrant) northern flickers and song sparrows. These species remain common in their respective roles in the larger Ballona ecosystem where native vegetation persists or has been restored. Other migrant songbirds recorded regularly at Ballona Lagoon that could use a restored Oxford Basin include the house wren, blue-gray gnatcatcher (*Polioptila caerulea*), common yellowthroat (*Geothlypis trichas*), and Lincoln's sparrow (*Melospiza lincolnii*). None of these currently occur at the site or in typical urban/residential vegetation, and all have responded positively to restoration at Ballona Lagoon and other nearby natural areas.

With increased tidal flushing, the mudflats of Oxford Basin could once again support numbers and a diversity of shorebirds, and possibly a wider variety of waterfowl than is currently represented (just four ducks and one shorebird were detected during surveys in 2009/2010, contrasting with five species of waterfowl and at least nine species of shorebirds in 1980). With most of the historical tidal mudflat habitat lost permanently in the Marina/Ballona area (and essentially absent from the rest of the Santa Monica Bay/Los Angeles Basin south of Malibu), restoration of this habitat could have a wide-reaching, positive impact on waterbirds in the region. It is also possible that such sensitive species as the California least tern could once again use the Oxford Basin as an alternate fishing site during its breeding season.

Please refer to the draft Marina del Rey Conservation & Management Plan (Hamilton and Cooper 2010) for additional species that could benefit from restoration at Oxford Basin.

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Schreiber, R. W., and Dock, C. F. 1980. *The Birds of the Bird Conservation Area, Marina del Rey, Los Angeles County.* Report to Department of Small Craft Harbors, County of Los Angeles, Marina del Rey, CA.

Appendix A. Previous reports on the birds and habitats of Oxford Basin ("Bird Conservation Area").

The following reports cited in the text are provided here as follows:

Los Angeles County Department of Small Craft Harbors. 1976. *DEIR, Proposed Japanese-American Cultural Garden, Marina del Rey*. August 19, 1976 (including "List of Plant Material at Bird Conservation Area - Marina del Rey").

Schreiber, R. W., and Dock, C. F. 1980. *The birds of the bird conservation area, Marina del Rey, Los Angeles County.* Report to Department of Small Craft Harbors, County of Los Angeles, Marina del Rey, CA.

Gustafson, R. J. 1980. Vegetation analysis [of Bird Conservation Area, Marina del Rey]. Appendix Four of Report to Department of Small Craft Harbors, County of Los Angeles, Marina del Rey, CA.

Schleicher, C. 1974. Ornithological Study of Bird Conservation Area, Marina del Rey, California. Appendix F. *In*: County of Los Angeles, Department of Small Craft Harbors. 1976. *DEIR, Proposed Japanese-American Cultural Garden, Marina del Rey*. August 19, 1976.

COUNTY OF LOS ANGELES / DEPARTMENT OF SMALL CRAFT HARBORS

Administration Building, Fiji Way, Marina del Rey, California 90291 / 823-4571 / 870-6782

VICTOR ADORIAN
Director

AUGUST 19, 1976

DRAFT ENVIRONMENTAL IMPACT REPORT

PROPOSED JAPANESE-AMERICAN CULTURAL GARDEN, MARINA DEL REY

CONTENTS

COUNTY OF LOS ANGELES / DEPARTMENT OF SMALL CRAFT HARBORS
Administration Building, Fiji Way, Marina del Rey, California 90291 / 823-4571 / 870-6782

August 20, 1976

VICTOR ADORIAN
Director

DRAFT: ENVIRONMENTAL IMPACT REPORT

SECTION I - PROJECT DESCRIPTION

1. Location: Parcel P, Marina del Rey Small Craft Harbor (See Appendix A)
   4350 Admiralty Way, Marina del Rey, Ca. 90291

2. Description: The proposed project would convert approximately 5 acres of bird habitat, constructed in 1962, into a Japanese-style public garden containing two gate houses with public restrooms, an arbor, an outdoor amphitheater, the importation and placement of a Japanese tea house and several artifacts, including two bridges, stone lanterns and similar art objects, the construction of rock dust walkways, and the addition of pebble surfaces in key dry and submerged areas and "Rangui" posts (natural timber pile bulkheads) along portions of the shoreline of the Oxford Drainage Basin, a storm water catchment constructed in 1960. An artificial pond and waterfall are also proposed to be added. Most of the existing vegitation will be displaced by new flowering trees and shrubs, lawn and ground covers; the existing irrigation system will be modified to suit new proposed conditions. (See Appendix B for schematic plan of project.)

   Proponents of the project, proposed to be constructed with private funds and donated to the County for public use and maintenance, contend that the present premises do not sustain significant bird life, both in terms of numbers of species and numbers of individuals; that birds observed in the area are typical to the region and would return to the gardens after construction; and that the premises do not now present an attractive appearance. The proposed change in the use of the land will afford employment opportunities and a much higher order of public recreational use than presently afforded.

   The estimated cost of the proposed project is $1,306,000.

SECTION II - DESCRIPTION OF ENVIRONMENTAL SETTING

1. Historical Background:

Marina del Rey Small Craft Harbor encompasses 804 acres of real property owned and managed by the County of Los Angeles. Approximately one-half of the site was excavated by dredging to constitute navigation channels and small craft berthing basins. This construction was initiated in 1957 and substantially completed by 1962. Approximately two-thirds of the land area and one-third of the water area has been leased to private entrepeneurs for the construction and operation of public use facilities, including boat slips and ancilliary facilities, shopping facilities, restaurant and residential and hotel accomodations. Refer to Appendix for complete tabulation of leasehold improvements. The remaining acreage--two-thirds of the water area, one-third of the land area--is under the development and/or operational control of the County's Department of Small Craft Harbors.

The construction of the harbor interrupted certain natural drainage features in the locale, as a result of which various storm drain projects were constructed concurrently. One such was the Oxford Drainage Basin, a storm water catchment of about 5 surface acres, intended to receive storm runoff at such times as the state of the tide within the harbor precluded its discharge causing inundation of low-lying lands adjacent to the north section of the harbor. The basin is equipped with a tide gate which closes to prevent tidal flooding of the low-lying areas and opens to release impounded waters when the tide is low. The lowest level of the tide experienced in this vicinity is -1.7' MLLW; the highest is +7.8'. The average daily range is on the order of 5 feet. The Oxford Drainage Basin and its appurtenant structures is under the operational control of the Los Angeles County Flood Control District.

At the time the Oxford Drainage Basin was constructed, various naturalist organizations requested that the Board of Supervisors set aside this parcel as a wildlife sanctuary, particularly for birds. In January, 1963, the Board designated Parcel P as the Bird Conservation Area. Plant materials were selected and planted to afford nesting, roosting and feeding capabilities. A band of dense shrubbery was planted along the periphery fence to afford privacy and minimize the impact of nearby streets and activity areas. A few years later, about 1965, fill was imported to construct a mound along the northeasterly property line and the area replanted and irrigated in an effort to further improve the habitat.

SECTION II (continuation)

2. <u>Current Environmental Setting:</u>

The premises encompass 10.716 acres, approximately half of which is submerged, and is bounded as follows:

- Along the northwest bondary by Washington Street, a secondary highway;
- Along the north boundary by a 60-foot railroad right of way belonging to the Southern Pacific Transportation Co. which has applied for authorization to abandon its infrequent rail service;
- On the east by Parcel Q, currently unimproved and vacant. This property is identified for public parking on the harbor's master development plan and the project proponents propose that a parking lot be constructed to serve the project;
- Along the southeast side by Admiralty Way, a heavily travelled harbor thoroughfare.
- On the southwest side by a public parking lot (Parking Lot "OT") operated by the Department of Small Craft Harbors.

A portion of the South Bay Bicycle Trail traverses the north side of the premises parallel with the railroad between Washington Street and Parcel Q. It is a 16-foot wide asphaltic concrete strip within a 20-foot right of way and is fenced on both sides. All of the foregoing are identifiable on the project plans and aerial photos enclosed.

A complete list of plant materials installed in the Bird Conservation Area is provided in Appendix D. Most of it was planted between 1964 and 1968. The lack of an adequate irrigation system resulted in a heavy loss of first plantings. A few trees died after reaching substantial growth. This was attributed to deep tap roots reaching the salt water level. However, most species have survived well and grown as expected. Pyrocantha introduced in 1974 has not propagated as well as expected and may be inhibited by either soil or climate or both. Soil tests and analysis will be necessary to determine the nature of treatment, if any, required to sustain desired exotic plant materials.

In 1973, between June 14 and November 30, an inventory of bird life by observation and catalogueing was completed by Mr. Carter Schleicher, a biology major enrolled at California State University, Humboldt. His report and recommendation is attached as Appendix F. No nests were found in the area and, with few exceptions, most birds sighted during this period are quite common throughout the region.

SECTION II (continuation)

In 1965, the apparent lack of bird life prompted the importation of a flock of domestic ducks from Alondra Park. The flock was augmented from time to time by citizens wishing to get rid of pet ducks and, occaisionally chickens. While the presence of these birds delighted many children, who watched and fed them through the fence along Washington Street, it became apparent that it not function as a lure to wild birds. Mr. Schleircher recommended their removal and a new home was found for them away from the Marina. However, "donations" of individual birds by tossing them over the fence continue and the crowing of roosters has brought several complaints from nearby apartment tenants.

Other than a few rabbits, there is little evidence of the presence of mammals or reptiles on the premises. However, a deliberate study has been initiated by personnel of the County's Museum of Natural History and the results will be distributed to recipients of this EIR for corelated review and comment.

The existing basin is kept submerged with salt water during the dry season with a maximum pool elevation of about +3' MLLW. The tide control gate is set to permit flows in and out with the daily harbor tide cycles. The Flood Control District may lower the pool level to about -1' MLLW in advance of expected winter storms. During the summer months, the low flows of fresh water into the pond create a brackish condition, particularly in the shallow East end, and there is a high incidence of algae and grass growth. There appears to be a thick mat of decomposed plant material over much of the bottom of the basin and Mr. Schleicher reported a "white cob-webby fungus." Various species of fish have been casually observed in the pond. However, no formal study has been accomplished heretofore. A comprehensive study of the nature and magnitude of marine life now present in the harbor waters, including the Oxford Drainage Basin, by a team from the University of Southern California has been commissioned by the County. The results of the study are not expected to be finalized before the latter part of 1977. A separate investigation of the "mud flats" areas of the basin where shore birds have been observed feeding will be made and reported concurrently with the data regarding animal life. The proposed project will not significantly affect the water areas except where pebble surfaces are proposed to be installed in shallow areas. Measures to obviate the undesired grass and algae will have to be devised and provided.

In addition to the Flood Control District's inlet and outlet structures, located on the property, a mainline sanitary sewer and water and power transmission facilities belonging to the City of Los Angeles traverse from East to West approximately 60-feet South of and parallel with Washington Street.

List of Plant Material at Bird Conservation Area -- Marina del Rey

Punicum (Pomegranate)

Pampas Grass

Oleander

Pyracantha

Hakea

Aleppo Pines

Armstrong Juniper

Hybiscus

Monterey Pine

Cistus (Rock Rose)

Sycamore

Meleleuca Species

Acacia Species

Thompson Seedless Grapes

Abelia

Myoporum

California Pepper

Lagenaria

Fruiting Loquat

Tam Juniper

Eucalyptus Glomerata

Baccaris Pilularis

Bouganvillea

Catalina Cherry

Sumac (Rhus ?)

Lonicera (Honeysuckle)

Fremontia

8/17/76
LWS

THE BIRDS OF THE BIRD CONSERVATION AREA

MARINA DEL REY, LOS ANGELES COUNTY

RALPH W. SCHREIBER and CHARLES F. DOCK

Report to

Department of Small Craft Harbors
County of Los Angeles
Administration Building, Fiji Way
Marina del Rey, California 90291

From

Ornithology Section
Natural History Museum, Los Angeles County
900 Exposition Boulevard
Los Angeles, California 90007

TABLE OF CONTENTS

LIST OF FIGURES AND APPENDICES

The Birds of the Bird Conservation Area
Marina del Rey, Los Angeles County

Ralph W. Schreiber and Charles F. Dock

Introduction

The "Bird Conservation Area" (BCA) is 10.7 acres known as Parcel P on the northwest corner of the Marina del Rey Small Craft Harbor, Los Angeles County, California. The BCA was so designated in 1963 by the County Board of Supervisors and is primarily fenced and planted land surrounding a storm water catchment basin. Various proposals have been made to improve this region for public use over the years. Under the California Coastal Act of 1976, regarding environmentally sensitive habitat areas (Sec. 30240), any such project must consider the effects of changes in the land on the biotic community. The present study was designed to determine the bird use of the region. This study is a portion of a larger study on the total avian populations of the Ballona wetlands, but this report deals only with the Bird Conservation Area (Dock and Schreiber, 1980, The Birds of Ballona Wetlands, Los Angeles County, California, Submitted to California Coastal Commission).

Summary

Based on weekly surveys during 17 months between October

1978 and August 1980 of the birds of the "Bird Conservation Area," we conclude that this area is not important as habitat for wild birds in the Los Angeles basin. While it serves as "green belt" space and as an area for a limited but important number of people to enjoy seeing and feeding domestic ducks, the area serves little or no purpose as a conservation area for a viable population of migratory or resident wild species. Because of its limited size and relative isolation, we believe that any efforts at habitat modification would have little or no effect at increasing the wild avian populations in the region. Certain modifications could make it more conducive for the domestic animals and as green space.

Methods

Avian populations of the Los Angeles County Bird Conservation Area (BCA) were studied from August 11, 1979 to August 8, 1980. Censuses were conducted on a weekly basis. Two censuses per week were made during all times when migrant and wintering birds were likely to alter the usual species composition of the area. Counts were usually made during morning hours, when terrestrial bird species are most active, but frequent afternoon studies were also conducted to assess the effects of time of day on census results. Relative water levels and weather conditions were recorded during each visit. Birds were systematically counted from the periphery of the pond. The area was circled slowly and all bird species and individuals observed were recorded. Each sampling period lasted approximately one hour. All species identifications were made with the aid of 9x35 binoculars.

A preliminary investigation was conducted from October 7, 1978 to April 14, 1979. Data obtained in this study are presented in Appendix 2. That study was conducted by other investigators, and data obtained were not included in the analysis of the yearly cycle, to assure strictly comparable comparisons. Daily comparisons of morning and afternoon censuses were made during this earlier study, and results of this investigation are discussed. Data on these daily comparisons are presented in Appendix 3.

Habitats

An account of the vegetation occurring at the Bird Conservation Area is given in Appendix 4, including a generalized map (Fig. 1). Birds, however, tend to respond to the structure of the vegetation rather than specific plant species in most instances. The following habitat classification appears to reflect patterns of bird utilization and is based generally on vegetation structure.

Open Water

This habitat includes the principal water mass and purely aquatic vegetation (e.g. algae). This habitat is primarily important as foraging and resting area for ducks, geese and coots. Occasionally, other species of waterbirds are seen on the water, including gulls and cormorants. Belted Kingfishers, herons and egrets forage in the shallow margins of the main water mass. Of particular interest are California Least Terns, an endangered species that nests on nearby Venice Beach and the Ballona Wetlands, and occasionally forages on small fish in the Bird Conservation Area.

Pickleweed

Pickleweed, *Salicornia virginica*, is found in a narrow strip along the southeastern border of the pond and along the margins of the inlet channel. This vegetation type is generally associated with salt marshes and is of interest as bird habitat primarily because Belding's Savannah Sparrow, an endangered species, is restricted to Pickleweed associations.

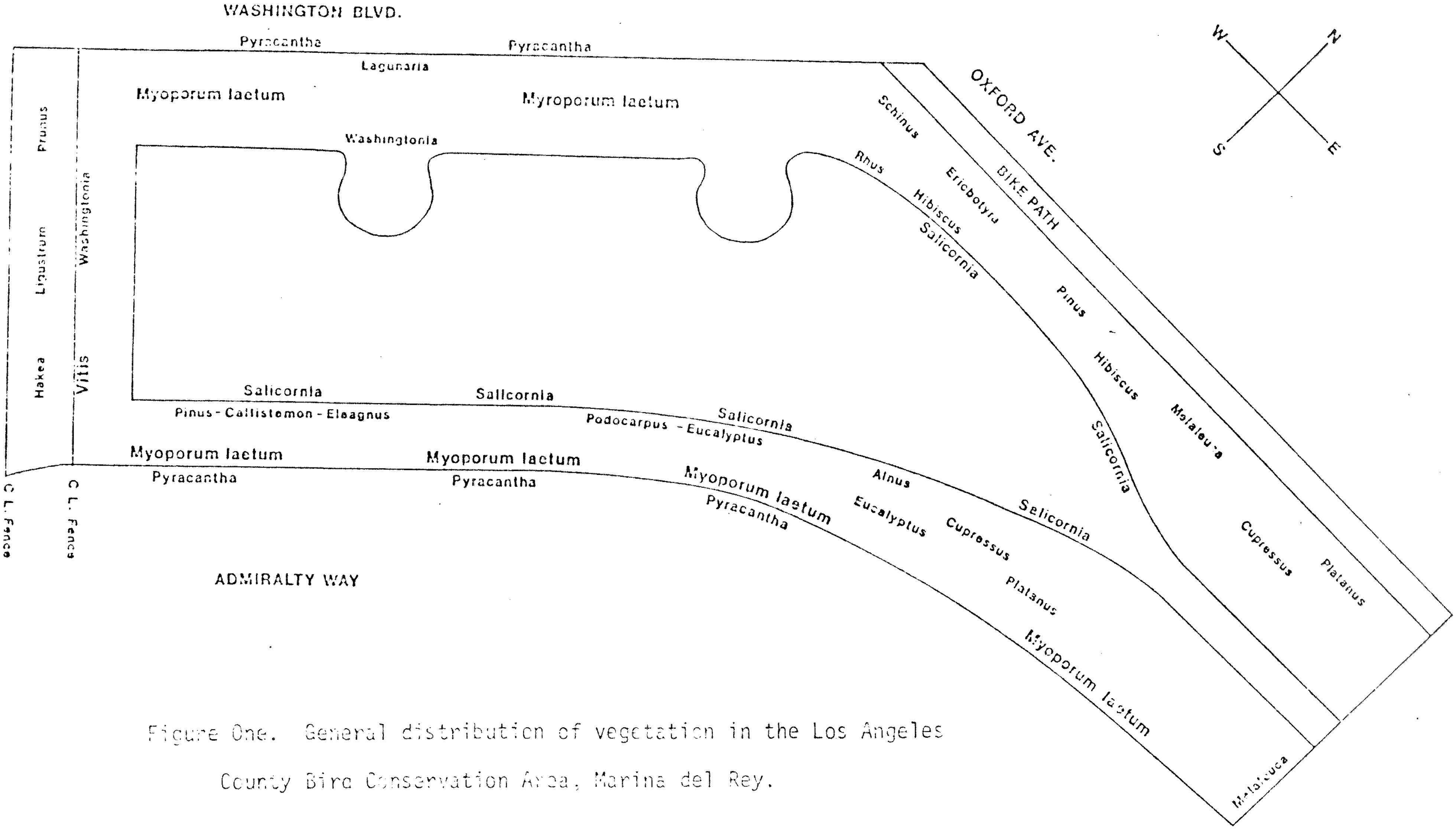

Figure One. General distribution of vegetation in the Los Angeles County Bird Conservation Area, Marina del Rey.

Pickleweed habitat at the BCA is of very limited extent, however, and does not support a population of Belding's Sparrows. During the course of this investigation, not a single individual of this species was recorded. Pickleweed at the BCA is used primarily for cover by the resident ducks, and to a lesser extent by Song Sparrows and Mockingbirds as foraging grounds.

Mudflats

When water levels are low, mudflats are exposed along the northwestern shore of the pond. This habitat type is important to a number of species that regularly or occasionally occur at the BCA. Most of the shorebirds recorded here are dependent on the mudflats for their occurrence, both to feed and to rest. The mudflats are also used as loafing grounds by gulls, ducks and coots.

Trees

Trees of several species cover much of the grounds surrounding the pond. These trees provide shade and general cover for the resident ducks, geese and chickens. In addition, they are used as perching sites for a number of species and nesting sites for Mockingbirds, Starlings, Jays and possibly a few other common birds. The most common nesting species is the Starling. In Spring, 1980, a sizable colony bred in the trees along the northwestern shore.

Undergrowth

In certain portions of the area, particularly along the southeastern shore, various herbaceous plants occur sporadically under the canopy. This undergrowth provides cover and foraging substrate for migrant terrestrial birds, including thrushes, wrens and especially White-crowned Sparrows. During the winter months, White-crowned Sparrows are found regularly in fairly large numbers in this particular habitat. Much of the area beneath the trees is devoid of vegetation, in part because of shading, but primarily due to the concentration of domestic fowl and domestic ducks. The ducks also use the existing undergrowth as cover for breeding activities, although reproduction in the duck population at present appears limited.

Shrubs

Large shrubs are scattered over the more open portions of the area, particularly along the northern border. These plants are used as foraging sites by House Finches, jays and Mockingbirds. White-crowned Sparrows commonly forage on the ground underneath the shrubs. Hummingbirds nest only in these fairly open areas where the shrubs provide not only nest sites, but also perches for display and observation.

Grasses and Herbs

Various species of grasses and herbs occur over much of the grounds. These plants provide a seed supply for finches, sparrows, Mourning Doves and Spotted Doves.

Results

Figure 2 shows changes in total species and total waterbird species recorded throughout the yearly cycle. Neither parameter exhibits particularly dramatic seasonal changes, and in fact are rather remarkable for their consistency. A few more species use the BCA in the fall and winter than in spring and summer. These minor differences are due to the seasonal presence of migrants, including ducks, Coots, California Gulls, White-crowned Sparrows and assorted occasional terrestrial species.

Seasonal differences in total numbers of individuals and numbers of individual waterbirds are shown in Figure 3. Seasonal differences in numbers of individuals are greater than seasonal differences in numbers of species. Some of the migrants are fairly abundant in winter, particularly coots and White-crowned Sparrows, which affect these figures markedly. Differences in waterbird numbers are especially influenced by changes in the status of the American Coot population as can be seen from an examination of Figure 4. Only stragglers are present in the summer, while considerable numbers are present during the winter months. Other waterbirds contribute relatively little to changes in overall numbers of individuals, being present as single individuals or small flocks.

Most of the individual waterbirds present on the area are domestic ducks and mallards that are year-around residents. Most of the variation in numbers of these birds, as shown in Figure 5, reflect census difficulties and not actual changes in the populations. At different times, the birds may be

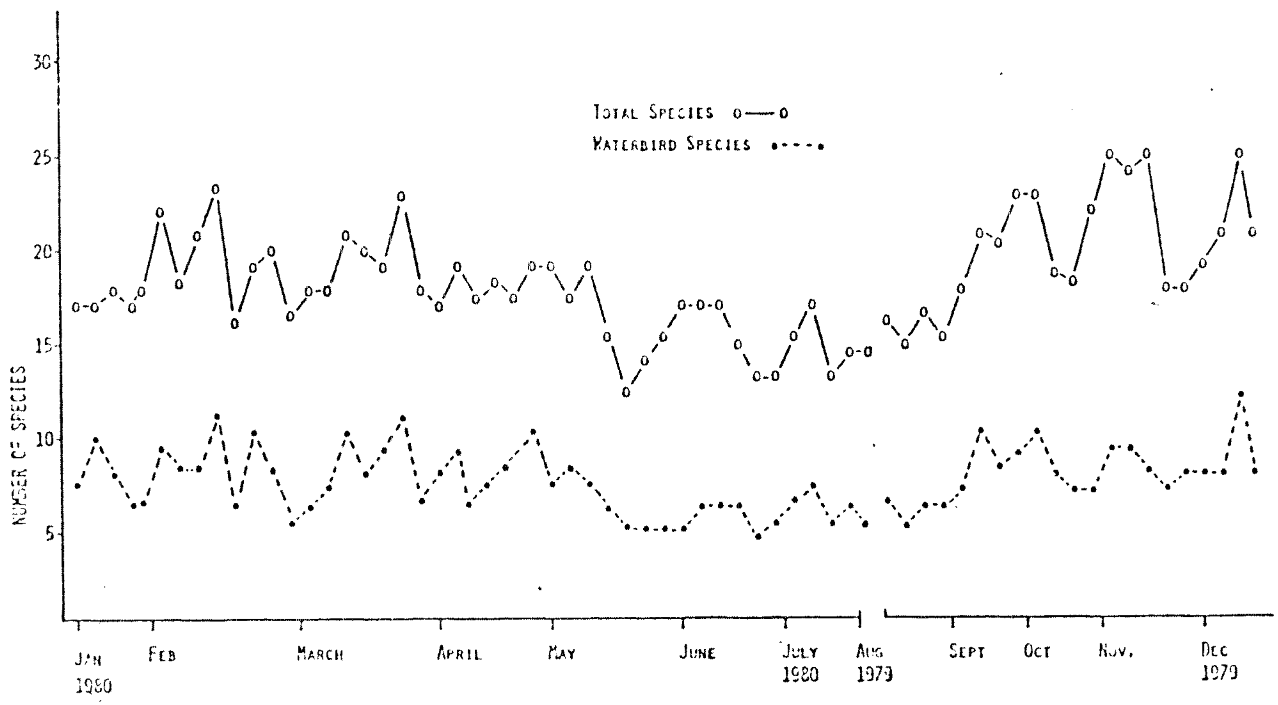

Figure Two. Total number of species and total waterbird species observed on individual censuses from August 1979 through July 1980.

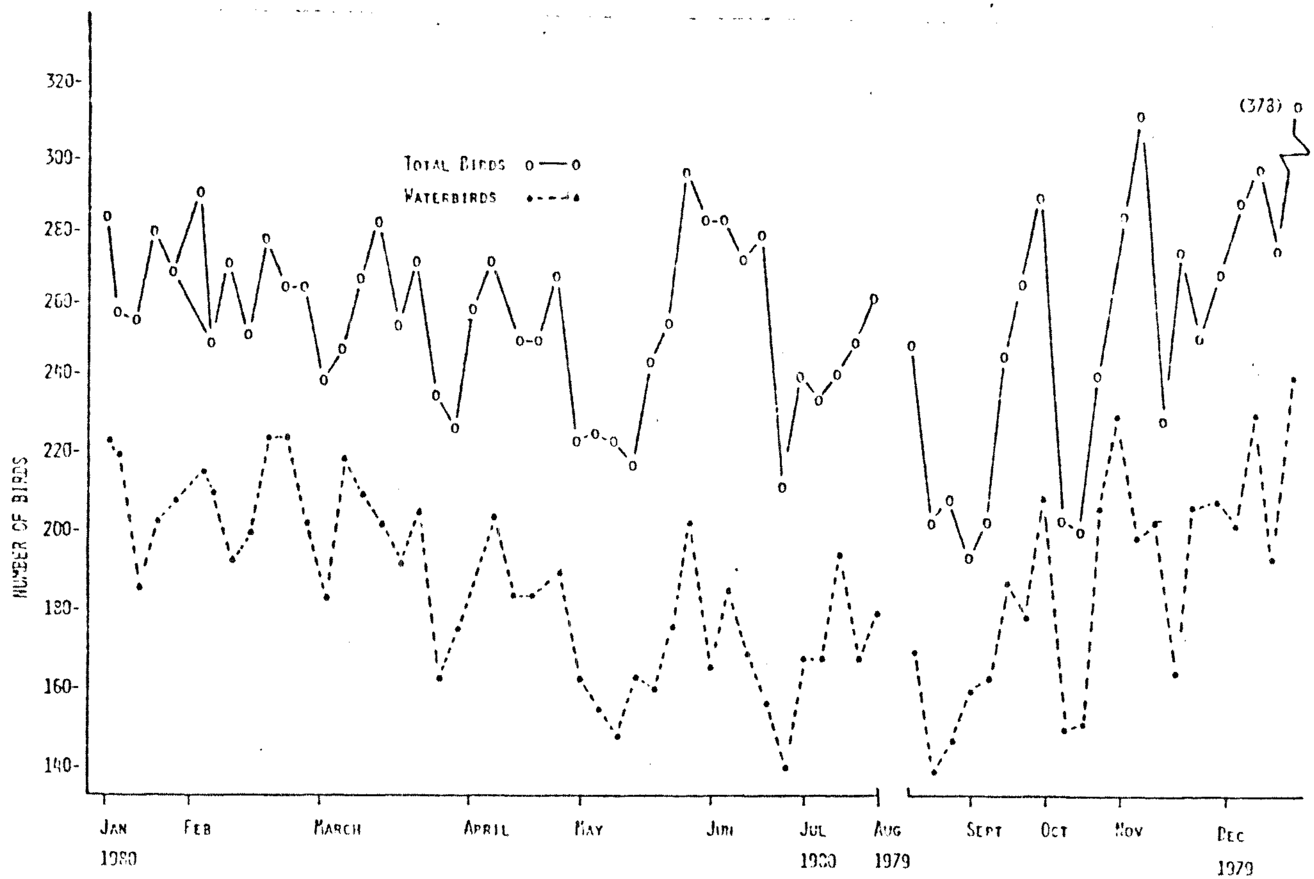

Figure Three. Total number of individual birds of all species and total number of waterbirds observed on individual censuses from August 1979 through July 1980.

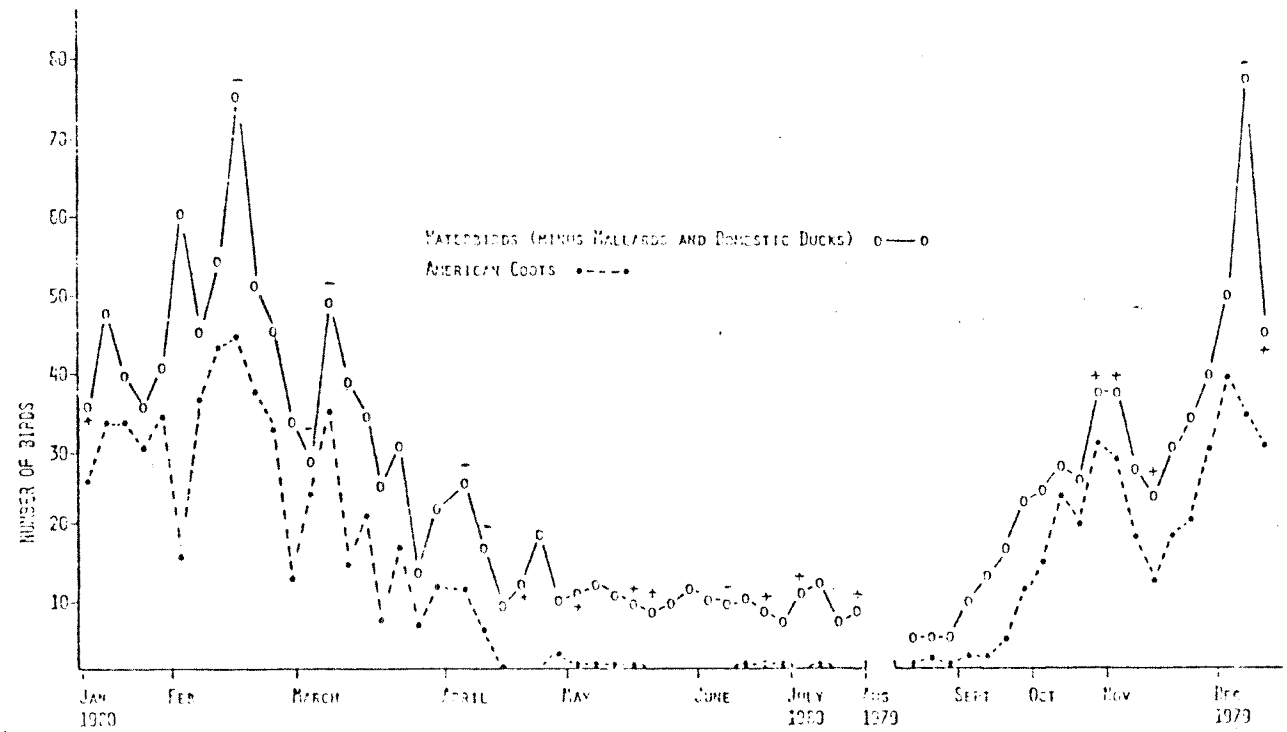

Figure Four. Total number of waterbirds, exclusive of resident Mallards and Domestic Ducks, and total number of American Coots observed on individual censuses from August 1979 through July 1980. Pluses (+) indicate times of particularly high water levels; minuses (-) indicate times of particularly low water levels.

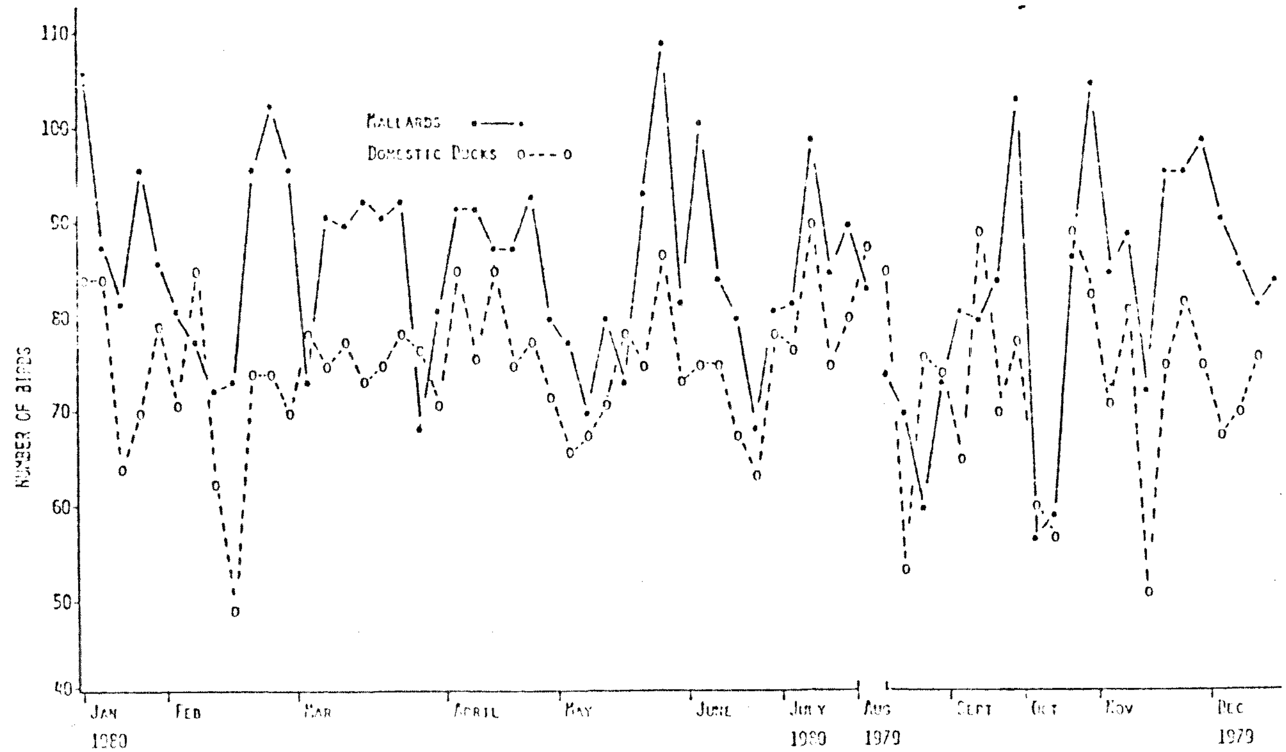

Figure Five. Total number of Mallards and Domestic Ducks observed on individual censuses from August 1979 through July 1980.

concentrated on the open water, or may be found primarily loafing or feeding under the trees adjacent to the pond. The ducks are much easier to census on the water than when they are in the vegetation.

The mallards and domestics breed to a limited extent within the BCA, and hybridization between the two forms is quite common. This reproduction is possibly contributing to a gradual increase in numbers of ducks through time, although there is singificant mortality in the populations. A number of dead ducks were observed during the course of this investigation. Much of this mortality is apparently due to predation from dogs, which were frequently seen inside the fence and were observed pursuing the ducks on several occasions. There may also be limited interchange of individuals between the BCA and the nearby Venice Canal system, although no individuals were actually observed flying between the two locations.

A complete tabulation of birds observed during the study, and their times of occurrence is given in Appendix 1.

Non-seasonal Factors Affecting Bird Utilization

At low water levels, fairly extensive areas of mudflat are exposed along the northwest side of the pond, while virtually no mudflat is exposed at high water levels. Many shorebirds, gulls and terns utilize mudflats for feeding and/or loafing. Figure 4 shows the number of waterbirds in relation to particularly high and low water levels. No completely consistent pattern emerges,but particularly low water levels in winter tend to be associated with increased waterbird usage. This becomes more apparent if differences between total waterbird numbers and American Coot numbers are considered. Additional species (other than coots) tend to contribute more to overall waterbird numbers during periods when more mudflat is exposed.

Certain species exhibit fairly predictable daily patterns of movement over their home range. In the Spring of 1979, same-day censuses were conducted in both mornings and afternoons over an eleven-week period to determine the effect of time of day on census numbers. The results of this study are summarized in Figure 6. More birds were recorded in the afternoon censuses than in early morning censuses. Most of this difference in numbers of individuals was attributable to an increase in waterbirds present in the afternoon. As can be seen from the figure, the numbers of terrestrial birds and resident ducks recorded remained relatively constant, as would be expected. More wild waterbirds were present on the area in the afternoon than in the morning. In particular, the number of gulls present at the study site increased in the afternoon.

While the overall differences are not dramatic, we tentatively conclude that more waterbirds are present at low water levels than at high water levels, and more individuals use the area in the afternoon than in the morning.

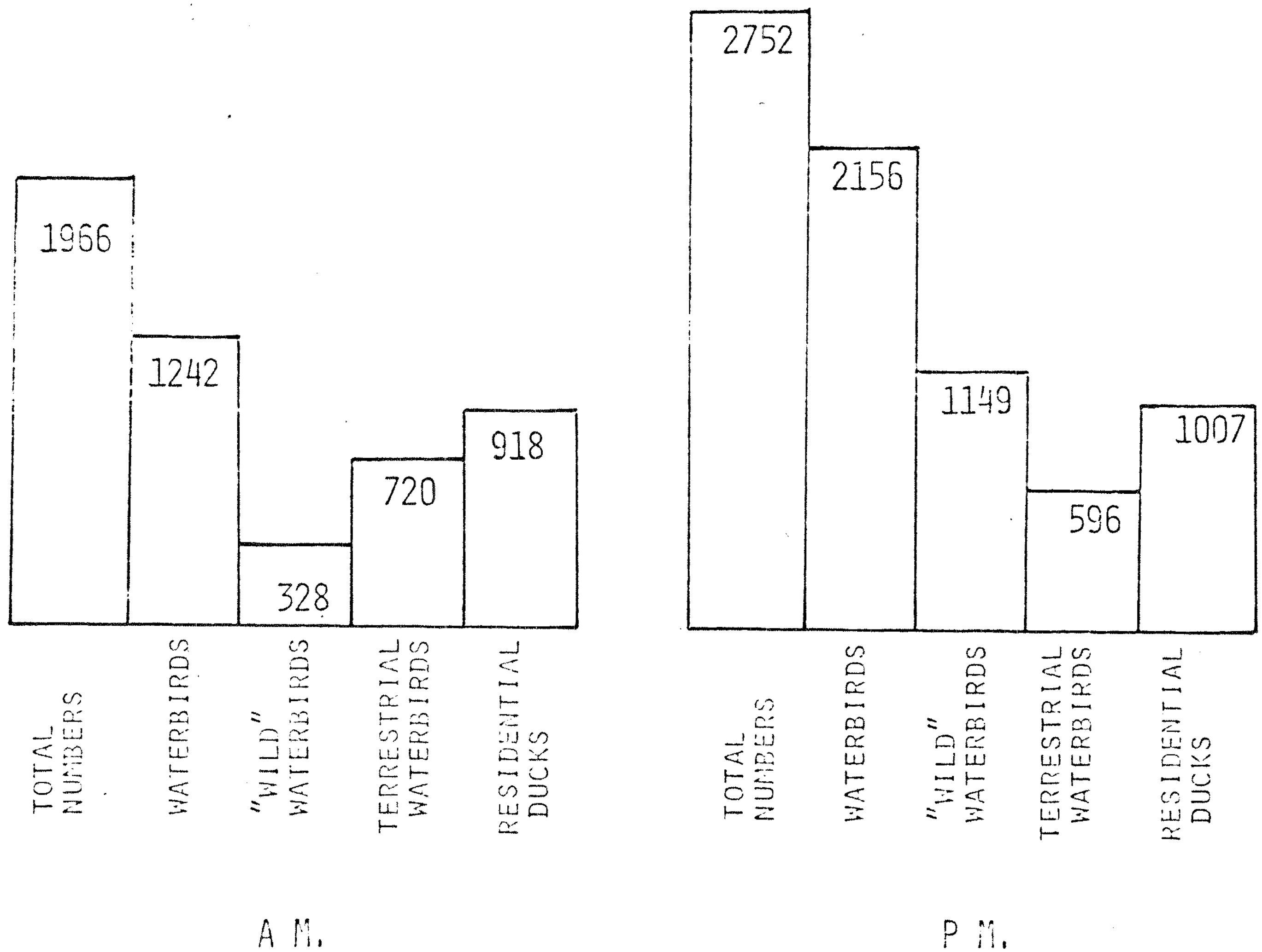

Figure Six. Numbers of birds observed during morning and afternoon censuses over eleven week period from 20 January 1979 to 14 April 1979.

SPECIES ACCOUNTS

ORDER PODICIPEDIFORMES
FAMILY PODICIPEDIDAE

EARED GREBE *Podiceps nigricollis*

Common migrant and winter visitor on protected coastal waters. One to three individuals were observed regularly on open water at the Bird Conservation Area from mid-October, 1978 to mid-January, 1979l

WESTERN GREBE *Aechmophorus occidentalis*

Common migrant and winter visitor offshore and occasionally on quiet inshore waters. Observed occasionally during winter months on open water at Bird Conservation Area.

PIED-BILLED GREBE *Podilymbus podiceps*

Fairly common migrant and winter visitor to protected bodies of both fresh and salt water. Individuals may occasionally be observed in summer. One to three individuals were regularly recorded at the Bird Conservation Area from late summer to early spring.

ORDER PELICANIFORMES
FAMILY PHALACROCORACIDAE

DOUBLE-CRESTED CORMORANT *Phalacrocorax auritus*

Common offshore species in all seasons but less numerous in summer. Most local adults breed on the Channel Islands. Occasional vagrants observed in the fall and winter, resting on open water at the Bird Conservation Area.

ORDER CICONIIFORMES
FAMILY ARDEIDAE

GREEN HERON *Butorides striatus*

Common resident around shallow water containing vertebrate and/or invertebrate prey. Breed in a variety of locations in southern California. Individuals commonly observed in all seasons around the Bird Conservation Area.

SNOWY EGRET *Egretta thula*

Common transient and winter visitor around fresh and salt water. Observed sporadically on mudflats from fall to late spring.

BLACK-CROWNED NIGHT HERON *Nycticorax nycticorax*

Uncommon transient and winter visitor in southern California. A pair of juveniles was observed on several occasions in late winter and spring in the trees surrounding the Bird Conservation Area.

ORDER ANSERIFORMES
FAMILY ANATIDAE

WHISTLING SWAN *Olor columbianus*
Uncommon winter visitor in coastal southern California. Single individual observed at Bird Conservation Area from September to early November.

DOMESTIC GOOSE *Anser anser*
Birds on area probably intentionally released. Several birds resident on Bird Conservation Area. Bred on area in Spring, 1980.

MALLARD *Anas platyrhynchos*
Wild birds are common southern California residents, with numbers increasing in winter with influx of migrants. Common residents on Bird Conservation Area. Commonly hybridize with domestic ducks.

DOMESTIC DUCK *Anas platyrhynchos*
Common "pets"; also raised commercially. Common residents on Bird Conservation Area.

CINNAMON TEAL *Anas cyanoptera*
Common migrant and winter visitor in coastal southern California, particularly in fresh water and wet agricultural fields. One individual observed at the Bird Conservation Area in early May, 1980.

AMERICAN WIDGEON *Anas americana*
Common migrant and winter visitor on protected fresh and salt water situations in southern California. A single individual was observed on the pond in mid-November, 1978.

GREATER SCAUP *Aythya marila*
Uncommon winter visitor in southern California. Small flocks observed in winter at Bird Conservation Area.

LESSER SCAUP *Aythya affinis*
Common winter visitor and migrant on quiet water. Small flocks observed regularly from December through March at the Bird Conservation Area.

BUFFLEHEAD *Bucephala albeola*
Regularly seen in small numbers during winter in southern California. Single individuals obsrved in late October on the Bird Conservation Area.

ORDER FALCONIFORMES
FAMILY FALCONIDAE

AMERICAN KESTREL *Falco sparverius*
Common resident in open areas with natural or man-made perch sites. Observed commonly in all seaons on tall perch sites around the Bird Conservation Area.

ORDER GALLIFORMES
FAMILY GALLIDAE

DOMESTIC FOWL *Gallus gallus*

Common "pets" and commercial birds. Several individuals resident in wooded portions of Bird Conservation Area. Exist primarily on food items provided by passersby.

ORDER GRUIFORMES
FAMILY RALLIDAE

AMERICAN COOT *Fulica americana*

Common resident in fresh water marshes, ponds, and slower-moving streams and canals. Year-round resident on Bird Conservation Area, but numbers greatly increase in winter.

ORDER CHARADRIIFORMES
FAMILY CHARADRIIDAE

SEMI-PALMATED PLOVER *Charadrius semipalmatus*

Common fall and spring transient and winter visitor to coastal mudflats. Three individuals were observed on the mudflats in October, 1978.

KILLDEER *Charadrius vociferus*

Common resident near fresh and salt water and in wet fields and meadows. Observed sporadically in all seasons on mudflats around pond.

BLACK-BELLIED PLOVER *Pluvialis squatarola*

Common winter visitor and migrant on mudflats along coast. Small numbers found on mudflats of the Bird Conservation Area in winter.

FAMILY SCOLOPACIDAE

SPOTTED SANDPIPER *Actitis macularia*

Fairly common spring and fall transient and winter visitor, primarily around fresh water. Individuals observed sporadically from September to May, primarily along water's edge at the Bird Conservation Area.

WILLET *Catoptrophorus semipalmatus*

Common visitor in all seasons on mudflats, beaches, and marshes, but does not breed in region. Observed commonly foraging and loafing on mudflats. Numbers greatest from late summer through the winter, and least in early summer.

GREATER YELLOWLEGS *Tringa melanoleuca*

Fairly common as migrant, less common as winter visitor at marshes, mudflats and shores of ponds. Two individuals were seen on a single occasion on the mudflats in late November, 1978.

RED KNOT *Calidris canutus*

Rare fall migrant in salt marshes and mudflats. Two individuals seen on mudflats in late November, 1978.

WESTERN SANDPIPER *Calidris mauri*

Common spring and fall transient and fairly common winter visitor on mudflats or moist shores of both fresh and salt water. Observed sporadically on mudflats during the winter months.

MARBLED GODWIT *Limosa fedoa*

Common winter visitor and migrant on mudflats, beaches and marshland along coast. Occasionally seen in wet areas further inland. A single individual was seen on the mudflat in Fall, 1979.

SANDERLING *Calidris alba*

Common migrant and winter visitor along beaches of coast. Somewhat less common on mudflats. One large flock (150 individuals) observed on the mudflats in late November, 1978.

FAMILY LARIDAE

WESTERN GULL *Larus occidentalis*

Common resident in coastal southern California, but restricted to offshore islands for breeding, south of San Luis Obispo County. Observed irregularly from throughout year loafing on mudflats.

HERRING GULL *Larus argentatus*

Fairly common to uncommon winter visitor along coast. Rarely observed inland. Three individuals observed on Bird Conservation Area in January, 1979.

CALIFORNIA GULL *Larus californicus*

Common spring and fall transient and winter visitor. May be found in virtually any open area with nearby water, but more common along coast. Observed irregularly on mudflats from late summer through the winter.

RING-BILLED GULL *Larus delawarensis*

Common visitor in all seasons. Numbers diminish appreciably in summer. May be found in variety of habitats where some moist ground is available for foraging. A regular visitor on mudflats and open water in all seasons.

BONAPARTE'S GULL *Larus philadelphia*

Very common migrant and winter visitor around protected waters and wet agricultural fields along coast. Occasionally observed on mudflats and open water in the fall and winter months.

HEERMANN'S GULL *Larus heermanni*

Primarily late summer and fall visitor. Some individuals present in all seasons. Restricted to coastal areas. Occasional vagrants observed loafing on mudflats during fall and winter.

FORSTER'S TERN *Sterna forsteri*

Common migrant and winter visitor around bays, lagoons and other protected waters along coast. Occasionally observed on mudflats in fall and winter.

LEAST TERN *Sterna albifrons*

Uncommon summer visitor, from late April to September or October along protected portions of coast. Formerly nested on upper beaches at a number of locations as far north as Monterey County. Breeding now limited to a small number of managed sites in southern California. Observed foraging in the pond at the Bird Conservation Area in Spring and Summer, 1980.

ORDER COLUMBIFORMES
FAMILY COLUMBIDAE

ROCK DOVE *Columba livia*

Common resident in urban, suburban and agricultural areas. Resident in urban areas surrounding wetlands. Common resident of urban area around Bird Conservation Area.

MOURNING DOVE *Zenaida macroura*

Common resident in open woodlands, agricultural areas, parks, residential areas. Numbers increase in winter. Commonly observed in all seasons in trees and open areas.

SPOTTED DOVE *Streptopelia chinensis*

Common resident in urban areas of coastal southern California, which comprises its entire North American range. Introduced. Resident in urban areas surrounding the Bird Conservation Area.

ORDER APODIFORMES
FAMILY TROCHILIDAE

ANNA'S HUMMINGBIRD *Calypte anna*

Common resident in open woodland, shrubland, parks and residential areas with appropriate vegetation. Observed in all seasons. Generally restricted to upland habitats with open shrubs providing perch sites.

ORDER CORACIIFORMES
FAMILY ALCEDINIDAE

BELTED KINGFISHER *Megaceryle alcyon*

Fairly common resident near waters containing fish. A pair of kingfishers probably nests at the Bird Conservation Area.

ORDER PICIFORMES
FAMILY PICIDAE

COMMON FLICKER *Colaptes auratus*

Common resident in open woodlands and parks throughout basin. Observed irregularly throughout the year in wooded portions of the study site.

ORDER PASSERIFORMES
FAMILY TYRANNIDAE

WESTERN WOOD PEWEE *Contopus sordidulus*
Common spring and fall migrant and transient in wooded areas, usually near water. Nests in Riparian Woodlands of nearby mountains. A single individual was observed in trees surrounding pond in May, 1980.

OLIVE-SIDED FLYCATCHER *Nuttallornis borealis*
Uncommon to rare transient in wooded regions of coastal southern California. Three individuals were recorded in trees around the Bird Conservation Area in January, 1979.

FAMILY HIRUNDINIDAE

BARN SWALLOW *Hirundo rustica*
Fairly common migrant and occasional summer resident in open areas near water. Requires mud for nest construction. Small numbers of individuals observed foraging over open water in late Spring and Summer, 1980.

FAMILY CORVIDAE

SCRUB JAY *Aphelocoma coerulescens*
Common resident in woodland, chaparral and urban areas with trees. A common resident of wooded urban areas. Observed commonly in trees and shrubs at the Bird Conservation Area.

COMMON RAVEN *Corvus corax*
Common resident in rocky areas of the foothills and mountains around the Los Angeles Basin. Less common within the city than the Common Crow. A single individual was observed soaring over the area in April, 1980.

COMMON CROW *Corvus brachyrhynchos*
Common resident in parks, suburbs and agricultural areas around the basin. Commonly observed soaring over areas in all seasons. Sometimes perch in trees.

FAMILY PARIDAE

COMMON BUSHTIT *Psaltriparus minimus*
Common resident of chaparral and coastal sage habitats in basin foothills. Flocks disperse widely outside breeding season. Small flocks were observed on four occasions in Winter, 1979, foraging in the trees and undergrowth at the Bird Conservation Area.

FAMILY TROGLODYTIDAE

HOUSE WREN *Troglodytes aedon*
Fairly common but patchily distributed resident in thickets and woodland edges. Northern birds transient in southern California in winter. Single individuals observed in late fall and winter in undergrowth at Bird Conservation Area.

FAMILY MIMIDAE

MOCKINGBIRD *Mimus polyglottos*

Common resident in urban areas and along edges of brushlands and woodlands. Common resident in urban areas. Regularly observed in trees and shrubs around pond. Probably nest at the Bird Conservation Area.

FAMILY TURDIDAE

HERMIT THRUSH *Catharus guttatus*

Fairly common transient and occasional winter visitor in lowland southern California. Breeds at higher elevations. Single individuals observed sporadically in late fall and winter amid undergrowth at Bird Conservation Area.

FAMILY PTILOGONATIDAE

PHAINOPEPLA *Phainopepla nitens*

Uncommon transient in lowlands and foothills surrounding Los Angeles Basin. One individual was observed in the trees around the Bird Conservation Area in October, 1978.

FAMILY LANIIDAE

LOGGERHEAD SHRIKE *Lanius leudovicianus*

Common resident in areas with lookout perches and open areas for foraging. Commonly observed perched on trees or shrubs in all seasons.

FAMILY STURNIDAE

STARLING *Sturnus vulgaris*

Common resident around human habitation. Nest in large numbers in and around the Bird Conservation Area, where they are common throughout the year.

FAMILY PARULIDAE

ORANGE-CROWNED WARBLER *Vermivora celata*

Common breeding resident in foothills and lower mountain slopes around Los Angeles. Most individuals winter further south, but some remain througout year. Two individuals observed on area in January, 1979.

YELLOW-RUMPED WARBLER *Dendroica coronata*

Common migrant and winter visitor; breed at higher elevations. Regularly observed in trees, shrubs and tall annuals from October to early April.

MACGILLIVRAY'S WARBLER *Oporornis tolmiei*

Fairly common spring and fall migrant in scrubby habitats throughout basin. A single individual was observed in undergrowth at Bird Conservation Area in early November.

WILSON'S WARBLER *Wilsonia pusilla*

Common spring and fall migrant, most commonly in brushland (esp. willow thickets) near water. A single individual was observed in the trees surrounding the pond in late April, 1980.

FAMILY PLOCEIDAE

HOUSE SPARROW *Passer domesticus*

Common resident around human habitation. Introduced. Small flocks may be observed regularly foraging in trees and undergrowth along periphery of area in all seasons. Nest in palms and man-made structures all around the Bird Conservation Area.

FAMILY ICTERIDAE

NORTHERN ORIOLE *Icterus galbula*

Fairly common summer visitor in deciduous woodlands and taller trees in parks, etc. One bird was sighted in trees surrounding the Bird Conservation Area in late August, 1979.

FAMILY THRAUPIDAE

WESTERN TANAGER *Piranga leudoviciana*

Common spring and fall migrant. Breed in higher life zones. Single individuals observed in August and September at the Bird Conservation Area.

FAMILY FRINGILLIDAE

BLACK-HEADED GROSBEAK *Pheucticus melanocephalus*

Fairly common trnasient in basin. Breeds in open woodland and forest. Observed in trees at Bird Conservation Area in latesummer.

HOUSE FINCH *Carpodacus mexicanus*

Common resident in open woodland and shrubland, both inside and outside of urban areas. Flocks move around in non-breeding season. Regularly observed in all seasons foraging in trees, shrubs, grasses and herbs.

LESSER GOLDFINCH *Carduelis psaltria*

Common resident in areas with scattered trees and/or large shrubs. Transient in non-breeding season. Observed in small numbers during late winter in trees at Bird Conservation Area.

GREEN-TAILED TOWHEE *Pipilo chlorurus*

Fairly common transient in spring and fall and as winter visitor. Breed in higher elevation chaparral. Single individuals observed on two occasions within undergrowth at Bird Conservation Area n late January.

WHITE-CROWNED SPARROW *Zonotrichia leucophrys*

Resident within southern California area. Generally restricted to "natural" areas of a variety of habitat types for breeding. Present from early October to late spring in trees, shrubs and undergrowth.

SONG SPARROW *Melospiza melodia*

Common resident in appropriate habitat. Numbers increase somewhat in fall and winter. Frequently seen in fall at the Bird Conservation Area, in dense vegetation near water.

Recommendations

Based on our investigations of avian utilization of the Bird Conservation Area, we propose two options for the future: 1) Leave the area essentially unchanged; and 2) Substantially alter the available habitat.

Option 1

Our investigations indicate that the current Bird Conservation Area is not a particularly important component of the overall pattern of avian distribution in the Los Angeles Basin. A number of factors contribute to this result, the most important of which are its limited size and its relative isolation. It is clearly a very small "island" of avian habitat in an increasingly urbanized region. Contributing to this isolation is the proximity of very tall apartment complexes which effectively cut the conservation area off from the general pattern of bird movement in the surrounding vicinity. These factors would be virtually impossible to alter substantially. On the other hand, several species of birds do use the area, if only in small numbers. The domestic waterfowl currently present on the area are of interest to many people who live in the surrounding community. These birds subsist largely on "handouts" from interested citizens who regularly visit the site. In this regard, the Bird Conservation Area is of some recreational value to the human community. A regular schedule of maintenance which would improve the aesthetic appeal of the area would undoubtedly be appreciated. This has been suggested by some of the local citizenry encountered during this study. In addition, stations might be created that would allow more efficient feeding of the birds and would allow better observation of the birds. Commercial waterfowl food might be provided in vending machines as it is at various other urban parks. Such a venture would probably pay for itself and would have the additional advantage of improving the nutrition of the ducks and geese. These would be low-cost measures and might well be the most popular with the general public.

Option 2

If a substantial effort is to be made to improve the current Bird Conservation Area in terms of its use by wild birds, the following recommendations should be considered.

1. Clear the area of introduced vegetation and replant with native species. This would mean an attempt to essentially reestablish a coastal scrub community on the grounds of the Bird Conservation Area. Such a program would improve the aesthetic appeal of the conservation area and could have an important educational value to the human community if information concerning the vegetation were made available to the public. Signs could be erected providing the names of the plants and historical and ecological facts pertaining to the species and coastal scrub communities in general. Such restoration measures concerning the vegetati on would be likely to attract larger numbers of migrating and wintering songbirds.

2. Remove the resident domestic waterfowl and gallinaceous birds that currently inhabit the area in large numbers. Such

a move might lessen the competition for space and food resources and lead to an increase in the number of wild birds. Removing domestics would also decrease the degree of degradation of ground cover currently seen at the area. Benefits of such action must, however, be weighed against potential costs. As previously mentioned, there is considerable interest in the resident waterfowl populations among local people, many of whom would be displeased by any efforts to eliminate these "pets." Removal of the chickens and other domestic fowl would probably not be opposed and should lead to an increase in ground cover which could improve the habitat for terrestrial migrants.

3. Increase the extent of available mudflat habitat. This would have the potential of increasing the number of shorebirds, gulls and terns using the Bird Conservation Area. Such change could be accomplished by grading the intertidal zone to create a more gradual shoreline around the pond. Any such effort would probably have to be accompanied by dredging of the deeper regions of the pond to maintain the potential water volume of the area for flood control purposes. An alternative, or additional step, would be to create a series of small mudflat islands within the pond itself. This could be preferable to the aforementioned approach,as it would provide greater isolation from human disturbance for any birds using this habitat, and might actually make them easier to observe by interested bird watchers.

4. Regulate water quality within the pond. Pollution levels within the pond should be monitored and controlled,

and the variability of salinity should be regulated to permit furtherdevelopment of the invertebrate community of the mudflats. The invertebrates provide food for most of the shorebirds and some of the duck species found on the area.

We must emphasize that the suggestions given above are a brief outline, and we are more than willing to discuss these factors further. However, we firmly believe that it is a real gamble whether or not this "Bird Conservation Area" can actually be improved as a wild bird habitat, no matter how much funds are expanded. No question exists that it can be improved as a "green belt" and as an area for people to enjoy the presence of and feeding of domestic ducks, but schemes to attract a large wild bird population probably will be fruitless.

APPENDIX ONE. BIRDS OBSERVED PER VISIT: AUGUST 1979 to AUGUST 1980.

*Observed but not counted.

APPENDIX TWO. BIRDS OBSERVED PER VISIT: OCTOBER 1978 to APRIL 1979.

		7 Oct.	14 Oct.	21 Oct.	28 Oct.	5 Nov.	11 Nov.	18 Nov.	26 Nov.	2 Dec.	9 Dec.	22 Dec.	1 Jan.	8 Jan.	13 Jan.	21 Jan.	28 Jan.	4 Feb.	11 Feb.	[illegible]	25 Feb.	4 Mar.	12 Mar.	18 Mar.	2 Apr.	7 Apr.	14 Apr.
Pied-billed Grebe		1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Eared Grebe		0	1	0	1	3	2	3	2	2	0	0	0	0	2	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Western Grebe		0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Double-cr. Cormorant		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Green Heron		3	1	3	1	1	1	3	3	2	0	0	1	1	0	1	1	0	0	[illegible]	0	0	0	0	0	0	0
Snowy Egret		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]	[illegible]	[illegible]	0	0	0	0	0	0	0
Mallard	♂	49	46	45	49	24	37	29	25	47	43	41	30	24	27	37	22	25	33	[illegible]	37	54	28	23	37	25	33
	♀	14	15	21	19	9	11	18	6	22	14	9	13	6	7	18	5	7	13	[illegible]	12	14	14	7	14	7	6
Scaup sp.	♂	0	0	0	0	0	0	7	6	7	0	0	0	1	0	0	10	4	0	[illegible]	2	15	0	1	0		0
	♀	0	0	0	0	0	3	11			0	0	0			0	7		0	[illegible]	3	7	0	2	0		0
Widgeon		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Muscovy		19	17	21	11	17	[illegible]	4	0	15	19	13	16	9	9	8	4	13	12	[illegible]	9	11	7	0	6	11	1
Peking Duck		86	79	71	55	75+	73	80	72	68	81	61	31	61	61	71	19	59	51	[illegible]	86	67	49	68	55	27	43
California Quail		0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0	[illegible]	0	0	1	0	0	0	1
Domestic Fowl		27	2	7	6	22	19	6	8	7	15*	16	12	12	12	8	9	8	7	[illegible]	0	5	6	0	4	3	5
American Coot		37	55	53	48	52	41	53	62	79	47	43	35	42	50	40	55	22	46	[illegible]	69	31	24	35	25	5	1
Black-bellied Plover		0	1	0	0	0	0	0	1	0		0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Semi-palmated Plover		0	3	0	0	0	[illegible]	0	0	0	0	[illegible]	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Killdeer		2	6	4	5	0	0	0	3	1	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	1	0
Long-billed Dowitcher		0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	[illegible]	0	0	0	0	0	0	0
Willet		1	1	1	0	1	0	1	2	4	1	1	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Spotted Sandpiper		2	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	[illegible]	1	1	0	0	1	1	1
Knot		0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Sanderling		0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Greater Yellowlegs		0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Bonaparte's Gull		0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Ring-billed Gull		1	3	2	6	0	1	1	37	12	1	1	5	4	0	4	1	6	1	[illegible]	2	6	10	0	0	1	0
California Gull		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Heermann's Gull		0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
[illegible] Gull		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Unk. Gull		0	0	0	4	0	0	0	1	0	6	0	0	0	0	0	0	0	0	[illegible]	0	0	0	10	4	0	22
Herring Gull		0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Rock Dove		41	37	12	27	48	31	19	20	15	20	19	18	8	6	0	2	0	7	[illegible]	0	7	3	0	[illegible]	0	15
Mourning Dove		2	0	0	0	25+	29	2	3	0	0	0	0	2	2	3	2	0	0	[illegible]	0	0	1	0	0	0	4
Anna's Hummingbird	♂	0	1	2	1	2	3	2	1	2	1	0	2	3	1	2	1	1	0	[illegible]	1	2	0	0	0	0	0
	♀								1																		
Belted Kingfisher	♂	1	1	1	1	0	1	0	1	0	0	0	0	1	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
	♀	0							0																		
Olive-sided Flycatcher		0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Scrubjay		2	1	2	2	1	1	1	2	2	1	1	1	1	0	2	2	1	1	[illegible]	1	2	0	0	0	1	0
Common Crow		1	1	3	0	4	1	0	1	0	0	0	0	0	0	0	0	0	1	[illegible]	0	1	1	0	0	0	0
Common Bushtit		0	0	19+	12+	0	0	0	0	6+	0	15	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Mockingbird		4-5	5+	11	14	3+	12	4	6	2	4	3	0	2	2	0	1	1	3	[illegible]	4	4	0	0	4	2	4
Phainopepla		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	[illegible]	0	0	0	0	0	0	0
Starling		4	6	2	0	0	1	6	49	0	1	0	0	0	0	0	0	0	0	[illegible]	5	0	0	0	2	0	[illegible]
Orange-crowned Warbler		0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
Warbler-Unknown		0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
House Finch		29	23	29	2[illegible]	33	17	13	30	[illegible]	20	10	0	30	3	0	1	0	0	[illegible]	67	12	20	0	22	6	21
White-crowned Sparrow		4	9	48	30	15	26+	41	17	52	52	30	25	30+	45+	43	47	37	12	[illegible]	60	+	10	0	40	0	27
House Wren		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	[illegible]	0	0	0	0	0	2	0
Brush Rabbit		2	0	3	2	0	0	2	2	4*	2	2	2	2	4	5	2	1	1	[illegible]	6	1	5	0	2**	3**	3*
[illegible]		0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0
[illegible]		0	1	1	0	[illegible]	0	0	0	0	0	1	0	1	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0

* [illegible]
** [illegible]

APPENDIX TABLE. BIRDS COUNTED IN MORNING AND AFTERNOON ON 11 DAYS IN 1979.

	Jan. 28		Feb. 4		Feb. 11		Feb. 17		Feb. 25		Mar. 4		Mar. 12		Mar. 18		Apr. 2		Apr. [illegible]		Apr. 11	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Pied-billed Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Eared Grebe	0	0	0	0	0	[illegible]	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Western Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Double-cr. Cormorant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0		0
Green Heron	1	0	0	2	0	0	0	0	0	0	0	1	0	[illegible]	0	0	0	0		0	1	0
Snowy Egret	0	0	1	0	[illegible]	0	0	0	0	0	0	1	0		0	0	0	1		1	[illegible]	0
Mallard ♂	22	41	25	35	35	14	23	14	37	22	34	27	2	23	21	0	37	37		25	32	26
♀	7	21	7	22	12	6	10	7	12	13	12	16	14	13	7	0	14	16		12	0	0
Scaup ♂	17	16	4	32	9	23	1	10	[illegible]	18	15	[illegible]	0	0	[illegible]	0	0	0		0	0	0
♀	7	11		9	0	2		2	3	15	7	2	0	1	2	0	6	0		0	0	0
Widgeon	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	0		0	0	0
Muscovy	4	2	13	2	12	10	0	0	[illegible]	4	11	8	7	9	0	0	2	13		1[illegible]	[illegible]	10
Peking Duck	10	63	50	40	51	27	1[illegible]	[illegible]	80	50	67	72	40	50	61	0	55	50*		68	41	29
California Quail	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0		0	1	0
Domestic Fowl	3	7	8	9	7	6	2	3	0	4	5	1	3	2	0	0	4	3		3	3	2
American Coot	53	64	22	67	40	21	37	21	69	70	31	19	21	40	33	[illegible]	25	20		18	1	3
Black-bellied Plover	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Semi-palmated Plover	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Killdeer	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Marbled Godwit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-billed Dowitcher	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
Willet	0	1	0	1	0	0	1	1	1	1	1	1	0		0	0	1	0	1	0	1	0
Spotted Sandpiper	0	0	0	0	0	0	0	0	0	1	0	0	0		0	0	0	0		0	0	0
Knot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanderling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Greater Yellowlegs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Heermann's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Ring-billed Gull (adult)	1	1[illegible]	6	92	1	0	2	1	2	0	6	4	1	0	0	0	0	0		0	0	0
(juvenile)		63										40	9	0	0	0	0	0		0	0	0
California Gull (adult)	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
(juvenile)	0	3	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0
Bonaparte's Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Western Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		0	0	0
Unid. Gull	0	0	0	0	0	53	0	54	0	125	0	0	0	115	10	0	4	0	0	60	22	50
Herring Gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Rock Dove (Pigeon)	2	10	3	28	7	0	2	5	0	0	7	14	1	21	0	0	4	43		37	12	0
Mourning Dove	2	2	0	0	0	0	0	2	0	0	0	0	1	1	0	0	0	5		0	0	0
Anna's Hummingbird	1	0	1	0	0	0	1	0	1	1	2	0	0	0	0	0	0	1		0	0	0
Belted Kingfisher	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0		0	0	0
Olive-sided Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Scrub Jay	2	0	1	0	1	0	1	0	1	1	2	0	0	0	0	0	0	1	1	0	0	0
Common Crow	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	3	0	0	0	0	0
Common Bushtit	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0		0	0	0
Mockingbird	1	2	1	2	3	2	0	1	4	1	4	1	0	3	0	0	4	2		0	1	0
Phainopepla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Starling	0	0	0	0	0	0	0	1	5	0	0	0	0	4	0	0	2	0	0	0	4	0
Orange-crowned Warbler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Warbler Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
House Finch	1	1[illegible]	0	25	[illegible]	0	+	5	60	45	11	-	2[illegible]	10	0	0	29	28		10	21	16
White-crowned Sparrow	47	7	37	1	17	0	13	37	69	65	+	-	16	1	0	0	42	0	1	0	27	22
House Sparrow	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0
Bush Rabbit	0	0	1	0	1	4	0	1	6	0	1	3	5	0	0	0	2**	2**	0**	1	0	2*

APPENDIX FOUR. VEGETATION ANALYSIS

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Assistant Curator, Botany

At the extreme western boundary of the park along a chain-link fence is *Vitis*, a vigorous, large-leaved climber that has spread out in all directions along the ground. Behind this first fence is another chain-link fence which forms the northern boundary of a parking lot. Between these areas are planted a small assemblage of ornamentals including *Hakea*, *Ligustrum*, *Prunus*, *Washingtonia*, etc. *Mesembryanthemum* (or an allied genus) is a fairly common ground cover in this area. Along the southern boundary as one proceeds west to east, the dominant tree or shrub is *Myoporum laetum*, forming dense thickets along most of the southern border. Interspersed along the chain-link fence are plantings of *Pyracantha*. *Salicornia virginica* can be found along the waterline along most of the southern boundary but is absent along the northern shore. Above the *Salicornia* one finds interspersed here and there planting of *Pinus*, *Callistemon*, *Eleagnus*, *Podocarpus*, *Alnus*, *Cupressus* and *Eucalyptus*. Several trees of *Eucalyptus* are planted toward the southeastern end. A *Melaleuca* is growing at the extreme southeastern boundary. Where the water channel narrows in this same area the *Salicornia* is more prominent along with *Artemisia*, *Chrysanthemum*, *Foeniculum*, *Picris*, annual grasses, *Raphanum*, *Brassica*, *Pennisetum*, Lactuca, etc. (all introduced weeds except the Artemisia which is native). Paralleling the bike path on the eastern perimeter are plantings of Cistus, Platanus, Meleleuca, Eriobotrya, Hibiscus, Schinus, Pinus, and Rhus laurina (a native plant). Interspersed among these ornamentals are Atriplex semibaccata, Conyza, Lolium, Sorghum, Avena, Salsola, Amaranthus, Plantago, Heliotropium, Convolvus, Anagallis, and Cortaderia. The northern boundary is almost solely Myoporum along with 1 Washingtonia and 1 Lagunaria patersonii. The fence has sporadic plantings of Pyracantha along it. Ditchgrass (Ruppia maritima) is in the flood control basin.

From a botanical viewpoint this area is extremely uninteresting, since hardly any native vegetation is in evidence. If the area were replanted with native plants and could somewhat approximate a coastal sage community flanking the flood control basin, more native birds might be induced to nest in this area. Recommended plantings of Rhus laurina, R. integrifolia, Salvia mellifera, Encelia californica, Haplopappus venetus, Baccharis pilularia consanguinea, Atriplex lentiformis, to mention a few, could certainly enhance the park.

PLANT LIST

Hakea sp.	Pincushion Tree
Prunus sp.	
Ligustrum sp.	Privet
Washingtonia sp.	Fan-Palm
Vitis sp.	Wild Grape
Mesembryanthemum (or an allied genus) sp.	Ice-Plant
Myoporum laetum	Myoporum
Pyracantha sp.	Firethorn
Salicornia virginica	Pickle Weed
Baccharis pilularis	Coyote Brush
Callistemon sp.	Bottlebush
Eleagnus sp.	Oleaster
Podocarpus sp.	Podocarpus
Alnus sp.	Alder
Cupressus sp.	Cypress
Eucalyptus sp.	Blue-gum
Melaleuca sp. (2 different species)	Honey Myrtle
Artemisia douglasiana	Mugwort
Chrysanthemum coronarium	Garland Chrysanthemum
Foeniculus vulgare	Fennel
Picris echioides	Bristly Ox-tongue
Raphanus sativus	Wild Radish
Brassica nigra	Black Mustard
Pennisetum setaceum	Fountain Grass
Lactuca serriola	Wild Lettuce
Platanus sp.	Sycamore
Eriobotrya japonica	Loquat
Hibiscus rosa-sinensis	Hibiscus
Pinus sp.	Pine
Schinus molle	Peruvian Pepper-tree
Cistus cf. *purpureus*	Rock Rose
Rhus laurina	Laurel Sumac
Conyza bonariensis	Horseweed
" *canadensis*	"
Lolium multiflorum	Ryegrass
Bromus rigidus	Ripgut Grass
" *mollis*	Soft Chess
" sp.	
Sorghum cf. *halepense*	Johnson Grass
Avena fatua	Wild Oats
Plantago lanceolata	English Plantain
Anagallis arvensis	Pimpernal
Amaranthus sp.	Amaranth
Heliotropium curassavicum oculatum	Wild Heliotrope
Convolvulus sp.	Bindweed
Cortaderia sellowiana	Pampas Grass
Lagunaria patersonii	Lagunaria
Ruppia maritima	Ditchgrass
Cynodon dactylon	Bermuda Grass

ORNITHOLOGICAL STUDY

OF

BIRD CONSERVATION AREA

MARINA DEL REY, CALIFORNIA

1 9 7 4

Carter Schleicher
Humboldt State College

APPENDIX F

TABLE OF CONTENTS

LIST OF FIGURES

I. PURPOSE

Reasons for Bird Conservation Area Study

There are three reasons to have conducted the study on the area termed Bird Conservation Area. First, there was the necessity of determining the species of birds using the area in its present condition. Secondly, it was desirable to determine whether the Bird Conservation Area was used to its potential. Finally, the study would help to establish guidelines for a management program.

II. DATA

The following data has been based on observations from June 14, 1973 through November 30, 1973, during unusual weather conditions. This past summer was not a usual one. The temperatures were lower than normal. The amount of fog and haze were greater than normal. The sun was out bright and hot three weekends all summer.

Bird Species Present at Different Times of the Day

The day was divided into the following three periods: morning, afternoon and evening. Morning was set as that time before twelve o'clock noon. The parameters of afternoon were twelve noon to five o'clock. Evening was considered to be that time after five p.m.

Morning. The primary species using the area are resident terrestrial birds such as Starlings, Mockingbirds, Scrub Jays and Rock Doves. Gulls increased usage after the 1st of November.

Bird species that are compatible with man were of greater abundance (Fig. 1). These species included Coots, Rock Doves and Starlings.

Afternoon. There was an average increase of three hundred forty-three birds from the morning count to the afternoon count. Six species had increased close to 100% or greater (Fig. 2). The species and percentages are as follows:

Species	% (Approx.)
Gulls	177
House Finch	77
Rock Doves	100
Spotted Sandpiper	
Starlings	129
Wh. Cr. Sparrow	567

Shore birds as a group increased 1200% from morning to afternoon.

Evening. A 23% decrease occurred between afternoon and night. Seven species increased their numbers over the afternoon. Four species are shore birds, one water fowl specie, one terrestrial and one fish eater. The species and percentages are as follows:

Species	% (Approx.)
Belted Kingfisher	50
Coot	14
House Finch	49
Great Blue Heron	150
Killdeer	500
Spotted Sandpiper	98
Snowy Egret	300

The number of sightings of shore birds as a group increased 138% over the number of afternoon sightings. Terrestrial bird sightings decreased from the number of sightings during the afternoon. (Compare Fig. 3 with Fig. 2).

Bird Species Present During Different Weather Conditions

Clear and Sunny. Twenty-seven of the thirty-five bird species were sighted on sunny days (Appendix A). This would appear normal. The sun ripens berries, increases the number of available insects flying, so the birds would be out also.

Cloudy. Again twenty-seven of the thirty-five species were sighted on cloudy days (Appendix B). Four of the twenty-seven species increased the number of sightings during cloudy days. The remaining twenty-three species decreased in the number of sightings. The difference between total of sightings during sunny days and cloudy days is an insignificant number.

Precipitation. Seventeen species appeared on days of precipitation, (Fig. 4), which accounts for only 111 individuals. This is a decrease of 88% from the number of individuals that appeared during sunny days and a decrease of 72% from the number of individuals on cloudy days. This is normal. Birds usually seek shelter or leave the area during precipitation.

Terrestrial Plant Utilization

Plant utilization was divided into four categories as follows: food, perching, cover and nesting. Plants were put into these categories based on observations.

Food. Plant species used for food.

Chrysanthemum

Yellow Sweet Clover
Castor Bean
Loquat
Pyracantha

Perch. Plant species used for perching.

Eucalyptus
Pepper Tree

Ca. Sycamore
Tree Tobacco

Myoporum

Bottle Brush

Rumex

Chrysanthemum

Fennel
Loquat

Fremontia

Castor Bean
Bouganvillea

Cover. Plant species used for cover.

Eucalyptus
Salicornia
Myoporum
Pepper tree
Conifer
Grapes
Pampas Grass

Nesting. Birds did not use the Bird Conservation Area for nesting.

Other Food Sources

The other food sources are the following: fish, insects, invertebrates in the mud flats, aquatic vegetation. The number of times the above sources were used are illustrated in Figs. 1 thru 4.

Fish
Insects
Mud Flats
Aquatic Vegetation

Data from Similar Areas

The data consists of the bird lists for the similar areas (See Table 1). These areas have been picked due to similar aspects of our Bird Conservation Area. The areas chosen are Marina del Rey, Hughes property south of Ballona Creek, Bolinas Lagoon and Whittier Narrows Wild Life Sanctuary.

Marina del Rey. The Marina del Rey data is comprised from the 1968, 1970, 1971 and 1972 Christmas counts conducted by the Los Angeles Audubon Society. This area encompasses Ballona Creek, entrance channel and basins of Marina del Rey, Venice Canal area and the land that constitutes Marina del Rey.

Hughes Property. Data concerning Hughes property is taken again from the 1968, 1970, 1971 and 1972 Christmas counts by the Los Angeles Audubon Society. This land runs from the west end of the runway to behind the apartments in Playa Del Rey, south from Ballona Creek to the hills of Playa Del Rey. This area's data and Marina del Rey's data were picked to give us a look as to what bird species are in this area.

Bolinas Lagoon. Bolinas Lagoon gives us bird life typical of a salt water lagoon, salt water estuary, grassland and upland areas. Bolinas Lagoon consists of 1,400 acres of salt water, tidal mudflats, marsh lands and sandbars. Bolinas Lagoon bird list came out of the blue cover manual prepared by California Department of Fish and Game on Bolinas Lagoon's natural resources.

Whittier Narrows. Whittier Narrows Wild Life Sanctuary is operated by Los Angeles County. It is 127 acres with a five-acre pond. This area was chosen to give us data for another area in Southern California. This area represents what can be done through manipulation. Their man-made pond supported breeding water fowl.

TABLE I. BIRD SIGHTING LIST COMPARISONS FROM SIMILAR AREAS

	Bird Cons. Area	MdR	Hughes	Bolinas Lagoon	Whittier Narrows
Loons					
Common Loon		x		x	
Arctic Loon		x		x	
Red-throated Loon		x	x	x	
Grebes					
Red-necked Grebe		x			
Horned Grebe		x	x	x	
Eared Grebe		x	x	x	
Western Grebe		x	x	x	
Pied-billed Grebe	x	x	x	x	
Pelicans and Allies					
White Pelican		x		x	
Brown Pelican		x		x	
Double-crested Cormorant		x		x	
Brandt's Cormorant				x	
Pelagic Cormorant		x		x	
Herons and Allies					
Great Blue Heron	x	x		x	x

	Bird Cons. Area	MdR	Hughes	Bolinas Lagoon	Whittier Narrows
Common Egret	x			x	x
Snowy Egret	x	x		x	x
Green Heron	x	x	x	x	x
Black-crowned Night Heron				x	x
American Bittern		x			
Common Heron				x	
<u>Water Fowl</u>					
Harlequin Duck		x			
Black Brandt				x	
Mallard			x	x	x*
American Widgeon		x	x	x	x
Pintail		x	x	x	
Green-winged Teal		x		x	
Blue-winged Teal	x				
Shoveller		x	x	x	
Red Head		x	x	x	
Canvas back		x		x	
Greater Scaup				x	
Lesser Scaup	x	x		x	
Common Golden-eye				x	
Buffle head		x		x	
White-winged Scoter		x		x	
Surf Scoter		x		x	
Common Scoter		x			
Ruddy Duck		x		x	
Common Merganser		x		x	
Red-breasted Merganser		x		x	
<u>Vultures, Hawks & Falcons</u>					
Turkey Vulture		x		x	
Bald Eagle				x	
White-tailed Kite		x	x		x
Sharp-skinned Hawk				x	x
Coopers Hawk				x	
Red-shouldered Hawk	x	x		x	x
Marsh Hawk		x	x	x	x
Osprey				x	
Sparrow Hawk	x	x	x	x	x
<u>Gallinaceous Birds</u>					
California Quail		x	x	x	x*
<u>Rails & Coots</u>					
Clapper Rail				x	

	Bird Cons. Area	MdR	Hughes	Bolinas Lagoon	Whittier Narrows
Virginia Rail				x	
Sora				x	
American Coot	x	x	x	x	x
<u>Shore Birds, Gulls</u>					
Mountain Plover			x		
Semi-palmated Plover		x	x	x	
Killdeer	x	x	x	x	x*
Black-bellied Plover	x	x	x	x	
Surfbird		x			
Ruddy Turnstone		x		x	
Black Turnstone		x	x		
Common Snipe		x	x		x
Long-billed Curlew		x	x	x	
Whimbrel		x	x	x	
Spotted Sandpiper	x	x	x		x
Wandering Tattler		x			
Willet	x	x	x	x	
Greater Yellow Legs		x	x	x	x
Lesser Yellow Legs				x	
American Golden Plover			x		
Least Sandpiper		x	x	x	x
Dunlun		x	x	x	
Dowitcher	x	x	x	x	x
Western Sandpiper		x	x	x	
Marbled Godwit		x	x	x	
Sanerling		x	x	x	
Red Phalarope		x		x	
Northern Phalarope				x	
Gulls	x	x	x	x	
Black-legged Kittiwake		x		x	
Forster's Tern		x		x	
Royal Tern				x	
Caspian Tern		x	x	x	
Least Tern		x	x		
<u>Owls</u>					
Barn Owl			x	x	x
Great Horned Owl				x	
Burrowing Owl		x	x		
<u>Swifts & Hummingbirds</u>					
White-throated Swift	x	x	x		x
Black-chinned Hummingbird				x	x*
Anna's Hummingbird		x	x	x	x*
Allen's Hummingbird				x	

	Bird Cons. Area	MdR	Hughes	Bolinas Lagoo	Whittier Narrows
Kingfishers					
Belted Kingfisher	x	x	x	x	x
Woodpeckers					
Red-shafted Flicker	x	x	x	x	x*
Acorn Woodpecker				x	
Downy Woodpecker				x	
Perching Birds					
Black Phoebe	x	x		x	x*
Say's Phoebe		x	x	x	
Western Flycatcher	x			x	
Tree Swallow				x	
Barn Swallow	x			x	
Scrub Jay	x	x		x	x*
Common Raven		x		x	
American Crow	x	x		x	x
House Wren		x			
Long-billed Marsh Wren		x		x	
Rock Wren		x			
Mockingbird	x	x	x		x*
American Robin		x	x	x	
Hermit Thrush		x	x	x	
Cedar Waxwing		x		x	x
Loggerhead Shrike	x	x	x	x	x*
Starling	x	x	x	x	x*
Hutton's Vireo				x	
Yellow Warbler				x	x
Audubon's Warbler		x	x	x	x
Common Yellow throat		x		x	
Wilson's Warbler	x			x	
House Sparrow	x	x	x	x	x*
Western Meadowlark		x	x	x	x*
Brewers Blackbird		x		x	
Purple Finch				x	
House Finch	x	x	x	x	x*
American Goldfinch	x			x	x
Lesser Goldfinch		x		x	x
Rufous-sided Towhee		x		x	x*
Brown Towhee		x	x	x	x*
Savannah Sparrow		x	x		
White-crowned Sparrow	x	x	x	x	x
Golden-crowned Sparrow		x		x	
Lincoln's Sparrow			x	x	
Song Sparrow	x	x	x		x*
Ash-throated Flycatcher	x				x*

* = Nesting - only valid count at Whittier Narrows. No nesting observed in Bird Conservation Area over a six-month period.

Whittier Narrows had also the following species:

Cinnamon Teal
Ring-necked Pheasant
Black-necked Stilt
Screech Owl
Western King bird
Common Bushtit
California Thrasher
Western Tanager
Blck-headed Grosbeak
Blue Grosbeak

Data from Other Observations

Surface of Basin. The surface of the basin is cluttered with papers, cans, bottles and other trash. The trash enters the basin through Flood Control District's storm drain on Washington Boulevard, and the easement from Oxford Avenue. Due to the fluctation of the tide, a portion of the trash is strewn onto the vegetation bordering the basin. Some of the trash helps to clog up the tide gates in the southwest corner of the basin. Bits of the trash are flushed into Basin E. A small portion sinks to the bottom.

In the summer and through the fall there is a vegetation bloom on the eastern third of the surface. The vegetation breaks up and a small portion finds its way to the tide gates and adds to their clogging, which decreases the flow through the gates. The majority of the vegetation falls to the bottom after the first storm in the fall.

Floor of the Basin. The floor is again cluttered with cans, bottles and other assorted garbage. The surface of the floor is from six inches to eighteen inches thick in decomposed matter, the thickest being where most of the matter of vegetation dropped. The eastern third of the floor is covered with a white cob-webby fungus. Again, we cannot ignore the correlation that the eastern third is where the majority of the surface vegetation dropped.

III. CONCLUSIONS

The Bird Conservation Area is not being used to its potential as a bird sanctuary. (See Data from Similar Areas). Our Bird Conservation Area does not offer the birds what they need in the following essential areas: food, cover, nesting.

Food

Terrestrial Species. Our bird sanctuary does not have the quantity of plants needed to produce the amount of food needed to attract the passing birds. The few plants we have are not producing to their capabilities as they are either planted in the wrong light or are overgrown by other plant species.

Waterfowl. Top smelt is the major species of fish. There are four generations present at a time. It seems to be adequate for fish eaters, though there are no fish in the eastern end. There seems to be a lack of quality and quantity of invertebrates and marsh plants on the tide flats. There is a definite lack of adquate submerged vegetation on the bottom. This lack of marsh food probably is inhibited by the trash, dirt and the scummy growth aided by storm drainage and lack of natural flushing.

Cover

Terrestrial Species. For the terrestrial species there is plenty of cover. We have for all practical purposes 100% cover on the land of which 90% is usable for the birds.

Waterfowl. Once again we lack a good marsh plant cover. When there is bad weather the waterfowl need tall, thick plants to shelter themselves. It is possible that the marsh plants have not really taken hold due to water and soil quality.

Nesting

The terrestrial birds and waterfowl did not use the Bird Sanctuary for nesting. There are various possibilities on why they did not. First, we did not offer them the plants with the right limb configuration to make a nest on. Secondly, the material needed to make a nest was of poor quality or in short supply. Third, we probably did not have on hand the necessary food for the mother and/or the young.

General Environment

The overall appearance is trashy. Since there was never any regular trash pickup schedule the papers, bottles and cans accumulated along the shoreline and can be seen by the passing public. Domestic animals get into the area through holes in the fence and harass the wildlife.

IV. RECOMMENDATIONS

These recommendations are set forth for ultimate development because of the good potential of the area.

Back Flushing System

We need to provide a back flushing system and/or route the storm water through the east end. The back flush system would minimize the eutrification of the Bird Conservation Area. Routing the storm water out through the east end would remove the trash from the Bird Conservation Area and cut down the amount of vegetational growth on the surface. Remove six to eighteen inches of decomposed matter from the floor of the basin.

Planting Development

The Bird Conservation Area is divided into 8 planting areas. (See Map 1).

Each planting area has its own plants to be taken out and its new replanting. (See Table 2)

Table 2. Planting Development

Area 1

Plants to be removed -

Eucalyptus
Pines
Myoporum
Pampus Grass

Plants to be planted -

17 California Sycamores
17 Willows

Area 2

Plants to be removed -

Pines
Grapes
Pampus Grass

Plants to be planted -

47 Pyracantha along the fence
14 California Sycamores on the slope of Parking Lot OT

Area 3

Plants to be removed -

Myoporum
Pines

Plants to be planted -

4 California Bay
4 California Sycamores

Area 4

Plants to be removed -

Pampus Grass
Oleander
Myoporum
Pines

Plants to be Planted -

34 Toyon

Area 5

Plants to be planted -

10 Coffeeberry
10 Elderberry

Area 6

Plants to be removed -

Myoporum

Plants to be planted -

150 Mulefat
45 Pyracantha

Area 7

Plants to be removed -

Myoporum

Plants to be planted -

100 Toyon

Area 8

Plants to be removed -

Salicornia
Spartina Grass

The high tide level should be lowered from 3.5' to 2.5'

Stocking

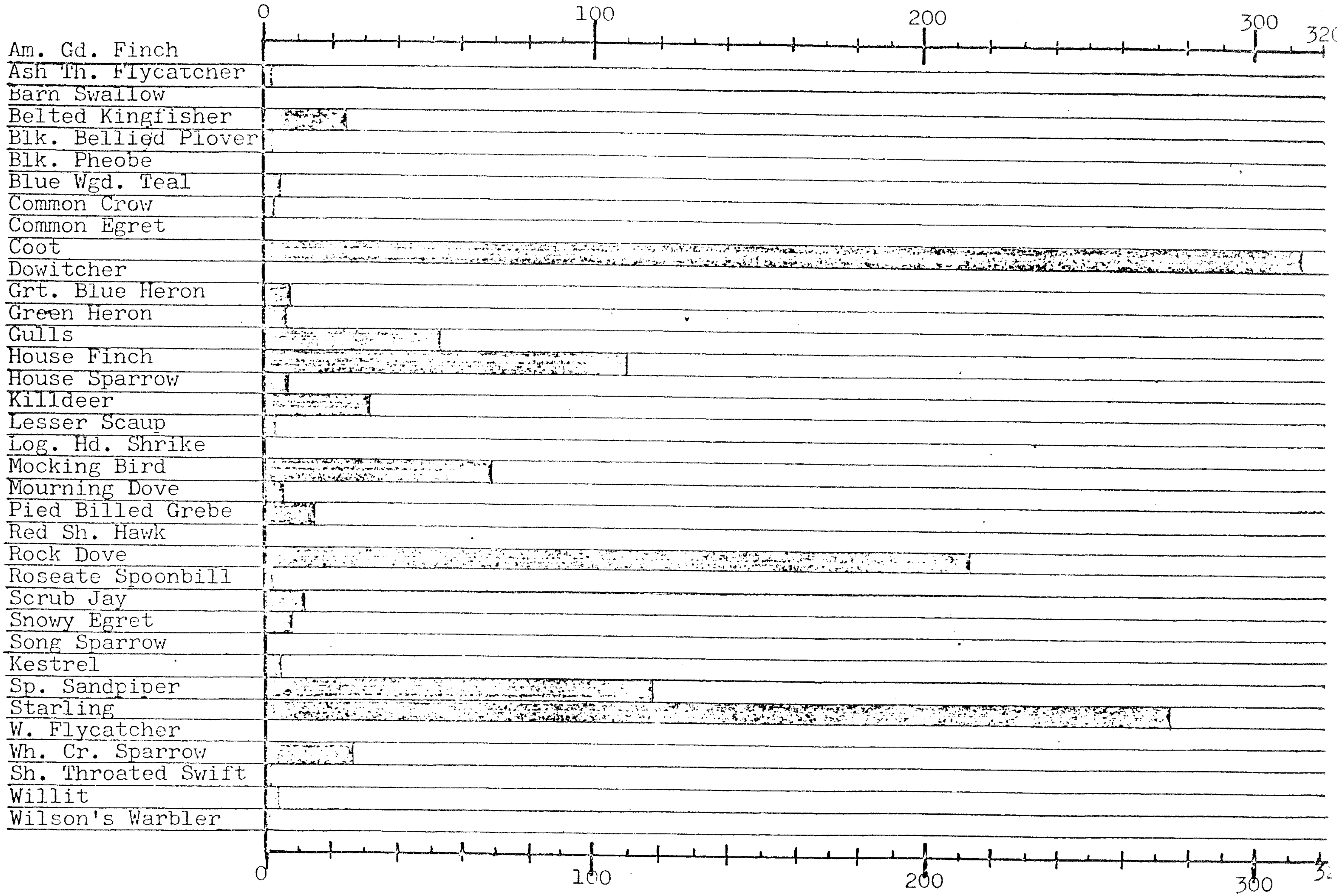
After the marsh plants are established, California Fish and Game will capture and stock an endangered species, the Clapper Rail.

Access Ruling

There should not be any public access for a period of two years after all manipulation is completed. Thereafter, limited access by the public in the form of guided groups through the Bird Conservation Area.

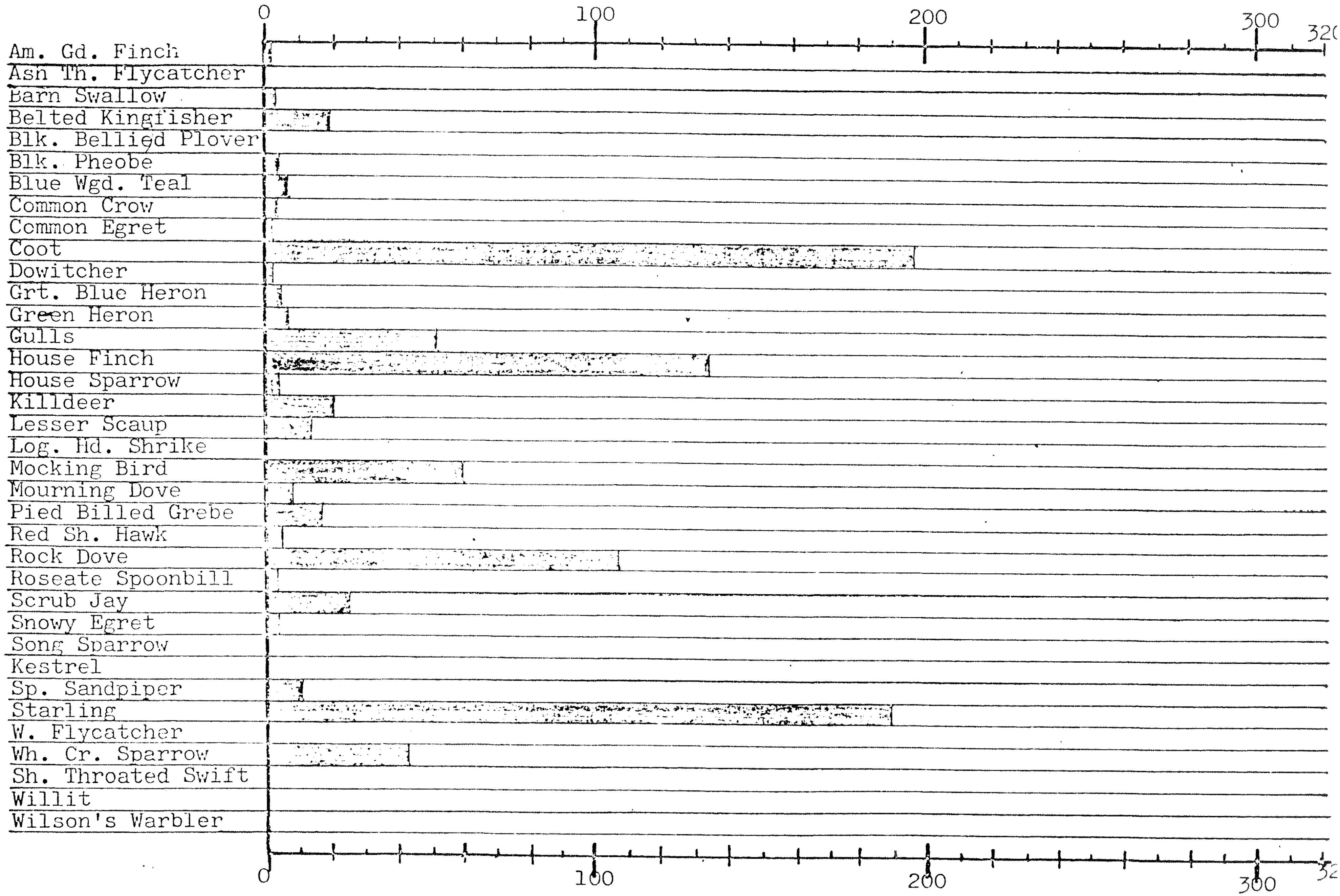
Maintenance

Periodic checking of the fence for holes in and under it so they can be fixed to keep the dogs out. A periodic trash pickup should be planned. Finally, constant removal of domestic fowl and mammals.



APPENDIX A

BIRDS OBSERVED ON SUNNY DAYS - AVERAGE NUMBER



APPENDIX B

BIRDS OBSERVED ON CLOUDY DAYS - AVERAGE NUMBER

APPENDIX C BIRD LIST

Common Name	Scientific Name
American Gold Finch	Spinus Tristis
Ash-Throated Flycatcher	Myiarchus Cinerascens
Barn Swallow	Hirundo Rustica
Belted Kingfisher	Megacergle Alcyon
Black Bellied Plover	Squatarola Squatarola
Black Phoebe	Sayornis Nigricans
Blue Winged Teal	Anas Discors
Common Crow	Corvus Brachyrhynchos
Common Egret	Casmerodius Albus
Coot	Fulica Americana
Dowitcher	Limnodromus Sp.
Great Blue Heron	Ardea Herodias
Green Heron	Butorides Virescens
Gulls	Larus Sp.
House Finch	Carpodacus Mexicanas
House Sparrow	Passer Domesticus
Killdeer	Charadrius Vociferus
Lesser Scaup	Aythya Affinis
Loggerhead Shrike	Lanius Ludovicianus
Mockingbird	Mimus Polyglottos
Mourning Dove	Zenaiduro Macroura
Pied-Billed Grebe	Podilymbus Podiceps
Red Shoulder Hawk	Buteo Lineatus
Rock Dove	Columba Livia
Roseate Spoonbill	Ajaja Ajaja
Scrub Jay	Aphelocoma Coerulescens
Snowy Egret	Leucophoyx Thula
Song Sparrow	Melospiza Melodia
Kestrel	Falco Sparverius
Spotted Sandpiper	Actitis Macularia
Starling	Sturnus Vulgaris
Western Flycatcher	Epidonax Difficilis
White Crowned Sparrow	Zonotrichia Leucophrys
White Throated Swift	Aeronautes Saxatalis
Willit	Catoptrophorus Semipalmatus
Wilson's Warbler	Wilsonia Pusilla

APPENDIX D REPTILE LIST

Southern Aligator Lizard	Gerrhonotus Multicarinatus

APPENDIX E AMPHIBIA LIST

Red-Eared Slider	Pseudemys Sp.

APPENDIX F MAMMAL LIST

Brush Rabbit	Sylvilagus Bachmani