Appendix 5.A
Comparison of 2001 Permit MCMs to 2012 Permit MCMs

MCM	2012 Permit Requirement	2001 Permit Requirement
D.2 Progressive Enforcement (Applies D.6, D.7, D.8, and D.10)	Develop and maintain a Progressive Enforcement Policy	
	Conduct follow-up inspection within 4 weeks of date of initial inspection	
	Take progressive enforcement	
	Retain records	
	Refer violations to Regional Board	
	Investigate complaints from Regional Board (RB)	
	Assist RB with Enforcement Actions	
D.5 Public Information and Participation Program (PIPP)	Participate in a Countywide PIPP, WMP PIPP, or individual PIPP that measurably increases knowledge and changes behavior, and involves a diversity of socio economic and ethnic communities	Implement public information and participation program
		Media campaign for Storm Water Pollution Prevention (SPP)
		Strategy to educate ethnic communities about SPP
		Enhance outreach for proper disposal of cigarette butts
		Conduct educational activities within jurisdiction and participate in county-wide events
		Organize Public Outreach Strategy meetings quarterly
		Conduct Media Outreach to 35 million impressions per year
		Coordinate watershed-specific pollution prevention outreach programs
		Corporate Outreach Program to target retail gas outlets and restaurant chains
		Coordinate an SPP program for a Business Assistance Program
		Behavioral change assessment strategy towards SPP
	Maintain reporting hotline	Maintain the (888) CLEAN-LA hotline
	Publish hotline info on web, telephone book	
	ID staff/department that serve as the contact (publish this info)	Provide a list of reporting contacts to public through www.888CleanLA.com
		Coordinate and provide contact information for public education activities
	Organize events (e.g., clean ups)	
	Residential Outreach (Individually or with group):	
	Public Service Announcements	
	(Develop) Public education materials on: vehicle fluids; household waste; construction waste; pesticides, fertilizers, and integrated pest management (IPM); green wastes; and animal wastes	
	Distribute public education materials at points of purchase	
	Maintain stormwater website	
	Provide schools with materials to educate children (K-12); can use state produced materials	Distribute SPP information to K-12 schools

MCM	2012 Permit Requirement	2001 Permit Requirement
		Strategy to measure effectiveness of in-school programs
		Convene an Advisory Committee
		Mark all storm drain inlets with a "no dumping" message
D.6 Industrial/ Commercial	Track Critical Sources - maintain inventory (watershed based or lat/long recorded)	Maintain a list of industrial/commercial facilities to be inspected
	Educate - notify critical sources of BMP requirements	
	Implement a Business Assistance Program for select sectors or small businesses - technical assistance, and distribute materials to specific sectors	
	Inspect Commercial Sources	Inspect restaurants twice during Permit cycle
	Inspect Industrial Sources - initial mandatory inspection	Inspect/visit industrial/commercial facilities appropriately
	Secondary mandatory inspection	
	No Exposure - evaluate and conduct 2nd inspection at 25% of facilities	
	As needed conduct Progressive Enforcement follow-up inspections (see D.2)	Initiate progressive enforcement for facilities failing to implement BMP's
D.7 Planning and Land Development		Implement development planning program that requires SUSMP
		Develop peak flow control criteria
		Amend codes and ordinances to give legal effect to SUSMP changes in permit
		Implement revised Standard Urban Storm Water Mitigation Plan (SUSMP)
		Submit an Environmentally Sensitive Areas (ESAs) Delineation map to RWQCB
		Implement SUSMP requirements for industrial/commercial projects >1 acre
		Update CEQA guidelines to include specific storm water related issues
		Update General Plan to include specific storm water related issues
		Train targeted employees in permit requirements for Development Planning
		Develop and make SUSMP guidelines available to the developer
		Develop a technical manual for the siting and design of BMPs
	Update ordinance/design standards to conform with new requirements (LID and Hydromod)	
	Optional: Establish alternative compliance for technical infeasibility, e.g., allow onsite biofiltration or offsite infiltration or gw replenishment or retrofit	
	Optional if allowing offsite mitigation: Develop a prioritized list of offsite mitigation projects	

MCM	2012 Permit Requirement	2001 Permit Requirement
	Optional if allowing offsite mitigation: Develop a schedule for completion of offsite projects (must be with 4 yrs of the Certificate of Occupancy of the first project that contributed funds)	
	Optional if allowing offsite mitigation: Notice offsite projects to RB website	
	Optional if allowing offsite mitigation: List of mitigation projects descriptions and estimated pollutant and flow reductions	
	Optional if allowing offsite mitigation: Provide aggregated comparison of alternative compliance to results that would have been expected with onsite retention of the SWQDv	
	Optional: Submit documentation that a previously adopted LID ordinance provides equivalent pollutant loading and flow reduction	
	Plan Review process - check LID and BMP sizing, etc.,	
	Establish internal agreements with structure for communication and authority for departments overseeing plan approval and project construction	
	Require O&M plan for LID, treatment and hydromod BMPs	
	Implement tracking and enforcement program for LID, treatment and hydromod BMPs	
	Inspect all development sites upon completion and prior to occupancy certificates	
	Verify O&M of BMPs operated by Permittee through inspection	
	Develop maintenance inspection checklist	
	Require private parties that operate BMPs to submit verification of O&M; enforce as needed	
	As needed conduct Progressive Enforcement follow-up inspections (see D.2)	
D.8 Construction		Implement a development construction program
		Require proof of a Waste Discharger ID (WDID) number prior to filing Notice of Intent (NOI)
		Require proof of an NOI and a copy of SWPPP for a transfer of ownership
		Track the number of issued building and grading permits
	Update erosion and sediment control ordinance/procedures to conform with new requirements	
	Sites < 1 acre; inspect based upon water quality threat	
	Establish priority inspection process	
	Site < 1 acre; Require sites with soil disturbing activities to implement minimum BMPs	
	Require construction sites to prepare erosion sediment control plan(ESCP); review and approve (≥ 1 acre)	

MCM	2012 Permit Requirement	2001 Permit Requirement
	Verify construction sites coverage under the CGP and 401 cert	Refer General Construction Activities Stormwater Permit (GCASP) violations to RWQCB
	Develop/implement ESCP review checklist	
	Require construction sites to adhere to standards and make standards readily available	
	Conduct inspections at public and private sites (at least 1x/2 weeks for high threat sites (more frequently when rain is predicted or occurs; at least monthly for lower threat; also must inspect during all phases of construction - at least 3 times)	
	Develop/implement SOPs/inspection checklist	
	Track number of inspections for inventoried sites and verify minimum inspections are completed	
	As needed conduct Progressive Enforcement follow-up inspections (see D.2)	
	Train plan review staff and inspectors	Train targeted employees in permit requirements for Development Construction
	Staff must be knowledgeable in QSD/P key objectives, local BMPs standards	
D.9 Public Agency Activities	Require public construction sites to implement Planning and Land Development requirements, implement Erosion and Sediment Control BMPs, and obtain Construction General Permit coverage	Implement Development Planning Program at Permittee-owned construction projects
		Implement Development Construction Program at Permittee-owned construction projects
		Develop, if needed, and implement SWPPPs for field facilities
	Maintain inventory of Permittee owned facilities (including parks and recreation facilities,)	
	Update inventory	
	Develop retrofit opportunity inventory; evaluate and rank	
	"Cooperate with private land owners to encourage site specific retrofitting"; includes pilot projects and outreach	
	Obtain IGP coverage for public facilities where appropriate	
	Develop procedures to assess impact of flood mgt projects on water quality of receiving waters; evaluate to determine if retrofitting is feasible	
	Evaluate existing structural flood control facilities to determine if retrofitting facility to provide additional pollutant removal is feasible	
	Implement source control BMPs at Permittee owned facilities/activities	
	Require city-hired contractors to implement source control BMPs	
	Prevent vehicle/equipment washing discharges to the MS4, including fire fighting and emergency response vehicles	
	Ensure new/redeveloped/replaced wash facilities are plumbed to the sanitary sewer or self contained.	Equip wash areas with a clarifier, pre-treatment device, or be connected to sewer

MCM	2012 Permit Requirement	2001 Permit Requirement
	Implement IPM program	
	Ordinances, policies, and procedures reflect IPM techniques and include commitments and schedules to reduce the use of pesticides that cause impairments	
	Annually update in inventory of pesticides used by agency; quantify pesticides used by staff and contractors; demonstrate IPM alternatives to reduce pesticide use	
	Use SOPs for pesticide application	Store pesticides/herbicides/fertilizers indoors and apply only in accordance with label directions
	Ensure no application of pesticides or fertilizers when two or more days with a 50% chance of rain is predicted by NOAA; within 48 hrs of 1/2 inch of rain; or when water is flowing off the site	
	Ensure staff applying pesticides are certified or working under supervision of a certified applicator in the appropriate category	
	Update catch basin map add GPS locations and update priority	
	Inspect/Clean catch basin in areas not subject to Trash TMDL- Priority A: 3x during wet season, 1x during dry 1x; Priority B: 1x during wet 1x and 1x during dry; Priority C: 1x per yr. Maintain records.	Designate Catch Basins as priority A, B, or C
	Required trash management at public events	Ensure that Catch Basins (CBs) are cleaned appropriately
	Place and maintain trash receptacles/capture devices at newly identified high trash generating areas	Place temporary screens on CBs prior to special events or cleanout immediately afterwards
		Place and maintain trash receptacles at all transit stops with shelters
		Designate curbed streets as priority A, B, or C based on liter accumulation
	Label storm drains	(Required under PIPP in 2001)
	Inspect labels prior to each wet season	Inspect the legibility of CB stencils and re-label within 180 days if necessary
	Record and relabel illegible labels within 180 days of inspection	
	Post signs at access points to water bodies (open channels, creeks; lakes)	
	In areas not subject to the Trash TMDL, install trash excluders on catch basins or outfalls in areas defined as Priority A, or implement substantially equivalent BMPs	
	Inspect and Remove trash and debris from open channels and other drainage structures 1x/yr before rainy season.	Visually monitor and clean all open channels annually for debris
	Eliminate discharge of contaminants during MS4 maintenance	
	Implement controls to limit infiltration of seepage from sanitary sewers to the storm drains	Implement a sewer overflow prevention and response program
	Implement routine preventative maintenance for both systems, survey sanitary sewer and MS4. May use SSO General WDR to fulfill this requirement.	

MCM	2012 Permit Requirement	2001 Permit Requirement
	Implement inspection and maintenance program for Permittee owned BMPs	
	Manage residual water in treatment control BMPs removed during maintenance	
	Street sweeping - Priority A: 2x/mo; B: 1x/mo; C: as needed, not less than 1x/yr	
	Implement road construction maintenance BMPs (e.g., restrict paving activity to exclude periods of rain)	
	Inspect and/or clean Permittee owned parking lots 2x/mo	Inspect and, if needed, clean Permittee owned parking lots twice per month, but at least once
	Train employees and contractors on stormwater requirements	Train targeted employees in permit requirements for Public Agency Activities
	Train employees and contractors on pesticide use	
		Recover saw cutting waste and dispose it offsite
		Conduct a dry weather diversion study and create a priority list of drains for diversion
D.10 Illicit Connections and Illicit Discharges Elimination	Continue IC/ID program	Develop an Implementation Program which specifies how revisions of the IC/ID SQMP are implemented
		Create a database for permitted storm drain connections and map IC/ID
		Field screen the storm drain system for illicit connections in open channels
		Field screen the storm drain system for illicit connections in underground storm drains in priority areas
		Field screen the storm drain system for illicit connections in underground s/d larger than 36 inch diameter
		Review all permitted connections to the storm drain system for compliance
	Written procedures for conducting investigations and eliminations	
	Initiate investigation within 72 hours from becoming aware of the discharge	Respond to illicit discharges within one business day of discovery
		Investigate illicit discharges as soon as practicable
	Implement solutions to eliminate discharge; conduct follow-up investigation to verify elimination; follow Progressive Enforcement Plan (see D.2)	
	When discharge originates upstream of jurisdiction, notify the upstream jurisdiction and Regional Board within 30 days	
	Initiate investigation within 21 days for illicit connection	Investigate illicit connections 21 days after discovery
	Permit or document illicit connection that only discharge stormwater or allowed non-stormwater	
	Eliminate illicit connection within 180 days of investigation	Terminate illicit connections 180 days after confirmation
	Facilitate public reporting via hotline	

MCM	2012 Permit Requirement	2001 Permit Requirement
	Signage adjacent to open channels provide info re: public reporting	
	Document calls and actions associated with hotline	
	Implement procedures on responding to complaints; evaluate and update procedures	
	Implement a spill response plan	
	Train staff and contractors on ID/IC	Train targeted employees in the permit requirements for IC/ID
	Create a list of positions and contractors that require ID/IC training	
		Perform IC/ID Trend Analysis

Appendix 5.B

Concept Report for the Arroyo Seco Urban Runoff Projects and Arroyo Seco Dry Weather Urban Runoff Projects – Conceptual Design Report

Concept Report for the Arroyo Seco Urban Runoff Projects

June 2015

Prepared for:

City of Los Angeles
Department of Public Works
Bureau of Sanitation, Watershed Protection Division
1149 S Broadway, 10th Floor
Los Angeles, CA 90015-2213

By:

MWH Americas Inc.,
300 N Lake Ave, Suite 400
Pasadena, CA 91101

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1 INTRODUCTION

This report describes the consideration and recommendation of conceptual designs for Total Maximum Daily Load (TMDL) implementation projects for the Los Angeles (LA) River Bacteria TMDL at Arroyo Seco Park, also known as Hermon Park (Park). This effort was performed to support the development of these projects for the City of Los Angeles (City) Watershed Protection Division (WPD) of the Bureau of Sanitation (BOS).

This concept report identifies best management practices (BMPs) to address dry weather flows in a portion of the Arroyo Seco drainage watershed to support the development of LA River Bacteria TMDL - Load Reduction Strategies (LRS). In addition, to support the Upper Los Angeles River Enhanced Watershed Management Plan (EWMP), this report includes conceptual designs for BMPs to support implementation of the Los Angeles River Metals TMDLs associated with wet weather. This report considers several treatment options for dry and wet weather flows into the Park basin through the use of low flow diversion (LFD) structures, green infrastructure, and a regional wet weather implementation through underground storage and treatment BMPs.

The Park is located in the LA River Basin (HUC 18070105) within the Arroyo Seco area of the City between S Avenue 60 and Via Marisol, west of Monterey Road. A site vicinity map is provided below in **Figure 1**.

1.1 Stormwater Regulations Background

The Arroyo Seco tributary is part of Segment B of the LA River. In July 2010, the LA Regional Water Quality Control Board (Regional Board) adopted the LA River Bacteria TMDL that established jurisdictional-based waste load allocations (WLAs) for bacteria. WLAs are defined as the portions of the LA River watershed load capacity which are assigned to its comprising jurisdictions. The measure became effective on March 23, 2013. The TMDL includes a dry weather TMDL option that provides the multiple separate storm sewer system (MS4) permittees an extension on meeting the compliance date in exchange for completing an extensive process of determining and documenting implementation strategies. For the first phase, the City is in the process of developing a LRS for Arroyo Seco independently of other MS4 permittees that will be submitted to the Regional Board by March 23, 2016. The City will be responsible for quantitatively demonstrating actions in the Arroyo Seco LRS that will result in compliance with the WLAs. The WLAs for Escherichia coli (E*. coli)* for the Arroyo Seco Segment B are 6.26 billion most probable number (MPN) per day for interim compliance and 5.74 billion MPN per day for final compliance. Interim and final WLA compliance must be met by September 23, 2023 and March 23, 2030, respectively.

In 2013, a draft Pre-LRS was completed for Arroyo Seco (City of Los Angeles Bureau of Sanitation, 2013). The report ranked outfalls that, if removed, are expected to allow the City to meet the final bacteria WLAs identified. Outfalls AS-15, AS-21, and AS-17, were identified as priority outfalls that conveyed dry weather flows with consistently high loading rates. Outfall AS-40 was identified as an outlier outfall that increased the storm drain load above the WLA during a snapshot in time. Outfall AS-40 will be analyzed within a separate study to determine if action is required to reduce or eliminate the flow from this outfall (City of Los Angeles Bureau of Sanitation, 2013). The Pre-LRS report covered outfall AS-21 as a priority, however, AS-22 is included in this report due to its proximity to outfall AS-21. The location of these two outfalls to the Park allowed for treatment of both outfalls with a combined BMP implementation approach

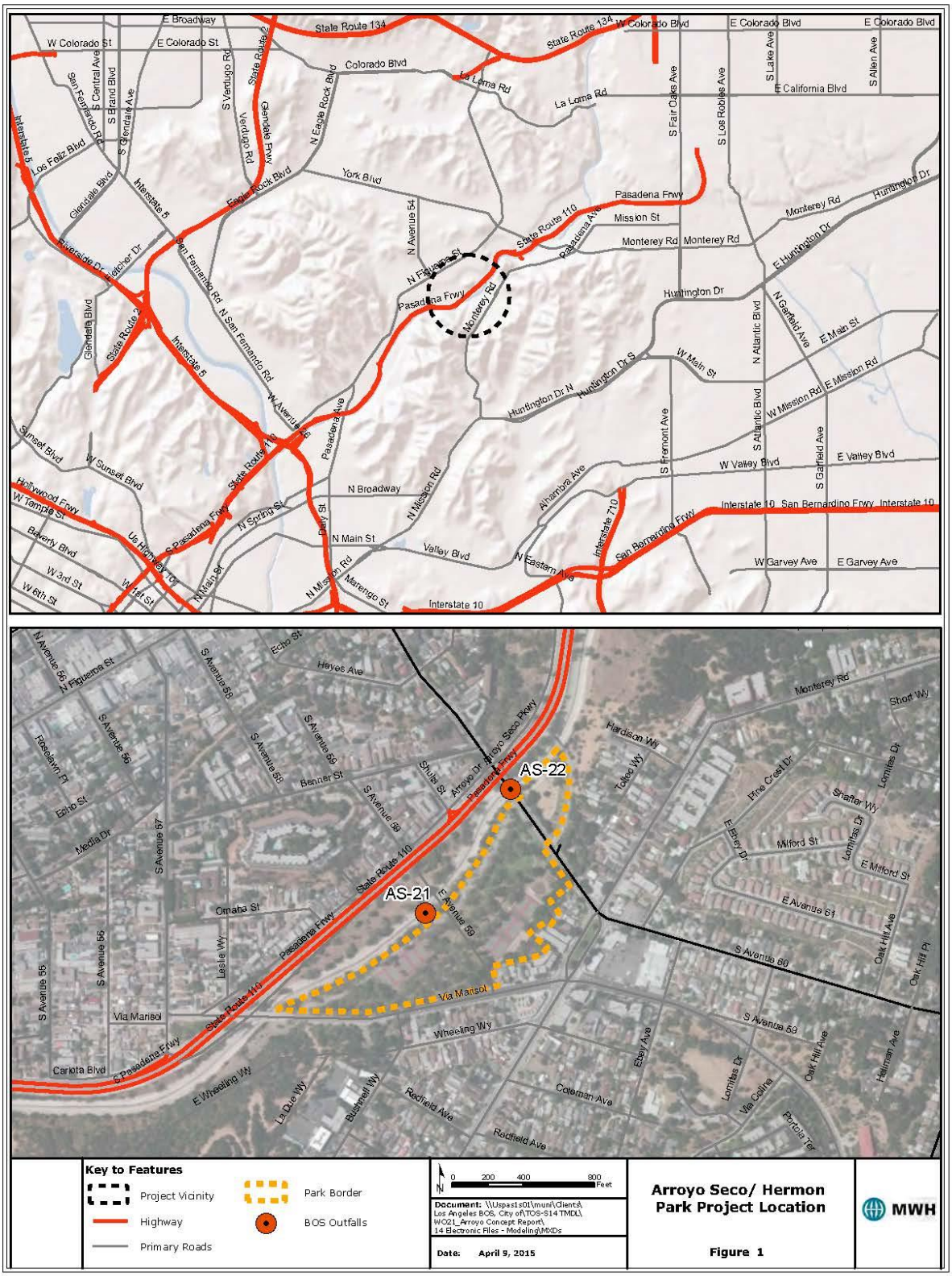

Figure 1 - Arroyo Seco/Hermon Park Project Location

In addition to the LRS, the BOS is collaborating on an EWMP for the Upper LA River. The development of the EWMP is an optional, customized approach to address priority wet and dry weather water quality conditions provided for in Section VI.C.1.g of the 2012 MS4 Permit (Order No. R-42012-0175; NPDES Permit No. CAS004001) (Permit). The objective of the EWMP is to achieve the required pollution reductions through a network of BMPs. The control measures are intended to provide multiple benefits to the community and leverage sustainable green infrastructure practices. The EWMP provides an alternative compliance metric to help determine whether compliance targets and / or non-stormwater control measures in the EWMP have been implemented. Opportunities for collaboration between the EWMP and LRS should be considered.

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2 SITE EVALUATION

The project site location and relevant tributary areas of the contributing watershed were evaluated by desktop research and field investigation in order to develop site-appropriate BMPs and inform the conceptual designs.

2.1 Desktop Site Evaluation

A desktop site evaluation was conducted to identify potential constraints and opportunities early in the conceptual design process. To evaluate the potential for implementing stormwater capture and treatment BMPs within the watershed, a site suitability analysis was conducted using several GIS data layers. These layers are summarized in **Table 1** and presented in multiple figures throughout this section**.**

Table 1 - GIS Data Layers and Descriptions

Layer	Source	Description
Existing Stormwater Infrastructure	Los Angeles County Department of Public Works' Storm Drain System	Features include existing storm drains, open channels, and outfalls
HRU Impervious Area	Los Angeles County Department of Public Works, WMMS support files	Shows percent impervious land cover for LA County
Land Use Type	Los Angeles County Department of Public Works, MODRAT support files	Contains 2005 land use type data
Space Requirements	Calculated	Determined based on BMP type and Watershed Treatment Area
Watershed Treatment Area	City of Los Angeles, Bureau of Sanitation, provided to MWH	Contains the contributing drainage area for AS-21 and AS-22
Soil Infiltration Rate	County of Los Angeles Department of Public Works	Infiltration rate
Ground Surface Slope	USGS Digital Elevation Model (DEM)	30-foot horizontal, 5-foot vertical resolution
Multi-purpose	MWH	Determined based on aerial imagery and field visits
Contaminated Groundwater	State of California, Department of Toxic Substances Control, Envirostor Website	Shows nearby cleanup sites and underground storage tank sites (USTs)

2.1.1 Existing Stormwater Infrastructure

Nearby storm drains were mapped to identify opportunities for BMPs. **Figure 2** shows the storm drains for outfalls AS-21 and AS-22 in proximity to the park. Because of their proximity to the park and open channel, these storm drains present an opportunity to divert runoff to the sanitary sewer. Both drains that convey water to outfalls AS-21 and AS-22 were constructed in the early 20th century and are likely in need of replacement. **Section 3.1** of the report discusses the use of a low flow diversion (LFD) structure for dry weather flow routing to either existing sanitary sewer lines.

2.1.2 Percent Impervious

The range and areas of percent impervious cover types are provided in **Figure 2** and **Figure 3**. Areas with higher percent imperviousness will produce more runoff during typical rain events. Higher impervious areas will be targeted for volume reduction and water quality. The immediate Hermon Park area in consideration for the use of green infrastructure BMP facilities is mainly pervious with values between 0% and 10% impervious cover. Opportunities for stormwater infiltration and capture within the park with a green infrastructure options are presented in **Section 3.2**.

Table 2 - Area of Percent Impervious Land Types

Percent Impervious	Area (acres)
0%-10%	92.7
11%-25%	0.3
26%-50%	123.3
51%-75%	4.4
76%-100%	45.8
Total	**266.5**

2.1.3 Land Use Type

Land use types historically known to generate elevated concentrations and loadings of potential pollutants will be given priority for implementation of stormwater capture and treatment BMPs. Land use in the study area is primarily residential with minor amounts of open space, commercial, and public facilities. **Figure 3** and **Figure 4** present a summary of land use types in the study area.

Table 3 - Summary of Land Use Types

Land Use Type	Area (acres)
Low Medium II Residential	22.3
Low Residential	126.6
Neighborhood Commercial	3.8
Open Space	47.3
Public Facilities	7.2
Unknown	59.3
Total	**266.5**

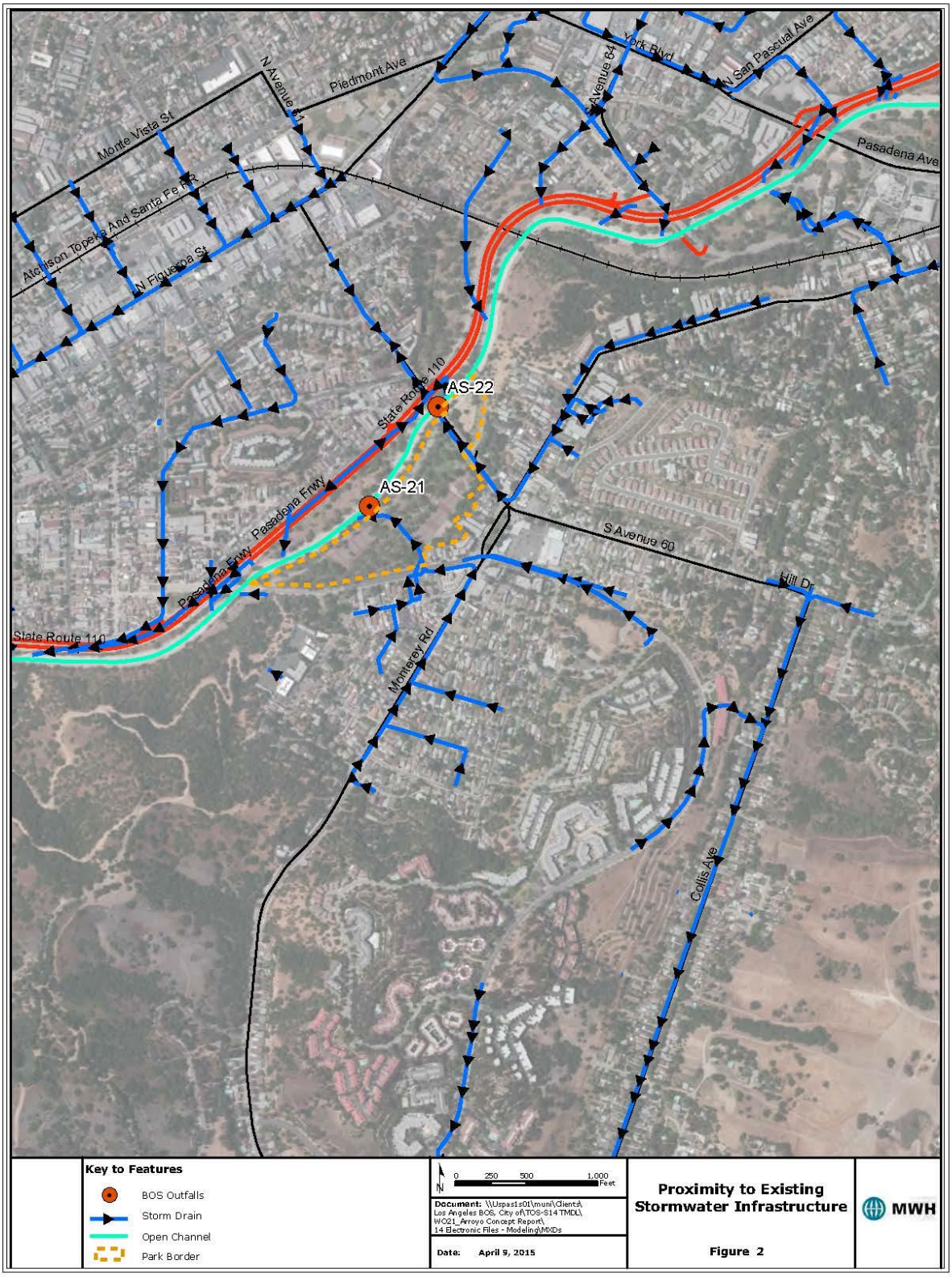

Figure 2 - Proximity to Existing Stormwater Infrastructure

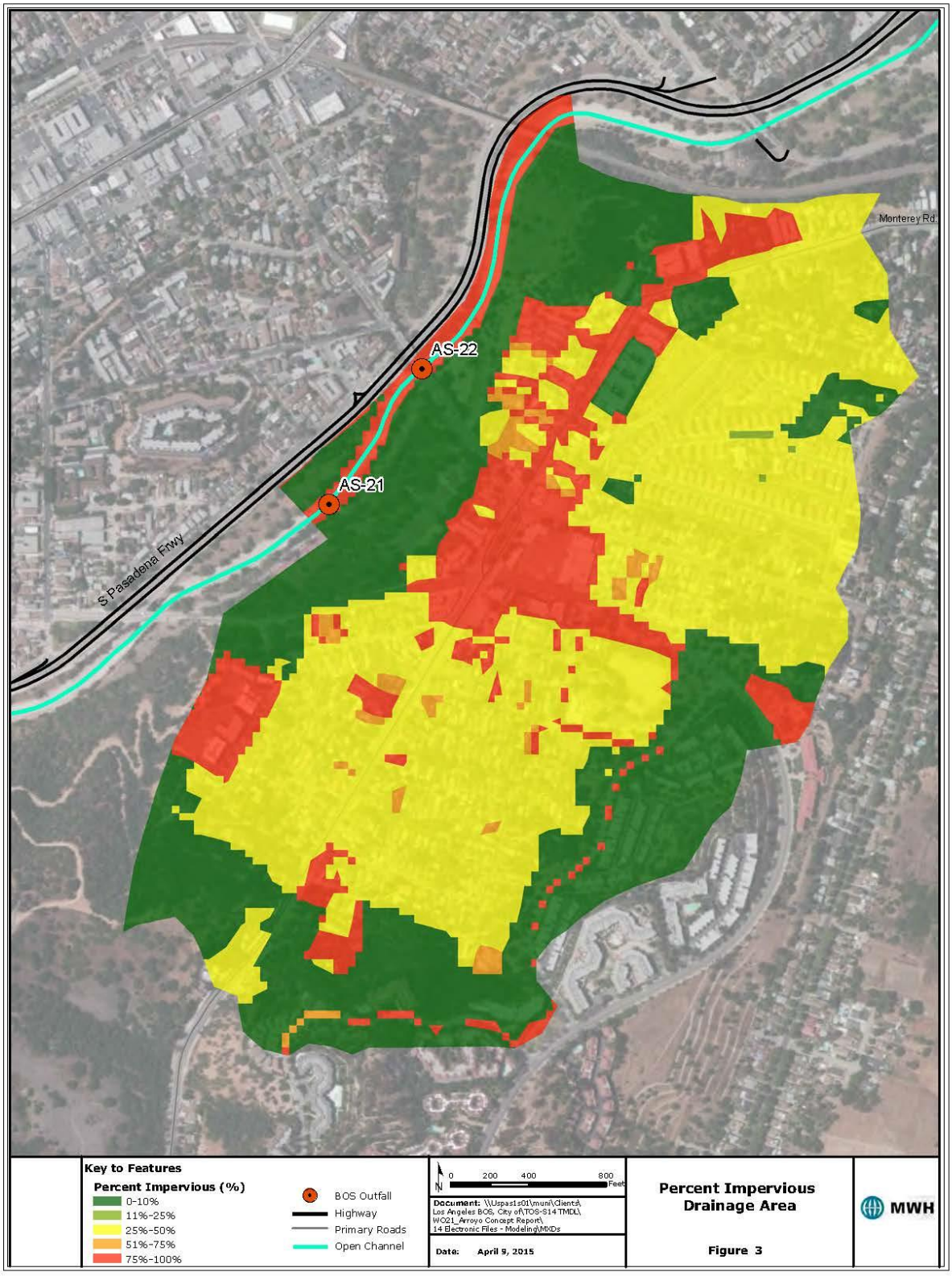

Figure 3 - Percent Impervious Drainage Area

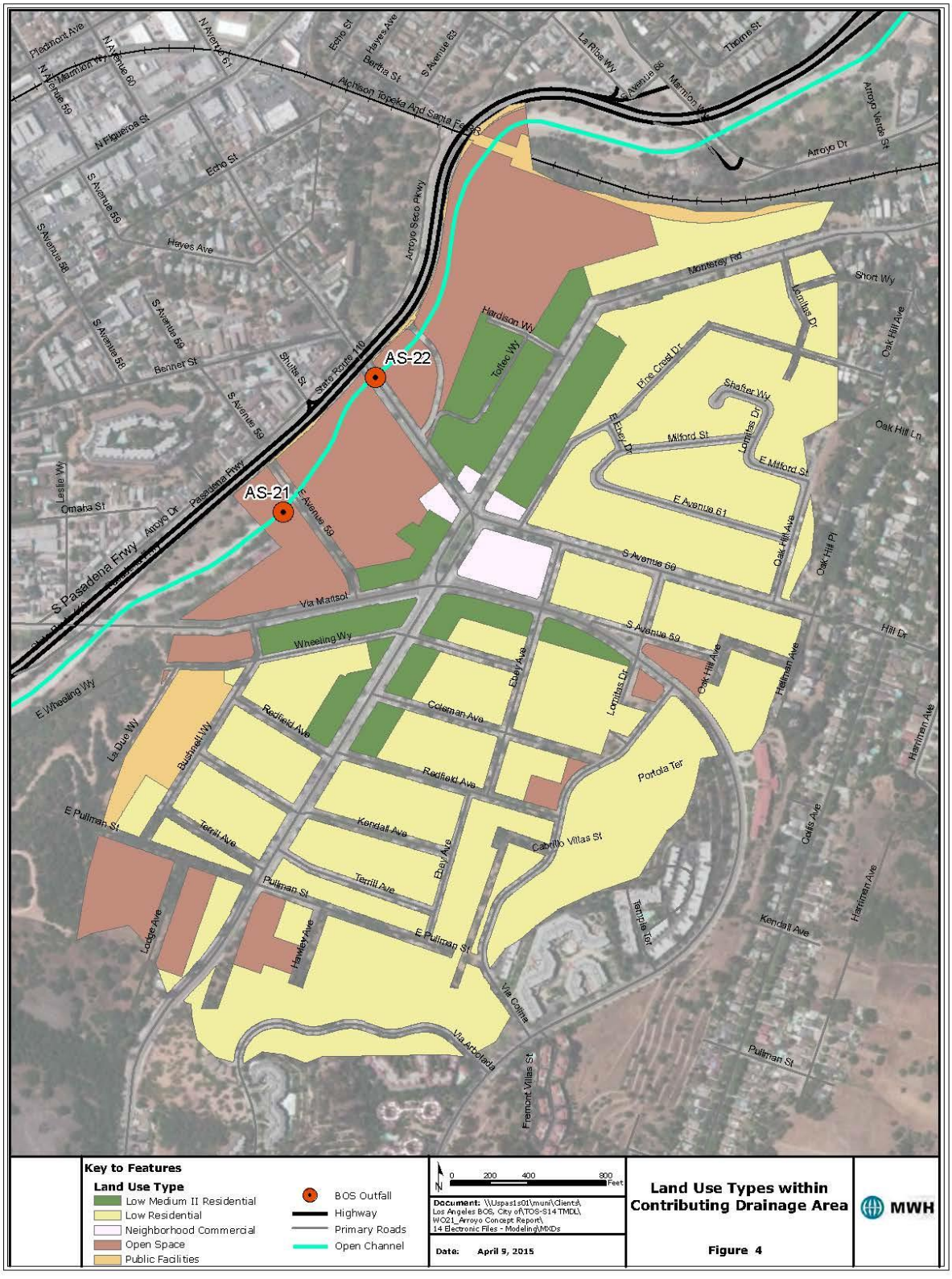

Figure 4 - Land Use Types within Contributing Drainage Area

2.1.4 Space Requirements

Sites were preliminarily evaluated to determine if sufficient space existed to implement an appropriately sized BMP that treats the required volume and peak flow within the Park right-of-way limits. During future design efforts, utility locations and structural setback distances should be thoroughly investigated to confirm adequate distance from design elements.

2.1.5 Watershed Treatment Area

The size of the watershed that contributes to AS-21 and AS-22 (and which will be treated by the low flow diversion and underground storage BMPs) was determined based on the diversion points of nearby storm drains. The watershed area draining to outfalls AS-21 and AS-22 are 168.5 and 97.9 acres, respectively, and is presented in **Figure 5**. The watershed area under consideration for treatment through green infrastructure is described in **Section 3.2**.

2.1.6 Soil Type

An evaluation was conducted of available GIS data and boring logs within the Park boundary to determine if the soil type would allow for adequate infiltration rates. Review of existing geotechnical and monitoring well 18 (MW-18) drilling log records by Delta Consultants near the site indicates the presence of relatively shallow groundwater within the general vicinity. A copy of the boring log is included in **Appendix A**. Groundwater level measurements vary throughout the time of year and can be lower, or higher, depending on precipitation trends within the tributary watershed area. In general, the groundwater table is estimated to be within 13 to 15 feet below ground surface (bgs). The soil classifications for the immediate area vary from gravelly sand, clayey sand and sandy clayey silt. The soils are intermingled with layers of clay material (soil classification CL) varying in thickness from 2.5 to 3-feet.

Due to the presence of high groundwater and thick clay layers, it was determined that an infiltration type BMP would not be feasible for treatment of dry and wet weather flows from the watershed areas draining to outfalls AS-21 and AS-22. However, the use of green infrastructure such as grass swales and bioretention areas for treating the immediate area of Hermon Park itself has been investigated and modeled in **Section 3.2** of the report. Soil types are detailed in **Table 4** and **Figure 6.**

Table 4 - Summary of Soil Types

Soil Classification	Sum of Area (Acres)	Infiltration Rate (in/hr)
Altamont Clay Loam	216	0.09
Hanford Fine Sandy Loam	29	0.27
Yolo Clay Loam	22	0.36
Grand Total	**267**	

Given the relatively shallow groundwater, any subsurface retention system design will likely require anti-flotation measures such as concrete collars and slabs attached to the sub-grade piping. The anti-flotation components would protect the underground retention piping in the event of a rising water table buoyant force acting on the system while it is empty or only partially full.

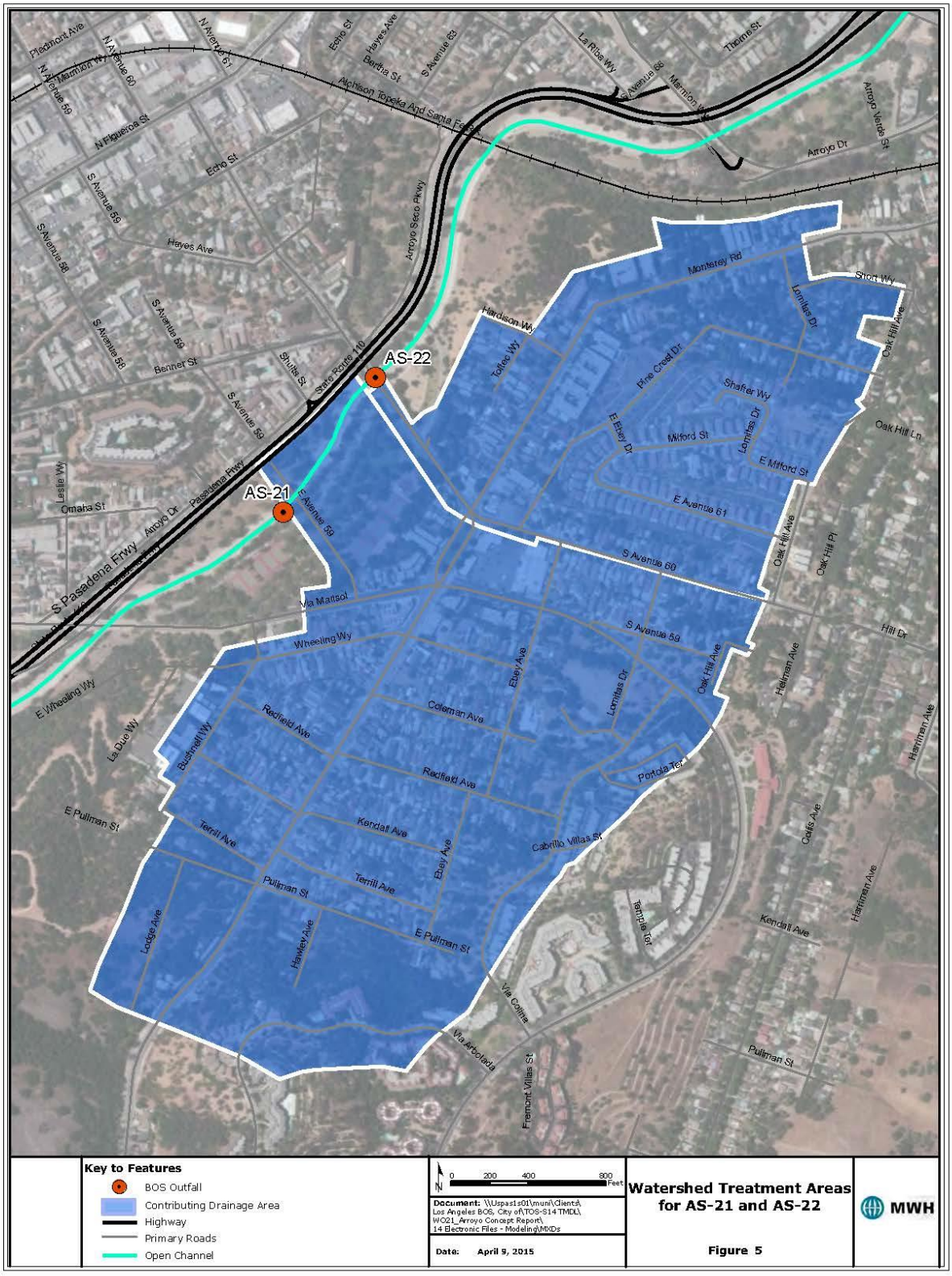

Figure 5 - Watershed Treatment Areas for AS-21 and AS-22

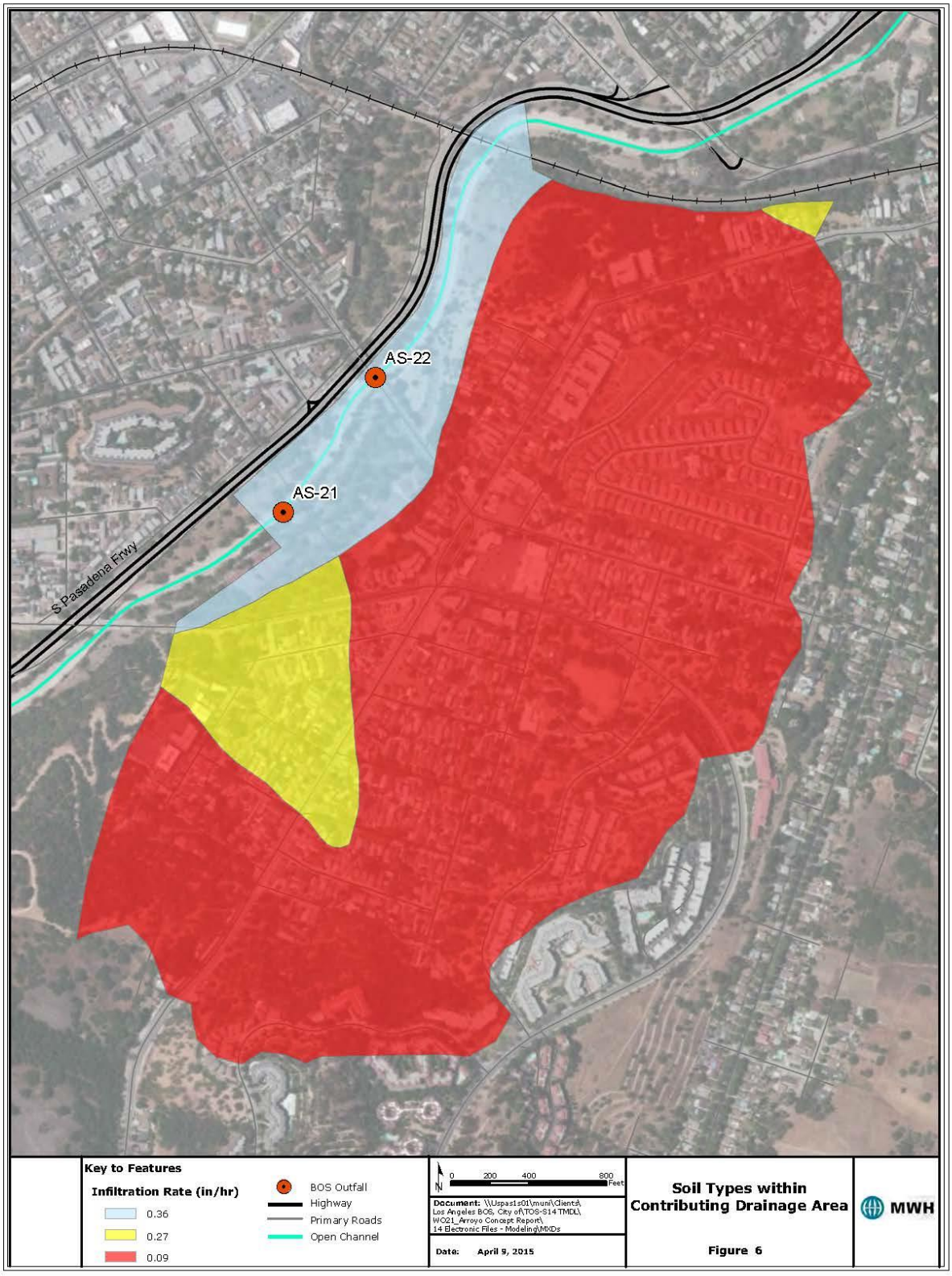

Figure 6 - Soil Types within Contributing Drainage Area

2.1.7 Slope

Slope was determined based on a digital elevation model (DEM) and later verified with field investigation. The majority of the park slopes gradually in a westerly direction, towards the Arroyo Seco channel. A high sloped berm exists near the eastern perimeter of the park near Via Marisol, Avenue 60, and Monterey Road, allowing for incoming storm drains to be routed to deliver flow to low impact development structures via gravity (as mentioned in **Section 3**). A slope map of the site vicinity is provided in **Figure 7**.

2.1.8 Multi-Purpose Areas

Some stormwater BMPs such as bioretention areas can serve a dual purpose of stormwater management and landscaping. Areas where a BMP can serve multiple purposes were given a higher priority. Based on the desktop review, it was determined that opportunities within the Park exist for green infrastructure to simultaneously improve park functionality, safety, and aesthetics as well as stormwater management.

2.1.9 Contaminated Groundwater

The site was evaluated for proximity to contaminated ground water based on known contamination sites as published by the Water Resources Control Board. It has been determined that an underground storage tank (UST) open remediation site exists immediately east of the park at the fuel station on the corner of South Avenue 60 and Via Marisol. There are also two closed remediated sites in the vicinity of the park. The use of infiltration practices is considered low priority for areas in the vicinity of environmental remediation sites. A separate study investigating the possible contamination of groundwater within the park would be recommended before an infiltration BMP is implemented. The location of the UST remediation site is show in **Figure 8**.

2.2 Field Investigation

A field visit was conducted January 15, 2015 with City staff to review desktop research assumptions and identify opportunities for siting of green infrastructure, LFD, and underground storage and treatment infrastructure. Based on the field visit, several conceptual designs were developed for different levels of treatment and use of the facilities and space within the park. Photos of the site visit are provided in **Appendix B**.

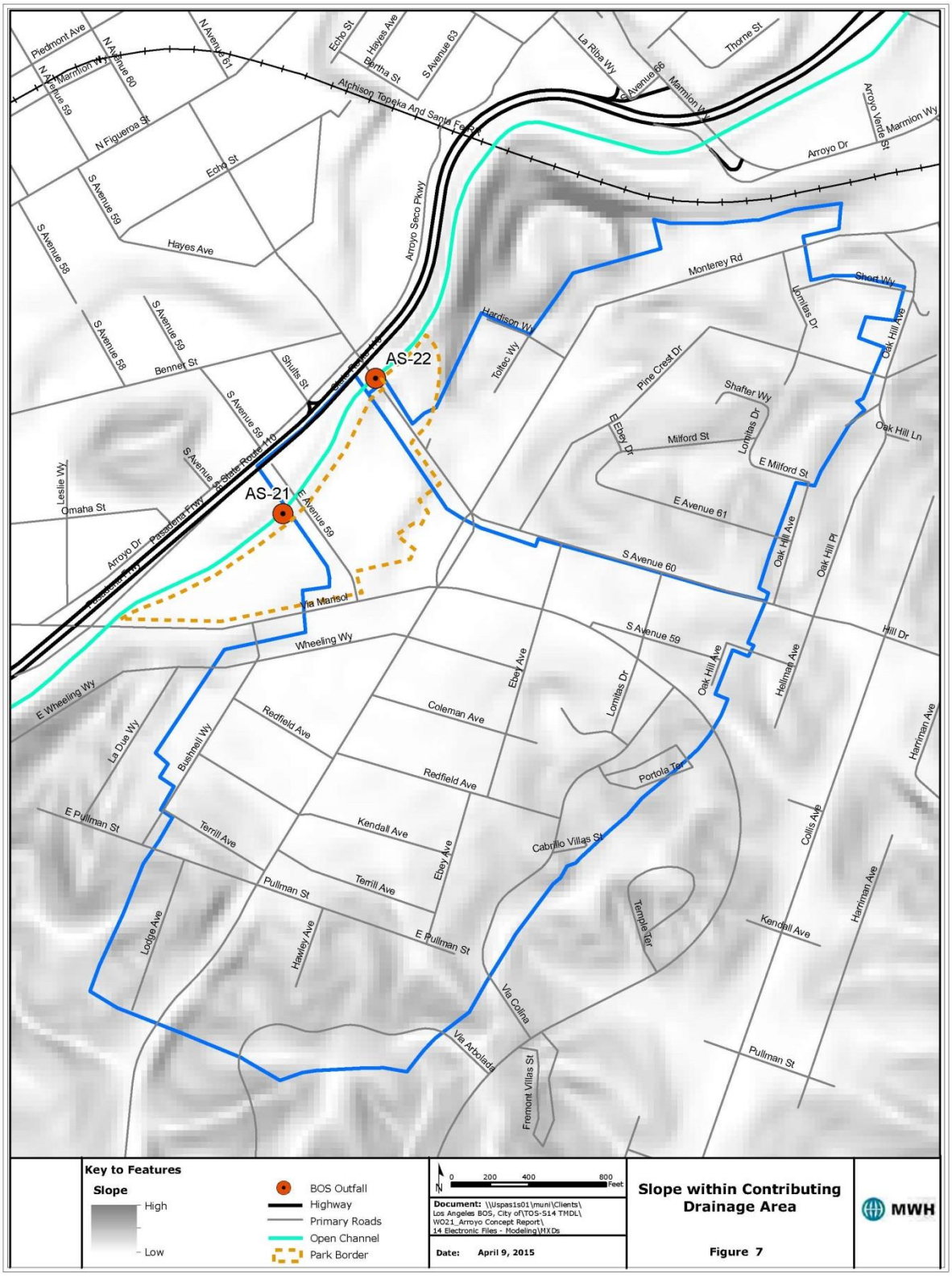

Figure 7 - Slope within Contributing Drainage Area

Figure 8 - Cleanup Sites and Underground Storage Tanks (USTs) near Study Area

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3 PROPOSED BMP ALTERNATIVES

Based on desktop site evaluations and field reconnaissance (**Section 2**), a variety of factors were considered and three separate BMP alternatives were developed: (1) low flow diversion for dry weather, (2) green infrastructure (grass-lined swales and bioretention areas), and (3) diversion and treatment for the 85th percentile storm for regional wet weather implementation. These are briefly described below:

1. Low Flow Diversion for Dry Weather: Treatment of dry weather runoff can be achieved with two low flow diversion structures which will route flows currently draining through outfalls AS-21 and AS-22.

    - To simplify the design of dry weather remediation, it is proposed that both storm drains for the AS-21 and AS-22 outfalls be routed through two low flow diversion structures. The diversion structures would route the dry weather low flows to nearby existing sanitary sewer lines with minimal impact on existing park facilities. Diversion of flows into the existing sanitary sewer system will require coordination with the local sanitary sewer operating agency and is subject to approval.

2. Green Infrastructure: Treatment of wet weather runoff can be achieved with low impact green infrastructure within the park boundary next to the parking lot consisting of a grass lined swale and rain garden.

    - Treatment and multi-benefit use is achieved through the proposal of grass lined swales and bioretention areas (rain gardens) along the western edge of the park next to the parking lot. This low impact green infrastructure within the park boundary allows for drainage towards the BMPs with minimal change to existing infrastructure outside the physical improvement boundaries while improving the aesthetics of the park and promoting multi-benefit use.

3. Region Wet Weather Implementation: Treatment for the 85th percentile storm volume can be attained with a combination subsurface storm water retention and ultraviolet (UV) disinfection system sited near the six existing tennis courts and storage area near the east side of the park. All southwest flows could be routed to this location in order to deliver runoff to the BMP by gravity. This area consists of open space and would minimize tree removal. Removal and replacement of six tennis courts would be required.

    - Wet weather flow treatment for bacteria is proposed to be accomplished through a centralized BMP. The proposed BMP would consist of an underground retention system. An ultraviolet (UV) light cistern is recommended as the preferred method of disinfection for the capture volume. However, the UV system is not effective for treatment of heavy metals. Two treatment options for heavy metals are to either reuse the water for park irrigation (which would allow subsequent treatment through infiltration) or convey the water into the existing sanitary sewer network. However, the reuse option is impractical due to the large volume of storm water and the relatively small demand of the Hermon Park facilities, and diversion of the wet weather flows into sanitary sewers has also been deemed infeasible due to the volumes of runoff exceeding the capacity of the sanitary sewer pipe network.

The conceptual design for each BMP alternative is discussed in further detail below in **Section 3.1**, **3.2**, and **3.3**.

3.1 Low Flow Diversion for Dry Weather

Dry weather flow treatment was considered the best means of removing bacteria loads from runoff waters. A dry weather BMP conceptual treatment system was designed based upon existing sanitary sewer infrastructure in the area.

3.1.1 Layout and Design

The conceptual dry weather BMP design consists of diverting dry flows from existing storm drain piping from both the AS-21 and AS-22 watersheds. A manhole type diversion structure with a bar screen is proposed at the intersection of Monterey Road and Avenue 60, and a second manhole diversion structure is proposed on Via Marisol Boulevard west of Monterey Road.

Dry weather flows will be diverted by an interconnection pipeline and routed into nearby existing sanitary sewer piping, as seen in **Figure 9**. Wet weather flows will bypass the diversion structure and flow out of existing infrastructure to outfalls AS-21 and AS-22 and into the Arroyo Seco channel. Dry weather flows will be conveyed via sanitary sewer piping to a downstream wastewater treatment plant, where primary, secondary, and tertiary treatment is performed.

The conceptual BMP layout and profile for dry weather treatment is depicted in **Figure 9** and **Figure 10.**

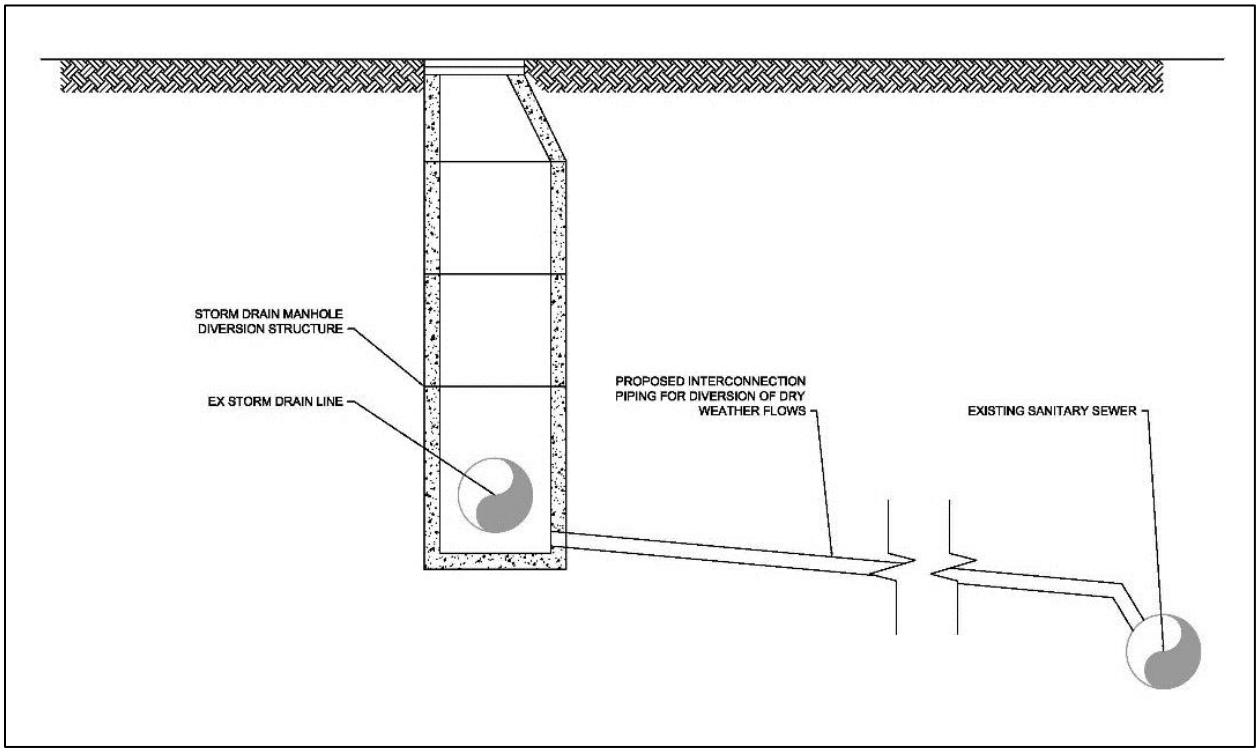

Figure 9 - Dry Weather Flow Diversion Conceptual Profile

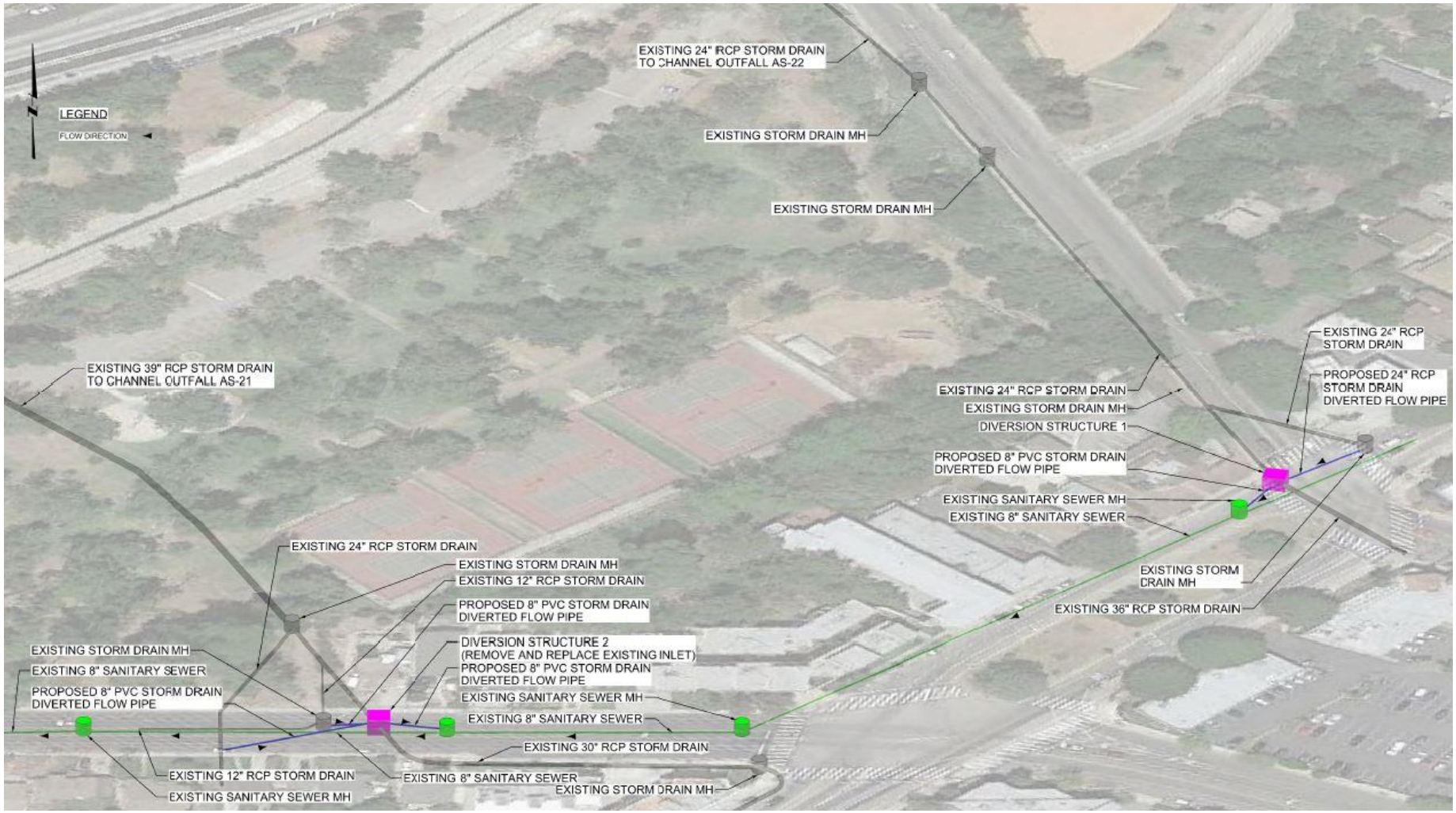

Figure 10 - Conceptual Dry Flow Diversion BMP Layout

3.1.2 Operations and Maintenance

Periodic operation and maintenance activities will be required in the same manner as traditional storm drain manholes to maintain flow diversion efficiency and to meet MS4 permitting compliance. Cleaning operations consists of removing pollutants from curb and gutters, catch basins, and manholes upstream of the BMP system which would reduce the likelihood of the dry weather flow diversion manhole structures from becoming clogged. The inspection and cleaning of the trash screening portion of the diversion manholes via vactor truck should have special consideration since these screens provide the first defense against large debris and litter. **Table 5** summarizes the minimum operations and maintenance activities that are expected to be required for successful implementation of the concept BMP design.

Table 5 - Summary of Minimum Operations and Maintenance Activities for Dry Weather BMP

System Component	Maintenance Activity	Maintenance Frequency
Trash Screening Facility	Remove trash and debris with vactor truck suction equipment	Monthly

Implementation of the dry weather BMP with stormwater diversion into sanitary sewers will remove all combined dry weather flows originating from outfalls AS-21 and AS-22. This configuration will have the greatest potential for reduction of bacteria loading into the Arroyo Seco Project during dry weather flows. Because the dry weather flows reported in latter sections of this report are minimal, diversion of this flow into the sanitary sewer system appears to be a viable option for treatment. However, analysis of the existing sanitary sewer flow volumes would need to be conducted in a separate report to ensure that the peak demand capacity would not be exceeded.

3.1.3 Cost Estimate

The dry weather BMP with stormwater diversion infrastructure is expected to cost approximately $1.1 Million. This estimate does not include cost associated with demolition and reconstruction of unforeseen landscape features, paving, and potential existing utility conflicts. Due to the removal of the entire dry weather flow and associated bacteria loads, this alternative is expected to be cost effective method of treating stormwater flows that currently drain into the Arroyo Seco Channel from outfalls AS-21 and AS-22. A breakdown of the cost estimate is provided in **Table 6**.

Table 6 - Dry Weather BMP Cost Details

Item No.	Item Description	Quantity	Unit	Unit Cost	Extended Amount
1	Traffic Control	1	LS	$150,000	$150,000
2	Shoring and Bracing	1	LS	$150,000	$150,000
3	Construction Conflicts and Additional Work	1	LS	$100,000	$100,000
4	Mobilization and Demobilization	1	LS	$100,000	$100,000
5	Clearing and Grubbing	1	LS	$100,000	$100,000
6	Pipeline Trench Excavation (assume 4-ft cover over pipe)	144	CY	$45	$6,480
7	5" Thick AC Pavement Repair	30	TON	$80	$2,360
8	24" RCP Class III (installed in place with backfill)	293	LF	$475	$139,175
9	72" storm drain / diversion type manhole structure	2	EA	$30,000	$60,000
				Sub Total	$808,015
				10% Mobilization, 10% Bond, 20% Contingency	$323,206
				Total	$1,131,220*

*****The estimate of costs shown and any resulting conclusions on the project financial, economic feasibility or funding requirements have been prepared from guidance in the project evaluation and implementation from the information available at the time the estimate was prepared. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions and other variable factors. Accordingly, the final project costs may vary from the estimate. Project feasibility, benefit/cost analysis, and risk must be reviewed prior to making specific funding decisions and establishment of the project budget.

3.2 Green Infrastructure

A conceptual green infrastructure treatment option for runoff within the park was considered based upon existing topography and infrastructure in the area. The section below describes the concept design components for green infrastructure implementation for treatment wet weather runoff within the Hermon Park boundary. Green infrastructure is considered a Low Impact Development BMP.

3.2.1 Layout and Design

The conceptual green infrastructure BMP design consists of two sets of grass-lined swales with bioretention BMPs on the west side of the park. The grass-lined swales collect runoff flowing from east to west across the park from the berm at the park boundary. The two swales drain into the bioretention BMPs which have been modeled in a separate analysis included in **Section 3.2.2**. The conceptual layout for the BMPs is depicted in **Figure 11** and **Figure 12.**

Figure 11 - Low Impact Development Site Layout

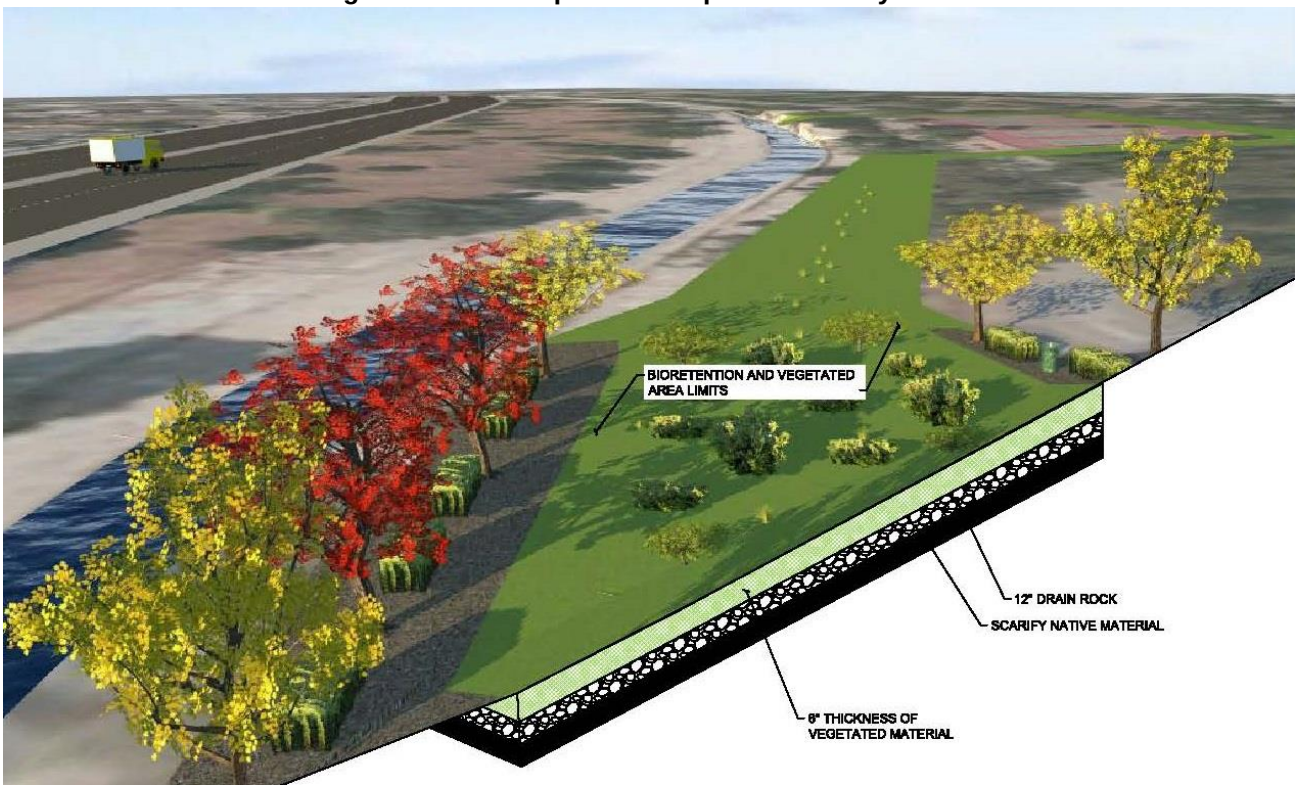

Figure 12 - Low Impact Development Conceptual Profile

3.2.2 Modeling and Analysis of Watershed Impacts

Once green infrastructure opportunities were identified, an additional modeling analysis was performed to:

1. Provide optimization of the most cost-effective BMP designs and sizes to achieve wet weather numeric water quality goals consistent with the EWMP.
2. Demonstrate pollutant load reductions achieved based on the BMPs.

The additional modeling analysis focused on the green infrastructure BMPs and did not consider the regional treatment BMP (**Section 3.3**), since the latter is focused on 100 percent capture dry weather runoff. Based on the size of the drainage areas and proposed locations of potential bioretention BMPs, a modeling system was configured to simulate hourly runoff, water quality, and BMP processes to evaluate cost-effective BMP designs to maximize performance and meet EWMP goals.

A site-scale modeling system was developed using a combination of the Loading Simulation Program C++ (LSPC) for simulation of runoff and pollutant loading, and the System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN) to simulate BMP processes and provide cost optimization. This modeling system was consistent with the reasonable assurance analysis of the EWMP. The LSPC model for the LA River was calibrated specifically for the EWMP, and provides hourly simulation of runoff and concentrations of metals and bacteria. SUSTAIN was developed by the United States Environmental Protection Agency (USEPA) to support practitioners in developing cost-effective management plans for municipal stormwater programs and evaluating and selecting BMPs to achieve water quality goals. SUSTAIN was specifically developed as a decision-support system for selection and placement of BMPs at strategic locations in urban watersheds. It includes a process-based continuous simulation BMP module for representing flow and pollutant transport routing through various types of structural BMPs. This simulation of process-based BMPs is coupled with a cost-benefit optimization module that allows for dynamic sizing and selection of BMPs in an urban stormwater system. SUSTAIN was tailored for the EWMP to represent conditions and costs specific to the LA River.

In this application, two proposed bioretention facilities were evaluated to quantify pollutant reductions. Grass swales were also located with the bioretention BMPs, but their primary purpose will be to convey runoff to the bioretention BMPs, and limited pollutant reduction is expected to result from the grass swales. Therefore, the modeling and design optimization for this analysis was focused on the two bioretention BMPs, indicated as Bioretention 1 and 2 in **Figure 11**.

Total zinc was determined to be the wet-weather limiting pollutant in the EWMP, suggesting that by managing total zinc the other pollutants would also be managed sufficiently to meet their respective water quality goals. To guide BMP implementation efforts, the Arroyo Seco portion of Los Angeles River was identified in the EWMP to have a goal of achieving 59 percent reduction in total zinc load for a 90^{th} percentile critical condition storm (critical storm identified based on review of hydrologic records from 10/1/2001 to 9/30/2011). For the combined drainage area of the proposed bioretention BMPs (Tributary Area 1 and 2 in **Figure 11**), the 90^{th} percentile storm and associated zinc concentrations are show in **Figure 13**.

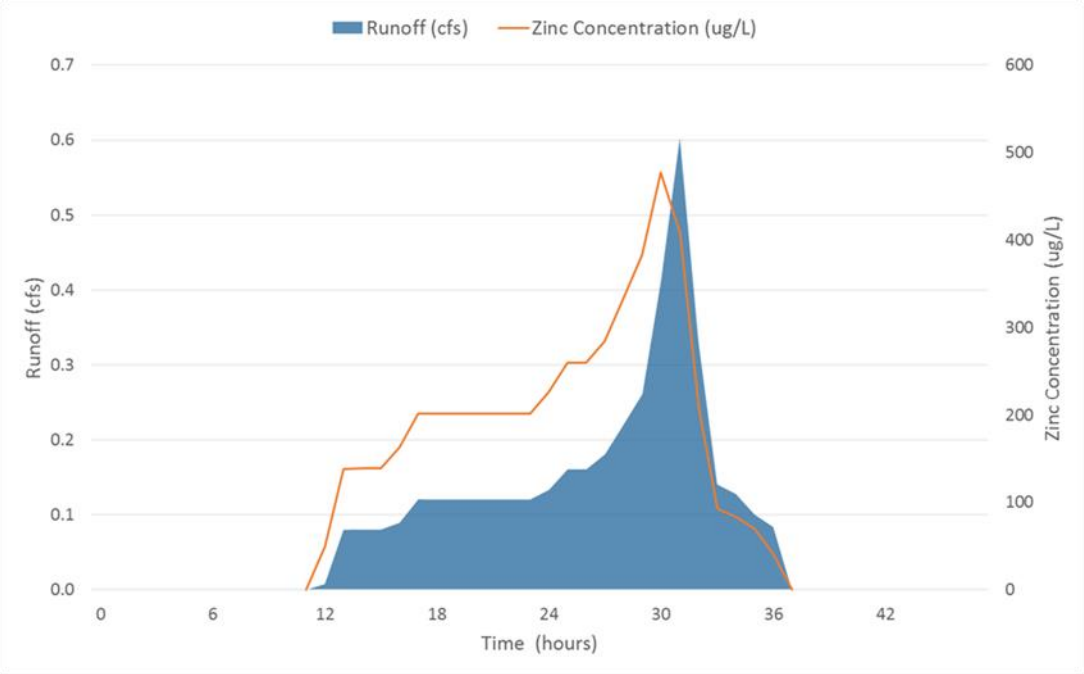

Figure 13 - 90th Percentile Critical Condition Storm for Managing Zinc (Total Rain Precipitation = 1.09")

Each of the two bioretention BMPs was optimized separately to determine the minimum size required to achieve a 59 percent total zinc load reduction for the critical condition storm. Both bioretention BMPs were configured with vertical design profiles consistent with assumptions used in the EWMP, and included in **Table 7**. Infiltration rates were assessed based on available Los Angeles County soil survey datasets and site specific geotechnical evaluations. The optimization process resulted in a cost-effectiveness curve (CE Curve) for each bioretention BMP, showing the total cost and total zinc load reduction across a range of BMP sizes up to the maximum available BMP footprint area. **Figure 14** and **Figure 15** present cost-effectiveness curves for the two bioretention BMPs. The figures depict increasing BMP costs (reflected by increased BMP sizes) and associated zinc load reductions, as well as the point at which the target zinc load reduction of 59 percent is met. It should be noted that these costs are based on mathematical cost functions within SUSTAIN and are meant for cost comparison, and do not represent estimated costs for planning of BMP design. For comparison purposes, the costs/benefits to capture the 85th percentile storm is also shown, which is a typical design metric for a water quality design storm. For the case of these bioretention BMPs, the 85th percentile storm would have resulted in approximately 3.5 times the size and costs of the BMPs needed to result in meeting the zinc load reduction target, and therefore was not recommended. **Table 7** presents the BMP vertical profile design assumptions, infiltration rates, and resulting optimized BMP footprint area for the two bioretention BMPs.

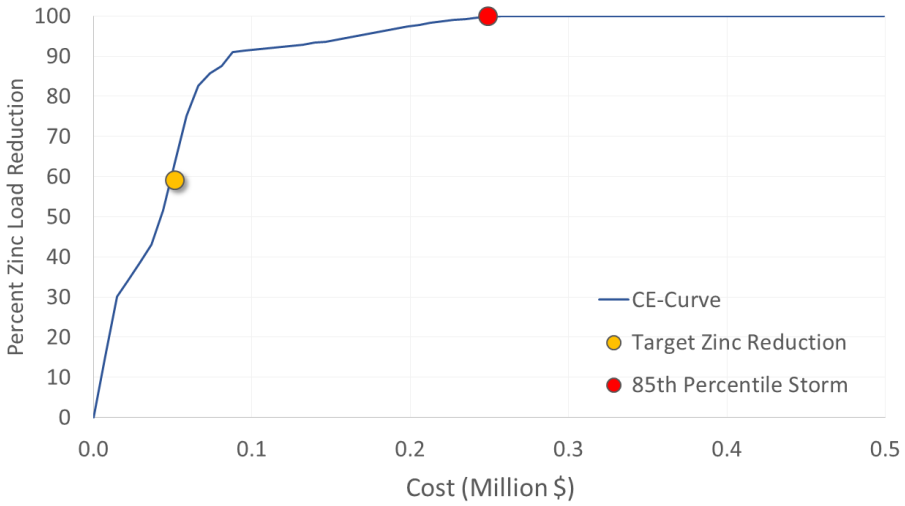

Figure 14 - Cost-Effectiveness Curve for Bioretention 1

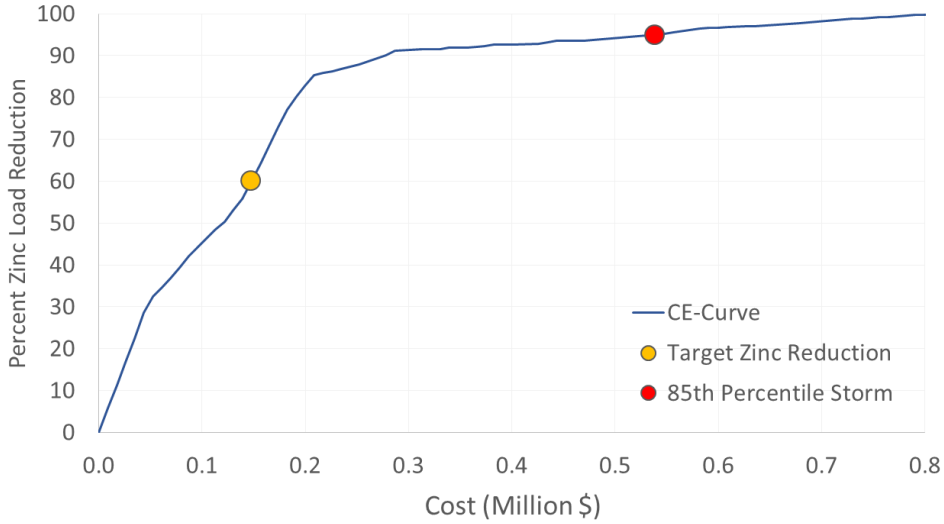

Figure 15 - Cost-Effectiveness Curve for Bioretention 2

Table 7 - Summary of Model BMP Configurations

Component	Units	Bioretention 1	Bioretention 2
Footprint	sq. ft.	610	1,750
Ponding Depth	in.	9	
Soil Media Depth	ft.	2.0	
Soil Media Porosity	--	0.35	
Underdrain Depth	ft.	1.5	
Underdrain Media Porosity	--	0.4	
Background Infiltration	in./hr.	0.36	

Based on the critical storm condition for managing zinc (**Figure 13**), each bioretention BMP was modeled to also determine associated reductions in runoff, sediment, copper, and lead. **Table 8** shows the runoff and loading from each tributary drainage area pre and post BMP implementation, and associated percent runoff and load reduction resulting from the bioretention BMPs. Similar load reductions of 59 percent are expected for copper, lead, and zinc, resulting in copper and lead reductions to exceed their respective load reductions targets specified in the EWMP.

Table 8 - Summary of Flow and Load Reductions by BMP for Critical Storm Condition for Managing Zinc

	Bioretention 1			Bioretention 2		
Parameter	**Pre**	**Post**	**%**	**Pre**	**Post**	**%**
Runoff (cu-ft)	3,577	2,894	19%	11,802	9,833	17%
Sediment (lbs)	60.4	21.5	64%	187.0	73.6	61%
Total Copper (g)	9.0	3.6	59%	24.8	9.8	60%
Total Lead (g)	6.9	2.8	59%	21.6	8.6	60%
Total Zinc (g)	30.0	12.2	59%	91.2	36.5	60%

The EWMP also specifies a critical storm condition for managing *E. coli*, which represents the 90th percentile wet day when bacteria receiving water limits (RWLs) apply (incorporating allowable days when RWLs can be exceeded). The resulting storm for the combined tributary drainage area for the bioretention BMPs is shown in **Figure 16**. Through a combination of BMPs recommended in the EWMP (beyond only green infrastructure), the goal is to manage runoff associated with this critical bacteria storm condition. For each tributary area, the runoff from the critical bacteria storm pre and post BMP implementation are presented in **Table 9**. Also shown

in **Table 9** are load reductions associated with sediment and metals, which indicate a significant reduction of 94-95 percent under this storm condition.

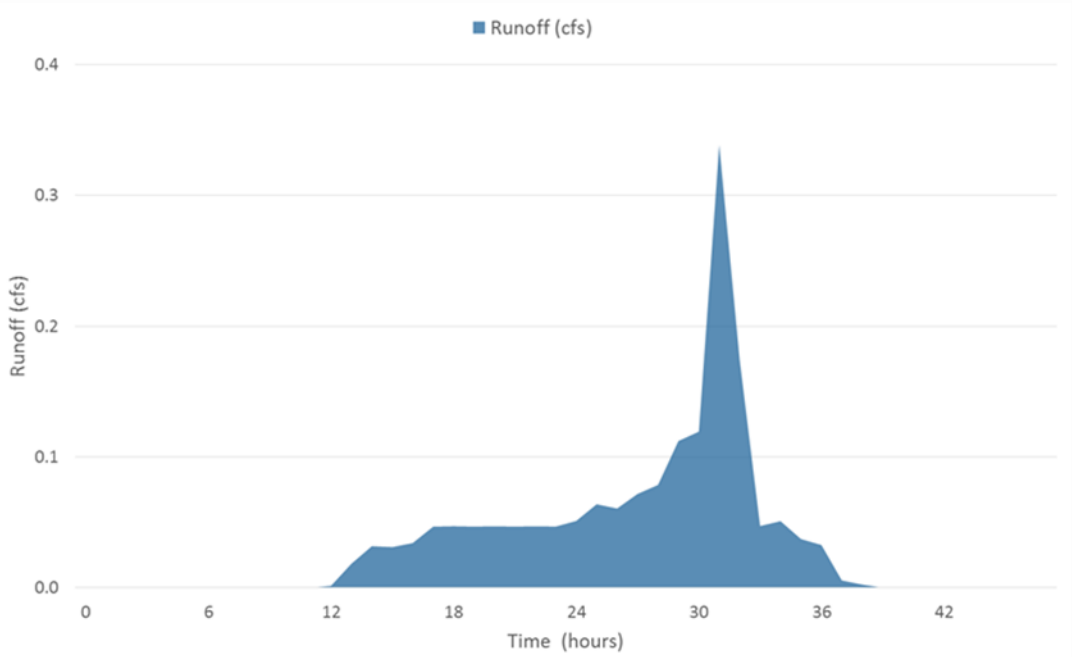

Figure 16 - 90th Percentile Critical Condition Storm for Managing E. coli (Total Rain Precipitation = 0.42")

Table 9 - Summary of Flow and Load Reductions by BMP for the Critical Storm Condition for Managing E. coli.

	Bioretention Garden 1			Bioretention Garden 2		
Parameter	**Pre**	**Post**	**%**	**Pre**	**Post**	**%**
Runoff (cu-ft)	1,278	398	69%	4,350	1,753	60%
Sediment (lbs)	15.7	0.8	95%	42.3	2.7	94%
Total Copper (g)	2.4	0.1	95%	5.7	0.4	94%
Total Lead (g)	1.9	0.1	95%	5.1	0.3	94%
Total Zinc (g)	8.6	0.4	95%	21.6	1.4	94%

Results of this analysis provided insights into design considerations for the bioretention BMPs that maximize cost-effectiveness to meet water quality goals. The optimization results for BMP sizing and design were subsequently used to guide concepts for these BMPs and provide OPCCs.

3.2.3 Operations and Maintenance

Periodic operation and maintenance activities will be required in the same manner as traditional landscaping facilities. Mowing and sodding of the grass lined swales will be required as well trimming of brush undergrowth and trash cleanup and disposal from the BMP facility. These upkeep procedures are expected to occur in one to three month intervals.

3.2.4 Cost Estimate

The green infrastructure BMPs with stormwater bioretention is estimated to cost approximately $137,000. This estimate does not include costs associated with demolition and reconstruction of unforeseen landscape features, paving, and potential existing utility conflicts. This alternative is only cost effective treating stormwater flows for heavy metal removal. However, green infrastructure type BMPs serves a dual purpose as an aesthetic and green option for stakeholders in the community. A breakdown of the cost estimate is provided in **Table 10**.

Table 10 - Low Impact Development BMP Cost Details

Item No.	Item Description	Quantity	Unit	Unit Cost	Extended Amount
1	Mobilization and Demobilization	1	LS	$10,000	$10,000
2	Bio Retention Area 1	1	LS	$20,000	$20,000
3	Bio Retention Area 2	1	LS	$52,000	$52,000
4	Vegetated Swale Area 1 (Assuming 12" Depth) Grading	3541	SY	$2	$7,082
5	Vegetated Swale Area 2 (Assuming 12" Depth) Grading	1594	SY	$2	$3,188
6	Landscaping and Seeding Area 1	3541	SY	$3	$10,623
7	Landscaping and Seeding Area 2	1594	SY	$3	$4,782
				Sub Total	$97,675
				10% Mobilization, 10% Bond, 20% Contingency	$39,070
				Total	$136,745*

*The estimate of costs shown and any resulting conclusions on the project financial, economic feasibility or funding requirements have been prepared from guidance in the project evaluation and implementation from the information available at the time the estimate was prepared. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions and other variable factors. Accordingly, the final project costs may vary from the estimate. Project feasibility, benefit/cost analysis, and risk must be reviewed prior to making specific funding decisions and establishment of the project budget.

3.2.5 Plant Selection

Plant material help to filter the rainwater as it moves through the soil layer, providing a water quality benefit in addition to the aesthetic benefits added through installation of plants in the park. Plant material used for swales and land terracing should consist of native species to create ecosystems where birds, butterflies and beneficial insects thrive. Low Impact BMP's consisting of appropriate native trees, shrubs ground cover and emergent plants installed in a properly designed soil media will capture sediments and filter pollution reducing the nutrient loading reaching the lake.

Plant material appropriate for LID BMP's (rain gardens, bio-swales), should consist of native and drought tolerant plants appropriate for the site and micro climate. The planting design

should include tree, shrub and ground cover layers. The vegetation should be maintained as necessary to maintain the aesthetic appearance as well as the filtration capabilities.

Table 11 provides a list of recommended native plant materials appropriate for use in these facilities. A full list of native and drought tolerant plants maintained by the city of Los Angeles and Los Angeles County is provided in **Appendix C**.

Table 11 – Recommended List of Native and Drought-Tolerant Plants

Scientific Name	Common Name	Plant Type
Abies concolor	White Fir	Tree
Acer negundo var. californicum	California Box Elder	Tree
Achillea millefolium	Common Yarrow	Perennial Herb
Arctostaphylos edmundsii	Little Sur Manzanita	Tree/Shrub
Baccharis pilularis	Drawf Coyote Bush	Shrub
Chrysothamnus nauseosus ssp. hololeucu	Common Rabbitbush	Shrub
Elymus glaucus ssp. glaucus	Blue Wildrye	Perennial Grass
Hazardia squarrosa var. grindelioides	Saw-toothed Goldenbush	Shrub
Heteromeles arbutifolia	Toyon	Shrub/Tree
Iris douglasiana	Douglas Iris	Bulb
Lupinus	Lupine	Perennial Herb
Muhlenbergia rigens	Deer Grass	Perennial Grass
Myrica californica	California Wax-Myrtle	Shrub
Rhamnus californica ssp. californica	California Coffeeberry	Shrub
Romneya coulteri	Coulter's Matilija Poppy	Shrub
Rosa californica	California Wild Rose	Shrub
Salvia apiana	White Sage	Shrub
Yucca [Hesperoyucca] whipplei	Chaparral Yucca	Shrub

3.3 Regional Wet Weather Implementation

A conceptual diversion and BMP treatment configuration was considered for the Arroyo Seco project site and watershed to capture and treat the 85th percentile storm volume. This section describes the concept design components for wet weather implementation as well as a discussion of the feasibility for treating wet weather flows.

3.3.1 BMP Sizing

The concept BMP design for Arroyo Seco has been sized to capture and treat the 24-hour, 85th percentile storm volume. The tributary 85th percentile storm volume is summarized in **Table 12**.

Table 12 - Summary of BMP Design Volume

Drainage Area	85th Percentile Storm Volume (ac-ft)
AS-21	4.6
AS-22	2.3

3.3.2 Layout and Design

The concept BMP design will consist of diverting wet weather flows from the existing manholes and storm drain piping from both the AS-21 and AS-22 watersheds. A manhole-type side weir diversion structure is proposed at the intersection of Monterey Road and Avenue 60. This diversion structure will divert stormwater through a new storm drain southward along Monterey Rd to Via Marisol. Along Via Marisol, the stormwater will combine with another diversion structure, as seen in **Figure 18**. A bar screened trash and large debris concrete capture basin is proposed downstream of the second diversion structure. This capture basin will act as a pre-treatment component within the train to remove large objects and trash debris that is conveyed within the storm drain piping system. After initial screening, the stormwater will travel into a subsurface retention system consisting of 96" diameter inter-connected corrugated metal pipes (CMPs). The stormwater is then routed into a wet well and pumped into a UV disinfection system before release into existing outfall AS-22. The conceptual BMP layout is depicted in **Figure 17** and **Figure 18.**

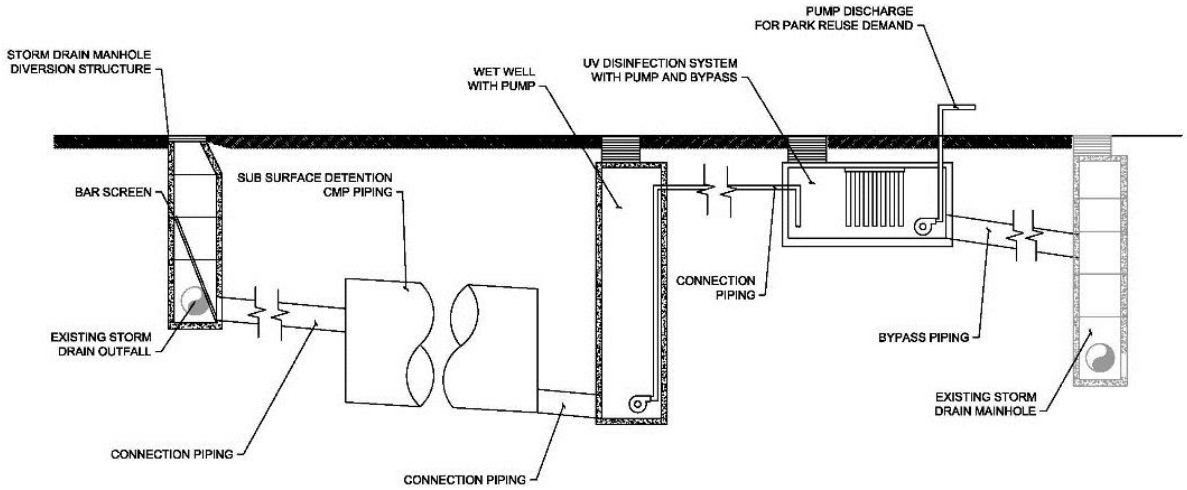

Figure 17 - Wet Weather Flow Diversion and UV Disinfection Profile

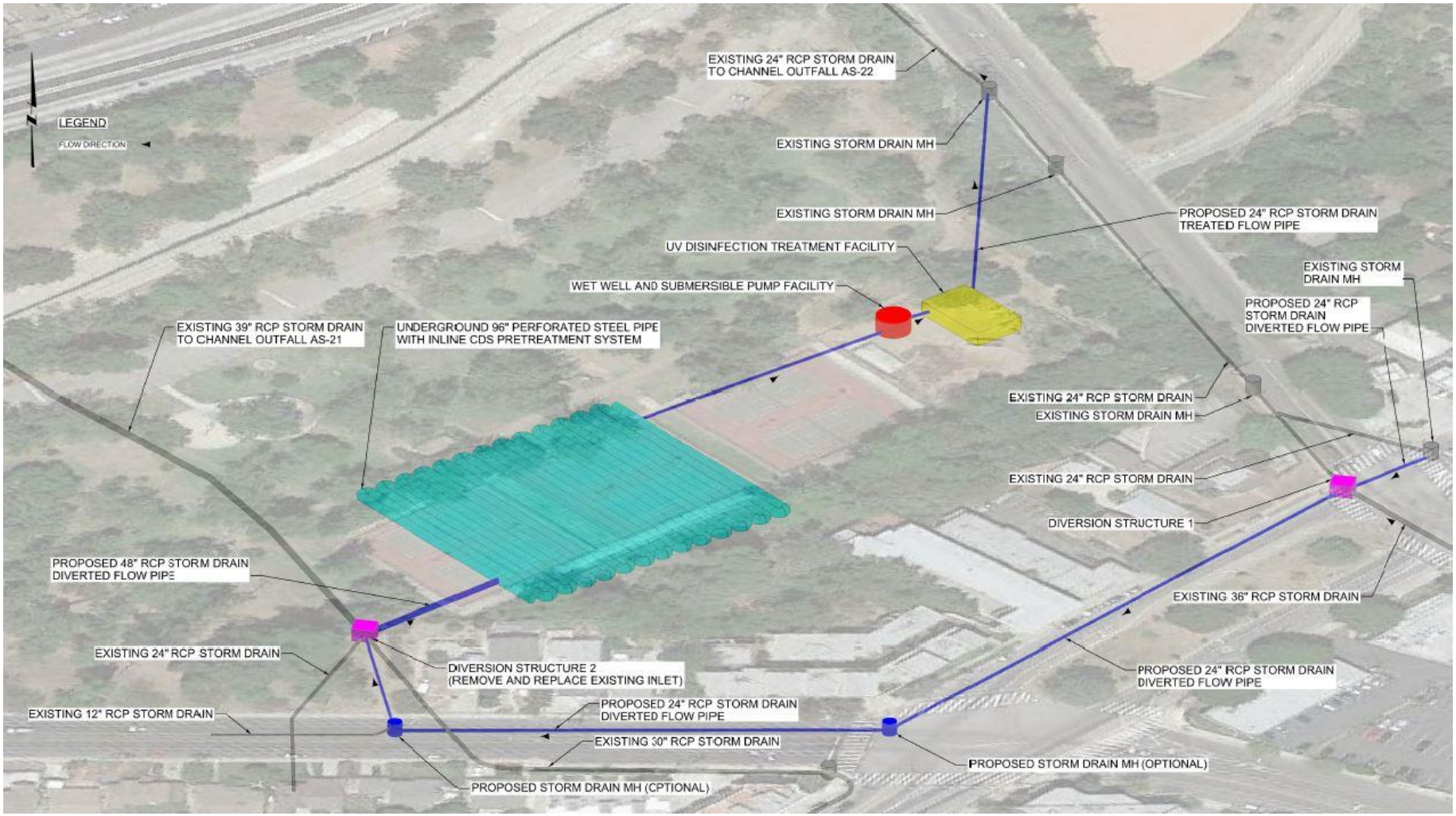

Figure 18 - Conceptual BMP Layout

3.3.3 Operations and Maintenance

Periodic operation and maintenance activities will be required for the diversion structures, trash screening facility, underground retention tank(s), and disinfection system to maintain TMDL design removal efficiency. Street sweeping operations and vactor truck suction cleaning should be implemented within both AS-21 and AS-22 drainage areas on a periodic basis to remove trash, large sediment, and litter. The purpose of the cleaning operations would be to remove these pollutants from curb and gutters, catch basins, and manholes upstream of the BMP system to improve effectiveness and decrease the potential for clogging downstream. The inspection and cleaning of the trash screening portion of the diversion manholes via vactor truck should have special consideration since these screens provide the first defense against large debris and litter.

Manholes installed with the subsurface retention system should be utilized on a periodic basis to access and inspect the subsurface facility for removal of settled sediment deposits. Adequate removal of sediment will maintain the design retention volume capacity as well as limit the introduction sediment to the pumping and disinfection treatment train located downstream of the storage facility.

Mechanical and instrumentation equipment such as pumps and motors within wet wells and level sensing equipment should also be inspected and tested periodically to ensure that electric motors and impellers are functioning as intended. Inspections should also occur after events such as power failures and large storm discharges. Level sensing equipment should be manually actuated during inspection to ensure that appropriate signals, alarms, and controls are produced by the system. The design will include adequate hatch openings and ladder rungs for maintenance staff to access, maintain, and visually inspect the system components.

It is imperative that all UV light bulbs are operable during disinfection operations to ensure maximum deactivation efficiency. During maintenance operations, staff should visually inspect the bulbs to ensure they are intact and not damaged. Damaged bulb assemblies should be removed and replaced with readily available standby parts. Bulb replacement due to operation wear and tear will also be required throughout the design life of the BMP treatment system. Typical research shows that, on average, UV bulbs have a service life ranging from 10,000 to 15,000 hours. Complete and accurate maintenance and bulb installation and replacement schedule will be crucial for a successful UV system operation.

Table 13 summarizes the minimum operations and maintenance activities that are expected to be required for successful implementation of the conceptual wet weather BMP design. It is expected that operation and maintenance personnel will require training and instruction from the system manufacturer in order to properly maintain all components.

Table 13 – Summary of Minimum Operations and Maintenance Activities for Wet Weather BMP

System Component	Maintenance Activity	Maintenance Frequency
Trash Screening Facility	Remove trash and debris with vactor truck suction equipment	Monthly
Underground Retention Facility	Remove sediment and debris with vactor truck suction equipment	Quarterly
Wet Well and Pump Component	Inspection of pump and motor components, test electrical and pumping system, replace as necessary	Quarterly
UV disinfection system	Inspection of bulbs, remove and replace exhausted bulb units	Quarterly

In addition to maintenance, accessibility was considered when developing the conceptual design. The retention system consisting of a series of inter-connected CMPS designed with multiple access manholes for inspection and maintenance purposes. The wet well pump station and UV disinfection cistern would also have access manholes for operations and maintenance procedures. Equipment access to the site could be reached by vehicle through the frontage road adjacent to the channel or by foot from Avenue 60.

3.3.4 Expected Watershed Impacts

Implementation of the wet weather BMP with UV disinfection treatment is expected to remove up to 99 percent of influent bacteria when using the manufacturer recommended exposure levels and maximum flow rates through the system, and when the system is operational (R-CAN Environmental Inc., 2015). A backup power generation system may be required to safeguard the system against power failures during rain events. Based upon the loading rates determined in the Arroyo Seco LRS report, UV disinfection treatment has the potential to remove up to 3.75 billion MPN per day in *E. coli* loading from the Arroyo Seco watershed (City of Los Angeles Bureau of Sanitation, 2013).

Heavy metal removal is not achieved with UV disinfection. Infiltration through existing soil is often a preferred method of stormwater treatment for heavy metal removal. However, as the existing soils and groundwater table have been analyzed and determined to be not conducive to infiltration, other methods of treatment would be required. Two ways of achieving heavy metal removal are reuse as irrigation and facility usage water within the park boundaries or storage and direct diversion to sanitary sewer systems for collection and advanced management at a waste water treatment facility. Both options were considered. It has been determined that the volume of the wet weather flow is too large to be used as irrigation for park facilities in a manner to be an effective method of timely storage and release. Additionally, the size of the existing sanitary sewers in the immediate area has been determined to be incapable of accommodating the increase in flow of the stored wet weather volume.

3.3.5 Cost Estimate

The wet weather BMP with UV disinfection treatment cost estimate is approximately $7.5 Million in the range of $3.5 to $13.8 Million. This estimate does not include costs associated with demolition and reconstruction of unforeseen landscape features, paving, and potential existing utility conflicts. Due to the nature of the site and the inability to reuse the stormwater in a cost effective manner, it has been determined that the retention BMP and UV disinfection system is not a cost effective method for treating the relatively small watershed areas that drain into the Arroyo Seco Channel from outfalls AS-21 and AS-22. A breakdown of the cost estimate is provided in **Table 14**.

Table 14 - Wet Weather BMP Cost Details

Item No.	Item Description	Quantity	Unit	Unit Cost	Amount
1	Traffic Control	1	LS	$150,000	$150,000
2	Shoring and Bracing	1	LS	$150,000	$150,000
3	Construction Conflicts and Additional Work	1	LS	$250,000	$250,000
4	Mobilization and Demobilization	1	LS	$250,000	$250,000
5	Clearing and Grubbing	1	LS	$100,000	$100,000
6	Demolish Existing Tennis Court Facilities	5,555	LS	$12	$66,660
7	Pipeline Trench Excavation (Assume 4-ft Cover over Pipe)	4,463	LS	$45	$200,835
8	BMP Facility Area Excavation	11,500	LS	$45	$517,500
9	5” Thick AC Pavement Trench Repair	182	LS	$80	$14,560
10	CMP Pipe Underground Detention System	1	LS	$805,000	$805,000
11	48” RCP Class III	56	LS	$575	$32,200
12	24” RCP Class III	1,338	LS	$475	$635,550
13	72” Storm Drain / Diversion Type Manhole Structure	2	LS	$30,000	$60,000

Item No.	Item Description	Quantity	Unit	Unit Cost	Amount
14	Re-Install Tennis Court Facilities Concrete Paving (6" Thickness)	1	LS	$80,000	$80,000
15	Disinfection System (Ultra Violet)	926	LS	$575	$532,450
				Sub Total	$5,344,755
				10% Mobilization, 10% Bond, 20% Contingency	$2,137,900
				Total	$7,482,660*

***** The estimate of costs shown and any resulting conclusions on the project financial, economic feasibility or funding requirements have been prepared from guidance in the project evaluation and implementation from the information available at the time the estimate was prepared. The final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions and other variable factors. Accordingly, the final project costs may vary from the estimate. Project feasibility, benefit/cost analysis, and risk must be reviewed prior to making specific funding decisions and establishment of the project budget.

4 PROJECT CONSIDERATIONS AND RECOMMENDATIONS

This conceptual report provides the City with several alternatives for implementing best management practices for reducing the waste load into the Arroyo Seco watershed. Project considerations for implementation included BMP cost, treatment effectiveness, footprint, applications of reuse water in the case of runoff storage, ability of existing infrastructure to accommodate increased flows in the case of diversion to sanitary sewers, and effects on existing and future park facilities.

Through cost analysis and modeling, it has been determined that green infrastructure low impact development in the Park is effective for the removal of heavy metals from runoff occurring within the park boundaries as well as serving the community in the form of being an aesthetic landscaping option for the park while requiring less modification of park amenities than a larger regional BMP. Bacteria load reduction for the entire watershed draining into the park and through outfalls AS-21 and AS-22 is feasible through dry flow diversion to nearby existing sanitary sewer systems and also requires substantially less modification to park facilities. Both the green infrastructure and dry weather flow diversion options have lower footprints, lower costs, higher effectiveness for their respective treatment capabilities, and minimal impacts on existing park facilities. Low flow diversion is the primary recommended method for compliance with dry weather bacteria TMDL limits. Low flow diversion and LID have the ability to be executed separately or as components to a larger management system for water quality in the Arroyo Seco watershed. Therefore, green infrastructure and dry weather flow diversion are recommended for implementation.

The following next steps, in order of importance and effectiveness, are recommended for implementation of the Arroyo Seco Urban Runoff Projects:

1. Monitor sewer flows to verify design criteria for LFDs during dry weather and ensure that adequate capacity is available in the sewer system to handle non-stormwater runoff diversions.

2. Install low flow diversion as a method for removing bacteria flows from the stormwater system during dry weather.

3. Conduct infiltration rate testing to determine if underdrains are required for green infrastructure and address potential flooding concerns during design.

4. Incorporate low impact development within Hermon Park as a treatment method for removing heavy metals from park runoff. Through modeling, LID has been determined to be an effective BMP and is recommended.

The City is currently developing an Enhance Watershed Management Program (EWMP) and Coordinated Integrated Monitoring Program (CIMP) for the Upper Los Angeles River Watershed. Monitoring activities associated with the Arroyo Seco Urban Runoff Projects should be conducted in accordance to the requirements of the final, approved CIMP.

Wet weather storage with UV disinfection is not considered to be a cost effective method of treatment due to the fact there is no readily applicable method for treatment of heavy metal constituents and release of the flow volume due to site conditions. Additionally, a storage and release system for wet weather flow volumes would require extensive modification to park facilities during which time there would be long term interruptions of usage for members of the community. This alternative is not recommended at this time.

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5 REFERENCES

City of Los Angeles Bureau of Sanitation. (2013). *Arroyo Seco Bacteria Load Reduction Strategry.* Los Angelese.

R-CAN Environmental Inc. (2015). *Micro-Organism Destruction Chart.*

City of Los Angeles LID program. http://www.lastormwater.org/green-la/low-impact-development

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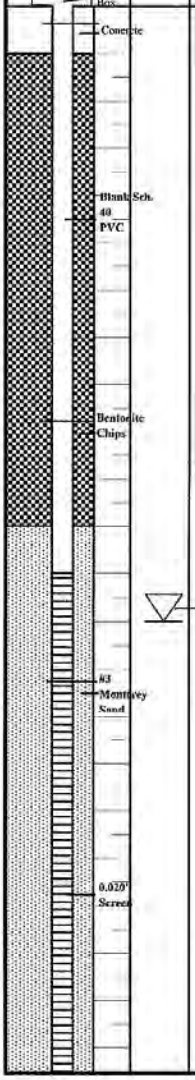
APPENDIX A – GEOTECHNICAL DATA

DELTA Consultants

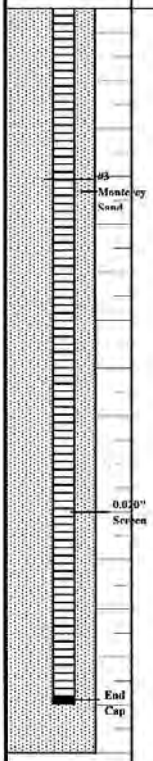
Project No:	C205948	Client:	ConocoPhillips	Well/Boring No:	MW-18
Logged By:	Megan Elovich	Location:	475 South Avenue 60, Los Angeles, CA	Page 1 of 2	
Driller:	JDK Drilling Inc.	Date Drilled	1/27/2010	Location Map	
Drilling Method:	HSA LAR	Borehole Diameter:	10"	See Figure for boring locations	
Sampling Method:	CA Mod SS	Borehole Depth:	38' bgs		
Casing Type:	Sch 40 PVC	Well Diameter:	4"		
Slot Size:	0.02 Slotted Screen	Well Depth:	37' bgs		
Gravel Pack:	#3 Monterey	Casing Stickup:	-		
Elevation		Northing		Easting	



Moisture Content	PID Reading (ppm)	Penetration (blows/ft)	Depth (feet)	Sample Recovery	Sample Interval	Soil Type	LITHOLOGY / DESCRIPTION
							Native Soil
			1				Air Knife to 5 feet below ground surface (bgs)
			2				
			3				
			4				
			5				
			6				
			7				
			8				
			9				
moist	0.0	24	10			SP / SM	GRAVELLY SAND (SP); orangish brown, poorly graded, low strength and toughness, 10% gravel, 90% sand GRAVELLY SILTY SAND (SM); light brown, fine grained, poorly graded, low strength and toughness, slightly saturated, gravel size < 5mm diameter, 10% gravel, 35% silt, 55% sand
			11				
			12				
			13				
			14				
wet	0.0	22	15			CL	SANDY CLAY (CL); light brown, very fine grained, poorly graded, medium strength and toughness, medium plasticity, saturated, 20% sand, 80% clay
			16				
			17				
			18				
			19			SC	CLAYEY SAND (SC); light brown, very fine grained, poorly graded, medium
wet	0.0	26	20			/ CL	strength and toughness, medium plasticity, saturated, 45% sand, 55% clay SANDY CLAY (CL); light brown, very fine grained, poorly graded, medium strength and toughness, high plasticity, saturated, 30% sand, 70% clay
			21				
			22				

DELTA Consultants

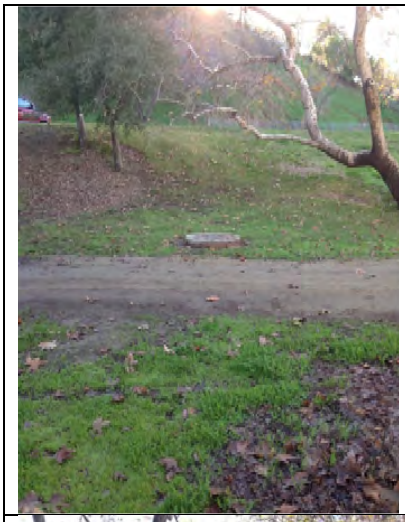
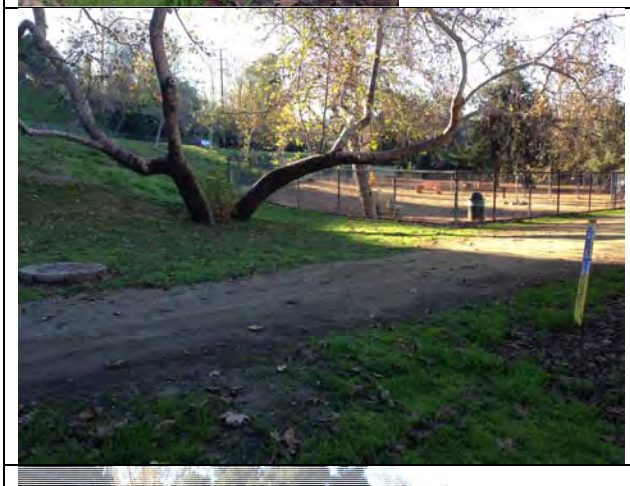
Project No:	C205948	Client:	ConocoPhillips	Well/Boring No:	**MW-18**
Logged By:	Megan Elovich	Location:	475 South Avenue 60, Los Angeles, CA	Page 2 of 2	
Driller:	JDK Drilling Inc.	Date Drilled	1/27/2010	Location Map	
Drilling Method:	HSA LAR	BoreHole Diameter:	10"	See Figure for boring locations	
Sampling Method:	CA Mod SS	BoreHole Depth:	38' bgs		
Casing Type:	Sch 40 PVC	Well Diameter:	4"		
Slot Size:	0.02 Slotted Screen	Well Depth:	37' bgs		
Gravel Pack:	#3 Monterey	Casing Stickup:	-		
Elevation		Northing		Easting	

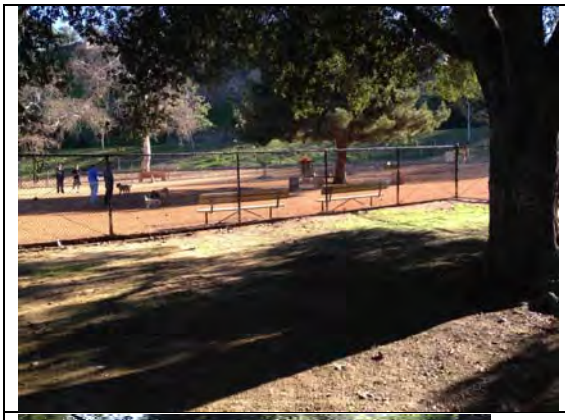
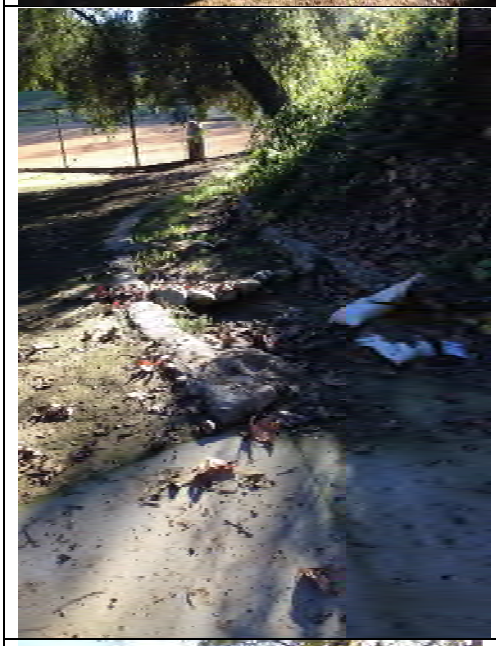
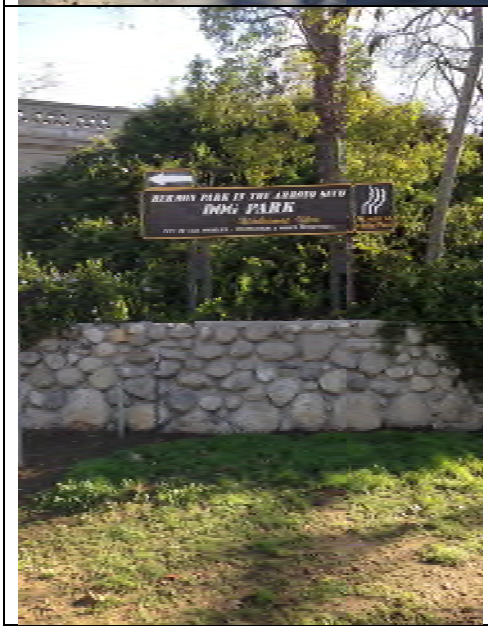


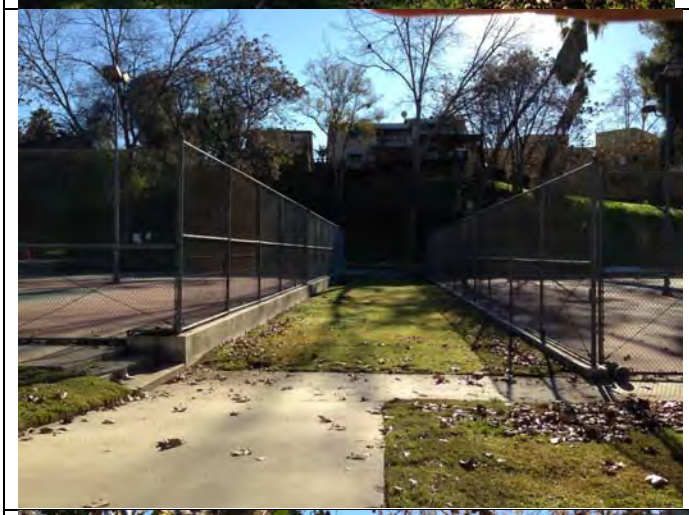
Moisture Content	PID Reading (ppm)	Penetration (blows/ft)	Depth (feet)	Sample Recovery	Sample Interval	Soil Type	LITHOLOGY / DESCRIPTION
			23				
			24				
wet	2.8	30	25			SC	CLAYEY SAND (SC); light brown, very fine grained, poorly graded, low strength and toughness, medium plasticity, trace gravel, <5% gravel, 40% clay, 55% sand
			26				
			27				
			28				
			29				
wet	0.0	50	30			SC	CLAYEY SAND (SC); ligth brown, very fine grained, poorly graded, low strength and toughness, medium plasticity, 50% clay, 50% sand
			31				
			32				
			33				
			34				
wet	0.0	34	35			ML	SANDY CLAYEY SILT (ML); light brown, very fine to fine grained, poorly graded, low strength and toughness, slight plasticity, 10% sand, 30% clay 60% silt
			36				
			37				
			38				Boring terminated at approximately 38 feet bgs. Groundwater encountered at approximately 13 feet bgs.
			39				
			40				
			41				
			42				
			43				
			44				

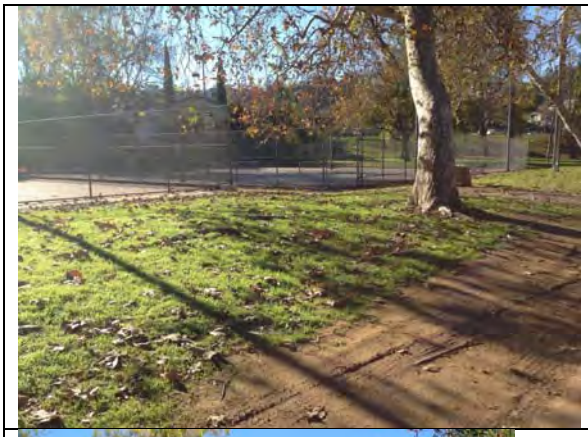
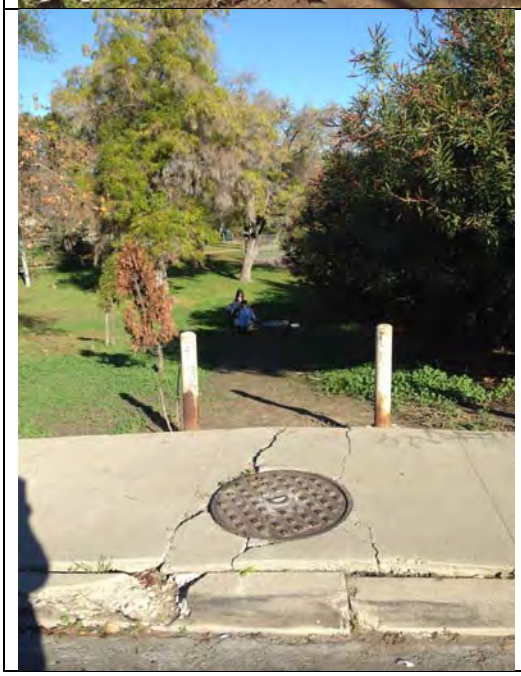

PASADENA FREEWAY 110
CREEK
PARKING LOT
SIDEWALK
MW-20
MW-19
MW-17
MW-16
MW-14
MW-13
MW-18
CLEAR AREA
RESIDENTIAL
HERMON PARK
TENNIS COURTS
LIGHT INDUSTRIAL
MONTEREY ROAD
RESIDENTIAL
LIGHT INDUSTRIAL
N
W
E
S
LEGEND
MW-18 MONITORING WELL LOCATION
MW-17 UPPER SCREENED MONITORING WELL
MW-7 LOWER SCREENED MONITORING WELL
VW-3 VAPOR EXTRACTION WELL
MW-6A MW-6B DUAL COMPLETED WELL
MW-2 ABANDONED WELL
DELTA CONSULTANTS
CONOCOPHILLIPS
76 SERVICE STATION NO. 5948
LOS ANGELES, CALIFORNIA
FIGURE 2
SITE MAP
475 SOUTH AVENUE 60
LOS ANGELES, CALIFORNIA
PROJECT NUMBER C270594804
APPROVED BY
CHECKED BY
DRAWN BY JCC 2-3-2010

APPENDIX B – SITE PHOTOGRAPHs

	Looking southeast along AS-22 storm drain alignment, manhole is other utility.
	Dog park, manhole is other utility
	Looking downstream between dog park and Arroyo Seco. Note, limited space along north east side of Avenue 60.

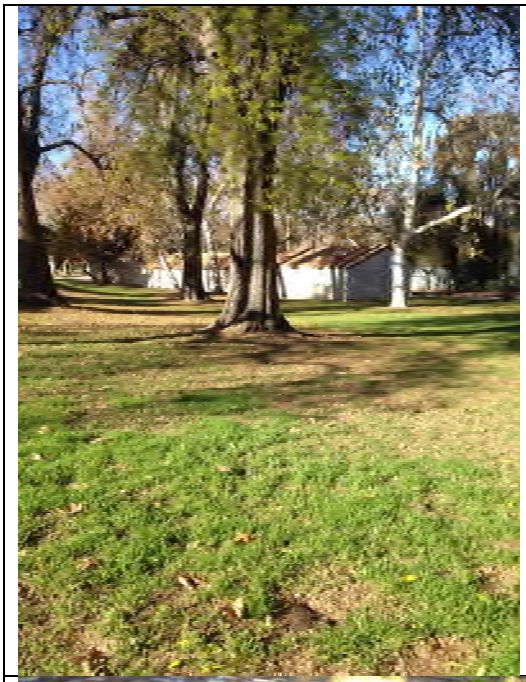
	Hermon Dog Park showing existing uses and trees.
	Opportunity for site improvements. Could be replaced with new bioswale.
	Welcome sign to Hermon Dog Park

	Proposed retention tank siting, existing storage area.
	Opportunities for green infrastructure improvements between tennis courts.
	Relatively large open area without trees, opportunity for BMP siting.

	Proposed BMP siting under existing tennis courts.
	Manhole for AS-21, storm drain is aligned under pathway to the Arroyo Seco channel.

	Existing manhole for AS-21storm drain.
	Existing manhole for AS-22, pending confirmation.

	AS-22 outfall.
	AS-21 outfall.

	Potential site improvements near existing equipment storage area.
	AS-21 storm drain manhole, showing exposed brick construction, poor condition.
	Sinkhole near existing AS-21 storm drain manhole, safety hazard.

	Potential green infrastructure opportunities using existing walkways.
	Flooded area within park, rain event previous day.
	Tennis courts near entrance of park, facing east.

APPENDIX C – Los Angeles County Drought-Tolerant Plant List

Los Angeles County Drought-tolerant Plant List

This Plant List contains species approved for use in areas required to contain drought-tolerant landscaping as required by Section 22.52.2230 of the Los Angeles County Code. There may be drought-tolerant or native plant species that are not contained on this list, but may still be appropriate for use in certain projects, including cultivars or sub-species of plants listed. Additional approval can be obtained to authorize the use of unlisted species.

Scientific Name	Common Name	CA native	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Plant Type	Flowers	Full Sun	Part Shade	Full Shade	Sunset Zones	Sunset Page
Abelia x grandiflora	Glossy Abelia							√	√	shrub	pink		√			
Abies bracteata	Santa Lucia Fir	√			√		√	√	√						18-21	163
Abies concolor	White Fir	√					√			tree	none	√	√	√		
Abronia maritima	Red Sand Verbena	√	√	√						perennial herb	red	√				
Abronia umbellata ssp. umbellata	Pink Sand Verbena	√	√	√						perennial herb	pink	√				
Abronia vilosa	Desert Sand Verbena	√						√	√	annual	purple	√				
Abutilon palmeri	Indian Mallow	√			√	√	√	√	√	shrub	orange	√				
Acacia constricta	White Thorn Acacia						√	√	√	shrub	yellow	√				
Acacia farnesiana	Sweet Acacia						√	√	√	fern	yellow	√	√			
Acacia greggii	Catclaw Acacia	√						√	√	shrub	yellow	√				
Acacia redolens	Desert Carpet		√	√	√		√	√	√	shrub	yellow	√			18-24	
Acacia stenophylla	Shoestring Acacia						√	√	√		cream	√	√			
Acamptopappus sphaerocephalus var. hirtellus	Rayless Goldenhead	√					√	√	√	shrub	yellow	√				
Acamptopappus sphaerocephalus var. sphaerocephalus	Goldenhead	√					√		√	shrub	yellow	√				
Acer macrophyllum	Big-leaf Maple	√					√			tree	pink	√	√			
Acer negundo var. californicum	California Box Elder	√					√			tree	white	√	√			
Achillea ageratifolia	Greek Yarrow			√	√		√	√	√							170
Achillea clavennae	Silvery Yarrow			√	√		√	√	√							170
Achillea filipendulina	Fernleaf Yarrow			√	√		√	√	√							170
Achillea millefolium	Common Yarrow	√	√	√	√	√	√	√	√	perennial herb	white	√				
Achillea ptarmica	Yarrow			√	√		√	√	√							170
Achillea tomentosa	Woolly Yarrow			√	√		√	√	√							170
Achillea x kellereri	Yarrow			√	√		√	√	√							170
Achnatherum coronatum	Giant Stipa	√				√	√	√		perennial						
Achnatherum hymenoides	Rice Grass	√					√	√	√	perennial grass	grass spikelet	√				
Achnatherum speciosum	Desert Needlegrass	√					√	√	√	perennial grass	grass spikelet	√				
Achnatherum speciosum	Desert Needlegrass	√					√	√	√							
Adenostoma		√														
Adolphia californica	California Adolphia	√			√	√	√			shrub	white	√				
Aegopodum podagraria	Bishop's Weed			√	√		√	√	√							173
Aeonium arboreum	Black Rose			√	√		√								20-24	173
Aeonium decorum	Triple Crest			√	√		√								20-24	173
Aeonium haworthii	Pinwheel			√	√		√								20-24	173
Aeonium pseudotabulaeforme	Dinner Plate Cactus			√	√		√								20-24	173
Aeonium simsii	Aeonium			√	√		√								20-24	173
Aeonium urbicum	Saucer Plant			√	√		√								20-24	173
Aeonium x floribundum	Aeonium Hybrid			√	√		√								20-24	173
Aesculus californica	California Buckeye	√			√		√	√	√							
Aethionema schistosum	Stonecress				√		√	√	√						18-21	173
Aethionema x warleyense	Stonecress Hybrid				√		√	√	√						18-21	173
Agapanthus africanus	Lily of the Nile			√	√		√	√	√							174
Agapanthus orientalis	Lily of the Nile			√	√		√	√	√							174
Agastache aurantiaca	Orange Hummingbird Mint			√	√		√	√	√							174
Agastache barberi	Tutti Frutti Flower			√	√		√	√	√							174
Agastache breviflora	Giant Hyssop			√	√		√	√	√							174
Agastache cana	Texas Hummingbird Mint			√	√		√	√	√							174
Agastache foeniculum	Anise Hyssop			√	√		√	√	√							174
Agastache mexicana	Giant Mexican Lemon Hyssop			√	√		√	√	√							174
Agastache rugosa	Korean Hummingbird Mint			√	√		√	√	√							174
Agastache rupestris	Licorice Mint			√	√		√	√	√							174
Agave americana	Century Plant			√	√		√	√	√							175
Agave attenuata	Agave			√	√		√								20-24	175
Agave deserti	Desert Agave						√	√		shrub	yellow	√				
Agave filifera	Agave			√	√		√	√								175
Agave parryi	Agave			√	√		√	√								175
Agave shawii	Shaw's Agave			√	√					shrub	yellow	√				
Agave victoriae-reginae	Agave			√	√		√								21-24	175
Agave vilmoriniana	Octopus Agave			√	√		√	√	√							175
Agonis flexuosa	Peppermint Tree				√					tree						
Agoseris grandiflora	Giant Mountain Dandelion	√				√	√	√		perennial herb	yellow	√	√			
Agoseris retrorsa	Spearleaf Mountain Dandelion	√					√	√		perennial herb	yellow	√	√			
Agrostemma githago	Corn Cockle			√	√		√	√	√							176
Albizia distachya	Plume Albizia			√	√										22-24	177
Albizia julibrissin	Silk Tree				√					tree						
Allium fimbriatum var. mohavense	Mojave Fringed Onion	√					√	√	√							

Allium haematochiton	Red-skinned Onion	√			√	√	√	√		bulb	pink	√	√	√		
Allium praecox	Early Onion	√	√	√	√	√	√	√		bulb	pink		√	√		
Almond	Almond				√		√	√	√						19-21	179
Aloe arborescens	Tree Aloe			√	√		√	√								180
Aloe aristata	Aloe			√	√		√	√								180
Aloe bainesii	Aloe			√	√		√	√								180
Aloe barbadensis	Aloe			√	√		√	√								180
Aloe brevifolia	Aloe			√	√		√	√								180
Aloe ciliaris	Aloe			√	√		√	√								180
Aloe distans	Jeweled Aloe			√	√		√	√								180
Aloe ferox	Bitter Aloe			√	√		√	√								180
Aloe marlothii	Aloe			√	√		√	√								180
Aloe nobilis	Aloe			√	√		√	√								180
Aloe plicatilis	Aloe			√	√		√	√								180
Aloe saponaria	Soap Aloe			√	√		√	√								180
Aloe striata	Coral Aloe			√	√		√	√								180
Aloe striatula	Aloe			√	√		√	√								180
Aloe tenuior	Aloe			√	√		√	√								180
Aloe variegata	Partridge-breast Aloe			√	√		√	√								180
Aloe vera	Medicinal Aloe			√	√		√	√								180
Aloe x spinosissima	Aloe Hybrid			√	√		√	√								180
Alyogyne huegelii	Blue Hibiscus			√	√		√								20-24	182
Alyssum montanum	Mountain Madwort			√	√		√	√	√							182
Alyssum wulfenianum	Alyssum			√	√		√	√	√							183
Amaryllus belladonna	Belladonna Lily			√	√		√	√	√							183
Ambrosia chamissonis	Silver Beach-bur	√	√	√						perennial herb	inconspicuous	√				
Ambrosia dumosa	Burro	√							√	perennial herb	inconspicuous	√				
Amelanchier utahensis	Utah Service-Berry	√					√	√		shrub						
Amorpha californica var. californica	California False-indigo	√			√	√	√	√		shrub	purple		√	√		
Amorpha fruticosa	Western False-indigo	√			√	√	√	√	√	shrub	purple	√	√	√		
Amsinckia tessellata	Fiddleneck	√					√	√	√							
Anacyclus depressus	Mount Atlas Daisy			√	√		√	√	√							186
Anaphalis margaritacea	Pearly Everlasting	√					√	√	√							
Andropogon glomeratus var. scabriglumis	Southwestern Bushy Bluestem	√								perennial						
							√	√								
Anisacanthus quadrifidus wrightii	Desert Honeysuckle				√		√	√	√						18-23	186
Anisacanthus thurberi	Chuparosa				√		√	√	√						18-23	187
Anisodontea x hypomandarum	Cape Mallow			√	√		√	√	√							187
Antirrhinum coulterianum	Coulter Snapdragon	√					√	√		perennial						
Antirrhinum kelloggii	Kellogg's Snapdragon	√					√	√		perennial						
Antirrhinum multiflorum	Multiflowered Snapdragon	√			√	√	√	√		perennial herb	pink	√				
Antirrhinum nuttallianum	Nuttall's Snapdragon	√					√	√		perenial						
Aquilegia formosa	Red Columbine	√			√	√	√	√		perennial herb	red		√	√		
Arabis caucasica	Wall Rockcress			√	√		√	√	√							196
Arabis ferdinandi-coburgi	Ferdinand's Rockcress			√	√		√	√	√							196
Arabis procurrens	Downy Rockcress			√	√		√	√	√							196
Arabis pulchra var. pulchra	Beautiful Rock-cress	√					√	√	√	perennial herb	purple	√				
Arabis pulchra var.gracilis	Hairless Rock-cress	√						√	√	perennial herb	purple	√				
Arabis sparsiflora var. arcuata	Elegant Rock-cress	√					√	√		perennial herb	purple	√				
Arabis sparsiflora var. californica	California Rock-cress	√			√	√	√	√		perennial herb	purple	√				
Arabis x sturii	Rockcress Hybrid			√	√		√	√	√							196
Arbutus marina	Hybrid Strawberry Tree		√	√			√	√	√	tree	white	√	√			18-24
Arbutus Unedo	Strawberry Tree									shrub	ish-red strawberry-like fruit					
Arctostaphylos catalinae	Catalina Manzanita	√	√	√	√	√	√	√		shrub	white	√	√			
Arctostaphylos densiflora	Vine Hill Manzanita	√			√		√	√							18-21	198
Arctostaphylos edmundsii	Little Sur Manzanita	√		√	√		√	√								198
Arctostaphylos fanciscana	Manzanita			√	√		√	√								198
Arctostaphylos gabrielensis	San Gabriel Manzanita	√			√	√	√	√		shrub	white	√				
Arctostaphylos glandulosa	Eastwood's Manzanita	√					√	√		tree/shrub						
Arctostaphylos glandulosa ssp mollis	Transverse Range Manzanita	√					√	√		shrub	white	√	√			
Arctostaphylos glandulosa ssp. glandulosa	Eastwood Manzanita	√			√	√	√	√		shrub	white	√	√			
Arctostaphylos glandulosa ssp. glaucomollis	San Gabriel Mtns. Manzanita	√					√	√		shrub	white	√	√			
Arctostaphylos glauca	Bigberry Manzanita	√			√	√	√	√	√	shrub/tree	white	√	√			
Arctostaphylos hookeri	Monterey Manzanita	√		√	√		√	√	√							198
Arctostaphylos insularis	Island Manzanita	√		√	√	√				shrub	white	√				
Arctostaphylos manzanita	Common Manzanita	√		√	√		√	√	√							198
Arctostaphylos nummularia	Fort Bragg Manzanita	√		√	√		√	√	√							198
Arctostaphylos pajaroensis	Pajaro Manzanita	√		√	√		√	√	√							198
Arctostaphylos parryana ssp. tumescens	Parry Manzanita	√					√	√		shrub	white	√	√			

Arctostaphylos patula	Greenleaf Manzanita	√					√			shrub	white	√				
Arctostaphylos pumila	Dune Manzanita	√		√	√		√	√	√							198
Arctostaphylos pungens	Mexican Manzanita	√			√	√	√	√	√	shrub	white	√	√			
Arctostaphylos uva-ursi	Bearberry	√		√	√		√	√	√							199
Arctotis acaulis	African Daisy			√	√		√	√	√							199
Arctotis breviscapa	African Daisy			√	√		√	√	√							199
Arctotis venusta	African Daisy			√	√		√	√	√							199
Arenaria montana	Sandwort			√	√		√	√	√							200
Argemone corymbosa	Mojave Prickly-poppy	√			√	√	√	√	√	perennial herb	white	√				
Argemone mexicana	Mexican Poppy			√	√		√	√	√							200
Argemone munita	Prickly-poppy	√					√			perennial herb	white	√				
Argemone polyanthemos	Pricklepoppy			√	√		√	√	√							200
Aristea ecklonii	Blue Flies			√	√		√	√	√							200
Aristida purpurea var. parishii	Parish Three-awn	√		√	√	√	√	√	√	perennial grass	grass spikelet	√	√			
Aristida ternipes var. hamulosa	Hook Three-awn	√		√	√	√	√	√	√	perennial grass	grass spikelet	√	√			
Armeria alliacea	Thrift			√	√		√	√	√							201
Armeria caespitosa	Thrift			√	√		√	√	√							201
Armeria girardii	Thrift			√	√		√	√	√							201
Armeria maritima	Thrift	√		√	√		√	√	√							201
Artemesia douglasiana	Mugwort	√		√	√		√	√	√	shrub						
Artemisia abrotanum	Southernwood			√	√		√	√	√							201
Artemisia absinthium	Common Wormwood			√	√		√	√	√							201
Artemisia arborescens	Tree Wormwood			√	√		√	√	√							202
Artemisia californica	California Sagebrush	√	√	√	√	√	√	√		shrub	inconspicuous	√				
Artemisia cana	Silver Sagebrush			√	√		√	√	√							202
Artemisia caucasica	Silver Spreader			√	√		√	√	√							202
Artemisia dracunculus	Tarragon	√	√	√	√	√	√	√	√	shrub	inconspicuous	√				
Artemisia filifolia	Sand Sage						√	√	√	shrub	yellow	√	√			
Artemisia frigida	Fringed Wormwood				√		√	√	√					18-21		202
Artemisia lactiflora	White Mugwort				√		√	√	√					18-21		202
Artemisia ludoviciana ssp. incompta	Mountain Mugwort	√					√			shrub	inconspicuous	√				
Artemisia ludoviciana ssp. ludoviciana	Silver Wormwood	√		√	√	√	√	√	√	shrub	inconspicuous	√				
Artemisia pontica	Roman Wormwood			√	√		√	√	√							202
Artemisia pycnocephala	Beach Sagewort	√		√	√	√				shrub	inconspicuous	√				
Artemisia schmidtiana	Angel's Hair			√	√		√	√	√							202
Artemisia stellerana	Beach Wormwood			√	√		√	√	√							202
Artemisia tridentata	Big Sagebrush	√					√	√	√	shrub	inconspicuous	√				
Artemisia x 'Powis Castle'	Powis Castle Wormwood							√	√	shrub	yellow	√				
Asclepias californica ssp. greenei	Green's California Milkweed	√			√	√	√	√		perennial herb	white/pink	√	√			
Asclepias curvassavica	Blood Flower			√	√		√	√	√							204
Asclepias eriocarpa	Indian Milkweed	√			√	√	√	√		perennial herb	white/pink	√	√			
Asclepias erosa	Desert Milkweed	√					√	√	√	perennial herb	white	√				
Asclepias fascicularis	Narrow-leaf Milkweed	√	√	√	√	√	√	√		perennial herb	white/pink	√	√			
Asclepias subulata	Rush Milkweed	√							√	perennial herb	white	√				
Asclepias tuberosa	Butterfly Weed			√	√		√	√	√							204
Astartea fascicularis	Winter Pink			√	√		√	√	√							206
Astelia nervosa chathamica	Silver Spear			√	√		√	√						19-24		207
Aster greatae	Greatae's Aster	√					√	√	√							
Asteriscus maritimus	Double Gold Coin			√	√		√	√	√							208
Asteriscus sericeus	Canary Island Daisy			√	√		√	√						19-24		208
Astragalus	Loco Weed	√					√	√	√							
Astragalus preussi var. laxiflorus	Lancaster Milk-Vetch	√					√	√	√							
Astragalus trichopodus var. lonchus	Santa Barbara Milk-vetch	√	√	√	√	√				perennial herb	yellow	√	√			
Astragalus trichopodus var. phoxus	Santa Barbara Milk-vetch	√	√	√	√	√	√	√	√	perennial herb	yellow	√	√			
Astragalus trichopodus var. trichopodus	Santa Barbara Milk-vetch	√	√	√	√					perennial herb	yellow	√	√			
Atriplex argentea	Silver Saltweed	√					√	√		shrub						
Atriplex barklayana	Evergreen Saltbush			√	√		√	√	√							209
Atriplex canescens	Fourwing Saltbush	√					√	√		shrub						
Atriplex canescens ssp. canescens	Four-wing Saltbush	√		√	√	√	√	√	√	shrub	inconspicuous	√				
Atriplex confertifolia	Shadscale	√					√	√		shrub						
Atriplex hymenelytra	Desert Holly	√							√	shrub	inconspicuous	√				
Atriplex lentiformis	Big Saltbush	√					√	√		shrub						
Atriplex lentiformis ssp. lentiformis	Brewer's Saltbush	√		√	√	√				shrub	inconspicuous	√				
Atriplex lentiformis ssp. torreyi	Big Saltbush	√							√	shrub	inconspicuous	√				
Atriplex leucophylla	Beach Saltbush	√	√	√						perennial herb	inconspicuous	√				
Atriplex nummularia	Evergreen Saltbush			√	√		√	√	√							209
Atriplex parryi	Parry's Saltbush	√					√	√		shrub						
Atriplex phyllostegia	Leafcover Saltweed	√					√	√		shrub						
Atriplex polycarpa	Allscale	√							√	shrub	inconspicuous	√				
Atriplex serenana	Tractscale	√					√	√		shrub						

Atriplex spinifera	Mojave Saltbush	√							√	shrub	inconspicuous	√					
Aurinia saxatilis	Basket of Gold			√	√		√	√	√								210
Baccharis emoryi	Emory's Baccharis	√					√	√		shrub							
Baccharis malibuensis	Malibu Baccharis	√		√	√					shrub	inconspicuous	√	√				
Baccharis pilularis	Coyote Brush	√	√	√	√	√	√	√	√	shrub	inconspicuous	√	√				
Baccharis plummerae ssp. plummerae	Plummer's Baccharis	√			√	√				shrub	inconspicuous	√	√				
Baccharis sarothroides	Desert Broom			√	√		√	√	√								212
Baccharis x 'Starn Thompson'	Trailing Desert Broom						√	√	√	ground cover	yellow	√					
Bacciiaris pilularis	Dwarf coyote bush	√								shrub							
Baileya multiradiata	Wild Marigold				√				√	perennial herb	yellow	√					
Baileya pleniradiata	Woolly Marigold	√			√	√	√	√	√	perennial herb	yellow	√					
Ballota pseudodictamnus	False Dittany			√	√		√	√	√								213
Banskia ericifolia	Heath Banksia			√	√		√	√	√								217
Banskia integrifolia	Coast Banksia			√	√		√	√	√								217
Banskia speciosa	Showy Banksia			√	√		√	√	√								217
Baptista alba	While False Indigo			√	√		√	√	√								218
Baptista australis	Blue False Indigo			√	√		√	√	√								218
Bebbia juncea var. aspera	Sweetbush	√							√	shrub	yellow	√					
Berberis [Mahonia] aquifolium var. aquifolium	Oregon Grape	√					√	√		shrub	yellow		√	√			
Berberis [Mahonia] aquifolium var. dictyota	Jepson's Oregon Grape	√					√	√		shrub	yellow		√	√			
Berberis [Mahonia] fremontii	Fremont Barberry	√							√	shrub	yellow	√					
Berberis [Mahonia] nevinii	Nevin's Barberry	√					√	√		shrub	yellow	√	√				
Berberis [Mahonia] pinnata ssp. pinnata	California Barberry	√					√			shrub	yellow		√	√			
Berberis fremontii	Fremont's Barberry	√					√	√		shrub							
Berberis nevinii [Mahonia n.]	Nevin's barberry	√								shrub							
Berberis pinnata	California Barberry	√					√	√		shrub							
Berberis thunbergii	Japanes barberry		√	√	√		√	√	√	shrub		√	√				18-24
Berlandiera lyrata	Chocolate Flower				√		√	√	√						18-23		222
Bloomeria crocea	Golden Stars	√	√	√	√	√	√	√		bulb	yellow	√	√				
Borago officinalis	Borage			√	√		√	√	√								228
Bothriochloa barbinodis	Beard Grass	√	√	√	√	√	√	√	√	perennial grass	grass spikelet	√	√				
Bougainvillea	Bougainvillea				√					grass							
Bouteloua curtipendula	Side-oats Grama	√			√		√	√	√						18-21		230
Bouteloua gracilis	Blue Grama	√			√		√	√	√						18-21		230
Bouvardia glaberrima	Scarlet Bouvardia			√	√		√	√	√								230
Bouvardia ternifolia	Firecracker Bush			√	√		√	√	√								230
Brachychiton acerifolius	Flame Tree			√	√		√	√	√								230
Brachychiton discolor	Queensland Lacebark			√	√		√	√	√								230
Brachychiton populneus	Bottle Tree			√	√		√	√	√								230
Brachychiton rupestris	Queensland Bottle Tree			√	√										21,23,24		230
Brahea armata	Mexican Blue Palm			√	√		√	√							19-24		231
Brahea brandegeei	San Jose Hesper Palm			√	√		√	√							19, 21-24		231
Brahea edulis	Guadalupe Palm			√	√		√	√	√								231
Brahea elegans	Franceschi Palm			√	√		√	√							19-24		231
Brickellia californica	California Brickellbush	√	√	√	√	√	√	√		shrub	white	√	√				
Brickellia nevinii	Nevin's Brickellbush	√			√	√	√	√		shrub	white	√					
Brodiaea coronaria	Harvest Brodiaea			√	√		√	√	√								232
Brodiaea elegans	Harvest Brodiaea			√	√		√	√	√								232
Brodiaea filifolia	Thread-leaved Brodiaea	√			√	√	√	√		bulb	purple	√					
Brodiaea jolonensis	Jolon Brodiaea	√	√	√	√	√	√	√		bulb	purple	√					
Brodiaea kinkiensis	San Clemente Island Brodiaea	√			√	√				bulb	purple	√					
Brodiaea terrestris	Dwarf Brodiaea	√			√	√	√	√		bulb	purple	√					
Bromus carinatus	California Brome	√	√	√	√	√	√	√		perennial grass	grass spikelet	√	√	√			
Buddleia davidii	Butterfly Bush							√	√	shrub	purple	√					
Bulbine frutescens	Yellow Bulbine						√	√	√	succulent		√	√				
Caesalpinia cacalaco	Cascalote			√	√										21-24		237
Caesalpinia gilliesii	Yellow Bird of Paradise			√	√		√	√	√								237
Caesalpinia mexicana	Mexican Bird of Paradise			√	√		√	√	√								237
Caesalpinia platyloba	Palo Colorado			√	√										21-24		237
Caesalpinia pulcherrima	Red Bird of Paradise				√		√	√	√						18-23		237
Calamintha grandiflora	Showy Calamint			√	√		√	√	√								238
Calamintha nepeta	Lesser Calamint			√	√		√	√	√								238
Calendula officinalis	Calendula			√	√		√	√	√								239
Calliandra californica	Baja Fairy Duster	√		√	√		√	√	√								239
Calliandra eriophylla	Fairy Duster	√		√	√		√	√	√								239
Calliandra tweedii	Brazilian Flame Bush			√	√		√	√	√								239
Callistemon	Bottlebrush				√					shrub							
Callistemon citrus	Lemon Bottlebrush							√	√	shrub	red	√					

Calocedrus decurrens	Incense Cedar	√			√		√	√	√	tree	none	√	√			
Calochortus albus	White Globe Lily	√	√		√	√	√	√		bulb	white/pink		√	√		
Calochortus catalinae	Catalina Mariposa Lily	√	√	√	√	√	√			bulb	white	√				
Calochortus clavatus var. gracilis	Slender Mariposa Lily	√					√			bulb	yellow	√	√			
Calochortus clavatus var. pallidus	Club-haired Mariposa Lily	√			√	√		√		bulb	yellow	√	√			
Calochortus palmeri var. palmeri	Palmer's Mariposa	√					√	√	√							
Calochortus plummerae	Plummer's Mariposa Lily	√			√	√	√			bulb	purple/yellow	√	√			
Calochortus splendens	Splendid Mariposa Lily	√			√	√	√	√		bulb	purple	√	√			
Calochortus striatus	Alkali Mariposa	√					√	√	√							
Calochortus venustus	Butterfly Mariposa Lily	√			√	√	√	√		bulb	variable	√				
Calochortus weedii	Weed's Mariposa	√								perennial herb						
Calycanthus occidentalis	Spice Bush	√			√	√	√	√		shrub	red	√	√			
Calylophus drummondianus	Angel's Trumpet			√	√		√	√	√							243
Calylophus hartwegii	Hartweg's Sundrops			√	√		√	√	√							243
Calylophus serrulatus	Yellow Sundrops			√	√		√	√	√							243
Calystegia macrostegia ssp. arida	So. California Morning Glory	√					√	√		vine	white/pink	√	√	√		
Calystegia macrostegia ssp. cyclostegia	Coast Morning Glory	√	√	√	√	√				vine	white/pink	√	√	√		
Calystegia macrostegia ssp. intermedia	South Coast Morning Glory	√	√	√	√	√	√	√		vine	white/pink	√	√	√		
Calystegia peirsonii	Peirson's Morning-Glory	√				√	√	√		vine	white	√	√			
Calytrix alpestris	Snow Myrtle			√	√		√	√	√							243
Calytrix tetragona	Fringe Myrtle			√	√		√	√	√							243
Camissonia boothii	Bottlewasher	√					√	√	√							
Camissonia californica [Eulobus c., Oenothera leptocarpa]	California evening primrose	√								annual herb						
Camissonia campestris	Mojave Sun Cups	√					√	√	√							
Camissonia cheiranthifolia ssp. suffruticosa	Beach Evening-Primrose	√		√	√	√				perennial herb	yellow	√				
Camissonia claviformis	Brown-eyed Primrose	√					√	√	√							
Camissonia palmeri	Sun Cups	√					√	√	√							
Campsis radicans	Trumpet Vine						√	√	√	vine	orange	√				
Capparis spinosa	Caper			√	√		√	√	√							250
Carex barberae	Santa Barbara Sedge			√	√		√	√	√							251
Carex buchananii	Leather Leaf Sedge			√	√		√	√	√							251
Carex comans	New Zealand Hair Sedge			√	√		√	√	√							251
Carex elata 'aurea'	Bowles Golden		√	√	√		√	√				√	√			18-24
Carex flacca	Blue Sedge			√	√		√	√	√							251
Carex flagellifera	Weeping Brown Sedge			√	√		√	√	√							251
Carex pansa (praegacillis)		√														
Carex spissa		√														
Carex testacea	Orange Sedge			√	√		√	√	√							251
Carex tumilicola		√														
Carissa macrocarpus	Natal Plum				√					shrub						
carnegiea gigantea	Saguaro				√		√								18-21	252
Carpenteria californica	Bush Anemone	√			√	√	√	√		shrub	white	√	√	√		
Carthamus tinctorius	Safflower			√	√		√	√	√							253
Caryopteris incana	Common Bluebeard			√	√		√	√	√							253
Caryopteris odorata	Himalayan Bluebeard			√	√		√	√	√							253
Caryopteris x clandonensis	Blue Mist			√	√		√	√	√							253
Cassia artemisiodides	Feathery cassia		√							shrub	yellow					
Cassia leptophylla	Gold Medallion Tree			√	√		√								20-24	254
Castilleja chromosa	Indian Paintbrush	√					√	√	√							
Castilleja exserta	Owl's Clover	√					√	√	√							
Catananche caerulea	Cupid's Dart			√	√		√	√	√							255
Catharanthus roseus	Madagascar Periwinkle			√	√		√	√	√							255
Ceanothus arboreus	Catalina Ceanothus	√	√	√	√	√				shrub/tree	blue	√				
Ceanothus crassifolius	Hoary Leaf Ceanothus	√					√	√		shrub						
Ceanothus crassifolius var. planus	Hoary-leaf Ceanothus	√			√	√	√	√		shrub/tree	white	√				
Ceanothus cuneatus	Wedgeleaf Ceanothus	√					√	√		shrub						
Ceanothus cuneatus var. cuneatus	Buck Brush	√			√	√	√	√		shrub	blue/white	√				
Ceanothus greggii	Cup-leaf Ceanothus	√					√	√		shrub	white	√				
Ceanothus integerrimus	Deerbrush	√					√	√		shrub	blue/white	√	√			
Ceanothus leucodermis	Chaparral Whitethorn	√			√	√	√	√		shrub	blue	√	√			
Ceanothus megacarpus	Big-pod Ceanothus	√			√	√				shrub	white	√				
Ceanothus oliganthus	Hairy Ceanothus	√			√	√	√	√		shrub/tree	blue	√				
Ceanothus spinosus	Greenbark Ceanothus	√			√	√	√	√		shrub	blue	√	√			
Ceanothus tomentosus var. olivaceus	Southern Woolly-leaf Ceanothus	√			√	√	√	√		shrub/tree	blue	√				
Cedrus atlantica	Atlas Cedar			√	√		√	√	√							256
Cedrus brevifolia	Cyprus			√	√		√	√	√							258
Cedrus deodara	Deodar Cedar			√	√		√	√	√							258
Cedrus libani	Cedar of Lebanon			√	√		√	√	√							259

Celtis australis	European Hackberry						√	√	√						18-20	260
Celtis occidentalis	Common Hackberry			√	√		√	√	√							260
Celtis pallida	Desert Hackberry						√	√	√	shrub	yellow	√				
Celtis reticulata	Western Hackberry			√	√		√	√	√							260
Celtis sinensis	Chinese Hackberry						√	√	√						18-20	260
Centaurea americana	Basket Flower			√	√		√	√	√							261
Centaurea cineraria	Dusty Miller			√	√		√	√	√							261
Centaurea cyanus	Cornflower			√	√		√	√	√							261
Centaurea gymnocarpa	Dusty Miller			√	√		√	√	√							261
Centaurea hypoleuca	Cornflower			√	√		√	√	√							261
Centaurea macrocephala	Bighead Knapweed			√	√		√	√	√							261
Centaurea rothrockii	Rothrock's Knapweed			√	√		√	√	√							261
Ceonothus leucodermis	Chaparral	√					√	√	√							
Cephalocereus senilis	Old Man Cactus			√	√		√	√	√							261
Ceratoides lanata	Winterfat							√	√	shrub	white	√				
Ceratonia siliqua	St. John's Beard			√	√		√	√	√							262
Cercidium 'Desert Museum'	Hybrid Palo Verde						√	√	√		yellow	√	√			
Cercidium floridum	Blue Palo Verde	√					√	√	√						18-20	263
Cercidium microphyllum	Littleleaf Palo Verde	√					√	√	√						18-20	263
Cercidium praecox	Palo Brea						√	√	√						18-20	263
Cercis occidentalis	Western Redbud	√			√		√	√		shrub/tree	pink	√	√			
Cercocarpus betuloides	Mountain-Mahogany	√					√	√		shrub						
Cercocarpus betuloides var. betuloides	Mountain Mahogany	√	√		√	√	√	√		shrub/tree	inconspicuous	√				
Cercocarpus intricatus	Little Leaf Mountain Mahogany			√	√		√	√	√							263
Cercocarpus ledifolius	Desert Mountain Mahogany	√					√	√		shrub/tree	inconspicuous	√				
Cercocarpus montanus	Mountain Mohogany							√	√	shrub	white	√				
Chamaebatiaria millefolium	Fernbush				√		√	√	√						18-21	265
Chamaemelum nobile	Chamomile			√	√		√	√	√							265
Chamaerops humilis	Mediterranean Fan Palm						√	√	√	palm	cream	√	√			
Chamelaucium uncinatum	Geraldton Waxflower			√	√		√	√	√							266
Chamomilla suaveolens	Pineapple Weed	√					√	√	√							
Chasmanthe aethiopica	Cobra Lily			√	√		√	√	√							266
Chilopsis linearis ssp. arcuata	Desert Willow	√							√	shrub/tree	pink/white	√				
Chilopsis linearis ssp. Linearis	Desert Willow	√					√	√	√							
Chimonanthus praecox	Wintersweet				√		√	√	√						18-21	269
Chitalpa X tashkentensis	Chitalpa						√	√	√		pink	√				
Chlorogalum pomeridianum var. pomeridianum	Wavyleaf Soap Plant	√			√	√	√	√		bulb	white	√				
Choisya ternata	Mexican Orange			√	√		√	√	√							271
Chorisia insignis	White Floss Silk Tree			√	√		√									271
Chorizanthe parryi var. fernandina	SF Valley Spineflower	√					√	√	√							
Chorizanthe parryi var. parryi	Parry's Spineflower	√					√	√	√							
Chorizanthe xanti S. Watson var. leucotheca	White-bracted Spineflower	√					√	√	√							
Chorizema cordatum	Heart-leaf Flame Pea			√	√		√								19-24	271
Chorizema ilicifolium	Holly Flame Pea			√	√		√								19-24	271
Chrysactinia mexicana	Damianita			√	√		√	√	√							271
Chrysothamnus nauseosus	Mohave Rubberbrush	√					√	√		shrub						
Chrysothamnus nauseosus ssp. bernardinus	San Bernardino Rabbitbrush	√					√	√		shrub	yellow	√				
Chrysothamnus nauseosus ssp. consimilis	Gray Rabbitbrush	√					√	√		shrub	yellow	√				
Chrysothamnus nauseosus ssp. hololeucus	Common Rabbitbrush	√					√	√		shrub	yellow	√				
Chrysothamnus nauseosus ssp. mohavensis	Mohave Common Rabbitbrush	√			√	√	√	√	√	shrub	yellow	√				
Chrysothamnus teretifolius	Terete-Leaved Rubberbrush	√					√	√		shrub						
Chrysothamnus viscidiflorus	Sticky Leafed Rabbitbrush	√		√	√		√	√	√							274
Cibotium glaucum	Hawaiian Tree Fern	√		√	√										23-24	274
Cirsium Mohavense	Mojave Thistle	√					√	√	√							
Cissus antarctica	Kangaroo Treebine			√	√		√	√	√							275
Cissus rhombifolia	Grape Ivy			√	√										21-24	275
Cissus striata	Miniature Grape Ivy			√	√		√	√	√							275
Cistus albidus	White-leaved Rockrose			√	√		√	√	√							276
Cistus crispus	Spotted Rockrose			√	√		√	√	√							276
Cistus incanus	Pink Rockrose			√	√		√	√	√							276
Cistus laurifolius	Laurel Rockrose			√	√		√	√	√							276
Cistus salviifolius	Showy Rockrose			√	√		√	√	√							276
Cistus x corbariensis	Rockrose Hybrid			√	√		√	√	√							276
Cistus x purpureus	Orchid Rockrose			√	√		√	√	√							276
Cistus x skanbergii	Rockrose Hybrid			√	√		√	√	√							276

Clarkia cylindrica	Farewell to Spring	√					√	√	√								
Clarkia unguiculata	elegant clarkia	√								annual herb							
Claytonia perfoliata	Miner's Lettus	√					√	√	√								
Clematis lasiantha	Chaparral Clematis	√			√	√	√	√		vine	white	√	√				
Clematis ligusticifolia	Virgin's Bower	√	√	√	√	√	√	√	√	vine	white	√	√	√			
Clematis pauciflora	Small-flowered Clematis	√			√		√	√		vine	white	√	√				
Cleome isomeris [Isomeris arborea]	Bladderpod	√	√	√	√	√	√	√	√	shrub	yellow	√	√				
Cneorum tricoccon	Spurge Olive			√	√		√	√	√								285
Coccoloba uvifera	Sea Grape			√												24	286
Comarostaphylis diversifolia	Summer Holly			√	√		√	√	√								288
Comarostaphylis diversifolia ssp. planifolia	Flat-leaf Summer Holly	√	√	√	√	√	√	√		shrub/tree	white	√	√	√			
Convolvulus althaeoides tenuissimus	Cretan Sunset			√	√		√	√	√								289
Convolvulus cneorum	Bush Morning Glory			√	√		√	√	√								289
Convolvulus sabatius	Ground Morning Glory			√	√		√	√	√								289
Convolvulus tricolor	Dwarf Morning Glory			√	√		√	√	√								289
Coprosma repens	Mirror Plant				√					shrub							
Cordia boissieri	Texas Olive			√	√		√	√	√								289
Cordia indivisa	Cordia			√	√										20-24		290
Cordia parvifolia	Little-leaf Cordia			√	√		√	√	√								289
Cordyline baueri	Cabbage Tree			√	√		√	√	√								290
Coreopsis auriculata	Mouse Ear Coreopsis			√	√		√	√	√								290
Coreopsis bigelovii	Bigelow's Coreopsis	√								annual herb							
Coreopsis californica	Californian Coreopsis	√					√	√	√								
Coreopsis gigantea	Giant Coreopsis	√	√	√	√	√				shrub	yellow	√					
Coreopsis grandiflora	Rising Sun Tickseed			√	√		√	√	√								290
Coreopsis lanceolata	Lanceleaf Coreopsis			√	√		√	√	√								290
Coreopsis maritima	Coastal Coreopsis			√	√		√	√	√								290
Coreopsis rosea	Pink Tickseed			√	√		√	√	√								290
Coreopsis tinctoria	Annual Coreopsis			√	√		√	√	√								290
Coreopsis verticillata	Golden Grain			√	√		√	√	√								290
Corieopsis calliopsidea	Leafy Stem	√					√	√	√								
Cornus nuttallii	Mountain Dogwood	√			√	√	√	√		tree	white		√	√			
Corokia cotoneaster	Wire Netting Bush			√	√		√	√	√								293
Corokia x virgata	Bronze King			√	√		√	√	√								293
Coronilla varia	Crown Vetch			√	√		√	√	√								293
Correa alba	White Correa			√	√		√	√	√								294
Correa backhousiana	Yellow Correa			√	√		√	√	√								294
Correa pulchella	Annie's Delight			√	√		√	√	√								294
Correa reflexa	Common Correa			√	√		√	√	√								294
Cosmos bipinnatus	Garden Cosmos			√	√		√	√	√								295
Cosmos sulphureus	Yellow Cosmos			√	√		√	√	√								295
Cotinus coggygria	Velvet Cloak			√	√		√	√	√								296
Cotinus obovatus	American Smoketree			√	√		√	√	√								296
Cotoneaster	Cotoneaster				√					shrub							
Cotoneaster adpressus praecox	Creeping Cotoneaster			√	√		√	√	√								296
Cotoneaster congestus	Pyrenees Cotoneaster			√	√		√	√	√								296
Cotoneaster glaucophyllus	Chinese Cotoneaster						√	√	√						18-20		296
Cotoneaster horizontalis	Rock Cotoneaster			√	√		√	√	√								296
Cotoneaster microphyllus	Rockspray Cotoneaster			√	√		√	√	√								296
Cotoneaster multiflorus	Cotoneaster				√		√	√	√						18-21		297
Cotoneaster salicifolius	Willowleaf Cotoneaster			√	√		√	√	√								297
Cotoneaster x watereri	Cotoneaster Hybrid			√	√		√	√	√								297
Cotyledon orbiculata	Pig's Ear			√	√										21-24		297
Cotyledon undulata	Silver Gumtree			√	√										23-24		297
Crassula arborescens	Jade Plant			√	√		√	√	√								298
Crassula capitella thyrsiflora	African Crassula			√	√		√	√	√								298
Crassula falcata	Propeller Plant			√	√		√	√	√								298
Crassula lactea	Flowering Crassula			√	√		√	√	√								298
Crassula lycopodioides	Watch Chain Crassula			√	√		√	√	√								298
Crassula multicava	Fairy Crassula			√	√		√	√	√								298
Crassula pyramidalis	Buddha's Temple			√	√		√	√	√								298
Crassula schmidtii	Desert Ruby			√	√		√	√	√								298
Crassula tetragona	Miniature Pine Tree			√	√		√	√	√								298
Croton californicus	California Croton	√	√	√	√	√	√	√	√	perennial herb	white	√					
Cryptanthus zonatus	Zebraplant			√	√										23-24		301
Cucurbita foetidissima	Coyote Gourd	√		√	√	√	√	√	√	vine	yellow	√					
Cunninghamia lanceolata	China Fir				√		√	√	√						18-21		302
Cuscuta californica	Bindweed	√					√	√	√								
Cycas revoluta	Sago Palm						√	√	√	succulent			√				
Cylindropuntia [Opuntia] echinocarpa	Silver Cholla	√							√	cactus	yellow	√					

Cylindropuntia [Opuntia] prolifera	Coast Cholla	√	√	√	√	√				cactus	red/purple	√					
Cylindropuntia californica [Opuntia parryi]	Cane Cholla	√			√		√	√		cactus	yellow	√					
Cynoglossum grande	Westerm Hound's Tongue			√	√		√	√	√								305
Dalea capitata 'Sierra Gold'	Golden Dalea							√	√	ground cover	yellow		√				
Dalea greggii	Trailing Dalea							√	√	ground cover	purple		√				
Dalea pulchra	Bush Dalea						√	√	√	shrub	purple	√					
Dasylirion longissimum	Grass Tree						√	√	√	succulent		√					
Dasylirion quadrangulatum	Mexican Grass Tree			√	√		√	√	√								310
Dasylirion wheeleri	Desert Spoon			√	√		√	√	√								310
Datura wrightii	Jimson Weed	√	√	√	√	√	√	√	√	perennial herb	white	√					
Deinandra mohavensis	Mojave Tarplant	√					√	√	√								
Delphinium cardinale	Scarlet Larkspur	√			√	√	√	√		perennial herb	red	√	√				
Delphinium parishii ssp. parishii	Sky Blue Larkspur	√					√	√	√	perennial herb	blue	√	√				
Delphinium parryi ssp. parryi	Parry's Larkspur	√	√	√	√	√	√	√		perennial herb	blue	√	√				
Dendromecon harfordii	Channel Island Tree Poppy	I	√	√	√	√	√	√		shrub/tree	yellow	√					
Dendromecon rigida	Bush Poppy	√	√	√	√	√	√	√		shrub	yellow	√					
Dianella caevulea	cassa blue		√	√	√		√	√		grass	blue	√	√				
Dianella revoluta	little rev		√	√	√		√	√		grass	blue	√	√				
Dicentra chrysantha	Golden Eardrops	√					√	√		perennial herb	yellow	√					
Dicentra sp.	Bleeding Heart	√					√	√	√								
Dichelostemma capitatum ssp. capitatum	Blue Dicks	√	√	√	√	√	√	√	√	bulb	blue	√					
Dicliptera resupinata	Arizona Foldwing				√		√	√	√						18-23		315
Diplacus [Mimulus] aurantiacus	Sticky Monkeyflower	√			√	√	√	√		shrub	orange	√	√				
Diplacus [Mimulus] longiflorus	Southern Bush Monkeyflower	√			√		√	√		shrub	red	√	√				
Dietes vegata	Fortnight Lily				√					shrub							
Dodecahema leptoceras	Slender-horned Spineflower	√					√	√	√								
Dodecatheon clevelandii ssp. clevelandii	Cleveland's Shooting Star	√		√	√	√	√	√		perennial herb	pink/white	√	√				
Dodecatheon clevelandii ssp. insulare	Island Shooting Star	√	√							perennial herb	pink/white	√	√				
Dodecatheon clevelandii ssp. sanctarum	Padre's Shooting Star	√					√	√		perennial herb	pink/white	√	√				
Dodonaea viscosca	Hopseed bush		√							shrub							
Dorotheanthus bellidiformis	Livingstone Daisy			√	√		√	√	√								319
Dracaena deremensis	Striped Pleomele			√												24	320
Dracaena draco	Dragon Tree			√	√										21-24		320
Dracaena fragrans	Corn Plant			√	√										21,23,24		320
Dracaena marginata	Madagascar Dragon Tree			√	√										21,23,24		320
Dracaena sanderana	Belgian Evergreen			√	√										21,23,24		320
Dryopteris arguta	California Wood Fern	√		√	√		√	√	√								321
Duchesnea indica	Indian Mock Strawberry			√	√		√	√	√								321
Dudlea densiflora	Dudlea	√					√	√	√								
Dudleya cymosa ssp. crebrifolia	San Gabriel River Dudleya	√					√	√		perennial herb	yellow/red	√	√				
Dudleya cymosa ssp. ovatifolia	Santa Monica Mtns. Dudleya	√			√	√				perennial herb	yellow/red	√	√				
Dudleya cymosa ssp. pumila	Low Canyon Dudleya	√					√	√		perennial herb	yellow/red	√	√				
Dudleya cymosa ssp.marescens	Marescent Dudleya	√			√	√				perennial herb	yellow/red	√	√				
Dudleya edulis	Fingertips	√			√	√	√	√		perennial herb	white	√					
Dudleya hassei	Santa Catalina Island Dudleya	I	√	√	√	√				perennial herb	yellow	√					
Dudleya lanceolata	Lance-leaved Dudleya	√		√	√	√	√	√		perennial herb	yellow/red	√	√				
Dudleya multicaulis	Many-stemmed Dudleya	√			√	√	√	√		perennial herb	yellow	√					
Dudleya pulverulenta var. pulverulenta	Chalk Dudleya	√			√	√	√	√		perennial herb	yellow	√	√				
Dypsis decaryi	Triangle Palm			√	√										20-24		322
Echeveria agavoides	Hen and Chicks			√	√		√	√	√								322
Echeveria elegans	Hen and Chicks			√	√		√	√	√								322
Echeveria secunda	Hen and Chicks			√	√		√	√	√								322
Echeveria setosa	Hen and Chicks			√	√										23-24		322
Echeveria x imbricata	Hen and Chicks			√	√		√	√	√								322
Echinocactus	Barrel Cactus			√	√		√	√	√								322
Echinocactus grusonii	Golden Barrel							√	√	cactus	yellow	√	√				
Echinocactus grusonii	Golden Barrel							√	√	cactus	yellow	√	√				
Echinocactus polycephalus	Cotton Top Cactus	√					√	√	√	perennial							
Echinocereus engelmannii	Hedgehog Cactus			√	√		√	√	√								323
Echinocereus triglochidiatus	Mojave Mound Cactus	√							√	cactus	red	√					
Elaeagnus angustifolia	Russian Olive						√	√	√		yellow	√					
Elaegnus pungens	Silverberry		√	√	√		√	√	√	shrub	white	√					18-24
Elymus elymoides	Squirreltail	√					√	√		perennial							
Elymus elymoides ssp. californicus	California Squirreltail	√					√			perennial grass	grass spikelet	√	√				
Elymus elymoides ssp. elymoides	Squirreltail	√					√	√	√	perennial grass	grass spikelet	√	√				
Elymus glaucus ssp. glaucus	Blue Wildrye	√	√	√	√	√	√	√	√	perennial grass	grass spikelet	√	√				

Elymus glaucus ssp. jepsonii	Jepson's Wildrye	√					√	√		perennial grass	grass spikelet	√	√			
Elymus multisetus	Big Squirreltail	√			√	√	√	√		perennial grass	grass spikelet	√				
Elymus stebbinsii	California Wheat Grass	√					√	√		perennial						
Encelia actoni	Acton Encelia	√					√	√	√	shrub	yellow	√	√			
Encelia californica	California Sunflower	√	√	√	√	√	√	√		shrub	yellow	√	√			
Encelia farinosa	Brittlebush	√					√	√	√	shrub	yellow	√				
Encelia virginensis	Bush Sunflower	√					√	√		shrub						
Ephedra californica	California Ephedra	√					√	√	√	shrub						
Ephedra nevadensis	Nevada Ephedra	√							√	shrub	none	√				
Ephedra trifurca	Mormon Tea				√		√	√	√					18-23	326	
Ephedra viridis	Green Ephedra	√					√	√		shrub	none	√				
Epilobium angustifolium	Fireweed	√			√		√	√	√					18-21	327	
Epilobium canum	California Fuchsia	√								perennial herb						
Epilobium canum ssp. canum	California Fuchsia	√	√	√	√	√	√	√		shrub	red	√	√			
Epilobium canum ssp. latifolium	Mountain California Fuchsia	√			√	√	√	√		shrub	red	√	√			
Eremophila decipiens	Emu Bush			√	√		√	√	√						328	
Eremophila flabra	Common Emu Bush			√	√		√	√	√						328	
Eremophila laanii	Emu Bush			√	√		√	√	√						328	
Eremophila maculata	Spotted Emu Bush			√	√		√	√	√						328	
Eriastrum densifolium ssp. austromontanum	Southern Mountain Eriastrum	√			√	√	√	√		shrub	blue	√				
Eriastrum densifolium ssp. elongatum	Giant Woolly-star	√		√	√	√	√	√		shrub	blue	√				
Eriastrum densifolium ssp. mohavense	Mojave Eriastrum	√							√	shrub	blue	√				
Eriastrum diffusum	Blue Mantle	√					√	√	√							
Ericameria cooperi var. cooperi	Cooper's Goldenbush	√							√	shrub	yellow	√				
Ericameria cuneata var. cuneata	Cliff Goldenbush	√					√	√		shrub	yellow	√	√			
Ericameria ericoides	Mock Heather	√		√	√	√				shrub	yellow	√				
Ericameria linearifolia	Narrowleaf Goldenbush	√					√	√	√	shrub	yellow	√	√			
Ericameria palmeri var. pachylepis	Palmer's Rabbitbrush	√	√	√	√	√	√	√		shrub	yellow	√	√			
Ericameria pinifolia	Pine-bush	√					√	√		shrub	yellow	√	√			
Erigeron glaucus	Beach Aster	√		√	√									22-24	329	
Erigeron karvinskianus	Mexican Daisy			√	√		√	√	√						332	
Erigeron speciosus	Flea Bane			√	√		√	√	√						332	
Erigonum Pusillum	Yellow Turban	√					√	√	√							
Eriobotrya japonica	Loquat				√					tree						
Eriodictyon crassifolium	Thick-Leaved Yerba Santa	√					√	√		shrub						
Eriodictyon crassifolium var. crassifolium	Felt-leaved Yerba Santa	√					√	√		shrub	blue	√				
Eriodictyon trichocalyx	Hairy Yerba Santa	√					√	√		shrub						
Eriodictyon trichocalyx var. trichocalyx	Hairy Yerba Santa	√					√	√	√	shrub	white/purple	√				
Eriogonum arborescens	Santa Cruz Island Buckwheat	√		√	√		√	√	√						333	
Eriogonum cinereum	Ashy-leaf Buckwheat	√		√	√	√	√	√		shrub	pink/white	√				
Eriogonum crocatum	Saffron Buckwheat	√		√	√		√	√	√						333	
Eriogonum deflexum	Skeleton Weed	√					√	√	√							
Eriogonum elongatum var. elongatum	Wand Buckwheat	√			√	√	√	√		perennial herb	pink	√				
Eriogonum giganteum var. giganteum	Sta. Catalina Island Buckwheat	√	√		√					shrub	white/pink	√	√			
Eriogonum grande rubescens	Red Buckwheat	√		√	√		√	√	√						333	
Eriogonum grande var. grande	Island Buckwheat	√	√		√					perennial herb	pink	√	√			
Eriogonum inflatum	Desert Trumpet	√							√	perennial herb	pink	√				
Eriogonum kennedyi var. alpigenum	Southern Alpine Buckwheat	√					√	√		perennial herb	pink	√	√			
Eriogonum nudum var. pauciflorum	Few-flowered Buckwheat	√			√		√	√		perennial herb	yellow/pink	√				
Eriogonum nudum var. pubiflorum	Hairy-flowered Buckwheat	√			√		√	√	√	perennial herb	yellow/pink	√				
Eriogonum nudum var. westonii	Hairy-flowered Buckwheat	√			√		√	√	√	perennial herb	yellow/pink	√				
Eriogonum parvifolium	Sea-cliff Buckwheat	√		√	√	√				shrub	yellow/pink	√	√			
Eriogonum saxatile	Rock Buckwheat	√			√		√	√		perennial herb	yellow/pink	√	√			
Eriogonum umbellatum var. minus	Alpine Sulphur Buckwheat	√					√			perennial herb	yellow	√	√			
Eriogonum umbellatum var. munzii	Munz's Buckwheat	√			√		√	√		perennial herb	yellow	√	√			
Eriogonum umbellatum var. subaridum	Sulphur Buckwheat	√			√		√	√		perennial herb	yellow	√	√			
Eriogonum wrightii	Wright's Buckwheat	√		√	√		√	√	√						333	
Eriophyllum confertiflorum	Golden Yarrow	√					√	√		shrub						
Eriophyllum confertiflorum var. confertiflorum	Golden Yarrow	√	√	√	√	√	√	√		perennial herb	yellow	√	√			
Eriophyllum nevinii	Nevin's Eriophyllum	√	√	√		√	√	√		shrub	yellow	√	√			
Erodium macrophyllum	Round-leaved Filaree	√					√	√	√							
Eryngium alpinum	Alpine Sea Holly			√	√		√	√	√						334	
Eryngium amethystinum	Sea Holly			√	√		√	√	√						334	
Eryngium planum	False Sea Holly			√	√		√	√	√						334	

Erysimum 'bowles mauve'	Bowles Mauve				√										22-23	334
Erysimum insulare ssp. suffrutescens	Suffrutescent Wallflower	√		√	√	√				perennial herb	yellow	√	√			
Erysimum kotschyanum	Wallflower				√		√	√	√						18-21	334
Erysimum x allionii	Siberian Wallflower			√	√		√	√	√							334
Erythrina caffra	Coral Tree			√	√										21-24	334
Erythrina coralloides	Naked Coral Tree			√	√		√								19-24	335
Erythrina crista-galli	Cockspur Coral Tree			√	√		√								19-24	335
Erythrina falcata	Coral Tree			√	√		√								19-24	335
Erythrina humeana	Natal Coral Tree			√	√										20-24	335
Erythrina lysistemon	Coral Tree			√	√										21-24	335
Erythrina x bidwillii	Coral Tree			√	√		√	√	√							334
Erythrina x sykesii	Coral Tree			√	√		√								19-24	335
Escallonia	Escallonia				√					shrub						
Eschscholtzia minutifloria ssp. Twisselmannii	Red Rock Poppy	√					√	√	√							
Eschscholtzia multiflora	Little Gold Poppy	√					√	√	√							
Eschscholzia californica	California poppy	√		√	√				√	annual herb						
Escobaria vivipara	Foxtail Cactus	√					√	√		perennial						
Espostoa lanata	Peruvian Old Man Cactus			√	√		√	√	√							336
Eucalyptus microtheca	Coolibah						√	√	√		cream					
Euphorbia antisyphilitica	Candelilla				√		√	√	√						18-21	344
Euphorbia characias	Mediterranean Spurge			√	√		√	√	√							344
Euphorbia cyparissias	Cypress Spurge			√	√		√	√	√							344
Euphorbia dulcis	Chameleon			√	√		√	√	√							344
Euphorbia misera	Cliff Spurge	√	√	√		√				shrub	white	√				
Euphorbia rigida	Gopher Plant			√	√		√	√	√							345
Euphorbia seguieriana niciana	Blue Haze			√	√		√	√	√							345
Euphorbia x martinii	Spurge Hybrid			√	√		√	√	√							344
Euryops pectinatus veridis	Green Euryops Daisy							√	√	perennial	yellow	√	√			
Eysenhardtia orthocarpa	Kidneywood						√	√	√	shrub	white	√	√			
Fallugia paradoxa	Apache Plume				√		√	√	√						18-23	347
Felicia fruticosa	Shrub Aster			√	√		√	√	√							349
Ferocactus cylindraceus	Barrel Cactus	√			√	√	√	√	√	cactus	yellow	√	√			
Ferocactus viridescens	Coast Barrel Cactus			√	√	√	√	√	√	cactus	yellow	√	√			
Ferocactus wislizenii	Fishhook Barrel Cactus			√	√		√	√	√							349
Ficus benjamina	Weeping Chinese Banyan				√					tree						
Forestiera neomexicana	New Mexican Privet			√	√		√	√	√							353
Forestiera pubescens	Desert Olive	√					√	√	√	shrub	yellow	√	√			
Fouquieria spendens	Ocotillo							√	√	succulent	orange		√			
Fragaria vesca [californica]	California Strawberry	√			√		√	√		perennial herb	white		√	√		
Fraxinus angustifolia	Narrowleaf Ash			√	√		√	√	√							356
Fraxinus dipetala	Flowering Ash	√			√	√	√	√		tree	white	√	√			
Fraxinus oxycarpa 'Raywood'	Raywood Ash						√	√	√	shrub	green	√	√			
Fraxinus velutina	Velvet Ash	√			√		√	√	√	tree	inconspicuous	√				
Fremontodendron californicum	California Flannelbush	√					√	√		shrub						
Fremontodendron californicum ssp. californicum	California Flannelbush	√			√		√	√		shrub/tree	yellow	√				
Fremontodendron mexicanum	Mexican Flannelbush				√		√	√		shrub/tree	yellow	√				
Fritillaria biflora var. biflora	Chocolate Lily	√			√	√	√	√		bulb	brown	√				
Gaillardia pulchella	Blanket Flower							√	√	annual	yellow	√				
Galium angustifolium ssp. angustifolium	Narrow-leaved Bedstraw	√	√	√	√	√	√	√		perennial herb	white		√	√		
Galium angustifolium ssp. gabrielense	San Antonio Canyon Bedstraw	√					√			perennial herb	white		√	√		
Galium angustifolium ssp. nudicaule	Naked-branch Bedstraw	√					√	√		perennial herb	white		√	√		
Galium grande	San Gabriel Bedstraw	√					√	√	√							
Galvezia speciosa	Island Bush Snapdragon	I	√	√	√	√				shrub	red	√	√			
Garrya elliptica	Coast Silktassel			√	√		√	√	√							361
Garrya flavescens	Ashy Silktassel	√					√	√		shrub	white	√	√			
Garrya fremontii	Fremont's Silktassel						√	√		shrub	white	√	√	√		
Garrya veatchii	Canyon Silktassel	√			√	√	√	√		shrub	white	√	√			
Gaura lindheimeri	Corries Gold			√	√		√	√	√							361
Gazania	Gazania							√	√	perennial	orange	√	√			
Geijera parviflora	Australian Willow			√	√		√	√	√							362
Gelsemium sempervirens	Carolina Jessamine						√	√		ground cover	yellow	√				
Genista aetnensis	Mt. Etna Broom			√	√		√	√	√							362
Genista fragrans	Broom			√	√		√	√	√							362
Genista hispanica	Spanish Broom				√		√	√	√						18-22	362
Genista pilosa	Broom				√		√	√	√						18-22	362
Genista sagittalis	Broom				√		√	√	√						18-22	363
Genista tinctoria	Dyer's Greenweed			√	√		√	√	√							363
Geranium incanum	Cranesbill			√	√		√	√	√							364

Geranium robustum	Cranesbill			√	√		√	√	√							364
Gilia capitata	Blue Field Gilia	√		√	√		√	√	√	annual herb						
Gilia latiflora ssp. Davyi	Davy Gilia	√					√	√	√							
Gilia tricolor	Bird's Eye			√	√		√	√	√							365
Glaucium corniculatum	Horned Poppy			√	√		√	√	√							367
Glaucium flavum	Sea Poppy			√	√		√	√	√							367
Gledistsia triacanthos inermis 'Shademaster'	Honey Locust						√	√	√	shrub	green	√				
Globularia cordifolia	Globe Daisy			√	√		√	√	√							367
Globularia x indubia	Globe Daisy Hybrid			√	√		√	√	√							367
Gnaphalium [Pseudognaph.] canescens microcephalum	White Everlasting	√	√	√	√	√	√	√		perennial herb	white/yellow	√	√			
Gnaphalium [Pseudognaphalium] californicum	California Everlasting	√	√	√	√	√	√	√		perennial herb	white	√	√			
Gnaphalium bicolor [Pseudognaphalium biolettii]	Bicolored Everlasting	√	√	√	√	√	√	√		perennial herb	yellow	√				
Gnaphalium canescens beneolens [Pseudo. beneolens]	Fragrant Everlasting	√	√	√	√	√	√	√		perennial herb	white/yellow	√	√			
Gomphrena globosa	Globe Amaranth			√	√		√	√	√							368
Gomphrena haageana	Globe Amaranth			√	√		√	√	√							368
Goniolimon tataricum	German Statice				√		√	√	√						18-21	368
Grayia spinosa	Hopsage	√						√	√	shrub	inconspicuous	√				
Grevillea alpina	Mountain Grevillea			√	√		√	√	√							375
Grevillea asplenifolia	Grevillea			√	√		√	√	√							375
Grevillea australis	Alpine Grevillea			√	√										23,24	375
Grevillea banksii	Grevillea			√	√		√	√	√							375
Grevillea curviloba	Grevillea			√	√		√	√	√							375
Grevillea lanigera	Woolly Grevillea			√	√		√	√	√							375
Grevillea lavadulacea	Lavender Grevillea			√	√		√	√	√							375
Grevillea robusta	Silk Oak			√	√		√	√	√							375
Grevillea rosmarinifolia	Rosemary Grevillea			√	√		√	√	√							375
Grevillea thelemanniana	Hummingbird Bush			√	√		√								19-24	375
Grevillea victoriae	Grevillea			√	√		√	√	√							376
Grevillea x gaudichaudii	Grevillea Hybrid			√	√		√	√	√							375
Grindelia camporum var. bracteosum	Bract Gumweed	√		√	√	√	√	√		perennial herb	yellow	√				
Grindelia camporum var. camporum	Great Valley Gumweed	√		√	√		√	√		perennial herb	yellow	√				
Guaiacum coulteri	Guayacan			√	√										23-24	376
Gutierrezia californica	Matchweed	√		√	√		√	√		perennial herb	yellow	√				
Gutierrezia microcephala asteaceae	Sticky Snakeweed	√					√	√	√							
Gutierrezia sarothrae	Broom Snakeweed	√		√	√	√	√	√		perennial herb	yellow	√				
Gypsophila cerastioides	Low Baby's Breath				√		√	√	√						18-21	377
Gypsophila elegans	Showy Baby's Breath			√	√		√	√	√							377
Gypsophila paniculata	Baby's Breath				√		√	√	√						18-21	377
Gypsophila repens	Creeping Baby's Breath				√		√	√	√						18-21	377
Hakea laurina	Sea Urchin			√	√		√								19-24	378
Hakea suaveolens	Sweet Hakea			√	√		√								19-24	378
Hakea victoria	Royal Hakea			√	√		√								19-24	378
Halimium lasianthum	Hannay Silver			√	√		√	√	√							379
Halimium ocymoides	Halimium			√	√		√	√	√							379
Halimium umbellatum	Halimium			√	√		√	√	√							379
Hardenbergia comptoniana	Lilac Vine			√	√		√	√	√							380
Hardenbergia violacea	Lilac Vine			√	√		√	√	√							380
Hazardia cana	San Clemente Island Hazardia	I		√	√					shrub	yellow	√	√			
Hazardia squarrosa var. grindelioides	Saw-toothed Goldenbush	√	√	√	√	√	√	√		shrub	yellow	√				
Helianthemum nummularium	Sunrose			√	√		√	√	√							382
Helianthemum scoparium	Peak Rush-rose	√	√		√	√	√	√		shrub	yellow	√				
Helianthus Annuus	Sunflower	√					√	√	√							
Helianthus gracilentus	Slender Sunflower	√			√	√	√	√		perennial herb	yellow	√	√			
Helianthus maximilianii	Maximilian Sunflower							√	√	perennial	yellow	√	√			
Helianthus nuttallii ssp. nuttallii	Nuttall's Sunflower	√					√	√		perennial						
Helichrysum bracteatum	Strawflower			√	√		√	√	√							383
Helichrysum italicum	Curry Plant			√	√		√	√	√							383
Heliotropium curassavicum	Chinese Pusley	√					√	√	√							
Helleborus argutifolius	Corsican Hellebore			√	√		√	√	√							384
Helleborus foetidus	Bear's Foort Hellebore			√	√		√	√	√							384
Helleborus lividus	Hellebore			√	√		√	√	√							384
Helleborus x sternii	Hellebore Hybrid			√	√		√	√	√							384
Hemerocallis	Daylily							√	√	perennial	multicolor	√	√			
Hesperaloe funifera	Giant Hesperaloe							√	√	succulent	white		√	√		
Hesperaloe parvifolia	Red Hesperaloe							√	√	succulent	red/yellow		√	√		
Hesperoyucca [Yucca] whipplei	Chaparral Yucca	√		√	√	√	√	√	√	shrub	yellow	√				
Heteromeles arbutifolia	Toyon	√	√	√	√	√	√	√		shrub/tree	white	√	√			

Heterotheca grandiflora	Telegraph Weed	√					√	√	√							
Heterotheca sessiliflora ssp. fastigiata	Erect Goldenaster	√			√	√	√	√		perennial herb	yellow	√	√			
Heterotheca sessiliflora ssp. sessiliflora	False Goldenaster	√		√	√	√	√			perennial herb	yellow	√	√			
Heterotheca villosa	Hairy Goldenaster	√					√	√		perennial herb	yellow	√				
Heuchera americana	Coral Bells			√	√		√	√	√							387
Heuchera elegans	Unr-flowered Alumroot	√					√	√		perennial herb	pink		√	√		
Heuchera maxima	Island Alumroot				√	√	√	√		perennial herb	pink		√	√		
Heuchera micrantha	Coral Bells			√	√		√	√	√							387
Heuchera sanguinea	Coral Bells			√	√		√	√	√							387
Heuchera x brizoides	Coral Bells Hybrid			√	√		√	√	√							387
Holodiscus discolor	Ocean-spray	√	√		√	√	√	√		shrub	white		√	√		
Horkelia cuneata ssp. cuneata	Coast Horkelia	√		√	√	√	√			perennial herb	white	√	√			
Horkelia cuneata ssp. puberula	Coast Horkelia	√			√	√	√			perennial herb	white	√	√			
Hunnemannia fumariifolia	Mexican Tulip Poppy			√	√		√	√	√							393
Hymenoclea salsola	Burrobush	√			√	√	√	√	√	shrub	white	√				
Hymenosporum flavum	Sweetshade			√	√		√	√	√							395
Hymenoxys acaulis	Angelita Daisy							√	√	perennial	yellow	√	√			
Hyptis emoryi	Desert Lavender	√		√	√		√	√	√							396
Ipomopsis aggregata	Ipomopsis				√		√	√	√						18-21	401
Ipomopsis rubra	Ipomopsis			√	√		√	√	√							401
Iris douglasiana	Douglas Iris	√			√		√	√		bulb	purple	√	√	√		
Iris hartwegii	Rainbow Iris	√					√	√		bulb	yellow/purple			√		
Isocoma menziesii [Haplopappus veneta]	Menzies's goldenbush	√								shrub						
Isocoma menziesii var. menziesii	Menzies' Goldenbush	√		√	√	√	√	√		shrub	yellow	√	√			
Isocoma menziesii var. sedoides	Prostrate Goldenbush	√	√	√	√	√				shrub	yellow	√	√			
Isocoma menziesii var. vernonioides	Coastal Goldenbush	√	√	√	√	√				shrub	yellow	√	√			
Isomeris arborea [Cleome isomeris]	Bladderpod	√		√	√	√	√	√	√	shrub	yellow	√	√			
Isopogon formosus	Rose Coneflower			√	√		√	√	√							406
Iva hayesiana	Poverty Weed			√	√										23-24	406
Ixiolirion tataricum	Siberian Lily				√		√	√	√						18-21	407
Jacaranda mimosifolia	Jacaranda			√	√		√	√	√							407
Jasminum mesnyi	Primrose Jasmine							√	√	ground cover	yellow	√	√			
Jubaea chilensis	Chilean Wine Palm			√	√		√	√	√							409
Juglans californica	Southern California Black Walnut	√					√	√		tree						
Juglans californica var. californica	So. California Black Walnut	√	√	√	√	√	√	√		tree	inconspicuous	√	√			
Juglans nigra	Black Walnut				√		√	√	√						18-21	409
Juniperus californica	California Juniper	√			√	√	√	√	√	shrub/tree	inconspicuous	√				
Juniperus chinensis	Hollywood Juniper						√	√	√							
Juniperus communis	Dwarf Juniper				√		√	√	√	shrub	inconspicuous	√	√			
Juniperus occidentalis	Western Juniper	√			√		√	√		shrub	inconspicuous	√				
Justicia brandegeeana	Shrimp Plant			√	√										21-24	415
Justicia californica	Chuparosa				√	√	√	√	√	shrub	red	√				
Keckiella antirrhinoides	Chaparral Beard-Tongue	√					√	√		shrub						
Keckiella antirrhinoides var. antirrhinoides	Chaparral Beard-tongue	√			√		√	√		shrub	yellow	√				
Keckiella antirrhinoides var. microphylla	Chaparral Beard-tongue	√							√	shrub	yellow	√				
Keckiella breviflora	Gaping Keckiella	√			√		√	√		shrub	white/purple	√				
Keckiella cordifolia	Heart-leaved Keckiella	√	√	√	√	√	√	√		shrub	red	√	√	√		
Keckiella ternata	Scarlet Keckiella	√			√		√	√		shrub	red	√	√			
Koeleria macrantha	June Grass	√			√	√	√	√		perennial grass	grass spikelet	√	√			
Krascheninnikovia lanata	Winter Fat	√					√	√	√	shrub	white	√				
Kunzea affinis	Kunzea			√	√		√	√	√							419
Kunzea baxteri	Scarlet Kunzea			√	√		√	√	√							419
Kunzea parvifolia	Kunzea			√	√		√	√	√							419
Lagerstroemia fauriei	Japanese Crape Myrtle				√		√	√	√						18-21	421
Lagerstroemia hybrids	Crape Myrtle Hybrids			√	√		√	√	√							421
Lagerstroemia indica	Crape Myrtle				√		√	√	√						18-21	421
Lagerstroemia Indica 'tuscarora'	Crape myrtle		√							tree	many varieties					
Lagunaria patersonii	Primrose Tree			√	√		√	√	√							421
Lampranthus aurantiacus	Ice Plant			√	√		√	√	√							422
Lampranthus deltoides	Ice Plant			√	√		√	√	√							422
Lampranthus filicaulis	Redondo Creeper			√	√		√	√	√							422
Lampranthus pedunculatus	Golden Chain			√	√		√	√	√							422
Lampranthus productus	Purple Ice Plant			√	√		√	√	√							422
Lampranthus spectabilis	Trailing Ice Plant			√	√		√	√	√							422
Larrea tridentata	Creosote Bush	√							√	shrub	yellow	√				
Lasthenia californica	Goldfields	√					√	√	√							
Lasthenia glabrata	Coulter's Goldfields	√					√	√	√							

Lathyrus latifolius	Perennial Sweet Pea			√	√		√	√	√								424
Lathyrus odoratus	Sweet Pea			√	√		√	√	√								424
Lathyrus splendens	Pride of California			√	√		√	√	√								424
Lathyrus vestitus var. alefeldii	San Diego Pea	I	√		√					vine	red/purple		√				
Lathyrus vestitus var. vestitus	Pacific Pea	√		√	√	√	√	√		vine	white/purple		√				
Lauraus nobilis	Sweet Bay			√	√		√	√	√								424
Lavandula angustifolia	English Lavender			√	√		√	√	√								425
Lavandula canariensis	Canary Island Lavender			√	√		√	√	√								425
Lavandula dentata	French Lavender			√	√		√	√	√								425
Lavandula lanata	Woolly Lavender			√	√		√	√	√								426
Lavandula latifolia	Spike Lavender			√	√		√	√	√								426
Lavandula multifida	Fernleaf Lavender			√	√		√	√	√								426
Lavandula stoechas	Spanish Lavender			√	√		√	√	√								426
Lavandula viridis	Green Lavender			√	√		√	√	√								426
Lavandula x allardii	Lavender			√	√		√	√	√								425
Lavandula x heterophylla	Sweet Lavender			√	√		√	√	√								426
Lavandula x intermedia	Lavandin			√	√		√	√	√								426
Lavatera assurgentiflora	Island Tree Mallow			√	√	√	√			shrub	pink	√					
Layia glandulosa	Desert Tidy Tips	√					√	√	√								
Layia heterotricha	Pale-yellow Layia	√					√	√	√								
Layia platyglossa	Tidytips	√		√	√		√	√	√								427
Leonotis leonurus	Lion's Tail			√	√		√	√	√								428
Lepechinia calycina	White Pitcher Sage	√					√	√		shrub	white	√	√				
Lepechinia fragrans	Fragrant Pitcher Sage	√	√		√	√				shrub	purple	√	√				
Lepechinia hastata	Pitcher Sage			√	√		√	√	√								428
Lepidium flavum	Yellow Pepper Grass	√					√	√	√								
Lepidium fremontii	Desert Alyssum	√					√	√		shrub							
Lepidospartum squamatum	Scale Broom	√		√	√	√	√	√	√	shrub	yellow	√					
Leptodactylon californicum	California Prickly Phlox	√					√	√		shrub							
Leptodactylon californicum [Linanthus californicus]	California Prickly Phlox	√		√	√	√	√	√		shrub	pink	√					
Leptospermum laevigatum	Australian Tea Tree			√	√		√	√	√								428
Leptospermum macrocarpum	Tea Tree			√	√		√	√	√								428
Leptospermum petersonii	Lemon-scented Tea Tree			√	√		√	√	√								428
Leptospermum polygalifolium	Tea Tree			√	√		√	√	√								428
Leptospermum rotundifolium	Tea Tree			√	√		√	√	√								428
Leptospermum scoparium	New Zealand Tea Tree			√	√		√	√	√								428
Lessingia filaginifolia var. filaginifolia	California Aster	√	√	√	√	√	√	√		perennial herb	purple	√	√				
Lessingia lemmoni	Autumn Vinegar Weed	√					√	√	√								
Leucadendron argenteum	Silver Tree			√	√		√								20-24		429
Leucadendron discolor	Flametip			√	√		√								20-24		429
Leucadendron tinctum	Spicey Conebush			√	√		√								20-24		429
Leucophyllum candidum	Violet Silverleaf			√	√		√	√	√								430
Leucophyllum frutescens	Texas Ranger			√	√		√	√	√								430
Leucophyllum laevigatum	Chihuahuan Sage			√	√		√	√	√								430
Leucophyllum langmaniae	Silverleaf			√	√		√	√	√								430
Leucophyllum pruinosum	Silverleaf			√	√		√	√	√								430
Leucophyllum revolutum	Silverleaf			√	√		√	√	√								430
Leucophyllum zygophyllum	Silverleaf			√	√		√	√	√								430
Leucospermum cordifolium	Nodding Pincushion			√	√										21-24		430
Leucospermum reflexum	Rocket Pincushion			√	√										21-24		430
Lewisia rediviva	Bitter Root	√			√	√	√	√		perennial herb	pink/white	√					
Leymus arenarius	Blue Lyme Grass			√	√		√	√	√								431
Leymus cinereus	Giant Wild Rye	√					√	√		perennial							
Leymus condensatus	Giant Wild Rye	√	√	√	√	√	√	√	√	perennial grass	grass spikelet	√	√	√			
Leymus triticoides	Creeping Wild Rye	√	√	√	√	√	√	√		perennial grass	grass spikelet	√	√	√			
Lilium humboldtii var. ocellatum	Ocellated Humboldt Lily	√			√	√	√	√		bulb	orange		√	√			
Limonium gmelinii	Statice			√	√		√	√	√								435
Limonium platyphyllum	Statice			√	√		√	√	√								435
Linanthus aureus	Golden Gilia	√					√	√	√								
Linanthus californicus [Leptodactylon californicum]	California Prickly Phlox	√		√	√	√	√	√		shrub	pink	√					
Linanthus dichotomus	Evening Snow	√					√	√	√								
Linanthus grandiflorus	Mountain Phlox			√	√		√	√	√								436
Linanthus parryae	Parry Gilia	√					√	√	√								
Linum flavum	Golden Flax			√	√		√	√	√								437
Linum grandiflorum	Flowering Flax			√	√		√	√	√								437
Linum lewisii var. lewisii	Blue Flax	√			√		√	√	√	perennial herb	blue	√	√	√			
Linum narbonense	Flax			√	√		√	√	√								437
Linum perenne	Perennial Blue Flax			√	√		√	√	√								437
Lithocarpus densiflorus var. densiflorus	Tanbark Oak				√		√	√		tree	white	√	√	√			

Lobelia laxiflora	Cardinal Flower			√	√		√	√	√							440
Loeflingia Squarrosa var. artemisiarum	Sagebrush Loeflingia	√					√	√	√							
Lomandra longifolia	Breeze Grass		√	√	√		√	√		grass		√	√			
Lomatium californicum	California Lomatium	√			√		√	√		perennial herb	yellow		√	√		
Lonciera japonica 'Halliana'	Hall's Honeysuckle							√	√	ground cover	white	√	√			
Lonicera hispidula var. vacillans	California Honeysuckle	√	√	√	√	√	√	√		vine	pink		√	√		
Lonicera interrupta	Chaparral Honeysuckle	√			√		√	√		vine	yellow	√	√			
Lonicera subspicata var. denudata	Johnston's Honeysuckle	√	√	√	√	√	√			vine	yellow	√	√			
Lonicera subspicata var. subspicata	Southern Honeysuckle	√			√	√	√	√		vine	yellow	√	√			
Lotus argophyllus var. argophyllus	Silver Bird's-Foot Trefoil	√					√	√		perennial						
Lotus crassifolius var. crassifolius	Broad-leaved Lotus	√					√	√		perennial herb	yellow/red	√				
Lotus grandiflorus var. grandiflorus	Chaparral Lotus	√	√	√	√	√	√	√		vine	yellow/red	√				
Lotus heermannii var. heermannii	Prostrate Woolly Lotus	√			√		√	√		perennial herb	yellow/red	√				
Lotus scopariu ssp. Brevialatus	Deer Weed	√					√	√	√							
Lotus scoparius	Deerweed	√	√	√	√	√	√	√		shrub	yellow/red	√				
Lotus tomentellus	Hairy Lotus	√					√	√	√							
Lupinus	Lupine	√					√	√	√							
Lupinus albifrons var. albifrons	Silver Bush Lupine	√	√	√	√		√	√		shrub	blue	√				
Lupinus arboreus	Lupine			√	√										22-24	443
Lupinus benthamii	Bentham Lupine	√					√	√	√							
Lupinus chamissonis	Dune Bush Lupine	√		√	√	√				shrub	purple	√				
Lupinus excubitus	Adonis Lupine	√					√	√		shrub						
Lupinus excubitus var. austromontanus	So. Mtn. Grape Soda Lupine	√					√	√		shrub	yellow/purple	√				
Lupinus excubitus var. excubitus	Desert Grape Soda Lupine	√							√	shrub	yellow/purple	√				
Lupinus excubitus var. hallii	Hall's Bush Lupine	√					√	√		shrub	yellow/purple	√				
Lupinus excubitus var. johnstoni	Interior Bush Lupine	√					√	√		shrub	yellow/purple	√				
Lupinus formosus var. formosus	Summer Lupine	√			√	√	√	√		perennial herb	blue	√				
Lupinus formosus var. robustus	Giant Western Lupine	√					√	√	√	perennial herb	blue	√				
Lupinus hartwegii	Lupine			√	√		√	√	√							443
Lupinus latifolius var. latifolius	Broad-leaf Lupine	√			√	√	√	√		perennial herb	purple	√				
Lupinus latifolius var. parishii	Parish's Lupine	√					√	√		perennial herb	purple	√				
Lupinus longifolius	Long-leaf Bush Lupine	√			√	√	√	√		shrub	yellow/purple	√				
Lupinus microcarpus	Chick Lupine	√					√	√	√							
Lupinus microcarpus densiflorus	Lupine			√	√		√	√	√							443
Lupinus nanus	Sky Lupine			√	√		√	√	√							443
Lupinus odoratus	Royal Desert Lupine	√					√	√	√							
Lupinus succulentus	Arroyo Lupine							√	√	annual	violet	√				
Lychnis coronaria	Crown-pink			√	√		√	√	√							444
Lycium andersonii	Anderson's Desert-thorn	√					√	√	√	shrub	white	√				
Lycium brevipes	Lycium			√	√		√	√	√							444
Lycium californicum	California Box-thorn	√	√	√	√	√	√			shrub	white	√				
Lycium chinense	Matrimony Vine			√	√		√	√	√							444
Lycium cooperi	Peach Thorn	√							√	shrub	white	√				
Lycium fremontii	Lycium			√	√		√	√	√							444
Lyonothamnus floribundus	Island Ironwood	I	√	√	√	√	√			tree	white	√				
Lysiloma microphylla thornberi	Feather Bush			√	√		√	√	√							445
Macfadyena unguis-cati	Cat Claw Vine						√	√	√	vine	white					
Magnolia grandiflora	Bull Bay				√					tree						
Mahonia	Mahonia				√					shrub						
Mahonia fremontii	Desert Mahonia			√	√		√	√	√							455
Mahonia nervosa	Longleaf Mahonia			√	√		√	√	√							456
Mahonia pinnata	California Holly Grape			√	√		√	√	√							456
Mahonia repens	Creeping Mahonia			√	√		√	√	√							456
Mahonia skylark	Skylark			√	√		√	√	√							456
Malacothamnus clementinus	San Clemente Is. Bushmallow			√	√					shrub	pink	√	√			
Malacothamnus davidsonii	Davidson's Bushmallow	√			√		√	√		shrub	pink	√				
Malacothamnus densiflorus	Bush Mallow	√					√	√	√							
Malacothamnus fasciculatus	Lax-flowered Bushmallow	√			√	√	√	√		shrub	pink	√				
Malacothamnus fasciculatus	Mesa Bushmallow	√					√	√		shrub						
Malacothamnus fremontii	Fremont's Bushmallow	√			√		√	√		shrub	pink	√				
Malacothamnus marrubioides	Pink-Flowered Bush Mallow	√					√	√		shrub						
Malacothrix glabrata	Desert Dandelion	√					√	√	√							
Malacothrix saxatilis var. tenuifolia	Cliff-aster	√		√	√	√	√	√		perennial herb	white	√				
Malephora crocea	Copper Ice Plant							√	√	ground cover	red	√				
Malephora lutea	Rocky Point Ice Plant			√	√		√	√	√							456
Malosma laurina	Laurel Sumac	√	√	√	√	√	√	√		shrub	white	√				
Malus x 'Prairfire'	Crabapple							√	√	shrub	pink	√	√			
Malvastrum lateritium	Trailing Mallow			√	√		√	√	√							457
Marah macrocarpus var. macrocarpus	Southern Wild Cucumber	√		√	√	√	√	√		vine	white	√	√			
Marah macrocarpus var. major	Island Wild Cucumber	√	√							vine	white	√	√			

Mascagnia lilacina	Lavender Orchid Vine			√	√		√	√	√							462
Mascagnia macroptera	Yellow Orchid Vine			√	√		√	√	√							462
Matricaria recutita	Chamomile			√	√		√	√	√							462
Maurandya [Maurandella] antirrhiniflora	Violet Twining Snapdragon	√			√		√	√	√	perennial herb	purple	√				
Maytenus phyllanthoides	Mangle Dulce			√	√										23-24	463
Melaleuca armillaris	Drooping Melaleuca			√	√		√	√	√							464
Melaleuca decussata	Lilac Melaleuca			√	√		√	√	√							464
Melaleuca elliptica	Granite Bottlebrush			√	√		√	√	√							464
Melaleuca ericifolia	Heath Melaleuca			√	√		√	√	√							464
Melaleuca fulgens	Scarlet Honey Myrtle			√	√		√	√	√							464
Melaleuca huegelii	Chenille Honey Myrtle			√	√		√	√	√							464
Melaleuca hypericifolia	Dotted Melaleuca			√	√		√	√	√							464
Melaleuca incana	Gray Honey Myrtle			√	√		√	√	√							464
Melaleuca lanceolata	Black Tea Tree			√	√		√	√	√							464
Melaleuca linariifolia	Flaxleaf Paperbark			√	√		√	√	√							464
Melaleuca nesophila	Pink Melaleuca			√	√		√	√	√							464
Melaleuca quinquenervia	Cajeput Tree			√	√		√								20-24	464
Melaleuca rhaphiophylla	Swamp Paperbark			√	√		√	√	√							464
Melaleuca styphelioides	Black Tea Tree			√	√		√	√	√							464
Melaleuca thymifolia	Thymelear Melaleuca			√	√		√	√	√							465
Melaleuca viridiflora	Broad-leafed Paperbark			√	√		√								19-24	465
Melaleuca wilsonii	Violet Honey Myrtle			√	√		√	√	√							465
Melampodium leucanthum	Blackfoot Daisy							√	√	perennial	white	√	√			
Melia azedarach	Chinaberry			√	√		√	√	√							465
Melica imperfecta	Small-flowered Melic	√	√	√	√	√	√	√		perennial grass	grass spikelet		√	√		
Melica stricta	Nodding Melic	√					√	√		perennial						
Mentzelia albicaulis	Blazing Star	√					√	√	√							
Mentzelia involucrata	Blazing Star	√					√	√	√							
Mentzelia laevicaulis	Blazing Star	√					√	√	√	perennial herb	yellow	√				
Metrosideros collinus	Springfire			√	√										23-24	467
Metrosideros excelsus	New Zealand Christmas Tree			√	√										23-24	467
Microlepia firma	Indian Fern			√	√										23-24	468
Microlepia strigosa	Lace Fern			√	√										23-24	468
Mimulus [Diplacus] aurantiacus	Sticky Monkeyflower	√	√	√	√	√	√	√		shrub	orange	√	√			
Mimulus [Diplacus] longiflorus	Southern Bush Monkeyflower	√			√		√	√		shrub	red	√	√			
Mimulus aurantiacus	Sticky Monkey Flower			√	√		√	√	√							469
Mimulus aurantiacus (incl. M. longiflorus)	Orange Bush Monkey-Flower	√								shrub						
							√	√								
Mimulus aurantiacus [incl. M. bifidus, M. flemingii, M. longiflorus [Diplacus l.]	Orange Bush Monkey-Flower	√								shrub						
Mimulus fremontii	Fairy Trumpet	√					√	√	√							
Mimulus guttatus	Common Monkey-flower	√								annual herb/perennial herb						
Mirabilis bigelovii [M. laevis var. villosa]	Bigelow's Desert Four O'Clock	√			√		√	√	√	perennial herb	white	√	√			
Mirabilis californica [M. laevis var. crassifolia]	Wishbone Bush	√	√	√	√	√	√	√	√	perennial herb	pink/purple	√	√			
Mirabilis multiflora var. pubescens	Desert Four O'clock	√			√		√	√	√	perennial herb	pink	√				
Monardella hypoleuca	White-leaf Monardella	√			√	√	√	√		perennial herb	purple		√	√		
Monardella linoides ssp. linoides	Narrow-leaved Monardella	√							√	perennial herb	white/pink	√				
Monardella linoides ssp. stricta	Flax-like Monardella	√					√			perennial herb	white/pink	√				
Monardella macrantha ssp. hallii	Hall's Monardella	√			√		√			perennial herb	red	√	√			
Monardella macrantha ssp. macrantha	Hummingbird Monardella	√			√		√	√		perennial herb	red	√	√			
Monardella odoratissima	Mountain Monardella	√					√			perennial herb	white/purple	√	√			
Monardella villosa	Coyote Mint				√		√	√		perennial herb	purple	√				
Mondarella viridis ssp. Saxicola	Rock Monardella	√					√	√	√							
Monoptilon bellidiforme	Desert Star	√					√	√	√							
Monoptilon bellioides	Desert Star	√					√	√	√							
Muhlenbergia capillaris	Pink Muhly			√	√		√	√	√							473
Muhlenbergia dumosa	Bamboo Muhly			√	√		√	√	√							473
Muhlenbergia emersleyi	Bull Grass			√	√		√	√	√							473
Muhlenbergia lindheimeri	Muhly			√	√		√	√	√							473
Muhlenbergia pubescens	Soft Blue Mexican Muhly			√	√		√	√	√							473
Muhlenbergia rigens	Deer Grass	√			√	√	√	√		perennial grass	grass spikelet	√	√			
Muhlenbergia rigida	Purple Muhly			√	√		√	√	√							473
Myoporum floribundum	Myoporum			√	√		√								19-24	474
Myoporum insulare	Myoporum			√	√		√								19-24	474
Myoporum parvifolium	Myoporum			√	√		√	√	√							474
Myrica californica	California Wax-myrtle	√		√	√	√				shrub	inconspicuous	√	√			
Myrica californica	Pacific Wax Myrtle			√	√		√	√	√							475

Myrsine africana	African Boxwood			√	√		√	√	√							475
Myrtus communis	Myrtle			√	√		√	√	√							476
Nassella cernua	Nodding Needlegrass	√			√	√	√	√		perennial grass	grass spikelet	√	√			
Nassella lepida	Foothill Needlegrass	√	√	√	√	√	√	√		perennial grass	grass spikelet	√	√	√		
Nassella lepida [Stipa l. var. l.]	Small-flowered Needlegrass	√								perennial herb						
Nassella pulchra	Purple Needlegrass	√	√	√	√	√	√	√		perennial grass	grass spikelet	√	√	√		
Nassella pulchra [Stipa p.]	Purple Needlegrass	√								perennial herb						
Navarretia peninsularis	Baja Navarretia	√					√	√	√							
Nemophila menziesii	Baby Blue Eyes	√								annual herb						
Nepeta cataria	Catnip			√	√		√	√	√							480
Nepeta clarkei	Catnip			√	√		√	√	√							480
Nepeta gradiflora	Catnip			√	√		√	√	√							480
Nepeta nervosa	Catnip			√	√		√	√	√							480
Nepeta racemosa	Catnip			√	√		√	√	√							480
Nepeta reichenbachiana	Catnip			√	√		√	√	√							480
Nepeta sibirica	Siberian Catnip			√	√		√	√	√							480
Nepeta x faassenii	Catmint			√	√		√	√	√							480
Nerium Oleander	Oleander							√	√							
Nicotiana bigelovii	Desert Tobacco	√					√	√	√							
Nicotiana obtusifolium	Desert Tobacco	√					√	√	√							
Nolana paradoxa	Nolana			√	√		√	√	√							483
Nolina bigelovii	Grass Tree			√	√		√	√	√							483
Nolina longifolia	Mexican Grass Tree			√	√		√	√	√							483
Nolina parryi	Parry's Nolina				√		√	√		shrub	yellow	√				
Nolina recurvata	Bottle Palm			√	√		√	√	√							483
Ochna serrulata	Bird's Eye Bush			√	√		√	√	√							484
Oenothera berlandieri	Mexican Evening Primrose						√	√	√	ground cover	pink	√				
Oenothera caespitosa	Fragrant Evening-Primrose	√							√	perennial herb	white	√				
Oenothera californica ssp. avita	California Evening-Primrose	√							√	perennial herb	white	√				
Oenothera californica ssp. californica	California Evening-Primrose	√		√	√	√				perennial herb	white	√				
Oenothera elata	Evening Primrose	√								perennial herb						
Oenothera elata hookeri	Evening Primrose			√	√		√	√	√							485
Oenothera fruticosa	Sundrops				√		√	√	√						18-21	485
Oenothera macrocarpa	Ozark Sundrops			√	√		√	√	√							485
Oenothera stubbei	Saltillo Evening Primrose			√	√		√	√	√							485
Olea europaea	Fruitless Olive						√	√	√		pink					
Olneya tesota	Desert Ironwood				√		√	√	√						18-23	486
Opuntia [Cylindropuntia] echinocarpa	Silver Cholla	√							√	cactus	yellow	√				
Opuntia [Cylindropuntia] prolifera	Coast Cholla	√	√	√	√	√				cactus	red/purple	√				
Opuntia acanthocarpa	Buckhorn Cholla	√					√	√		perennial						
Opuntia basilaris	Beavertail Cactus	√					√	√		perennial						
Opuntia basilaris var. basilaris	Beavertail Cactus	√					√		√	cactus	pink	√				
Opuntia basilaris var. brachyclada	Beavertail Cactus	√					√	√		cactus	pink	√				
Opuntia bigelovii	Teddybear Cactus			√	√		√	√	√							487
Opuntia echinocarpa	Golden Cholla	√					√	√		perennial						
Opuntia engelmannii	Engelmann's Prickly Pear							√	√	cactus	yellow	√	√			
Opuntia leptocaulis	Desert Christmas Cactus			√	√		√	√	√							488
Opuntia littoralis	Coastal Prickly-Pear	√	√	√	√	√	√	√		cactus	yellow	√				
Opuntia macrocentra	Cactus			√	√		√	√	√							488
Opuntia micodasys	Bunny Ears			√	√		√	√	√							488
Opuntia oricola	Chaparral Prickly-pear	√	√	√	√	√				cactus	yellow	√				
Opuntia parryi	Cane Cholla	√					√	√		perennial						
Opuntia parryi [Cylindropuntia californica]	Cane Cholla	√			√		√	√		cactus	yellow	√				
Opuntia ramoisissima	Diamond Cholla	√					√	√		perennial						
Opuntia santa-rita	Purple Prickly Pear							√	√	cactus	yellow	√	√			
Orcuttia californica	California Orcutt Grass	√					√	√	√							
Origanum amanum	Oregano			√	√		√	√	√							489
Origanum calcaratum	Oregano			√	√		√	√	√							489
Origanum dictamnus	Dittany of Crete			√	√		√	√	√							489
Origanum laevigatum	Oregano			√	√		√	√	√							489
Origanum libanoticum	Oregano			√	√		√	√	√							489
Origanum majorana	Sweet Marjoram			√	√		√	√	√							489
Origanum onites	Pot Marjoram			√	√		√	√	√							489
Origanum rotundifolium	Oregano			√	√		√	√	√							489
Origanum syriacum	Biblical Hyssop			√	√		√	√	√							489
Origanum vulgare	Oregano			√	√		√	√	√							489
Origanum x hybridum	Oregano Hybrid			√	√		√	√	√							489
Origanum x majoricum	Italian Marjoram			√	√		√	√	√							489
Ornithostaphylos oppositifolia	Baja California Birdbush				√		√			shrub/tree	white	√	√			
Orthocarpus purpurascens	Owl's Clover							√	√	annual	pink	√	√			

Paeonia californica	California Peony				√	√	√	√		perennial herb	red	√	√	√			
Pandorea pandorana	Wonga-wonga Vine			√	√		√										495
Panicum virgatum	Switch Grass				√		√	√	√						18-23		495
Parthenocissus inserta	Virginia Creeper			√	√		√	√	√								498
Parthenocissus quinquefolia	Virginia Creeper			√	√		√	√	√								498
Parthenocissus tricuspidata	Boston Ivy			√	√		√	√	√								498
Pasania edulis	Japanese False Oak			√	√		√	√	√								498
Pedilanthus macrocarpus	Lady's Slipper			√	√		√	√							19-24		508
Pellaea andromedifolia	Coffee Fern	√			√	√	√	√		fern	none	√	√	√			
Pellaea mucronata	Bird's Foot Fern			√	√		√	√	√								510
Pellaea mucronata ssp. californica	California Cliff-brake	√			√		√	√		fern	none	√	√	√			
Pellaea mucronata ssp. mucronata	Bird's-foot Fern	√	√	√	√	√	√	√		fern	none	√	√	√			
Penstemon ambiguus	Prairie Penstemon				√		√	√	√						18-21		511
Penstemon baccharifolius	Firecracker Penstemon						√	√	√	perennial	red	√	√				
Penstemon barbatus	Penstemon				√		√	√	√						18-21		511
Penstemon centranthifolius	Scarlet Bugler	√			√	√	√	√		perennial herb	red	√	√				
Penstemon digitalis	Penstemon			√	√		√	√	√								511
Penstemon eatonii var. undosus	Eaton's Penstemon	√			√		√	√		perennial herb	red	√	√	√			
Penstemon grinnellii	Grinnell's Beardtongue	√					√	√		perennial							
Penstemon grinnellii var. grinnellii	Grinnell's Penstemon	√			√		√	√		perennial herb	purple	√					
Penstemon heterophyllus	Foothill Penstemon	√								perennial herb							
Penstemon heterophyllus var. australis	Southern Foothill Penstemon	√			√	√	√	√		perennial herb	blue	√	√				
Penstemon heterophyllus var. heterophyllus	Foothill Penstemon	√			√		√	√		perennial herb	blue	√	√				
Penstemon incertus	Western Desert Penstemon	√			√				√	perennial herb	blue	√					
Penstemon labrosus	San Gabriel Pentstemon	√			√		√	√		perennial herb	red	√	√				
Penstemon laetus var. laetus	Mountain Blue Penstemon	√			√		√	√		perennial herb	blue	√					
Penstemon newberryi	Mountain Pride						√	√	√						18-19		511
Penstemon parryi	Parry's Penstemon							√	√	perennial	pink	√	√				
Penstemon pinifolius	Penstemon			√	√		√	√	√								511
Penstemon pseudospectabilis	Canyon Penstemon							√	√	perennial	purple	√	√				
Penstemon speciosus	Royal Penstemon	√			√		√	√		perennial herb	blue/purple	√					
Penstemon spectabilis	Showy Penstemon	√			√		√	√		perennial herb	blue/purple	√					
Penstemon superbus	Superb Penstemon							√	√	perennial	scarlet	√	√				
Penstemon utahensis	Utah Penstemon	√					√	√	√								
Penstemon x gloxinioides	Border Penstemon			√	√		√	√	√								511
Perovskia atriplicifolia	Russian Sage			√	√		√	√	√								512
Petalonyx thurberi ssp. thurberi	Thurber's Sandpaper Plant	√							√	perennial herb	white	√					
Phacelia campanularia	California Desert Bluebells			√	√		√	√	√								515
Phacelia Cryptantha	Lacy Phacelia	√					√	√	√								
Phacelia egena	Rock Phacelia	√			√	√	√	√		perennial herb	white	√	√				
Phacelia fremontii	Fremont Phacelia	√					√	√	√								
Phacelia imbricata ssp. imbricata	Imbricate Phacelia	√			√	√	√	√		perennial herb	white	√	√				
Phacelia imbricata ssp. patula	Imbricate Phacelia	√					√			perennial herb	white	√	√				
Phacelia ramosissima	Branching Phacelia	√			√	√	√	√		perennial herb	white/purple	√	√				
Philadelphus lewisii	Mock Orange	√					√			shrub	white	√	√				
Phlomis fruticosa	Jerusalem Sage			√	√		√	√	√								517
Phlomis italica	Pink Glory			√	√		√	√	√								517
Phlomis lanata	Jerusalem Sage			√	√		√	√	√								517
Phlomis purpurea	Green Leaf			√	√		√	√	√								517
Phlomis russeliana	Jerusalem Sage			√	√		√	√	√								517
Phlomis samia	Greek Jerusalem Sage			√	√		√	√	√								517
Phlomis tuberosa	Jerusalem Sage			√	√		√	√	√								517
Photinia x 'Fraseri'	Fraser's Photinia							√	√	shrub	white		√				
Pinus attenuata	Knobcone Pine	√					√			tree	none	√	√				
Pinus contorta ssp. murrayana	Lodgepole Pine	√					√	√		tree	none	√	√	√			
Pinus coulteri	Coulter Pine	√					√	√		tree	none	√					
Pinus eldarica	Afghan Pine							√	√	tree							
Pinus flexilis	Limber Pine	√					√			tree	none	√					
Pinus halepensis	Aleppo Pine							√	√	tree							
Pinus lambertiana	Sugar Pine	√					√			tree	none	√					
Pinus monophylla	Single-leaf Pinyon	√					√	√	√	shrub/tree	none	√					
Pinus pinea	Italian Stone Pine							√	√	tree							
Pinus ponderosa	Ponderosa Pine	√			√		√	√	√	tree	none	√					
Pinus sabiniana	Digger Pine	√			√		√	√	√	tree	none	√	√				
Pinus torreyana	Torrey Pine			√	√	√				tree	none	√					
Pistachia chinensis	Chinese Pistache							√	√	tree							
Pistachio nut	Pistachio				√		√	√	√						18-21		529
Pistachio nut	Mastic			√	√		√	√	√								530
Plagiobothrys sp.	Popcorn Flower	√					√	√	√								
Platanus mexicana	Mexican Sycamore		√	√	√		√	√	√	tree		√					18-24

Platanus racemosa	California Sycamore	√			√	√				tree	inconspicuous	√	√				
Platanus x acerifolia	London plane tree		√	√	√		√	√	√	tree		√					18-24
Platystemon californicus ssp. Crinitus	Cream Cups	√					√	√	√								
Plecostachys serpyllifolia	Licorice Plant			√	√		√	√	√								532
Pleuraphis rigida	Galleta Grass	√							√	perennial grass	grass spikelet	√					
Plumeria obtusa	Singapore Plumeria			√												24	538
Plumeria rubra	Plumeria			√	√		√								19,21-24		538
Podocarpus	Yew Pine				√					tree							
Polypodium californicum	California Polypody	√	√	√	√	√	√	√		fern	none		√	√			
Populus balsamifera	Black Cottonwood	√								tree							
Populus deltoides	Cottonwood	√					√	√	√								
Populus fremontii	Freemont cottonwood	√								tree							
Populus trichocarpa	Black Cottonwood	√					√	√	√								
Portulacaria afra	Elephant's Food			√	√		√	√	√								544
Prosopis alba	Argentine Mesquite			√	√		√	√	√								548
Prosopis chilensis	Chilean Mesquite			√	√		√	√	√								548
Prosopis glandulosa	Mesquite	√					√	√		tree/shrub							
Prosopis glandulosa var. torreyana	Honey Mesquite	√			√		√	√	√	shrub/tree	yellow	√					
Prosopis pubescens	Screw-bean Mesquite	√			√		√	√	√	shrub/tree	yellow	√	√				
Prosopis veluntina	Arizona Mesquite			√	√		√	√	√								548
Prosopis x chilensis	Chilean Hybrid Mesquite							√	√	tree	yellow		√				
Prostanthera nivea induta	Mint Bush			√	√		√								19-24		548
Prostanthera rotundifolia	Mint Bush			√	√		√								19-24		548
Protea compacta	Pink Protea			√	√		√								21-24		548
Protea cynaroides	King Protea			√	√		√								21-24		548
Protea eximia	Rose-spoon Protea			√	√		√								21-24		548
Protea neriifolia	Mink Protea			√	√		√								21-24		548
Protea susannae	Susanna Protea			√	√		√								21-24		548
Prunus besseyi	Western Sandcherry						√	√	√	shrub	white		√				
Prunus caroliniana	Carolina Laurel Cherry		√	√	√		√	√	√	tree		√					18-24
Prunus cerasifera	Purple Leaf Plum		√	√	√		√	√	√	tree	pink	√					
Prunus emarginata	Bitter Cherry	√					√	√		tree/shrub							
Prunus fasciculata	Desert Almond	√					√	√		tree/shrub							
Prunus fasciculata var. fasciculata	Desert Almond	√					√	√	√	shrub	white/yellow	√					
Prunus ilicifolia	Holly-Leaved Cherry	√					√	√		tree/shrub							
Prunus ilicifolia ssp. ilicifolia	Hollyleaf Cherry	√			√	√	√	√		shrub/tree	white	√	√				
Prunus ilicifolia lyonii	Catalina Cherry	√	√	√													
Prunus virginiana	Western Choke-Cherry	√					√	√		tree/shrub							
Prunus virginiana var. demissa	Western Chokecherry	√					√	√		shrub	white	√	√	√			
Pseudognaph. beneolens [Gnaph. canescens beneolens]	Fragrant Everlasting	√	√	√	√	√	√	√		perennial herb	white/yellow	√	√				
Pseudognaphalium [Gnaph.] canescens microcephalum	White Everlasting	√	√	√	√	√	√	√		perennial herb	white/yellow	√	√				
Pseudognaphalium [Gnaphalium] californicum	California Everlasting	√	√	√	√	√	√	√		perennial herb	white	√	√				
Pseudognaphalium [Gnaphalium] stramineum	Everlasting Cudweed	√	√	√	√	√	√	√	√	perennial herb	white/yellow	√	√				
Pseudognaphalium biolettii [Gnaphalium bicolor]	Bicolored Everlasting	√	√	√	√	√	√	√		perennial herb	yellow	√					
Pseudotsuga macrocarpa	Bigcone Douglas-fir	√			√		√	√		tree	none	√	√	√			
Psilostrophe cooperi	Paper Daisy				√		√	√	√						18-21		554
Psilostrophe tagetina	Wooly Paperflower						√	√	√	perennial	yellow	√	√				
Punica granatum	Pomegranate						√	√	√	shrub	orange-red	√					
Purshia mexicana	Cliff Rose				√		√	√	√						18-23		556
Purshia mexicana stansburyana	Cliff Rose				√		√	√	√						18-23		556
Purshia tridentata	Antelope Bush	√					√	√		shrub							
Purshia tridentata var. glandulosa	Antelope Bitterbrush	√						√	√	shrub	white						
Puya berteroniana	Puya			√	√		√								19-24		557
Pyracantha crenatoserrata	Firethorn			√	√		√	√	√								557
Pyracantha koidzumii	Firethorn			√	√		√	√	√								557
Pyrostegia venusta	Flame Vine			√	√		√								21-24		557
Pyrrosia lingua	Japanese Felt Fern			√	√		√								19-24		558
Pyrus calleryana	Ornamental Pear				√		√	√	√						18-21		558
Pyrus kawakamii	Evergreen Pear			√	√		√	√	√								558
Pyrus pyrifolia	Sand Pear				√		√	√	√						18-21		558
Pyrus salicifolia	Weeping Willow-leafed Pear				√		√	√	√						18-21		558
Quercus agrifolia	coast live oak	√								tree							
Quercus agrifolia var. agrifolia	Coast Live Oak	√	√	√	√	√	√	√		tree	inconspicuous	√	√				
Quercus berberidifolia	Scrub Oak	√	√	√	√	√	√	√		shrub/tree	inconspicuous	√					
Quercus chrysolepis	Canyon Live Oak	√	√		√		√	√		tree	inconspicuous	√					
Quercus chrysolepis	Canyon Oak	√					√	√		tree							
Quercus douglasii	Blue Oak	√					√	√		tree							

Quercus dumosa	Nuttall's Scrub Oak	√	√	√	√	√				shrub	inconspicuous	√						
Quercus durata var. gabrielensis	San Gabriel Mtns. Leather Oak	√					√	√		shrub	inconspicuous	√						
Quercus engelmannii	Engelmann Oak	√	√	√	√		√	√		tree	inconspicuous	√	√					
Quercus garryana var. breweri	Brewer's Oak	√					√	√		tree	inconspicuous	√						
Quercus john-tuckeri	Tucker's Oak	√					√	√		tree/shrub								
Quercus john-tuckeri [Q. turbinella californica]	Tucker Oak	√					√	√		shrub/tree	inconspicuous	√						
Quercus kelloggii	Blue Oak	√					√	√		tree	inconspicuous	√						
Quercus lobata	Valley Oak	√	√		√	√	√	√		tree	inconspicuous	√						
Quercus tomentella	Island Oak	I	√	√	√					tree	inconspicuous	√						
Quercus turbinella	California Scrub	√					√	√	√									
Quercus wislizenii	Interior Live Oak	√					√	√		tree								
Quercus wislizenii var. frutescens	Dwarf Interior Live Oak	√			√	√	√			shrub/tree	inconspicuous	√						
Quercus wislizenii var. wislizenii	Interior Live Oak	√						√		shrub/tree	inconspicuous	√						
Ranunculus californicus	California Buttercup	√	√	√	√	√	√	√		perennial herb	yellow	√	√					
Raoulia australis	Saxon's Pass			√	√		√	√	√									564
Ratibida columnifera	Mexican Hat							√	√	perennial	yellow	√	√					
Rhamnus alaternus	Italian Buckthorn			√	√		√	√	√									566
Rhamnus californica	California Coffeeberry	√					√	√		shrub								
Rhamnus californica ssp. californica	California Coffeeberry	√			√	√	√	√		shrub	inconspicuous	√	√					
Rhamnus crocea	Redberry	√			√	√	√	√		shrub	inconspicuous	√	√					
Rhamnus ilicifolia	Hollyleaf Redberry	√			√	√	√	√		shrub	inconspicuous	√	√					
Rhamnus tomentella	Hoary Coffeeberry	√					√	√		shrub								
Rhamnus tomentella ssp. cuspidata	Hoary Coffeeberry	√					√	√	√	shrub	yellow	√	√					
Rhaphiolepis indica	indian hawthorn		√	√	√		√	√	√	shrub	pink	√						18-24
Rhaphiolepis 'majestic bounty'	majestic bounty		√	√	√		√	√	√	shrub	pink	√						18-24
Rhaphiolepis umbellata	Hawthorn		√	√	√		√	√	√	shrub	pink	√						18-24
Rhus copallina	Shining Sumac							√	√								18	576
Rhus integrifolia	Lemonade Berry	√	√	√	√	√	√			shrub	white/pink	√	√					
Rhus lancea	African Sumac			√	√		√	√	√									576
Rhus laurina	Laurel Sumac			√	√		√	√	√									576
Rhus ovata	Sugar Bush	√	√		√	√	√	√		shrub	white	√	√					
Rhus trilobata	Skunk Bush	√			√	√	√	√		shrub	yellow	√	√					
Ribes aureum	Golden Currant	√					√	√		shrub								
Ribes aureum var. gracillimum	Golden Currant	√			√	√	√	√		shrub	yellow	√	√					
Ribes californicum	California Gooseberry	√			√	√	√	√		shrub	red/white	√	√					
Ribes cereum	Wax Currant	√					√	√		shrub	pink		√	√				
Ribes indecorum	White-flowering Currant	√			√	√	√	√		shrub	white	√	√					
Ribes malvaceum	Chaparral Currant	√					√	√		shrub								
Ribes malvaceum var. malvaceum	Chaparral Currant	√					√	√		shrub	pink		√					
Ribes malvaceum var. viridifolium	Chaparral Currant	√			√	√	√	√		shrub	pink	√	√					
Ribes quercetorum	Foothill Gooseberry	√					√	√		shrub								
Ribes roezlii	Sierra Gooseberry	√					√	√		shrub								
Ribes sanguiuneum	Pink Winter Currant			√	√		√	√	√									577
Ribes speciosum	Fuchsia-flowered Gooseberry	√			√	√		√		shrub	red		√	√				
Ribes viburnifolium	Catalina Currant	√	√		√					shrub	red		√	√				
Robinia neomexicana	Desert Locust			√	√		√	√	√									578
Robinia x ambigua	Locust			√	√		√	√	√									578
Romneya coulteri	Coulter's Matilija Poppy	√	√	√	√	√	√	√		shrub	white	√						
Rosa banksiae	Lady Banks Rose						√	√	√	vine	yellow	√	√					
Rosa californica	California Wild Rose	√	√	√	√	√	√	√		shrub	pink		√	√				
Rosa minutifolia	Baja Rose				√					shrub	pink	√	√					
Rosa woodsii var. ultramontana	Interior Wild Rose	√					√	√		shrub	pink	√	√					
Rosemarinus officinalis prostratus	Dwarf Rosemary		√							shrub								
Rosmarinus officinalis	Rosemary			√	√		√	√	√									587
Rubus ursinus	California blackberry	√								shrub								
Sabal blackburniana	Hispaniola Palmetto			√	√		√								19-24			590
Sabal mexicana	Oaxaca Palmetto			√	√		√								19-24			590
Sabal minor	Palmetto			√	√		√								19-24			590
Sabal palmetto	Cabbage Palm			√	√		√								19-24			590
Saliva dorrii	Blue Sage	√					√	√	√									
Salix laevigata	Red Willow	√								tree								
Salix lasiolepsis	Arroyo Willow	√								tree								
Salsola iragus	Russian Thistle	√					√	√	√									
Salvia apiana	White Sage	√	√	√	√	√	√	√	√	shrub	white	√						
Salvia carduacea	Sage Thistle	√					√	√	√									
Salvia clevelandii	Cleveland Sage				√	√	√	√		shrub	blue	√						
Salvia dorrii	Desert Sage	√					√	√		shrub								
Salvia dorrii var. dorri	Dorr's Sage	√						√	√	shrub	blue	√						
Salvia dorrii var. pilosa	Hairy Sage	√						√	√	shrub	blue	√						
Salvia greggi	Autumn sage		√							shrub	many varieties							
Salvia leucantha	Mexican Bush Sage							√	√	perennial	purple	√	√					

Salvia leucophylla	Purple Sage		√			√	√		√		shrub	purple	√					
Salvia mellifera	Black Sage		√	√	√	√	√	√	√		shrub	white	√	√				
Salvia spathacea	Hummingbird Sage		√			√	√	√	√		perennial herb	red	√	√	√			
Sambucus mexicana	Mexican Elderberry		√								tree/shrub							
Sambucus mexicana [S. nigra canadensis]	Mexican Elderberry		√	√	√	√	√	√	√		shrub/tree	yellow	√	√				
Sansevieria trifasciata	Bowstring Hemp				√	√										23-24		598
Santolina chamaecyparissus	Lavender Cotton				√	√		√	√	√								598
Santolina pinnata	Lavender Cotton				√	√		√	√	√								598
Santolina rosmarinifolia	Lavender Cotton				√	√		√	√	√								598
Santolina virens	Green Santolina							√	√	√	shrub	yellow	√					
Sapium sebiferum	Chinese Tallow Tree	√		√	√	√		√	√		tree	yellow	√					18-21
Satureja douglasii	Yerba Buena		√			√	√				perennial herb	white			√			
Scirpus sp. Sedges	Tule		√					√	√	√								
Scrophularia californica var. californica	California Bee Plant		√			√	√	√	√		perennial herb	red	√	√				
Scrophularia californica var. floribunda	California Figwort		√						√		perennial herb	red	√	√				
Scutellaria bolanderia ssp. Austromontana	Southern Skullcap		√					√	√	√								
Sedum acre	Goldmoss Sedum				√	√		√	√	√								604
Sedum album	Stonecrop				√	√		√	√	√								604
Sedum brevifolium	Stonecrop				√	√		√	√	√								605
Sedum cauticolum	Stonecrop				√	√		√	√	√								605
Sedum confusum	Stonecrop				√	√		√	√	√								605
Sedum dasyphyllum	Stonecrop				√	√		√	√	√								605
Sedum dendroideum	Stonecrop				√	√		√	√	√								605
Sedum kamtschaticum	Stonecrop					√		√	√	√						18-21		605
Sedum lineare	Stonecrop				√	√		√	√	√								605
Sedum morganianum	Donkey Tail				√	√										22-24		605
Sedum oxypetalum	Stonecrop				√	√		√								21-24		605
Sedum praealtum	Stonecrop				√	√		√	√	√								605
Sedum reflexum	Stonecrop				√	√		√	√	√								605
Sedum rubrotinctum	Pork and Beans				√	√		√	√	√								605
Sedum sediforme	Stonecrop				√	√		√	√	√								605
Sedum sieboldii	Stonecrop				√	√		√	√	√								605
Sedum spathulifolium	Pacific Stonecrop		√			√	√	√	√		perennial herb	yellow		√				
Sedum spectabile	Stonecrop				√	√		√	√	√								605
Sedum spurium	Stonecrop				√	√		√	√	√								605
Sedum telephium	Stonecrop				√	√		√	√	√								605
Sempervivum arachnoideum	Cobweb Houseleek				√	√		√	√	√								606
Sempervivum tectorum	Hen and Chickens				√	√		√	√	√								606
Senecio aphanactis	Rayless Ragwort		√					√	√	√								
Senecio cineraria	Dusty Miller				√	√		√	√	√								606
Senecio flaccidus var. douglasii	Douglas's Groundsel		√			√	√	√	√		shrub	yellow	√	√				
Senecio flaccidus var. monoensis	Mono Groundsel		√							√	shrub	yellow	√	√				
Senecio madraliscae	Flame Vine				√	√		√								21-24		606
Senecio marcroglossus	Kenya Ivy				√	√										22-24		606
Senecio viravira	Dusty Miller				√	√		√	√	√								607
Senna armata	Desert Senna		√							√	shrub	yellow	√					
Senna artemisioides	Feathery Cassia					√		√	√	√						18-23		607
Senna corymbosa	Flowery Senna				√	√		√								21-24		607
Senna nemophila	Senna				√	√		√	√	√								607
Senna phyllodinea	Silver Leaf Cassia				√	√		√	√	√								607
Senna splendida	Golden Wonder Senna				√	√										21-24		607
Senna surattensis	Scrambled Eggs				√	√		√								19-24		607
Senna wislizenii	Shrubby Senna							√	√	√	shrub	yellow	√					
Sequoiadendron giganteum	Giant Sequoia					√		√	√	√						18-23		608
Sida fallax	Ililma				√	√										23-24		609
Sidalcea malviflora	Dwarf Checkerbloom		√			√	√	√	√		perennial herb	purple	√	√				
Sidalcea neomexicana	Checker Bloom		√					√	√	√								
Silene alpestris	Alpine Campion				√	√		√	√	√								609
Silene armeria	Sweet William Catchfly								√	√	annual	pink	√					
Silene laciniata ssp. major	Indian Pink		√			√	√	√	√		perennial herb	red			√			
Silene schafta	Moss Campion					√		√	√	√						18-21		610
Silene uniflora	Double Bladder Campion				√	√		√	√	√								610
Simmondsia chinensis	Jojoba				√	√		√	√	√								610
Sisyrinchium bellum	Blue-eyed Grass		√	√	√	√	√	√	√		perennial herb	blue	√	√				
Sisyrinchium bellum	Blue-Eyed-Grass		√					√	√		perennial							
Sisyrinchium striatum	Grass				√	√		√	√	√								610
Slavia columbariae	Chia		√					√	√	√								
Solanum douglasii	Douglas's Nightshade		√	√	√	√	√	√	√		perennial herb	white			√			

Solanum umbelliferum	Blue Witch	√					√	√		shrub	purple	√	√				
Solanum wallacei	Catalina Nightshade	I	√	√	√	√				shrub	purple	√	√				
Solanum xanti	Purple Nightshade	√	√	√	√	√	√	√		shrub	purple	√	√				
Solidago rugosa	Fireworks				√		√	√	√						18-23		612
Solidago sphacelata	Golden Fleece				√		√	√	√						18-23		612
Sophora japonica	Japanese Pagoda Tree			√	√		√	√	√								613
Sophora secundiflora	Mescal Bean			√	√		√	√	√								613
Spathodea campanulata	African Tulip Tree			√	√		√								21-24		615
Sphaeralcea ambigua var. rosacea	Rose Apricot Mallow	√							√	perennial herb	pink	√					
Sphaeralcea ambigua var. rugosa	Apricot Mallow	√					√	√	√	perennial herb	orange	√					
Sphaeralcea incana	Orange Mallow							√	√							18	615
Sphaeralcea munroana	Globe Mallow			√	√		√	√	√								615
Sporobolus airoides	Alkaki Sacaton			√	√		√	√	√								617
Stachys albotomentosa	Hidalgo			√	√		√	√	√								618
Stachys byzantina	Lamb's Ears			√	√		√	√	√								618
Stachys coccinea	Scarlet Hedge Nettle			√	√		√	√	√								618
Stachys macrantha	Big Betony			√	√		√	√	√								618
Stanleya pinnata var. pinnata	Prince's Plume	√			√	√	√	√	√	perennial herb	yellow	√	√				
Stenocereus thurberi	Organpipe Cactus			√	√		√	√	√								618
Stephanomeria cichoriacea	Chickory-leaved Stephanomeria	√			√	√	√	√		perennial herb	pink	√					
Stephanomeria paucifloria	Desert Straw	√					√	√	√								
Stillingia paucidentata	Mojave Stillingia	√							√	perennial herb	yellow	√					
Streptanthus bernardinus	Jewel Flower	√					√	√	√								
Streptanthus campestris	Southern Jewel Flower	√					√	√	√								
Styrax redivivus [S. officinalis]	California Snowdrop Bush	√					√	√		shrub	white		√	√			
Symphoricarpos albus var. laevigatus	Common Snowberry	√					√	√		shrub	pink	√	√				
Symphoricarpos mollis	Trailing Snowberry	√	√		√	√	√	√		shrub	pink		√	√			
Symphoricarpos orbiculatus	Coralberry				√		√	√	√						18-21		624
Symphoricarpos x chenaultii	Snowberry				√		√	√	√						18-21		624
Symphyotrichum defoliatum	San Bernardino Aster	√					√	√	√								
Taxodium distichum	Bald Cypress			√	√		√	√	√								627
Taxodium mucronatum	Montezuma Cypress			√	√		√	√	√								628
Tecoma garrocha	Argentine Tecoma			√	√		√								21-24		629
Tecoma stans	Yellow Bells			√	√		√								21-24		629
Tecoma x alata	Orange Bells			√	√		√								21-24		628
Tetradymia axillaris ssp. Lonispina	Cotton Thorn	√					√	√	√								
Tetradymia axillaris var. longispina	Cotton Catclaw	√					√	√	√	perennial herb	yellow	√					
Tetradymia comosa	Cotton-thorn	√			√		√	√		perennial herb	yellow	√					
Tetradymia spinosa	Spiny Cotton-thorn	√							√	perennial herb	yellow	√					
Tetraneuris acaulis	Angelita Daisy			√	√		√	√	√								629
Tetraneuris scaposa	Clustered Goldflower			√	√		√	√	√								629
Teucrium chamaedrys 'Prostratum'	Prostrate Rosemary						√	√	√	ground cover	blue	√					
Teucrium cossonii majoricum	Germander			√	√		√	√	√								630
Teucrium fruticans	Bush Germander			√	√		√	√	√								630
Teucrium marum	Cat Thyme			√	√		√	√	√								630
Teucrium x lucidrys	Germander			√	√		√	√	√								630
Thymophylla acerosa	Prickly-leaf Dogweed				√		√	√	√						18-23		632
Thymophylla pentachaeta	Golden Dyssodia				√		√	√	√						18-23		632
Thymophylla tenuiloba	Dahlberg Daisy				√		√	√	√						18-23		632
Thymus camphoratus	Camphor Thyme			√	√		√	√	√								632
Thymus herba-barona	Caraway-scented Thyme			√	√		√	√	√								632
Thymus pseudolanuginosus	Woolly Thyme			√	√		√	√	√								632
Thymus pulegioides	Thyme			√	√		√	√	√								632
Thymus serpyllum	Mother-of-Thyme			√	√		√	√	√								632
Thymus vulgaris	Common Thyme			√	√		√	√	√								632
Thymus x citriodorus	Lemon Thyme			√	√		√	√	√								632
Tithonia rotundifolia	Mexican Sunflower							√	√	annual	yellow	√	√				
Torreya californica	California Nutmeg			√	√		√	√	√								636
Toxicodendron diversilobum	Poison Oak	√	√	√	√	√	√	√	√	shrub	yellow	√	√	√			
Trachycarpus fortunei	Windmill Palm							√	√	tree	white		√				
Tradescantia pallida	Purple Heart			√	√		√	√	√								637
Trichostema lanatum	Woolly Bluecurls	√	√	√	√	√	√	√		shrub	blue/purple	√					
Trichostema parishii	Parish's Bluecurls	√					√	√		shrub	blue/purple	√	√				
Triteleia grandiflora	Largeflower Triplet Lily			√	√		√	√	√								638
Triteleia hyacinthina	White Triplet Lily			√	√		√	√	√								638
Triteleia ixioides	Prettyface	√			√	√	√	√		bulb	yellow	√					
Triteleia laxa	Ithuriel's spear	√					√	√		bulb	purple	√					
Triteleia tubergenii	Triplet Lily			√	√		√	√	√								638
Triteleia uniflora	Oneflower Triplet Lily			√	√		√	√	√								638
Tulbaghia violacea	Society Garlic							√	√	pereniial	purple	√	√				
Turricula parryi	Poodle-dog Bush	√					√	√		perennial herb	purple	√					
Typha latifolia	Cattails	√					√	√	√								

Typha spp.	Monocot cattails	√								shrub						
Umbellularia californica	California Bay	√			√	√	√	√		shrub/tree	yellow	√	√			
Urtica dioica ssp. Holosericea	Stinging nettle	√								shrub						
Vauquelinia californica	Arizona Roseweed							√	√	shrub	yellow		√			
Venegasia carpesioides	Canyon Sunflower	√			√	√	√	√		perennial herb	yellow		√	√		
Verbascum bobyciferum	Arctic Summer			√	√		√	√	√							644
Verbascum chaixii	Mullein			√	√		√	√	√							644
Verbascum dumosum	Mullein			√	√		√	√	√							644
Verbascum olympicum	Green Mullein			√	√		√	√	√							644
Verbascum phoeniceum	Purple Mullein			√	√		√	√	√							644
Verbena bipinnatifida	Verbena			√	√		√	√	√							645
Verbena bonariensis	Verbena			√	√		√	√	√							645
Verbena gooddingii	Verbena			√	√		√	√	√							645
Verbena lasiostachys	Western Vervain	√	√	√	√	√	√	√		perennial herb	blue/purple	√	√			
Verbena lilacina	Verbena			√	√		√	√	√							645
Verbena peruviana	Verbena			√	√		√	√	√							645
Verbena pulchella gracilior	Moss Verbena			√	√		√	√	√							645
Verbena x hybrida	Garden Verbena			√	√		√	√	√							645
Veronica pectinata	Speedwell			√	√		√	√	√							646
Veronica prostrata	Speedwell			√	√		√	√	√							646
Veronica repens	Speedwell			√	√		√	√	√							646
Viguiera deltoidea	Goldeneye			√	√		√	√	√							648
Viguiera laciniata	San Diego Sunflower	√					√	√		shrub	yellow	√				
Viguiera multiflora	Goldeneye			√	√		√	√	√							648
Viguiera stenoloba	Skeleton Leaf Golden Eye						√	√	√	shrub	yellow	√				
Vinca minor	Dwarf Periwinkle			√	√		√	√	√							648
Viola aurea	Golden Violet	√					√	√	√							
Viola pedunculata	Johnny Jump-up	√	√	√	√	√	√	√		perennial herb	yellow	√	√			
Vitex agnus-castus	Chaste Tree							√	√	shrub	lavender	√				
Vitis californica	California Wild Grape			√	√		√	√	√							650
Vitis girdiana	Desert Wild Grape	√	√	√	√	√	√	√	√	vine	inconspicuous	√	√	√		
Washingtonia filifera	California Fan Palm	√						√	√	tree	white					
Westringia fruticosa	Coast Rosemary			√	√		√	√	√							652
Wisteria brachybotrys	Silky Wisteria			√	√		√	√	√							653
Wisteria floribunda	Japanese Wisteria			√	√		√	√	√							653
Wisteria sinensis	Chinese Wisteria			√	√		√	√	√							653
x chitalpa tashkentensis	Chitlapi			√	√		√	√	√							270
x chitalpa tashkentensis	Chitlapi		√	√	√		√	√	√	tree	pink	√				18-24
x halimiocistus sahucii	Hybrid Rockrose			√	√		√	√	√							379
x halimiocistus wintonensis	Merrist Wood Cream			√	√		√	√	√							379
Xanthorrhoea preisii	Grass Tree			√	√		√	√	√							653
Xanthorrhoea quadrangulata	Grass Tree			√	√		√	√	√							653
Xylococcus bicolor	Mission Manzanita	√	√	√	√	√				shrub	white/pink	√	√			
Xylorhiza tortifolia asteraceae	Mojave Aster	√					√	√	√							
Xylorhiza tortifolia var. tortifolia	Mojave Aster	√							√	perennial herb	blue/purple	√				
Xylosma congestum	Dense Logwood			√	√		√	√	√							654
Xylosma congestum	Xylosma		√							shrub						
Xylosmo congestum	Shiny Xylosmo				√					shrub						
Yucca [Hesperoyucca] whipplei	Chaparral Yucca	√		√	√	√	√	√	√	shrub	yellow	√				
Yucca aloifolia	Spanish Bayonet			√	√		√	√	√							654
Yucca baccata	Banana Yucca			√	√		√	√	√							654
Yucca brevifolia	Joshua Tree	√							√	shrub/tree	yellow	√				
Yucca elata	Soaptree Yucca			√	√		√	√	√							654
Yucca elephantipes	Giant Yucca			√	√		√								19-24	654
Yucca filamentosa	Adam's Needle			√	√		√	√	√							654
Yucca flaccida	Yucca			√	√		√	√	√							654
Yucca gloriosa	Spanish Dagger			√	√		√	√	√							654
Yucca recurvifolia	Yucca			√	√		√	√	√							655
Yucca schidigera	Mojave Yucca	√							√	shrub	yellow	√				
Yucca whipplei	Whipple's yucca	√								shrub						
Zauschneria californica	California Fuschia			√	√		√	√	√							656
Zauschneria canum garrettii	California Fuschia			√	√		√	√	√							656
Zauschneria canum latifolium	California Fuschia			√	√		√	√	√							656
Zauschneria septentrionalis	Humboldt County Fuschia			√	√		√								19-24	656
Zephyranthes candida	Rain Lily							√	√	perennial	white	√	√			
Zigadenus brevibracteatus	Desert Star Lily	√							√	bulb	yellow	√				
Zigadenus fremontii	Fremont's Star Lily	√			√	√	√	√		bulb	white	√	√			
Zinnia acerosa	Desert Zinnia							√	√	perennial	white	√	√			
Zinnia grandiflora	Prairie Zinnia							√	√	perennial	yellow	√	√			

REVISED DRAFT

ARROYO SECO DRY WEATHER URBAN RUNOFF PROJECTS

Conceptual Design Report

B&V PROJECT NO. 177349.1200

PREPARED FOR

City of Los Angeles

5 JUNE 2015

BLACK & VEATCH
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1 Introduction

This report provides conceptual designs for structural and institutional best management practices (BMP) projects along Arroyo Seco, near Outfalls AS-15, AS-17, and AS-G. The overarching goal for the projects is to demonstrate compliance with the Los Angeles River (LA River) Bacteria Total Maximum Daily Load (TMDL). These green infrastructure projects may also provide additional secondary community benefits such as new green recreational spaces and a "pilot" demonstration of the versatility of green infrastructure within a highly urbanized setting.

1.1 TMDL BACKGROUND

Arroyo Seco is one of thirteen tributaries named in the LA River Bacteria TMDL. This TMDL was adopted by the Los Angeles Regional Water Quality Control Board (Regional Board) in July 2010 and became effective on March 23, 2012. The City of Los Angeles (City) has chosen a "Load Reduction Strategy" implementation approach in order to achieve compliance with the Bacteria TMDL. This approach provides the City with a longer timeframe for demonstrating compliance with the final wasteload allocations (WLAs), but requires a more rigorous process for determining necessary implementation actions.

As part of this approach, the City performed an intensive outfall monitoring program from summer 2012 through spring 2013. Data and results are documented in *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring* (July 2013) (Outfall Monitoring Report). These monitoring efforts identified Arroyo Seco Outfalls AS-15 and AS-17 as Priority Outfalls, or outfalls that were observed to have relatively consistent, problematic discharges that drive the storm drain loading above the final WLA. Thus, as part of the Load Reduction Strategy (LRS) submittal, the City must include implementation plans for projects at these outfall locations that will attain the final WLAs for *E. coli* in order to demonstrate compliance with the TMDL.

1.2 TMDL SCHEDULE

The TMDL's implementation schedule is staggered according to LA River Segments and their tributaries. Arroyo Seco is tributary to Segment B of the LA River; therefore, the LRS must be submitted by March 23, 2016 (within 4 years of the TMDL effective date of March 23, 2012). The TMDL's implementation schedule for the LA River Segment B and Segment B tributaries is summarized in Table 1-1.

Table 1-1 LA River Bacteria TMDL Compliance Schedule for LA River Segment B and Tributaries

IMPLEMENTATION ACTION	RESPONSIBLE PARTIES	DEADLINE
Submit a Load Reduction Strategy (LRS) **for Segment B** *(or submit an alternative compliance plan)*	MS4 and Caltrans NPDES Permittees discharging to Segment B	2.5 years after effective date of the TMDL (Sept. 2014)
Submit a Load Reduction Strategy (LRS) **for Segment B tributaries** *(or submit an alternative compliance plan)*	MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries	4 years after effective date of the TMDL (March 2016)
Complete implementation of LRS for **Segment B**	MS4 and Caltrans NPDES Permittees discharging to Segment B	7 years after effective date of the TMDL (March 2019)
Complete implementation of LRS **for Segment B tributaries**	MS4 and Caltrans NPDES Permittees discharging to Segment B tributaries, if using LRS	8.5 years after effective date of the TMDL (Sept. 2020)
Achieve interim or (final) WLA and submit report to Regional Board **for Segment B**, if using LRS	MS4 and Caltrans NPDES Permittees discharging to Segment B, if using LRS	10 years after effective date of the TMDL (March 2022)
Achieve final WLA or demonstrate that non-compliance is only due to upstream contributions and submit report to Regional Board	MS4 and Caltrans NPDES Permittees discharging to Segment B, if using alternative compliance plan	10 years after effective date of the TMDL (March 2022)

Note: *Segment B* refers to Upper and Middle Reach 2 (Figueroa Street to Rosecrans Avenue) and *Segment B Tributaries* include Rio Hondo and Arroyo Seco.

As shown in the schedule above, the deadline for submitting the Arroyo Seco Bacteria LRS is March 23, 2016. The LRS must identify factors that are known to or may cause the high bacterial loadings in Arroyo Seco as well as propose solutions for attaining compliance with the final WLA. Problematic outfalls were identified during the Outfall Monitoring Study. This report provides recommended solutions for addressing the high bacterial loadings at the identified outfalls.

Also per the schedule above, complete implementation of the LRS must be achieved by September 23, 2020. Thus, the projects proposed in this report must be constructed and operational by this date.

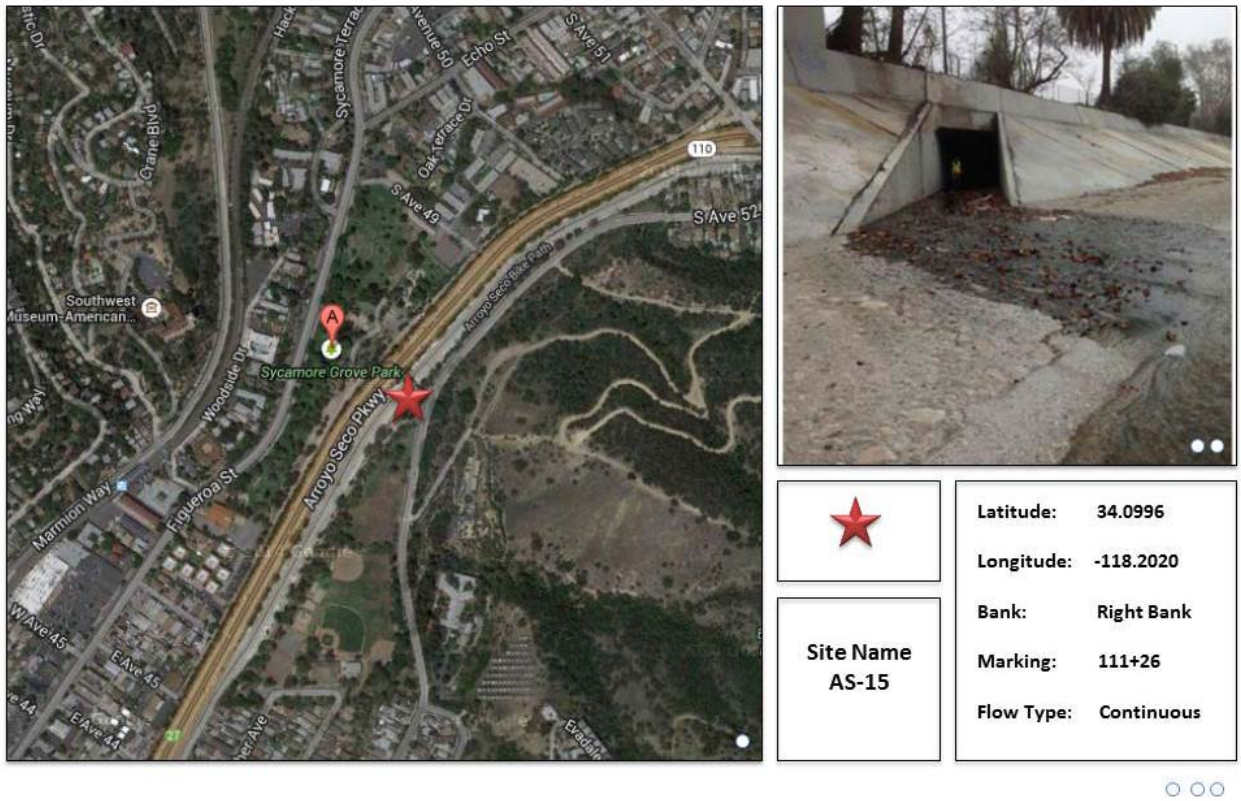
2 Outfall AS-15 Project

The proposed project at this location focuses on dry weather runoff from approximately 1,135 acres of the Arroyo Seco watershed. Several different BMP types, including infiltration and treatment and reuse, were considered for this location. The proposed project aims to divert 100 percent of the dry weather flows at this outfall location.

2.1 OUTFALL LOCATION

The proposed project site is Sycamore Grove Park, near the intersection of Figueroa Street and S Avenue 49. Project location details are provided in in Figure 2-1.

Figure 2-1 Sycamore Grove Park and AS-15 Outfall Location



Source: *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring*. Prepared for the City of Los Angeles Bureau of Sanitation Department of Public Works, July 2013.

2.2 INITIAL SITE INVESTIGATIONS

The desktop analyses and field investigations performed at the onset of the project are described in this section. Preferred BMP opportunity areas were identified based on the desktop analyses and field investigations.

2.2.1 Field Assessment

The proposed project location was visited by City and Black & Veatch team members on December 10, 2014. The locations of constructed facilities, established trees, and catch basins were noted. General observations also included park utilization, land slopes, and land uses immediately

surrounding Sycamore Grove Park. Notes from the field visit are provided in Appendix A. The recommended project site and proposed BMP opportunity areas are shown in Figure 2-2.

2.2.2 Desktop Geotechnical Analysis

A desktop analysis was performed to identify some general geotechnical parameters around the project site. Two main concerns were the depth to groundwater and soil infiltration rate. As stated above, these parameters may affect the performance of the selected BMP.

Based on the City's geotechnical database (which provides soil type and infiltration rate data by street intersection), groundwater depths in the project area are approximately 19 feet below surface. The database also identifies the soil type as Ramona Loam, with an infiltration rate of approximately 0.3 inches/hour.

Due to the wide range of infiltration rates observed for loam soil types and specifically the Ramona soil classification, it is recommended that a geotechnical field investigation be completed at the project site prior to final design and construction.

2.2.3 Drainage Area and Existing Infrastructure

The drainage area and existing storm drainage infrastructure are shown in Figure 2-3. The drainage area identifies the area upstream of the project location that contributes dry weather flows to Outfall AS-15.

As shown in Figure 2-3, two large storm drains converge below the park before entering the Arroyo Seco channel at Outfall AS-15. Per the City's as-built records (accessed via NavigateLA), both storm drains are nine feet in diameter; one pipeline is owned by the City and the other pipeline is owned by the County of Los Angeles (County). The City and County pipelines are constructed at approximately 426 feet and 430 feet, respectively. Contour information shows that the ground elevation of the park near Figueroa Avenue is approximately 445 feet. This results in the City and County storm drains falling approximately 19 feet and 15 feet below grade, respectively.

The two storm drains converge just north of the Union Pacific Railroad Company (RR Co.) right-of-way that borders CA-110. As-built records show that the invert elevation of the storm drain is approximately 418 feet. This places the storm drain approximately 17 feet below grade.

LEGEND

- Contours
- Catch Basin
- Storm Drain Network
- Open Channel Storm Drain

Soil Type

- Hanford Gravelly Sandy Loam
- Ramona Loam
- BMP Opportunity Area
- Parcels

N

1 inch = 125 feet

0 75 150

Feet

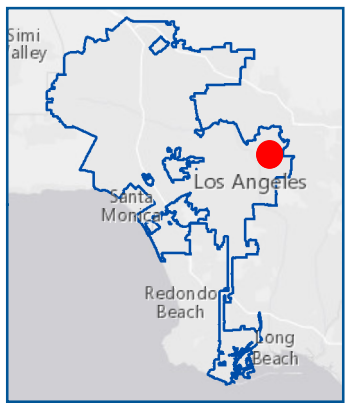


Figure 2-2
Outfall AS-15 Project Location

Arroyo Seco Dry Weather Urban Runoff Project

177349.1200

environment LA SANITATION CITY OF LOS ANGELES

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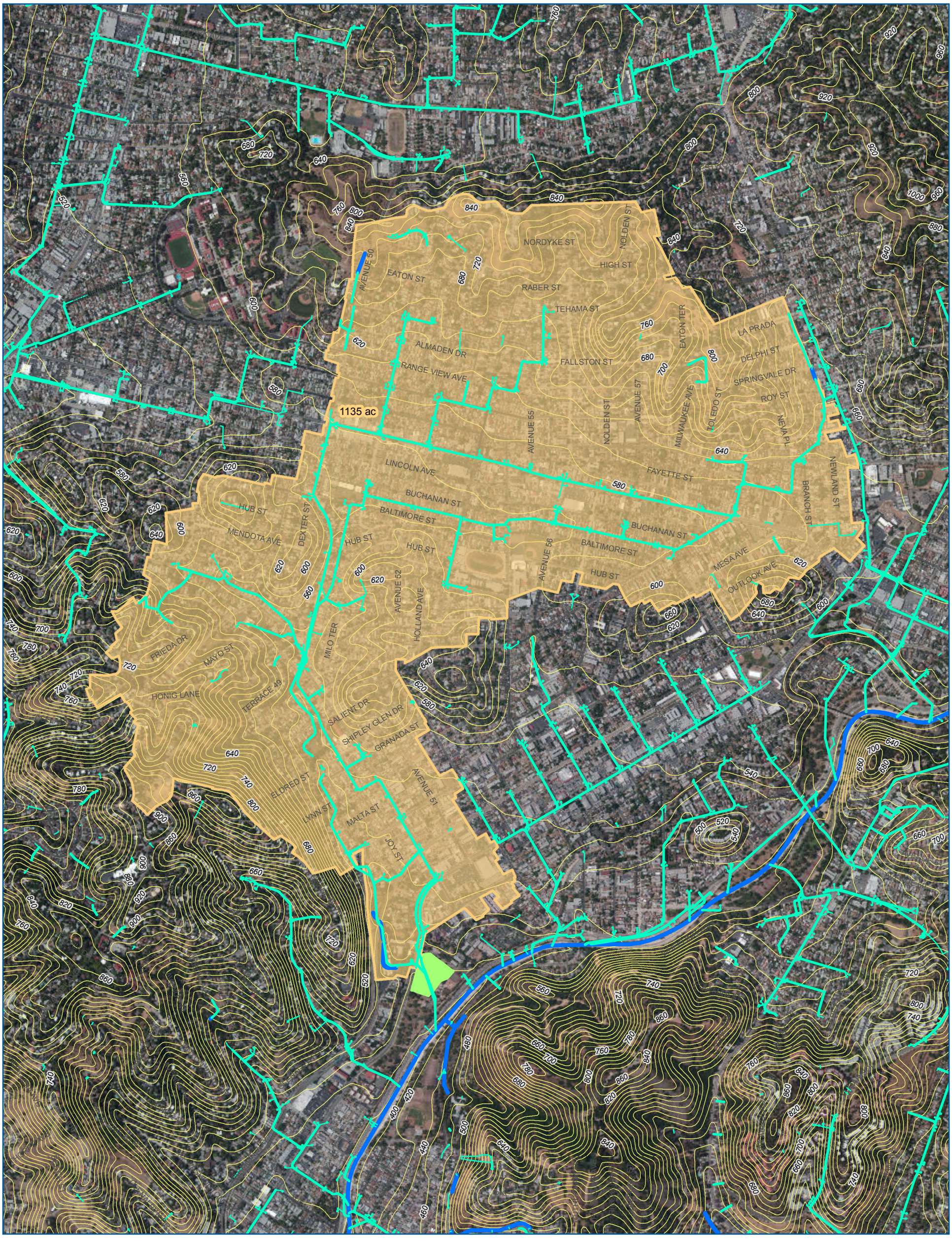
Figure2-2_AS15ProjectLocation



LEGEND

- Catch Basin
- Storm Drain Network
- Open Channel Storm Drain
- Drainage Area
- BMP Opportunity Area
- Contours

N

1 inch = 1,250 feet

0 700 1,400

Feet

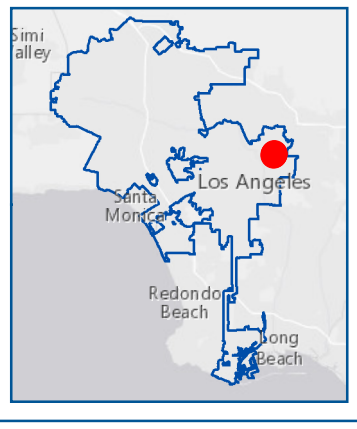


Figure 2-3
Outfall AS-15 Drainage Area

Arroyo Seco Dry Weather Urban Runoff Project

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Figure2-3_AS15DrainageArea March 25, 2015

2.3 DRY WEATHER FLOWS AND WATER QUALITY

In accordance with the TMDL, monitoring was based on data collected during the six selected monitoring days, or "snapshots." The dry weather monitoring days were scheduled over at least two seasons of the same year per TMDL requirements. The six selected monitoring days for outfalls along Arroyo Seco are summarized in Table 2-1 below.

Table 2-1 Arroyo Seco Outfall Monitoring Schedule

MONITORING EVENT	CALENDAR SEASON	DATE
1	Summer	September 13, 2012
2	Summer	September 26, 2012
3	Summer	October 10, 2012
4	Fall	November 28, 2012
5	Winter	February 5, 2013
6	Spring	March 19, 2013

Source: *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring*. Prepared for the City of Los Angeles Bureau of Sanitation Department of Public Works, July 2013.

Flow rates and other water quality parameters, including indicator bacteria concentrations, were measured at all observed flowing outfalls along Arroyo Seco. The flow rates measured at Outfall AS-15 during the six monitoring events are presented in Table 2-2. It should be noted that two measurements were obtained by two different sampling teams during Event 4. The flow rates measured on this date vary significantly. The average flow observed at this site during the sampling period was 0.19 cubic feet per second (cfs) or 141 acre-feet per year (AFY). All seven measurements obtained as part of the Outfall Monitoring Report are shown below and included in the average flow calculation. The observed runoff result of 425 gpd/acre compares reasonably well (although somewhat higher) with data developed for the region as part of the July 2004 Integrated Resources Plan (IRP) for the City of Los Angeles. In the IRP, runoff rates were found between 190 gpd/acre to 320 gpd/acre.

Table 2-2 Outfall AS-15 Outfall Monitoring Data

EVENT	SAMPLING DATE	FLOW (CFS)	E. COLI LOADING RATE (10^9 MPN/DAY)	TURBIDITY (NTU)
1	9/13/2012	0.07025	5.328083	ND
2	9/26/2012	0.20831	2.395354	0.29
3	10/10/2012	0.31910	12.491426	0.74
4	11/28/2012	0.08356	0.347529	1.4
4	11/28/2012	0.30561	0.725266	0.48
5	2/5/2013	0.24628	144.609137	0.13
6	3/19/2013	0.13043	0.274424	0.15

Source: *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring*. Prepared for the City of Los Angeles Bureau of Sanitation Department of Public Works, July 2013.

2.3.1 Design Flow

Outfall AS-15 discharges continuous dry weather flows into Arroyo Seco. This outfall is considered "continuous" because dry weather discharges were observed at this location during all six monitoring events as part of the Outfall Monitoring Study. Because the overall aim of this project is to divert 100 percent of dry weather flows, the recommended project at this location will be sized to accommodate maximum dry weather flows. Based on an evaluation of the data and assumptions regarding sources of the dry weather flow and recommended peaking factors in the IRP, a peaking factor of 1.5 to 2.0 times the average flow would be a reasonable range to assume for BMP design.

2.3.2 Water Quality

Water quality data collected at Outfall AS-15 during the flow monitoring events is documented in Appendix 3 of the Outfall Monitoring Report. E. coli (MPN/100ml) measured at this location ranged from 86 to 24,000 and appears to have no particular correlation with flow rate. Turbidity of the samples was low, ranging from not detected (ND) to 1.4 NTU. Total dissolved solids (TDS) is also a useful water quality parameter for determining the suitability of water for irrigation needs; however, this parameter was not provided in the Outfall Monitoring Report.

2.4 DRY WEATHER IMPLEMENTATION STRATEGY FOR OUTFALL AS-15

The evaluation of a strategy for dry weather implementation for outfall AS-15 could take many courses. This site is located in Sycamore Grove Park, a highly urbanized area, and the park is heavily utilized by the nearby community. During the site visit, the City noted that the Arroyo Seco Foundation may be planning for a historic restoration in this park. One strategy could be to develop a subsurface retention/infiltration BMP. During the site visit, such a buried BMP was discussed and it was noted that it could be implemented within the sports field or parking lot. Another strategy could be to develop a treatment alternative in which the stormwater system infiltration could be treated and beneficially reused. Such a system was developed in the initial stages of this evaluation. Upon review of this initial system, the City requested a system that surfaced the dry weather flows into a proposed creek (along with wetland treatment). It was further requested that any return flows we returned to the sewer. This refinement was requested based on new perspectives that the

City will achieve more cost-effective water harvesting through recycling of wastewater. It was acknowledged that currently the sanitary system is not set up to recycled flows from this area, but it is planned in the future.

After further consideration, implementation of a system with a vortex separation unit (VSU) followed by a submersible pump station that feeds a new-created creek area is recommended at Sycamore Gove Park, upstream of Arroyo Seco Outfall AS-15. Current County Environmental Health Department Guidelines require disinfection for harvesting projects where public contact with the water is possible. In order to simplify the project, it is suggested signage, planting and other exclusionary tactics are utilized to prevent contact.

The proposed project will abate pollution from dry weather runoff contributed from an approximately 1,135-acre drainage area, as shown in Figure 2-3. Water quality improvements and the available park site provide a great opportunity for implementing this dry weather urban runoff project as a demonstration project. Project components and benefits are described below.

2.4.1 Project Components

The proposed project would divert flows from the two storm drains to a VSU, and then pump to a creek with a wetland treatment area. Channeling the flows through the creek and wetland area will allow for irrigation of wetland plants and infiltration. Remaining flows at the end of the wetland treatment area would be conveyed to a nearby sewer with adequate capacity. Flows being returned to the sewer will ultimately support the City's recycling efforts at the Hyperion Treatment Plant.

2.4.2 Community Benefits

The proposed solution upstream of Outfall AS-15 provides a variety of community benefits. Because the Sycamore Grove Park is heavily utilized and has historical significance within the neighborhood, it may be appropriate to utilize this location, and the proposed treatment system, to provide the opportunity to educate the public through incorporating a "Learning Center" into the treatment system. This Learning Center would provide bilingual education to the public on the watershed within which they live, stormwater management, treatment, and water harvesting.

The Learning Center should include the following key features:

- Signage with diagrams of the 1,135 acre watershed, and the system to put harvested water use in perspective.
- Viewing areas where visitors can the water flowing and the wetland plants.
- The exhibit will be unstaffed, but may be monitored via closed circuit TV.

Planning for such a project would likely be a two phase effort. Phase 1 would involve preparing a communication and education plan for the Learning Center including identification of anticipated user groups, educational objectives, and implementation activities such as a brochures and interactive displays, so that the team can agree on the next phase. Phase 2 would involve preparing the products and materials identified in the plan.

The Learning Center would attract citizens to the park, and would be interactive and self-guided. If this strategy resonates with the City additional research will be conducted in collaboration with the Parks and Recreation Department to better define the Learning Center.

Use of the harvested water would include irrigation of the proposed creek and wetland treatment areas. Data provided by the California Irrigation Management Information System (CIMIS) was used to estimate the irrigation needs of proposed creek and wetland treatment areas. CIMIS calculates the estimated evapotranspiration (ETo) rate for various reference locations. The ETo for the representative location is then applied to a plant factor or species coefficient (Kc) to calculate the overall ET for the project. The ET is an indicator of how much water specific plants need for healthy growth and productivity. It helps water-users develop water budgets and determine how much water to apply for irrigation.

For the project area, CIMIS data identified an annual average ETo of 34.29 inches, or 2.86 feet per year. Based on the proposed BMP type, contours, and available park space, it was determined that the creek and wetlands would encompass approximately 0.43 acres of land in Sycamore Grove Park. It was assumed that the entire creek and wetlands area would be comprised of water features (Kc=100%) or wetland plants with high water requirements (typical Kc=80-100%).

The creek and wetland area would be unlined. Table 2-3 shows a breakdown of the anticipated average utilization of water based on the surface area of the creek and wetlands. It is anticipated that approximately 94 acre-feet per year (AFY) of dry weather flows would be utilized. Plants and other features will be selected in an effort to spread and infiltrate the intercepted dry weather flows in the creek and wetland areas. Overall, large rocks and riprap at the daylight and throughout the surfaced creek will slow the dry weather flow velocity, allowing it to irrigate the nearby plants and infiltrate into the ground. Once the velocity has slowed, flows will be spread over the wetland treatment area. Plant selection for this area will maximize the use of dry weather flows, so plants with high species factors will be preferred.

Table 2-3 Average Annual BMP Water Utilization

BMP COMPONENT	AREA (AC)	% WATER FEATURE[1]	% PLANT COVER[2]	UTILIZATION OF WATER (AFY)			
				EVAPORATION[3]	EVAPO-TRANSPIRATION[4]	INFILTRATION[5]	TOTAL[6]
Daylighted Creek	0.11	70%	30%	0.47	0.13	24.09	24.69
Wetlands	0.31	30%	70%	0.57	0.89	67.89	69.34
TOTAL	**0.42**			**1.03**	**1.02**	**91.98**	**94.03**

(1) Assumed percentage of BMP Component area covered by water surface.
(2) Assumed percentage of BMP Component area with plant cover.
(3) Evaporation utilization applies only to BMP Component areas covered by water surface.
(4) Evapotranspiration utilization applies only to BMP Component areas with plant cover.
(5) Infiltration utilization applies to entire BMP Component area.
(6) Total utilization is sum of Evaporation, Evapotranspiration, and Infiltration.

2.5 CONCEPTUAL DESIGN AND LAYOUT

Figure 2-4 shows the conceptual layout of the proposed project. Dry weather flows will be diverted from the two large box culverts into a VSU. The VSU will remove floatables and debris, protecting the downstream pumps and the wetland systems. A submersible pump station will pump the flow

to the proposed creek. The pump station wet well and pumps will be sized to maintain a consistent flowrate. Flows will be released to the creek through a modified cleanout structure with a weir.

The creek will consist of a 235 feet long reach of creek with signage, planting and other exclusionary measures along the perimeter. Downstream of the creek, a wetland area consisting of 0.3 acres of constructed wetlands will be provided. Sizing of the wetland area is based on the open space available near the storm drains in the park. Excess dry weather flows would be returned to the City's sewer via through a grated overflow and connection to the 18-inch sewer downstream. The wetland area would be designed to provide vegetative filtering of the flow which, in conjunction with the grated drain cover, would prevent debris from entering the sewer system. Most of these dry weather return flows to sewer would occur during cooler, wetter months. Higher flows and stormwater would be prevented from entering the proposed creek and wetland treatment system by simply shutting down the pump on high level.

Figure 2-4 AS-15 Conceptual Project Layout

2.6 OPERATIONS AND MAINTENANCE

Expected operations and maintenance activities for the proposed system are described below.

2.6.1 Pump Stations

The pumping facilities will likely require monthly inspections to verify that pumps and associated equipment are working properly and free from debris. Pumps will require maintenance and inspection per the manufacturer's recommendations, which may include lubrication and cleaning. The pumps will be designed for easy withdrawal for inspection and maintenance. Pump station operations shall be monitored on a regular basis to ensure satisfactory performance. Any

abnormalities noted shall be investigated and corrected at the earliest opportunity. Associated piping will not likely require regular maintenance; however, as-needed maintenance may include clearing unexpected blockages.

2.6.2 Vortex Separator Unit

It is recommended to perform quarterly inspections for the first year to determine the accumulated amount of sediment, litter, and other floatables. The maintenance schedule will be based on the accumulated amount of debris encountered throughout the year; thus, frequency will be dependent on site conditions. At a minimum, it is recommended to perform an annual inspection and debris removal once before the winter season and once after the winter season is over.

Entry into the unit is not required, but access is provided through a standard 24-inch to 36-inch manhole or a 5-foot by 5-foot hatch over the treatment chamber so that visual inspections can be performed. Maintenance can be performed using typical vacuum trucks to remove accumulated material from within the treatment chamber. It may be necessary to remove and dispose the floatables separately due to the presence of petroleum products.

2.7 COST ESTIMATE

The table below summarizes estimated project costs. As requested by the City in the Scope of Work, engineering design is estimated at approximately 40% of total project construction cost; mobilization is estimated at 10% of total project construction cost; and WPCP or SWPPP, field orders, and contingency are estimated at 20% of the total project construction cost. Typically, contingency for this level of design complete is estimated to be between 35% and 40% of the total project construction cost.

Table 2-4 Outfall AS-15 Project Cost Estimate

PROJECT COMPONENT	UNIT COST	# UNITS	TOTAL
Diversion Structure	$40,000	2	$80,000
Vortex Separator Unit	$50,000	1	$50,000
Influent Submersible Pump Station (100 gpm)	$350,000	1	$350,000
Surfaced Creek	$250,000	1	$250,000
Wetland Area	$300,000	1	$300,000
Grated Return Structure	$40,000	1	$40,000
Return Piping	$200	225	$45,000
Diversion Piping	$200	450	$90,000
Educational Signage	$100,000	1	$100,000
Electrical, Instrumentation & Controls	$100,000	1	$100,000
subtotal			**$1,405,000**
Engineering Design	40%		$562,000
Mobilization	10%		$140,500

WPCP or SWPPP	20%		$281,000
Field Orders	20%		$281,000
Contingency	20%		$281,000
TOTAL			**$2,950,000**

2.8 IMPLEMENTATION SCHEDULE

The proposed implementation schedule is shown below. This will allow time for engineering design and construction of the project to be completed in time for the Bacteria TMDL deadline of September 2020.

Figure 2-5 Estimated Project Implementation Schedule for the Outfall AS-15 Project

	2015				2016				2017				2018				2019				2020			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conceptual Design																								
Permitting																								
Engineering Design																								
Construction																								
Follow-up Monitoring and Observation																								

3 Outfall AS-17 Project

The proposed project at this location focuses dry weather runoff contributed from approximately 300 acres of Arroyo Seco watershed. Several green infrastructure solutions were considered for this location, including bioretention cells, vegetated bioswales, and curb cut-outs. The proposed project aims to divert 100 percent of the dry weather flows at this outfall location.

3.1 OUTFALL LOCATION

Outfall AS-17 is located in the Arroyo Seco channel near the on-ramp to CA-110 at S Avenue 52. Project location details are provided in Table 3-1. A picture of the outfall from the Arroyo Seco channel is provided in Figure 3-1. Figure 3-2 provides an overview of the proposed project location.

Table 3-1 AS-17 Outfall Location

SITE NAME	LATITUDE	LONGITUDE	BANK	MARKING	FLOW TYPE
AS-17	34.1025	-118.1974	Right Bank	129+20	Intermittent

Source: *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring*. Prepared for the City of Los Angeles Bureau of Sanitation Department of Public Works, July 2013.

Figure 3-1 Arroyo Seco Outfall AS-17

Source: *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring*. Prepared for the City of Los Angeles Bureau of Sanitation Department of Public Works, July 2013.

3.2 INITIAL SITE INVESTIGATIONS

The desktop analyses and field investigations performed at the onset of the project are described in this section. Preferred BMP opportunity areas were identified based on the desktop analyses and field investigations.

3.2.1 Field Assessment

The proposed project location was visited by City and Black & Veatch team members on December 10, 2015. The initial proposed location was near the intersection of Avenue 52 and Longfellow Street; however, upon visiting the area, it was clear that traffic control and overhead power lines may pose some challenges. The team walked further upstream in the drainage area and found that the intersection of Avenue 53 and Longfellow Street may be a more preferable location to implement the BMP project. Notes from the field visit are provided in Appendix A.

Based on further desktop analyses and investigations, an area near the on-ramp to CA-110 along S Avenue 52 was also considered as a potential BMP opportunity area. This additional area was considered because it would intercept flows that enter the storm drain system downstream of the Avenue 53 and Longfellow Street intersection. Figure 3-2 shows the Glen Ellen gravity main that converges with the Avenue 52 gravity main at this location. The recommended project site and potential BMP opportunity areas are shown in Figure 3-2.

3.2.2 Desktop Geotechnical Analysis

A desktop analysis was performed to identify some general geotechnical parameters around the project site. Two main concerns were the depth to groundwater and soil infiltration rate. As stated above, these parameters may affect the performance of the selected BMP.

Based on the City's geotechnical database (which provides soil type and infiltration rate data by street intersection), groundwater depths in the project area are approximately 20 feet below surface. The database also identifies the soil type as Ramona Loam, with an infiltration rate of approximately 0.3 inches/hour.

Due to the wide range of infiltration rates observed for loam soil types and specifically the Ramona soil classification, it is recommended that a geotechnical field investigation be completed at the project site prior to final design and construction.

3.2.3 Drainage Area and Existing Infrastructure

The drainage area and existing infrastructure are shown in Figure 3-3. The drainage area identifies the area upstream of the project location that contributes dry weather flows to Outfall AS-17.

As shown in Figure 3-3, one main storm drain conveys flows down Avenue 52 and into the Arroyo Seco channel slightly southeast of the CA-110 overpass at Avenue 52. Per the City's as-built records (accessed via NavigateLA), this storm drain is a 66-inch diameter reinforced concrete arch (RCA), owned by the City. Upstream of the outfall, a 51-inch diameter RCA contributes flows to the main storm drain at the intersection of Avenue 52 and Glen Ellen Place. Flows from the majority of the drainage area are contributed further upstream through the storm drains in Avenue 53 and Longfellow Street to the 66-inch gravity main in Avenue 52.

LEGEND

- Contours
- Catch Basin
- Storm Drain Network
- Open Channel Storm Drain
- BMP Opportunity Area
- Parcels

N

1 inch = 150 feet

0 85 170

Feet

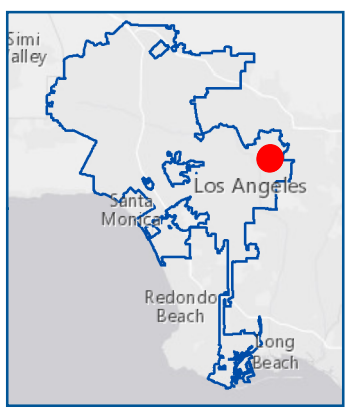

Figure 3-2
Outfall AS-17 Project Location

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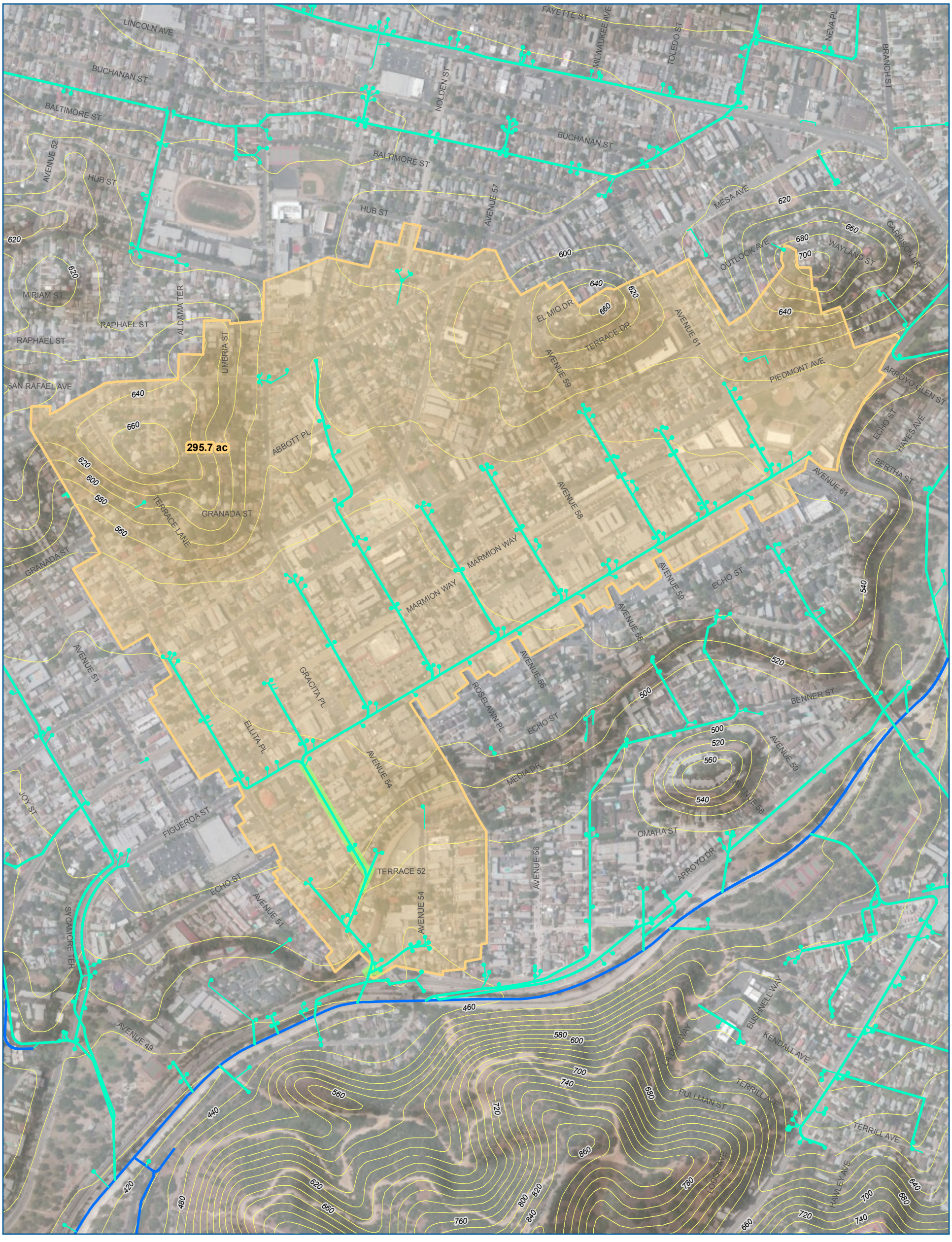
Figure3-2_AS17ProjectLocation



LEGEND

- Catch Basin
- Storm Drain Network
- Open Channel Storm Drain
- BMP Opportunity Area
- Drainage Area
- Contours

N

1 inch = 600 feet

0 300 600

Feet

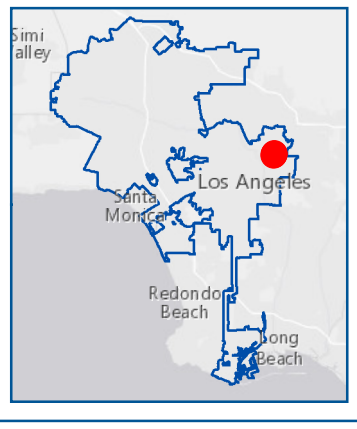


Figure 3-3
Outfall AS-17 Drainage Area

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3.3 DRY WEATHER FLOWS

In accordance with the TMDL, monitoring was based on six "snapshots" that measured flow rates and bacteria concentrations from all outfalls along Arroyo Seco observed to be flowing. These dry weather snapshots were scheduled over at least two seasons of the same year per TMDL requirements. The flow rates measured at Outfall AS-17 during the six snapshots are presented in Table 3-2. The average flow observed at this site during the sampling period was 0.016 cfs. As shown, no flows were observed at the outfall during Event 3. To be conservative, this event was not included in the average flow calculation.

Table 3-2 Outfall AS-17 Flow Monitoring Data

EVENT	SAMPLING DATE	FLOW (CFS)	E. COLI LOADING RATE (10^9 MPN/DAY)	TURBIDITY (NTU)
1	9/13/2012	0.00010	0.001537	6.8
2	9/26/2012	0.02178	0.340996	5.9
3	10/10/2012	--[1]	None	None
4	11/28/2012	0.00202	0.790190	2.7
5	2/5/2013	0.03522	70.668274	3.5
6	3/19/2013	0.02051	1.555727	24

[1] No flow was observed at Outfall AS-17 during this snapshot.

Source: *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring*. Prepared for the City of Los Angeles Bureau of Sanitation Department of Public Works, July 2013.

3.3.1 Design Flow

Outfall AS-17 discharges intermittent dry weather flows into Arroyo Seco. This outfall is considered "intermittent" because dry weather discharges were not observed at this location during all six snapshots as part of the Outfall Monitoring Study. Because the overall aim of this project is to divert 100 percent of dry weather flows, the recommended project at this location will be sized to accommodate maximum dry weather flows. Thus, it is recommended that the design flow for the proposed project be 0.035 cfs, which is the maximum dry weather flow observed during the Outfall Monitoring Study.

3.4 DRY WEATHER IMPLEMENTATION STRATEGY FOR OUTFALL AS-17

The proposed project upstream of Outfall AS-17 will abate stormwater pollution from a nearly 300-acre drainage area, as shown in Figure 3-3. Several green infrastructure solutions were considered for this location, including bioretention cells, vegetated bioswales, and curb cut-outs. Due to space constraints and potentially limiting soil infiltration rates, proprietary biotreatment solutions ares proposed at this site.

3.4.1 Project Components

Proprietary biotreatment devices are designed to mimic natural systems such as wetlands to provide treatment given a lower footprint than their natural counterparts. Incoming flows are typically filtered through natural media and either infiltrated or collected in an underdrain.

The installation of multiple stormwater biofiltration proprietary devices are recommended upstream of Outfall AS-17. This project considered the installation of Modular Wetlands systems manufactured by BioClean Environmental Inc., which are advanced dual-stage high flow rate media and biofiltration system for the treatment of urban stormwater runoff.

This proposed system removes pollutants using pre-treatment and biofiltration processes. Runoff first enters a pre-treatment chamber containing a screening device for trash and larger debris, a separation chamber for larger TSS, and a series of media filter cartridges for removal of fine TSS and other particulate pollutants. Pre-treated runoff is then transferred to the biofiltration chamber, which contains an engineered ion exchange media designed to support an abundant plant and microbe community that captures, absorbs, transforms, and uptakes pollutants through physical, chemical, and biological mechanisms.

Treated runoff discharged from the biofiltration chamber can be conveyed back into the storm drain system, infiltrated through an infiltration basin, reused onsite for irrigation purposes, or diverted to the sewer.

3.4.2 Community Benefits

In general, green infrastructure BMPs provide a number of community benefits such as often creating green jobs, creating new green recreational spaces, improving water and air quality, and increasing property value. The implementation of a modular wetlands system upstream of Outfall AS-17 will provide water quality improvements in Arroyo Seco and may also promote the growth and health of surrounding vegetation as treated flows are allowed to infiltrate into the soil.

3.5 CONCEPTUAL DESIGN AND LAYOUT

The recommended solution to treat flows discharging at Outfall AS-17 is the Modular Wetland System Linear 2.0 (MWS-L 2.0). Details provided by the manufacturer are included in Appendix B.

Given siting constraints and the design flow rate, the MWS-L-4-4 is the model recommended for implementation at this project site. The flow-based treatment capacity of this unit is 0.052 cfs, which is above the maximum dry weather flow (0.035 cfs) observed at the AS-17 outfall. The MWS-L-4-4 is a smaller unit, covering a surface area of approximately 25 square feet.

MWS-L 2.0 systems are designed to allow for a variety of intake configurations. This flexibility allows the system to accommodate all different storm drain system set-ups. Runoff can enter the MWS-L 2.0 directly from impervious surfaces through a curb inlet, grate inlet, or via diversion structure and pipe from the existing storm drain system.

For the project proposed upstream of Outfall AS-17, it was initially recommended that the MWS-L-4-4 unit be installed in the right-of-way near the CA-110 onramp, shown as Site A in Figure 3-4. This location is downstream of all contributing gravity main connections, intercepting 100 percent of dry weather flows discharging at Outfall AS-17. It was later determined that this location was not ideal due to the fact that it falls within the Caltrans right-of-way.

Per the City's request, alternative BMP locations within the public right-of-way were investigated. It was understood that selecting a BMP location upstream in the drainage area could result in diverting less than 100 percent of the dry weather flows.

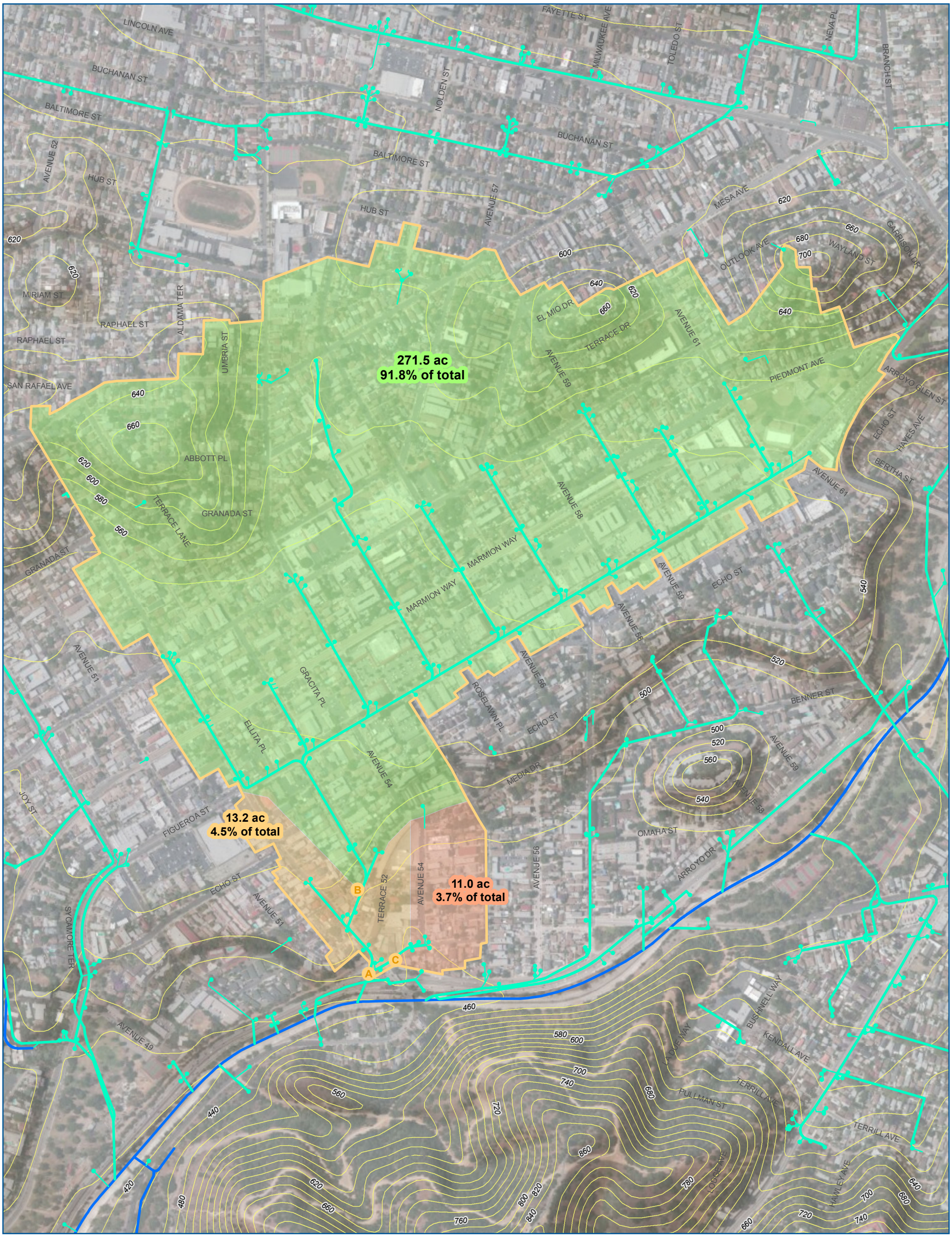

Figure 3-4
Sub-Drainage Areas

Arroyo Seco Dry Weather Urban Runoff Project

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Figure3-4_AS17DrainageArea_divided May 14, 2015

Two alternative BMP locations and their resulting sub-drainage areas were identified. These locations are labeled B and C in Figure 3-4. The sub-drainage area for each of these locations is summarized in Table 3-3.

Table 3-3 Sub-Drainage Areas

BMP LOCATION[1]	SUB-DRAINAGE AREA (AC)	PERCENT OF TOTAL
A	295.7	100%
B	271.4	91.8%
C	11.0	3.7%

1 BMP Locations shown in Figure 3-4.

As described above, if Site A were selected for BMP installation, dry weather flows from 100 percent of the drainage area would be diverted. Site B would receive flows from approximately 92 percent of the total AS-17 drainage area, and Site C would receive flows from approximately four percent of the total AS-17 drainage area.

Because dry weather flows are a result of human activity, it is understood that the relationship between drainage area size and flowrates may not be linear. For example, while a BMP installed at Site C receive flows from approximately four percent of the total drainage area, it does not necessarily receive four percent of the total dry weather flows.

The alternatives considered and the resulting contributing and non-contributing drainage areas are summarized in Table 3-4. Due to the uncertainty regarding the sources of dry weather flows and the lack of more refined flow monitoring data, the installed BMPs should aim to intercept and divert flows from as much of the total drainage area as practical. Thus, it is recommended that the City install stormwater biofiltration BMPs at Site B (Option 2 in Table 3-4). A device installed at this location will receive flows from approximately 92 percent of the total AS-17 drainage area.

Table 3-4 BMP Location Drainage Area Evaluation

Option	Description	Drainage Area Intercepted		Drainage Area Not Intercepted	
		Area (ac)	Percent of Total	Area (ac)	Percent of Total
1	Install BMP at Site A	295.7	100%	0	0%
2	Install BMP at Site B Only	271.5	91.8%	24.2	8.2%
3	Install BMP at Site C Only	11.0	3.7%	274.7	96.3%
4	Install BMP at Site B + Site C	282.5	95.5%	13.2	4.5%

It should be noted that Option 4 (installing BMP devices at both Site B and Site C locations) presented in the table above yields the greatest percentage of the total drainage area to be diverted; however, the cost of installing a second device at Site C may not be considered justifiable given its small incremental sub-drainage area. Rather, it is recommended that the City supplement the installation of the biofiltration BMP at Site B with the implementation of institutional measures

throughout the entire drainage area and continue to monitor the dry weather discharges at Outfall AS-17.

Under the recommended project of installing a biofiltration BMP at Site B, dry weather flows will be diverted from the 66-inch storm drain in Longfellow Street to the MWS-L-4-4 self-contained treatment train. It is recommended that the treated flows are then conveyed to an adjacent infiltration basin, which should be conservatively sized to accommodate intermittent periods of higher flows. The diversion manhole should be installed downstream of the point where the 54-inch storm drain in Avenue 53 and the 36-inch storm drain in Longfellow Street converge.

3.6 OPERATIONS AND MAINTENANCE

Modular Wetland's MWS-Linear 2.0 is supplied to the project site completely assembled and ready for use. One advantage of the MWS-L 2.0 design is that the pre-treatment chamber removes and isolates trash, sediments, and hydrocarbons, which helps preserve the more expensive biofiltration media. General maintenance required includes the simple up-keep of the separate pre-treatment chamber that can be cleaned by hand or with a standard vac truck. Periodic replacement of the low-cost media in the pre-filter cartridges may be required for long term operation, but there should be no need to replace the biofiltration media.

Annual maintenance guidelines are summarized in Table 3-5. Details on maintenance procedures can be found in the MWS-L 2.0 maintenance manual provided in Appendix B.

Table 3-5 MWS-L 2.0 Maintenance Summary

MAINTENANCE PROCEDURE	AVERAGE SERVICE TIME	AVERAGE INTERVAL
Remove Trash from Screening Device	5 minutes	6 – 12 months
Remove Sediment from Separation Chamber	10 minutes	12 – 24 months
Replace Cartridge Media	10-15 minutes per cartridge	12 – 24 months
Replace Drain Down Filter Media	5 minutes	12 – 24 months
Trim Vegetation	Varies	6 – 12 months

3.7 COST ESTIMATE

The table below summarizes estimated project costs. As requested by the City in the Scope of Work, engineering design is estimated at approximately 40% of total project construction cost; mobilization is estimated at 10% of total project construction cost; and WPCP or SWPPP, field orders, and contingency are also estimated at 20% of total project construction cost.

Table 3-6 Outfall AS-17 Project Cost Estimate

COMPONENT	UNIT COST	# UNITS	TOTAL
MWS-L-4-4 + tax (assumed 10% tax)	$ 10,000	1.1	$ 11,000
MWS-L Manhole Covers	$ 350	1	$ 400
MWS-L Shipping	$ 400	1	$ 400
Diversion Structure	$ 40,000	1	$ 40,000
Infiltration Basin	$ 30	600	$ 18,000
Pipeline	$ 200	100	$ 20,000
subtotal			**$ 89,800**
Engineering Design	40%		$ 35,900
Mobilization	10%		$ 9,000
WPCP or SWPP	20%		$ 18,000
Field Orders	20%		$ 18,000
Contingency	20%		$ 18,000
TOTAL			**$ 188,700**

3.8 IMPLEMENTATION SCHEDULE

The proposed implementation schedule is shown below. This schedule allows for engineering design and construction of the project to be completed in time for the Bacteria TMDL deadline of September 2020.

Figure 3-5 Estimated Project Implementation Schedule

	2015				2016				2017				2018				2019				2020			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Conceptual Design																								
Permitting																								
Engineering Design																								
Construction																								
Follow-up Monitoring and Observation																								

4 Outfall AS-G Project

The City also identified Outfall AS-G as a potential candidate for a dry weather urban runoff project. This outfall is located near the intersection of Avenue 49 and the Arroyo Seco channel. The proposed solution would address dry weather runoff from an eleven-acre watershed.

4.1 OUTFALL LOCATION

The City has proposed a retrofit project promoting infiltration of runoff discharged to Arroyo Seco. A vacant lot located near the intersection of Echo Street and Avenue 51 is the proposed project location. The project would treat flows that discharge at Outfall AS-G, near the intersection of Avenue 49 and the Arroyo Seco channel. Outfall location details are provided in Table 4-1.

Table 4-1 AS-G Outfall Location

SITE NAME	LATITUDE	LONGITUDE	BANK	MARKING	FLOW TYPE
AS-G	34.1014	-118.2002	Right Bank	156+18	Intermittent

Source: *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring*. Prepared for the City of Los Angeles Bureau of Sanitation Department of Public Works, July 2013.

4.2 INITIAL SITE INVESTIGATIONS

The desktop analyses and field investigations performed at the onset of the project are described in this section.

4.2.1 Field Assessment

The proposed project location was visited by City and Black & Veatch team members on December 10, 2015. The vacant lot near the intersection of Echo Street and Avenue 51 was identified as a potential location for the green infrastructure project. Upon visiting the area and walking the surrounding blocks, it was determined that the proposed lot would not intercept runoff from much of the drainage area given the street slopes and street crowns. Notes from the field visit are provided in Appendix A.

4.2.2 Desktop Geotechnical Analysis

A desktop analysis was performed to identify some general geotechnical parameters throughout the drainage area. Two main concerns were the depth to groundwater and soil infiltration rate. The entire drainage area was considered, instead of a specific project location, because a specific structural solution is not recommended at this time. Should a structural solution be implemented in the future, these parameters may affect the performance of the selected BMP.

According to the Regional Board's Depth-to-Groundwater database, groundwater levels in the project area vary between 22 and 45 feet below surface.

LACDPW provides data on soil type for all of LA County. This data was obtained from LA County's GIS Data Portal. Data shows that the drainage area is located in areas of Ramona Loam soil (Soil Class 013) and Hanford Gravelly Sandy Loam (Soil Class 007). A typical NRCS infiltration rate for Ramona Loam soils is approximately 0.3 inches/hour (in/hr); the Hanford Gravelly Sandy Loam soil type has an infiltration rate of approximately 0.8 in/hr. These areas are depicted in Figure 4-1. If an infiltration BMP is ever constructed within this drainage area, it is recommended that the BMP be

sited over the Hanford Gravelly Sandy Loam soil because areas with well drained soils are preferred over tighter soils, with lower infiltration rates.

4.2.3 Drainage Area and Existing Infrastructure

The drainage area and existing infrastructure are shown in Figure 4-1. The drainage area identifies the area upstream of the project location that contributes dry weather flows to Outfall AS-G.

As shown in Figure 4-1, flows are conveyed down Avenue 49 and into the Arroyo Seco channel. Per the City's as-built records (accessed via NavigateLA), this storm drain is a 15-inch diameter pipelines owned by the City.

LEGEND

- Contours
- Catch Basin
- Storm Drain Network
- Open Channel Storm Drain

Soil Type

- Hanford Gravelly Sandy Loam
- Ramona Loam
- Drainage Area

N

1 inch = 150 feet

0 75 150

Feet

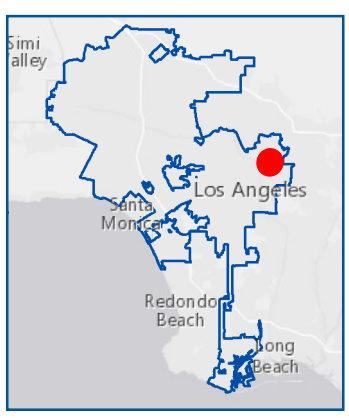

Figure 4-1
Outfall AS-G Drainage Area

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Figure4-1_ASGDrainageArea

4.3 DRY WEATHER FLOWS

In accordance with the TMDL, monitoring was based on six "snapshots" that measured flow rates and bacteria concentrations from all outfalls along Arroyo Seco observed to be flowing. These dry weather snapshots were scheduled over at least two seasons of the same year per TMDL requirements. Outfall AS-G was only observed to be discharging dry weather flows during one of the six monitoring events. Flow rate and water quality data measured at Outfall AS-G is provided in Table 4-2.

Table 4-2 Outfall AS-G Outfall Monitoring Data

EVENT	SAMPLING DATE	FLOW (CFS)	E. COLI LOADING RATE (10^9 MPN/DAY)	TURBIDITY (NTU)
1	9/13/2012	0.00048	0.071963	1.8
2	9/26/2012	--[1]	None	None
3	10/10/2012	--[1]	None	None
4	11/28/2012	--[1]	None	None
5	2/5/2013	--[1]	None	None
6	3/19/2013	--[1]	None	None

[1] No flow was observed at Outfall AS-G during this snapshot.

Source: *Arroyo Seco Bacteria Load Reduction Strategy: Analysis of Priority and Outlier Outfalls based on Outfall Monitoring*. Prepared for the City of Los Angeles Bureau of Sanitation Department of Public Works, July 2013.

4.4 DRY WEATHER IMPLEMENTATION STRATEGY FOR OUTFALL AS-G

During the water quality monitoring period as part of the Outfall Monitoring Report, Outfall AS-G was only observed to be flowing during one of the six data collection snapshots. It is recommended that the Outfall Monitoring Report data collection, analysis, and results be reviewed to verify that dry weather runoff at Outfall AS-G is problematic. In Table 9 of the Outfall Monitoring Report, Outfall AS-G is ranked just below the Priority Outfalls, with an individual *E. coli* loading rate of 0.184 x 10^9 MPN per day. Appendix 3 of the same report provides tabular data collected during the six monitoring events at each of the Arroyo Seco outfalls. The data collected at AS-G during one monitoring event shows that the *E. coli* loading rate at that outfall is 0.071963 x 10^9 MPN per day. Water quality parameters collected as part of the Outfall Monitoring Report are provided above in Table 4-2. It is unclear how the loading rate observed at Outfall AS-G is expected to increase.

Based on the initial site investigations and a review of the Outfall Monitoring Report, it is recommended that additional monitoring be performed at Outfall AS-G before implementing a structural solution. Increased institutional control efforts in the area may begin addressing the dry weather discharges while follow-up investigations are completed.

4.4.1 Project Components

In order to reduce the occurrence of future dry weather discharges, institutional measures, such as signage, ordinance, or enforcement activities regarding vehicle cleansing and proper disposal of pet

waste, should be implemented throughout the drainage area. Furthermore, increased street sweeping efforts may also help to reduce dry weather bacteria loadings contributed at this outfall.

A literature review of the effectiveness of institutional measures for reducing bacterial loads in provides examples of agencies recording between 2 percent and 95 percent reduction in bacteria loads by providing doggy poop bags for removing pet waste (Black & Veatch, 2012). A study by the South Florida Water Management District in 2006 indicated that 95 percent of fecal matter could be eliminated from urban watershed with proper disposal of pet waste. Because the area is largely comprised of high-density residential land use, pet waste may be a significant contributing bacteria source. The City should consider posting signage around the residential buildings and near grassy areas often used by animals.

Furthermore, impervious surfaces, including streets, parking lots, and sidewalks, make up a large percentage of the drainage area, which consists of high-density residential and commercial land use types. A four-year study of two urbanized areas of Wisconsin showed that streets and parking lots contribute between approximately 54 to 80 percent of runoff within a given urban drainage area (Strassler, 1999). Based on the data from this study, streets within residential and commercial land uses contributed approximately 78 percent and 82 percent, respectively, of the total fecal coliform contribution within a selected area. By addressing the accumulation of bacteria on impervious surfaces within the drainage area, the City may be able to reduce the loadings in Arroyo Seco.

Thus, it is recommended that the City review the current street-sweeping practices within the drainage area. If not already in place, the City should consider utilizing vacuum filter technology in their street-sweeping operations. Vacuum filter equipment can be found for either wet or dry conditions. Dry vacuum processes include a mechanical broom sweeping with a vacuum, which collects the finer particles exposed from the sweeping action. Wet vacuum equipment uses water dust suppression with scrubbers that apply water to wet pavement, followed by vacuuming of suspended particles. Due to the water shortage and the possibility of increasing dry weather flows in the area, a dry vacuum machine would likely be better for the City's uses. Data from a recent study suggests that vacuum sweepers deployed at least once per week may result in total suspended solids removal of 79 percent on major roads and 78 percent on residential streets (Pennsylvania Stormwater Best Management Practices Manual, 2006).

5 Conclusions

The goal of the projects presented in this report is to address and reduce the bacterial loading to Arroyo Seco at specific outfalls. Implementing these projects will improve the water quality of one of Los Angeles' valued waterways and help the City achieve compliance with the Bacteria TMDL.

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APPENDIX A

Notes from Arroyo Seco Site Visit on December 10, 2014

Arroyo Seco Site Tour Summary by Black & Veatch

A site visit was held on 12/10/14 at the three proposed project locations to assess potential conceptual designs for green infrastructure projects within the Arroyo Seco watershed. The green infrastructure projects aim to demonstrate compliance with the Los Angeles River Segment B Tributaries Bacteria TMDL (Arroyo Seco). Sheila Brice, Alfredo Magallanes, Jana Parathara, and Miller Zou with the City of LA met Jim Rasmus, Amanda Burns, and Jennifer Thompson of Black & Veatch onsite and attended the site walks.

AS-15: Arroyo Seco & Ave 49

General:

- The site is located in Sycamore Grove Park, a highly urbanized area. This park seems to be highly utilized by the community.
- It was discussed that a buried BMP within the sports field or parking lot is likely the best option to avoid disruption to park activities
- The City noted that there is an Arroyo Seco Foundation which may be planning and have funding for historic restoration in this park
- The City shared information on the Garvanza Park BMP Project which may provide some similarities to this conceptual design
- Black & Veatch will complete the following as follow up to this site visit: (1) obtain available soil borings to determine if permeable soils are present (2) delineate the watershed (3) outline ideas/opportunity areas (4) develop a rough idea of the volume to be treated (5) determine extent of city owned land
- There was a representative from the Parks & Recreation department who provided the following contact information: (323) 255-0370 if needed. Black & Veatch will follow up with this contact at Parks & Recreation as required.

Pedestrian access to walking path on east side of park

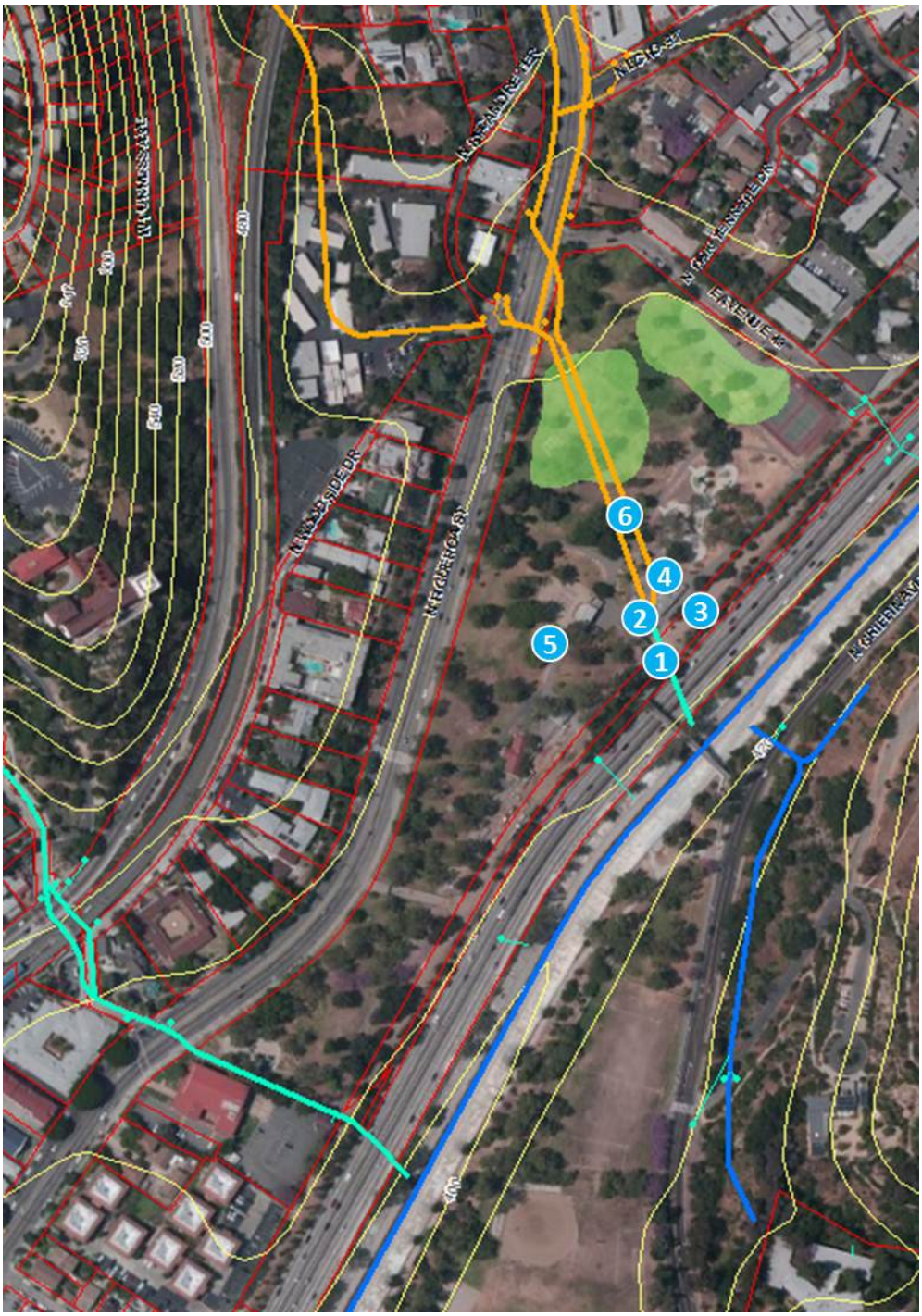
Catch basins for storm drain entering east side of park

Walking path on east side of park parallel to the 110 Freeway

Storage area located on eastern side of park

Open area on south eastern side of park(potential opportunity area for buried treatment)

Playground on northern end of park



Opportunity Areas (highlighted in green) would likely include subsurface BMPs.

AS-G: Echo St & Ave 51

General:

- The site is located in a residential/commercial area in a vacant lot behind a Food 4 Less.
- It is unclear which storm drains contribute to this location.
- Black & Veatch will investigate the potential contributing watershed and will also look into parcel data for this location.
- The intersection of Figueroa and Avenue 52 was visited as potential for diversion of stormwater to the site. A pipe to bypass street drainage to the site was discussed as one potential option.

Grassy lot behind Food 4 Less

Avenue 52 & Echo St

Avenue 52 just north of Echo St.

Team investigated intersection of Figueroa St and Avenue 52 to see if there was potential drainage that could be diverted to the site

Opportunity Area (highlighted in green) would likely include subsurface BMP.

AS-17: Longfellow St and Ave 52

General:

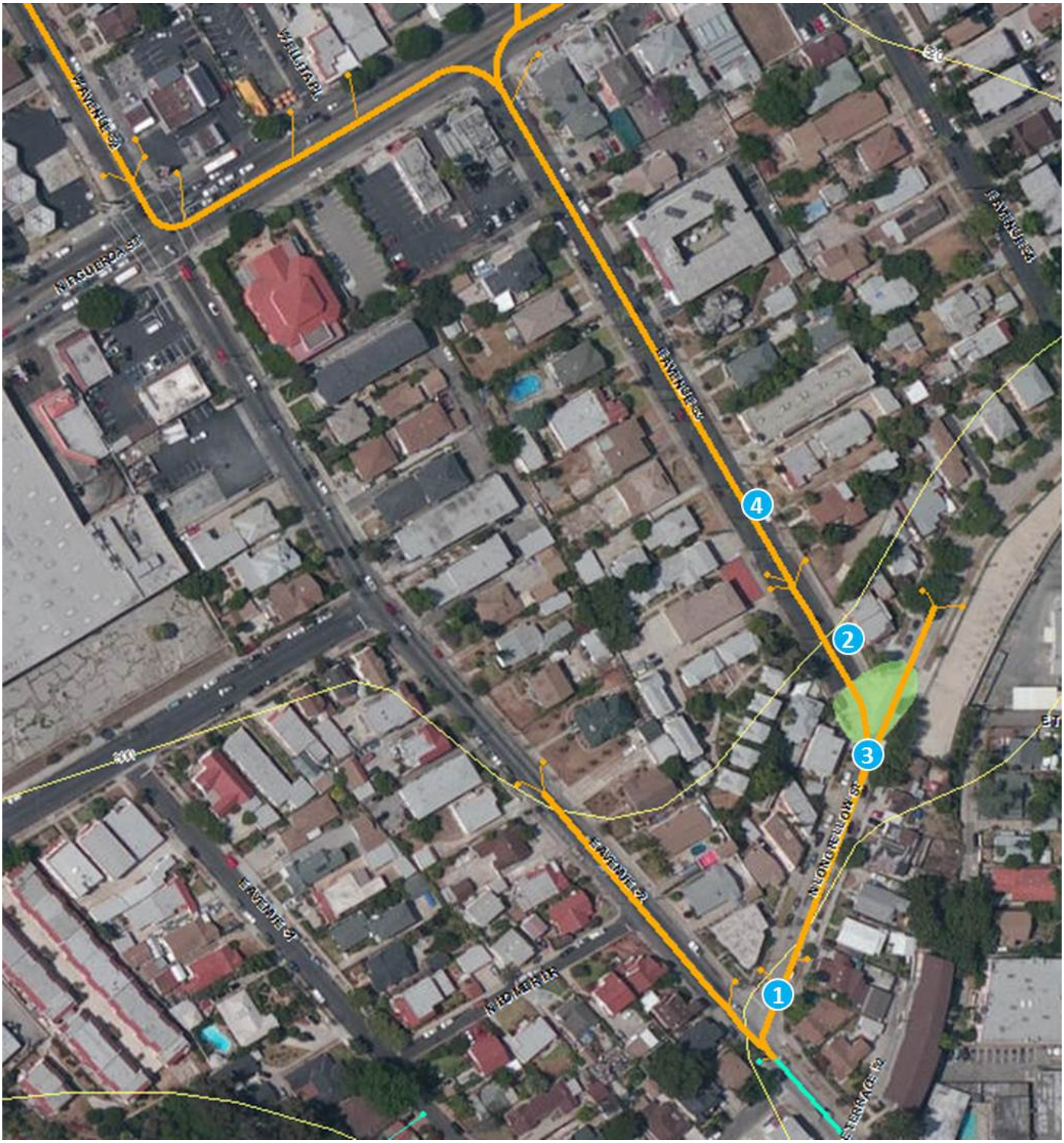
- The site is located in a residential area near the on-ramp for the 110 freeway
  - Heavy traffic
- Avenue 53 & Longfellow was visited and may be a better location
- Avenue 53 would be a good location for a BMP & due to the slope of the street it would be easy to divert and capture stormwater from contributory storm drains at this location while accommodating headloss
  - It was noted that there are less overhead electrical poles/wires on Avenue 53

Avenue 52 & Longfellow St looking northeast

Avenue 53 looking northwest

Avenue 53 & Longfellow St looking west

Avenue 53 looking southeast



Opportunity Area (highlighted in green) would likely include subsurface BMP or bioswale.

APPENDIX B

MWS-L Information from BioClean Environmental, Inc.

DESIGN REQUEST – MODULAR WETLAND SYSTEM - LINEAR

Fill out the information below. This will assist us in providing you with detailed sizing, drawings & pricing.

1. Project Name: _____

2. Project State & City: _____

3. Unit ID (if several units are on same project): _____

4. Your Name: _____

5. Your Contact Email/Phone #: _____

6. Desired Date to Receive Sizing/Drawings/Pricing: _____

7. Configuration: Standard (open vegetated planter-depth limited) ☐ Underground (no plants-full concrete top) ☐

NOTE: Some regulators will only accept units with vegetated open planters to meet their definition of biofiltration.

8. Loading Requirements: Parkway ☐ Indirect Traffic ☐ Direct Traffic ☐ Other ☐

8a. If Other Please List Details (i.e. HS25): _____

NOTE: Standard units have parkway rated manholes and/or hatches. Underground configurations can have traffic rated manholes/hatches by request. All will be bolt & pull style. Hinged hatches are available per request but will add cost. Standard units require irrigation and must be placed in a landscape area.

9. Runoff Entry Method: Piped Flow ☐ Built-In Curb Inlet ☐ Built-In Grate Inlet ☐

NOTE: Units may have only piped flow or a combination of piped flow and a grate or curb inlet. Units may be able to accept multiple inflow pipes. Size of pipe is limited based upon the size of the unit.

10. Water Quality Flow Rate: _____CFS (Dependent on local regulations) **OR**

10a. Water Quality Volume: _____CU FT (Dependent on local regulations) **OR**

10b. Drainage Area (acres) & Impervious Coefficient: _____

NOTE: Units may be sized for either the water quality flow or water quality volume. For water quality volume a pre-detention is required. For areas of the country where flow based design is desired but local regulations do not offer a method to calculate water quality flow please provide the drainage area (acres) and the impervious coefficient. Our engineering team will determine the necessary size required based upon local rainfall patterns to treat 90% of storm events.

11. Internal Bypass Desired: Yes ☐ No ☑

11b. Peak Flow Rate (if internal bypass desired): _____CFS (Dependent on local regulations)

NOTE: Side-by-side orientation units have the option of internal bypass. End-to-end units do not have an internal bypass option. Internal bypass needs to be used with caution and a hydraulic assessment is required for each unit including running the HGL calculations over the bypass weir during peak flow and comparing this to FS elevations of the units and all upstream catch basins. For a standard height unit (4.13 ft) the water level must build to 3.4 ft above invert of outflow pipe to treat listed flow capacity on sizing sheet. Shallower and deeper units are available. Weir can be set lower to accommodate higher bypass flows and lower the associated HGL but will reduce flow capacity of the unit. Please contact manufacturer for calculations and assistance. Other external bypass configurations available such as an external diversions structure, secondary catch basin, or DVERT trough.

12. Finish Grade Elevation (FS, TC, TG): _____

13. Inlet Pipe Invert Elevation (if applicable): _____

13a. Inlet Pipe Diameter/Type (i.e. 8" / PVC): _____

14. Outlet Pipe Invert Elevation: _____

14a. Outlet Pipe Diameter/Type (i.e. 12" / RCP): _____

NOTE: For flow based design at least 16" of fall required between invert in and invert out. For volume based design at least 6" of fall required between invert in and invert out for hydraulically connected pre-detention.

15. Ground Water Elevation (if applicable): _____

16. Corrosive Soil Conditions (if applicable): _____

Please email to us: info@modularwetlands.com
Any questions, contact: (866) 566-3938

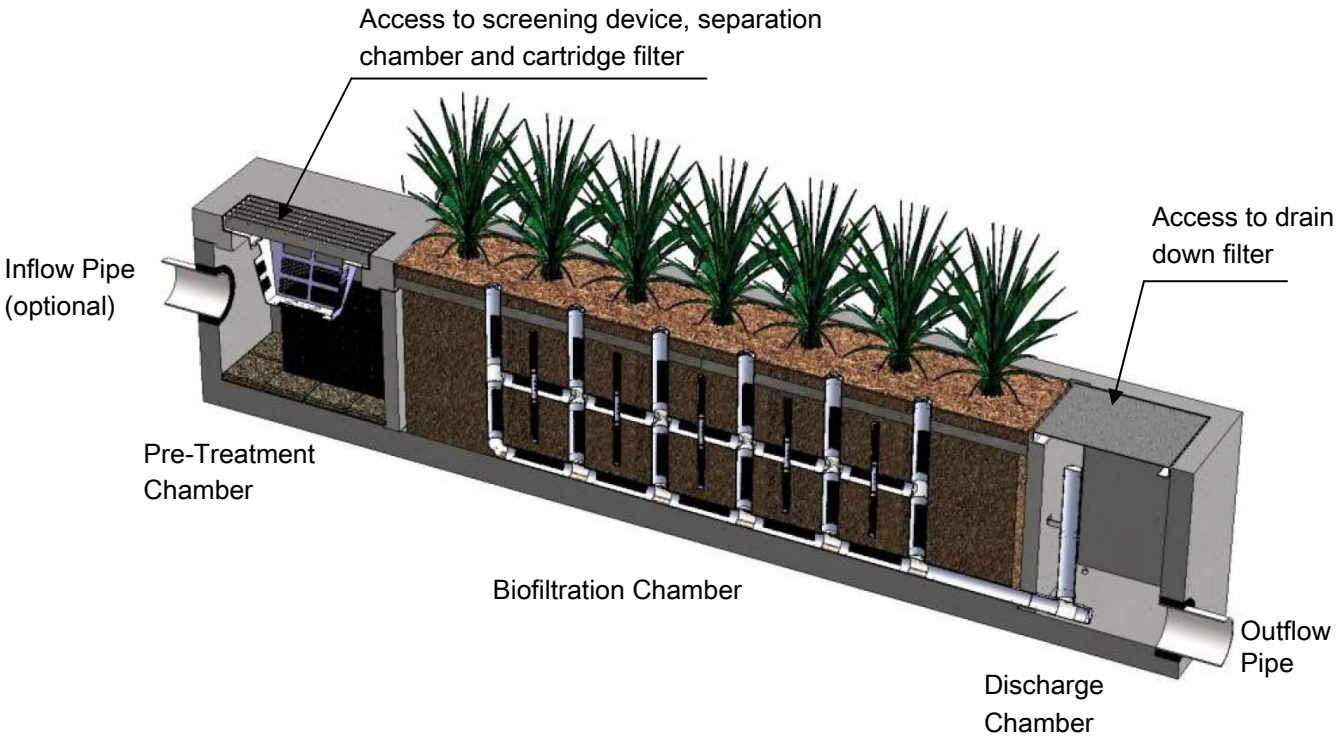
MODULAR WETLANDS

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.

Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.

Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Inspection Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes:

2972 San Luis Rey Road, Oceanside, CA 92058 P (760) 433-7640 F (760) 433-3176

Maintenance Report

Modular Wetland System, Inc.
P. 760.433-7640
F. 760-433-3176
E. Info@modularwetlands.com

www.modularwetlands.com

Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

2972 San Luis Rey Road, Oceanside, CA 92058 P. 760.433.7640 F. 760.433.3176

SITE SPECIFIC DATA*	
PROJECT NAME	
PROJECT LOCATION	
STRUCTURE ID	

PERFORMANCE DATA	
TREATMENT FLOW (CFS)	0.051
TREATMENT HGL (FT)	
BYPASS FLOW RATE (CFS)	DEPENDANT ON PIPE SIZE

PROJECT PARAMETERS			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1		PVC	8"
OUTLET PIPE	-4.13	PVC	8"
RIM ELEVATION	0.0		
SURFACE LOADING REQUIREMENT		PARKWAY	

FRAME & COVER	PRETREATMENT	BIOFILTRATION	DISCHARGE
	22"X40"	OPEN PLANTER	N/A

WETLANDMEDIA VOLUME (CY)	2.4
MEDIA DELIVERED	TBD
ORIFICE SIZE (DIA)	TBD
MAX PICK WEIGHT (LBS)	TBD

NOTES:

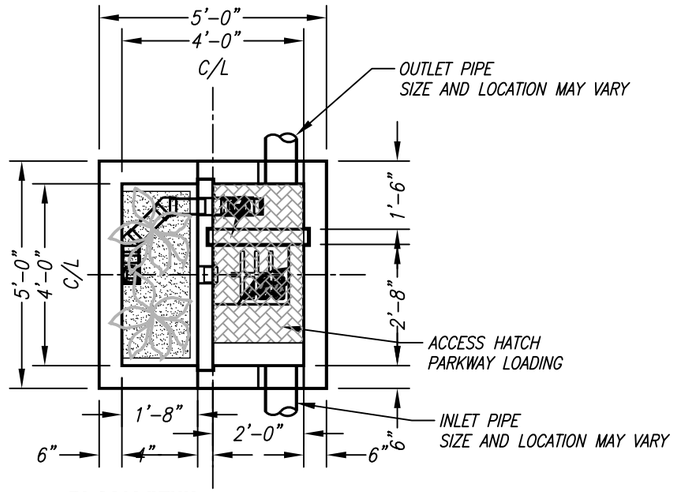
*PER ENGINEER OF RECORD

INSTALLATION NOTES

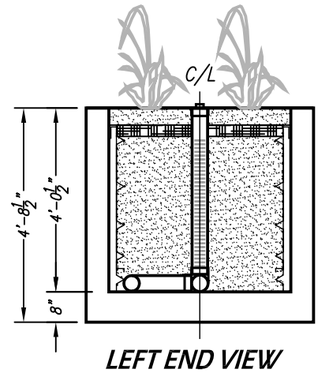
1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. MANUFACTURER RECOMMENDS A MINIMUM 6"LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH).
4. INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR.
5. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
6. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
7. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.

GENERAL NOTES

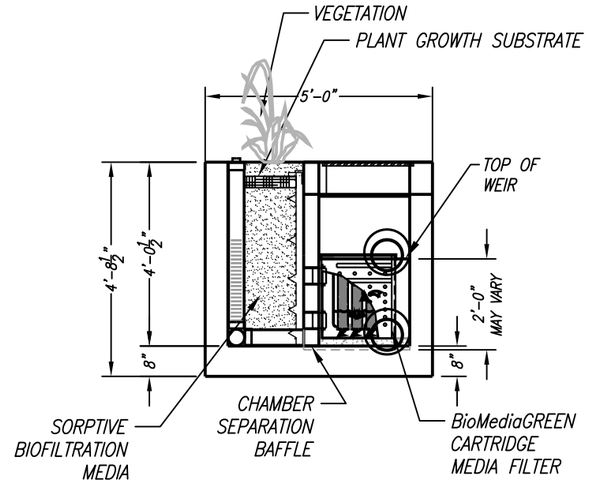
1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.



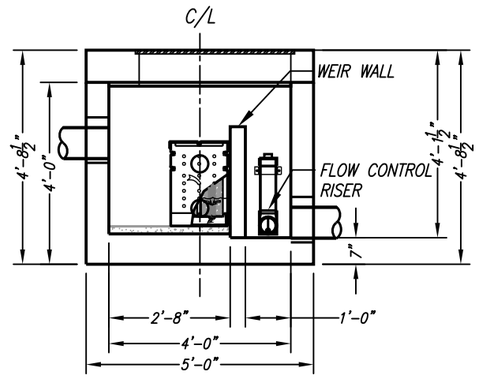
PLAN VIEW



LEFT END VIEW
BIOFILTRATION CHAMBER



ELEVATION VIEW



RIGHT END VIEW
PRETREATMENT/DISCHARGE CHAMBER

MWS UNIT DESIGN DATA	
TREATMENT CAPACITY (CFS)	0.052
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	1.8
WETLAND LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

MWS-L-4-4-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

MWS Linear 2.0 Flow Based Sizing Calculations - *State of California*

Model #	Physical Depth of Model from TC, FS, TC to INVERT OUT	Wetland Perimiter (ft)	**Wetland Chamber Max HGL Height (ft)	Wetland Surface Area (sq ft)	Treatment Capacity for Flow Based Design **FLOW DESIGN**	
					GPM	CFS
MWS-L-4-4	4.13'	6.7	3.40	22.78	**23.46**	**0.052**
MWS-L-4-6	4.13'	9.4	3.40	31.96	**32.92**	**0.073**
MWS-L-4-8	4.13'	14.8	3.40	50.32	**51.83**	**0.115**
MWS-L-4-13	4.13'	18.4	3.40	62.56	**64.44**	**0.144**
MWS-L-4-15	4.13'	22.4	3.40	76.16	**78.44**	**0.175**
MWS-L-4-17	4.13'	26.4	3.40	89.76	**92.45**	**0.206**
MWS-L-4-19	4.13'	30.4	3.40	103.36	**106.46**	**0.237**
MWS-L-4-21	4.13'	34.4	3.40	116.96	**120.47**	**0.268**
MWS-L-8-12	4.13'	44.4	3.40	150.96	**155.49**	**0.346**
MWS-L-8-16	4.13'	59.2	3.40	201.28	**207.32**	**0.462**

Shallow or Deeper Units Available. Change in Height Will Affect Treatment Capacity

** Not the physical height of the unit but the max HGL in the system at peak treatment flow rate

Based on loading rate of 100 in/hr or 1.03 gpm/sq ft

Modular Wetland Systems, Inc. **Copyright 2013** **www.modularwetlands.com**

info@modularwetlands.com **P: 760-433-7640** **2972 San Luis Rey Rd, Oceanside CA 92058**

TAPE PERFORMANCE SUMMARY

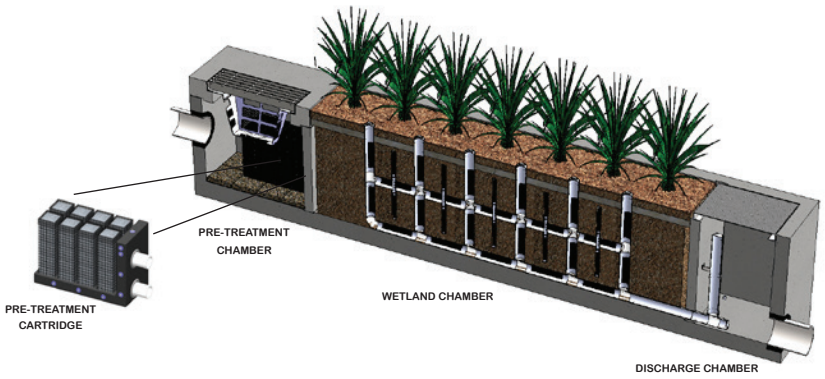
MWS-LINEAR 2.0

Application: Stand Alone Stormwater Treatment Best Management Practice
Type of Treatment: High Flow Rate Media Filtration and Biofiltration (dual-stage)

DESCRIPTION

Modular Wetland System Linear 2.0 (MWS-L 2.0) is an advanced dual-stage high flow rate media and biofiltration system for the treatment of urban stormwater runoff. Superior pollutant removal efficiencies are achieved by treating runoff through a pre-treatment chamber containing a screening device for trash and larger debris, a separation chamber for larger TSS and a series of media filter cartridges for removal of fine TSS and other particulate pollutants. Pre-treated runoff is transferred to the biofiltration chamber which contains an engineered ion exchange media designed to support an abundant plant and microbe community that captures, absorbs, transforms and uptakes pollutants through an array of physical, chemical, and biological mechanisms.

MWS-L 2.0 is a self-contained treatment train that is supplied to the job site completely assembled and ready for use. Once installed, stormwater runoff drains directly from impervious surfaces through an built-in curb inlet, drop in, or via pipe from upstream inlets or downspouts. Treated runoff is discharged from the system through an orifice control riser to assure the proper amount of flow is treated. The treated water leaving the system is connected to the storm drain system, infiltration basins, or to be re-used on site for irrigation or other uses.



TAPE PERFORMANCE

Modular Wetland System Linear 2.0 (MWS-L 2.0) completed its TAPE field testing in the spring of 2013. The Washington DOE has approved the system under the TAPE protocol. The MWS-Linear has met the performance benchmarks for the three major pollutant categories as defined by TAPE: Basic Treatment (TSS), Phosphorus and Enhanced (dissolved zinc and copper). It is the first system tested under the protocol to meet the benchmarks for all three categories.

Pollutant	Avg. Influent (mg/L)	Avg. Effluent (mg/L)	Removal Efficiency	Notes
Total Suspended Solids	75.0	15.7	85%	Summary of all data meeting TAPE parameters pertaining to this pollutant. Mean of 8 microns.
Total Phosphorus	0.227	0.074	64%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Ortho Phosphorus	0.093	0.031	67%	Summary of all data meeting TAPE parameters for total phosphorus.
Nitrogen	1.40	0.77	45%	Utilizing the Kjeldahl method (Total Kjeldahl nitrogen). Summary of all data during testing.
Dissolved Zinc	0.062	0.024	66%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Dissolved Copper	0.0086	0.0059	38%	Summary of all data meeting TAPE parameters pertaining to this pollutant.
Total Zinc	0.120	0.038	69%	Summary of all data during testing.
Total Copper	0.017	0.009	50%	Summary of all data during testing.
Motor Oil	24.157	1.133	95%	Summary of all data during testing.

NOTES:
1. The MWS-Linear was proven effective at infiltration rates of up to 121 in/hr.
2. A minimum of 10 aliquots were collected for each event.
3. Sampling was targeted to capture at least 75 percent of the hydrograph.

Modular Wetland System, Inc.
2972 San Luis Rey Rd
Oceanside, CA 92058

www.modularwetlands.com
P 760-433-7640
F 760-433-3179

MODULAR WETLANDS™
Nature & Technology Working Together In Perfect Harmony™

WASHINGTON STATE DEPARTMENT OF ECOLOGY

April 2014

GENERAL USE LEVEL DESIGNATION FOR BASIC, ENHANCED, AND PHOSPHORUS TREATMENT

For the

MWS-Linear Modular Wetland

Ecology's Decision:

Based on Modular Wetland Systems, Inc. application submissions, including the Technical Evaluation Report, dated April 1, 2014, Ecology hereby issues the following use level designation:

1. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Basic treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

2. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Phosphorus treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

3. General use level designation (GULD) for the MWS-Linear Modular Wetland Stormwater Treatment System for Enhanced treatment

    - Sized at a hydraulic loading rate of 1 gallon per minute (gpm) per square foot (sq ft) of wetland cell surface area. For moderate pollutant loading rates (low to medium density residential basins), size the Prefilters at 3.0 gpm/sq ft of cartridge surface area. For high loading rates (commercial and industrial basins), size the Prefilters at 2.1 gpm/sq ft of cartridge surface area.

4. Ecology approves monitoring for the MWS - Linear Modular Wetland Stormwater Treatment System units for Basic, Phosphorus, and Enhanced treatment at the hydraulic

loading rate listed above. Designers shall calculate the water quality design flow rates using the following procedures:

- Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
- Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.2.5 of the Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
- Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

5. These use level designations have no expiration date but may be revoked or amended by Ecology, and are subject to the conditions specified below.

Ecology's Conditions of Use:

Applicants shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain the MWS – Linear Modular Wetland Stormwater Treatment System units, in accordance with Modular Wetland Systems, Inc. applicable manuals and documents and the Ecology Decision.
2. Each site plan must undergo Modular Wetland Systems, Inc. review and approval before site installation. This ensures that site grading and slope are appropriate for use of a MWS – Linear Modular Wetland Stormwater Treatment System unit.
3. MWS – Linear Modular Wetland Stormwater Treatment System media shall conform to the specifications submitted to, and approved by, Ecology.
4. Maintenance: The required maintenance interval for stormwater treatment devices is often dependent upon the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.

- Typically, Modular Wetland Systems, Inc. designs MWS - Linear Modular Wetland systems for a target prefilter media life of 6 to 12 months.
- Indications of the need for maintenance include effluent flow decreasing to below the design flow rate or decrease in treatment below required levels.
- Owners/operators must inspect MWS - Linear Modular Wetland systems for a minimum of twelve months from the start of post-construction operation to determine site-specific maintenance schedules and requirements. You must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in western Washington is October 1 to April 30. According to SWMMEW, the wet season in eastern Washington is October 1 to June 30). After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.

- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flowrate and/or a decrease in pollutant removal ability.
- When inspections are performed, the following findings typically serve as maintenance triggers:
    - Standing water remains in the vault between rain events, or
    - Bypass occurs during storms smaller than the design storm.
    - If excessive floatables (trash and debris) are present (but no standing water or excessive sedimentation), perform a minor maintenance consisting of gross solids removal, not prefilter media replacement.
    - Additional data collection will be used to create a correlation between pretreatment chamber sediment depth and pre-filter clogging (see *Issues to be Addressed by the Company* section below)

6. Discharges from the MWS - Linear Modular Wetland Stormwater Treatment System units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant:	Modular Wetland Systems, Inc.
Applicant's Address:	*PO. Box 869* *Oceanside, CA 92054*

Application Documents:

- *Original Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., January 2011
- *Quality Assurance Project Plan*: Modular Wetland system – Linear Treatment System performance Monitoring Project, draft, January 2011.
- *Revised Application for Conditional Use Level Designation*, Modular Wetland System, Linear Stormwater Filtration System Modular Wetland Systems, Inc., May 2011
- *Memorandum: Modular Wetland System-Linear GULD Application Supplementary Data, April 2014*
- *Technical Evaluation Report: Modular Wetland System Stormwater Treatment System Performance Monitoring, April 2014.*

Applicant's Use Level Request:

General use level designation as a Basic, Enhanced, and Phosphorus treatment device in accordance with Ecology's Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE) January 2011 Revision.

Applicant's Performance Claims:

- The MWS – Linear Modular wetland is capable of removing a minimum of 80-percent of TSS from stormwater with influent concentrations between 100 and 200 mg/l.

- The MWS – Linear Modular wetland is capable of removing a minimum of 50-percent of Total Phosphorus from stormwater with influent concentrations between 0.1 and 0.5 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 30-percent of dissolved Copper from stormwater with influent concentrations between 0.005 and 0.020 mg/l.
- The MWS – Linear Modular wetland is capable of removing a minimum of 60-percent of dissolved Zinc from stormwater with influent concentrations between 0.02 and 0.30 mg/l.

Ecology Recommendations:

- Modular Wetland Systems, Inc. has shown Ecology, through laboratory and field-testing, that the MWS - Linear Modular Wetland Stormwater Treatment System filter system is capable of attaining Ecology's Basic, Total phosphorus, and Enhanced treatment goals.

Findings of Fact:

Laboratory Testing

The MWS-Linear Modular wetland has the:

- Capability to remove 99 percent of total suspended solids (using Sil-Co-Sil 106) in a quarter-scale model with influent concentrations of 270 mg/L.
- Capability to remove 91 percent of total suspended solids (using Sil-Co-Sil 106) in laboratory conditions with influent concentrations of 84.6 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 93 percent of dissolved Copper in a quarter-scale model with influent concentrations of 0.757 mg/L.
- Capability to remove 79 percent of dissolved Copper in laboratory conditions with influent concentrations of 0.567 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 80.5-percent of dissolved Zinc in a quarter-scale model with influent concentrations of 0.95 mg/L at a flow rate of 3.0 gpm per square foot of media.
- Capability to remove 78-percent of dissolved Zinc in laboratory conditions with influent concentrations of 0.75 mg/L at a flow rate of 3.0 gpm per square foot of media.

Field Testing

- Modular Wetland Systems, Inc. conducted monitoring of an MWS-Linear (Model # MWS-L-4-13) from April 2012 through May 2013, at a transportation maintenance facility in Portland, Oregon. The manufacturer collected flow-weighted composite samples of the system’s influent and effluent during 28 separate storm events. The system treated approximately 75 percent of the runoff from 53.5 inches of rainfall during the monitoring period. The applicant sized the system at 1 gpm/sq ft. (wetland media) and 3gpm/sq ft. (prefilter).

- Influent TSS concentrations for qualifying sampled storm events ranged from 20 to 339 mg/L. Average TSS removal for influent concentrations greater than 100 mg/L (n=7) averaged 85 percent. For influent concentrations in the range of 20-100 mg/L (n=18), the upper 95 percent confidence interval about the mean effluent concentration was 12.8 mg/L.
- Total phosphorus removal for 17 events with influent TP concentrations in the range of 0.1 to 0.5 mg/L averaged 65 percent. A bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean total phosphorus reduction was 58 percent.
- The lower 95 percent confidence limit of the mean percent removal was 60.5 percent for dissolved zinc for influent concentrations in the range of 0.02 to 0.3 mg/L (n=11). The lower 95 percent confidence limit of the mean percent removal was 32.5 percent for dissolved copper for influent concentrations in the range of 0.005 to 0.02 mg/L (n=14) at flow rates up to 28 gpm (design flow rate 41 gpm). Laboratory test data augmented the data set, showing dissolved copper removal at the design flow rate of 41 gpm (93 percent reduction in influent dissolved copper of 0.757 mg/L).

Issues to be addressed by the Company:

1. Modular Wetland Systems, Inc. should collect maintenance and inspection data for the first year on all installations in the Northwest in order to assess standard maintenance requirements for various land uses in the region. Modular Wetland Systems, Inc. should use these data to establish required maintenance cycles.
2. Modular Wetland Systems, Inc. should collect pre-treatment chamber sediment depth data for the first year of operation for all installations in the Northwest. Modular Wetland Systems, Inc. will use these data to create a correlation between sediment depth and pre-filter clogging.

Technology Description:
Download at http://www.modularwetlands.com/

Contact Information:

Applicant: Greg Kent
Modular Wetland Systems, Inc.
P.O. Box 869
Oceanside, CA 92054
gkent@biocleanenvironmental.net

Applicant website: http://www.modularwetlands.com/

Ecology web link: http://www.ecy.wa.gov/programs/wg/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
June 2011	Original use-level-designation document
September 2012	Revised dates for TER and expiration
January 2013	Modified Design Storm Description, added Revision Table, added maintenance discussion, modified format in accordance with Ecology standard
December 2013	Updated name of Applicant
April 2014	Approved GULD designation for Basic, Phosphorus, and Enhanced treatment