

MOJAVE RIVER WATERSHED

Water Quality Management Plan

For:

Tract 18940

APN # 3091-141-01-0000

Prepared for:

John & Janet Kavak, Trustee of the Kavak Family Trust

1317 Avenida Colina

San Dimas CA 91773

626-331-4631

Prepared by:

TMS Consortium

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951-272-1710

Submittal Date: 11/28/18

Revision No. and Date: 8-8-19

Revision No. and Date: 10-8-19

Revision No. and Date: _____

Revision No. and Date: _____

Revision No. and Date: _____

Final Approval Date:_____

Project Owner's Certification

This Mojave River Watershed Water Quality Management Plan (WQMP) has been prepared for John & Janet Kavak, Trustee of the Kavak Family Trust by TMS Consortium. The WQMP is intended to comply with the requirements of the City of Victorville and the Phase II Small MS4 General Permit for the Mojave River Watershed. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the Phase II Small MS4 Permit and the intent of San Bernardino County (unincorporated areas of Phelan, Oak Hills, Spring Valley Lake and Victorville) and the incorporated cities of Hesperia and Victorville and the Town of Apple Valley. Once the undersigned transfers its interest in the property, its successors in interest and the city/county/town shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	n/a	Grading Permit Number(s):	n/a
Tract/Parcel Map Number(s):	Tract 18940	Building Permit Number(s):	n/a
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			
Owner's Signature			
Owner Name: John & Janet Kavak			
Title	Owner		
Company	John & Janet Kavak, Trustee of the Kavak Family Trust		
Address	1317 Avenida Colina, San Dimas CA 91773		
Email	TBD		
Telephone #	626-331-4631		
Signature	[Signature: John & Janet Kavak]		Date: 11/29/2018

Preparer's Certification

Project Data			
Permit/Application Number(s):	n/a	Grading Permit Number(s):	n/a
Tract/Parcel Map Number(s):	Tract 18940	Building Permit Number(s):	n/a
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			3091-141-01-0000

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of the California State Water Resources Control Board Order No. 2013-0001-DWQ.

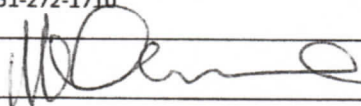
Engineer: Tariq Shamma P.E., S.E.		PE Stamp Below 
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Company	TMS Consortium	
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Signature		
Date	1/17/19	

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Section I – Introduction

This WQMP template has been prepared specifically for the Phase II Small MS4 General Permit in the Mojave River Watershed. This location is within the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

WQMP preparers must refer to the MS4 Permit for the Mojave Watershed WQMP template and Technical Guidance (TGD) document found at: <http://cms.sbcounty.gov/dpw/Land/NPDES.aspx> to find pertinent arid region and Mojave River Watershed specific references and requirements.

Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name		Tract 18940			
Project Owner Contact Name:		John & Janet Kavak, Trustee of the Kavak Family Trust			
Mailing Address:	1317 Avenida Colina San Dimas CA 91773	E-mail Address:	TBD	Telephone:	626-331-4631
Permit/Application Number(s):		30150021.0051 ID: 00121	Tract/Parcel Map Number(s):	Tract 18940 APN #3091-141-01-0000	
Additional Information/ Comments:					
Description of Project:		The approximately 4.77 acre site is currently undeveloped and vacant with minimal desert vegetation. The site rectangular in shape with approximately 650 feet along north/south and 330 feet along east/west property lines. The site topography has mild slopes, here is a high point on the site that drains part of the site to the west and part to the east. Proposed improvements including 17 residential homes, new street cul-de-sac and landscaping. The site will be designed with two (2) Drainage Areas separated by ridge/high point on the site. Drainage Area DA1 is about 2.97 acres and Drainage Area DA2 is about 1.80 acres. In post developed condition, DA1 runoff will be captured with catch basin inlets and discharged to the proposed infiltration basin at the entrance of the site via storm drain pipe. The basin is over-sized to retain DCV of the WQMP storm as well as mitigate for higher design storm flows. Due to the topography of the site, part of the site drains to an existing drainage ditch located along the west property line. Drainage Area DA2 runoff is discharged to the site. Due to the site constraints, this runoff will be treated in a bio-swale. The swale will be about 10 feet wide along the northern lot line of lot 9. Curb core pipes are proposed at the low point in the Cul-de-Sac to direct the water to the swale. In addition, 10'x10'x2' sump pit will be proposed at the end of the swale to retain the water before discharging to the existing drainage ditch via a 4-inch pipe.			

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Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	n/a
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Section 2 Project Description

2.1 Project Information

The WQMP shall provide the information listed below. The information provided for Conceptual/Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

2.1.1 Project Sizing Categorization

If the Project is greater than 5,000 square feet, and not on the excluded list as found on Section 1.4 of the TGD, the Project is a Regulated Development Project.

If the Project is creating and/or replacing greater than 2,500 square feet but less than 5,000 square feet of impervious surface area, then it is considered a Site Design Only project. This criterion is applicable to all development types including detached single family homes that create and/or replace greater than 2,500 square feet of impervious area and are not part of a larger plan of development.

Form 2.1-1 Description of Proposed Project

¹ Regulated Development Project Category (Select all that apply):

☒ #1 New development involving the creation of 5,000 ft ² or more of impervious surface collectively over entire site	☐ #2 Significant re-development involving the addition or replacement of 5,000 ft ² or more of impervious surface on an already developed site	☐ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface	☐ #4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface
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☐ Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) Will require source control Site Design Measures. Use the "PCMP" Template. Do not use this WQMP Template.

² Project Area (ft ²):	207,750	³ Number of Dwelling Units:	17	⁴ SIC Code:	1521
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⁵ Is Project going to be phased? Yes ☐ No ☒ If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

Home Owner Association will be responsible for maintenance of onsite BMPs.

2.3 Potential Stormwater Pollutants

Best Management Practices (BMP) measures for pollutant generating activities and sources shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment (or an equivalent manual). Pollutant generating activities must be considered when determining the overall pollutants of concern for the Project as presented in Form 2.3-1.

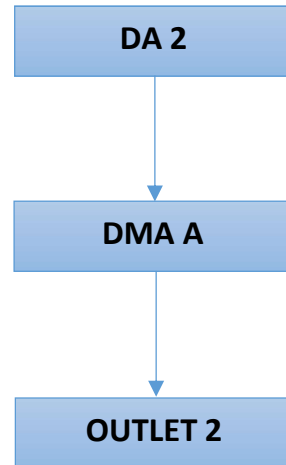
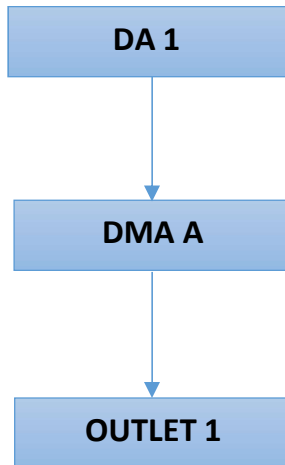
Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	
Nutrients - Phosphorous	E ☒	N ☐	
Nutrients - Nitrogen	E ☒	N ☐	
Noxious Aquatic Plants	E ☐	N ☒	
Sediment	E ☒	N ☐	
Metals	E ☒	N ☐	
Oil and Grease	E ☒	N ☐	
Trash/Debris	E ☒	N ☐	
Pesticides / Herbicides	E ☒	N ☐	
Organic Compounds	E ☒	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMPs through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed Drainage Management Areas (DMAs)) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet. A map presenting the DMAs must be included as an appendix to the WQMP document.***

Form 3-1 Site Location and Hydrologic Features			
Site coordinates take GPS measurement at approximate center of site	Latitude 34.4807	Longitude 117.2999	Thomas Bros Map page n/a
1 San Bernardino County climatic region: ☒ Desert			
2 Does the site have more than one drainage area (DA): Yes ☒ No ☐ <i>If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached</i>			
Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA		
DA1 DMA C flows to DA1 DMA A	Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property		
DA1 DMA A to Outlet 1	The site is divided by a ridge line that runs north to south approximately 270 feet east of the west property line. There is 1.80 acres that drain west to an existing improved concrete box channel and drainage easement. The remaining 2.97 acres will drain east to Second Avenue. The high point of the site is at an elevation of 3007 feet. The low point at the northwest corner of the site is at an elevation of 2991 feet and the low point at the northeast corner of the site is at an elevation of 2996 feet. DMA A area east of the high point/ridge line will drain to catch basins and discharge to the infiltration basin proposed near the entrance of the proposed site. DA1 DMA 1 design capture volume is 3,291 cu. ft and provided volume in infiltration basin is 3,375 cu. ft.		



DA1 DMA B to Outlet 1	
DA2 to Outlet 2	DA 2 DMA 1 area west of the high point in the proposed street will drain to the bio swale 90'x8' in size proposed along Lot 9 property line. Design Capture volume for this area is 1,986 cu. ft. and provided volume is 1,977 cu. ft. The treated flow will reach a sump pit and then discharge to existing offsite drainage ditch via a 4-inch pvc pipe. Infiltration Basin proposed to treat the entire site, but since part of the site (DA 2) drains to the east and it was not possible to treat the runoff from this area to drain to the infiltration basin. This physical condition and limitation of the site necessitated bio swale treatment for DA 2. The treated water will still get detained in a sump pit before discharging to the offsite drainage ditch. The infiltration basin was over-sized (over mitigated) for this reason. In existing condition, the site generated runoff mostly sheet flows to the low points of the site. Proposed condition because of the development will increase the flow rates and decrease the time of concentrations. The runoff in proposed condition drains to retention basin for water quality treatment and flood mitigation. Please refer to the hydrology report for the hydrological analysis between pre and post development condition and how the LID BMP (Infiltration Basin) is used for detaining/retaining the flow rate and also reducing the erosion and sediments concerns for the downstream facilities and waterbodies.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
¹ DMA drainage area (ft ²)	129555			
² Existing site impervious area (ft ²)	0	0		
³ Antecedent moisture condition <i>For desert areas, use</i> http://www.sbcounty.gov/dpw/floodcontrol/pdf/2	Not applicable per link provided			

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0100412 map.pdf				
4 Hydrologic soil group <i>Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf</i>	B			
5 Longest flowpath length (ft)	392			
6 Longest flowpath slope (ft/ft)	0.02			
7 Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>	Barren			
8 Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>	Poor			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA 1)				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA E	DMA F	DMA G	DMA H
1 DMA drainage area (ft ²)				
2 Existing site impervious area (ft ²)				
3 Antecedent moisture condition <i>For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</i>				
4 Hydrologic soil group <i>County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_addendum.pdf</i>				
5 Longest flowpath length (ft)				
6 Longest flowpath slope (ft/ft)				
7 Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>				
8 Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating</i>				

Form 3-3 Watershed Description for Drainage Area	
Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Mojave River (Upper Narrows to Lower Narrows)
Applicable TMDLs http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	No approved TMDLs
303(d) listed impairments http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	Fluoride, Sulfates, Total Dissolved Solids
Environmentally Sensitive Areas (ESA) Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP	Desert Tortoise Habitat Cat3, Mojave Ground Squirrel, Merriam K Rat
Hydromodification Assessment	☐ Yes Complete Hydromodification Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design BMP Measures

The information and data in this section are required for both Regulated Development and Site Design Only Projects. Source Control BMPs and Site Design BMP Measures are the basis of site-specific pollution management.

4.1.1 Source Control BMPs

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

The identified list of source control BMPs correspond to the CASQA Stormwater BMP Handbook for New Development and Redevelopment.

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Property owner will familiarize him/herself with the educational materials in Attachment "E" and the contents of the WQMP.
N2	Activity Restrictions	☒	☐	No outdoor work areas, processing, storage or wash area.
N3	Landscape Management BMPs	☒	☐	Irrigation must be consistent with City's Water Conservation Ordinance. Fertilizer and pesticide usage will be consistent with County Management Guidelines for Use of Fertilizers and Pesticides.
N4	BMP Maintenance	☒	☐	BMP maintenance, implementation schedules, and responsible parties are included with each specific BMP narrative.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous wastes onsite.
N6	Local Water Quality Ordinances	☐	☒	Local agency does not have additional water quality ordinances.
N7	Spill Contingency Plan	☒	☐	Owner/tenant will have a spill contingency plan based on individual site needs.
N8	Underground Storage Tank Compliance	☐	☒	No USTs onsite.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials onsite.

Form 4.1-1 Non-Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☒	☐	Owner will comply with Article 80 of the Uniform Fire Code enforced by the fire protection agency.
N11	Litter/Debris Control Program	☒	☐	Contract with the landscape maintenance firm to provide this service during regularly schedule maintenance.
N12	Employee Training	☒	☐	The owner will ensure that home owners are also familiar with onsite BMPs and necessary maintenance required of the tenants. Home Owner's Association (HOA) shall be trained to clean up spills and participate in ongoing maintenance. HOA will check with City and County at least once a year to obtain new or updated educational materials and provide these materials to tenants. The WQMP requires annual training for the HOA members.
N13	Housekeeping of Loading Docks	☐	☒	No loading docs
N14	Catch Basin Inspection Program	☒	☐	Monthly inspection by HOA designee. Vacuum when sediment or trash becomes 2-inches deep and dispose of properly.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	All landscape maintenance contractors will be required to sweep up all landscape cuttings, mowings and fertilizer materials off paved areas weekly and dispose of properly. Parking areas and drive ways will be swept monthly by sweeping contractor.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not a public agency project.
N17	Comply with all other applicable NPDES permits	☒	☐	Will comply with Construction General Permit.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	"No Dumping – Drains to River" stencils will be applied. Legibility of stencil will be maintained on a yearly basis.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage areas onsite.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements diverted around the area, screened or walled to prevent off-site transport of trash. Provide solid roof or awning to prevent direct contact with rainfall.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	Irrigation systems shall include reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines. Timers will be used to avoid over watering and watering cycles and duration shall be adjusted seasonally by the landscape maintenance contractor. The landscaping areas will be grouped with plants that have similar water requirements. Native or drought tolerant species shall also be used where appropriate to reduce excess irrigation runoff and promote surface filtration.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Landscaped areas will be suppressed in order to increase retention of stormwater/irrigation water and promote infiltration.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	Not applicable, No slopes or channels will require energy dissipation.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Finished goods being loaded and unloaded at the docks does not have the potential to contribute to stormwater pollution. No direct connections will be made to a MS4.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Not applicable, no maintenance bay is being proposed.

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S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☐	Not applicable, no vehicle wash areas being proposed.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Not applicable, no outdoor processing areas are being proposed.
Form 4.1-2 Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not applicable, no equipment wash areas are being proposed.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Not applicable, no fueling areas are being proposed.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Not applicable, no hillside landscaping is being proposed.
S14	Wash water control for food preparation areas	☐	☒	Not applicable, no food preparation areas are being proposed.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Not applicable, no community car wash is being proposed.

4.1.2 Site Design BMPs

As part of the planning phase of a project, the site design practices associated with new LID requirements in the Phase II Small MS4 Permit must be considered. Site design BMP measures can result in smaller Design Capture Volume (DCV) to be managed by both LID and hydromodification control BMPs by reducing runoff generation.

As is stated in the Permit, it is necessary to evaluate site conditions such as soil type(s), existing vegetation and flow paths will influence the overall site design.

Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Site Design Practices Checklist
Site Design Practices <i>If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets</i>
Minimize impervious areas: Yes ☐ No ☒ Explanation: Site is proposing single family homes with driveway and access road which will increase impervious areas
Maximize natural infiltration capacity; Including improvement and maintenance of soil: Yes ☒ No ☐ Explanation: A infiltration basin with uncompacted soil underneath is being proposed to maximize natural infiltration
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Site will be design to maintain the pre-development drainage patterns as much as possible
Disconnect impervious areas. Including rerouting of rooftop drainage pipes to drain stormwater to storage or infiltration BMPs instead of to storm drain : Yes ☒ No ☐ Explanation: Roof downspouts will outlet to splash blocks allow for maximum infiltration in the landscape areas.
Use of Porous Pavement.: Yes ☐ No ☒ Explanation: Porous pavement was not used for the site.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: The existing site contains little to no vegetation to protect.
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. : Yes ☒ No ☐ Explanation: Landscaping with local drought tolerant plant species will be provided where applicable in the development.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Undisturbed earth will be required under infiltration basin
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: The existing site does not utilize the vegetated drainage swales
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☐ No ☒ Explanation: Efforts will be made to reduce compaction in landscape areas
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.: Yes ☐ No ☒ Explanation: Rain Barrels and Cisterns are not used for on-site water collection system due to space restrictions in the site design
Stream Setbacks. Includes a specified distance from an adjacent stream: : Yes ☐ No ☒ Explanation: No adjacent stream exist near the site

It is noted that, in the Phase II Small MS4 Permit, site design elements for green roofs and vegetative swales are required. Due to the local climatology in the Mojave River Watershed, proactive measures are taken to maximize the amount of drought tolerant vegetation. It is not practical in this region to have green roofs or vegetative swales. As part of site design the project proponent should utilize locally recommended vegetation types for landscaping. Typical landscaping recommendations are found in following local references:

San Bernardino County Special Districts:

Guide to High Desert Landscaping -

<http://www.specialdistricts.org/Modules/ShowDocument.aspx?documentid=795>

Recommended High-Desert Plants -

<http://www.specialdistricts.org/modules/showdocument.aspx?documentid=553>

Mojave Water Agency:

Desert Ranch: <http://www.mojavewater.org/files/desertranchgardenprototype.pdf>

Summertree: <http://www.mojavewater.org/files/Summertree-Native-Plant-Brochure.pdf>

Thornless Garden: <http://www.mojavewater.org/files/thornlessgardenprototype.pdf>

Mediterranean Garden: <http://www.mojavewater.org/files/mediterraneangardenprototype.pdf>

Lush and Efficient Garden: <http://www.mojavewater.org/files/lushandefficientgardenprototype.pdf>

Alliance for Water Awareness and Conservation (AWAC) outdoor tips – <http://hdawac.org/save-outdoors.html>

4.2 Treatment BMPs

After implementation and design of both Source Control BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evapotranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in Section E.12.e.ii.c and Section E.12.f of the Phase II Small MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection from hydromodification.

If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.

It is noted that in the Phase II Small MS4 Permit jurisdictions, the LID BMP Design Capture Volume criteria is based on the 2-year rain event. The hydromodification performance criterion is based on the 10-year rain event.

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), San Bernardino County requires use of the P_6 method (Form 4.2-1) For pre- and post-development hydrologic calculation, San Bernardino County requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi²), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for hydromodification performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)

1 Project area DA 1 (ft ²): 129,555	2 Imperviousness after applying preventative site design practices (Imp%): 50%	3 Runoff Coefficient (Rc): _0.34 $R_c = 0.858(Imp\%)^{0.3} - 0.78(Imp\%)^{0.2} + 0.774(Imp\%) + 0.04$
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr-1hr}$ (in): 0.37 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6 , Mean 6-hr Precipitation (inches): 0.46 <i>$P_6 = \text{Item 4} * C_1$, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)</i>		
6 Drawdown Rate Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft ³): 3,291 $DCV = 1/12 * [\text{Item 1} * \text{Item 3} * \text{Item 5} * C_2]$, where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2		

Form 4.2-2 Summary of Hydromodification Assessment (DA 1)

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ No ☐

If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below (Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft ³)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 Form 4.2-3 Item 12	2 Form 4.2-4 Item 13	3 Form 4.2-5 Item 10
Post-developed	4 Form 4.2-3 Item 13	5 Form 4.2-4 Item 14	6 Form 4.2-5 Item 14
Difference	7 Item 4 – Item 1	8 Item 2 – Item 5	9 Item 6 – Item 3
Difference (as % of pre-developed)	10 % Item 7 / Item 1	11 % Item 8 / Item 2	12 % Item 9 / Item 3

Form 4.2-3 Hydromodification Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft ² <i>sum of areas of DMA should equal area of DA</i>								
4a Curve Number (CN) <i>use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP</i>								
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft ² <i>sum of areas of DMA should equal area of DA</i>								
4b Curve Number (CN) <i>use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP</i>								
5 Pre-Developed area-weighted CN:	7 Pre-developed soil storage capacity, S (in): $S = (1000 / \text{Item 5}) - 10$					9 Initial abstraction, I _a (in): $I_a = 0.2 * \text{Item 7}$		
6 Post-Developed area-weighted CN:	8 Post-developed soil storage capacity, S (in): $S = (1000 / \text{Item 6}) - 10$					10 Initial abstraction, I _a (in): $I_a = 0.2 * \text{Item 8}$		
11 Precipitation for 10 yr, 24 hr storm (in): Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html								
12 Pre-developed Volume (ft ³): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 9})^2 / ((\text{Item 11} - \text{Item 9} + \text{Item 7}))]$								
13 Post-developed Volume (ft ³): $V_{pre} = (1 / 12) * (\text{Item sum of Item 3}) * [(\text{Item 11} - \text{Item 10})^2 / ((\text{Item 11} - \text{Item 10} + \text{Item 8}))]$								
14 Volume Reduction needed to meet hydromodification requirement, (ft ³): $V_{hydro} = (\text{Item 13} * 0.95) - \text{Item 12}$								

Form 4.2-4 Hydromodification Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA (For projects using the Hydrology Manual complete the form below)

Variables	Pre-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>				Post-developed DA1 <i>Use additional forms if there are more than 4 DMA</i>			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) <i>Use Form 3-2 Item 5 for pre-developed condition</i>								
2 Change in elevation (ft)								
3 Slope (ft/ft), $S_o = \text{Item 2} / \text{Item 1}$								
4 Land cover								
5 Initial DMA Time of Concentration (min) <i>Appendix C-1 of the TGD for WQMP</i>								
6 Length of conveyance from DMA outlet to project site outlet (ft) <i>May be zero if DMA outlet is at project site outlet</i>	0				0			
7 Cross-sectional area of channel (ft ²)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) $V_{fps} = (1.49 / \text{Item 9}) * (\text{Item 7}/\text{Item 8})^{0.67} * (\text{Item 3})^{0.5}$								
11 Travel time to outlet (min) $T_t = \text{Item 6} / (\text{Item 10} * 60)$	0				0			
12 Total time of concentration (min) $T_c = \text{Item 5} + \text{Item 11}$								
13 Pre-developed time of concentration (min):	<i>Minimum of Item 12 pre-developed DMA</i>							
14 Post-developed time of concentration (min):	<i>Minimum of Item 12 post-developed DMA</i>							
15 Additional time of concentration needed to meet hydromodification requirement (min):	$T_{C-Hydro} = (\text{Item 13} * 0.95) - \text{Item 14}$							

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables	Pre-developed DA to Project Outlet (Use additional forms if more than 3 DMA)			Post-developed DA to Project Outlet (Use additional forms if more than 3 DMA)							
	DMA A	DMA B	DMA C	DMA A	DMA B	DMA C					
1 Rainfall Intensity for storm duration equal to time of concentration $I_{peak} = 10^{(LOG \text{ Form 4.2-1 Item 4} - 0.7 LOG \text{ Form 4.2-4 Item 5} / 60)}$											
2 Drainage Area of each DMA (Acres) <i>For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>											
3 Ratio of pervious area to total area <i>For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>											
4 Pervious area infiltration rate (in/hr) <i>Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP</i>											
5 Maximum loss rate (in/hr) $F_m = \text{Item 3} * \text{Item 4}$ <i>Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)</i>											
6 Peak Flow from DMA (cfs) $Q_p = \text{Item 2} * 0.9 * (\text{Item 1} - \text{Item 5})$											
7 Time of concentration adjustment factor for other DMA to site discharge point <i>Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)</i>	DMA A	n/a		n/a							
	DMA B		n/a		n/a						
	DMA C		n/a			n/a					
8 Pre-developed Q_p at T_c for DMA A: $Q_p = \text{Item 6}_{DMAA} + [\text{Item 6}_{DMAB} * (\text{Item 1}_{DMAA} - \text{Item 5}_{DMAB}) / (\text{Item 1}_{DMAB} - \text{Item 5}_{DMAB}) * \text{Item 7}_{DMAA/2}] + [\text{Item 6}_{DMAC} * (\text{Item 1}_{DMAA} - \text{Item 5}_{DMAC}) / (\text{Item 1}_{DMAC} - \text{Item 5}_{DMAC}) * \text{Item 7}_{DMAA/3}]$	9 Pre-developed Q_p at T_c for DMA B: $Q_p = \text{Item 6}_{DMAB} + [\text{Item 6}_{DMAA} * (\text{Item 1}_{DMAB} - \text{Item 5}_{DMAA}) / (\text{Item 1}_{DMAA} - \text{Item 5}_{DMAA}) * \text{Item 7}_{DMAB/1}] + [\text{Item 6}_{DMAC} * (\text{Item 1}_{DMAB} - \text{Item 5}_{DMAC}) / (\text{Item 1}_{DMAC} - \text{Item 5}_{DMAC}) * \text{Item 7}_{DMAB/3}]$		10 Pre-developed Q_p at T_c for DMA C: $Q_p = \text{Item 6}_{DMAC} + [\text{Item 6}_{DMAA} * (\text{Item 1}_{DMAC} - \text{Item 5}_{DMAA}) / (\text{Item 1}_{DMAA} - \text{Item 5}_{DMAA}) * \text{Item 7}_{DMAC/1}] + [\text{Item 6}_{DMAB} * (\text{Item 1}_{DMAC} - \text{Item 5}_{DMAB}) / (\text{Item 1}_{DMAB} - \text{Item 5}_{DMAB}) * \text{Item 7}_{DMAC/2}]$								
10 Peak runoff from pre-developed condition confluence analysis (cfs): Maximum of Item 8, 9, and 10 (including additional forms as needed)											
11 Post-developed Q_p at T_c for DMA A: <i>Same as Item 8 for post-developed values</i>	12 Post-developed Q_p at T_c for DMA B: <i>Same as Item 9 for post-developed values</i>		13 Post-developed Q_p at T_c for DMA C: <i>Same as Item 10 for post-developed values</i>								
14 Peak runoff from post-developed condition confluence analysis (cfs): Maximum of Item 11, 12, and 13 (including additional forms as needed)											
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): $Q_{p-hydro} = (\text{Item 14} * 0.95) - \text{Item 10}$											

4.3 BMP Selection and Sizing

Complete the following forms for each project site DA to document that the proposed treatment (LID/Bioretenention) BMPs conform to the project DCV developed to meet performance criteria specified in the Phase II Small MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the Phase II Small MS4 Permit (see Section 5.3 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design Measures (Form 4.3-2)
- Retention and Infiltration BMPs (Form 4.3-3) or
- Biotreatment BMPs (Form 4.3-4).

Please note that the selected BMPs may also be used as dual purpose for on-site, hydromodification mitigation and management.

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is “Yes,” provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Form 4.3-2 to determine the feasibility of applicable Site Design BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable Site Design BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of site design, retention and/or infiltration BMPs is unable to mitigate the entire DCV, then the remainder of the volume-based performance criteria that cannot be achieved with site design, retention and/or infiltration BMPs must be managed through biotreatment BMPs. If biotreatment BMPs are used, then they must be sized to provide equivalent effectiveness based on Template Section 4.3.4.

4.3.1 Exceptions to Requirements for Bioretention Facilities

Contingent on a demonstration that use of bioretention or a facility of equivalent effectiveness is infeasible, other types of biotreatment or media filters (such as tree-box-type biofilters or in-vault media filters) may be used for the following categories of Regulated Projects:

- 1) Projects creating or replacing an acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85% of the entire project site covered by permanent structures;
- 2) Facilities receiving runoff solely from existing (pre-project) impervious areas; and
- 3) Historic sites, structures or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

¹ Would infiltration BMP pose significant risk for groundwater related concerns?

Yes ☐ No ☒

Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

² Would installation of infiltration BMP significantly increase the risk of geotechnical hazards?

Yes ☐ No ☒

(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than ten feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis: (attach)

³ Would infiltration of runoff on a Project site violate downstream water rights?

Yes ☐ No ☒

If Yes, Provide basis: (attach)

⁴ Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils?

Yes ☐ No ☒

If Yes, Provide basis: (attach)

⁵ Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)?

Yes ☐ No ☒

If Yes, Provide basis: (attach)

⁶ Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses?

Yes ☐ No ☒

See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach)

⁷ Any answer from Item 1 through Item 3 is “Yes”:

Yes ☐ No ☒

If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Selection and Evaluation of Biotreatment BMP.

If no, then proceed to Item 8 below.

⁸ Any answer from Item 4 through Item 6 is “Yes”:

Yes ☐ No ☒

If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Site Design BMP.

If no, then proceed to Item 9, below.

⁹ All answers to Item 1 through Item 6 are “No”:

Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.

Proceed to Form 4.3-2, Site Design BMPs.

4.3.2 Site Design BMP

Section E.12.e. of the Small Phase II MS4 Permit emphasizes the use of LID preventative measures; and the use of Site Design Measures reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable Site Design Measures shall be provided except where they are mutually exclusive

with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of Site Design BMPs. If a project cannot feasibly meet BMP sizing requirements or cannot fully address hydromodification, feasibility of all applicable Site Design BMPs must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design BMP. Refer to Section 5.4 in the TGD for more detailed guidance.

Form 4.3-2 Site Design BMPs (DA 1)			
1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ If yes, complete Items 2-5; If no, proceed to Item 6	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
2 Total impervious area draining to pervious area (ft ²)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft ³) $V = \text{Item 2} * \text{Item 3} * (0.5/12)$, assuming retention of 0.5 inches of runoff			
5 Sum of retention volume achieved from impervious area dispersion (ft ³):		$V_{\text{retention}} = \text{Sum of Item 4 for all BMPs}$	
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒ If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
7 Ponding surface area (ft ²)			
8 Ponding depth (ft) (min. 0.5 ft.)			
9 Surface area of amended soil/gravel (ft ²)			
10 Average depth of amended soil/gravel (ft) (min. 1 ft.)			
11 Average porosity of amended soil/gravel	0		
12 Retention volume achieved from on-lot infiltration (ft ³) $V_{\text{retention}} = (\text{Item 7} * \text{Item 8}) + (\text{Item 9} * \text{Item 10} * \text{Item 11})$			
13 Runoff volume retention from on-lot infiltration (ft ³):		$V_{\text{retention}} = \text{Sum of Item 12 for all BMPs}$	

Form 4.3-2 cont. Site Design BMPs (DA 1)			
14 Implementation of Street Trees: Yes ☐ No ☒ <i>If yes, complete Items 14-18. If no, proceed to Item 19</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
15 Number of Street Trees			
16 Average canopy cover over impervious area (ft ²)			
17 Runoff volume retention from street trees (ft ³) <i>$V_{\text{retention}} = \text{Item 15} * \text{Item 16} * (0.05/12)$ assume runoff retention of 0.05 inches</i>			
18 Runoff volume retention from street tree BMPs (ft ³): <i>$V_{\text{retention}} = \text{Sum of Item 17 for all BMPs}$</i>			
19 Total Retention Volume from Site Design BMPs: <i>Sum of Items 5, 13 and 18</i>			

4.3.3 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix C of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

4.3.3.1 Allowed Variations for Special Site Conditions

The bioretention system design parameters of this Section may be adjusted for the following special site conditions:

- 1) Facilities located within 10 feet of structures or other potential geotechnical hazards established by the geotechnical expert for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard.
- 2) Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”).
- 3) Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain.
- 4) Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft ³): 3,291 $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 19}$			
BMP Type Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs	DA 1 DMA 1 infiltration basin BMP Type	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
2 Infiltration rate of underlying soils (in/hr) See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods	4		
3 Infiltration safety factor See TGD Section 5.4.2 and Appendix D	2		
4 Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	2		
5 Ponded water drawdown time (hr) Copy Item 6 in Form 4.2-1	48		
6 Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	4		
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	4		
8 Infiltrating surface area, SA_{BMP} (ft ²) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP	750		
9 Amended soil depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details	0		
10 Amended soil porosity	0		
11 Gravel depth, d_{media} (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	0		
12 Gravel porosity	0		
13 Duration of storm as basin is filling (hrs) Typical ~ 3hrs	3		
14 Above Ground Retention Volume (ft ³) $V_{retention} = \text{Item 8} * [\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$	3375		
15 Underground Retention Volume (ft ³) Volume determined using manufacturer's specifications and calculations	0		
16 Total Retention Volume from LID Infiltration BMPs: 3,375 (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
17 Fraction of DCV achieved with infiltration BMP: 102% $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.			

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-4 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV. Biotreatment computations are included as follows:

- Use Form 4.3-5 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-6 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-7 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-4 Selection and Evaluation of Biotreatment BMP (DA 1)			
1 Remaining LID DCV not met by site design , or infiltration, BMP for potential biotreatment (ft ³): 0 <i>Form 4.2-1 Item 7 - Form 4.3-2 Item 19 – Form 4.3-3 Item 16</i>		List pollutants of concern <i>Copy from Form 2.3-1.</i> Pathogens, Nutrients, Sediment, Metals, Oils and Grease, Trash, Pesticides, Organic Compounds	
2 Biotreatment BMP Selected <i>(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)</i>	Volume-based biotreatment <i>Use Forms 4.3-5 and 4.3-6 to compute treated volume</i>		Flow-based biotreatment <i>Use Form 4.3-7 to compute treated flow</i>
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention		☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft ³): 0 <i>Form 4.3-5 Item 15 + Form 4.3-6 Item 13</i>	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft ³): 0 <i>Item 1 – Item 3</i>		5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % <i>Item 4 / Item 1</i>
6 Flow-based biotreatment BMP capacity provided (cfs): 0 <i>Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)</i>			
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ <i>If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.</i>			

Form 4.3-5 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

Biotreatment BMP Type <i>(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
1 Pollutants addressed with BMP <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP</i>			
2 Amended soil infiltration rate <i>Typical ~ 5.0</i>			
3 Amended soil infiltration safety factor <i>Typical ~ 2.0</i>			
4 Amended soil design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$			
5 Ponded water drawdown time (hr) <i>Copy Item 6 from Form 4.2-1</i>			
6 Maximum ponding depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
7 Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$			
8 Amended soil surface area (ft ²)			
9 Amended soil depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
10 Amended soil porosity, n			
11 Gravel depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
12 Gravel porosity, n			
13 Duration of storm as basin is filling (hrs) <i>Typical ~ 3hrs</i>			
14 Biotreated Volume (ft ³) $V_{biotreated} = \text{Item 8} * [(\text{Item 7}/2) + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))]$			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: <i>Sum of Item 14 for all volume-based BMPs included in this form</i>			

Form 4.3-6 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type <i>Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (E.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.</i>	DA DMA BMP Type		DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP</i>				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft ²) $A_{bottom} = \text{Item 2} * \text{Item 3}$				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft ²) $A_{surface} = (\text{Item 2} + (2 * \text{Item 5} * \text{Item 6})) * (\text{Item 3} + (2 * \text{Item 5} * \text{Item 6}))$				
8 Storage volume (ft ³) <i>For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i> $V = \text{Item 6} / 3 * [\text{Item 4} + \text{Item 7} + (\text{Item 4} * \text{Item 7})^{0.5}]$				
9 Drawdown Time (hrs) <i>Copy Item 6 from Form 2.1</i>				
10 Outflow rate (cfs) $Q_{BMP} = (\text{Item 8}_{forebay} + \text{Item 8}_{basin}) / (\text{Item 9} * 3600)$				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft ³) $V_{biotreated} = (\text{Item 8}_{forebay} + \text{Item 8}_{basin}) * (\text{Item 10} * \text{Item 11} * 3600)$				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : <i>(Sum of Item 12 for all BMP included in plan)</i>				

Form 4.3-7 Flow Based Biotreatment (DA 1)			
Biotreatment BMP Type <i>Vegetated swale, vegetated filter strip, or other comparable proprietary BMP</i>	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
1 Pollutants addressed with BMP <i>List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5</i>			
2 Flow depth for water quality treatment (ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
3 Bed slope (ft/ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
4 Manning's roughness coefficient			
5 Bottom width (ft) $b_w = (\text{Form 4.3-5 Item 6} * \text{Item 4}) / (1.49 * \text{Item 2}^{1.67} * \text{Item 3}^{0.5})$			
6 Side Slope (ft/ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
7 Cross sectional area (ft ²) $A = (\text{Item 5} * \text{Item 2}) + (\text{Item 6} * \text{Item 2}^2)$			
8 Water quality flow velocity (ft/sec) $V = \text{Form 4.3-5 Item 6} / \text{Item 7}$			
9 Hydraulic residence time (min) <i>Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
10 Length of flow based BMP (ft) $L = \text{Item 8} * \text{Item 9} * 60$			
11 Water surface area at water quality flow depth (ft ²) $SA_{top} = (\text{Item 5} + (2 * \text{Item 2} * \text{Item 6})) * \text{Item 10}$			

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)	
1	Total LID DCV for the Project DA-1 (ft ³): 3,291+1,986 = 5,277 <i>Copy Item 7 in Form 4.2-1</i>
2	On-site retention with site design BMP (ft ³): 0 <i>Copy Item 18 in Form 4.3-2</i>
3	On-site retention with LID infiltration BMP (ft ³): 5,363 <i>Copy Item 16 in Form 4.3-3</i>
4	On-site biotreatment with volume based biotreatment BMP (ft ³): 0 <i>Copy Item 3 in Form 4.3-4</i>
5	Flow capacity provided by flow based biotreatment BMP (cfs): 0 <i>Copy Item 6 in Form 4.3-4</i>
6	LID BMP performance criteria are achieved if answer to any of the following is "Yes": - Full retention of LID DCV with site design or infiltration BMP: Yes ☒ No ☐ <i>If yes, sum of Items 2, 3, and 4 is greater than Item 1</i> - Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☒ No ☐ <i>If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3-5 Item 6 and Items 2, 3 and 4 are maximized</i> - On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒ <i>If yes, Form 4.3-1 Items 7 and 8 were both checked yes</i>
7	If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance: - Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐ <i>Checked yes if Form 4.3-4 Item 7 is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, $V_{alt} = (Item\ 1 - Item\ 2 - Item\ 3 - Item\ 4 - Item\ 5) * (100 - Form\ 2.4-1\ Item\ 2)\%$</i> - Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated: 1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐ 2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐ 3) Equal or greater protection against shock loadings and spills; ☐ 4) Equal or greater accessibility and ease of inspection and maintenance. ☐

4.3.6 Hydromodification Control BMP

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs (DA 1)	
1 Volume reduction needed for hydromodification performance criteria (ft ³): <i>(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1</i>	2 On-site retention with site design and infiltration, BMP (ft ³): <i>Sum of Form 4.3-8 Items 2, 3, and 4. Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving hydromodification volume reduction</i>
3 Remaining volume for hydromodification volume capture (ft ³): - <i>Item 1 – Item 2</i>	4 Volume capture provided by incorporating additional on-site BMPs (ft ³): -
5 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐ <i>If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:</i> - Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site BMP ☐ - Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐	
6 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐ <i>If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:</i> Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site retention BMPs ☐	

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance.

Alternative Designs — Facilities, or a combination of facilities, of a different design than in Permit Section E.12.e.(ii)(f) may be permitted if all of the following measures of equivalent effectiveness are demonstrated:

- 1) Equal or greater amount of runoff infiltrated or evapotranspired;
- 2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;
- 3) Equal or greater protection against shock loadings and spills;
- 4) Equal or greater accessibility and ease of inspection and maintenance.

The Project Proponent will need to obtain written approval for an alternative design from the Lahontan Regional Water Board Executive Officer (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMPs included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and a Maintenance Agreement. The Maintenance Agreement must also be attached to the WQMP.

Note that at time of Project construction completion, the Maintenance Agreement must be completed, signed, notarized and submitted to the County Stormwater Department

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Infiltration Basin	HOA	Landscaping, Debris and Trash Removal.	Ongoing, before storm season, after rain event, annual
Bio-retention Swal	HOA	Landscaping, Debris and Trash Removal.	Ongoing, before storm season, after rain event, annual

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Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post Construction

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C,C&R's & Lease Agreements

ATTACHMENT A

WQMP EXHIBIT & VICINITY MAP

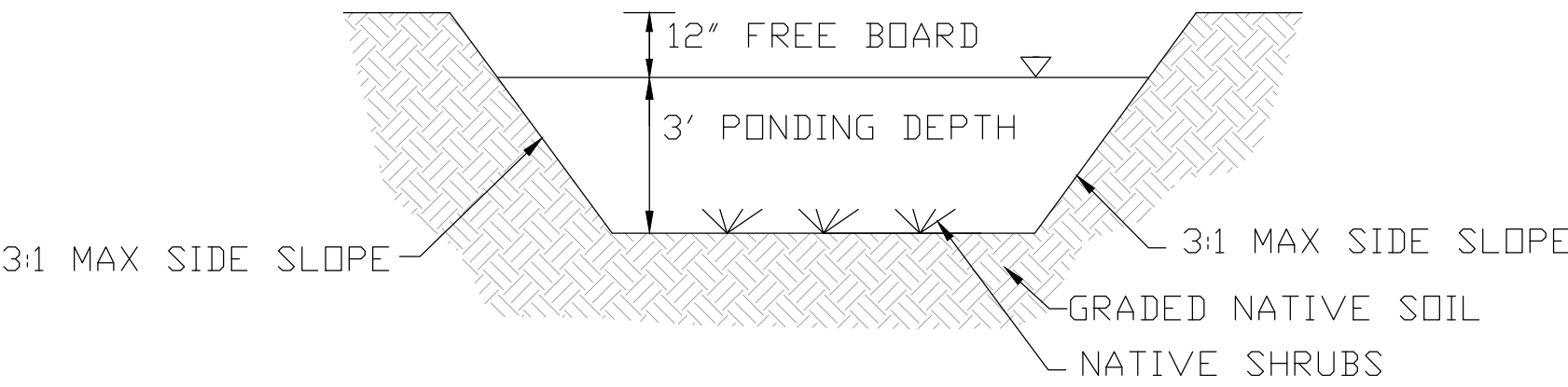
CL COUNTRY RANCH COURT

WQMP SITE PLAN TRACT NO. 18940

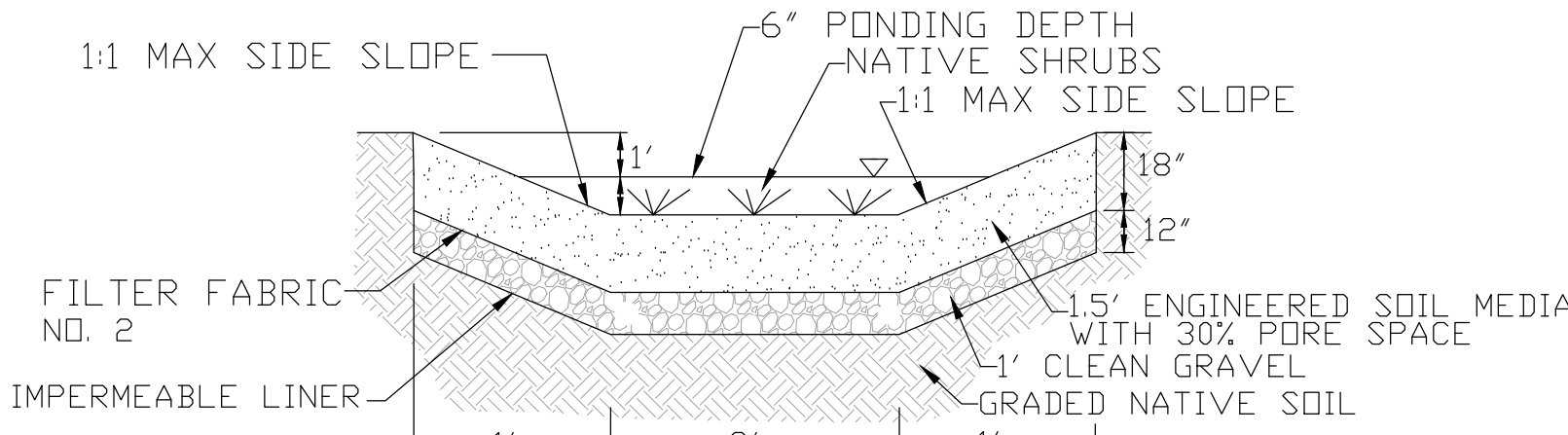
LEGEND:

— DRAINAGE AREA BOUNDARY

DA1 — DMA ID
2.97 — ACRES
AC

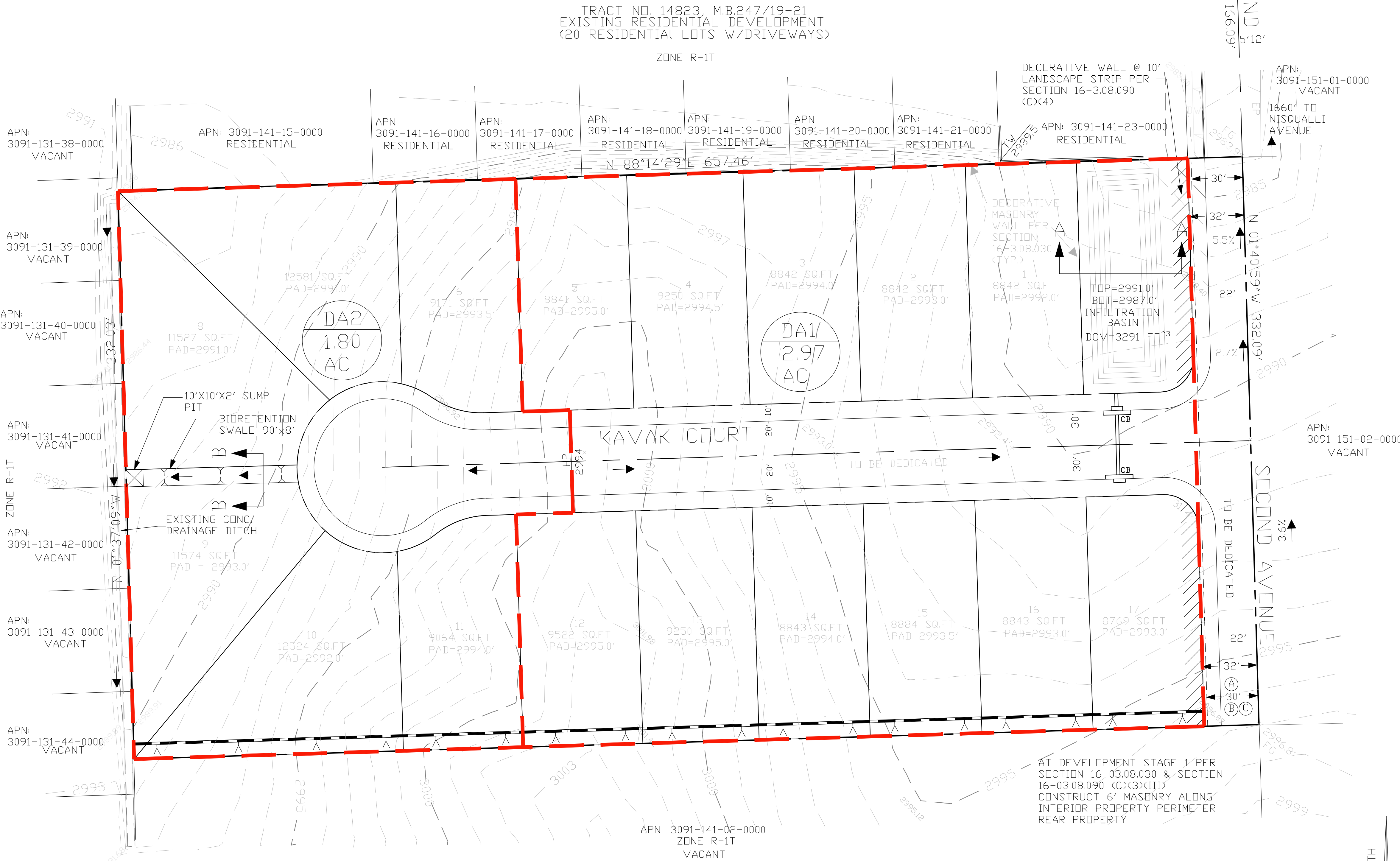
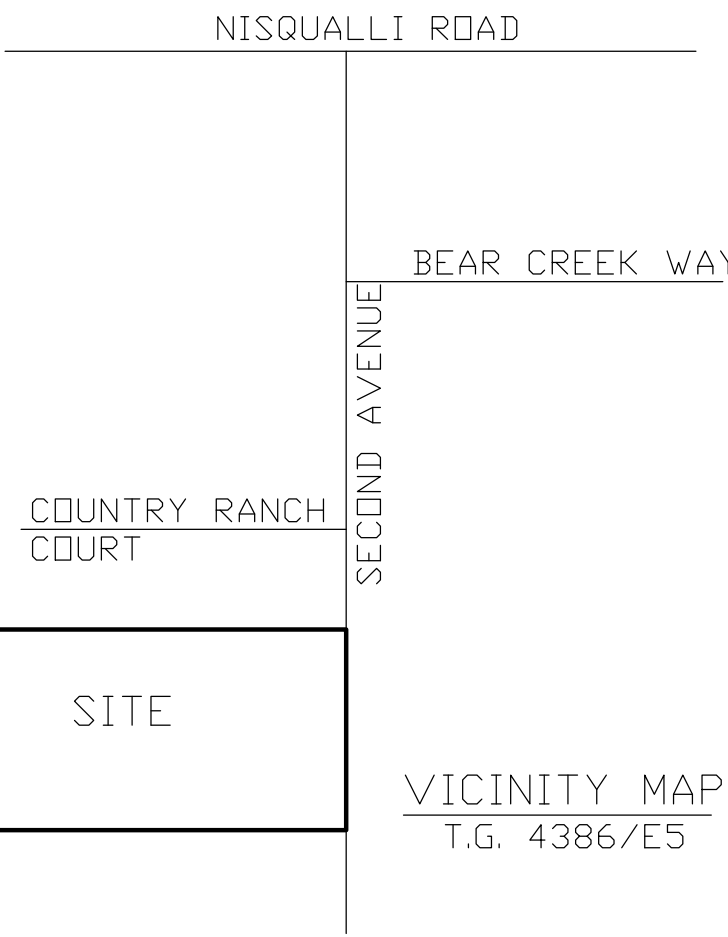


INFILTRATION BASIN
SECTION A-A
NOT TO SCALE



BIO RETENTION SWALE
SECTION B-B
NOT TO SCALE

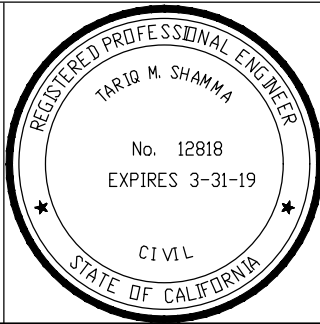
ENGINEERED SOIL MEDIA
70-80% SAND
15-20% SILT
5-10% CLAY



MARK	REVISION	APPR.	DATE
		TS	1/29/15



TMS CONSORTIUM
PLANNING, BUILDING, CIVIL & STRUCTURAL ENGINEERING
807 E. Chase Dr. Corona, California 92881
TEL. (951) 272-1710 FAX (951) 272-0787



CITY OF VICTORVILLE ENGINEERING DEPARTMENT		WQMP SITE PLAN		JOB NO.
APPROVED BY: _____		KAVAK COURT TRACT MAP NO. 18940		SHEET 1 OF 1
DATE: _____		SCALE: 1" = 40'		DESIGN BY: _____
SENIOR ENGINEER		CITY ENGINEER		

WQMP SITE PLAN		JOB NO.
KAVAK COURT TRACT MAP NO. 18940		SHEET 1 OF 1
SCALE: 1" = 40'		DESIGN BY: _____
CITY ENGINEER		

[illegible]

VICINITY MAP

TRACT 18940



LOCATION MAP

TRACT 18940



ATTACHMENT B

GEOTECHNICAL INVESTIGATION

CITY & COUNTY ENGINEERING AND TESTING INC.

2324 S. Vineyard Ave. Suite B, Ontario, CA 91761 Ph (909) 930-5868

October 25, 2018

Project No. J&P2018057-DRI.INF.RPT

JOHN KOVAK, TRUSTEE, KOVAL FAMILY TRUST
1317 Avenida Colima
San Dimas, CA 91773-4201

Subject: Basic Infiltration Testing Report in General Accordance with ASTM 3385-03 Test Method, Tentative Tract Map No. 18940, Proposed 17 Single Family Homes, Approximately 5.0 Acres, West of 2nd Avenue, City of Victorville, County of San Bernardino, California.

Introduction

This report provides a summary of the geotechnical engineering services conducted to support evaluation of the feasibility of infiltration at the subject site. The purpose of our services was to complete one (1) in-situ infiltration test utilizing the double-ring infiltrometer to evaluate the feasibility of infiltration for disposal of stormwater runoff following the falling/constant head method.

Project Description

We understand that an infiltration trench/swale will be utilized to capture storm runoff for onsite disposal.

Scope of Services

City and County Engineering and Testing was retained to provide geotechnical engineering services to support the project. Our scope of work consisted of the following specific tasks:

- 1) Complete one (1) infiltration test at the site utilizing the double ring infiltrometer. The test was completed in general accordance with the falling head method.
- 2) Complete data analysis.
- 3) Preparation of this report summarizing our findings, conclusions, and recommendations. The report includes:
 - Site plan showing the location of infiltration test.
 - Summary of log of conditions observed at the testing location.
 - Discussion of the results of in-situ infiltration testing.

- A discussion of the surficial soil and anticipated groundwater conditions at the site.
- Evaluation of the feasibility of infiltration.
- Recommendations for in-situ infiltration rate.

Existing Site Conditions

The subject property of 5.0 acres, rectangular is covered by vacant undeveloped land to its north, south and west and **2ND Avenue to the east, Victorville, County, of San Bernardino, California**. The property is currently vacant and, undeveloped and secured by wood fence from north and open from all other sides. The site is covered by light seasonal grass, vegetation. The entire site is relatively sloping to the east towards 2nd Avenue with surface drainage flowing to the east from the west by about 2-3 percent. No drainage course is located on the site or in the near vicinity of the site. The proposed retention basin is located to its north east corner. The site is covered by wind blown fine silty sand to about 12 to 18 inches. There are few depressions caused by wind and flood over the site.

Groundwater

Groundwater study is not within the scope of this work. However, no groundwater was encountered in the exploratory trenches to 15 feet depth during the current exploration.

Based on the California Department of Water Resources and local water company's website; the depth of groundwater at the site is more than 150 feet below the existing ground.

Please note that the potential for rain or irrigation water locally seeping through from adjacent elevated areas and showing up near grades cannot be precluded. Our experience indicates that surface or near-surface groundwater conditions can develop in areas where groundwater conditions did not exist prior to site development, especially in areas where a substantial increase in surface water infiltration results from landscape irrigation. Fluctuations in perched and static water elevations are likely to occur in the future due to variations in precipitation, temperature, consumptive uses, and other factors including urbanization and development. However; it is not likely to be less than 100 feet.

Subsurface Soils

Based on the field observations of the soil borings and infiltration tests pit excavations; sieve analysis of the soil sample from the test pit location and visual classification, the soil in the upper 15 feet appeared to be fine to medium silty sand (SM) with few silt-cliché layers.

Test Method and Findings

One infiltration test was conducted at 4-feet below ground surface, in native soil. Based on the results of this study, infiltration of stormwater at the site is feasible. The following summarizes the result of the infiltration feasibility study and the recommended field infiltration rate for use in design.

Trench excavation for infiltration testing was conducted utilizing a 303 CR-extended hoe backhoe. The bottom of the test trench was cut level to the desired infiltration depth of 4 feet below ground surface. The soil profile is described in the form of an Exploratory Trench Log, see Appendix B.

Infiltrometer Device

The double-ring infiltrometer test method consists of driving two open cylinders, 24-inch and 12-inch diameter, connected one inside the other, into the ground and then partially filling the rings with water to about 12-inch depth from the fixed point. The water is added at the constant mark at every time interval. The volume of water added each time interval is equal to the measure of the volume of liquid that infiltrates into the soil. The volume of water infiltrated during the time intervals can be converted into an infiltration velocity (in^3/hr). The incremental infiltration velocity within the inner test cylinder is equivalent to the infiltration rate (in/hr).

Infiltration Test Result

Based on the test results, water infiltration rate stabilized at **4.0 inch per hour or 10.16 /hr** for the test that was conducted 4 feet below ground surface, see Appendix C. These results are raw test result.

Factors of Safety

Based on **Worksheet "H" in the Technical Guidance Document** for Water Quality Management Plans prepared for The County of San Bernardino Areawide Stormwater Program dated June 09, 2016, the minimum safety factor for this suitability assessment is 1. The design engineer should complete Worksheet "H" to determine the Total Safety Factor for the BMP. Minimum safety factor should not be less than 2, but may be higher at the discretion of the design engineer and acceptance of the plan reviewer.

Conclusions/Recommendations

- In our opinion, water infiltration at the site is feasible. Filter fabric should be used whenever aggregates are placed against native soils.
- Infiltration water should not be allowed to saturate pavement and concrete structures subgrade soils.

- The planned infiltration system should extend vertically into native soil. The designer should review the attached geotechnical log for soil classification.
- Please note that soils in infiltration areas should not be subject to compaction during construction.
- The proposed system by the civil engineer should be constructed and maintained in accordance with manufacturer guidelines.

An important consideration for infiltration facilities is that, during construction, great care must be taken not to reduce the infiltrative capacity of the soil in the facility through compaction by heavy equipment or by using the infiltration area as a sediment trap. Infiltration facilities should be constructed late in the site development after soils (that might erode and clog the units) have been stabilized or should be protected (by flagging) until site work is completed.

Infiltration facilities should be sited with the following guidelines:

INFILTRATION FACILITY SETBACKS	
Setback From	Distance
Property Lines and Public Right of Way	5 feet
Foundations	15 feet or within a 1:1 plane drawn up from the bottom of foundation
Slopes	H/2, 5 feet minimum (H: is slope height)
Private drinking water wells	100 feet

Ferrous metal pipes should be protected from potential corrosion by bituminous coating, etc. We recommend that all utility pipes be nonmetallic and/or corrosion resistant. Recommendations should be verified by soluble sulfate and corrosion testing of soil samples obtained from specific locations during construction.

If applicable, four to six-inch diameter with locking cap observation well(s) extending vertically into the system's bottom is suggested as an observation point. Observation well(s) should be checked regularly and after large storm events. Once performance stabilizes, frequency of monitoring may be reduced.

City & County Engineerings should observe the basin excavation. Additional laboratory testing including but not limited to grain size analysis, sand equivalent, sulfate content, etc should be conducted during construction.

Use of this Report

This report was prepared for the exclusive use of the owner and their consultants for specific applications to the proposed site. The use by others, or for the purposes other than intended, is at the user's sole risk.

The findings, conclusions, and recommendations presented herein are based on our understanding of the project and on subsurface conditions observed during our site work. Within the limitations of scope, schedule, and budget, the conclusions and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering principals and practices in the area at the time the report was prepared. We make no other warranty either expressed or implied.

We appreciate this opportunity to provide geotechnical services on this project and look forward to assisting the Project Team as the design progresses. Please call our office if you have any questions or comments regarding the information contained in this report, or if we may be of further services

Submitted for
City and County Engineering and Testing Inc.



Zen Bhatia, RCE #36150

Distribution: [3] Addressee

Attachments:	Plate 1	Site Photos
	Plate 2	Index Map
	Plate 3	Topographic Map
	Plate-4	Aerial Map
	Plate 5	Infiltration Test Location Map
	Appendix A	Percolation Data/Graphs

REFERENCES

The County of San Bernardino Area Wide Storm Water Program, Technical Guidance Document for Water Quality Management Plans, June 7, 2013.

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BMP Handbook, Part B, Planning Activities, Stormwater Mitigation Measures, Watershed Protection Division, City of Los Angeles.

ATTACHMENT C

PHASE 1 ESA SUPPORTING DOCUMENTS



TMS CONSORTIUM

Structural & Civil Engineering

807 E. Chase Drive, Corona, CA 92881 Phone (951)272-1710 Fax (951)272-0787
email: tmsconsortium@sbcglobal.net

October 10, 2019

City of Victorville
Planning & Engineering Depts.
14343 Civic Drive
Victorville, CA 92393

RE: PLAN 000023 WQMP
TTM 18940
APN #3091-141-01

To Whom It May Concern:

At the time of viewing, visually there were no hazardous materials showing at the Site listed above that may induce any environmental concerns.

Sincerely,

TMS CONSORTIUM

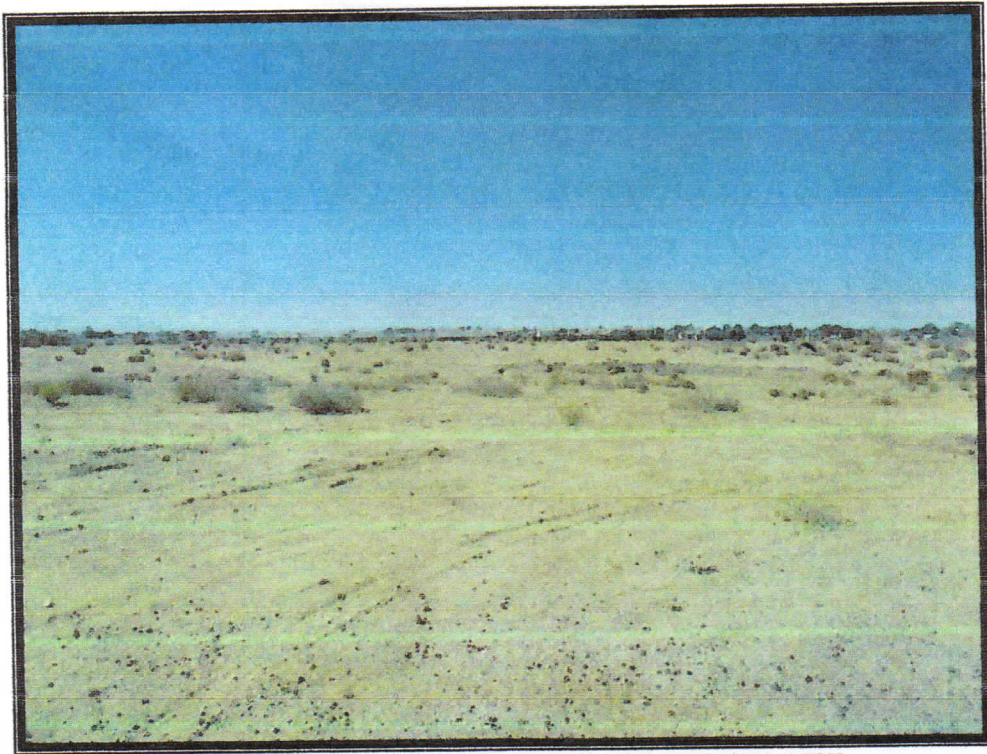
Tariq Shamma, P.E., S.E.
President



Enclosures: 2 Pages Photo Exhibits

APN #3091-141-01 (5± Acres in City of Victorville, CA)

TTM 18940 / PLAN - 000023



PERSPECTIVE: LOOKING WEST ACROSS THE SITE



PERSPECTIVE: LOOKING SOUTH ALONG SECOND STREET

APN #3091-141-01 (5± Acres in City of Victorville, CA)

TTM 18940 / PLAN - 000023



PERSPECTIVE: LOOKING SOUTH ALONG CONCRETE CHANNEL ALONG WEST PROPERTY LINE



PERSPECTIVE: LOOKING NORTH ALONG SECOND STREET AT SUBDIVISION

Sites and Facilities - INFO

Cleanup Sites

- ☒ ■ LUST Cleanup Sites
- ☒ ■ Cleanup Program Sites
- ☒ ■ Military Cleanup Sites
- ☒ ▲ DTSC Cleanup Sites

Permitted Facilities

- ☒ ■ Waste Discharge Requirements (WDR) Sites
- ☒ ■ Permitted USTs - INFO
- ☒ ▲ DTSC Hazardous Waste Sites

Land Disposal Sites - SELECT

- ☒ ■ Burn Dump
- ☒ ■ Compost Facility
- ☒ ■ Illegal Disposal Site
- ☒ ■ Other
- ☒ ■ Pre-Title 27 - CAI
- ☒ ■ Title 27 - Land Treatment Unit
- ☒ ■ Title 27 - Mining Unit
- ☒ ■ Title 27 - Municipal Solid Waste Landfill
- ☒ ■ Title 27 - Non-Municipal Solid Waste Landfill
- ☒ ■ Title 27 - Surface Impoundment
- ☒ ■ Title 27 - Waste Pile
- ☒ ■ Unknown

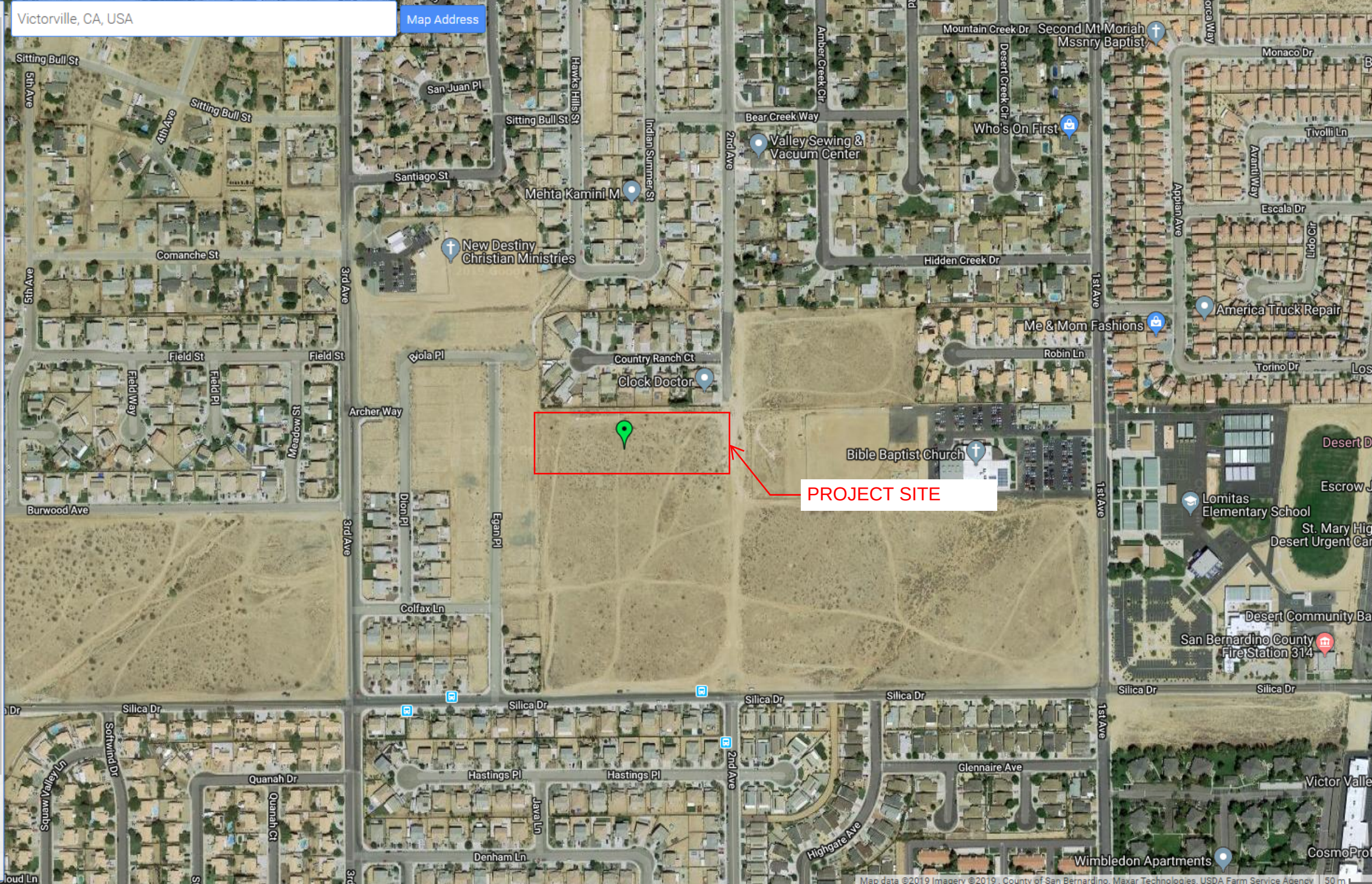
Irrigated Lands Regulatory Program Sites

- ☒ ■ Oil / Gas Sites
- ☒ ■ Other Oil and Gas Projects
- ☒ ■ Produced Water Ponds
- ☒ ■ Underground Injection Control (UIC)
- ☒ ■ Well Stimulation Project - Exclusion
- ☒ ■ Well Stimulation Project - Groundwater Monitoring Plan
- ☒ ■ Well Stimulation Projects - Property Owner Sampling

Confined Animal Sites

Other Sites

- ☒ ■ Project Sites
- ☒ ■ Non-Case Information Sites
- ☒ ■ Sampling Points - Public
- ☒ ● Field Points
- ☒ ● AGLand Domestic Wells



PROJECT SITE

ATTACHMENT D

HYDROLOGY REPORT

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RandyAICP@aol.com

BCA ENGINEERING CORP.

19531 Hwy 18
Apple Valley, Ca. 92307
(760) 242-9900 * Fax 242-9918

**PRELIMINARY HYDROLOGY STUDY &
HYDRAULIC CALCULATIONS**

CITY OF VICTORVILLE: ENG 14-00317

PROPOSED RESIDENTIAL SUBDIVISION

TT 18980
APN 3094-141-01
SECOND AVENUE
VICTORVILLE

PREPARED FOR

Mr. John Kavak
Kavak Family Trust

**Date Prepared:
January, 2015**

W.O.# 143-14

BCA Engineering, Inc.

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RandyAICP@aol.com

DISCUSSION**PURPOSE**

This study was performed to determine the drainage flows that affect the proposed development of a residential subdivision so that an adequate drainage plan could be designed to conduct these flows through the site and reduce the outflows from the site.

LOCATION & DISCUSSION

This property is located on the west side of Second Avenue approximately 660 feet north of Silica Drive in Victorville. The site is approximately 5 acres and is rectangular in shape (see attached map). The site is currently vacant. There are no existing structures or improvements on the site. The entire site is pervious.

The current proposed site improvements include the construction of approximately 20 $\pm$.25 acre single family residential lots. On-site storm run-off will be directed away from the proposed buildings to existing storm drain facilities in the area.

OFF-SITE RUNOFF

There is no off-site runoff that affects the site. The area to the south drains to either Second Avenue or a storm drain located along the westerly property line of the site. The storm drain is an open concrete box culvert 48" wide and 24" deep. The open channel connects to a 24" diameter reinforced concrete pipe with a grated entrance. This carries the flows northerly into progressively larger storm drains.

ON -SITE RUNOFF

The on-site runoff was determined using a combination of the San Bernardino County Rational Method and San Bernardino County Unit Hydrograph Method. The Rational Method was used to determine the Time of Concentration for the site. This was then used in the Unit Hydrograph to determine the runoff volume. Both the current land use and the proposed land use were analyzed. This information was used to determine the amount of runoff from the site.

The site is divided by a ridge line that runs north to south approximately 270 feet east of the west

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property line. There are 2.06 acres that drain west to an existing improved concrete box and drainage easement. The remaining 2.94 acres will drain east to Second Avenue. The high point of the site is at an elevation of 3007 feet. The low point at the northwest corner of the site is at an elevation of 2991 feet and the low point at the northeast corner of the site is at an elevation of 2996 feet.

WEST SIDE OF SITE

The runoff from the existing undeveloped site was found to be 4.95 cubic feet per second with a volume of .45 acre feet. The runoff from the developed site was found to be 6.15 cubic feet per second with a volume of .43 acre feet.

Existing	Developed
4.95 cfs	6.15 cfs
.45 a.f.	.43 a.f.

EAST SIDE OF SITE

The runoff from the existing undeveloped site was found to be 6.76 cubic feet per second with a volume of .65 acre feet. The runoff from the developed site was found to be 7.32 cubic feet per second with a volume of .61 acre feet.

Existing	Developed
6.76 cfs	7.32 cfs
.65 a.f.	.61 a.f.

METHODOLOGY

The storm flow volume was determined using the Rational Method to determine the Time of Concentration for the pre-developed and fully developed sites. This information was then used in the Unit Hydrograph Method to determine the runoff volumes. The following analysis values were used:

- (a) 100 -year design storm frequency.
- (b) Hydrologic soils group "C"
- (c) Development type: Residential

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- (d) 100 Year Intensity
 - 1 hour – 1.11
 - 6 hour – 2.20
 - 24 hour – 3.98
- (e) SCS Curve Number – 85 existing, 4 units/acre developed

CONCLUSION

The storm run-off for a 100-year storm event created by the site in its existing undeveloped condition is 11.71 cubic feet per second. The storm run-off for the proposed developed condition is 13.47 cubic feet per second. These flows can be controlled within the existing storm drain and streets.

- $Q_{\text{developed}} < Q_{\text{existing}}$: The totals of the post development creates a lower volume and does not create a typical volume for calculations for a Retention Volume.
- $V_{\text{developed}} > V_{\text{existing}}$: However the post development Velocity is higher than the pre-development velocity, for as estimated time for each of approximate 10 minutes reviewing the Unit Hydrograph and is the following:
 - West 2.06 acres: 6.15 CFS – 4.95 CFS * 10 minutes = 720 CF
 - East 2.94 acres: 7.52 CFS – 6.76 CFS * 10 minutes = 456 CF
 - CONCLUSION: The Final Street and Grading Plan Design will require bioswale volumes for 720 cubic feet for the western 2.06 acres and 456 cubic feet for the eastern 2.94 acres.
- Therefore the $V_{\text{developed}}$ being higher does warrant a Water Quality Management Plan
- This site is a Priority Project per MS4.

The final design of this site is too include a 30 feet long by 4 feet wide bio-swale incorporated into the drainage easement located at the west end of the cul-de-sac.

The development of this site will have no adverse drainage affect on this or surrounding properties.

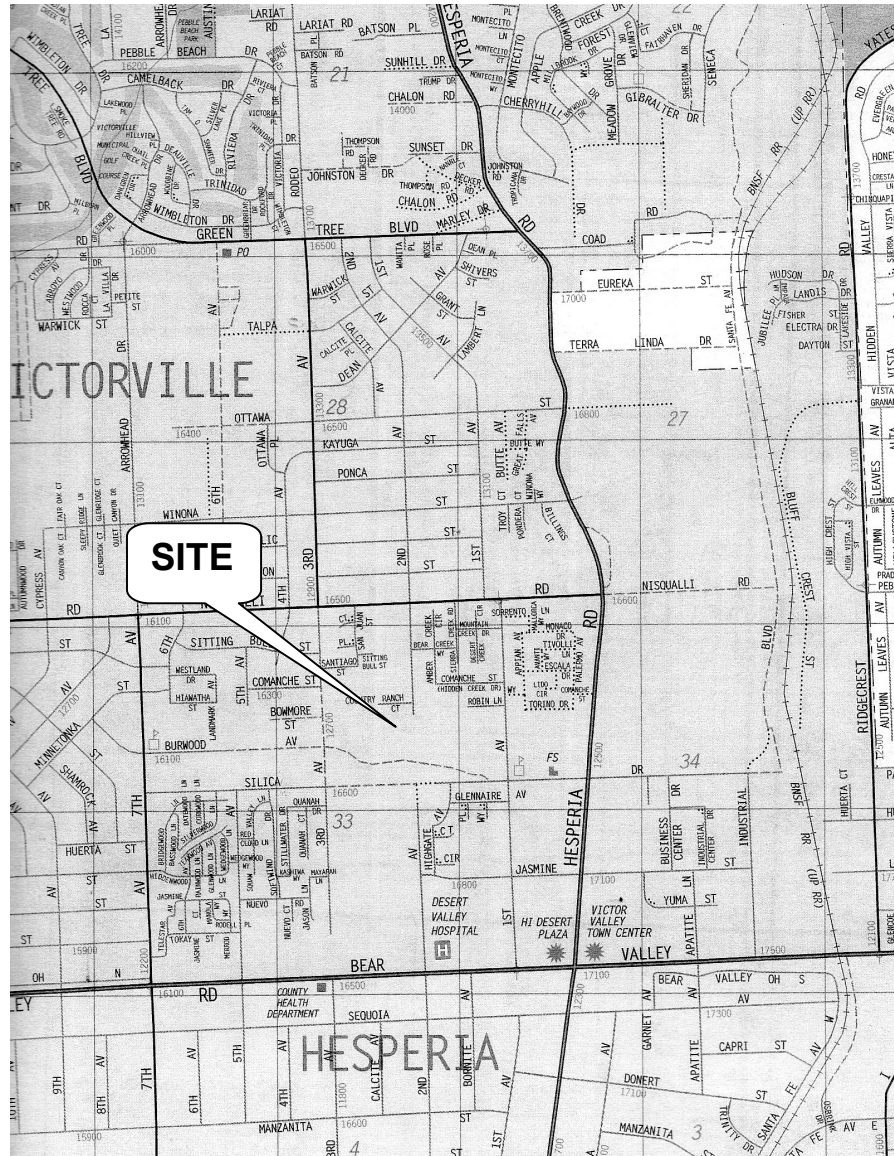
Randolph J. Coleman RCE 36293, Exp 6-30-2016

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**LOCATION MAP – WEST SIDE SECOND AVENUE SOUTH OF NISQUALLI ROAD
APPLE VALLEY**

DRAWING 1

Civil Engineering
Land Surveying & GPS
Land Planning & GIS

Biological, Native Plant & Phase I Assessments
Valuations & Marketing Studies

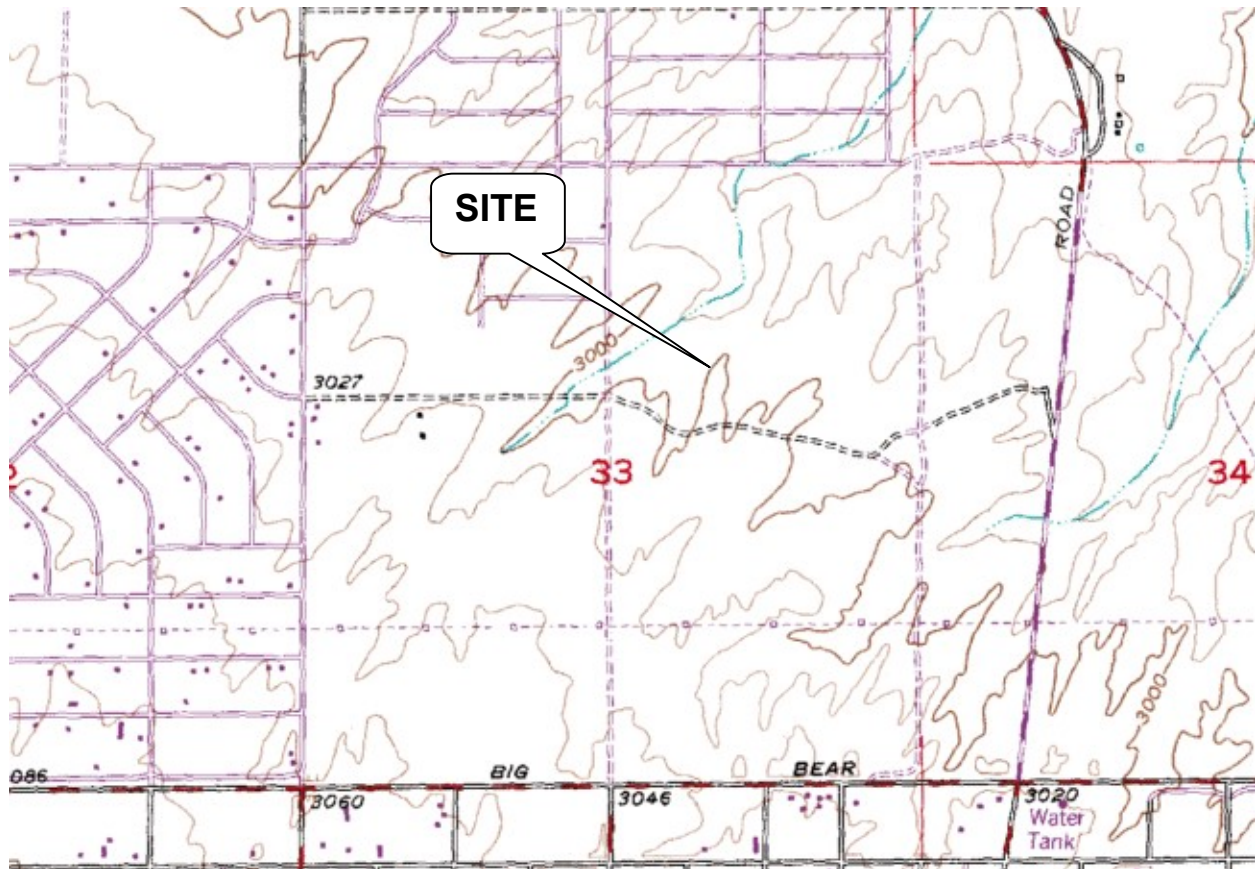
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USGS QUAD SHEET - VICTORVILLE

DRAWING 2

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THIS MAP IS FOR THE PURPOSE
OF AD VALOREM TAXATION ONLY.

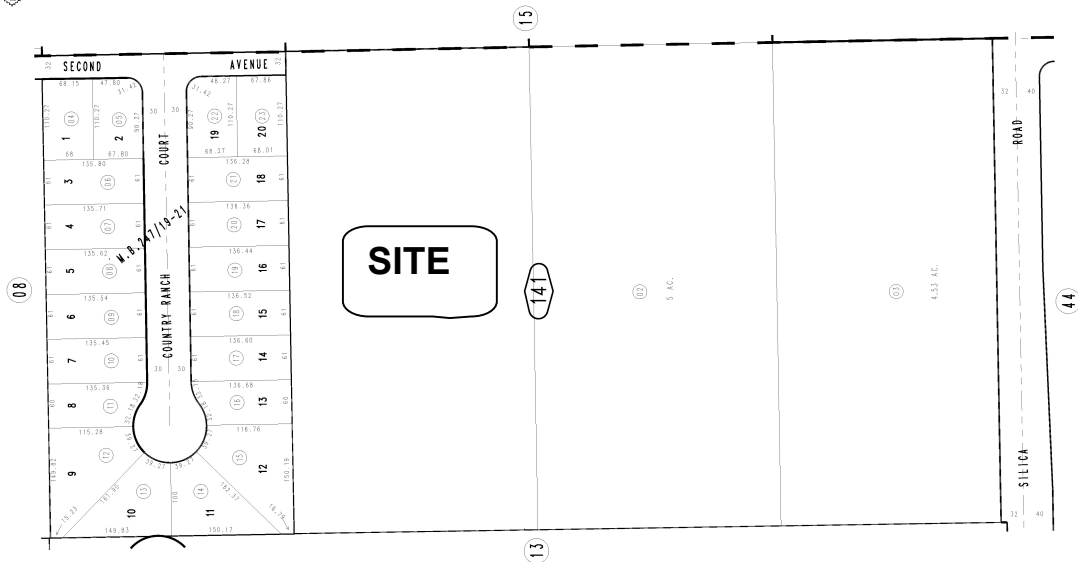
Ptn. E.1/2, S.W.1/4, N.E.1/4 Sec. 33, T.5N.,R.4W., S.B.M.

City of Victorville
Tax Rate Area
12064

3091 - 14



1"=100'



OCTOBER 1993

Tract No. 14823, W.B. 247/19-21

Assessor's Map
Book 3091 Page 14
San Bernardino County

REVISED
08/03/06 GW

ASSESSOR'S MAP - APN 3091-141-01

DRAWING 3

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Land Planning & GIS

Biological, Native Plant & Phase I Assessments
Valuations & Marketing Studies

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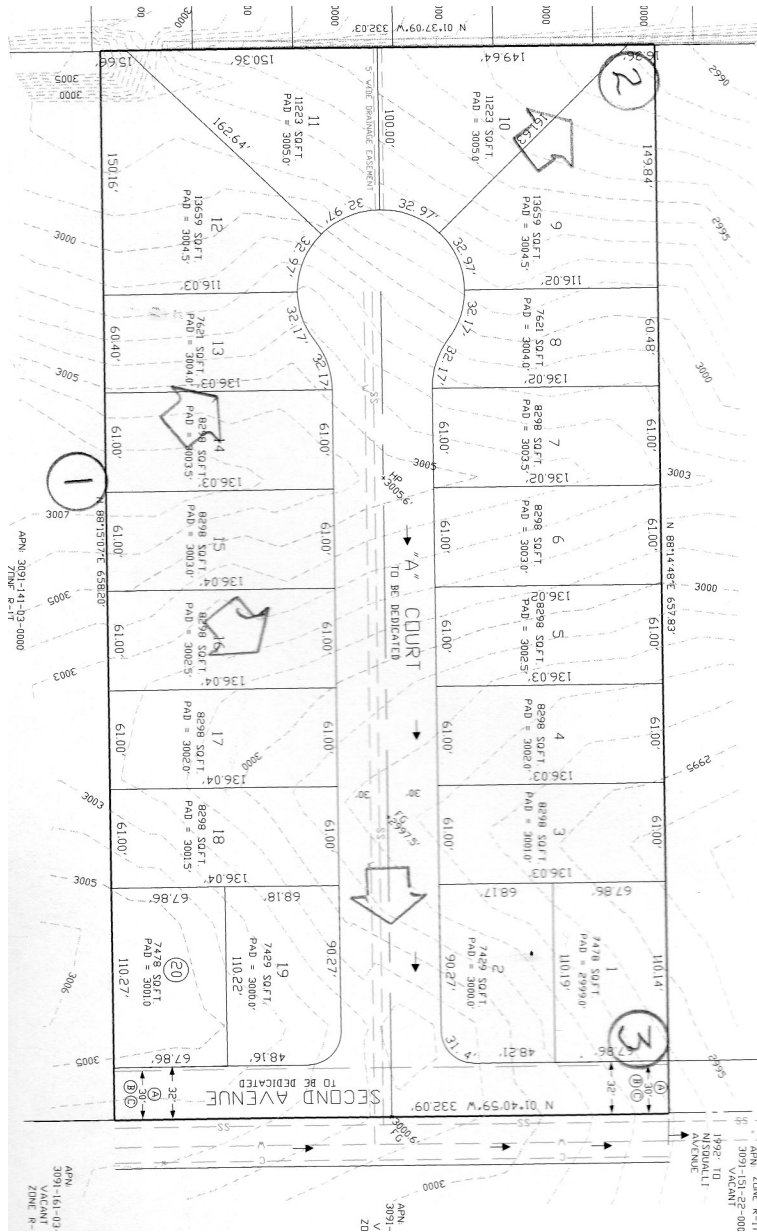
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DRAINAGE NODES - APN 3091-141-01

DRAWING 4

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AERIAL - APN 3091-141-01

DRAWING 5

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Land Planning & GIS

Biological, Native Plant & Phase I Assessments
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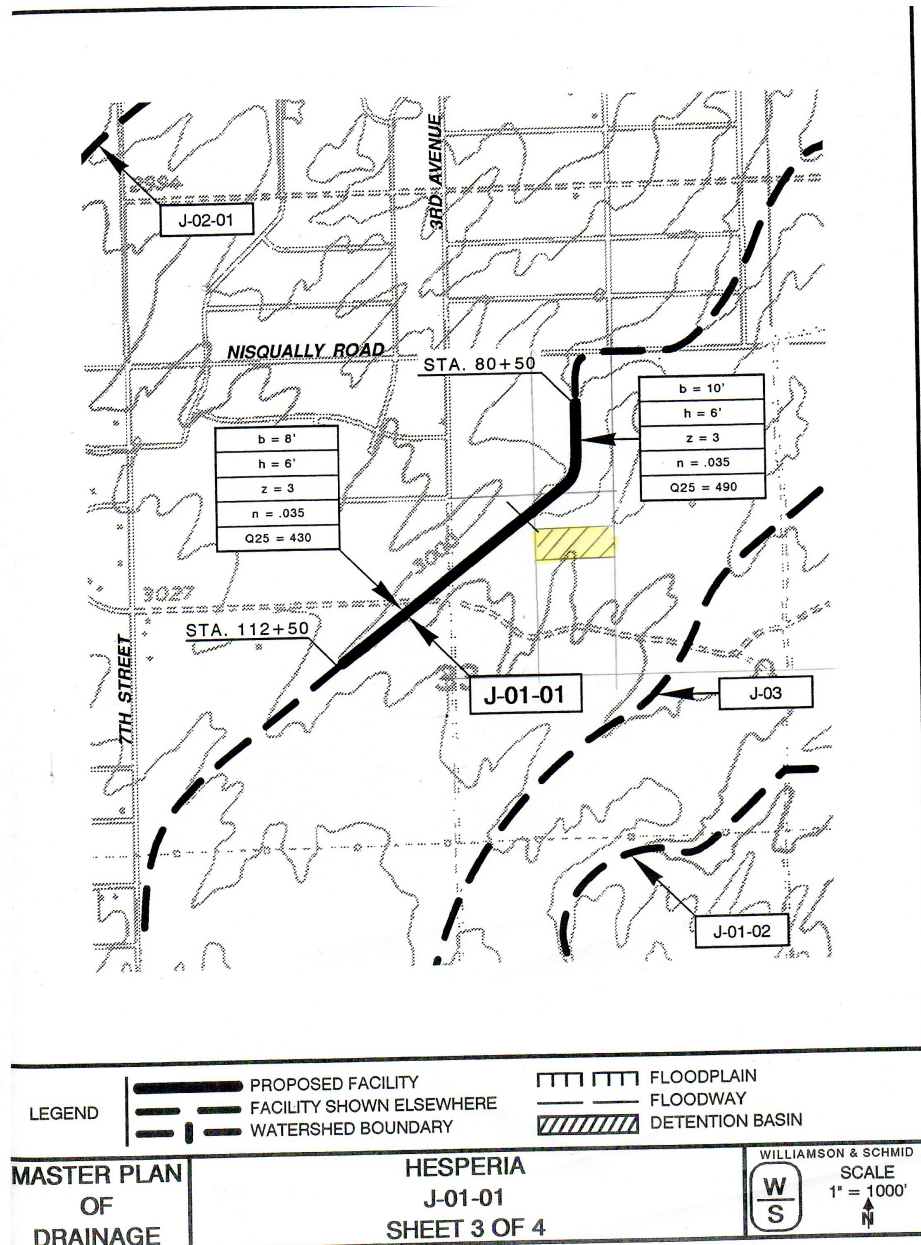
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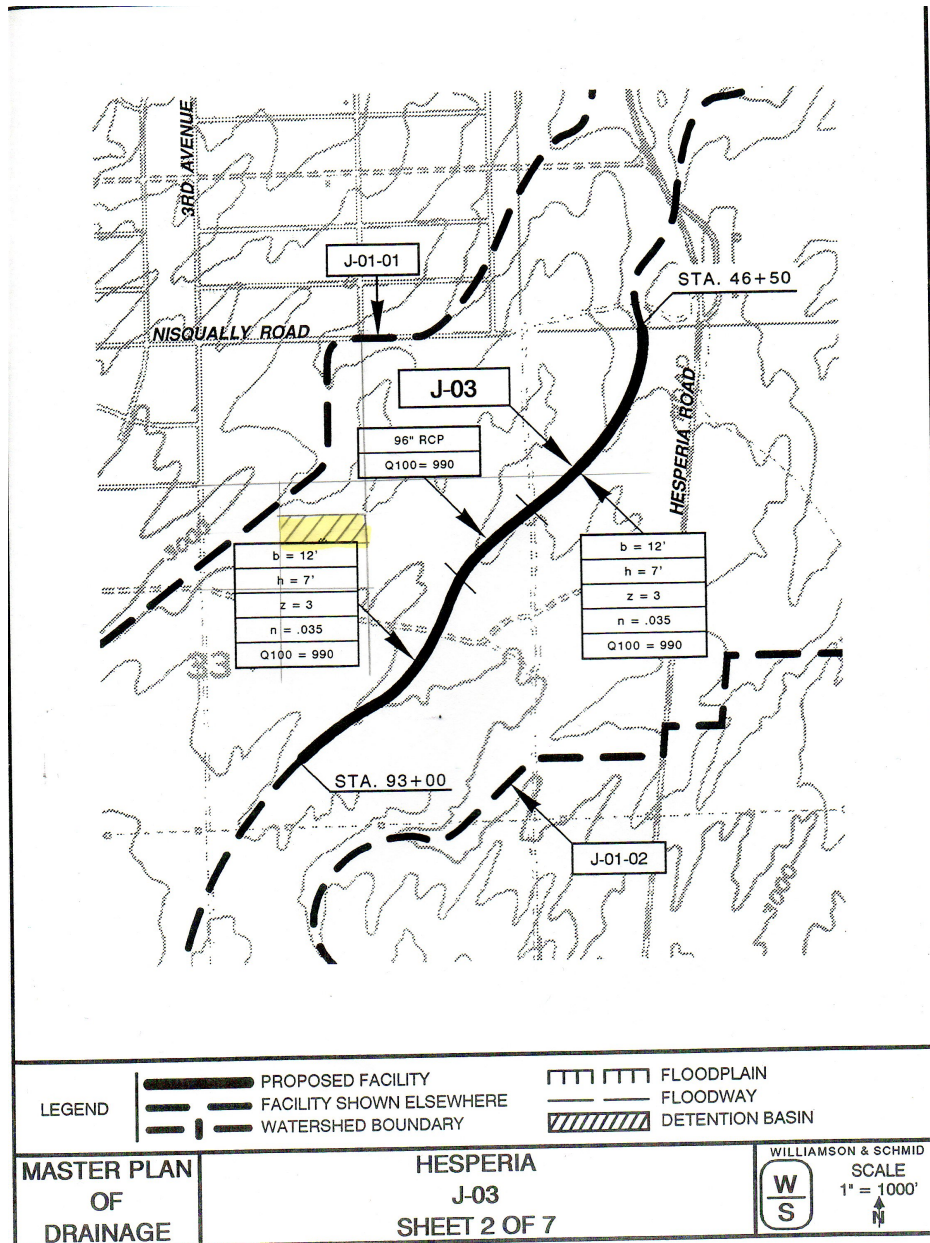
MASTER PLAN OF DRAINAGE J-01-01
DRAWING 6

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WEST PORTION

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 12/15/14

TT 18980 (west portion)
Predevelopment Time of Concentration
100 Year Storm Event
tt18980pretcw.out

Program License Serial Number 6286

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.110 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

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+++++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Soil classification AP and SCS values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2) = 85.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.283(In/Hr)
Initial subarea data:
Initial area flow distance = 428.000(Ft.)
Top (of initial area) elevation = 3007.000(Ft.)
Bottom (of initial area) elevation = 2991.000(Ft.)
Difference in elevation = 16.000(Ft.)
Slope = 0.03738 s(%)= 3.74
 $TC = k(0.529)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 11.523 min.
Rainfall intensity = 3.523(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.828
Subarea runoff = 6.007(CFS)
Total initial stream area = 2.060 (Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.283(In/Hr)
End of computations, Total Study Area = 2.06 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 85.0

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U n i t H y d r o g r a p h A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

Study date 12/15/14

+++++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6286

TT 18980 (west portion)
Predevelopment Runoff Volume
100 Year Storm Event
tt18980prevolw.out

Storm Event Year = 100

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
2.06	1	1.11

Rainfall data for year 100		
2.06	6	2.20

Rainfall data for year 100		
2.06	24	3.98

+++++

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***** Area-averaged max loss rate, Fm *****

SCS curve No. (AMCII)	SCS curve NO. (AMC 2)	Area (Ac.)	Area Fraction	Fp (Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
85.0	85.0	2.06	1.000	0.283	1.000	0.283

Area-averaged adjusted loss rate Fm (In/Hr) = 0.283

***** Area-Averaged low loss rate fraction, Yb *****

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
2.06	1.000	85.0	85.0	1.76	0.613

Area-averaged catchment yield fraction, Y = 0.613

Area-averaged low loss fraction, Yb = 0.387

User entry of time of concentration = 0.192 (hours)

+++++

Watershed area = 2.06 (Ac.)

Catchment Lag time = 0.154 hours

Unit interval = 5.000 minutes

Unit interval percentage of lag time = 54.2252

Hydrograph baseflow = 0.00 (CFS)

Average maximum watershed loss rate (Fm) = 0.283 (In/Hr)

Average low loss rate fraction (Yb) = 0.387 (decimal)

DESERT S-Graph Selected

Computed peak 5-minute rainfall = 0.527 (In)

Computed peak 30-minute rainfall = 0.902 (In)

Specified peak 1-hour rainfall = 1.110 (In)

Computed peak 3-hour rainfall = 1.688 (In)

Specified peak 6-hour rainfall = 2.200 (In)

Specified peak 24-hour rainfall = 3.980 (In)

Rainfall depth area reduction factors:

Using a total area of 2.06 (Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.527 (In)

30-minute factor = 1.000 Adjusted rainfall = 0.902 (In)

1-hour factor = 1.000 Adjusted rainfall = 1.110 (In)

3-hour factor = 1.000 Adjusted rainfall = 1.688 (In)

6-hour factor = 1.000 Adjusted rainfall = 2.200 (In)

24-hour factor = 1.000 Adjusted rainfall = 3.980 (In)

Unit Hydrograph

+++++

Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
--------------------	--------------------------	--------------------------

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(K = 24.91 (CFS))

1	4.577	1.140
2	35.346	7.665
3	64.077	7.158
4	76.411	3.073
5	83.590	1.789
6	88.438	1.208
7	91.673	0.806
8	94.089	0.602
9	95.864	0.442
10	97.162	0.323
11	97.989	0.206
12	98.583	0.148
13	99.232	0.162
14	99.700	0.117
15	100.000	0.075

Total soil rain loss = 1.33(In)
Total effective rainfall = 2.65(In)
Peak flow rate in flood hydrograph = 4.95 (CFS)

+++++
24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time (h+m)	Volume Ac.Ft	Q (CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000	0.00	Q				
0+10	0.0002	0.03	Q				
0+15	0.0006	0.06	Q				
0+20	0.0011	0.07	Q				
0+25	0.0016	0.08	Q				
0+30	0.0022	0.08	Q				
0+35	0.0028	0.08	Q				
0+40	0.0034	0.09	Q				
0+45	0.0040	0.09	Q				
0+50	0.0046	0.09	Q				
0+55	0.0052	0.09	Q				
1+ 0	0.0058	0.09	Q				
1+ 5	0.0065	0.09	Q				
1+10	0.0071	0.09	Q				
1+15	0.0078	0.09	Q				
1+20	0.0084	0.09	Q				
1+25	0.0091	0.09	Q				
1+30	0.0097	0.09	Q				

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1+35	0.0104	0.09	Q				
1+40	0.0110	0.10	Q				
1+45	0.0117	0.10	QV				
1+50	0.0123	0.10	QV				
1+55	0.0130	0.10	QV				
2+ 0	0.0137	0.10	QV				
2+ 5	0.0143	0.10	QV				
2+10	0.0150	0.10	QV				
2+15	0.0157	0.10	QV				
2+20	0.0163	0.10	QV				
2+25	0.0170	0.10	QV				
2+30	0.0177	0.10	QV				
2+35	0.0184	0.10	QV				
2+40	0.0190	0.10	QV				
2+45	0.0197	0.10	QV				
2+50	0.0204	0.10	QV				
2+55	0.0211	0.10	QV				
3+ 0	0.0218	0.10	QV				
3+ 5	0.0225	0.10	QV				
3+10	0.0232	0.10	Q V				
3+15	0.0239	0.10	Q V				
3+20	0.0246	0.10	Q V				
3+25	0.0253	0.10	Q V				
3+30	0.0260	0.10	Q V				
3+35	0.0267	0.10	Q V				
3+40	0.0274	0.10	Q V				
3+45	0.0281	0.10	Q V				
3+50	0.0288	0.10	Q V				
3+55	0.0296	0.10	Q V				
4+ 0	0.0303	0.10	Q V				
4+ 5	0.0310	0.11	Q V				
4+10	0.0317	0.11	Q V				
4+15	0.0325	0.11	Q V				
4+20	0.0332	0.11	Q V				
4+25	0.0339	0.11	Q V				
4+30	0.0347	0.11	Q V				
4+35	0.0354	0.11	Q V				
4+40	0.0362	0.11	Q V				
4+45	0.0369	0.11	Q V				
4+50	0.0377	0.11	Q V				
4+55	0.0384	0.11	Q V				
5+ 0	0.0392	0.11	Q V				
5+ 5	0.0400	0.11	Q V				
5+10	0.0407	0.11	Q V				
5+15	0.0415	0.11	Q V				
5+20	0.0423	0.11	Q V				
5+25	0.0430	0.11	Q V				
5+30	0.0438	0.11	Q V				
5+35	0.0446	0.11	Q V				
5+40	0.0454	0.11	Q V				
5+45	0.0462	0.11	Q V				

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5+50	0.0470	0.12	Q	V					
5+55	0.0478	0.12	Q	V					
6+ 0	0.0486	0.12	Q	V					
6+ 5	0.0494	0.12	Q	V					
6+10	0.0502	0.12	Q	V					
6+15	0.0510	0.12	Q	V					
6+20	0.0518	0.12	Q	V					
6+25	0.0526	0.12	Q	V					
6+30	0.0534	0.12	Q	V					
6+35	0.0543	0.12	Q	V					
6+40	0.0551	0.12	Q	V					
6+45	0.0559	0.12	Q	V					
6+50	0.0568	0.12	Q	V					
6+55	0.0576	0.12	Q	V					
7+ 0	0.0585	0.12	Q	V					
7+ 5	0.0593	0.12	Q	V					
7+10	0.0602	0.12	Q	V					
7+15	0.0610	0.13	Q	V					
7+20	0.0619	0.13	Q	V					
7+25	0.0628	0.13	Q	V					
7+30	0.0636	0.13	Q	V					
7+35	0.0645	0.13	Q	V					
7+40	0.0654	0.13	Q	V					
7+45	0.0663	0.13	Q	V					
7+50	0.0672	0.13	Q	V					
7+55	0.0681	0.13	Q	V					
8+ 0	0.0690	0.13	Q	V					
8+ 5	0.0699	0.13	Q	V					
8+10	0.0708	0.13	Q	V					
8+15	0.0718	0.13	Q	V					
8+20	0.0727	0.13	Q	V					
8+25	0.0736	0.14	Q	V					
8+30	0.0746	0.14	Q	V					
8+35	0.0755	0.14	Q	V					
8+40	0.0764	0.14	Q	V					
8+45	0.0774	0.14	Q	V					
8+50	0.0784	0.14	Q	V					
8+55	0.0793	0.14	Q	V					
9+ 0	0.0803	0.14	Q	V					
9+ 5	0.0813	0.14	Q	V					
9+10	0.0823	0.14	Q	V					
9+15	0.0833	0.14	Q	V					
9+20	0.0843	0.15	Q	V					
9+25	0.0853	0.15	Q	V					
9+30	0.0863	0.15	Q	V					
9+35	0.0873	0.15	Q	V					
9+40	0.0883	0.15	Q	V					
9+45	0.0894	0.15	Q	V					
9+50	0.0904	0.15	Q	V					
9+55	0.0915	0.15	Q	V					
10+ 0	0.0925	0.15	Q	V					

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10+ 5	0.0936	0.16	Q	V					
10+10	0.0947	0.16	Q	V					
10+15	0.0958	0.16	Q	V					
10+20	0.0969	0.16	Q	V					
10+25	0.0980	0.16	Q	V					
10+30	0.0991	0.16	Q	V					
10+35	0.1002	0.16	Q	V					
10+40	0.1013	0.16	Q	V					
10+45	0.1025	0.17	Q	V					
10+50	0.1036	0.17	Q	V					
10+55	0.1048	0.17	Q	V					
11+ 0	0.1060	0.17	Q	V					
11+ 5	0.1071	0.17	Q	V					
11+10	0.1083	0.17	Q	V					
11+15	0.1095	0.17	Q	V					
11+20	0.1107	0.18	Q	V					
11+25	0.1120	0.18	Q	V					
11+30	0.1132	0.18	Q	V					
11+35	0.1145	0.18	Q	V					
11+40	0.1157	0.18	Q	V					
11+45	0.1170	0.19	Q	V					
11+50	0.1183	0.19	Q	V					
11+55	0.1196	0.19	Q	V					
12+ 0	0.1209	0.19	Q	V					
12+ 5	0.1223	0.19	Q	V					
12+10	0.1236	0.19	Q	V					
12+15	0.1248	0.18	Q	V					
12+20	0.1261	0.18	Q	V					
12+25	0.1274	0.19	Q	V					
12+30	0.1287	0.19	Q	V					
12+35	0.1300	0.19	Q	V					
12+40	0.1313	0.19	Q	V					
12+45	0.1326	0.19	Q	V					
12+50	0.1340	0.20	Q	V					
12+55	0.1353	0.20	Q	V					
13+ 0	0.1367	0.20	Q	V					
13+ 5	0.1381	0.20	Q	V					
13+10	0.1395	0.21	Q	V					
13+15	0.1410	0.21	Q	V					
13+20	0.1425	0.21	Q	V					
13+25	0.1440	0.22	Q	V					
13+30	0.1455	0.22	Q	V					
13+35	0.1471	0.23	Q	V					
13+40	0.1487	0.23	Q	V					
13+45	0.1503	0.24	Q	V					
13+50	0.1520	0.24	Q	V					
13+55	0.1537	0.25	Q	V					
14+ 0	0.1554	0.25	IQ	V					
14+ 5	0.1572	0.26	IQ	V					
14+10	0.1590	0.26	IQ	V					
14+15	0.1609	0.27	IQ	V					

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14+20	0.1628	0.28	Q			V				
14+25	0.1647	0.29	Q			V				
14+30	0.1668	0.29	Q			V				
14+35	0.1688	0.30	Q			V				
14+40	0.1710	0.31	Q			V				
14+45	0.1732	0.32	Q			V				
14+50	0.1755	0.33	Q			V				
14+55	0.1779	0.35	Q			V				
15+ 0	0.1804	0.36	Q			V				
15+ 5	0.1830	0.38	Q			V				
15+10	0.1857	0.39	Q			V				
15+15	0.1886	0.41	Q			V				
15+20	0.1916	0.44	Q			V				
15+25	0.1947	0.46	Q			V				
15+30	0.1979	0.45	Q			V				
15+35	0.2010	0.46	Q			V				
15+40	0.2043	0.49	Q			V				
15+45	0.2080	0.53	Q			V				
15+50	0.2122	0.61	Q			V				
15+55	0.2172	0.72	Q			V				
16+ 0	0.2243	1.03	Q	Q		V				
16+ 5	0.2380	2.00		Q		V				
16+10	0.2721	4.95				Q	V			
16+15	0.3029	4.47				Q		V		
16+20	0.3194	2.40			Q			V		
16+25	0.3306	1.62		Q				V		
16+30	0.3391	1.24		Q				V		
16+35	0.3459	0.99		Q				V		
16+40	0.3516	0.83		Q				V		
16+45	0.3564	0.70	Q					V		
16+50	0.3605	0.59	Q					V		
16+55	0.3640	0.50	Q					V		
17+ 0	0.3670	0.44	Q					V		
17+ 5	0.3699	0.42	Q					V		
17+10	0.3725	0.37	Q					V		
17+15	0.3747	0.33	Q					V		
17+20	0.3766	0.28	Q					V		
17+25	0.3784	0.26	Q					V		
17+30	0.3802	0.25	Q					V		
17+35	0.3818	0.24	Q					V		
17+40	0.3834	0.23	Q					V		
17+45	0.3849	0.22	Q					V		
17+50	0.3864	0.21	Q					V		
17+55	0.3878	0.21	Q					V		
18+ 0	0.3891	0.20	Q					V		
18+ 5	0.3905	0.19	Q					V		
18+10	0.3918	0.19	Q					V		
18+15	0.3932	0.20	Q					V		
18+20	0.3945	0.19	Q					V		
18+25	0.3958	0.19	Q					V		
18+30	0.3971	0.19	Q					V		

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18+35	0.3984	0.18	Q				V	
18+40	0.3996	0.18	Q				V	
18+45	0.4008	0.18	Q				V	
18+50	0.4020	0.17	Q				V	
18+55	0.4032	0.17	Q				V	
19+ 0	0.4044	0.17	Q				V	
19+ 5	0.4055	0.17	Q				V	
19+10	0.4066	0.16	Q				V	
19+15	0.4077	0.16	Q				V	
19+20	0.4088	0.16	Q				V	
19+25	0.4099	0.16	Q				V	
19+30	0.4109	0.15	Q				V	
19+35	0.4120	0.15	Q				V	
19+40	0.4130	0.15	Q				V	
19+45	0.4140	0.15	Q				V	
19+50	0.4150	0.14	Q				V	
19+55	0.4160	0.14	Q				V	
20+ 0	0.4169	0.14	Q				V	
20+ 5	0.4179	0.14	Q				V	
20+10	0.4188	0.14	Q				V	
20+15	0.4198	0.14	Q				V	
20+20	0.4207	0.13	Q				V	
20+25	0.4216	0.13	Q				V	
20+30	0.4225	0.13	Q				V	
20+35	0.4234	0.13	Q				V	
20+40	0.4243	0.13	Q				V	
20+45	0.4251	0.13	Q				V	
20+50	0.4260	0.13	Q				V	
20+55	0.4269	0.12	Q				V	
21+ 0	0.4277	0.12	Q				V	
21+ 5	0.4285	0.12	Q				V	
21+10	0.4294	0.12	Q				V	
21+15	0.4302	0.12	Q				V	
21+20	0.4310	0.12	Q				V	
21+25	0.4318	0.12	Q				V	
21+30	0.4326	0.12	Q				V	
21+35	0.4334	0.11	Q				V	
21+40	0.4342	0.11	Q				V	
21+45	0.4349	0.11	Q				V	
21+50	0.4357	0.11	Q				V	
21+55	0.4365	0.11	Q				V	
22+ 0	0.4372	0.11	Q				V	
22+ 5	0.4380	0.11	Q				V	
22+10	0.4387	0.11	Q				V	
22+15	0.4394	0.11	Q				V	
22+20	0.4402	0.11	Q				V	
22+25	0.4409	0.11	Q				V	
22+30	0.4416	0.10	Q				V	
22+35	0.4423	0.10	Q				V	
22+40	0.4430	0.10	Q				V	
22+45	0.4437	0.10	Q				V	

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22+50	0.4444	0.10	Q				V
22+55	0.4451	0.10	Q				V
23+ 0	0.4458	0.10	Q				V
23+ 5	0.4465	0.10	Q				V
23+10	0.4472	0.10	Q				V
23+15	0.4479	0.10	Q				V
23+20	0.4485	0.10	Q				V
23+25	0.4492	0.10	Q				V
23+30	0.4499	0.10	Q				V
23+35	0.4505	0.10	Q				V
23+40	0.4512	0.09	Q				V
23+45	0.4518	0.09	Q				V
23+50	0.4525	0.09	Q				V
23+55	0.4531	0.09	Q				V
24+ 0	0.4537	0.09	Q				V
24+ 5	0.4543	0.09	Q				V
24+10	0.4547	0.06	Q				V
24+15	0.4550	0.03	Q				V
24+20	0.4551	0.02	Q				V
24+25	0.4552	0.02	Q				V
24+30	0.4553	0.01	Q				V
24+35	0.4553	0.01	Q				V
24+40	0.4554	0.01	Q				V
24+45	0.4554	0.00	Q				V
24+50	0.4554	0.00	Q				V
24+55	0.4554	0.00	Q				V
25+ 0	0.4554	0.00	Q				V
25+ 5	0.4555	0.00	Q				V
25+10	0.4555	0.00	Q				V

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San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 12/15/14

TT 18980 (west portion)
Postdevelopment Time of Concentration
100 Year Storm Event
ttl18980posttcw.out

Program License Serial Number 6286

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.110 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

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+++++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(3 - 4 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 69.00
Pervious ratio(Ap) = 0.6000 Max loss rate(Fm)= 0.329(In/Hr)
Initial subarea data:
Initial area flow distance = 428.000(Ft.)
Top (of initial area) elevation = 3007.000(Ft.)
Bottom (of initial area) elevation = 2991.000(Ft.)
Difference in elevation = 16.000(Ft.)
Slope = 0.03738 s(%)= 3.74
TC = $k(0.412)*[(\text{length}^3)/(\text{elevation change})]^{0.2}$
Initial area time of concentration = 8.973 min.
Rainfall intensity = 4.197(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.830
Subarea runoff = 7.172(CFS)
Total initial stream area = 2.060(Ac.)
Pervious area fraction = 0.600
Initial area Fm value = 0.329(In/Hr)
End of computations, Total Study Area = 2.06 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.600
Area averaged SCS curve number = 69.0

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U n i t H y d r o g r a p h A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

Study date 12/15/14

+++++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6286

TT 18980 (west portion)
Postdevelopment Runoff Volume
100 Year Storm Event
tt18980postvolw.out

Storm Event Year = 100

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
2.06	1	1.11

Rainfall data for year 100		
2.06	6	2.20

Rainfall data for year 100		
2.06	24	3.98

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***** Area-averaged max loss rate, Fm *****

SCS curve No. (AMCII)	SCS curve NO. (AMC 2)	Area (Ac.)	Area Fraction	Fp (Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
69.0	69.0	2.06	1.000	0.548	0.600	0.329

Area-averaged adjusted loss rate Fm (In/Hr) = 0.329

***** Area-Averaged low loss rate fraction, Yb *****

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
1.24	0.600	69.0	69.0	4.49	0.315
0.82	0.400	98.0	98.0	0.20	0.941

Area-averaged catchment yield fraction, Y = 0.565

Area-averaged low loss fraction, Yb = 0.435

User entry of time of concentration = 0.150 (hours)

+++++

Watershed area = 2.06 (Ac.)

Catchment Lag time = 0.120 hours

Unit interval = 5.000 minutes

Unit interval percentage of lag time = 69.6301

Hydrograph baseflow = 0.00 (CFS)

Average maximum watershed loss rate (Fm) = 0.329 (In/Hr)

Average low loss rate fraction (Yb) = 0.435 (decimal)

DESERT S-Graph Selected

Computed peak 5-minute rainfall = 0.527 (In)

Computed peak 30-minute rainfall = 0.902 (In)

Specified peak 1-hour rainfall = 1.110 (In)

Computed peak 3-hour rainfall = 1.688 (In)

Specified peak 6-hour rainfall = 2.200 (In)

Specified peak 24-hour rainfall = 3.980 (In)

Rainfall depth area reduction factors:

Using a total area of 2.06 (Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.527 (In)

30-minute factor = 1.000 Adjusted rainfall = 0.902 (In)

1-hour factor = 1.000 Adjusted rainfall = 1.110 (In)

3-hour factor = 1.000 Adjusted rainfall = 1.688 (In)

6-hour factor = 1.000 Adjusted rainfall = 2.200 (In)

24-hour factor = 1.000 Adjusted rainfall = 3.980 (In)

Unit Hydrograph

Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
--------------------	--------------------------	--------------------------

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(K = 24.91 (CFS))

1	7.717	1.922
2	50.181	10.579
3	73.395	5.783
4	83.504	2.518
5	89.418	1.473
6	93.107	0.919
7	95.608	0.623
8	97.288	0.419
9	98.229	0.234
10	99.038	0.202
11	99.694	0.163
12	100.000	0.076

Total soil rain loss = 1.49(In)
Total effective rainfall = 2.49(In)
Peak flow rate in flood hydrograph = 6.15(CFS)

+++++

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume	Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000	0.01	Q					
0+10	0.0003	0.04	Q					
0+15	0.0008	0.06	Q					
0+20	0.0012	0.07	Q					
0+25	0.0018	0.08	Q					
0+30	0.0023	0.08	Q					
0+35	0.0028	0.08	Q					
0+40	0.0034	0.08	Q					
0+45	0.0040	0.08	Q					
0+50	0.0046	0.08	Q					
0+55	0.0052	0.09	Q					
1+ 0	0.0057	0.09	Q					
1+ 5	0.0063	0.09	Q					
1+10	0.0069	0.09	Q					
1+15	0.0075	0.09	Q					
1+20	0.0081	0.09	Q					
1+25	0.0087	0.09	Q					
1+30	0.0093	0.09	Q					
1+35	0.0099	0.09	Q					
1+40	0.0105	0.09	Q					

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1+45	0.0111	0.09	QV				
1+50	0.0117	0.09	QV				
1+55	0.0124	0.09	QV				
2+ 0	0.0130	0.09	QV				
2+ 5	0.0136	0.09	QV				
2+10	0.0142	0.09	QV				
2+15	0.0148	0.09	QV				
2+20	0.0154	0.09	QV				
2+25	0.0161	0.09	QV				
2+30	0.0167	0.09	QV				
2+35	0.0173	0.09	QV				
2+40	0.0179	0.09	QV				
2+45	0.0186	0.09	QV				
2+50	0.0192	0.09	QV				
2+55	0.0198	0.09	QV				
3+ 0	0.0205	0.09	QV				
3+ 5	0.0211	0.09	QV				
3+10	0.0218	0.09	Q V				
3+15	0.0224	0.09	Q V				
3+20	0.0231	0.09	Q V				
3+25	0.0237	0.09	Q V				
3+30	0.0244	0.09	Q V				
3+35	0.0250	0.10	Q V				
3+40	0.0257	0.10	Q V				
3+45	0.0263	0.10	Q V				
3+50	0.0270	0.10	Q V				
3+55	0.0277	0.10	Q V				
4+ 0	0.0283	0.10	Q V				
4+ 5	0.0290	0.10	Q V				
4+10	0.0297	0.10	Q V				
4+15	0.0304	0.10	Q V				
4+20	0.0310	0.10	Q V				
4+25	0.0317	0.10	Q V				
4+30	0.0324	0.10	Q V				
4+35	0.0331	0.10	Q V				
4+40	0.0338	0.10	Q V				
4+45	0.0345	0.10	Q V				
4+50	0.0352	0.10	Q V				
4+55	0.0359	0.10	Q V				
5+ 0	0.0366	0.10	Q V				
5+ 5	0.0373	0.10	Q V				
5+10	0.0380	0.10	Q V				
5+15	0.0387	0.10	Q V				
5+20	0.0394	0.10	Q V				
5+25	0.0401	0.10	Q V				
5+30	0.0408	0.10	Q V				
5+35	0.0416	0.10	Q V				
5+40	0.0423	0.11	Q V				
5+45	0.0430	0.11	Q V				
5+50	0.0438	0.11	Q V				
5+55	0.0445	0.11	Q V				

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6+ 0	0.0452	0.11	Q	V						
6+ 5	0.0460	0.11	Q	V						
6+10	0.0467	0.11	Q	V						
6+15	0.0475	0.11	Q	V						
6+20	0.0482	0.11	Q	V						
6+25	0.0490	0.11	Q	V						
6+30	0.0497	0.11	Q	V						
6+35	0.0505	0.11	Q	V						
6+40	0.0513	0.11	Q	V						
6+45	0.0520	0.11	Q	V						
6+50	0.0528	0.11	Q	V						
6+55	0.0536	0.11	Q	V						
7+ 0	0.0544	0.11	Q	V						
7+ 5	0.0552	0.11	Q	V						
7+10	0.0560	0.12	Q	V						
7+15	0.0568	0.12	Q	V						
7+20	0.0576	0.12	Q	V						
7+25	0.0584	0.12	Q	V						
7+30	0.0592	0.12	Q	V						
7+35	0.0600	0.12	Q	V						
7+40	0.0608	0.12	Q	V						
7+45	0.0616	0.12	Q	V						
7+50	0.0625	0.12	Q	V						
7+55	0.0633	0.12	Q	V						
8+ 0	0.0641	0.12	Q	V						
8+ 5	0.0650	0.12	Q	V						
8+10	0.0658	0.12	Q	V						
8+15	0.0667	0.12	Q	V						
8+20	0.0675	0.12	Q	V						
8+25	0.0684	0.13	Q	V						
8+30	0.0693	0.13	Q	V						
8+35	0.0702	0.13	Q	V						
8+40	0.0710	0.13	Q	V						
8+45	0.0719	0.13	Q	V						
8+50	0.0728	0.13	Q	V						
8+55	0.0737	0.13	Q	V						
9+ 0	0.0746	0.13	Q	V						
9+ 5	0.0755	0.13	Q	V						
9+10	0.0764	0.13	Q	V						
9+15	0.0773	0.13	Q	V						
9+20	0.0783	0.13	Q	V						
9+25	0.0792	0.14	Q	V						
9+30	0.0801	0.14	Q	V						
9+35	0.0811	0.14	Q	V						
9+40	0.0820	0.14	Q	V						
9+45	0.0830	0.14	Q	V						
9+50	0.0840	0.14	Q	V						
9+55	0.0850	0.14	Q	V						
10+ 0	0.0859	0.14	Q	V						
10+ 5	0.0869	0.14	Q	V						
10+10	0.0879	0.14	Q	V						

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10+15	0.0889	0.15	Q	V					
10+20	0.0899	0.15	Q	V					
10+25	0.0910	0.15	Q	V					
10+30	0.0920	0.15	Q	V					
10+35	0.0930	0.15	Q	V					
10+40	0.0941	0.15	Q	V					
10+45	0.0951	0.15	Q	V					
10+50	0.0962	0.15	Q	V					
10+55	0.0973	0.16	Q	V					
11+ 0	0.0984	0.16	Q	V					
11+ 5	0.0995	0.16	Q	V					
11+10	0.1006	0.16	Q	V					
11+15	0.1017	0.16	Q	V					
11+20	0.1028	0.16	Q	V					
11+25	0.1039	0.17	Q	V					
11+30	0.1051	0.17	Q	V					
11+35	0.1063	0.17	Q	V					
11+40	0.1074	0.17	Q	V					
11+45	0.1086	0.17	Q	V					
11+50	0.1098	0.17	Q	V					
11+55	0.1110	0.18	Q	V					
12+ 0	0.1123	0.18	Q	V					
12+ 5	0.1135	0.18	Q	V					
12+10	0.1147	0.17	Q	V					
12+15	0.1158	0.17	Q	V					
12+20	0.1170	0.17	Q	V					
12+25	0.1182	0.17	Q	V					
12+30	0.1194	0.17	Q	V					
12+35	0.1206	0.17	Q	V					
12+40	0.1218	0.18	Q	V					
12+45	0.1230	0.18	Q	V					
12+50	0.1243	0.18	Q	V					
12+55	0.1255	0.18	Q	V					
13+ 0	0.1268	0.19	Q	V					
13+ 5	0.1281	0.19	Q	V					
13+10	0.1295	0.19	Q	V					
13+15	0.1308	0.20	Q	V					
13+20	0.1322	0.20	Q	V					
13+25	0.1336	0.20	Q	V					
13+30	0.1350	0.21	Q	V					
13+35	0.1365	0.21	Q	V					
13+40	0.1380	0.22	Q	V					
13+45	0.1395	0.22	Q	V					
13+50	0.1411	0.23	Q	V					
13+55	0.1426	0.23	Q	V					
14+ 0	0.1443	0.24	Q	V					
14+ 5	0.1459	0.24	Q	V					
14+10	0.1476	0.25	Q	V					
14+15	0.1494	0.25	IQ	V					
14+20	0.1512	0.26	IQ	V					
14+25	0.1530	0.27	IQ	V					

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14+30	0.1549	0.28	Q			V				
14+35	0.1568	0.28	Q			V				
14+40	0.1589	0.29	Q			V				
14+45	0.1610	0.30	Q			V				
14+50	0.1631	0.31	Q			V				
14+55	0.1654	0.33	Q			V				
15+ 0	0.1677	0.34	Q			V				
15+ 5	0.1702	0.35	Q			V				
15+10	0.1727	0.37	Q			V				
15+15	0.1754	0.39	Q			V				
15+20	0.1783	0.42	Q			V				
15+25	0.1813	0.43	Q			V				
15+30	0.1841	0.42	Q			V				
15+35	0.1871	0.43	Q			V				
15+40	0.1903	0.46	Q			V				
15+45	0.1938	0.51	Q			V				
15+50	0.1979	0.59	Q			V				
15+55	0.2029	0.73	Q			V				
16+ 0	0.2105	1.11	Q	Q		V				
16+ 5	0.2274	2.45			Q	V				
16+10	0.2698	6.15				QV				
16+15	0.2955	3.73				Q		V		
16+20	0.3093	2.01			Q			V		
16+25	0.3186	1.36		Q				V		
16+30	0.3256	1.02		Q				V		
16+35	0.3313	0.82		Q				V		
16+40	0.3358	0.66	Q					V		
16+45	0.3394	0.53	Q					V		
16+50	0.3427	0.47	Q					V		
16+55	0.3456	0.42	Q					V		
17+ 0	0.3480	0.35	Q					V		
17+ 5	0.3500	0.29	Q					V		
17+10	0.3518	0.27	Q					V		
17+15	0.3536	0.26	Q					V		
17+20	0.3553	0.24	Q					V		
17+25	0.3569	0.23	Q					V		
17+30	0.3584	0.22	Q					V		
17+35	0.3599	0.21	Q					V		
17+40	0.3613	0.20	Q					V		
17+45	0.3626	0.20	Q					V		
17+50	0.3639	0.19	Q					V		
17+55	0.3652	0.18	Q					V		
18+ 0	0.3665	0.18	Q					V		
18+ 5	0.3677	0.18	Q					V		
18+10	0.3689	0.18	Q					V		
18+15	0.3701	0.18	Q					V		
18+20	0.3713	0.18	Q					V		
18+25	0.3725	0.17	Q					V		
18+30	0.3737	0.17	Q					V		
18+35	0.3749	0.17	Q					V		
18+40	0.3760	0.16	Q					V		

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18+45	0.3771	0.16	Q				V	
18+50	0.3782	0.16	Q				V	
18+55	0.3793	0.16	Q				V	
19+ 0	0.3804	0.15	Q				V	
19+ 5	0.3814	0.15	Q				V	
19+10	0.3824	0.15	Q				V	
19+15	0.3834	0.15	Q				V	
19+20	0.3844	0.14	Q				V	
19+25	0.3854	0.14	Q				V	
19+30	0.3864	0.14	Q				V	
19+35	0.3873	0.14	Q				V	
19+40	0.3882	0.14	Q				V	
19+45	0.3892	0.13	Q				V	
19+50	0.3901	0.13	Q				V	
19+55	0.3910	0.13	Q				V	
20+ 0	0.3918	0.13	Q				V	
20+ 5	0.3927	0.13	Q				V	
20+10	0.3936	0.13	Q				V	
20+15	0.3944	0.12	Q				V	
20+20	0.3953	0.12	Q				V	
20+25	0.3961	0.12	Q				V	
20+30	0.3969	0.12	Q				V	
20+35	0.3977	0.12	Q				V	
20+40	0.3986	0.12	Q				V	
20+45	0.3993	0.12	Q				V	
20+50	0.4001	0.11	Q				V	
20+55	0.4009	0.11	Q				V	
21+ 0	0.4017	0.11	Q				V	
21+ 5	0.4025	0.11	Q				V	
21+10	0.4032	0.11	Q				V	
21+15	0.4040	0.11	Q				V	
21+20	0.4047	0.11	Q				V	
21+25	0.4054	0.11	Q				V	
21+30	0.4062	0.11	Q				V	
21+35	0.4069	0.10	Q				V	
21+40	0.4076	0.10	Q				V	
21+45	0.4083	0.10	Q				V	
21+50	0.4090	0.10	Q				V	
21+55	0.4097	0.10	Q				V	
22+ 0	0.4104	0.10	Q				V	
22+ 5	0.4111	0.10	Q				V	
22+10	0.4118	0.10	Q				V	
22+15	0.4125	0.10	Q				V	
22+20	0.4131	0.10	Q				V	
22+25	0.4138	0.10	Q				V	
22+30	0.4145	0.10	Q				V	
22+35	0.4151	0.10	Q				V	
22+40	0.4158	0.09	Q				V	
22+45	0.4164	0.09	Q				V	
22+50	0.4171	0.09	Q				V	
22+55	0.4177	0.09	Q				V	

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23+ 0	0.4183	0.09	Q				V
23+ 5	0.4189	0.09	Q				V
23+10	0.4196	0.09	Q				V
23+15	0.4202	0.09	Q				V
23+20	0.4208	0.09	Q				V
23+25	0.4214	0.09	Q				V
23+30	0.4220	0.09	Q				V
23+35	0.4226	0.09	Q				V
23+40	0.4232	0.09	Q				V
23+45	0.4238	0.09	Q				V
23+50	0.4244	0.09	Q				V
23+55	0.4250	0.09	Q				V
24+ 0	0.4256	0.08	Q				V
24+ 5	0.4261	0.08	Q				V
24+10	0.4264	0.04	Q				V
24+15	0.4266	0.02	Q				V
24+20	0.4267	0.01	Q				V
24+25	0.4267	0.01	Q				V
24+30	0.4268	0.01	Q				V
24+35	0.4268	0.00	Q				V
24+40	0.4268	0.00	Q				V
24+45	0.4268	0.00	Q				V
24+50	0.4268	0.00	Q				V
24+55	0.4268	0.00	Q				V

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EAST PORTION

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 12/15/14

TT 18980 (east portion)
Predevelopment Time of Concentration
100 Year Storm Event
tt18980pretce.out

Program License Serial Number 6286

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.110 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

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+++++
Process from Point/Station 1.000 to Point/Station 3.000
**** INITIAL AREA EVALUATION ****

Soil classification AP and SCS values input by user
USER INPUT of soil data for subarea
SCS curve number for soil(AMC 2) = 85.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.283(In/Hr)
Initial subarea data:
Initial area flow distance = 509.000(Ft.)
Top (of initial area) elevation = 3007.000(Ft.)
Bottom (of initial area) elevation = 2996.000(Ft.)
Difference in elevation = 11.000(Ft.)
Slope = 0.02161 s(%)= 2.16
 $TC = k(0.529)*[(length^3)/(elevation\ change)]^{0.2}$
Initial area time of concentration = 13.781 min.
Rainfall intensity = 3.108(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.818
Subarea runoff = 7.476(CFS)
Total initial stream area = 2.940(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.283(In/Hr)
End of computations, Total Study Area = 2.94 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 85.0

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U n i t H y d r o g r a p h A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

Study date 12/15/14

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6286

TT 18980 (east portion)
Predevelopment Runoff Volume
100 Year Storm Event
tt18980prevole.out

Storm Event Year = 100

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
2.94	1	1.11

Rainfall data for year 100		
2.94	6	2.20

Rainfall data for year 100		
2.94	24	3.98

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***** Area-averaged max loss rate, Fm *****

SCS curve No. (AMCII)	SCS curve NO. (AMC 2)	Area (Ac.)	Area Fraction	Fp (Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
85.0	85.0	2.94	1.000	0.283	1.000	0.283

Area-averaged adjusted loss rate Fm (In/Hr) = 0.283

***** Area-Averaged low loss rate fraction, Yb *****

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
2.94	1.000	85.0	85.0	1.76	0.613

Area-averaged catchment yield fraction, Y = 0.613

Area-averaged low loss fraction, Yb = 0.387

User entry of time of concentration = 0.230 (hours)

+++++

Watershed area = 2.94 (Ac.)

Catchment Lag time = 0.184 hours

Unit interval = 5.000 minutes

Unit interval percentage of lag time = 45.3490

Hydrograph baseflow = 0.00 (CFS)

Average maximum watershed loss rate (Fm) = 0.283 (In/Hr)

Average low loss rate fraction (Yb) = 0.387 (decimal)

DESERT S-Graph Selected

Computed peak 5-minute rainfall = 0.527 (In)

Computed peak 30-minute rainfall = 0.902 (In)

Specified peak 1-hour rainfall = 1.110 (In)

Computed peak 3-hour rainfall = 1.688 (In)

Specified peak 6-hour rainfall = 2.200 (In)

Specified peak 24-hour rainfall = 3.980 (In)

Rainfall depth area reduction factors:

Using a total area of 2.94 (Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.527 (In)

30-minute factor = 1.000 Adjusted rainfall = 0.901 (In)

1-hour factor = 1.000 Adjusted rainfall = 1.110 (In)

3-hour factor = 1.000 Adjusted rainfall = 1.688 (In)

6-hour factor = 1.000 Adjusted rainfall = 2.200 (In)

24-hour factor = 1.000 Adjusted rainfall = 3.980 (In)

Unit Hydrograph

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Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
--------------------	--------------------------	--------------------------

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(K = 35.56 (CFS))

1	3.372	1.199
2	24.993	7.687
3	55.911	10.993
4	70.372	5.142
5	78.696	2.960
6	84.173	1.947
7	88.213	1.437
8	91.030	1.002
9	93.247	0.788
10	94.947	0.604
11	96.280	0.474
12	97.287	0.358
13	97.966	0.241
14	98.449	0.172
15	98.991	0.193
16	99.493	0.179
17	99.802	0.110
18	100.000	0.071

Total soil rain loss = 1.33 (In)
Total effective rainfall = 2.65 (In)
Peak flow rate in flood hydrograph = 6.76 (CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time (h+m)	Volume	Ac.Ft	Q (CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000	0.00	Q					
0+10	0.0003	0.03	Q					
0+15	0.0007	0.07	Q					
0+20	0.0014	0.09	Q					
0+25	0.0021	0.10	Q					
0+30	0.0028	0.11	Q					
0+35	0.0036	0.11	Q					
0+40	0.0044	0.12	Q					
0+45	0.0053	0.12	Q					
0+50	0.0061	0.12	Q					
0+55	0.0070	0.13	Q					
1+ 0	0.0079	0.13	Q					
1+ 5	0.0088	0.13	Q					
1+10	0.0097	0.13	Q					
1+15	0.0106	0.13	Q					

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1+20	0.0115	0.13	Q				
1+25	0.0124	0.13	Q				
1+30	0.0134	0.13	Q				
1+35	0.0143	0.13	Q				
1+40	0.0152	0.14	Q				
1+45	0.0162	0.14	Q				
1+50	0.0171	0.14	QV				
1+55	0.0180	0.14	QV				
2+ 0	0.0190	0.14	QV				
2+ 5	0.0199	0.14	QV				
2+10	0.0209	0.14	QV				
2+15	0.0218	0.14	QV				
2+20	0.0228	0.14	QV				
2+25	0.0238	0.14	QV				
2+30	0.0247	0.14	QV				
2+35	0.0257	0.14	QV				
2+40	0.0267	0.14	QV				
2+45	0.0276	0.14	QV				
2+50	0.0286	0.14	QV				
2+55	0.0296	0.14	QV				
3+ 0	0.0306	0.14	QV				
3+ 5	0.0316	0.14	QV				
3+10	0.0326	0.14	Q V				
3+15	0.0336	0.14	Q V				
3+20	0.0346	0.15	Q V				
3+25	0.0356	0.15	Q V				
3+30	0.0366	0.15	Q V				
3+35	0.0376	0.15	Q V				
3+40	0.0386	0.15	Q V				
3+45	0.0396	0.15	Q V				
3+50	0.0406	0.15	Q V				
3+55	0.0417	0.15	Q V				
4+ 0	0.0427	0.15	Q V				
4+ 5	0.0437	0.15	Q V				
4+10	0.0448	0.15	Q V				
4+15	0.0458	0.15	Q V				
4+20	0.0468	0.15	Q V				
4+25	0.0479	0.15	Q V				
4+30	0.0489	0.15	Q V				
4+35	0.0500	0.15	Q V				
4+40	0.0511	0.15	Q V				
4+45	0.0521	0.15	Q V				
4+50	0.0532	0.16	Q V				
4+55	0.0543	0.16	Q V				
5+ 0	0.0554	0.16	Q V				
5+ 5	0.0564	0.16	Q V				
5+10	0.0575	0.16	Q V				
5+15	0.0586	0.16	Q V				
5+20	0.0597	0.16	Q V				
5+25	0.0608	0.16	Q V				
5+30	0.0619	0.16	Q V				

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5+35	0.0631	0.16	Q	V					
5+40	0.0642	0.16	Q	V					
5+45	0.0653	0.16	Q	V					
5+50	0.0664	0.16	Q	V					
5+55	0.0676	0.16	Q	V					
6+ 0	0.0687	0.17	Q	V					
6+ 5	0.0698	0.17	Q	V					
6+10	0.0710	0.17	Q	V					
6+15	0.0721	0.17	Q	V					
6+20	0.0733	0.17	Q	V					
6+25	0.0745	0.17	Q	V					
6+30	0.0756	0.17	Q	V					
6+35	0.0768	0.17	Q	V					
6+40	0.0780	0.17	Q	V					
6+45	0.0792	0.17	Q	V					
6+50	0.0804	0.17	Q	V					
6+55	0.0816	0.17	Q	V					
7+ 0	0.0828	0.18	Q	V					
7+ 5	0.0840	0.18	Q	V					
7+10	0.0852	0.18	Q	V					
7+15	0.0865	0.18	Q	V					
7+20	0.0877	0.18	Q	V					
7+25	0.0889	0.18	Q	V					
7+30	0.0902	0.18	Q	V					
7+35	0.0914	0.18	Q	V					
7+40	0.0927	0.18	Q	V					
7+45	0.0940	0.18	Q	V					
7+50	0.0952	0.18	Q	V					
7+55	0.0965	0.19	Q	V					
8+ 0	0.0978	0.19	Q	V					
8+ 5	0.0991	0.19	Q	V					
8+10	0.1004	0.19	Q	V					
8+15	0.1017	0.19	Q	V					
8+20	0.1030	0.19	Q	V					
8+25	0.1044	0.19	Q	V					
8+30	0.1057	0.19	Q	V					
8+35	0.1070	0.20	Q	V					
8+40	0.1084	0.20	Q	V					
8+45	0.1097	0.20	Q	V					
8+50	0.1111	0.20	Q	V					
8+55	0.1125	0.20	Q	V					
9+ 0	0.1139	0.20	Q	V					
9+ 5	0.1153	0.20	Q	V					
9+10	0.1167	0.20	Q	V					
9+15	0.1181	0.21	Q	V					
9+20	0.1195	0.21	Q	V					
9+25	0.1210	0.21	Q	V					
9+30	0.1224	0.21	Q	V					
9+35	0.1238	0.21	Q	V					
9+40	0.1253	0.21	Q	V					
9+45	0.1268	0.21	Q	V					

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9+50	0.1283	0.22	Q	V					
9+55	0.1298	0.22	Q	V					
10+ 0	0.1313	0.22	Q	V					
10+ 5	0.1328	0.22	Q	V					
10+10	0.1343	0.22	Q	V					
10+15	0.1359	0.22	Q	V					
10+20	0.1374	0.23	Q	V					
10+25	0.1390	0.23	Q	V					
10+30	0.1406	0.23	Q	V					
10+35	0.1422	0.23	Q	V					
10+40	0.1438	0.23	Q	V					
10+45	0.1454	0.24	Q	V					
10+50	0.1470	0.24	Q	V					
10+55	0.1487	0.24	Q	V					
11+ 0	0.1503	0.24	Q	V					
11+ 5	0.1520	0.24	Q	V					
11+10	0.1537	0.25	Q	V					
11+15	0.1554	0.25	Q	V					
11+20	0.1571	0.25	IQ	V					
11+25	0.1589	0.25	IQ	V					
11+30	0.1607	0.26	IQ	V					
11+35	0.1624	0.26	IQ	V					
11+40	0.1642	0.26	IQ	V					
11+45	0.1660	0.26	IQ	V					
11+50	0.1679	0.27	IQ	V					
11+55	0.1697	0.27	IQ	V					
12+ 0	0.1716	0.27	IQ	V					
12+ 5	0.1735	0.27	IQ	V					
12+10	0.1754	0.27	IQ	V					
12+15	0.1772	0.26	IQ	V					
12+20	0.1790	0.26	IQ	V					
12+25	0.1808	0.26	IQ	V					
12+30	0.1826	0.27	IQ	V					
12+35	0.1845	0.27	IQ	V					
12+40	0.1864	0.27	IQ	V					
12+45	0.1882	0.27	IQ	V					
12+50	0.1902	0.28	IQ	V					
12+55	0.1921	0.28	IQ	V					
13+ 0	0.1941	0.29	IQ	V					
13+ 5	0.1961	0.29	IQ	V					
13+10	0.1981	0.29	IQ	V					
13+15	0.2002	0.30	IQ	V					
13+20	0.2022	0.30	IQ	V					
13+25	0.2044	0.31	IQ	V					
13+30	0.2066	0.32	IQ	V					
13+35	0.2088	0.32	IQ	V					
13+40	0.2110	0.33	IQ	V					
13+45	0.2133	0.33	IQ	V					
13+50	0.2157	0.34	IQ	V					
13+55	0.2181	0.35	IQ	V					
14+ 0	0.2205	0.36	IQ	V					

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14+ 5	0.2230	0.36	Q			V				
14+10	0.2256	0.37	Q			V				
14+15	0.2282	0.38	Q			V				
14+20	0.2309	0.39	Q			V				
14+25	0.2337	0.40	Q			V				
14+30	0.2365	0.41	Q			V				
14+35	0.2395	0.43	Q			V				
14+40	0.2425	0.44	Q			V				
14+45	0.2456	0.45	Q			V				
14+50	0.2489	0.47	Q			V				
14+55	0.2522	0.49	Q			V				
15+ 0	0.2557	0.51	Q			V				
15+ 5	0.2593	0.53	Q			V				
15+10	0.2631	0.55	Q			V				
15+15	0.2671	0.58	Q			V				
15+20	0.2713	0.61	Q			V				
15+25	0.2757	0.64	Q			V				
15+30	0.2802	0.65	Q			V				
15+35	0.2846	0.64	Q			V				
15+40	0.2892	0.68	Q			V				
15+45	0.2943	0.74	Q			V				
15+50	0.3000	0.83	Q			V				
15+55	0.3067	0.98	Q			V				
16+ 0	0.3158	1.32	Q			V				
16+ 5	0.3326	2.43	Q			V				
16+10	0.3710	5.58	Q			V				
16+15	0.4176	6.76					V	Q		
16+20	0.4439	3.83				Q		V		
16+25	0.4616	2.56			Q			V		
16+30	0.4748	1.93			Q			V		
16+35	0.4858	1.59			Q			V		
16+40	0.4947	1.29			Q			V		
16+45	0.5023	1.11			Q			V		
16+50	0.5089	0.96			Q			V		
16+55	0.5146	0.83			Q			V		
17+ 0	0.5197	0.73	Q					V		
17+ 5	0.5240	0.63	Q					V		
17+10	0.5279	0.57	Q					V		
17+15	0.5317	0.55	Q					V		
17+20	0.5352	0.51	Q					V		
17+25	0.5383	0.45	Q					V		
17+30	0.5410	0.41	Q					V		
17+35	0.5435	0.35	Q					V		
17+40	0.5458	0.34	Q					V		
17+45	0.5480	0.32	Q					V		
17+50	0.5502	0.31	Q					V		
17+55	0.5522	0.30	Q					V		
18+ 0	0.5542	0.29	Q					V		
18+ 5	0.5562	0.28	Q					V		
18+10	0.5581	0.28	Q					V		
18+15	0.5601	0.28	Q					V		

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18+20	0.5620	0.28	IQ				V	
18+25	0.5639	0.27	IQ				V	
18+30	0.5657	0.27	IQ				V	
18+35	0.5675	0.26	IQ				V	
18+40	0.5693	0.26	IQ				V	
18+45	0.5711	0.26	IQ				V	
18+50	0.5728	0.25	IQ				V	
18+55	0.5745	0.25	Q				V	
19+ 0	0.5762	0.24	Q				V	
19+ 5	0.5778	0.24	Q				V	
19+10	0.5794	0.23	Q				V	
19+15	0.5810	0.23	Q				V	
19+20	0.5826	0.23	Q				V	
19+25	0.5841	0.22	Q				V	
19+30	0.5856	0.22	Q				V	
19+35	0.5871	0.22	Q				V	
19+40	0.5886	0.21	Q				V	
19+45	0.5901	0.21	Q				V	
19+50	0.5915	0.21	Q				V	
19+55	0.5929	0.20	Q				V	
20+ 0	0.5943	0.20	Q				V	
20+ 5	0.5957	0.20	Q				V	
20+10	0.5970	0.20	Q				V	
20+15	0.5984	0.19	Q				V	
20+20	0.5997	0.19	Q				V	
20+25	0.6010	0.19	Q				V	
20+30	0.6023	0.19	Q				V	
20+35	0.6036	0.19	Q				V	
20+40	0.6048	0.18	Q				V	
20+45	0.6061	0.18	Q				V	
20+50	0.6073	0.18	Q				V	
20+55	0.6085	0.18	Q				V	
21+ 0	0.6097	0.18	Q				V	
21+ 5	0.6109	0.17	Q				V	
21+10	0.6121	0.17	Q				V	
21+15	0.6133	0.17	Q				V	
21+20	0.6145	0.17	Q				V	
21+25	0.6156	0.17	Q				V	
21+30	0.6168	0.17	Q				V	
21+35	0.6179	0.16	Q				V	
21+40	0.6190	0.16	Q				V	
21+45	0.6201	0.16	Q				V	
21+50	0.6212	0.16	Q				V	
21+55	0.6223	0.16	Q				V	
22+ 0	0.6234	0.16	Q				V	
22+ 5	0.6245	0.16	Q				V	
22+10	0.6255	0.15	Q				V	
22+15	0.6266	0.15	Q				V	
22+20	0.6276	0.15	Q				V	
22+25	0.6287	0.15	Q				V	
22+30	0.6297	0.15	Q				V	

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22+35	0.6307	0.15	Q				V	
22+40	0.6317	0.15	Q				V	
22+45	0.6328	0.15	Q				V	
22+50	0.6338	0.15	Q				V	
22+55	0.6347	0.14	Q				V	
23+ 0	0.6357	0.14	Q				V	
23+ 5	0.6367	0.14	Q				V	
23+10	0.6377	0.14	Q				V	
23+15	0.6387	0.14	Q				V	
23+20	0.6396	0.14	Q				V	
23+25	0.6406	0.14	Q				V	
23+30	0.6415	0.14	Q				V	
23+35	0.6424	0.14	Q				V	
23+40	0.6434	0.14	Q				V	
23+45	0.6443	0.13	Q				V	
23+50	0.6452	0.13	Q				V	
23+55	0.6461	0.13	Q				V	
24+ 0	0.6471	0.13	Q				V	
24+ 5	0.6479	0.13	Q				V	
24+10	0.6486	0.10	Q				V	
24+15	0.6490	0.06	Q				V	
24+20	0.6493	0.04	Q				V	
24+25	0.6495	0.03	Q				V	
24+30	0.6496	0.02	Q				V	
24+35	0.6497	0.02	Q				V	
24+40	0.6498	0.01	Q				V	
24+45	0.6499	0.01	Q				V	
24+50	0.6499	0.01	Q				V	
24+55	0.6499	0.00	Q				V	
25+ 0	0.6500	0.00	Q				V	
25+ 5	0.6500	0.00	Q				V	
25+10	0.6500	0.00	Q				V	
25+15	0.6500	0.00	Q				V	
25+20	0.6500	0.00	Q				V	
25+25	0.6500	0.00	Q				V	

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San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 12/15/14

TT 18980 (east portion)
Postdevelopment Time of Concentration
100 Year Storm Event
tt18980posttce.out

Program License Serial Number 6286

***** Hydrology Study Control Information *****

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.110 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

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+++++
Process from Point/Station 1.000 to Point/Station 3.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(3 - 4 dwl/acre)
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 69.00
Pervious ratio(Ap) = 0.6000 Max loss rate(Fm)= 0.329(In/Hr)
Initial subarea data:
Initial area flow distance = 509.000(Ft.)
Top (of initial area) elevation = 3007.000(Ft.)
Bottom (of initial area) elevation = 2996.000(Ft.)
Difference in elevation = 11.000(Ft.)
Slope = 0.02161 s(%)= 2.16
TC = k(0.412)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.731 min.
Rainfall intensity = 3.703(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff = 8.929(CFS)
Total initial stream area = 2.940(Ac.)
Pervious area fraction = 0.600
Initial area Fm value = 0.329(In/Hr)
End of computations, Total Study Area = 2.94 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.600
Area averaged SCS curve number = 69.0

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U n i t H y d r o g r a p h A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

Study date 12/15/14

+++++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 6286

TT 18980 (east portion)
Postdevelopment Runoff Volume
100 Year Storm Event
tt18980postvole.out

Storm Event Year = 100

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
-------------------	---------------------	-------------------

Rainfall data for year 100		
2.94	1	1.11

Rainfall data for year 100		
2.94	6	2.20

Rainfall data for year 100		
2.94	24	3.98

***** Area-averaged max loss rate, Fm *****

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SCS curve No. (AMCII)	SCS curve NO. (AMC 2)	Area (Ac.)	Area Fraction	Fp (Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
69.0	69.0	2.94	1.000	0.548	0.600	0.329

Area-averaged adjusted loss rate Fm (In/Hr) = 0.329

***** Area-Averaged low loss rate fraction, Yb *****

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
1.76	0.600	69.0	69.0	4.49	0.315
1.18	0.400	98.0	98.0	0.20	0.941

Area-averaged catchment yield fraction, Y = 0.565

Area-averaged low loss fraction, Yb = 0.435

User entry of time of concentration = 0.179 (hours)

+++++

Watershed area = 2.94 (Ac.)

Catchment Lag time = 0.143 hours

Unit interval = 5.000 minutes

Unit interval percentage of lag time = 58.2262

Hydrograph baseflow = 0.00 (CFS)

Average maximum watershed loss rate (Fm) = 0.329 (In/Hr)

Average low loss rate fraction (Yb) = 0.435 (decimal)

DESERT S-Graph Selected

Computed peak 5-minute rainfall = 0.527 (In)

Computed peak 30-minute rainfall = 0.902 (In)

Specified peak 1-hour rainfall = 1.110 (In)

Computed peak 3-hour rainfall = 1.688 (In)

Specified peak 6-hour rainfall = 2.200 (In)

Specified peak 24-hour rainfall = 3.980 (In)

Rainfall depth area reduction factors:

Using a total area of 2.94 (Ac.) (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.527 (In)

30-minute factor = 1.000 Adjusted rainfall = 0.901 (In)

1-hour factor = 1.000 Adjusted rainfall = 1.110 (In)

3-hour factor = 1.000 Adjusted rainfall = 1.688 (In)

6-hour factor = 1.000 Adjusted rainfall = 2.200 (In)

24-hour factor = 1.000 Adjusted rainfall = 3.980 (In)

Unit Hydrograph

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Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
--------------------	--------------------------	--------------------------

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(K = 35.56 (CFS))

1	5.258	1.870
2	39.665	12.234
3	66.925	9.693
4	78.578	4.143
5	85.388	2.421
6	89.881	1.597
7	92.925	1.082
8	95.131	0.784
9	96.728	0.568
10	97.785	0.376
11	98.442	0.234
12	99.135	0.247
13	99.674	0.192
14	100.000	0.116

Total soil rain loss = 1.49 (In)
Total effective rainfall = 2.49 (In)
Peak flow rate in flood hydrograph = 7.52 (CFS)

+++++
24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time (h+m)	Volume	Ac.Ft	Q (CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000		0.01 Q					
0+10	0.0004		0.05 Q					
0+15	0.0009		0.08 Q					
0+20	0.0016		0.09 Q					
0+25	0.0023		0.10 Q					
0+30	0.0030		0.11 Q					
0+35	0.0038		0.11 Q					
0+40	0.0046		0.11 Q					
0+45	0.0054		0.12 Q					
0+50	0.0062		0.12 Q					
0+55	0.0070		0.12 Q					
1+ 0	0.0078		0.12 Q					
1+ 5	0.0087		0.12 Q					
1+10	0.0095		0.12 Q					
1+15	0.0104		0.12 Q					
1+20	0.0112		0.12 Q					
1+25	0.0121		0.12 Q					
1+30	0.0129		0.12 Q					
1+35	0.0138		0.12 Q					

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1+40	0.0147	0.13	Q				
1+45	0.0155	0.13	QV				
1+50	0.0164	0.13	QV				
1+55	0.0173	0.13	QV				
2+ 0	0.0181	0.13	QV				
2+ 5	0.0190	0.13	QV				
2+10	0.0199	0.13	QV				
2+15	0.0208	0.13	QV				
2+20	0.0217	0.13	QV				
2+25	0.0226	0.13	QV				
2+30	0.0234	0.13	QV				
2+35	0.0243	0.13	QV				
2+40	0.0252	0.13	QV				
2+45	0.0261	0.13	QV				
2+50	0.0270	0.13	QV				
2+55	0.0279	0.13	QV				
3+ 0	0.0289	0.13	QV				
3+ 5	0.0298	0.13	QV				
3+10	0.0307	0.13	Q V				
3+15	0.0316	0.13	Q V				
3+20	0.0325	0.13	Q V				
3+25	0.0335	0.13	Q V				
3+30	0.0344	0.14	Q V				
3+35	0.0353	0.14	Q V				
3+40	0.0363	0.14	Q V				
3+45	0.0372	0.14	Q V				
3+50	0.0381	0.14	Q V				
3+55	0.0391	0.14	Q V				
4+ 0	0.0400	0.14	Q V				
4+ 5	0.0410	0.14	Q V				
4+10	0.0420	0.14	Q V				
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4+25	0.0449	0.14	Q V				
4+30	0.0458	0.14	Q V				
4+35	0.0468	0.14	Q V				
4+40	0.0478	0.14	Q V				
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4+50	0.0498	0.14	Q V				
4+55	0.0508	0.14	Q V				
5+ 0	0.0518	0.15	Q V				
5+ 5	0.0528	0.15	Q V				
5+10	0.0538	0.15	Q V				
5+15	0.0548	0.15	Q V				
5+20	0.0558	0.15	Q V				
5+25	0.0568	0.15	Q V				
5+30	0.0579	0.15	Q V				
5+35	0.0589	0.15	Q V				
5+40	0.0599	0.15	Q V				
5+45	0.0610	0.15	Q V				
5+50	0.0620	0.15	Q V				

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5+55	0.0631	0.15	Q	V					
6+ 0	0.0641	0.15	Q	V					
6+ 5	0.0652	0.15	Q	V					
6+10	0.0662	0.15	Q	V					
6+15	0.0673	0.16	Q	V					
6+20	0.0684	0.16	Q	V					
6+25	0.0695	0.16	Q	V					
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6+50	0.0749	0.16	Q	V					
6+55	0.0760	0.16	Q	V					
7+ 0	0.0772	0.16	Q	V					
7+ 5	0.0783	0.16	Q	V					
7+10	0.0794	0.16	Q	V					
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7+55	0.0899	0.17	Q	V					
8+ 0	0.0911	0.17	Q	V					
8+ 5	0.0923	0.17	Q	V					
8+10	0.0935	0.18	Q	V					
8+15	0.0947	0.18	Q	V					
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8+25	0.0971	0.18	Q	V					
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9+35	0.1152	0.20	Q	V					
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10+ 5	0.1235	0.20	Q	V					

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10+10	0.1249	0.21	Q	V					
10+15	0.1263	0.21	Q	V					
10+20	0.1278	0.21	Q	V					
10+25	0.1292	0.21	Q	V					
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10+50	0.1367	0.22	Q	V					
10+55	0.1382	0.22	Q	V					
11+ 0	0.1397	0.22	Q	V					
11+ 5	0.1413	0.23	Q	V					
11+10	0.1429	0.23	Q	V					
11+15	0.1445	0.23	Q	V					
11+20	0.1461	0.23	Q	V					
11+25	0.1477	0.23	Q	V					
11+30	0.1493	0.24	Q	V					
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12+20	0.1663	0.24	Q	V					
12+25	0.1680	0.24	Q	V					
12+30	0.1697	0.25	Q	V					
12+35	0.1714	0.25	Q	V					
12+40	0.1731	0.25	Q	V					
12+45	0.1749	0.25	Q	V					
12+50	0.1766	0.26	Q	V					
12+55	0.1784	0.26	Q	V					
13+ 0	0.1803	0.27	Q	V					
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13+10	0.1840	0.27	Q	V					
13+15	0.1859	0.28	Q	V					
13+20	0.1879	0.28	Q	V					
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14+10	0.2097	0.35	Q	V					
14+15	0.2122	0.36	Q	V					
14+20	0.2147	0.37	Q	V					

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14+25	0.2173	0.38	Q			V			
14+30	0.2200	0.39	Q			V			
14+35	0.2227	0.40	Q			V			
14+40	0.2256	0.41	Q			V			
14+45	0.2285	0.43	Q			V			
14+50	0.2316	0.44	Q			V			
14+55	0.2347	0.46	Q			V			
15+ 0	0.2380	0.48	Q			V			
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15+10	0.2451	0.52	Q			V			
15+15	0.2489	0.55	Q			V			
15+20	0.2529	0.58	Q			V			
15+25	0.2570	0.61	Q			V			
15+30	0.2612	0.60	Q			V			
15+35	0.2653	0.60	Q			V			
15+40	0.2698	0.65	Q			V			
15+45	0.2747	0.71	Q			V			
15+50	0.2802	0.81	Q			V			
15+55	0.2870	0.98	Q			V			
16+ 0	0.2968	1.43	Q			V			
16+ 5	0.3170	2.93	Q		Q	V			
16+10	0.3687	7.52					V	Q	
16+15	0.4101	6.01					Q	V	
16+20	0.4320	3.18				Q		V	
16+25	0.4468	2.14			Q			V	
16+30	0.4580	1.63			Q			V	
16+35	0.4669	1.30			Q			V	
16+40	0.4743	1.07			Q			V	
16+45	0.4805	0.89			Q			V	
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17+ 0	0.4940	0.59	Q					V	
17+ 5	0.4977	0.53	Q					V	
17+10	0.5009	0.46	Q					V	
17+15	0.5035	0.38	Q					V	
17+20	0.5059	0.36	Q					V	
17+25	0.5083	0.34	Q					V	
17+30	0.5105	0.32	Q					V	
17+35	0.5126	0.31	Q					V	
17+40	0.5147	0.30	Q					V	
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17+50	0.5186	0.28	Q					V	
17+55	0.5204	0.27	Q					V	
18+ 0	0.5222	0.26	Q					V	
18+ 5	0.5240	0.25	Q					V	
18+10	0.5257	0.26	Q					V	
18+15	0.5275	0.26	Q					V	
18+20	0.5292	0.25	Q					V	
18+25	0.5310	0.25	Q					V	
18+30	0.5327	0.25	Q					V	
18+35	0.5343	0.24	Q					V	

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18+40	0.5360	0.24	Q				V	
18+45	0.5376	0.23	Q				V	
18+50	0.5391	0.23	Q				V	
18+55	0.5407	0.22	Q				V	
19+ 0	0.5422	0.22	Q				V	
19+ 5	0.5437	0.22	Q				V	
19+10	0.5452	0.21	Q				V	
19+15	0.5466	0.21	Q				V	
19+20	0.5480	0.21	Q				V	
19+25	0.5494	0.20	Q				V	
19+30	0.5508	0.20	Q				V	
19+35	0.5522	0.20	Q				V	
19+40	0.5535	0.19	Q				V	
19+45	0.5548	0.19	Q				V	
19+50	0.5561	0.19	Q				V	
19+55	0.5574	0.19	Q				V	
20+ 0	0.5587	0.18	Q				V	
20+ 5	0.5599	0.18	Q				V	
20+10	0.5612	0.18	Q				V	
20+15	0.5624	0.18	Q				V	
20+20	0.5636	0.18	Q				V	
20+25	0.5648	0.17	Q				V	
20+30	0.5660	0.17	Q				V	
20+35	0.5672	0.17	Q				V	
20+40	0.5683	0.17	Q				V	
20+45	0.5695	0.17	Q				V	
20+50	0.5706	0.16	Q				V	
20+55	0.5717	0.16	Q				V	
21+ 0	0.5728	0.16	Q				V	
21+ 5	0.5739	0.16	Q				V	
21+10	0.5750	0.16	Q				V	
21+15	0.5761	0.16	Q				V	
21+20	0.5771	0.15	Q				V	
21+25	0.5782	0.15	Q				V	
21+30	0.5792	0.15	Q				V	
21+35	0.5803	0.15	Q				V	
21+40	0.5813	0.15	Q				V	
21+45	0.5823	0.15	Q				V	
21+50	0.5833	0.15	Q				V	
21+55	0.5843	0.15	Q				V	
22+ 0	0.5853	0.14	Q				V	
22+ 5	0.5863	0.14	Q				V	
22+10	0.5873	0.14	Q				V	
22+15	0.5882	0.14	Q				V	
22+20	0.5892	0.14	Q				V	
22+25	0.5902	0.14	Q				V	
22+30	0.5911	0.14	Q				V	
22+35	0.5920	0.14	Q				V	
22+40	0.5930	0.14	Q				V	
22+45	0.5939	0.13	Q				V	
22+50	0.5948	0.13	Q				V	

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22+55	0.5957	0.13	Q				V
23+ 0	0.5966	0.13	Q				V
23+ 5	0.5975	0.13	Q				V
23+10	0.5984	0.13	Q				V
23+15	0.5993	0.13	Q				V
23+20	0.6002	0.13	Q				V
23+25	0.6011	0.13	Q				V
23+30	0.6019	0.13	Q				V
23+35	0.6028	0.13	Q				V
23+40	0.6037	0.12	Q				V
23+45	0.6045	0.12	Q				V
23+50	0.6053	0.12	Q				V
23+55	0.6062	0.12	Q				V
24+ 0	0.6070	0.12	Q				V
24+ 5	0.6078	0.11	Q				V
24+10	0.6083	0.07	Q				V
24+15	0.6086	0.04	Q				V
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24+35	0.6090	0.01	Q				V
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24+55	0.6091	0.00	Q				V
25+ 0	0.6091	0.00	Q				V
25+ 5	0.6091	0.00	Q				V

ATTACHMENT E

WQMP Agreement

(to be Provided in Final Specific WQMP)

RECORDING REQUESTED BY:

City of Victorville
Engineering Department

AND WHEN RECORDED MAIL TO:

City of Victorville
Engineering Department
14343 Civic Drive
Victorville, CA 92392

SPACE ABOVE THIS LINE FOR RECORDER'S USE

AGREEMENT

THIS PAGE ADDED TO PROVIDE ADEQUATE SPACE FOR RECORDING INFORMATION

**Water Quality Management Plan and Stormwater Best Management Practices
Transfer, Access and Maintenance Agreement**

OWNER NAME: _____

PROPERTY ADDRESS: _____

APN: _____

THIS AGREEMENT is made and entered into in

_____, California, this _____ day of

_____, by and between

_____, hereinafter

referred to as Owner, and the CITY OF VICTORVILLE, a municipal corporation, located in the County of San Bernardino, State of California, hereinafter referred to as CITY;

WHEREAS, the Owner owns real property ("Property") in the City of Victorville, State of California, more specifically described in Exhibit "A" and depicted in Exhibit "B", each of which exhibits is attached hereto and incorporated herein by this reference;

WHEREAS, at the time of initial approval of development project known as

_____ within the Property described herein, the CITY required the project to employ Best Management Practices, hereinafter referred to as "BMPs," to minimize pollutants in urban runoff;

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the CITY, hereinafter referred to as "WQMP", to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff;

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the City;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. All maintenance or replacement of BMPs proposed as part of the WQMP are the sole responsibility of the Owner in accordance with the terms of this Agreement.
2. Owner hereby provides the City of Victorville's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by the City's Director of Public Works, no advance notice, for the purpose of inspection, sampling, testing of the Device, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 3 below. The City shall make every effort at all times to minimize or avoid interference with Owner's use of the Property. Denial of access to any premises or facility that contains WQMP features is a violation of the City Stormwater Ordinance. If there is reasonable cause to believe that an illicit discharge or breach of the WQMP operation and maintenance commitments is occurring on the premises then the authorized enforcement agency may seek issuance of a search warrant from any court of competent jurisdiction in addition to other enforcement actions.
3. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.
4. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the City, the City is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense against the property and/or to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the City Code from the date of the notice of expense until paid in full.
5. The City may require the owner to post security in form and for a time period satisfactory to the City to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under the Agreement, the City may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of the Agreement. As an additional remedy, the Director of Public Works may withdraw any previous stormwater-related approval with respect to the property on which BMPs have been installed and/or implemented until such time as Owner repays to City its reasonable costs incurred in accordance with paragraph 3 above.

6. This agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.
7. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to hold the City harmless and pay all costs incurred by the City in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.
8. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.
9. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.
10. Time is of the essence in the performance of this Agreement.
11. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.
12. The Owner its successors and assigns, hereby agrees to save and hold harmless the City, any of its departments, agencies, officers or employees, all of whom while working within their respective authority, from all cost, injury and damage incurred by any of the above, and from any other injury or damage to any person or property whatsoever, any of which is caused by an activity, condition or event arising out of the performance, preparation for performance or nonperformance of any provision of this agreement by the Owner, its agents, or any of its independent contractors.

IF TO CITY:

City of Victorville – Engineering Department

14343 Civic Drive,

Victorville, CA 92392

IF TO OWNER:

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

OWNER:

Signature: _____

Name: _____

Title: _____

OWNER:

Signature: _____

Name: _____

Title: _____

NOTARIES ON FOLLOWING PAGE

A notary acknowledgement is required for recordation (attach appropriate acknowledgement).

ACCEPTED BY:

Brian W. Gengler., City Engineer for City of Victorville

Date: _____

Attachment: Standard Notary Acknowledgement

EXHIBIT A
(Legal Description)

EXHIBIT B
(Map/illustration)

ATTACHMENT F

EDUCATIONAL MATERIALS

Stormwater Pollution Prevention

*Best Management Practices for Homeowner's Associations,
Property Managers and Property Owners*



*Your Guide To Maintaining Water
Friendly Standards In Your Community*

sbcountystormwater.org

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

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Hazardous Waste	2
Working Outdoors & Handling Spills	4
Commercial Landscape	5
Sidewalk, Plaza, Entry Monument & Fountain Maintenance	6
Equipment Maintenance & Repair	10
Pool Maintenance	14
Paint	16
Vehicle Maintenance	17
Pet Waste Disposal	18
Get In Touch With Us Online	19

COMMERCIAL TRASH ENCLOSURES

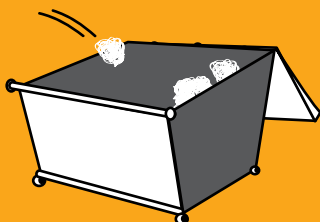
FOLLOW THESE REQUIREMENTS TO KEEP OUR WATERWAYS CLEAN

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility.

These materials are NOT meant to go into our local lakes and rivers.

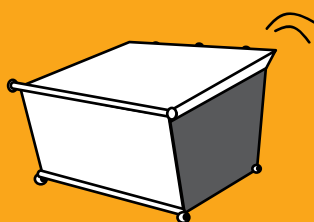
PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



Place trash inside the bin
(preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering
the bin in order to avoid
leakage of polluted water
runoff

KEEP TOXICS OUT



- Paint
- Grease, fats and used oils
- Batteries, electronics
and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ SWEEP FREQUENTLY

Sweep trash enclosure areas
frequently, instead of hosing
them down, to prevent polluted
water from flowing into the
streets and storm drains.

✓ FIX LEAKS

Address trash bin leaks
immediately by using dry clean
up methods and report to your
waste hauler to receive a
replacement.

✓ CONSTRUCT ROOF

Construct a solid cover roof over the
existing trash enclosure structure to
prevent rainwater from coming into
contact with trash and garbage.
Check with your local City/County
for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!



In the event of a spill or discharge to a storm drain or waterway, contact San Bernardino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

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HAZARDOUS WASTE

CESQG PROGRAM

Conditionally Exempt Small Quantity Generator

WHAT IS A CESQG?

Businesses that generate 27 gallons or 220 lbs. of hazardous waste, or 2.2 lbs. of extremely hazardous waste per month are called "Conditionally Exempt Small Quantity Generators," or CESQGs. San Bernardino County Household Hazardous Program provides waste management services to CESQG businesses. The most common CESQGs in San Bernardino County are painters, print shops, auto shops, builders, agricultural operators and property managers, but there are many others. When you call, be ready to describe the types and amounts of waste your business generates in a typical month. If you generate hazardous waste on a regular basis, you must:

- Register with San Bernardino County Fire Department (909) 386-8401 as a hazardous waste generator.
- To obtain an EPA ID# and application form from the State visit www.dtsc.ca.gov.
- Manage hazardous waste in accordance with all applicable local, state and federal laws and regulations.

HOW DO I GET SERVICE?

To arrange an appointment for the CESQG Program, call 1-800-OILY CAT or 909-382-5401. Be ready to describe the type and amount of hazardous waste your business is ready to dispose of, and the types and size(s) of containers that the waste is in.

Waste Type and Cost

There is a small handling fee involved in the collection of hazardous waste from your business. Disposal costs depend on the type of waste.

Aerosols	\$1.29/lb.
Automobile motor oil	\$.73/gal.
Anti-freeze	\$1.57/gal.
Contaminated oil	\$4.48/gal.
Car batteries	\$.62/ea.
Corrosive liquids, solids	\$2.80/lb.
Flammable solids, liquids	\$1.57/lb.
Latex Paint	\$.73/lb.
Mercury	\$10.08/lb.
NiCad/Alkaline Batteries	\$2.13/lb.
Oil Base Paints	\$1.00/lb.
Oil Filters	\$.56/ea.
Oxidizers	\$9.63/lb.
PCB Ballasts	\$5.94/lb.
Pesticides (most)	\$2.91/lb.
Photofixer, developer	\$4.31/gal.
Television & Monitors	\$11.20/ea.
Additional Handling	\$138.00/hr.

Rates subject to change without notice

WE CANNOT ACCEPT

- * Radioactives
- * Water reactives
- * Explosives
- * Compressed gas cylinders
- * Medical or biohazardous waste
- * Asbestos
- * Remediation wastes



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HAZARDOUS WASTE

WHY IS THE FIRE DEPARTMENT COLLECTING HAZARDOUS WASTE?

Small Quantity Generators often have difficulty disposing of small quantities of hazardous waste. Hazardous waste companies usually have a minimum amount of waste that they will pick up, or charge a minimum fee for service. Typically, the minimum fee exceeds the cost of disposal for the hazardous waste. This leaves the small quantity generator in a difficult situation. Some respond by storing hazardous waste until it becomes economical for the hazardous waste transporter to pick it up, putting the business out of compliance by exceeding regulatory accumulation time limits. Other businesses simply store their hazardous wastes indefinitely, creating an unsafe work environment and exceeding accumulation time limits. Yet other businesses attempt to illegally dispose of their waste at household hazardous waste collection facilities. These facilities are not legally permitted to accept commercial wastes, nor are prepared to provide legal documentation for commercial hazardous waste disposal. In answer to the problems identified above, the San Bernardino County Fire Department Household Hazardous Program instituted the Conditionally Exempt Small Quantity Generator Program.

PAYMENT FOR SERVICES

The CESQG Program will prepare an invoice for your business at the time of service. You can pay at the time of service with cash or a check, or you can mail your payment to the Fire Department within 30 days. Please note that we do not accept credit card payments. The preferred method of payment is to handle payment at time of service. Additional charges may apply for accounts not paid within 30 days.

ARE THERE ANY OTHER WAYS THAT I CAN SAVE MONEY ON HAZARDOUS WASTE DISPOSAL?

Yes! First, start by reducing the amount of waste that you produce by changing processes or process chemicals, at your business. Next, examine if there is a way that you can recycle your waste back into your processes. Network with similar businesses or trade associations for waste minimization and pollution prevention solutions.

WHAT IF YOUR BUSINESS DOES NOT QUALIFY?

Call the San Bernardino County Fire Department Field Services Division for assistance with hazardous waste management at 909-386-8401. If you reduce the amount of waste you generate each month to 27 gallons or less, you may qualify in the future.

WHAT HAPPENS TO YOUR HAZARDOUS WASTE?

Hazardous waste collected by the CESQG Program is transported to a state permitted processing facility in San Bernardino. The waste is further processed at this point and packaged for off-site recycling (oil filters, oil, latex paint, antifreeze, and batteries) or destructive incineration (pesticides, corrosives, flammables, oil based paint).

San Bernardino County Fire Department
CESQG Program
2824 East "W" Street
San Bernardino, CA 92415-0799
Phone: 909-382-5401
Fax: 909-382-5413
www.sbcfire.org/hazmat/hhw.asp
Email: jschwab@sbcfire.org



In the event of a spill or discharge to a storm drain or waterway, contact San Bernardino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

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WORKING OUTDOORS & HANDLING SPILLS

WHEN WORKING OUTDOORS USE THE 3Cs

CUANDO TRABAJE AL AIRE LIBRE UTILICE LAS 3Cs

CONTROL | CONTROL



Locate the nearest storm drain and ensure nothing can enter or be discharged into it.

Ubique el desagüe de aguas pluviales más cercano y asegúrese de que nada pueda ingresar a éste ni descargarse en él.

CONTAIN | CONTENER



Isolate your area to prevent material from potentially flowing or being blown away.

Aísle su área para evitar que el material pueda discurrirse o ser llevado por el viento.

CAPTURE | CAPTURAR



Sweep up debris and place it in the trash. Clean up spills with an absorbent material (e.g. kitty litter) or vacuum with a Wet-Vac and dispose of properly.

Recoja los restos y colóquelos en la basura. Limpie los derrames con un material absorbente (como la arena para gatos) o aspírelos con una Wet-Vac (aspiradora de humedad) y deséchelos correctamente.

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COMMERCIAL LANDSCAPE

DISCHARGE TO THE STORM DRAIN, **ACCIDENTAL OR NOT**, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE



- ✓ Recycle leaves, grass clippings and other yard waste.
- ✓ Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- ✓ **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

For more information, please visit:
www.calrecycle.ca.gov/organics/grasscycling

USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY



- ✓ Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- ✓ If you must use chemical fertilizers, herbicides or pesticides:
 - Spot apply, rather than blanketing entire areas.
 - Avoid applying near curbs and driveways, and **never** before a rain.
 - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
 - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

USE WATER WISELY



- ✓ Control the amount of water and direction of sprinklers. Sprinklers should only be on long enough to allow water to soak into the ground, but not so long as to cause runoff.
- ✓ Periodically inspect, fix leaks and realign sprinkler heads.
- ✓ Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

! HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.



Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,
(909) 382-5401 or 1-800-OILY CAT.

*FREE for San Bernardino County residents only. Businesses can call for cost inquiries and to schedule an appointment.



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SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. Fountain water containing chlorine and copperbased algaecides is toxic to aquatic life. Proper inspection, cleaning, and repair of pedestrian areas and HOA owned surfaces and structures can reduce pollutant runoff from these areas. Maintaining these areas may involve one or more of the following activities:

1. Surface Cleaning
2. Graffiti Cleaning
3. Sidewalk Repair
4. Controlling Litter
5. Fountain Maintenance

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for sidewalk, plaza, and fountain maintenance and cleaning include:

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).
- Once per year, educate HOA staff and tenants on pollution prevention measures.

MODEL PROCEDURES:

1. Surface Cleaning

Discharges of wash water to the storm water drainage system from cleaning or hosing of impervious surfaces is prohibited.

Sidewalks, Plazas

- ✓ Use dry methods (e.g. sweeping, backpack blowers, vacuuming) whenever practical to clean sidewalks and plazas rather than hosing, pressure washing, or steam cleaning. DO NOT sweep or blow material into curb; use devices that contain the materials.
- ✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.



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SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

Parking Areas, Driveways, Drive-thru

- ✓ Parking facilities should be swept/vacuumed on a regular basis. Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- ✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.
- ✓ Sweep all parking lots at least once before the onset of the wet season.
- ✓ Use absorbents to pick up oil; then dry sweep.
- ✓ Appropriately dispose of spilled materials and absorbents.

OPTIONAL:

- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc.

Building Surfaces, Decks, etc., without loose paint

- ✓ Use high-pressure water, no soap.
- ✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

Unpainted Building Surfaces, Wood Decks, etc.

- ✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.
- ✓ Use biodegradable cleaning agents to remove deposits.
- ✓ Make sure pH is between 6.5 and 8.5 THEN discharge to landscaping (if cold water without a cleaning agent) otherwise dispose of properly.

2. Graffiti Cleaning

Graffiti Removal

- ✓ Avoid graffiti abatement activities during rain events.
- ✓ When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal in the Roads, Streets, and Highway Operation and Maintenance procedure sheet.
- ✓ Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.



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SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

- ✓ Note that care should be taken when disposing of waste since it may need to be disposed of as hazardous waste.

OPTIONAL:

- Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

3. Sidewalk Repair

Surface Removal and Repair

- ✓ Schedule surface removal activities for dry weather if possible.
- ✓ Avoid creating excess dust when breaking asphalt or concrete.
- ✓ Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up material.
- ✓ Designate an area for clean up and proper disposal of excess materials.
- ✓ Remove and recycle as much of the broken pavement as possible.
- ✓ When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains shovel or vacuum the slurry, remove from site and dispose of properly.
- ✓ Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Discharge wash water to landscaping, pump to the sanitary sewer if permitted to do so or contain and dispose of properly.

Concrete Installation and Repair

- ✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.
- ✓ Wash concrete trucks off-site or in designated areas on-site, such that there is no discharge of concrete wash water into storm drain inlets, open ditches, streets, or other storm water conveyance structures. (See Concrete Waste Management BMP WM – 8)



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SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

- ✓ Store dry and wet concrete materials under cover, protected from rainfall and runoff and away from drainage areas. After job is complete remove temporary stockpiles (asphalt materials, sand, etc.) and other materials as soon as possible.
- ✓ Return leftover materials to the transit mixer. Dispose of small amounts of excess concrete, grout, and mortar in the trash.
- ✓ When washing concrete to remove fine particles and expose the aggregate, contain the wash water for proper disposal.
- ✓ Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stock pile, or dispose in the trash.
- ✓ Protect applications of fresh concrete from rainfall and runoff until the material has hardened.

4. Litter Control

- ✓ Enforce anti-litter laws.
- ✓ Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- ✓ Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.

OPTIONAL:

- Post "No Littering" signs.

5. Fountain Maintenance

- ✓ Do not use copper-based algacides. Control algae with chlorine or other alternatives, such as sodium bromide.
- ✓ Allow chlorine to dissipate for a few days and then recycle/reuse water by draining it gradually onto a landscaped area. Water must be tested prior to discharge to ensure that chlorine is not present (concentration must be less than 0.1 ppm).
- ✓ Contact local agency for approval to drain into sewer or storm drain.
- ✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.



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EQUIPMENT MAINTENANCE & REPAIR

Vehicle or equipment maintenance has the potential to be a significant source of stormwater pollution. Engine repair and service (parts cleaning, spilled fuel, oil, etc.), replacement of fluids, and outdoor equipment storage and parking (dripping engines) can all contaminate stormwater. Conducting the following activities in a controlled manner will reduce the potential for stormwater contamination:

- 1. General Maintenance and Repair**
- 2. Vehicle and Machine Repair**
- 3. Waste Handling/Disposal**

Related vehicle maintenance activities are covered under the following program headings in this manual: “Vehicle and Equipment Cleaning”, “Vehicle and Equipment Storage”, and “Vehicle Fueling”.

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for equipment maintenance and repair include:

- Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Minimize use of solvents. Clean parts without using solvents whenever possible. Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.
- Once per year, educate HOA staff and tenants on pollution prevention measures.



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EQUIPMENT MAINTENANCE & REPAIR

MODEL PROCEDURES:

1. General Maintenance and Repair

General Guidelines

→ Note: Permission must be obtained for any discharge of wash water to the sanitary sewer from the local sewerage agency.

- ✓ Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- ✓ Regularly inspect vehicles and equipment for leaks.
- ✓ Move activity indoors or cover repair area with a permanent roof if feasible.
- ✓ Minimize contact of stormwater with outside operations through berming the local sewerage and drainage routing.
- ✓ Place curbs around the immediate boundaries of the process equipment.
- ✓ Clean yard storm drain inlets regularly and stencil them.

Good Housekeeping

- ✓ Avoid hosing down work areas. If work areas are washed and if discharge to the sanitary sewer is allowed, treat water with an appropriate treatment device (e.g. clarifier) before discharging. If discharge to the sanitary sewer is not permitted, pump water to a tank and dispose of properly.
- ✓ Collect leaking or dripping fluids in drip pans or container. Fluids are easier to recycle or dispose of properly if kept separate.
- ✓ Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, any discharge of or remove other parts. Place a drip pan under any vehicle that might leak while you work on it to keep splatters or drips off the shop floor.
- ✓ Educate employees on proper handling and disposal of engine fluids.
- ✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- ✓ Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- ✓ Post signs at sinks and stencil outdoor storm drain inlets.

2. Vehicle Repair

General Guidelines

- ✓ Perform vehicle fluid removal or changing inside of a building or in a contained covered area, where feasible, to prevent the run-on of stormwater and the runoff of spills.
- ✓ Regularly inspect vehicles and equipment for leaks, and repair as needed.



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EQUIPMENT MAINTENANCE & REPAIR

- ✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
 - ✓ Immediately drain all fluids from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).
 - ✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
 - ✓ Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.
 - ✓ Oil filters disposed of in trash cans or dumpsters can leak oil. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.
 - ✓ Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling facilities or at County hazardous waste disposal site.
-

Vehicle Leak and Spill Control

- ✓ Use absorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- ✓ Place a stockpile of spill cleanup materials where it will be readily accessible.
- ✓ Sweep floor using dry absorbent material.

3. Machine Repair

- ✓ Keep equipment clean; don't allow excessive build-up of oil or grease.
- ✓ Minimize use of solvents.
- ✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- ✓ Perform major equipment repairs at the corporation yard, when practical.
- ✓ Following good housekeeping measures in Vehicle Repair section.

4. Waste Handling/Disposal

Waste Reduction

- ✓ Prevent spills and drips of solvents and cleansers to the shop floor.
- ✓ Do liquid cleaning at a centralized station so the solvents and residues stay in one area. Recycle liquid cleaners when feasible.



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EQUIPMENT MAINTENANCE & REPAIR

- ✓ Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

OPTIONAL:

- If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:
 - Use non-caustic detergents instead of caustic cleaning for parts cleaning.
 - Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.
 - Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.
 - Choose cleaning agents that can be recycled.

Recycling

OPTIONAL:

- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.
- Label and track the recycling of waste material (e.g. used oil, spent solvents, batteries).
- Purchase recycled products to support the market for recycled materials.

LIMITATIONS:

Space and time limitations may preclude all work being conducted indoors. It may not be possible to contain and clean up spills from vehicles/equipment brought on-site after working hours. Dry floor cleaning methods may not be sufficient for some spills – see spill prevention and control procedures sheet. Identification of engine leaks may require some use of solvents.



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POOL MAINTENANCE

Pool chemicals and filter solids, when discharged to the City streets, gutters or storm drains, DO NOT GET TREATED before reaching the Santa Ana River. Chlorine, acid cleaning chemicals and metal-based algaecides used in pools can kill beneficial organisms in the food chain and pollute our drinking water.

When emptying your swimming pool, spa or fountain, please use one of the following best management practices to prevent water pollution:

- Reuse the water as landscape irrigation
- Empty the water into the sewer between midnight and 6:00 am
- Remove solids and floating debris and dispose of in the trash, de-chlorinate the water to a chlorine residual = 0, wait 24 hours, then discharge the water to the street or storm drain
- Try not to use metal-based algaecides (i.e. copper sulfate) in your pool or spa. If you have, empty your pool or spa into the sewer. Prior to discharging pool water into the sanitary sewer system, contact your local agency.
- If the pool contains algae and mosquito larvae, discharge the water to the sewer

When acid cleaning or other chemical cleaning:

- Neutralize the pool water to pH of 6.5 to 8.5, then discharge to the sewer

For swimming pool and spa filter backwash:

- Dispose of solids into trash bag, then wash filter into a landscape area
- Settle, dispose of solids in trash and discharge water to the sewer, never to the storm drain



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» For Residents

The following is a preview of the information we have available to residents. For more fact sheets, visit sbcountystormwater.org

Household Hazardous Waste Center Locations

TOO TOXIC TO TRASH

Dispose of your **HOUSEHOLD HAZARDOUS WASTE (HHW)** at a **FREE** HHW Center near you. Examples of items collected: pesticides, fertilizers, paints, cleaners, antifreeze, batteries, motor oil, oil filters, and electronic waste.

SERVICE AREA	LOCATION	DAYS OPEN	HOURS
Big Bear Lake (does not accept E-waste)	42040 Garstin Dr. (cross: Big Bear Blvd.)	Saturdays	9 a.m. - 2 p.m.
Chino	5050 Schaefer Ave. (cross: 4th St.)	2 nd & 4 th Sat.	8 a.m. - 1 p.m.
Fontana (Fontana residents only)	16454 Orange Way (cross: Cypress Ave.) Note: Provide a trash bill and a driver's license as proof of residency.	Saturdays	8 a.m. - 12 p.m.
Ontario	1430 S. Cucamonga Ave. (cross: Belmont St.)	Fri. & Sat.	9 a.m. - 2 p.m.
Rancho Cucamonga	8794 Lion Street. (Off 9th St, between Vineyard and Hellman)	Saturdays	8 a.m. - 12 p.m.
Redlands	500 Kansas St. (cross: Park Ave.)	Saturdays	9:30 a.m. - 12:30 p.m.
Rialto (does not accept E-waste)	246 Willow Ave. (cross: Rialto Ave.)	2 nd & 4 th Fri. & Sat.	8 a.m. - 12 p.m.
San Bernardino	2824 East 'W' St., 302 (cross: Victoria Ave.)	Mon. - Fri.	9 a.m. - 4 p.m.
Upland	1370 N. Benson Ave. (cross: 14th St.)	Saturdays	9 a.m. - 2 p.m.



To report illegal dumping, call (877) WASTE18
or visit sbcountystormwater.org

Artwork Courtesy of the City of Los Angeles Stormwater Program. Printed on recycled paper.

TAKE ONE



WE DID IT OURSELVES AND WE DID IT RIGHT



When painting your home,
protect your family and community.

- **PAINTS** that are water-based are less toxic and should be used whenever possible.
- **BRUSHES** with water-based paint should be washed in the sink. Those with oil-based paint should be cleaned with paint thinner.
- **SAFELY** dispose of unwanted paint and paint thinner. The County of San Bernardino offers 9 HHW Centers that accept paint and other household hazardous waste from residents **FREE** of charge. For a list of acceptable materials, location information, and hours of operation call 1-800-OILY CAT.



In the event of a spill or discharge to a storm drain or waterway, contact San Bernadino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

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VEHICLE MAINTENANCE

Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Cleaning Auto Parts

Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the parts washer or the fluid holding tank. Do not wash parts or equipment in a sink, parking lot, driveway or street.

Storing Hazardous Waste

Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.

Preventing Leaks and Spills

Conduct all vehicle maintenance inside of a garage. Place drip pans underneath vehicle to capture fluids. Use absorbent materials instead of water to clean work areas.

Cleaning Spills

Use dry methods for spill cleanup (sweeping, absorbent materials). To report accidental spills into the street or storm drain call (877) WASTE18 or 911.

Proper Disposal of Hazardous Waste

Dispose of household hazardous waste by taking it to your nearest household hazardous waste center. For more information, call 1-800-OILY CAT or check out sbcountystormwater.org/Disposal.html



In the event of a spill or discharge to a storm drain or waterway, contact San Bernardino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

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PET WASTE DISPOSAL

FREE DOGGIE WASTE BAGS

Remember to pick up after your pet **every time** to keep San Bernardino County clean and healthy!

To **RECEIVE** your
FREE CONTAINER
visit us online at
sbcountystormwater.org/dog



In the event of a spill or discharge to a storm drain or waterway, contact San Bernardino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

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info@sbcountystormwater.org

LANDSCAPE MAINTENANCE

DISCHARGE TO THE STORM DRAIN, ACCIDENTAL OR NOT, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE



- ✓ Recycle leaves, grass clippings and other yard waste.
- ✓ Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- ✓ **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

For more information, please visit:
www.calrecycle.ca.gov/organics/grasscycling

USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY



- ✓ Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- ✓ If you must use chemical fertilizers, herbicides or pesticides:
 - Spot apply, rather than blanketing entire areas.
 - Avoid applying near curbs and driveways, and **never** before a rain.
 - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
 - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

USE WATER WISELY



- ✓ Control the amount of water and direction of sprinklers. Sprinklers should only be on long enough to allow water to soak into the ground, but not so long as to cause runoff.
- ✓ Periodically inspect, fix leaks and realign sprinkler heads.
- ✓ Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

! HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.



Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,
(909) 382-5401 or 1-800-OILY CAT.

*FREE for San Bernardino County residents only. Businesses can call for cost inquiries and to schedule an appointment.



To report illegal dumping, call (877) WASTE18 or visit sbcountystormwater.org
To report toxic spills, call 1(800) 33 TOXIC
To dispose of hazardous waste, call 1(800) OILY CAT

sbcountystormwater.org

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MANTENIMIENTO DE JARDINERÍA

LAS DESCARGAS A LOS DESAGUES PLUVIALES, DE MANERA ACCIDENTAL O NO, PUEDEN INDUCIR A LA APLICACIÓN DE MULTAS Y OTRAS MEDIDAS.

Siga las mejores prácticas descritas debajo para evitar la contaminación del agua por actividades de jardinería.

RECICLAJE DE LOS DESECHOS DE JARDÍN



- ✓ Reciclar las hojas, recortes de césped y otros desechos de jardín.
- ✓ No soplar, barrer, o usar la manguera para empujar los desechos de jardín a la calle.
- ✓ Poner a prueba el reciclaje de césped (grasscycling): la manera natural de reciclar el césped dejando los recortes sobre el césped cuando son cortados. Para más información, visite la página web: www.calrecycle.ca.gov/organics/grasscycling

USAR FERTILIZANTES, HERBICIDAS Y PESTICIDAS DE MANERA SEGURA



- ✓ Los fertilizantes, herbicidas y pesticidas son arrastrados con frecuencia hacia el sistema de desagüe pluvial mediante el escurrimiento de los rociadores. Use alternativas naturales no tóxicas siempre que sea posible.
- ✓ Si tiene que usar fertilizantes, herbicidas o pesticidas químicos: Aplicar solo en el sitio necesario, en lugar de cubrir todas las áreas. Evitar aplicar cerca de los bordillos y las calzadas, y nunca antes de que llueva. Aplicar los fertilizantes cuando sea necesario: esto es, cuando las plantas mejor podrían usarlo y el posible escurrimiento sea bajo. Seguir las instrucciones del fabricante cuidadosamente – esto no solo le proporcionará los mejores resultados, pero le permitirá ahorrar dinero.

USAR EL AGUA DE MANERA PRUDENTE



- ✓ Controlar la cantidad de agua y la orientación de los rociadores. Los rociadores deben ser solo lo suficientemente largos como para permitir que el agua remoje el suelo, pero no tan largos que causen un escurrimiento.
- ✓ Inspeccione, repare los escapes y alinee los aspersores periódicamente.
- ✓ Siembre plantas nativas para reducir el uso de agua, fertilizantes, herbicidas y pesticidas.

! PROPIETARIOS DE HOGARES

Tengan en cuenta estos consejos cuando contraten a paisajistas profesionales y recuérdenselos según sea necesario.



Los sobrantes de pesticidas, fertilizantes y herbicidas contaminan los vertederos y deben ser desechados a través de Plantas de Tratamiento para Residuos Peligrosos.

*GRATIS únicamente para los residentes del Condado de San Bernardino. Las empresas pueden llamar para indagar sobre los costos y concertar una cita.

Para más información sobre el manejo adecuado de residuos peligrosos, llame a (909) 382-5401 o 1-800-OILY CAT.



Para denunciar el vertido ilegal de basura, llame al (877) WASTE18 o visite sbcountystormwater.org
Para denunciar derrames tóxicos, llame al 1(800) 33 TOXIC
Para desechar residuos peligrosos, llame al 1(800) OILY CAT

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WASH YOUR CAR THE ECO-FRIENDLY WAY!

When possible, wash in a professional car wash.

- 1 **Locate** the nearest storm drain and ensure that wash water does not flow into it.



- 2 **Wash** in a contained area or on grass*, gravel or other permeable surface. Dispose of excess soapy water into the sanitary sewer (*ie. sink or toilet*) or onto grass.

- 3 **Use** eco-friendly cleaning products (*non-toxic, phosphate free or biodegradable*). Use as little soap as possible and wipe brake dust off tires with a rag before washing.

- 4 **Conserve** water by using a high pressure hose and turn off the water when not in use.

*Some local ordinances may not allow a car to be parked on the front lawn. Check with your City's Building and Code department if you are unsure.



How Does Eco Car Washing Help Local Waterways?

When excess wash water travels through the street it has the potential to pick up oil, grease and other chemicals along the way before it ends up in the curb, gutter and the storm drain system. **This contaminated water then travels to our creeks and the Santa Ana River making it unsafe for people and wildlife.**



To report illegal dumping, call **(877) WASTE18** or visit **sbcountystormwater.org**

To find a Hazardous Waste Facility, call **(800) OILY CAT**

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Printed on 55% Recycled, 30% Post Consumer Waste Paper



¡LAVE SU AUTO DE MANERA ECOLÓGICA!

Cuando sea posible, lávelo en un lavadero profesional de autos.

1

Ubique el desagüe pluvial más cercano y asegúrese de que nada pueda entrar en él o que pueda descargarse allí.



2

Lave su auto sobre el césped, grava u otras superficies permeables. Elimine el exceso de agua jabonosa en un drenaje sanitario (*por ejemplo, lavamanos o inodoro*) o en el césped.

3

Use productos de limpieza ecológicos (*no tóxicos, sin fosfato o biodegradables*). Use la menor cantidad de jabón posible y limpie el polvo de frenos de los neumáticos con un trapo antes de lavar.

4

Conserve agua usando una manguera de alta presión y cierre el agua cuando no la use.

* Es posible que algunas ordenanzas locales no permitan estacionar sobre el césped en el frente de la casa. Consulte con el departamento de Código Urbano y Edificación de su ciudad si no está seguro.



¿De qué Manera el Lavado de Autos Ecológico Ayuda a Proteger los Canales Fluviales Locales?

Cuando el exceso de agua de lavado viaja por la calle, es posible que recoja aceite, grasa y otros elementos químicos en el camino antes de que llegue en el desagüe pluvial y el sistema de la boca de tormenta. **Esa agua contaminada luego viaja hacia nuestros arroyos y al Río Santa Ana, haciendo que sea inseguro para la gente y los animales.**



Para reportar actividades ilegales, llame a **(877) WASTE18** o visite **sbcountystormwater.org**. Para encontrar un establecimiento de Desechos Peligrosos, llame al **(800) OILY CAT**

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Impreso en Papel 55% Reciclado y 30% de Postconsumo



Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☒
Nutrients	
Trash	☒
Metals	☒
Bacteria	
Oil and Grease	☒
Organics	☒
Oxygen Demanding	☒

Description

Streets, roads, and highways are significant sources of pollutants in stormwater discharges, and operation and maintenance (O&M) practices, if not conducted properly, can contribute to the problem. Stormwater pollution from roadway and bridge maintenance should be addressed on a site-specific basis. Use of the procedures outlined below, that address street sweeping and repair, bridge and structure maintenance, and unpaved roads will reduce pollutants in stormwater.

Approach

Pollution Prevention

- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal)
- Recycle paint and other materials whenever possible.
- Enlist the help of citizens to keep yard waste, used oil, and other wastes out of the gutter.

Suggested Protocols

Street Sweeping and Cleaning

- Maintain a consistent sweeping schedule. Provide minimum monthly sweeping of curbed streets.
- Perform street cleaning during dry weather if possible.



- Avoid wet cleaning or flushing of street, and utilize dry methods where possible.
- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc. For example:
 - Increase the sweeping frequency for streets with high pollutant loadings, especially in high traffic and industrial areas.
 - Increase the sweeping frequency just before the wet season to remove sediments accumulated during the summer.
 - Increase the sweeping frequency for streets in special problem areas such as special events, high litter or erosion zones.
- Maintain cleaning equipment in good working condition and purchase replacement equipment as needed. Old sweepers should be replaced with new technologically advanced sweepers (preferably regenerative air sweepers) that maximize pollutant removal.
- Operate sweepers at manufacturer requested optimal speed levels to increase effectiveness.
- To increase sweeping effectiveness consider the following:
 - Institute a parking policy to restrict parking in problematic areas during periods of street sweeping.
 - Post permanent street sweeping signs in problematic areas; use temporary signs if installation of permanent signs is not possible.
 - Develop and distribute flyers notifying residents of street sweeping schedules.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- If available use vacuum or regenerative air sweepers in the high sediment and trash areas (typically industrial/commercial).
- Keep accurate logs of the number of curb-miles swept and the amount of waste collected.
- Dispose of street sweeping debris and dirt at a landfill.
- Do not store swept material along the side of the street or near a storm drain inlet.
- Keep debris storage to a minimum during the wet season or make sure debris piles are contained (e.g. by berming the area) or covered (e.g. with tarps or permanent covers).

Street Repair and Maintenance

Pavement marking

- Schedule pavement marking activities for dry weather.

- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.
- Provide drop cloths and drip pans in paint mixing areas.
- Properly maintain application equipment.
- Street sweep thermoplastic grindings. Yellow thermoplastic grindings may require special handling as they may contain lead.
- Paints containing lead or tributyltin are considered a hazardous waste and must be disposed of properly.
- Use water based paints whenever possible. If using water based paints, clean the application equipment in a sink that is connected to the sanitary sewer.
- Properly store leftover paints if they are to be kept for the next job, or dispose of properly.

Concrete installation and repair

- Schedule asphalt and concrete activities for dry weather.
- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place sand bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- When making saw cuts in pavement, use as little water as possible and perform during dry weather. Cover each storm drain inlet completely with filter fabric or plastic during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site. Alternatively, a small onsite vacuum may be used to pick up the slurry as this will prohibit slurry from reaching storm drain inlets.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Patching, resurfacing, and surface sealing

- Schedule patching, resurfacing and surface sealing for dry weather.
- Stockpile materials away from streets, gutter areas, storm drain inlets or watercourses. During wet weather, cover stockpiles with plastic tarps or berm around them if necessary to prevent transport of materials in runoff.
- Pre-heat, transfer or load hot bituminous material away from drainage systems or watercourses.
- Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and maintenance holes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from covered maintenance holes and storm drain inlets when the job is complete.
- Prevent excess material from exposed aggregate concrete or similar treatments from entering streets or storm drain inlets. Designate an area for clean up and proper disposal of excess materials.
- Use only as much water as necessary for dust control, to avoid runoff.
- Sweep, never hose down streets to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Equipment cleaning maintenance and storage

- Inspect equipment daily and repair any leaks. Place drip pans or absorbent materials under heavy equipment when not in use.
- Perform major equipment repairs at the corporation yard, when practical.
- If refueling or repairing vehicles and equipment must be done onsite, use a location away from storm drain inlets and watercourses.
- Clean equipment including sprayers, sprayer paint supply lines, patch and paving equipment, and mud jacking equipment at the end of each day. Clean in a sink or other area (e.g. vehicle wash area) that is connected to the sanitary sewer.

*Bridge and Structure Maintenance**Paint and Paint Removal*

- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Do not transfer or load paint near storm drain inlets or watercourses.

- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- Plug nearby storm drain inlets prior to starting painting where there is significant risk of a spill reaching storm drains. Remove plugs when job is completed.
- If sand blasting is used to remove paint, cover nearby storm drain inlets prior to starting work.
- Perform work on a maintenance traveler or platform, or use suspended netting or tarps to capture paint, rust, paint removing agents, or other materials, to prevent discharge of materials to surface waters if the bridge crosses a watercourse. If sanding, use a sander with a vacuum filter bag.
- Capture all clean-up water, and dispose of properly.
- Recycle paint when possible (e.g. paint may be used for graffiti removal activities). Dispose of unused paint at an appropriate household hazardous waste facility.

Graffiti Removal

- Schedule graffiti removal activities for dry weather.
- Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.
- When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal above.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a landscaped or dirt area. If such an area is not available, filter runoff through an appropriate filtering device (e.g. filter fabric) to keep sand, particles, and debris out of storm drains.
- If a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound), plug nearby storm drains and vacuum/pump wash water to the sanitary sewer.
- Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

Repair Work

- Prevent concrete, steel, wood, metal parts, tools, or other work materials from entering storm drains or watercourses.
- Thoroughly clean up the job site when the repair work is completed.
- When cleaning guardrails or fences follow the appropriate surface cleaning methods (depending on the type of surface) outlined in SC-71 Plaza & Sidewalk Cleaning fact sheet.

- If painting is conducted, follow the painting and paint removal procedures above.
- If graffiti removal is conducted, follow the graffiti removal procedures above.
- If construction takes place, see the Construction Activity BMP Handbook.
- Recycle materials whenever possible.

Unpaved Roads and Trails

- Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes.
- For roadside areas with exposed soils, the most cost-effective choice is to vegetate the area, preferably with a mulch or binder that will hold the soils in place while the vegetation is establishing. Native vegetation should be used if possible.
- If vegetation cannot be established immediately, apply temporary erosion control mats/blankets; a comma straw, or gravel as appropriate.
- If sediment is already eroded and mobilized in roadside areas, temporary controls should be installed. These may include: sediment control fences, fabric-covered triangular dikes, gravel-filled burlap bags, biobags, or hay bales staked in place.

Non-Stormwater Discharges

Field crews should be aware of non-stormwater discharges as part of their ongoing street maintenance efforts.

- Refer to SC-10 Non-Stormwater Discharges
- Identify location, time and estimated quantity of discharges.
- Notify appropriate personnel.

Training

- Train employees regarding proper street sweeping operation and street repair and maintenance.
- Instruct employees and subcontractors to ensure that measures to reduce the stormwater impacts of roadway/bridge maintenance are being followed.
- Require engineering staff and/or consulting A/E firms to address stormwater quality in new bridge designs or existing bridge retrofits.
- Use a training log or similar method to document training.
- Train employees on proper spill containment and clean up, and in identifying non-stormwater discharges.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Densely populated areas or heavily used streets may require parking regulations to clear streets for cleaning.
- No currently available conventional sweeper is effective at removing oil and grease. Mechanical sweepers are not effective at removing finer sediments.
- Limitations may arise in the location of new bridges. The availability and cost of land and other economic and political factors may dictate where the placement of a new bridge will occur. Better design of the bridge to control runoff is required if it is being placed near sensitive waters.

Requirements

Costs

- The maintenance of local roads and bridges is already a consideration of most community public works or transportation departments. Therefore, the cost of pollutant reducing management practices will involve the training and equipment required to implement these new practices.
- The largest expenditures for street sweeping programs are in staffing and equipment. The capital cost for a conventional street sweeper is between \$60,000 and \$120,000. Newer technologies might have prices approaching \$180,000. The average useful life of a conventional sweeper is about four years, and programs must budget for equipment replacement. Sweeping frequencies will determine equipment life, so programs that sweep more often should expect to have a higher cost of replacement.
- A street sweeping program may require the following.
 - Sweeper operators, maintenance, supervisory, and administrative personnel are required.
 - Traffic control officers may be required to enforce parking restrictions.
 - Skillful design of cleaning routes is required for program to be productive.
 - Arrangements must be made for disposal of collected wastes.

- If investing in newer technologies, training for operators must be included in operation and maintenance budgets. Costs for public education are small, and mostly deal with the need to obey parking restrictions and litter control. Parking tickets are an effective reminder to obey parking rules, as well as being a source of revenue.

Maintenance

- Not applicable

Supplemental Information***Further Detail of the BMP******Street sweeping***

There are advantages and disadvantages to the two common types of sweepers. The best choice depends on your specific conditions. Many communities find it useful to have a compliment of both types in their fleet.

Mechanical Broom Sweepers - More effective at picking up large debris and cleaning wet streets. Less costly to purchase and operate. Create more airborne dust.

Vacuum Sweepers - More effective at removing fine particles and associated heavy metals. Ineffective at cleaning wet streets. Noisier than mechanical broom sweepers which may restrict areas or times of operation. May require an advance vehicle to remove large debris.

Street Flushers - Not affected by biggest interference to cleaning, parked cars. May remove finer sediments, moving them toward the gutter and stormwater inlets. For this reason, flushing fell out of favor and is now used primarily after sweeping. Flushing may be effective for combined sewer systems. Presently street flushing is not allowed under most NPDES permits.

Cross-Media Transfer of Pollutants

The California Air Resources Board (ARB) has established state ambient air quality standards including a standard for respirable particulate matter (less than or equal to 10 microns in diameter, symbolized as PM₁₀). In the effort to sweep up finer sediments to remove attached heavy metals, municipalities should be aware that fine dust, that cannot be captured by the sweeping equipment and becomes airborne, could lead to issues of worker and public safety.

Bridges

Bridges that carry vehicular traffic generate some of the more direct discharges of runoff to surface waters. Bridge scupper drains cause a direct discharge of stormwater into receiving waters and have been shown to carry relatively high concentrations of pollutants. Bridge maintenance also generates wastes that may be either directly deposited to the water below or carried to the receiving water by stormwater. The following steps will help reduce the stormwater impacts of bridge maintenance:

- Site new bridges so that significant adverse impacts to wetlands, sensitive areas, critical habitat, and riparian vegetation are minimized.

- Design new bridges to avoid the use of scupper drains and route runoff to land for treatment control. Existing scupper drains should be cleaned on a regular basis to avoid sediment/debris accumulation.
- Reduce the discharge of pollutants to surface waters during maintenance by using suspended traps, vacuums, or booms in the water to capture paint, rust, and paint removing agents. Many of these wastes may be hazardous. Properly dispose of this waste by referring to CA21 (Hazardous Waste Management) in the Construction Handbook.
- Train employees and subcontractors to reduce the discharge of wastes during bridge maintenance.

De-icing

- Do not over-apply deicing salt and sand, and routinely calibrate spreaders.
- Near reservoirs, restrict the application of deicing salt and redirect any runoff away from reservoirs.
- Consider using alternative deicing agents (less toxic, biodegradable, etc.).

References and Resources

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Photo Credit: Geoff Brosseau

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Approach

Suggested Protocols

Catch Basins/Inlet Structures

- Municipal staff should regularly inspect facilities to ensure the following:
 - Immediate repair of any deterioration threatening structural integrity.
 - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
 - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

Objectives

- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	☒
Nutrients	☒
Trash	☒
Metals	☒
Bacteria	☒
Oil and Grease	☒
Organics	☒
Oxygen Demanding	☒



- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

Open Channel

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a stream or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

Illicit Connections and Discharges

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
 - Is there evidence of spills such as paints, discoloring, etc.
 - Are there any odors associated with the drainage system
 - Record locations of apparent illegal discharges/illicit connections
 - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
 - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
 - Illegal dumping hot spots
 - Types and quantities (in some cases) of wastes
 - Patterns in time of occurrence (time of day/night, month, or year)
 - Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accidents/spills)
 - Responsible parties
- Post “No Dumping” signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).
- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Only properly trained individuals are allowed to handle hazardous materials/wastes.
- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.
- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.
- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

- Refer to SC-11, Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.
- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from “environmental fees” or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vector trucks.
- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents “plug flow” discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to

cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

Flow Management

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows are allowed to spread out.

Stream Corridor Planning

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for stream alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration - Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to be reclaimed.

Examples

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank and watershed instability and floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

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http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Site Design & Landscape Planning SD-10



Design Objectives

- ☒ Maximize Infiltration
- ☒ Provide Retention
- ☒ Slow Runoff
- ☒ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.



SD-10 Site Design & Landscape Planning

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

Site Design & Landscape Planning SD-10

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

SD-10 Site Design & Landscape Planning

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.



Rain Garden

Design Objectives

- ☒ Maximize Infiltration
- ☒ Provide Retention
- ☒ Slow Runoff
 - Minimize Impervious Land Coverage
 - Prohibit Dumping of Improper Materials
- ☒ Contain Pollutants
 - Collect and Convey

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain



barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say 1/4 to 1/2 inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Supplemental Information

Examples

- City of Ottawa’s Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

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Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD.
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Design Objectives

- ☒ Maximize Infiltration
- ☒ Provide Retention
- ☒ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.



- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
 - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
 - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
 - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
 - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.



Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☒ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include “NO DUMPING



– DRAINS TO OCEAN” and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of “redevelopment”, then the requirements stated under “designing new installations” above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner’s association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.
- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☒ Contain Pollutants
- Collect and Convey



- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

Additional Information***Maintenance Considerations***

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

3.1 INFILTRATION BASIN

Type of BMP	LID - Infiltration
Treatment Mechanisms	Infiltration, Evapotranspiration (when vegetated), Evaporation, and Sedimentation
Maximum Treatment Area	50 acres
Other Names	Bioinfiltration Basin

Description

An Infiltration Basin is a flat earthen basin designed to capture the design capture volume, V_{BMP} . The stormwater infiltrates through the bottom of the basin into the underlying soil over a 72 hour drawdown period. Flows exceeding V_{BMP} must discharge to a downstream conveyance system. Trash and sediment accumulate within the forebay as stormwater passes into the basin. Infiltration basins are highly effective in removing all targeted pollutants from stormwater runoff.



Figure 1 – Infiltration Basin

See Appendix A, and Appendix C, Section 1 of *Basin Guidelines*, for additional requirements.

Siting Considerations

The use of infiltration basins may be restricted by concerns over ground water contamination, soil permeability, and clogging at the site. See the applicable WQMP for any specific feasibility considerations for using infiltration BMPs. Where this BMP is being used, the soil beneath the basin must be thoroughly evaluated in a geotechnical report since the underlying soils are critical to the basin's long term performance. To protect the basin from erosion, the sides and bottom of the basin must be vegetated, preferably with native or low water use plant species.

In addition, these basins may not be appropriate for the following site conditions:

- Industrial sites or locations where spills of toxic materials may occur
- Sites with very low soil infiltration rates
- Sites with high groundwater tables or excessively high soil infiltration rates, where pollutants can affect ground water quality
- Sites with unstabilized soil or construction activity upstream
- On steeply sloping terrain
- Infiltration basins located in a fill condition should refer to Appendix A of this Handbook for details on special requirements/restrictions

INFILTRATION BASIN BMP FACT SHEET

Setbacks

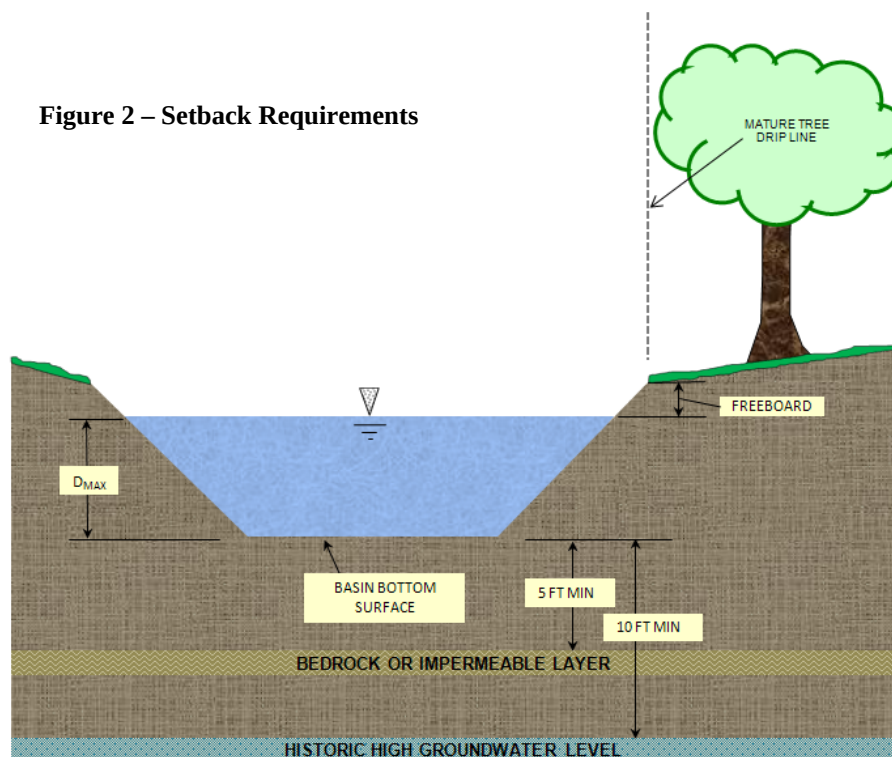
Always consult your geotechnical engineer for site specific recommendations regarding setbacks for infiltration trenches. Recommended setbacks are needed to protect buildings, existing trees, walls, onsite or nearby wells, streams, and tanks. Setbacks should be considered early in the design process since they can affect where infiltration facilities may be placed and how deep they are allowed to be. For instance, depth setbacks can dictate fairly shallow facilities that will have a larger footprint and, in some cases, may make an infiltration basin infeasible. In that instance, another BMP must be selected.

Infiltration basins typically must be set back:

- 10 feet from the historic high groundwater (measured vertically from the bottom of the basin, as shown in Figure 2)
- 5 feet from bedrock or impermeable surface layer (measured vertically from the bottom of the basin, as shown in Figure 2)
- From all existing mature tree drip lines as indicated in Figure 2 (to protect their root structure)
- 100 feet horizontally from wells, tanks or springs

Setbacks to walls and foundations must be included as part of the Geotechnical Report. All other setbacks shall be in accordance with applicable standards of the District's *Basin Guidelines* (Appendix C).

Figure 2 – Setback Requirements



INFILTRATION BASIN BMP FACT SHEET

Forebay

A concrete forebay shall be provided to reduce sediment clogging and to reduce erosion. The forebay shall have a design volume of at least 0.5% V_{BMP} and a minimum 1 foot high concrete splashwall / berm. Full height notch-type weir(s), offset from the line of flow from the basin inlet to prevent short circuiting, shall be used to outlet the forebay. It is recommended that two weirs be used and that they be located on opposite sides of the forebay (see Figure 2).

Overflow

Flows exceeding V_{BMP} must discharge to an acceptable downstream conveyance system. Where an adequate outlet is present, an overflow structure may be used. Where an embankment is present, an emergency spillway may be used instead. Overflows must be placed just above the design water surface for V_{BMP} and be near the outlet of the system. The overflow structure shall be similar to the District's Standard Drawing CB 110. Additional details may be found in the District's *Basin Guidelines* (Appendix C).

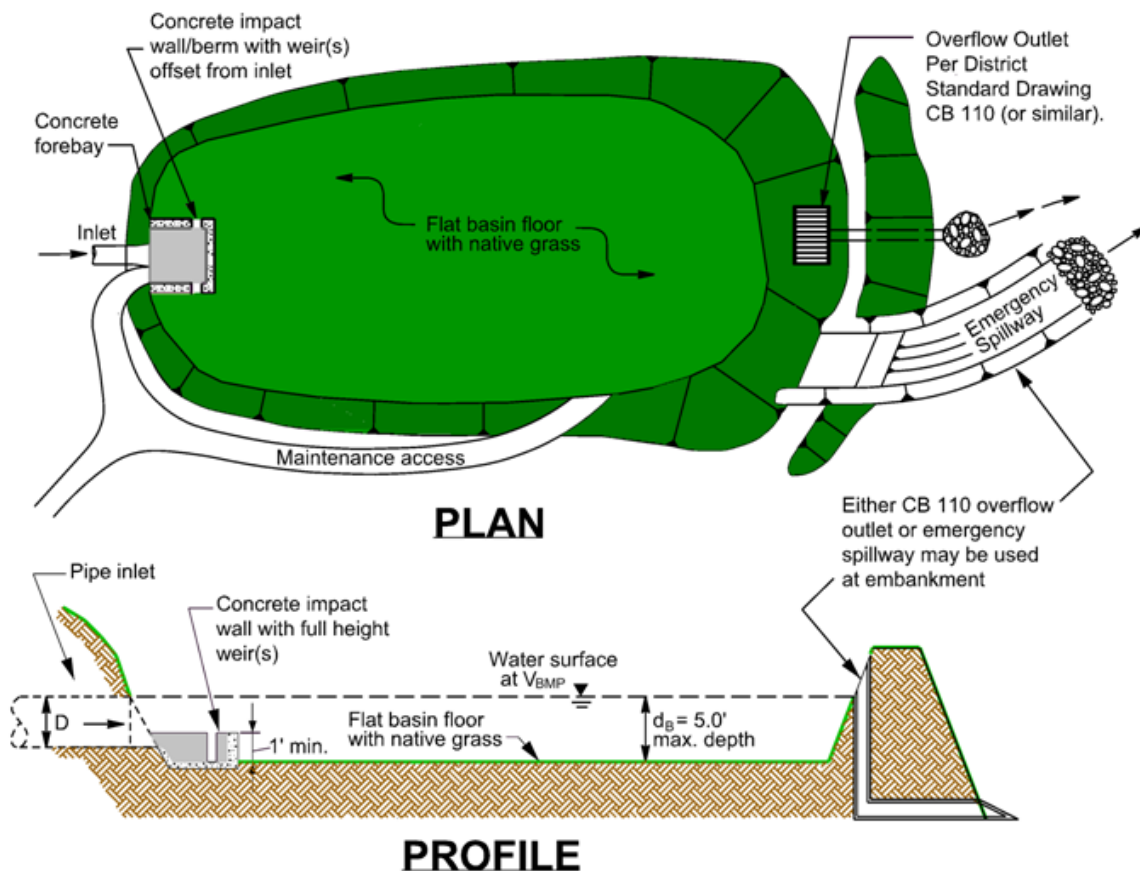


Figure 3 – Infiltration Basin

INFILTRATION BASIN BMP FACT SHEET

Landscaping Requirements

Basin vegetation provides erosion protection, improves sediment removal and assists in allowing infiltration to occur. The basin surface and side slopes shall be planted with native grasses. Proper landscape management is also required to ensure that the vegetation does not contribute to water pollution through pesticides, herbicides, or fertilizers. Landscaping shall be in accordance with County of Riverside Ordinance 859 and the District's *Basin Guidelines* (Appendix C), or other guidelines issued by the Engineering Authority.

Maintenance

Normal maintenance of an infiltration basin includes the maintenance of landscaping, debris and trash removal from the surface of the basin, and tending to problems associated with standing water (vectors, odors, etc.). Significant ponding, especially more than 72 hours after an event, may indicate that the basin surface is no longer providing sufficient infiltration and requires aeration. See the District's *Basin Guidelines* (Appendix C) for additional requirements (i.e., fencing, maintenance access, etc.).

Table 1 - Inspection and Maintenance

Schedule	Inspection and Maintenance Activity
Ongoing including just before annual storm seasons and following rainfall events.	- Maintain vegetation as needed. Use of fertilizers, pesticides and herbicides should be strenuously avoided to ensure they don't contribute to water pollution. If appropriate native plant selections and other IPM methods are used, such products shouldn't be needed. If such projects are used, - Products shall be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding. - Fertilizers should not be applied within 15 days before, after, or during the rain season. - Remove debris and litter from the entire basin to minimize clogging and improve aesthetics. - Check for obvious problems and repair as needed. Address odor, insects, and overgrowth issues associated with stagnant or standing water in the basin bottom. There should be no long-term ponding water. - Check for erosion and sediment laden areas in the basin. Repair as needed. Clean forebay if needed. - Revegetate side slopes where needed.
Annually. If possible, schedule these inspections within 72 hours after a significant rainfall.	- Inspection of hydraulic and structural facilities. Examine the inlet for blockage, the embankment and spillway integrity, as well as damage to any structural element. - Check for erosion, slumping and overgrowth. Repair as needed. - Check basin depth for sediment build up and reduced total capacity. Scrape bottom as needed and remove sediment. Restore to original cross-section and infiltration rate. Replant basin vegetation. - Verify the basin bottom is allowing acceptable infiltration. Use a disc or other method to aerate basin bottom only if there is actual significant loss of infiltrative capacity, rather than on a routine basis¹. - No water should be present 72 hours after an event. No long term standing water should be present at all. No algae formation should be visible. Correct problem as needed.
1. CA Stormwater BMP Handbook for New Development and Significant Redevelopment	

INFILTRATION BASIN BMP FACT SHEET

Table 2 - Design and Sizing Criteria for Infiltration Basins

Design Parameter	Infiltration Basin
Design Volume	V_{BMP}
Forebay Volume	0.5% V_{BMP}
Drawdown time (maximum)	72 hours
Maximum tributary area	50 acres ²
Minimum infiltration rate	Must be sufficient to drain the basin within the required Drawdown time over the life of the BMP. The WQMP may include specific requirements for minimum tested infiltration rates.
Maximum Depth	5 feet
Spillway erosion control	Energy dissipators to reduce velocities ¹
Basin Slope	0%
Freeboard (minimum)	1 foot ¹
Historic High Groundwater Setback (max)	10 feet
Bedrock/impermeable layer setback (max)	5 feet
Tree setbacks	Mature tree drip line must not overhang the basin
Set back from wells, tanks or springs	100 feet
Set back from foundations	As recommended in Geotechnical Report
^{1.} Ventura County's Technical Guidance Manual for Stormwater Quality Control Measures ^{2.} CA Stormwater BMP Handbook for New Development and Significant Redevelopment	

Note: The information contained in this BMP Factsheet is intended to be a summary of design considerations and requirements. Additional information which applies to all detention basins may be found in the District's Basin Guidelines (Appendix C). In addition, information herein may be superseded by other guidelines issued by the co-permittee.

INFILTRATION BASIN SIZING PROCEDURE

1. Find the Design Volume, V_{BMP} .
 - a) Enter the Tributary Area, A_T .
 - b) Enter the Design Volume, V_{BMP} , determined from Section 2.1 of this Handbook.
2. Determine the Maximum Depth.
 - a) Enter the infiltration rate. The infiltration rate shall be established as described in Appendix A: "Infiltration Testing".
 - b) Enter the design Factor of Safety from Table 1 in Appendix A: "Infiltration Testing".
 - c) The spreadsheet will determine D_1 , the maximum allowable depth of the basin based on the infiltration rate along with the maximum drawdown time (72 hours) and the Factor of Safety.

$$D_1 = [(t) \times (I)] / 12s$$

Where I = site infiltration rate (in/hr)
 s = safety factor
 t = drawdown time (maximum 72 hours)

INFILTRATION BASIN BMP FACT SHEET

- d) Enter the depth of freeboard.
- e) Enter the depth to the historic high groundwater level measured from the top of the basin.
- f) Enter the depth to the top of bedrock or other impermeable layer measured from the finished grade.
- g) The spreadsheet will determine D_2 , the total basin depth (including freeboard, if used) of the basin, based on restrictions to the depth by groundwater and an impermeable layer.

$$D_2 = \text{Depth to groundwater} - (10 + \text{freeboard}) \text{ (ft);}$$

or

$$D_2 = \text{Depth to impermeable layer} - (5 + \text{freeboard}) \text{ (ft)}$$

Whichever is least.

- h) The spreadsheet will determine the maximum allowable effective depth of basin, D_{MAX} , based on the smallest value between D_1 and D_2 . D_{MAX} is the maximum depth of water only and does not include freeboard. D_{MAX} shall not exceed 5 feet.

3. Basin Geometry

- a) Enter the basin side slopes, z (no steeper than 4:1).
- b) Enter the proposed basin depth, d_B excluding freeboard.
- c) The spreadsheet will determine the minimum required surface area of the basin:

$$A_s = V_{BMP} / d_B$$

Where A_s = minimum area required (ft^2)

V_{BMP} = volume of the infiltration basin (ft^3)

d_B = proposed depth not to exceed maximum allowable depth, D_{MAX} (ft)

- d) Enter the proposed bottom surface area. This area shall not be less than the minimum required surface area.

4. Forebay

A concrete forebay with a design volume of at least 0.5% V_{BMP} and a minimum 1 foot high concrete splashwall shall be provided. Full-height rectangular weir(s) shall be used to outlet the forebay. The weir(s) must be offset from the line of flow from the basin inlet. It is recommended that two weirs be used and that they be located on opposite sides of the forebay (see Figure 2).

- a) The spreadsheet will determine the minimum required forebay volume based on 0.5% V_{BMP} .
- b) Enter the proposed depth of the forebay berm/splashwall (1foot minimum).
- c) The spreadsheet will determine the minimum required forebay surface area.
- d) Enter the width of rectangular weir to be used (minimum 1.5 inches). Weir width should be established based on a 5 minute drawdown time.

3.5 Bioretention Facility

Type of BMP	LID – Bioretention
Treatment Mechanisms	Infiltration, Evapotranspiration, Evaporation, Biofiltration
Maximum Drainage Area	This BMP is intended to be integrated into a project’s landscaped area in a distributed manner. Typically, contributing drainage areas to Bioretention Facilities range from less than 1 acre to a maximum of around 10 acres.
Other Names	Rain Garden, Bioretention Cell, Bioretention Basin, Biofiltration Basin, Landscaped Filter Basin, Porous Landscape Detention

Description

Bioretention Facilities are shallow, vegetated basins underlain by an engineered soil media. Healthy plant and biological activity in the root zone maintain and renew the macro-pore space in the soil and maximize plant uptake of pollutants and runoff. This keeps the Best Management Practice (BMP) from becoming clogged and allows more of the soil column to function as both a sponge (retaining water) and a highly effective and self-maintaining biofilter. In most cases, the bottom of a Bioretention Facility is unlined, which also provides an opportunity for infiltration to the extent the underlying onsite soil can accommodate. When the infiltration rate of the underlying soil is exceeded, fully biotreated flows are discharged via underdrains. Bioretention Facilities therefore will inherently achieve the maximum feasible level of infiltration and evapotranspiration and achieve the minimum feasible (but highly biotreated) discharge to the storm drain system.

Siting Considerations

These facilities work best when they are designed in a relatively level area. Unlike other BMPs, Bioretention Facilities can be used in smaller landscaped spaces on the site, such as:

- ✓ Parking islands
- ✓ Medians
- ✓ Site entrances

Landscaped areas on the site (such as may otherwise be required through minimum landscaping ordinances), can often be designed as Bioretention Facilities. This can be accomplished by:

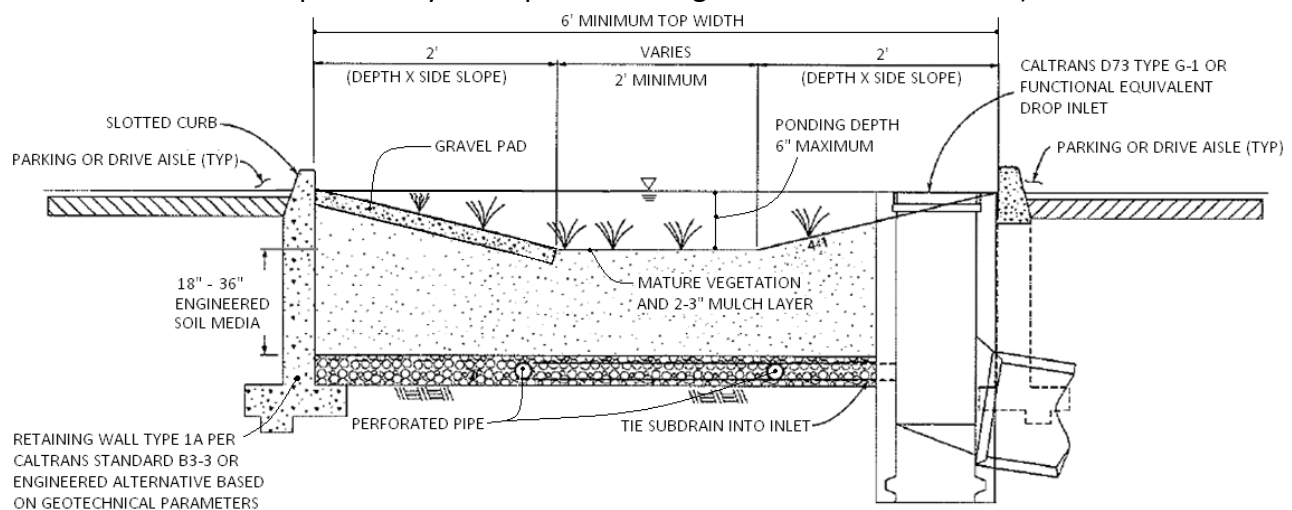
- *Depressing* landscaped areas below adjacent impervious surfaces, rather than elevating those areas
- Grading the site to direct runoff from those impervious surfaces *into* the Bioretention Facility, rather than away from the landscaping
- Sizing and designing the depressed landscaped area as a Bioretention Facility as described in this Fact Sheet

Bioretention Facilities should however not be used downstream of areas where large amounts of sediment can clog the system. Placing a Bioretention Facility at the toe of a steep slope should also be avoided due to the potential for clogging the engineered soil media with erosion from the slope, as well as the potential for damaging the vegetation.

Design and Sizing Criteria

The recommended cross section necessary for a Bioretention Facility includes:

- Vegetated area
- 18' minimum depth of engineered soil media
- 12' minimum gravel layer depth with 6' perforated pipes (added flow control features such as orifice plates may be required to mitigate for HCOG conditions)



While the 18-inch minimum engineered soil media depth can be used in some cases, it is recommended to use 24 inches or a preferred 36 inches to provide an adequate root zone for the chosen plant palate. Such a design also provides for improved removal effectiveness for nutrients. The recommended ponding depth inside of a Bioretention Facility is 6 inches; measured from the flat bottom surface to the top of the water surface as shown in Figure 1.

Because this BMP is filled with an engineered soil media, pore space in the soil and gravel layer is assumed to provide storage volume. However, several considerations must be noted:

- Surcharge storage above the soil surface (6 inches) is important to assure that design flows do not bypass the BMP when runoff exceeds the soil's absorption rate.
- In cases where the Bioretention Facility contains engineered soil media deeper than 36 inches, the pore space within the engineered soil media can only be counted to the 36-inch depth.
- A maximum of 30 percent pore space can be used for the soil media whereas a maximum of 40 percent pore space can be use for the gravel layer.

Figure 1: Standard Layout for a Bioretention Facility

BIORETENTION FACILITY BMP FACT SHEET

Engineered Soil Media Requirements

The engineered soil media shall be comprised of 85 percent mineral component and 15 percent organic component, by volume, drum mixed prior to placement. The mineral component shall be a Class A sandy loam topsoil that meets the range specified in Table 1 below. The organic component shall be nitrogen stabilized compost¹, such that nitrogen does not leach from the media.

Table 1: Mineral Component Range Requirements

Percent Range	Component
70-80	Sand
15-20	Silt
5-10	Clay

The trip ticket, or certificate of compliance, shall be made available to the inspector to prove the engineered mix meets this specification.

Vegetation Requirements

Vegetative cover is important to minimize erosion and ensure that treatment occurs in the Bioretention Facility. The area should be designed for at least 70 percent mature coverage throughout the Bioretention Facility. To prevent the BMP from being used as walkways, Bioretention Facilities shall be planted with a combination of small trees, densely planted shrubs, and natural grasses. Grasses shall be native or ornamental; preferably ones that do not need to be mowed. The application of fertilizers and pesticides should be minimal. To maintain oxygen levels for the vegetation and promote biodegradation, it is important that vegetation not be completely submerged for any extended period of time. Therefore, a maximum of 6 inches of ponded water shall be used in the design to ensure that plants within the Bioretention Facility remain healthy.

A 2 to 3-inch layer of standard shredded aged hardwood mulch shall be placed as the top layer inside the Bioretention Facility. The 6-inch ponding depth shown in Figure 1 above shall be measured from the top surface of the 2 to 3-inch mulch layer.

Curb Cuts

To allow water to flow into the Bioretention Facility, 1-foot-wide (minimum) curb cuts should be placed approximately every 10 feet around the perimeter of the Bioretention Facility. Figure 2 shows a curb cut in a Bioretention Facility. Curb cut flow lines must be at or above the V_{BMP} water surface level.

¹ For more information on compost, visit the US Composting Council website at: <http://compostingcouncil.org/>

BIORETENTION FACILITY BMP FACT SHEET



Figure 2: Curb Cut located in a Bioretention Facility

To reduce erosion, a gravel pad shall be placed at each inlet point to the Bioretention Facility. The gravel should be 1- to 1.5-inch diameter in size. The gravel should overlap the curb cut opening a minimum of 6 inches. The gravel pad inside the Bioretention Facility should be flush with the finished surface at the curb cut and extend to the bottom of the slope.

In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet. See Figure 3.

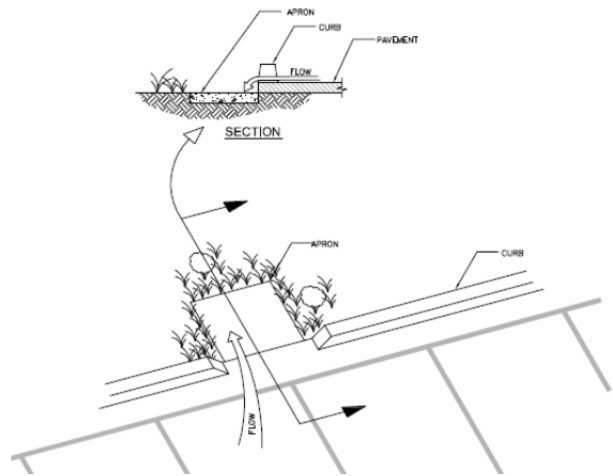


Figure 3: Apron located in a Bioretention Facility

Terracing the Landscaped Filter Basin

It is recommended that Bioretention Facilities be level. In the event the facility site slopes and lacks proper design, water would fill the lowest point of the BMP and then discharge from the basin without being treated. To ensure that the water will be held within the Bioretention Facility on sloped sites, the BMP must be terraced with nonporous check dams to provide the required storage and treatment capacity.

The terraced version of this BMP shall be used on non-flat sites with no more than a 3 percent slope. The surcharge depth cannot exceed 0.5 feet, and side slopes shall not exceed 4:1. Table 2 below shows the spacing of the check dams, and slopes shall be rounded up (i.e., 2.5 percent slope shall use 10' spacing for check dams).

Table 2: Check Dam Spacing

6" Check Dam Spacing	
Slope	Spacing
1%	25'
2%	15'
3%	10'

BIORETENTION FACILITY BMP FACT SHEET

Roof Runoff

Roof downspouts may be directed towards Bioretention Facilities. However, the downspouts must discharge onto a concrete splash block to protect the Bioretention Facility from erosion.

Retaining Walls

It is recommended that Retaining Wall Type 1A, per Caltrans Standard B3-3 or equivalent, be constructed around the entire perimeter of the Bioretention Facility. This practice will protect the sides of the Bioretention Facility from collapsing during construction and maintenance or from high service loads adjacent to the BMP. Where such service loads would not exist adjacent to the BMP, an engineered alternative may be used if signed by a licensed civil engineer.

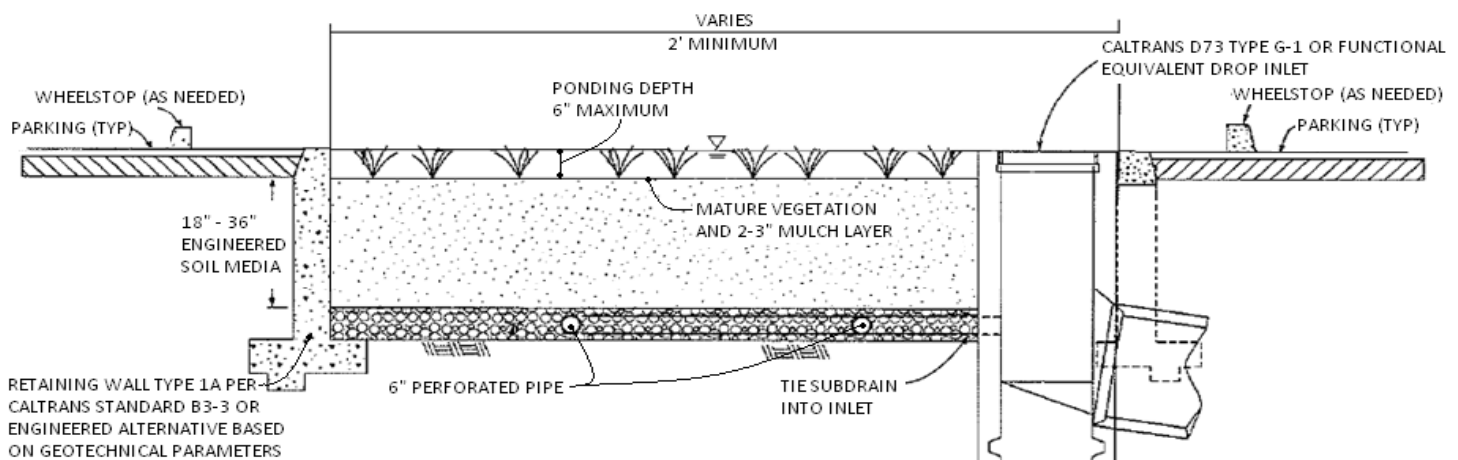
Side Slope Requirements

Bioretention Facilities Requiring Side Slopes

The design should assure that the Bioretention Facility does not present a tripping hazard. Bioretention Facilities proposed near pedestrian areas, such as areas parallel to parking spaces or along a walkway, must have a gentle slope to the bottom of the facility. Side slopes inside of a Bioretention Facility shall be 4:1. A typical cross section for the Bioretention Facility is shown in Figure 1.

Bioretention Facilities Not Requiring Side Slopes

Where cars park perpendicular to the Bioretention Facility, side slopes are not required. A 6-inch maximum drop may be used, and the Bioretention Facility must be planted with trees and shrubs to prevent pedestrian access. In this case, a curb is not placed around the Bioretention Facility, but wheel stops shall be used to prevent vehicles from entering the Bioretention Facility, as shown in Figure 4.



BIORETENTION FACILITY BMP FACT SHEET

Planter Boxes

Bioretention Facilities can also be placed above ground as planter boxes. Planter boxes must have a minimum width of 2 feet, a maximum surcharge depth of 6 inches, and no side slopes are necessary. Planter boxes must be constructed so as to ensure that the top surface of the engineered soil media will remain level. This option may be constructed of concrete, brick, stone or other stable materials that will not warp or bend. Chemically treated wood or galvanized steel, which has the ability to contaminate stormwater, should not be used. Planter boxes must be lined with an impermeable liner on all sides, including the bottom. Due to the impermeable liner, the inside bottom of the planter box shall be designed and constructed with a cross fall, directing treated flows within the subdrain layer toward the point where subdrain exits the planter box, and subdrains shall be oriented with drain holes oriented down. These provisions will help avoid excessive stagnant water within the gravel underdrain layer. Similar to the in-ground Bioretention Facility versions, this BMP benefits from healthy plants and biological activity in the root zone. Planter boxes should be planted with appropriately selected vegetation.



Figure 5: Planter Box

Source: LA Team Effort

Overflow

An overflow route is needed in the Bioretention Facility design to bypass stored runoff from storm events larger than V_{BMP} or in the event of facility or subdrain clogging. Overflow systems must connect to an acceptable discharge point, such as a downstream conveyance system as shown in Figure 1 and Figure 4. The inlet to the overflow structure shall be elevated inside the Bioretention Facility to be flush with the ponding surface for the design capture volume (V_{BMP}) as shown in Figure 4. This will allow the design capture volume to be fully treated by the Bioretention Facility, and for larger events to safely be conveyed to downstream systems. The overflow inlet shall **not** be located in the entrance of a Bioretention Facility, as shown in Figure 6.

BIORETENTION FACILITY BMP FACT SHEET

Underdrain Gravel and Pipes

An underdrain gravel layer and pipes shall be provided in accordance with Appendix B – Underdrains.



Figure 6: Incorrect Placement of an Overflow Inlet.

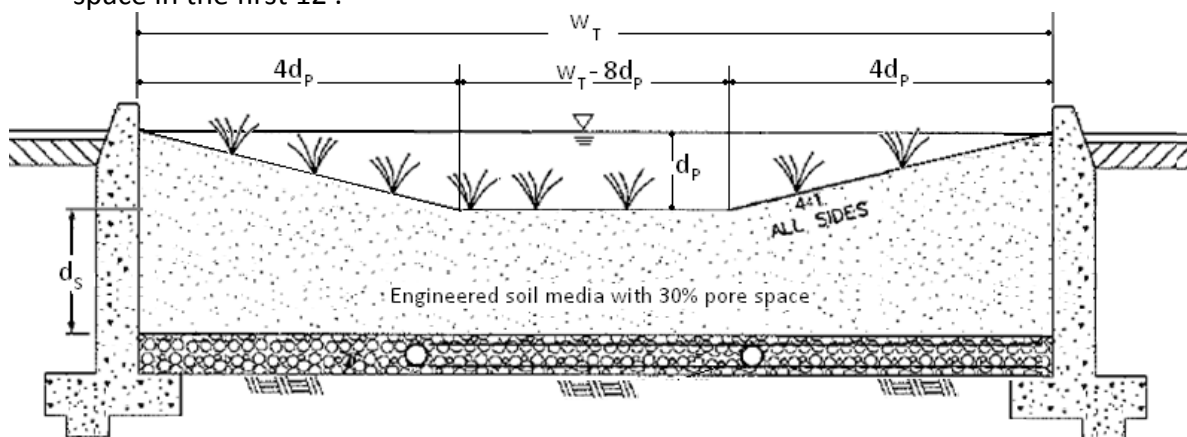
Inspection and Maintenance Schedule

The Bioretention Facility area shall be inspected for erosion, dead vegetation, soggy soils, or standing water. The use of fertilizers and pesticides on the plants inside the Bioretention Facility should be minimized.

Schedule	Activity
Ongoing	• Keep adjacent landscape areas maintained. Remove clippings from landscape maintenance activities. • Remove trash and debris • Replace damaged grass and/or plants • Replace surface mulch layer as needed to maintain a 2-3 inch soil cover.
After storm events	• Inspect areas for ponding
Annually	• Inspect/clean inlets and outlets

Bioretention Facility Design Procedure

- 1) Enter the area tributary, A_T , to the Bioretention Facility.
- 2) Enter the Design Volume, V_{BMP} , determined from Section 2.1 of this Handbook.
- 3) Select the type of design used. There are two types of Bioretention Facility designs: the standard design used for most project sites that include side slopes, and the modified design used when the BMP is located perpendicular to the parking spaces or with planter boxes that do not use side slopes.
- 4) Enter the depth of the engineered soil media, d_s . The minimum depth for the engineered soil media can be 18' in limited cases, but it is recommended to use 24' or a preferred 36' to provide an adequate root zone for the chosen plant palette. Engineered soil media deeper than 36' will only get credit for the pore space in the first 36'.
- 5) Enter the top width of the Bioretention Facility.
- 6) Calculate the total effective depth, d_E , within the Bioretention Facility. The maximum allowable pore space of the soil media is 30% while the maximum allowable pore space for the gravel layer is 40%. Gravel layer deeper than 12' will only get credit for the pore space in the first 12'.



- a. For the design with side slopes the following equation shall be used to determine the total effective depth. Where, d_p is the depth of ponding within the basin.

$$d_E(\text{ft}) = \frac{0.3 \times \left[(w_T(\text{ft}) \times d_s(\text{ft})) + 4(d_p(\text{ft}))^2 \right] + 0.4 \times 1(\text{ft}) + d_p(\text{ft})[4d_p(\text{ft}) + (w_T(\text{ft}) - 8d_p(\text{ft}))]}{w_T(\text{ft})}$$

This above equation can be simplified if the maximum ponding depth of 0.5' is used. The equation below is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\text{ft}) = (0.3 \times d_s(\text{ft}) + 0.4 \times 1(\text{ft})) - \left(\frac{0.7(\text{ft}^2)}{w_T(\text{ft})} \right) + 0.5(\text{ft})$$

- b. For the design without side slopes the following equation shall be used to determine the total effective depth:

$$d_E(\text{ft}) = d_P(\text{ft}) + [(0.3) \times d_S(\text{ft}) + (0.4) \times 1(\text{ft})]$$

The equation below, using the maximum ponding depth of 0.5', is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\text{ft}) = 0.5 (\text{ft}) + [(0.3) \times d_S(\text{ft}) + (0.4) \times 1(\text{ft})]$$

- 7) Calculate the minimum surface area, A_M , required for the Bioretention Facility. This does not include the curb surrounding the Bioretention Facility or side slopes.

$$A_M(\text{ft}^2) = \frac{V_{\text{BMP}}(\text{ft}^3)}{d_E (\text{ft})}$$

- 8) Enter the proposed surface area. This area shall not be less than the minimum required surface area.
- 9) Verify that side slopes are no steeper than 4:1 in the standard design, and are not required in the modified design.
- 10) Provide the diameter, minimum 6 inches, of the perforated underdrain used in the Bioretention Facility. See Appendix B for specific information regarding perforated pipes.
- 11) Provide the slope of the site around the Bioretention Facility, if used. The maximum slope is 3 percent for a standard design.
- 12) Provide the check dam spacing, if the site around the Bioretention Facility is sloped.
- 13) Describe the vegetation used within the Bioretention Facility.

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