

Preliminary

# Water Quality Management Plan

For:

**Tec Equipment**

**Truck Sales, Service/Repair, and Parts Sales Dealership**

APN: 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83, AND 84

Prepared for:

San Bernardino County Redevelopment Agency; (APN: 0231-021-76, 82, 83 & 84)

The County of San Bernardino Redevelopment Agency; (APN: 0231-021-48)

Redevelopment Agency of the County of San Bernardino (APN: 0231-021-24, 25, 32, 54, 55)

County of San Bernardino (APN: 0231-021-57)

C/o Tec Equipment, Inc.

Attn: David Thompson

750 NE Columbia Blvd.

Portland, OR 97211

(503) 247-4655

Prepared by:

Thatcher Engineering and Associates, Inc

1461 Ford Street, Suite 105

Redlands, CA

(909) 748-7777

Prepared: November 12, 2015

Approval Date: \_\_\_\_\_

### Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for San Bernardino County Redevelopment Agency; The County of San Bernardino Redevelopment Agency; Redevelopment Agency of the County of San Bernardino; County of San Bernardino by Thatcher Engineering and Associates, Inc.. The WQMP is intended to comply with the requirements of the Santa Ana Regional Water Quality Control Board and the NPDES Areawide Stormwater Program requiring the preparation of a WQMP. 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 San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county 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):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):	APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83, and 84	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83, and 84
Owner's Signature			
Owner Name:			
Title			
Company	San Bernardino County Redevelopment Agency (APN: 0231-021-76, 82, 83&84) C/o Tec Equipment, Inc. Attn: David Thompson		
Address	750 NE Columbia Blvd., Portland, OR 97211		
Email	dothompson@tectrucks.com		
Telephone #	(503) 247-4655		
Signature		Date	

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Owner Name:			
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Company	Redevelopment Agency of the County of San Bernardino (APN: 0231-021-24, 25, 32, 54&55) C/o Tec Equipment, Inc. Attn: David Thompson		
Address	750 NE Columbia Blvd., Portland, OR 97211		
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Owner's Signature			
Owner Name:			
Title			
Company	County of San Bernardino (APN: 0231-021-57) C/o Tec Equipment, Inc. Attn: David Thompson		
Address	750 NE Columbia Blvd., Portland, OR 97211		
Email	dothompson@tctrucks.com		
Telephone #	(503) 247-4655		
Signature		Date	

### Preparer's Certification

<b>Project Data</b>			
Permit/Application Number(s):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):	APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83, and 84	Building Permit Number(s):	
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“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 Regional Water Quality Control Board Order No. R8-2010-0036.”

<b>Engineer:</b> Melvin W. Thatcher III		<b>PE Stamp Below</b>
Title	Professional Engineer	
Company	Thatcher Engineering and Associates, Inc.	
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Email	bthatcher@thatcherengineering.com	
Telephone #	(909) 748-7777	
Signature		
Date		

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# Section 1 Discretionary Permit(s)

<b>Form 1-1 Project Information</b>					
Project Name		Tec Equipment Truck Sales, Service/Repair, and Parts Sales Dealership			
Project Owner Contact Name:		San Bernardino County Redevelopment Agency; (APN: 0231-021-76, 82, 83 & 84) The County of San Bernardino Redevelopment Agency; (APN: 0231-021-48) Redevelopment Agency of the County of San Bernardino (APN: 0231-021-24, 25, 32, 54, 55) County of San Bernardino (APN: 0231-021-57) c/o Tec Equipment, Inc. Attn: David Thompson			
Mailing Address:	750 NE Columbia Blvd. Portland, OR 97211	E-mail Address:	dothompson@tectrucks.com	Telephone:	(503) 247-4655
Permit/Application Number(s):		Tract/Parcel Map Number(s):	APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83, and 84		
Additional Information/Comments:					
Description of Project:	The project proposes to develop a vacant site to create a truck sales, service/repair and parts sales dealership including a 166,200 sf service and sales building, display areas and related access, parking and landscape improvements.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	N/A for Preliminary WQMP				

## Section 2 Project Description

### 2.1 Project Information

This section of the WQMP should 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.

<b>Form 2.1-1 Description of Proposed Project</b>				
<b><sup>1</sup> Development Category (Select all that apply):</b>				
<input type="checkbox"/> Significant re-development involving the addition or replacement of 5,000 ft <sup>2</sup> or more of impervious surface on an already developed site	<input checked="" type="checkbox"/> New development involving the creation of 10,000 ft <sup>2</sup> or more of impervious surface collectively over entire site	<input type="checkbox"/> Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	<input type="checkbox"/> Restaurants (with SIC code 5812) where the land area of development is 5,000 ft <sup>2</sup> or more	
<input type="checkbox"/> Hillside developments of 5,000 ft <sup>2</sup> or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	<input type="checkbox"/> Developments of 2,500 ft <sup>2</sup> of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	<input checked="" type="checkbox"/> Parking lots of 5,000 ft <sup>2</sup> or more exposed to storm water	<input type="checkbox"/> Retail gasoline outlets that are either 5,000 ft <sup>2</sup> or more, or have a projected average daily traffic of 100 or more vehicles per day	
<input type="checkbox"/> Non-Priority / Non-Category Project <i>May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements.</i>				
<b><sup>2</sup> Project Area (ft<sup>2</sup>):</b>	615,492	<b><sup>3</sup> Number of Dwelling Units:</b>	0	<b><sup>4</sup> SIC Code:</b> 5511,7699
<b><sup>5</sup> Is Project going to be phased?</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.</i>				
<b><sup>6</sup> Does Project include roads?</b> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)</i>				

## 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:

The Owners are responsible for development of a report to the County on an annual basis. The Owner will complete a walk of the development and inspect the BMPs outlined in this WQMP. The Owner will report on the capacity and repair of facilities. Records shall be transmitted to the County for their use and keeping. These records must be kept on file by the Owner for at least 5 years from the date generated.

**Project Owners:**

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The County of San Bernardino Redevelopment Agency; (APN: 0231-021-48)

Redevelopment Agency of the County of San Bernardino (APN: 0231-021-24, 25, 32, 54, 55)

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C/o Tec Equipment, Inc.

**Attention:**

David Thompson

750 NE Columbia Blvd.

Portland, OR 97211

(503) 247-4655

dothompson@tetrucks.com

## 2.3 Potential Stormwater Pollutants

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

<b>Form 2.3-1 Pollutants of Concern</b>			
Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Santa Ana River Reach 3 (Dairies) Santa Ana River Reach 2 (Non-point source)
Phosphorous	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Nitrogen	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Sediment	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Metals	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	Santa Ana River Reach 3 (Non-point source)
Oil and Grease	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Trash/Debris	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Pesticides / Herbicides	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Organic Compounds	E <input checked="" type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	
Other:	E <input type="checkbox"/>	N <input type="checkbox"/>	

## 2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

<b>Form 2.4-1 Water Quality Credits</b>			
<sup>1</sup> Project Types that Qualify for Water Quality Credits: <i>Select all that apply</i>			
<input type="checkbox"/> Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects <input type="checkbox"/> Vertical density [20%] <input type="checkbox"/> 7 units/ acre [5%]	<input type="checkbox"/> Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	<input type="checkbox"/> Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
<input type="checkbox"/> Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	<input type="checkbox"/> Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	<input type="checkbox"/> In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	<input type="checkbox"/> Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
<sup>2</sup> Total Credit % N/A (Total all credit percentages up to a maximum allowable credit of 50 percent)			
Description of Water Quality Credit Eligibility (if applicable)	N/A		

## Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMP 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 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.***

<b>Form 3-1 Site Location and Hydrologic Features</b>			
Site coordinates take GPS measurement at approximate center of site	Latitude 34.085554	Longitude -117.48724	Thomas Bros Map page 604, C4
<b>1</b> San Bernardino County climatic region: <input checked="" type="checkbox"/> Valley <input type="checkbox"/> Mountain			
<b>2</b> Does the site have more than one drainage area (DA): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <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>			
<pre>                     graph TD                         DA1DMAA[DA1 DMA A] --&gt; Outlet1[Outlet 1]                         DA1DMAB[DA 1 DMA B] --&gt; Outlet1                         DA1DMAC[DA1 DMA C] --&gt; DA1DMAA                         DA2[DA2] --&gt; Outlet2[Outlet 2]                     </pre>			
Example only – modify for project specific WQMP using additional form			
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	<i>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</i>		
DA1 DMA A to Outlet 1			
DA1 DMA B to Outlet 1			
DA2 to Outlet 2			

<b>Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1</b>				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
<b>1</b> DMA drainage area (ft <sup>2</sup> )	615,492			
<b>2</b> Existing site impervious area (ft <sup>2</sup> )	0			
<b>3</b> Antecedent moisture condition <i>For desert areas, use <a href="http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf">http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</a></i>	AMC II			
<b>4</b> Hydrologic soil group <i>Refer to Watershed Mapping Tool – <a href="http://sbcounty.permitrack.com/WAP">http://sbcounty.permitrack.com/WAP</a></i>	A			
<b>5</b> Longest flowpath length (ft)	1,140			
<b>6</b> Longest flowpath slope (ft/ft)	0.013			
<b>7</b> Current land cover type(s) <i>Select from Fig C-3 of Hydrology Manual</i>	Barren			
<b>8</b> Pre-developed pervious area condition: <i>Based on the extent of wet season vegetated cover good &gt;75%; Fair 50-75%; Poor &lt;50% Attach photos of site to support rating</i>	Good			



Barren

<b>Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1</b> <b>(use only as needed for additional DMA w/in DA 1)</b>				
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 <sup>2</sup> )				
2 Existing site impervious area (ft <sup>2</sup> )				
3 Antecedent moisture condition <i>For desert areas, use</i> <a href="http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf">http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf</a>				
4 Hydrologic soil group <i>Refer to Watershed Mapping Tool –</i> <a href="http://sbcounty.permitrack.com/WAP">http://sbcounty.permitrack.com/WAP</a>				
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 &gt;75%; Fair 50-75%; Poor &lt;50% Attach photos of site to support rating</i>				

<b>Form 3-3 Watershed Description for Drainage Area</b>	
<p>Receiving waters</p> <p><i>Refer to Watershed Mapping Tool -</i>  <a href="http://sbcounty.permitrack.com/WAP">http://sbcounty.permitrack.com/WAP</a></p> <p><i>See "Drainage Facilities" link at this website</i></p>	<p>San Sevaine Channel</p> <p>Santa Ana River Reach 3 (Primary Basin No. 801.21, Secondary Basin No. 801.27 and 801.25)</p> <p>Santa Ana River Reach 2 (Primary Basin No. 801.11 and Secondary Basin No. 801.12)</p> <p>Santa Ana River Reach 1 (Primary Basin No. 801.11)</p> <p>Pacific Ocean</p>
<p>Applicable TMDLs</p> <p><i>Refer to Local Implementation Plan</i></p>	<p>Santa Ana River Reach 3 for Copper and Lead still required</p> <p>Santa Ana River Reach 3 for Pathogens is being addressed by USEPA approved TMDL.</p> <p>Santa Ana River Reach 2 for Bacteria still required</p>
<p>303(d) listed impairments</p> <p><i>Refer to Local Implementation Plan and Watershed Mapping Tool -</i>  <a href="http://sbcounty.permitrack.com/WAP">http://sbcounty.permitrack.com/WAP</a> and State Water Resources Control Board website -  <a href="http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml">http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml</a></p>	<p>Santa Ana River Reaches 3 and 2 are impaired by pathogens/bacteria.</p> <p>Santa Ana River Reach 3 is also impaired by metals.</p>
<p>Environmentally Sensitive Areas (ESA)</p> <p><i>Refer to Watershed Mapping Tool -</i>  <a href="http://sbcounty.permitrack.com/WAP">http://sbcounty.permitrack.com/WAP</a></p>	<p>None</p>
<p>Unlined Downstream Water Bodies</p> <p><i>Refer to Watershed Mapping Tool -</i>  <a href="http://sbcounty.permitrack.com/WAP">http://sbcounty.permitrack.com/WAP</a></p>	<p>Santa Ana River Reaches 3, 2 and 1</p>
<p>Hydrologic Conditions of Concern</p>	<p><input type="checkbox"/> Yes Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal</p> <p><input checked="" type="checkbox"/> No</p>
<p>Watershed-based BMP included in a RWQCB approved WAP</p>	<p><input type="checkbox"/> Yes Attach verification of regional BMP evaluation criteria in WAP</p> <ul style="list-style-type: none"> <li>• More Effective than On-site LID</li> <li>• Remaining Capacity for Project DCV</li> <li>• Upstream of any Water of the US</li> <li>• Operational at Project Completion</li> </ul>

Water Quality Management Plan (WQMP)

	<p>• <i>Long-Term Maintenance Plan</i></p> <p><input checked="" type="checkbox"/> No</p>
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## Section 4 Best Management Practices (BMP)

### 4.1 Source Control BMP

#### 4.1.1 Pollution Prevention

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.

### 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	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Owners and tenants are to familiarize themselves with the BMP's included in this document.
N2	Activity Restrictions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Restrictions include: vehicle washing, outdoor materials storage, outdoor work or processing areas, outdoor food preparation air/water supply, pesticide application by any other person than an applicator certified by the California Department of Pesticide Regulation, and hazardous materials storage. See maintenance bay section for more information on activity restrictions specific to maintenance bay areas.
N3	Landscape Management BMPs	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<p>All landscaping will be with native and drought tolerant trees and shrubs and groundcovers. Wood fiber will be used in the landscaping design. Plants will be grouped with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Landscaping will correlate to the climate, soil, related natural resources and existing vegetation of the site, as well as the type of development proposed.</p> <p>Rain triggered shutoff devices and shutoff devices designed to limit water supply in the event of a broken sprinkler will be used in the landscape design for new landscape areas. Irrigation and landscaping will be coordinated to avoid overspray, etc. Wood fiber will be used to limit the area requiring irrigation.</p>
N4	BMP Maintenance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The isolator row of the underground basin shall be inspected every 6 months for the first year and annually thereafter or more frequently as needed and shall be cleaned out when the average depth of sediment exceeds 3" throughout the length of the isolator row using the Jetvac process per manufacturer's recommendations. If inspection indicates the need for maintenance access is necessary, OSHA rules for contained space entries shall be followed.
N5	Title 22 CCR Compliance (How development will comply)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The Owner will file a Business Emergency Contingency Plan as required based on the nature and quantities of hazardous materials stored.

<b>Form 4.1-1 Non-Structural Source Control BMPs</b>				
N6	Local Water Quality Ordinances	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The Owner is responsible to comply with all County of San Bernardino Water Quality Ordinances.
N7	Spill Contingency Plan	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The Owner will file a Business Emergency Contingency Plan as required based on the nature and quantities of hazardous materials stored.
N8	Underground Storage Tank Compliance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The new septic system shall comply with state regulations.
N9	Hazardous Materials Disclosure Compliance	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The Owner will file a Business Emergency Contingency Plan as required based on the nature and quantities of hazardous materials stored.

### 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	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The Owner will file a Business Emergency Contingency Plan as required based on the nature and quantities of hazardous materials stored.
N11	Litter/Debris Control Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The Owner will ensure that the overall site is trash free including the infiltration basin and trash enclosure.
N12	Employee Training	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The Owner is to schedule an annual seminar and refresher course based on this document which can be conducted by a designated representative.
N13	Housekeeping of Loading Docks	<input checked="" type="checkbox"/>	<input type="checkbox"/>	A landscape maintenance company will be retained to provide housekeeping service for loading dock areas to include litter control and sweeping. This will occur on a monthly basis.
N14	Catch Basin Inspection Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The catch basin is to be inspected after the first storm event of the rainy season and two times per month thereafter until the end of the rainy season. It is to be cleaned out as necessary or when filled to 25% capacity.
N15	Vacuum Sweeping of Private Streets and Parking Lots	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The owners will contract with a sweepint company to to complete this BMP. Sweeping will occur annually, prior to the rainy season.
N16	Other Non-structural Measures for Public Agency Projects	<input type="checkbox"/>	<input checked="" type="checkbox"/>	This is not a public agency project.
N17	Comply with all other applicable NPDES permits	<input checked="" type="checkbox"/>	<input type="checkbox"/>	A construction SWPPP will be required for the project during construction.

**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)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The top of the catch basin will be painted with a "No Dumping, Drains to River" sign or equivalent.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No material storage areas are proposed.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Site drainage is designed to flow around the enclosure and not through it. Bins are to be equipped with working covers.
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)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Landscape planning should couple considerations of land suitability for urban uses with consideration of 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. Plants should be grouped with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Landscaping shall correlate to the climate, soil, related natural resources and existing vegetation of the site, as well as the type of development proposed. Irrigation methods shall be utilized to minimize runoff of excess irrigation water across impervious surfaces and into the stormwater conveyance system. Such measures include employing rain-triggered shutoff devices to eliminate or reduce irrigation during and immediately after precipitation, using mulches (such as wood chips) to minimize sediment in runoff and to maintain soil infiltration capacity, and coordinating design of the irrigation system and landscape to minimize overspray and runoff. Irrigation systems shall use flow reducers or shutoff valves triggered by pressure drop to control water loss in the event of broken sprinkler heads or water supply lines. Water conservation devices such as programmable irrigation timers and soil moisture sensors should also be considered. Scrap pipe and extra materials shall be recycled if possible. All non-recyclable wastes shall be landfilled. Hazardous wastes shall be disposed of per County hazardous material disposal regulations.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	<input checked="" type="checkbox"/>	<input type="checkbox"/>	The finished grade of landscape areas will be 1-2" below adjacent surface.

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S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No significant slopes or channels are proposed
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No covered dock areas are proposed.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	All maintenance will occur under the roof of the building.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	A wash rack will be provided. Wash rack water will be directed through both an Old Castle 3-stage oil-water clarifier as well as a Contech Stormwater cartridge prior to entering the septic system.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No outdoor processing areas are 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)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No new equipment wash areas are proposed.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No new fueling areas are part of the project.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No hillside landscaping is part of the project.
S14	Wash water control for food preparation areas	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No food preparation areas are part of the project.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	No community car wash racks are part of the project.

### 4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. 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.

<b>Form 4.1-3 Preventative LID Site Design Practices Checklist</b>	
<b>Site Design Practices</b> <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 <input checked="" type="checkbox"/> No <input type="checkbox"/>	Explanation: Of the 615,492 square feet of proposed project area, 10% is proposed pervious landscaping. A portion of the building is two stories.
Maximize natural infiltration capacity: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Explanation: The underground infiltration basin will provide natural treatment of runoff.
Preserve existing drainage patterns and time of concentration: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Explanation:
Disconnect impervious areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Explanation: The runoff from proposed improvements is directed to the underground infiltration basin for treatment.
Protect existing vegetation and sensitive areas: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Explanation: All existing vegetation will be removed to accommodate necessary site improvements.
Re-vegetate disturbed areas: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Explanation: Disturbed areas that are not proposed buildings or pavement will be landscaped.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Explanation: Unnecessary compaction will be minimized in the underground infiltration basins.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Explanation: Due to the nature of the use of the site, use of vegetated swales is not feasible.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Explanation: Unnecessary compaction will be minimized within the proposed landscape areas.

## 4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the 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 of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P<sub>6</sub> method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program 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 mi<sup>2</sup>), 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 HCOC performance criteria.

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

<b>Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)</b>		
<b>1</b> Project area DA 1 (ft <sup>2</sup> ): 615,492	<b>2</b> Imperviousness after applying preventative site design practices (Imp%): 90	<b>3</b> Runoff Coefficient (Rc): <u>.73</u> $R_c = 0.858(\text{Imp}\%)^{.73} - 0.78(\text{Imp}\%)^{.72} + 0.774(\text{Imp}\%) + 0.04$
<b>4</b> Determine 1-hour rainfall depth for a 2-year return period P <sub>2yr-1hr</sub> (in): 0.53 <a href="http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html">http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html</a>		
<b>5</b> Compute P <sub>6</sub> , Mean 6-hr Precipitation (inches): 0.78 <i>P<sub>6</sub> = Item 4 * C<sub>1</sub>, where C<sub>1</sub> is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)</i>		
<b>6</b> 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 <input type="checkbox"/> 48-hrs <input checked="" type="checkbox"/>
<b>7</b> Compute design capture volume, DCV (ft <sup>3</sup> ): 57,330 $DCV = 1/12 * [\text{Item 1} * \text{Item 3} * \text{Item 5} * C_2]$ , where C <sub>2</sub> 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 HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes  No

Go to: <http://sbcounty.permitrack.com/WAP>

If "Yes", then complete HCOC assessment of site hydrology for 2yr 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)

If "No," then proceed to Section 4.3 Project Conformance Analysis

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

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

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

## Form 4.2-4 HCOC 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
<b>1</b> Length of flowpath (ft) <i>Use Form 3-2 Item 5 for pre-developed condition</i>								
<b>2</b> Change in elevation (ft)								
<b>3</b> Slope (ft/ft), $S_o = \text{Item 2} / \text{Item 1}$								
<b>4</b> Land cover								
<b>5</b> Initial DMA Time of Concentration (min) <i>Appendix C-1 of the TGD for WQMP</i>								
<b>6</b> Length of conveyance from DMA outlet to project site outlet (ft) <i>May be zero if DMA outlet is at project site outlet</i>								
<b>7</b> Cross-sectional area of channel (ft <sup>2</sup> )								
<b>8</b> Wetted perimeter of channel (ft)								
<b>9</b> Manning's roughness of channel (n)								
<b>10</b> Channel flow velocity (ft/sec) $V_{fbs} = (1.49 / \text{Item 9}) * (\text{Item 7}/\text{Item 8})^{0.67} * (\text{Item 3})^{0.5}$								
<b>11</b> Travel time to outlet (min) $T_t = \text{Item 6} / (\text{Item 10} * 60)$								
<b>12</b> Total time of concentration (min) $T_c = \text{Item 5} + \text{Item 11}$								
<b>13</b> Pre-developed time of concentration (min):	<i>Minimum of Item 12 pre-developed DMA</i>							
<b>14</b> Post-developed time of concentration (min):	<i>Minimum of Item 12 post-developed DMA</i>							
<b>15</b> Additional time of concentration needed to meet HCOC requirement (min):	$T_{C-HCOC} = (\text{Item 14} * 0.95) - \text{Item 13}$							

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

Compute peak runoff for pre- and post-developed conditions

Variables	Pre-developed DA to Project Outlet <i>(Use additional forms if more than 3 DMA)</i>			Post-developed DA to Project Outlet <i>(Use additional forms if more than 3 DMA)</i>		
	DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
<b>1</b> Rainfall Intensity for storm duration equal to time of concentration $I_{peak} = 10^A(\text{LOG Form 4.2-1 Item 4} - 0.6 \text{ LOG Form 4.2-4 Item 5} / 60)$						
<b>2</b> Drainage Area of each DMA (ft <sup>2</sup> ) <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>						
<b>3</b> 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>						
<b>4</b> 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>						
<b>5</b> Maximum loss rate (in/hr) $F_m = \text{Item 3} * \text{Item 4}$ <i>Use area-weighted <math>F_m</math> 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>						
<b>6</b> Peak Flow from DMA (cfs) $Q_p = \text{Item 2} * 0.9 * (\text{Item 1} - \text{Item 5})$						
<b>7</b> 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
<b>8</b> Pre-developed $Q_p$ at $T_c$ for DMA A: $Q_p = \text{Item } 6_{DMAA} + \{\text{Item } 6_{DMAB} * (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAB}) / (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAB}) * \text{Item } 7_{DMAA/2}\} + \{\text{Item } 6_{DMAC} * (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAC}) / (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAC}) * \text{Item } 7_{DMAA/3}\}$	<b>9</b> Pre-developed $Q_p$ at $T_c$ for DMA B: $Q_p = \text{Item } 6_{DMAB} + \{\text{Item } 6_{DMAA} * (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAA}) / (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAA}) * \text{Item } 7_{DMAB/1}\} + \{\text{Item } 6_{DMAC} * (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAC}) / (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAC}) * \text{Item } 7_{DMAB/3}\}$			<b>10</b> Pre-developed $Q_p$ at $T_c$ for DMA C: $Q_p = \text{Item } 6_{DMAC} + \{\text{Item } 6_{DMAA} * (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAA}) / (\text{Item } 1_{DMAA} - \text{Item } 5_{DMAA}) * \text{Item } 7_{DMAC/1}\} + \{\text{Item } 6_{DMAB} * (\text{Item } 1_{DMAC} - \text{Item } 5_{DMAB}) / (\text{Item } 1_{DMAB} - \text{Item } 5_{DMAB}) * \text{Item } 7_{DMAC/2}\}$		
<b>10</b> Peak runoff from pre-developed condition confluence analysis (cfs): <span style="float: right;"><i>Maximum of Item 8, 9, and 10 (including additional forms as needed)</i></span>						
<b>11</b> Post-developed $Q_p$ at $T_c$ for DMA A: <i>Same as Item 8 for post-developed values</i>	<b>12</b> Post-developed $Q_p$ at $T_c$ for DMA B: <i>Same as Item 9 for post-developed values</i>			<b>13</b> Post-developed $Q_p$ at $T_c$ for DMA C: <i>Same as Item 10 for post-developed values</i>		
<b>14</b> Peak runoff from post-developed condition confluence analysis (cfs): <span style="float: right;"><i>Maximum of Item 11, 12, and 13 (including additional forms as needed)</i></span>						
<b>15</b> Peak runoff reduction needed to meet HCOC Requirement (cfs): <span style="float: right;"><math>Q_{p-HCOC} = (\text{Item 14} * 0.95) - \text{Item 10}</math></span>						

## 4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the 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 MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

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 5.3.2.1 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 Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use 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 HSC 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 LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment.**

## 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 eight 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, Harvest and Use BMP. If no, then proceed to Item 9 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, Hydrologic Source Control 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, Hydrologic Source Control BMP.*

### 4.3.1 Site Design Hydrologic Source Control BMP

Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC 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 HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC 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 HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.

<b>Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)</b>			
<b>1</b> 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 <input type="checkbox"/> No <input checked="" type="checkbox"/> If yes, complete Items 2-5; If no, proceed to Item 6	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
<b>2</b> Total impervious area draining to pervious area (ft <sup>2</sup> )			
<b>3</b> Ratio of pervious area receiving runoff to impervious area			
<b>4</b> Retention volume achieved from impervious area dispersion (ft <sup>3</sup> ) $V = \text{Item 2} * \text{Item 3} * (0.5/12)$ , assuming retention of 0.5 inches of runoff			
<b>5</b> Sum of retention volume achieved from impervious area dispersion (ft <sup>3</sup> ):		$V_{\text{retention}} = \text{Sum of Item 4 for all BMPs}$	
<b>6</b> Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> 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 <i>(Use additional forms for more BMPs)</i>
<b>7</b> Ponding surface area (ft <sup>2</sup> )			
<b>8</b> Ponding depth (ft)			
<b>9</b> Surface area of amended soil/gravel (ft <sup>2</sup> )			
<b>10</b> Average depth of amended soil/gravel (ft)			
<b>11</b> Average porosity of amended soil/gravel			
<b>12</b> Retention volume achieved from on-lot infiltration (ft <sup>3</sup> ) $V_{\text{retention}} = (\text{Item 7} * \text{Item 8}) + (\text{Item 9} * \text{Item 10} * \text{Item 11})$			
<b>13</b> Runoff volume retention from on-lot infiltration (ft <sup>3</sup> ):		$V_{\text{retention}} = \text{Sum of Item 12 for all BMPs}$	

### Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

<b>14</b> Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, complete Items 15-20. If no, proceed to Item 21</i>	DA    DMA BMP Type	DA    DMA BMP Type	DA    DMA BMP Type <i>(Use additional forms for more BMPs)</i>
<b>15</b> Rooftop area planned for ET BMP (ft <sup>2</sup> )			
<b>16</b> Average wet season ET demand (in/day) <i>Use local values, typical ~ 0.1</i>			
<b>17</b> Daily ET demand (ft <sup>3</sup> /day) <i>Item 15 * (Item 16 / 12)</i>			
<b>18</b> Drawdown time (hrs) <i>Copy Item 6 in Form 4.2-1</i>			
<b>19</b> Retention Volume (ft <sup>3</sup> ) <i>V<sub>retention</sub> = Item 17 * (Item 18 / 24)</i>			
<b>20</b> Runoff volume retention from evapotranspiration BMPs (ft <sup>3</sup> ): <span style="float: right;"><i>V<sub>retention</sub> = Sum of Item 19 for all BMPs</i></span>			
<b>21</b> Implementation of Street Trees: Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, complete Items 20-2. If no, proceed to Item 24</i>	DA    DMA BMP Type	DA    DMA BMP Type	DA    DMA BMP Type <i>(Use additional forms for more BMPs)</i>
<b>22</b> Number of Street Trees			
<b>23</b> Average canopy cover over impervious area (ft <sup>2</sup> )			
<b>24</b> Runoff volume retention from street trees (ft <sup>3</sup> ) <i>V<sub>retention</sub> = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches</i>			
<b>25</b> Runoff volume retention from street tree BMPs (ft <sup>3</sup> ): <span style="float: right;"><i>V<sub>retention</sub> = Sum of Item 24 for all BMPs</i></span>			
<b>26</b> Implementation of residential rain barrels/cisterns: Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, complete Items 27-28; If no, proceed to Item 29</i>	DA    DMA BMP Type	DA    DMA BMP Type	DA    DMA BMP Type <i>(Use additional forms for more BMPs)</i>
<b>27</b> Number of rain barrels/cisterns			
<b>28</b> Runoff volume retention from rain barrels/cisterns (ft <sup>3</sup> ) <i>V<sub>retention</sub> = Item 27 * 3</i>			
<b>29</b> Runoff volume retention from residential rain barrels/Cisterns (ft3): <span style="float: right;"><i>V<sub>retention</sub> = Sum of Item 28 for all BMPs</i></span>			
<b>30</b> Total Retention Volume from Site Design Hydrologic Source Control BMPs: <span style="float: right;"><i>Sum of Items 5, 13, 20, 25 and 29</i></span>			

### **4.3.2 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 D 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 5.5.1 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).

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

<sup>1</sup> Remaining LID DCV not met by site design HSC BMP (ft<sup>3</sup>): 57,330  $V_{unmet} = \text{Form 4.2-1 Item 7} - \text{Form 4.3-2 Item 30}$

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 BMP Type Infiltration Basin	DA DMA BMP Type	DA DMA BMP Type (Use additional forms for more BMPs)
<sup>2</sup> Infiltration rate of underlying soils (in/hr) See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods	N/A*		
<sup>3</sup> Infiltration safety factor See TGD Section 5.4.2 and Appendix D	N/A*		
<sup>4</sup> Design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$	N/A*		
<sup>5</sup> Ponded water drawdown time (hr) Copy Item 6 in Form 4.2-1	48 hours		
<sup>6</sup> Maximum ponding depth (ft) BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details	N/A		
<sup>7</sup> Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$	N/A		
<sup>8</sup> Infiltrating surface area, $SA_{BMP}$ (ft <sup>2</sup> ) the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP	N/A		
<sup>9</sup> 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	N/A		
<sup>10</sup> Amended soil porosity	N/A		
<sup>11</sup> Gravel depth, $d_{media}$ (ft) Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details	N/A		
<sup>12</sup> Gravel porosity	N/A		
<sup>13</sup> Duration of storm as basin is filling (hrs) Typical ~ 3hrs	N/A		
<sup>14</sup> Above Ground Retention Volume (ft <sup>3</sup> ) $V_{retention} = \text{Item 8} * \{\text{Item 7} + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))\}$	N/A		
<sup>15</sup> Underground Retention Volume (ft <sup>3</sup> ) Volume determined using manufacturer's specifications and calculations	60,000		
<sup>16</sup> Total Retention Volume from LID Infiltration BMPs: 60,000 CF (Sum of Items 14 and 15 for all infiltration BMP included in plan)			
<sup>17</sup> Fraction of DCV achieved with infiltration BMP: 105% $\text{Retention\%} = \text{Item 16} / \text{Form 4.2-1 Item 7}$			

<sup>18</sup> Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and 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.

\*Testing is in progress. Results will be provided under separate cover.

### 4.3.3 Harvest and Use BMP

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

<b>Form 4.3-4 Harvest and Use BMPs (DA 1)</b>			
<b>1</b> Remaining LID DCV not met by site design HSC or infiltration BMP (ft <sup>3</sup> ): Not applicable. <i>V<sub>unmet</sub> = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 - Form 4.3-3 Item 16</i>			
BMP Type(s) <i>Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs</i>	DA BMP Type	DMA BMP Type	DA DMA BMP Type <i>(Use additional forms for more BMPs)</i>
<b>2</b> Describe cistern or runoff detention facility			
<b>3</b> Storage volume for proposed detention type (ft <sup>3</sup> ) <i>Volume of cistern</i>			
<b>4</b> Landscaped area planned for use of harvested stormwater (ft <sup>2</sup> )			
<b>5</b> Average wet season daily irrigation demand (in/day) <i>Use local values, typical ~ 0.1 in/day</i>			
<b>6</b> Daily water demand (ft <sup>3</sup> /day) <i>Item 4 * (Item 5 / 12)</i>			
<b>7</b> Drawdown time (hrs) <i>Copy Item 6 from Form 4.2-1</i>			
<b>8</b> Retention Volume (ft <sup>3</sup> ) <i>V<sub>retention</sub> = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))</i>			
<b>9</b> Total Retention Volume (ft <sup>3</sup> ) from Harvest and Use BMP <i>Sum of Item 8 for all harvest and use BMP included in plan</i>			
<b>10</b> Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest and use BMPs? Yes <input type="checkbox"/> No <input type="checkbox"/> <i>If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.</i>			

### 4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. 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 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

<b>Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)</b>		
<b>1</b> Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft <sup>3</sup> ): Not Applicable <i>Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9</i>	List pollutants of concern <i>Copy from Form 2.3-1.</i>	
<b>2</b> 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>	<b>Volume-based biotreatment</b> <i>Use Forms 4.3-6 and 4.3-7 to compute treated volume</i> <input type="checkbox"/> Bioretention with underdrain <input type="checkbox"/> Planter box with underdrain <input type="checkbox"/> Constructed wetlands <input type="checkbox"/> Wet extended detention <input type="checkbox"/> Dry extended detention	<b>Flow-based biotreatment</b> <i>Use Form 4.3-8 to compute treated volume</i> <input type="checkbox"/> Vegetated swale <input type="checkbox"/> Vegetated filter strip <input type="checkbox"/> Proprietary biotreatment
<b>3</b> Volume biotreated in volume based biotreatment BMP (ft <sup>3</sup> ): <i>Form 4.3-6 Item 15 + Form 4.3-7 Item 13</i>	<b>4</b> Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft <sup>3</sup> ): <i>Item 1 – Item 3</i>	<b>5</b> Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % <i>Item 4 / Item 1</i>
<b>6</b> Flow-based biotreatment BMP capacity provided (cfs): <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>		
<b>7</b> Metrics for MEP determination: <ul style="list-style-type: none"> <li>• 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: <input type="checkbox"/> <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></li> </ul>		

### Form 4.3-6 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	DA	DMA	DA	DMA
	BMP Type	BMP Type				
	Not Applicable	Not Applicable				
					<i>(Use additional forms for more BMPs)</i>	
<b>1</b> 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>						
<b>2</b> Amended soil infiltration rate <i>Typical ~ 5.0</i>						
<b>3</b> Amended soil infiltration safety factor <i>Typical ~ 2.0</i>						
<b>4</b> Amended soil design percolation rate (in/hr) $P_{design} = \text{Item 2} / \text{Item 3}$						
<b>5</b> Ponded water drawdown time (hr) <i>Copy Item 6 from Form 4.2-1</i>						
<b>6</b> Maximum ponding depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>						
<b>7</b> Ponding Depth (ft) $d_{BMP} = \text{Minimum of } (1/12 * \text{Item 4} * \text{Item 5}) \text{ or Item 6}$						
<b>8</b> Amended soil surface area (ft <sup>2</sup> )						
<b>9</b> Amended soil depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>						
<b>10</b> Amended soil porosity, <i>n</i>						
<b>11</b> Gravel depth (ft) <i>see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>						
<b>12</b> Gravel porosity, <i>n</i>						
<b>13</b> Duration of storm as basin is filling (hrs) <i>Typical ~ 3hrs</i>						
<b>14</b> Biotreated Volume (ft <sup>3</sup> ) $V_{biotreated} = \text{Item 8} * \{(\text{Item 7}/2) + (\text{Item 9} * \text{Item 10}) + (\text{Item 11} * \text{Item 12}) + (\text{Item 13} * (\text{Item 4} / 12))\}$						
<b>15</b> 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 4.3-7 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 Not applicable		DA    DMA BMP Type <i>(Use additional forms for more BMPs)</i>	
	Forebay	Basin	Forebay	Basin
<b>1</b> 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>				
<b>2</b> Bottom width (ft)				
<b>3</b> Bottom length (ft)				
<b>4</b> Bottom area (ft <sup>2</sup> ) $A_{bottom} = \text{Item 2} * \text{Item 3}$				
<b>5</b> Side slope (ft/ft)				
<b>6</b> Depth of storage (ft)				
<b>7</b> Water surface area (ft <sup>2</sup> ) $A_{surface} = (\text{Item 2} + (2 * \text{Item 5} * \text{Item 6})) * (\text{Item 3} + (2 * \text{Item 5} * \text{Item 6}))$				
<b>8</b> Storage volume (ft <sup>3</sup> ) <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> $V = \text{Item 6} / 3 * [\text{Item 4} + \text{Item 7} + (\text{Item 4} * \text{Item 7})^{0.5}]$				
<b>9</b> Drawdown Time (hrs) <i>Copy Item 6 from Form 2.1</i>				
<b>10</b> Outflow rate (cfs) $Q_{BMP} = (\text{Item 8}_{forebay} + \text{Item 8}_{basin}) / (\text{Item 9} * 3600)$				
<b>11</b> Duration of design storm event (hrs)				
<b>12</b> Biotreated Volume (ft <sup>3</sup> ) $V_{biotreated} = (\text{Item 8}_{forebay} + \text{Item 8}_{basin}) * (\text{Item 10} * \text{Item 11} * 3600)$				
<b>13</b> 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>				

<b>Form 4.3-8 Flow Based Biotreatment (DA 1)</b>			
Biotreatment BMP Type <i>Vegetated swale, vegetated filter strip, or other comparable proprietary BMP</i>	DA    DMA BMP Type Not Applicable	DA    DMA BMP Type	DA    DMA BMP Type <i>(Use additional forms for more BMPs)</i>
<b>1</b> 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>			
<b>2</b> 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>			
<b>3</b> Bed slope (ft/ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>4</b> Manning's roughness coefficient			
<b>5</b> Bottom width (ft) $b_w = (\text{Form 4.3-5 Item 6} * \text{Item 4}) / (1.49 * \text{Item 2}^{1.67} * \text{Item 3}^{0.5})$			
<b>6</b> Side Slope (ft/ft) <i>BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>7</b> Cross sectional area (ft <sup>2</sup> ) $A = (\text{Item 5} * \text{Item 2}) + (\text{Item 6} * \text{Item 2}^2)$			
<b>8</b> Water quality flow velocity (ft/sec) $V = \text{Form 4.3-5 Item 6} / \text{Item 7}$			
<b>9</b> Hydraulic residence time (min) <i>Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details</i>			
<b>10</b> Length of flow based BMP (ft) $L = \text{Item 8} * \text{Item 9} * 60$			
<b>11</b> Water surface area at water quality flow depth (ft <sup>2</sup> ) $SA_{top} = (\text{Item 5} + (2 * \text{Item 2} * \text{Item 6})) * \text{Item 10}$			

### 4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, 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.

<b>Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)</b>	
<b>1</b>	Total LID DCV for the Project DA-1 (ft <sup>3</sup> ): 57,330 <i>Copy Item 7 in Form 4.2-1</i>
<b>2</b>	On-site retention with site design hydrologic source control LID BMP (ft <sup>3</sup> ): 0 CF <i>Copy Item 30 in Form 4.3-2</i>
<b>3</b>	On-site retention with LID infiltration BMP (ft <sup>3</sup> ): 60,000 CF <i>Copy Item 16 in Form 4.3-3</i>
<b>4</b>	On-site retention with LID harvest and use BMP (ft <sup>3</sup> ): 0 <i>Copy Item 9 in Form 4.3-4</i>
<b>5</b>	On-site biotreatment with volume based biotreatment BMP (ft <sup>3</sup> ): 0 <i>Copy Item 3 in Form 4.3-5</i>
<b>6</b>	Flow capacity provided by flow based biotreatment BMP (cfs): 0 <i>Copy Item 6 in Form 4.3-5</i>
<b>7</b>	<p>LID BMP performance criteria are achieved if answer to any of the following is "Yes":</p> <ul style="list-style-type: none"> <li>• Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> <i>If yes, sum of Items 2, 3, and 4 is greater than Item 1</i></li> <li>• 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 <input type="checkbox"/> No <input checked="" type="checkbox"/> <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></li> <li>• On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> <i>If yes, Form 4.3-1 Items 7 and 8 were both checked yes</i></li> </ul>
<b>8</b>	<p>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:</p> <ul style="list-style-type: none"> <li>• Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: <input type="checkbox"/> <i>Checked yes for Form 4.3-5 Item 7, 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, <math>V_{alt} = (Item\ 1 - Item\ 2 - Item\ 3 - Item\ 4 - Item\ 5) * (100 - Form\ 2.4-1\ Item\ 2)\%</math></i></li> <li>• An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: <input type="checkbox"/> <i>Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed</i></li> </ul>

### 4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

<b>Form 4.3-10 Hydromodification Control BMPs (DA 1)</b>	
<p><b>1</b> Volume reduction needed for HCOC performance criteria (ft<sup>3</sup>): Not applicable (Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1</p>	<p><b>2</b> On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft<sup>3</sup>): <i>Sum of Form 4.3-9 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 HCOC volume reduction</i></p>
<p><b>3</b> Remaining volume for HCOC volume capture (ft<sup>3</sup>): <i>Item 1 – Item 2</i></p>	<p><b>4</b> Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft<sup>3</sup>): <i>Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)</i></p>
<p><b>5</b> If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification <input type="checkbox"/> <i>Attach in-stream control BMP selection and evaluation to this WQMP</i></p>	
<p><b>6</b> Is Form 4.2-2 Item 11 less than or equal to 5%: Yes <input type="checkbox"/> No <input type="checkbox"/></p> <p><i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i></p> <ul style="list-style-type: none"> <li>• Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP <input type="checkbox"/> <i>BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)</i></li> <li>• 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 <input type="checkbox"/></li> <li>• Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California <input type="checkbox"/></li> </ul>	
<p><b>7</b> Form 4.2-2 Item 12 less than or equal to 5%: Yes <input type="checkbox"/> No <input type="checkbox"/></p> <p><i>If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:</i></p> <ul style="list-style-type: none"> <li>• Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs <input type="checkbox"/> <i>BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)</i></li> <li>• Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California <input type="checkbox"/></li> </ul>	

## 4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, 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 compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

## Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

All BMP 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 may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

<b>Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)</b>			
BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
<p>N-1 Education of Property Owners, Tenants and occupants on storm-water BMPs</p>	<p>Owner</p>	<p>This BMP will begin at building occupancy. Practical informational materials are provided in this document in Section 6. These include BMPs that eliminate or reduce pollution during property improvements. The property owners are encouraged to implement the use of alternative building materials, drought resistant and native plant species in landscaping and pervious pavement in all additions and modifications to the property.</p>	<p>Within 6 months of employment of new employees and annually thereafter.</p>
<p>N-3 Landscape Management BMPs</p>	<p>Owner</p>	<p>This BMP will begin within 30 days of building occupancy and will occur on a monthly basis (or more frequently if desired). The owners will retain a landscape maintenance company or will have staff designated to service all site landscaping. They are to ensure that turf is in good condition and little raw ground is exposed. Site trees and shrubs are to be trimmed as necessary and all wastes disposed of offsite. Wood fiber that has been disturbed is to be replaced. They are also to ensure that all areas are trash free. Trash is to be disposed of offsite. Ongoing maintenance shall be consistent with local guidelines, and fertilizer and pesticide usage shall be consistent with the instructions</p>	<p>Monthly</p>

Water Quality Management Plan (WQMP)

		<p>contained on product labels and with the regulations administered by the State Department of Pesticide Regulation. Clippings and yard waste shall be composted. A landscape maintenance company will be retained to service all site irrigation. Any adjustments to ensure that sprinklers are not overspraying should be made in a timely manner. Any breaks or leaks in piping must be repaired within 2 business days of report to the landscaper.</p>	
<p>N-4 Infiltration Basin Maintenance</p>	<p>Owner</p>	<p>The isolator row of the underground basin shall be inspected every 6 months for the first year and annually thereafter or more frequently as needed and shall be cleaned out when the average depth of sediment exceeds 3" throughout the length of the isolator row using the Jetvac process per manufacturer's recommendations. If inspection indicates the need for maintenance access is necessary, OSHA rules for contained space entries shall be followed.</p>	<p>After Major Storm Events</p>
<p>N-11 Litter/Debris Control Program</p>	<p>Owner</p>	<p>This BMP will begin within 30 days of project completion and will occur on a weekly basis (or more frequently if dictated by volume of trash). A landscape maintenance company will be retained to provide litter control services. They are to ensure that overall site is trash free, including the inside of the trash enclosure. Trash in these areas is to be removed and placed inside the trash bins. They are also to report to the Owners if the trash bins or lids have become damaged so that they can be replaced.</p>	<p>Weekly</p>
<p>N-12 Employee Training</p>	<p>Owner</p>	<p>This BMP will begin within 30 days of building occupancy and refresher course will occur annually thereafter. The owners shall insure that all employees are familiar with the contents of this plan and appendix.</p>	<p>Annually</p>
<p>N-13 House-keeping of Loading Docks</p>	<p>Owner</p>	<p>This BMP will begin within 30 days of project completion and sweeping will occur monthly thereafter. All wastes shall be landfilled. There will be no loading dock cleaning with water.</p>	<p>Monthly</p>

**Water Quality Management Plan (WQMP)**

<p>N-14 Catch Basin Inspection Program</p>	<p>Owner</p>	<p>This BMP will begin within 30 days of project completion. Inspections will be done by a landscape maintenance company or other staff after the first storm of the rainy season and two times per month thereafter for the duration of the rainy season. The inspector is also required to clean the facilities as needed or when filled to 25% capacity. Cleaning can be by pump or shopvac or by hand. Debris and trash shall be landfilled.</p>	<p>Monthly</p>
<p>N-15 Vacuum Sweeping of Private Streets and Parking Lots</p>	<p>Owner</p>	<p>This BMP will begin within 1 year of project completion and sweeping will occur annually thereafter, prior to the rainy season. The owners will contract with a sweeping company to complete this BMP. All wastes shall be landfilled. The parking lots shall be swept. There will be no parking lot cleaning with water.</p>	<p>Annual</p>

## 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

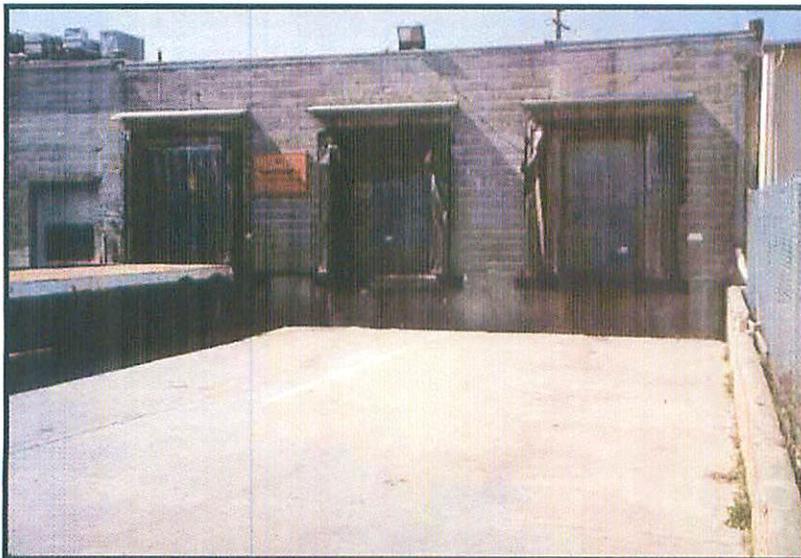
Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Local Implementation Plan), this section will describe the contents (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



## Objectives

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

## Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

### *Pollution Prevention*

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

## Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓



***Suggested Protocols******Loading and Unloading – General Guidelines***

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

***Inspection***

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

***Training***

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

## ***Spill Response and Prevention***

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

## ***Other Considerations (Limitations and Regulations)***

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

## **Requirements**

### ***Costs***

Costs should be low except when covering a large loading/unloading area.

### ***Maintenance***

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

## **Supplemental Information**

### ***Further Detail of the BMP***

#### ***Special Circumstances for Indoor Loading/Unloading of Materials***

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.
- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

**References and Resources**

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual  
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>



## Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

## Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

## Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

## Objectives

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

## Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	



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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

## ***Suggested Protocols***

### *Pressure Washing of Buildings, Rooftops, and Other Large Objects*

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

### *Landscaping Activities*

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

### *Building Repair, Remodeling, and Construction*

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

### *Mowing, Trimming, and Planting*

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

### *Fertilizer and Pesticide Management*

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

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- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

## *Inspection*

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

## *Training*

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

## *Spill Response and Prevention*

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

## *Other Considerations*

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

## **Requirements**

### *Costs*

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

### *Maintenance*

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

## Supplemental Information

### *Further Detail of the BMP*

#### *Fire Sprinkler Line Flushing*

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, polyphosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

## References and Resources

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual  
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org/>

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org/>

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>

# Parking/Storage Area Maintenance SC-43



## Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

## Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

## Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

## Objectives

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

## Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓



# **SC-43 Parking/Storage Area Maintenance**

## ***Suggested Protocols***

### ***General***

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

### ***Controlling Litter***

- Post “No Littering” signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

### ***Surface Cleaning***

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

# **Parking/Storage Area Maintenance SC-43**

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

## ***Surface Repair***

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- 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.

## ***Inspection***

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

## ***Training***

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

## ***Spill Response and Prevention***

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

## ***Other Considerations***

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

# **SC-43 Parking/Storage Area Maintenance**

## **Requirements**

### ***Costs***

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

### ***Maintenance***

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

## **Supplemental Information**

### ***Further Detail of the BMP***

#### ***Surface Repair***

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

## **References and Resources**

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual  
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). <http://www.basmaa.org/>

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net/>



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

## Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

## Approach

### *Pollution Prevention*

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

### *Suggested Protocols*

#### *Catch Basins/Inlet Structures*

- Staff should regularly inspect facilities to ensure compliance with 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 SC34 Waste Handling and Disposal).

## Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	



# SC-44      **Drainage System Maintenance**

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- 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.
- 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 if necessary 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. Do not dewater near a storm drain or stream.

## *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 and pump flushed effluent to the sanitary sewer for treatment whenever possible.

## *Pump Stations*

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

## *Open Channel*

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and 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*

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - 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 upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.
- Stencil or demarcate 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*

- Inspect and clean up hot spots and other storm drainage areas regularly 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.

### *Training*

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

***Spill Response and Prevention***

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using “dry” methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

***Other Considerations (Limitations and Regulations)***

- Clean-up 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 prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

**Requirements*****Costs***

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
  - Purchase and installation of signs.
  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
  - Purchase of landfill space to dispose of illegally-dumped items and material.

- 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.

## ***Maintenance***

- Two-person teams may be required to clean catch basins with vacuor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

## **Supplemental Information**

### ***Further Detail of the BMP***

#### ***Storm Drain Flushing***

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents “plug flow” discharges of concentrated pollutant loadings and sediments. 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, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect 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 recollect 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% for organics and 55-65% 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 sewer flushing.

# **SC-44            Drainage System Maintenance**

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## **References and Resources**

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Clark County Storm Water Pollution Control Manual  
<http://www.co.clark.wa.us/pubworks/bmpman.pdf>

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program <http://www.scvurppp.org>

The Storm Water Managers Resource Center <http://www.stormwatercenter.net>

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:  
[http://www.epa.gov/npdes/menuofbmps/poll\\_16.htm](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**

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## ***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

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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

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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.

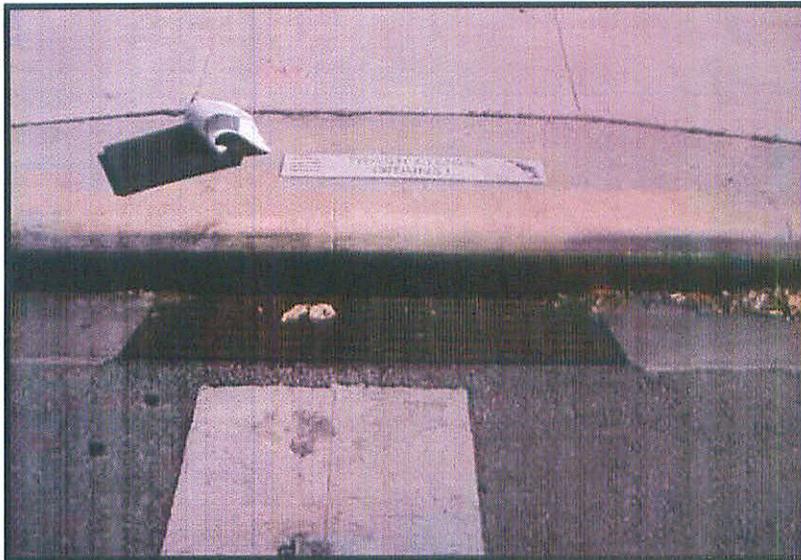
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A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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.

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## 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.

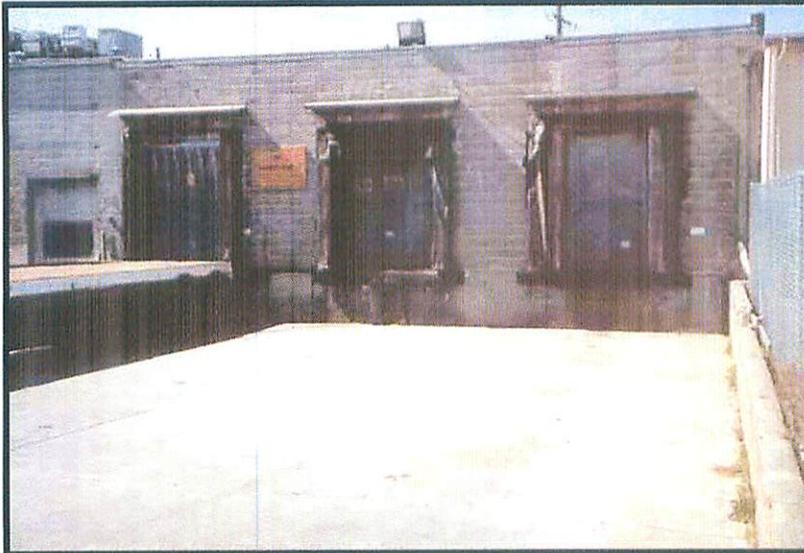
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## Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

## Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

## Suitable Applications

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

## Design Considerations

Design requirements for vehicle maintenance and repair 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 requirements.

## Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).



- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters from entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.
- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.
- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.
- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.
- Other features may be 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.

### **Additional Information**

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

### **Other Resources**

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

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## 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
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- 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.

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## Description

An infiltration basin is a shallow impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice has high pollutant removal efficiency and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

## California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

## Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

## Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

## Targeted Constituents

<input checked="" type="checkbox"/>	Sediment	■
<input checked="" type="checkbox"/>	Nutrients	■
<input checked="" type="checkbox"/>	Trash	■
<input checked="" type="checkbox"/>	Metals	■
<input checked="" type="checkbox"/>	Bacteria	■
<input checked="" type="checkbox"/>	Oil and Grease	■
<input checked="" type="checkbox"/>	Organics	■

### Legend (Removal Effectiveness)

- Low
- High
- ▲ Medium



significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

### **Limitations**

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

### **Design and Sizing Guidelines**

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

### **Construction/Inspection Considerations**

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabilized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

## Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation. If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

## Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.
- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.
- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.
- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

- Base flow should not be present in the tributary watershed.

### **Secondary Screening Based on Site Geotechnical Investigation**

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.
- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.
- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.
- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

### **Additional Design Guidelines**

- (1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.
- (2) Provide pretreatment if sediment loading is a maintenance concern for the basin.
- (3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.
- (4) Basin invert area should be determined by the equation:

$$A = \frac{WQV}{kt}$$

where A = Basin invert area (m<sup>2</sup>)

WQV = water quality volume (m<sup>3</sup>)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

- (5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

## Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

## Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about \$2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about \$18/ft<sup>3</sup> for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

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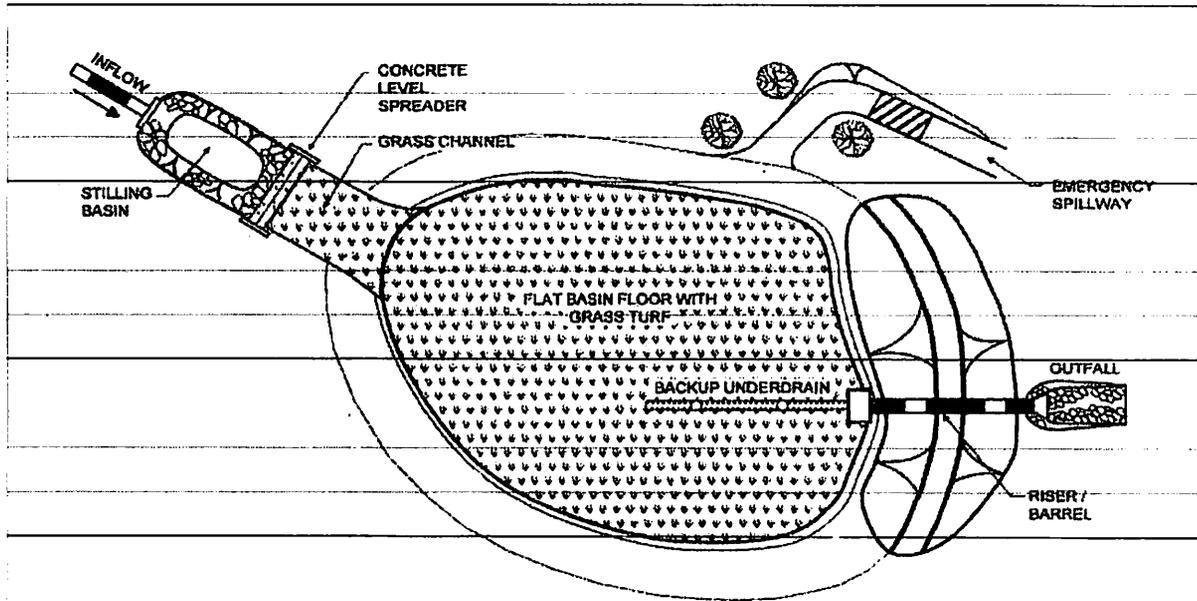
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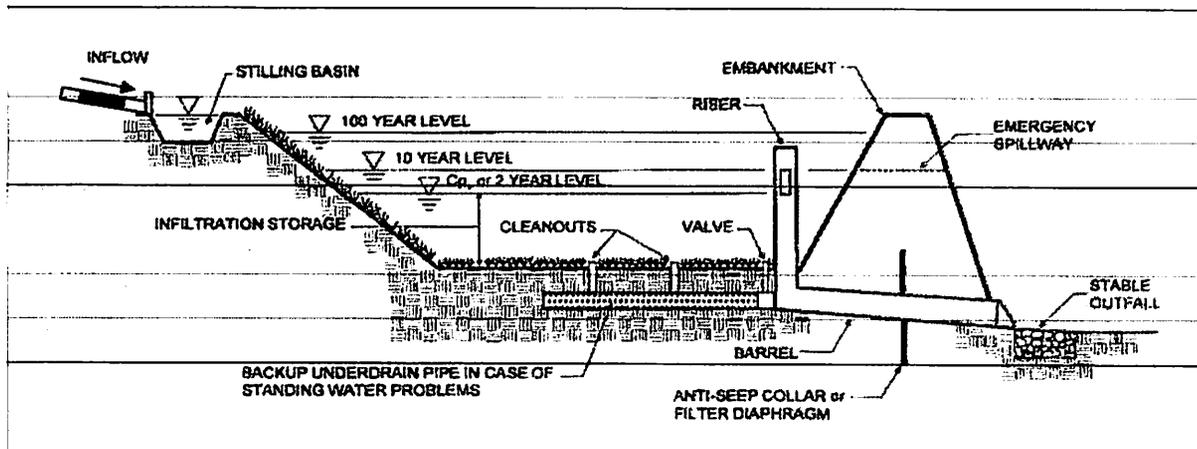
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PLAN VIEW



PROFILE



Photo Credit: Geoff Brosseau

## Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
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## Description

Vehicle washing, equipment washing, and steam cleaning may contribute high concentrations of metals, oil and grease, solvents, phosphates, and suspended solids to wash waters that drain to stormwater conveyance systems.

## Approach

Project plans should include appropriately designed area(s) for washing-steam cleaning of vehicles and equipment. Depending on the size and other parameters of the wastewater facility, wash water may be conveyed to a sewer, an infiltration system, recycling system or other alternative. Pretreatment may be required for conveyance to a sanitary sewer.

## Suitable Applications

Appropriate applications include commercial developments, restaurants, retail gasoline outlets, automotive repair shops and others.

## Design Considerations

Design requirements for vehicle maintenance are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. Design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

## Designing New Installations

Areas for washing/steam cleaning should incorporate one of the following features:

- Be self-contained and/or covered with a roof or overhang
- Be equipped with a clarifier or other pretreatment facility
- Have a proper connection to a sanitary sewer



- Include other features which are comparable and equally effective

**CAR WASH AREAS** - Some jurisdictions' stormwater management plans include vehicle-cleaning area source control design requirements for community car wash racks in complexes with a large number of dwelling units. In these cases, wash water from the areas may be directed to the sanitary sewer, to an engineered infiltration system, or to an equally effective alternative. Pre-treatment may also be required.

Depending on the jurisdiction, developers may be directed to divert surface water runoff away from the exposed area around the wash pad ( parking lot, storage areas), and wash pad itself to alternatives other than the sanitary sewer. Roofing may be required for exposed wash pads.

It is generally advisable to cover areas used for regular washing of vehicles, trucks, or equipment, surround them with a perimeter berm, and clearly mark them as a designated washing area. Sumps or drain lines can be installed to collect wash water, which may be treated for reuse or recycling, or for discharge to the sanitary sewer. Jurisdictions may require some form of pretreatment, such as a trap, for these areas.

### ***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.

### **Additional Information**

#### ***Maintenance Considerations***

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

#### **Other Resources**

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

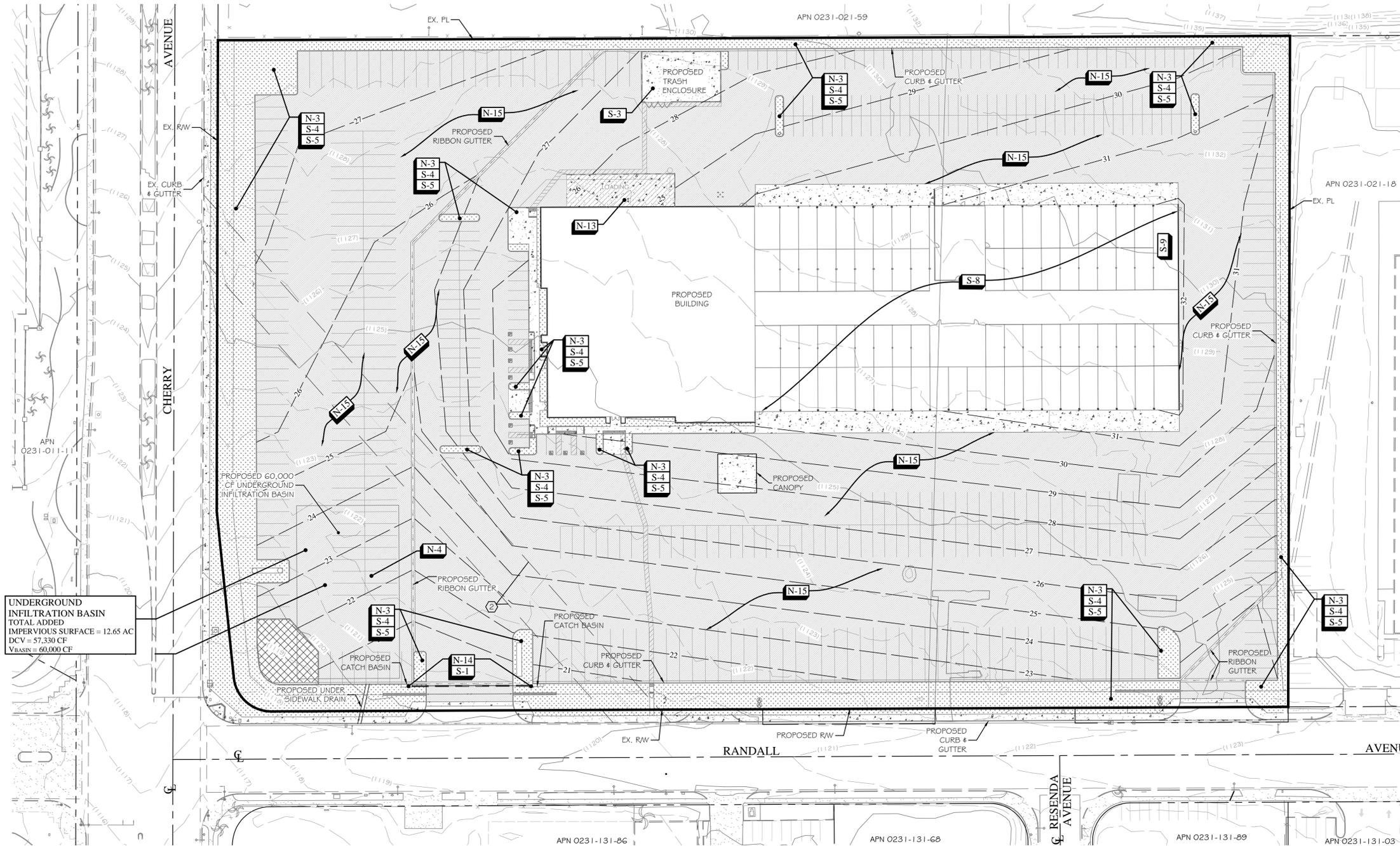
Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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.

# PRELIMINARY WATER QUALITY MANAGEMENT PLAN

APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83 & 84  
 NORTH EAST CORNER OF CHERRY AVENUE  
 & RANDALL AVENUE  
 COUNTY OF SAN BERNARDINO



**UNDERGROUND INFILTRATION BASIN**  
 TOTAL ADDED IMPERVIOUS SURFACE = 12.65 AC  
 DCV = 57,330 CF  
 VRAIN = 60,000 CF

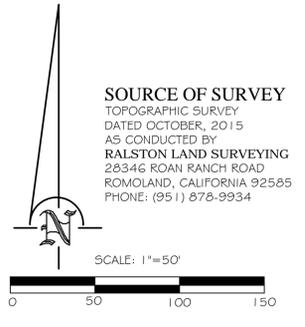
**KEY NOTES:**

BMP SYMBOL	DESCRIPTION	RESPONSIBLE PARTY
N-1	EDUCATION OF PROPERTY OWNERS, TENANTS AND OCCUPANTS ON STORMWATER BMP'S	DEVELOPER/OWNER
N-2	ACTIVITY RESTRICTIONS	DEVELOPER/OWNER
N-3	LANDSCAPE MANAGEMENT BMP'S	DEVELOPER/OWNER
N-4	BMP MAINTENANCE	DEVELOPER/OWNER
N-5	TITLE 22 CCR COMPLIANCE	DEVELOPER/OWNER
N-6	LOCAL WATER QUALITY ORDINANCES	DEVELOPER/OWNER
N-7	SPILL CONTINGENCY PLAN	DEVELOPER/OWNER
N-8	UNDERGROUND STORAGE TANK COMPLIANCE	DEVELOPER/OWNER
N-9	HAZARDOUS MATERIALS DISCLOSURE COMPLIANCE	DEVELOPER/OWNER
N-10	UNIFORM FIRE CODE IMPLEMENTATION	DEVELOPER/OWNER
N-11	LITTER/DEBRIS CONTROL PROGRAM	DEVELOPER/OWNER
N-12	EMPLOYEE TRAINING	DEVELOPER/OWNER
N-13	HOUSEKEEPING OF LOADING DOCKS	DEVELOPER/OWNER
N-14	CATCH BASIN INSPECTION PROGRAM	DEVELOPER/OWNER
N-15	VACUUM SWEEPING OF PARKING LOTS	DEVELOPER/OWNER
N-17	COMPLY WITH ALL OTHER APPLICABLE NPDES PERMITS	DEVELOPER/OWNER
S-1	PROVIDE STORM DRAIN SYSTEM STENCILING AND SIGNAGE	DEVELOPER/OWNER
S-3	DESIGN AND CONSTRUCT TRASH AND WASH STORAGE AREAS TO REDUCE POLLUTION INTRODUCTION	DEVELOPER/OWNER
S-4	EFFICIENT IRRIGATION SYSTEMS & LANDSCAPE SOURCE CONTROL	DEVELOPER/OWNER
S-5	FINISH GRADE OF LANDSCAPED AREAS 1-2" BELOW ADJACENT SURFACE	DEVELOPER/OWNER
S-8	COVERED MAINTENANCE BAYS WITH SPILL CONTAINMENT PLANS	DEVELOPER/OWNER
S-9	VEHICLE WASH AREAS WITH SPILL CONTAINMENT PLANS	DEVELOPER/OWNER

**SITE WIDE BMP'S**

N-1	N-9
N-2	N-10
N-3	N-11
N-4	N-12
N-5	N-13
N-6	N-14
N-7	N-15
N-8	N-17

- EASEMENTS**
- AN EASEMENT FOR THE PURPOSE OF PIPE LINES IN FAVOR OF THE FONTANA LAND COMPANY, A CORPORATION, AS RECORDED FEBRUARY 18, 1932, IN BOOK 805, PAGE 29 OF OFFICIAL RECORDS. AFFECTS PARCEL: 1, 2, 3, 4, 5, 6, 7. SAID EASEMENT IS BLANKET IN NATURE.
  - AN EASEMENT FOR THE PURPOSE OF PIPE LINES IN FAVOR OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, RECORDED FEBRUARY 14, 1936, IN BOOK 1122, PAGE 42, OFFICIAL RECORDS. AFFECTS PARCEL: 1, 2, 3, 4, 5, 6.
  - AN EASEMENT FOR THE PURPOSE OF PUBLIC UTILITY FACILITY IN FAVOR OF THE SEMI-TROPIC LAND AND WATER COMPANY, RECORDED OCTOBER 10, 2006, AS 2006-0689080 OF OFFICIAL RECORDS. AFFECTS PARCEL: 1. SAID EASEMENT IS SHOWN IN THE CHERRY AVENUE RIGHT-OF-WAY.
  - AN EASEMENT FOR THE PURPOSE OF SURFACE DRAINAGE IN FAVOR OF MASTER-HALCO, INC., A CALIFORNIA CORPORATION, RECORDED MAY 14, 1986, AS 86-125631 OF OFFICIAL RECORDS. AFFECTS PARCEL: 1, 4. SAID EASEMENT IS BLANKET IN NATURE.
  - AN EASEMENT FOR THE PURPOSE OF PIPELINES IN FAVOR OF CORPORATION OF AMERICA, A CORPORATION, RECORDED JULY 20, 1945, IN BOOK 1800, PAGE 18 OF OFFICIAL RECORDS. AFFECTS PARCEL: 2, 3, 4, 5, 6. SAID EASEMENT IS BLANKET IN NATURE.
  - AN EASEMENT FOR THE PURPOSE OF HIGHWAY AND ROADWAY PURPOSES IN FAVOR OF THE COUNTY OF SAN BERNARDINO, RECORDED FEBRUARY 27, 2003, AS 2003-131995 OF OFFICIAL RECORDS. SAID EASEMENT IS CONTAINED WITHIN THE RIGHT-OF-WAY.
  - AN EASEMENT FOR THE PURPOSE OF HIGHWAY AND ROAD PURPOSES IN FAVOR OF THE COUNTY OF SAN BERNARDINO, RECORDED APRIL 16, 1970, IN BOOK 7425, PAGE 906 OF OFFICIAL RECORDS. AFFECTS PARCEL: 5, 6. SAID EASEMENT IS CONTAINED WITHIN THE RIGHT-OF-WAY.
  - AN EASEMENT FOR THE PURPOSE OF ROADS IN FAVOR OF THE COUNTY OF SAN BERNARDINO, RECORDED IN BOOK 2950, PAGE 498 OF OFFICIAL RECORDS. AFFECTS PARCEL: 1, 4. SAID EASEMENT IS CONTAINED WITHIN THE RIGHT-OF-WAY.
  - AN EASEMENT FOR THE PURPOSE OF ROADS IN FAVOR OF THE COUNTY OF SAN BERNARDINO, RECORDED IN BOOK 3502, PAGE 24, OF OFFICIAL RECORDS. AFFECTS PARCEL: 1, 4. SAID EASEMENT IS CONTAINED WITHIN THE RIGHT-OF-WAY.



**UTILITIES**

**ELECTRIC:**  
 SOUTHERN CALIFORNIA EDISON COMPANY  
 7951 REDWOOD AVE.  
 FONTANA, CA 92336  
 (714) 796-9932

**TELEPHONE:**  
 AT&T  
 3939 E. COLORADO ST.  
 2ND FLOOR  
 ANAHEIM, CA 92807 (909) (714)507-3526

**WATER:**  
 FONTANA WATER COMPANY  
 15966 ARROW ROUTE  
 FONTANA, CA 92335  
 (909) 201-7371

**GAS:**  
 SOUTHERN CALIFORNIA GAS COMPANY  
 1981 WEST LUGONIA AVENUE  
 REDLANDS, CA 92373  
 (909)335-7836

**CABLE:**  
 TIME WARNER CABLE  
 1500 AUTO CENTER DRIVE  
 ONTARIO, CA 91761  
 (909) 975-3439

**SEWER:**  
 CITY OF FONTANA  
 8353 SIERRA AVE.  
 FONTANA, CA 92335  
 (909) 350-7629

**LINE DATA:**  
 LI 155.02' N05°51'47"W

**CURVE DATA:**  
 CI Δ = 84°23'26"  
 R = 35.00'  
 L = 51.55'  
 T = 31.73'

**PAVING LEGEND**

[Pattern]	PROPOSED AC PAVING
[Pattern]	PROPOSED ENHANCED PAVING
[Pattern]	PROPOSED PCC PAVING
[Pattern]	PROPOSED LANDSCAPING
[Pattern]	EXISTING PCC PAVING

**LEGEND**

AC	ASPHALT CONCRETE
EX	EXISTING
PCC	PORTLAND CEMENT CONCRETE
PL	PROPERTY LINE
RAW	RIGHT-OF-WAY
WC	WATER CAP
---	TRIBUTARY BOUNDARY

**PREPARED FOR:**

**TEC EQUIPMENT, INC.**  
 ATTN: DAVID THOMPSON  
 750 NORTH EAST COLUMBIA BLVD.  
 FORTLAND, CA 97211  
 PHONE: (503) 247-4655  
 FAX: (503) 972-4311

**PRELIMINARY WATER QUALITY MANAGEMENT PLAN**  
 APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83 & 84  
 NORTH EAST CORNER CHERRY AVENUE & RANDALL AVENUE  
 COUNTY OF SAN BERNARDINO

**thatcher engineering & associates, inc.**  
 1461 Ford Street, Suite 105, Redlands, CA 92373

• land planning  
 • civil engineering  
 • landscape architecture

MELVIN W. THATCHER, III  
 No. 39964  
 Exp. 12/31/17  
 CIVIL

Melvin W. Thatcher, III R.C.E. 39964 Exp. Dec 31, 2017

Job No.	Date Prepared	Designed By	Drawn By	Reference No.	Sheet No.
56003	11/23/15	MWT	PF	56003WQ2	1 of 1



- land planning
- civil engineering
- landscape architecture

phone 909.748.7777  
fax 909.748.7776

**thatcher engineering & associates, inc.**

1461 ford street, suite 105, redlands, ca 92373

**Preliminary Drainage Study**  
**APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83 & 84**  
**County of San Bernardino**  
**November 11, 2015**

**Prepared for:**

TEC Equipment, Inc.  
Attn: David Thompson  
750 North East Columbia Boulevard  
Portland, CA 97211

## **Description**

The project site is approximately 14.13 acres in size and consists of 11 parcels: APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83 & 84. The site is located at the northwest corner of Cherry Avenue and Randall Avenue in the Fontana area of unincorporated San Bernardino County. The site is currently vacant with the exception of a few patches of concrete pavement that remain from single family residences that have since been removed. The site currently drains from northeast to southwest at an approximate grade of 1.3%. The frontage along Cherry Avenue is currently improved with curb & gutter that directs flows to the south. The frontage along Randall Avenue is mostly unimproved with the exception of the frontage along APN 0231-021-48 which consists of curb & gutter. Flows from Randall Avenue are directed to the west along a flowline in the shoulder and join the flows of Cherry Avenue. Flows from the intersection continue south to an existing channel that runs along the north side of the Interstate 10 Freeway. From here, flows continue westward to the San Sevaine Channel and eventually to the Santa Ana River.

The neighboring property to the north, APN 0231-021-59, drains to the west and doesn't provide any flows to the subject site. Neighboring property to the east, APN 0231-021-18, is currently developed as a construction equipment rental company with flows directed to the south to Randall Avenue via ribbon gutter and does not contribute any flows to the site.

Proposed development of the site includes the construction of a 166,200 SF facility for truck sales, repair, and parts sales as well as associated parking and landscaping. Flows will be directed to the southeast as they have been historically, via proposed ribbon gutters and curb & gutter around the proposed building. Flows ultimately make their way to a proposed catch basin that will connect to a 60,000 cubic foot underground infiltration basin. This underground basin has been sized for water quality purposes and will help mitigate any increase in both flows and volume from the site due to development. Any excess flows will be allowed to leave the site via an under sidewalk drain at the back of the proposed catch basin to Randall Avenue as they have historically.

## Purpose

The purpose of this study is to analyze the flows to and through the site, both pre-development and post-development, and demonstrate that the post-development flows leaving the site will be less than pre-development flows.

## Analysis

To achieve the desired goal the following steps will be taken:

1. Determine the 10, 25 and 100 year pre-development flows.
2. Determine the 10, 25 and 100 year post-development flows.
3. Determine if any onsite mitigation will have to occur in order to have post-development flows that leave the site be less than pre-development flows in both intensity and volume.

## Results

1. The 10, 25 & 100 year pre-development flows were determined utilizing the Rational Method per San Bernardino County Hydrology Manual. AES 2014 Software was utilized for the calculations and they can be found in the appendix of this report. The variables used were:

Rainfall Values (per NOAA Atlas 14, Volume 6, Version 2 Map, Figure 3.1):

$$Y_{10} = 0.851$$

$$Y_{100} = 1.42$$

Soil Group (per reference Soil Group Map in appendix, Figure 3.2): A

Pervious Cover Designations:

Natural Poor Cover, Grass

Calculations:

**10-year peak flows:  $Q_{10} = 16.26$  CFS**

**10-year time of concentration:  $T_{c10} = 16.32$  min**

$$\text{10-year volume produced} = (Q)(T_c)(60 \text{ min})\left(\frac{3}{2}\right)$$

$$= (16.26 \text{ cfs})(16.32 \text{ min})(60 \text{ min})\left(\frac{3}{2}\right) = \mathbf{23,883 \text{ cubic feet}}$$

**25-year peak flows:  $Q_{25} = 21.73$  CFS**

**25-year time of concentration:  $T_{c_{25}} = 16.32$  min**

$$\begin{aligned} \text{25-year volume produced} &= (Q)(T_c)(60 \text{ min}) \left(\frac{3}{2}\right) \\ &= (21.73 \text{ cfs})(16.32 \text{ min})(60 \text{ min}) \left(\frac{3}{2}\right) = \mathbf{31,918 \text{ cubic feet}} \end{aligned}$$

**100-year peak flows:  $Q_{100} = 35.67$  CFS**

**100-year time of concentration:  $T_{c_{100}} = 16.32$  min**

$$\begin{aligned} \text{100-year volume produced} &= (Q)(T_c)(60 \text{ min}) \left(\frac{3}{2}\right) \\ &= (35.67 \text{ cfs})(16.32 \text{ min})(60 \text{ min}) \left(\frac{3}{2}\right) = \mathbf{55,330 \text{ cubic feet}} \end{aligned}$$

2. The 10, 25 and 100 year post-development flows were determined utilizing the Rational Method per San Bernardino County Hydrology Manual. AES 2014 Software was utilized for the calculations and they can be found in the appendix of this report. The variables used were:

Rainfall Values (per NOAA Atlas 14, Volume 6, Version 2 Map, Figure 3.1):

$$Y_{10} = 0.851$$

$$Y_{100} = 1.42$$

Soil Group (per reference Soil Group Map in appendix, Figure 3.2): A

Pervious Cover Designations:

Commercial

**Calculations:**

**10-year peak flows:  $Q_{10} = 26.65$  CFS**

**10-year time of concentration:  $T_{c_{10}} = 12.59$  min**

$$\begin{aligned} \text{10-year volume produced} &= (Q)(T_c)(60 \text{ min}) \left(\frac{3}{2}\right) \\ &= (26.65 \text{ cfs})(12.59 \text{ min})(60 \text{ min}) \left(\frac{3}{2}\right) = \mathbf{30,197 \text{ cubic feet}} \end{aligned}$$

**25-year peak flows:  $Q_{25} = 33.04$  CFS**

**25-year time of concentration:  $T_{c25} = 12.59$  min**

$$\begin{aligned} \text{25-year volume produced} &= (Q)(T_c)(60 \text{ min}) \left(\frac{3}{2}\right) \\ &= (33.04 \text{ cfs})(12.59 \text{ min})(60 \text{ min}) \left(\frac{3}{2}\right) = \mathbf{37,438 \text{ cubic feet}} \end{aligned}$$

**100-year peak flows:  $Q_{100} = 45.14$  CFS**

**100-year time of concentration:  $T_{c100} = 12.59$  min**

$$\begin{aligned} \text{100-year volume produced} &= (Q)(T_c)(60 \text{ min}) \left(\frac{3}{2}\right) \\ &= (45.14 \text{ cfs})(12.59 \text{ min})(60 \text{ min}) \left(\frac{3}{2}\right) = \mathbf{51,149 \text{ cubic feet}} \end{aligned}$$

3. All flows will be mitigated by an onsite underground infiltration basin that has been sized for water quality purposes, holding 60,000 cubic feet. All flow intensities and volumes have been decreased from their pre-development conditions due to the proposed infiltration basin. In the case of back to back 100-year storms flows will be allowed to leave the site via an under sidewalk drain at the back of the proposed catch basin to Randall Avenue as they have historically.

	<b>Pre-development</b>	<b>Post-development Leaving the Site</b>	<b>% of Pre</b>
10-year flows	16.26 cfs	0.00 cfs	100
10-year volume	23,883 cubic feet	0 cubic feet	100
25-year flows	21.73 cfs	0.00 cfs	100
25-year volume	31,918 cubic feet	0 cubic feet	100
100-year flows	35.67 cfs	0.00 cfs	100
100-year volume	55,330 cubic feet	0 cubic feet	100

**Conclusion**

Any potential increase in post-development volume from pre-development conditions has been mitigated through the use of a 60,000 cubic foot underground infiltration basin. All post-development flows and volumes have been decreased by the proposed 60,000 cubic foot basin. All emergency flows will continue through the site as they have historically and will exit the site to Randall Avenue.

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Shane Smith, EIT 143791

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M.W. "Bud" Thatcher III, P.E.  
RCE 39964      Exp 12/31/17

**APPENDIX**

- Figure 1.1 PRE-DEVELOPMENT FLOW CALCULATIONS – 10-YEAR STORM
- Figure 1.2 PRE-DEVELOPMENT FLOW CALCULATIONS – 25-YEAR STORM
- Figure 1.3 PRE-DEVELOPMENT FLOW CALCULATIONS – 100-YEAR STORM
- Figure 2.1 POST DEVELOPMENT FLOW CALCULATIONS – 10-YEAR STORM
- Figure 2.2 POST DEVELOPMENT FLOW CALCULATIONS – 25-YEAR STORM
- Figure 2.3 POST DEVELOPMENT FLOW CALCULATIONS – 100-YEAR STORM
- Figure 3.1 NOAA ATLAS 14, VOLUME 6, VERSION 2
- Figure 3.2 SOIL GROUP
- Figure 4.1 PRE-DEVELOPMENT TRIBUTARY MAP
- Figure 4.2 POST-DEVELOPMENT TRIBUTARY MAP

\*\*\*\*\*  
RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
(Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)  
(c) Copyright 1983-2014 Advanced Engineering Software (aes)  
Ver. 21.0 Release Date: 06/01/2014 License ID 1533

Analysis prepared by:

THATCHER ENGINEERING & ASSOCIATES, INC.  
1461 FORD STREET, SUITE 105  
REDLANDS, CA 92373  
PHONE: (909) 748-7777 FAX: (909) 748-7776

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* 56003 - TEC EQUIPMENT \*  
\* PRE-DEVELOPMENT DRAINAGE STUDY \*  
\* 10-YEAR STORM EVENT \*  
\*\*\*\*\*

FILE NAME: 56003PR.DAT  
TIME/DATE OF STUDY: 09:49 10/28/2015

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT(YEAR) = 10.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 4.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 0.851  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.420  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 10.00 1-HOUR INTENSITY(INCH/HOUR) = 0.8595  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/PARK- SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH LIP (FT) (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00 0.0312	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

INITIAL SUBAREA FLOW-LENGTH(FEET) = 702.00  
ELEVATION DATA: UPSTREAM(FEET) = 33.90 DOWNSTREAM(FEET) = 22.00

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$ (MIN.) = 16.325

\* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 1.877

SUBAREA  $T_c$  AND LOSS RATE DATA(AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
NATURAL POOR COVER "GRASS"	A	14.13	0.60	1.000	67	16.32

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$ (INCH/HR) = 0.60

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 1.000

SUBAREA RUNOFF(CFS) = 16.26

TOTAL AREA(ACRES) = 14.13 PEAK FLOW RATE(CFS) = 16.26

END OF STUDY SUMMARY:

TOTAL AREA(ACRES) = 14.1 TC(MIN.) = 16.32

EFFECTIVE AREA(ACRES) = 14.13 AREA-AVERAGED  $F_m$ (INCH/HR) = 0.60

AREA-AVERAGED  $F_p$ (INCH/HR) = 0.60 AREA-AVERAGED  $A_p$  = 1.000

PEAK FLOW RATE(CFS) = 16.26

END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
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Ver. 21.0 Release Date: 06/01/2014 License ID 1533

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1461 FORD STREET, SUITE 105  
REDLANDS, CA 92373  
PHONE: (909) 748-7777 FAX: (909) 748-7776

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*

- \* 56003 - TEC EQUIPMENT \*
  - \* PRE-DEVELOPMENT DRAINAGE STUDY \*
  - \* 25-YEAR STORM EVENT \*
- \*\*\*\*\*

FILE NAME: 56003PR.DAT  
TIME/DATE OF STUDY: 09:49 10/28/2015

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT(YEAR) = 25.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 4.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 0.851  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.420  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 25.00 1-HOUR INTENSITY(INCH/HOUR) = 1.0564  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/PARK- SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH LIP (FT) (FT)	MANNING HIKE (FT)	FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00 0.0312	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

\*\*\*\*\*  
FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21  
-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<  
=====

INITIAL SUBAREA FLOW-LENGTH(FEET) = 702.00  
ELEVATION DATA: UPSTREAM(FEET) = 33.90 DOWNSTREAM(FEET) = 22.00

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$ (MIN.) = 16.325

\* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 2.307

SUBAREA  $T_c$  AND LOSS RATE DATA(AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
NATURAL POOR COVER "GRASS"	A	14.13	0.60	1.000	67	16.32

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$ (INCH/HR) = 0.60

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 1.000

SUBAREA RUNOFF(CFS) = 21.73

TOTAL AREA(ACRES) = 14.13 PEAK FLOW RATE(CFS) = 21.73  
=====

END OF STUDY SUMMARY:

TOTAL AREA(ACRES) = 14.1 TC(MIN.) = 16.32

EFFECTIVE AREA(ACRES) = 14.13 AREA-AVERAGED  $F_m$ (INCH/HR) = 0.60

AREA-AVERAGED  $F_p$ (INCH/HR) = 0.60 AREA-AVERAGED  $A_p$  = 1.000

PEAK FLOW RATE(CFS) = 21.73  
=====

END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

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Analysis prepared by:

THATCHER ENGINEERING & ASSOCIATES, INC.  
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REDLANDS, CA 92373  
PHONE: (909) 748-7777 FAX: (909) 748-7776

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* 56003 - TEC EQUIPMENT \*  
\* PRE-DEVELOPMENT DRAINAGE STUDY \*  
\* 100-YEAR STORM EVENT \*  
\*\*\*\*\*

FILE NAME: 56003PR.DAT  
TIME/DATE OF STUDY: 09:48 10/28/2015

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 4.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 0.851  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.420  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 100.00 1-HOUR INTENSITY(INCH/HOUR) = 1.4200  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- CROWN TO	STREET-CROSSFALL:	CURB	GUTTER-GEOMETRIES:			MANNING	
	WIDTH	CROSSFALL	IN- / OUT-/PARK-	HEIGHT	WIDTH	LIP		HIKE
	(FT)	(FT)	SIDE / SIDE/ WAY	(FT)	(FT)	(FT)	(FT)	(n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH(FEET) = 702.00  
ELEVATION DATA: UPSTREAM(FEET) = 33.90 DOWNSTREAM(FEET) = 22.00

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$ (MIN.) = 16.325

\* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 3.101

SUBAREA  $T_c$  AND LOSS RATE DATA(AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
NATURAL POOR COVER "GRASS"	A	14.13	0.30	1.000	85	16.32

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$ (INCH/HR) = 0.30

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 1.000

SUBAREA RUNOFF(CFS) = 35.67

TOTAL AREA(ACRES) = 14.13 PEAK FLOW RATE(CFS) = 35.67

=====

END OF STUDY SUMMARY:

TOTAL AREA(ACRES) = 14.1 TC(MIN.) = 16.32

EFFECTIVE AREA(ACRES) = 14.13 AREA-AVERAGED  $F_m$ (INCH/HR) = 0.30

AREA-AVERAGED  $F_p$ (INCH/HR) = 0.30 AREA-AVERAGED  $A_p$  = 1.000

PEAK FLOW RATE(CFS) = 35.67

=====

END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

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Analysis prepared by:

THATCHER ENGINEERING & ASSOCIATES, INC.  
1461 FORD STREET, SUITE 105  
REDLANDS, CA 92373  
PHONE: (909) 748-7777 FAX: (909) 748-7776

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* 56003 - TEC EQUIPMENT \*  
\* POST-DEVELOPMENT DRAINAGE STUDY \*  
\* 10-YEAR STORM EVENT \*  
\*\*\*\*\*

FILE NAME: 56003PO.DAT  
TIME/DATE OF STUDY: 13:21 11/11/2015

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT(YEAR) = 10.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 4.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 0.851  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.420  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 10.00 1-HOUR INTENSITY(INCH/HOUR) = 0.8595  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT- / PARK- SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0312	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

INITIAL SUBAREA FLOW-LENGTH(FEET) = 1198.00

ELEVATION DATA: UPSTREAM(FEET) = 33.90 DOWNSTREAM(FEET) = 19.80

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$ (MIN.) = 12.592

\* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 2.193

SUBAREA  $T_c$  AND LOSS RATE DATA(AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
COMMERCIAL	A	14.13	0.98	0.100	32	12.59

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$ (INCH/HR) = 0.98

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 0.100

SUBAREA RUNOFF(CFS) = 26.65

TOTAL AREA(ACRES) = 14.13 PEAK FLOW RATE(CFS) = 26.65

END OF STUDY SUMMARY:

TOTAL AREA(ACRES) = 14.1 TC(MIN.) = 12.59

EFFECTIVE AREA(ACRES) = 14.13 AREA-AVERAGED  $F_m$ (INCH/HR) = 0.10

AREA-AVERAGED  $F_p$ (INCH/HR) = 0.98 AREA-AVERAGED  $A_p$  = 0.100

PEAK FLOW RATE(CFS) = 26.65

END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

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Analysis prepared by:

THATCHER ENGINEERING & ASSOCIATES, INC.  
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REDLANDS, CA 92373  
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\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* 56003 - TEC EQUIPMENT \*  
\* POST-DEVELOPMENT DRAINAGE STUDY \*  
\* 25-YEAR STORM EVENT \*  
\*\*\*\*\*

FILE NAME: 56003PO.DAT  
TIME/DATE OF STUDY: 13:20 11/11/2015

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT(YEAR) = 25.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 4.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 0.851  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.420  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 25.00 1-HOUR INTENSITY(INCH/HOUR) = 1.0564  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/ SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0312	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

INITIAL SUBAREA FLOW-LENGTH(FEET) = 1198.00

ELEVATION DATA: UPSTREAM(FEET) = 33.90 DOWNSTREAM(FEET) = 19.80

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$ (MIN.) = 12.592

\* 25 YEAR RAINFALL INTENSITY(INCH/HR) = 2.696

SUBAREA  $T_c$  AND LOSS RATE DATA(AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
COMMERCIAL	A	14.13	0.98	0.100	32	12.59

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$ (INCH/HR) = 0.98

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 0.100

SUBAREA RUNOFF(CFS) = 33.04

TOTAL AREA(ACRES) = 14.13 PEAK FLOW RATE(CFS) = 33.04

END OF STUDY SUMMARY:

TOTAL AREA(ACRES) = 14.1  $T_c$ (MIN.) = 12.59

EFFECTIVE AREA(ACRES) = 14.13 AREA-AVERAGED  $F_m$ (INCH/HR) = 0.10

AREA-AVERAGED  $F_p$ (INCH/HR) = 0.98 AREA-AVERAGED  $A_p$  = 0.100

PEAK FLOW RATE(CFS) = 33.04

END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

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\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* 56003 - TEC EQUIPMENT \*  
\* POST-DEVELOPMENT DRAINAGE STUDY \*  
\* 100-YEAR STORM EVENT \*  
\*\*\*\*\*

FILE NAME: 56003PO.DAT  
TIME/DATE OF STUDY: 13:20 11/11/2015

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 4.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
\*USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL\*  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 0.851  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.420  
COMPUTED RAINFALL INTENSITY DATA:  
STORM EVENT = 100.00 1-HOUR INTENSITY(INCH/HOUR) = 1.4200  
SLOPE OF INTENSITY DURATION CURVE = 0.6000

\*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT- / PARK- SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH LIP HIKE (FT) (FT) (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00 0.0313 0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21  
 -----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<  
 =====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 1198.00  
 ELEVATION DATA: UPSTREAM (FEET) = 33.90 DOWNSTREAM (FEET) = 19.80

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$  (MIN.) = 12.592

\* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 3.623

SUBAREA  $T_c$  AND LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
COMMERCIAL	A	14.13	0.74	0.100	52	12.59

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$  (INCH/HR) = 0.74

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 0.100

SUBAREA RUNOFF (CFS) = 45.14

TOTAL AREA (ACRES) = 14.13 PEAK FLOW RATE (CFS) = 45.14  
 =====

END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 14.1 TC (MIN.) = 12.59

EFFECTIVE AREA (ACRES) = 14.13 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.07

AREA-AVERAGED  $F_p$  (INCH/HR) = 0.74 AREA-AVERAGED  $A_p$  = 0.100

PEAK FLOW RATE (CFS) = 45.14  
 =====

END OF RATIONAL METHOD ANALYSIS



NOAA Atlas 14, Volume 6, Version 2  
 Location name: Fontana, California, US\*  
 Latitude: 34.0856°, Longitude: -117.4867°  
 Elevation: 1124 ft\*  
 \* source: Google Maps



**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

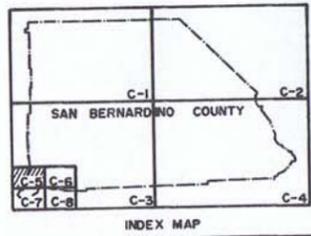
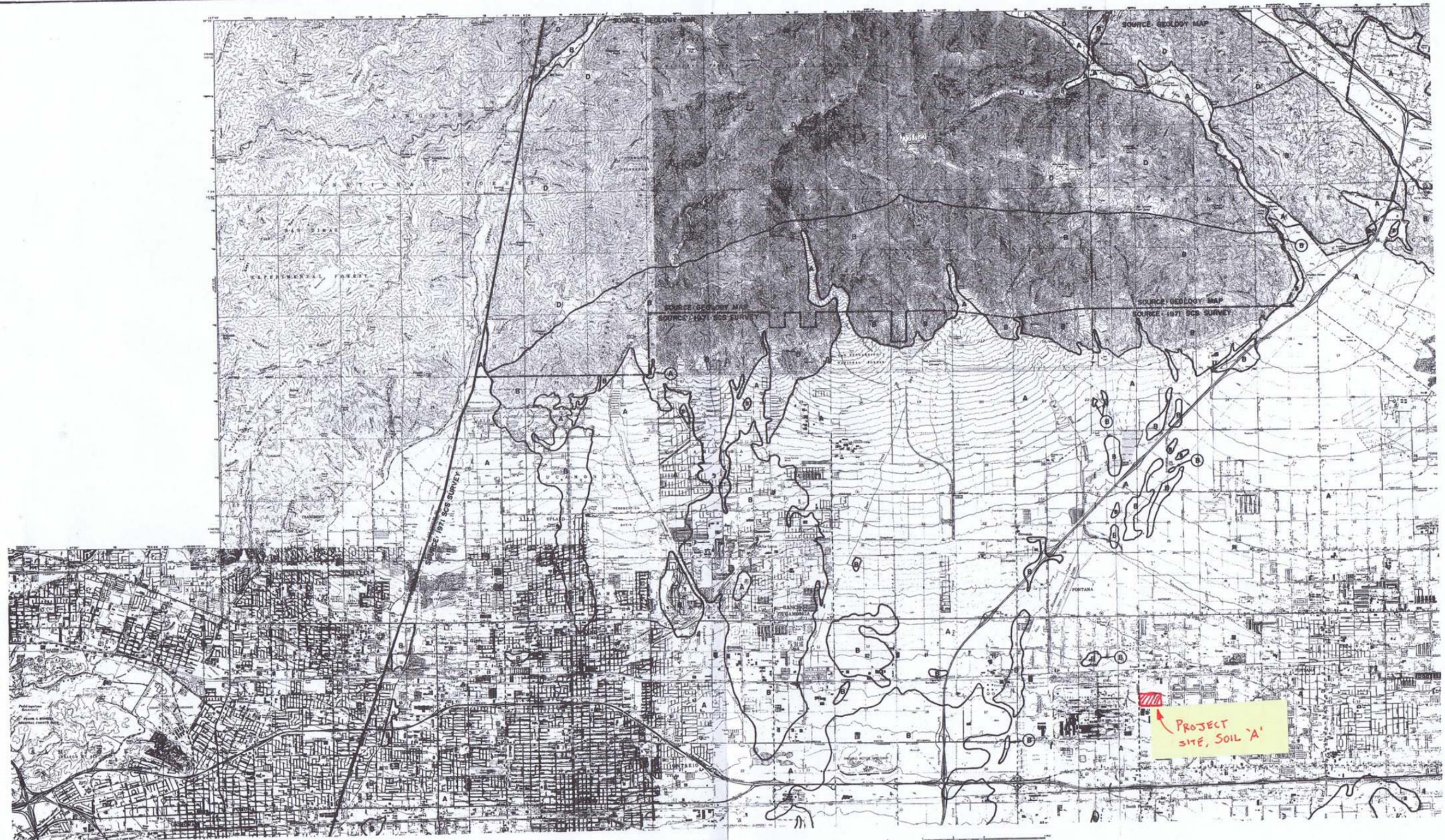
**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.106 (0.089-0.129)	0.140 (0.116-0.170)	0.186 (0.154-0.226)	0.225 (0.185-0.276)	0.281 (0.224-0.357)	0.327 (0.254-0.424)	0.375 (0.285-0.500)	0.428 (0.315-0.586)	0.503 (0.355-0.719)	0.564 (0.384-0.837)
10-min	0.152 (0.127-0.185)	0.200 (0.167-0.243)	0.266 (0.221-0.324)	0.322 (0.265-0.396)	0.403 (0.320-0.512)	0.468 (0.364-0.608)	0.538 (0.408-0.716)	0.613 (0.452-0.840)	0.720 (0.508-1.03)	0.809 (0.551-1.20)
15-min	0.184 (0.154-0.223)	0.242 (0.202-0.294)	0.322 (0.267-0.392)	0.390 (0.321-0.479)	0.487 (0.387-0.619)	0.566 (0.441-0.736)	0.650 (0.493-0.866)	0.741 (0.546-1.02)	0.871 (0.615-1.25)	0.978 (0.666-1.45)
30-min	0.275 (0.229-0.333)	0.361 (0.300-0.438)	0.480 (0.398-0.584)	0.581 (0.478-0.713)	0.726 (0.577-0.923)	0.844 (0.657-1.10)	0.969 (0.735-1.29)	1.10 (0.814-1.51)	1.30 (0.916-1.86)	1.46 (0.993-2.16)
60-min	0.402 (0.335-0.487)	0.528 (0.440-0.641)	0.702 (0.583-0.855)	0.851 (0.700-1.04)	1.06 (0.845-1.35)	1.24 (0.961-1.60)	1.42 (1.08-1.89)	1.62 (1.19-2.22)	1.90 (1.34-2.72)	2.13 (1.45-3.16)
2-hr	0.609 (0.508-0.738)	0.788 (0.656-0.956)	1.03 (0.853-1.25)	1.23 (1.01-1.51)	1.51 (1.20-1.92)	1.73 (1.35-2.25)	1.97 (1.49-2.62)	2.21 (1.63-3.03)	2.56 (1.80-3.66)	2.83 (1.93-4.20)
3-hr	0.781 (0.651-0.947)	1.00 (0.836-1.22)	1.30 (1.08-1.58)	1.55 (1.27-1.90)	1.89 (1.50-2.40)	2.15 (1.67-2.79)	2.43 (1.84-3.23)	2.71 (2.00-3.72)	3.11 (2.19-4.45)	3.42 (2.33-5.08)
6-hr	1.12 (0.934-1.36)	1.44 (1.20-1.75)	1.85 (1.54-2.26)	2.19 (1.80-2.69)	2.65 (2.10-3.36)	2.99 (2.33-3.89)	3.35 (2.54-4.46)	3.71 (2.73-5.08)	4.20 (2.96-6.01)	4.58 (3.12-6.79)
12-hr	1.49 (1.24-1.80)	1.93 (1.60-2.34)	2.49 (2.06-3.03)	2.93 (2.41-3.60)	3.52 (2.80-4.47)	3.96 (3.08-5.14)	4.40 (3.33-5.86)	4.83 (3.56-6.63)	5.42 (3.82-7.75)	5.85 (3.99-8.68)
24-hr	2.00 (1.77-2.31)	2.65 (2.34-3.05)	3.45 (3.04-3.99)	4.08 (3.57-4.76)	4.90 (4.15-5.91)	5.51 (4.57-6.78)	6.10 (4.94-7.69)	6.69 (5.27-8.66)	7.46 (5.64-10.1)	8.03 (5.87-11.2)
2-day	2.42 (2.15-2.79)	3.28 (2.90-3.78)	4.36 (3.85-5.05)	5.22 (4.57-6.09)	6.35 (5.38-7.65)	7.19 (5.96-8.84)	8.02 (6.50-10.1)	8.86 (6.98-11.5)	9.95 (7.53-13.4)	10.8 (7.88-15.0)
3-day	2.64 (2.34-3.04)	3.63 (3.21-4.19)	4.90 (4.32-5.67)	5.92 (5.18-6.90)	7.28 (6.16-8.77)	8.30 (6.89-10.2)	9.33 (7.56-11.8)	10.4 (8.18-13.4)	11.8 (8.90-15.9)	12.8 (9.38-17.9)
4-day	2.85 (2.52-3.28)	3.96 (3.50-4.57)	5.40 (4.76-6.25)	6.56 (5.74-7.65)	8.13 (6.88-9.79)	9.32 (7.73-11.5)	10.5 (8.52-13.2)	11.7 (9.25-15.2)	13.4 (10.1-18.1)	14.7 (10.7-20.5)
7-day	3.25 (2.87-3.74)	4.60 (4.07-5.31)	6.37 (5.62-7.37)	7.82 (6.84-9.12)	9.78 (8.28-11.8)	11.3 (9.37-13.9)	12.8 (10.4-16.2)	14.4 (11.4-18.7)	16.6 (12.5-22.4)	18.3 (13.4-25.5)
10-day	3.51 (3.11-4.05)	5.03 (4.45-5.80)	7.03 (6.20-8.14)	8.68 (7.59-10.1)	10.9 (9.26-13.2)	12.7 (10.5-15.6)	14.5 (11.7-18.2)	16.4 (12.9-21.2)	18.9 (14.3-25.5)	20.9 (15.3-29.2)
20-day	4.16 (3.68-4.79)	6.04 (5.34-6.97)	8.57 (7.56-9.92)	10.7 (9.36-12.5)	13.7 (11.6-16.5)	16.0 (13.3-19.7)	18.5 (15.0-23.3)	21.0 (16.6-27.3)	24.7 (18.7-33.3)	27.6 (20.2-38.4)
30-day	4.91 (4.34-5.65)	7.12 (6.29-8.21)	10.1 (8.94-11.7)	12.7 (11.1-14.8)	16.3 (13.8-19.7)	19.2 (16.0-23.7)	22.3 (18.1-28.1)	25.6 (20.2-33.1)	30.2 (22.9-40.8)	34.0 (24.9-47.5)
45-day	5.80 (5.13-6.68)	8.30 (7.34-9.58)	11.8 (10.4-13.6)	14.8 (12.9-17.2)	19.1 (16.1-23.0)	22.6 (18.7-27.8)	26.3 (21.3-33.2)	30.4 (23.9-39.3)	36.2 (27.4-48.9)	41.0 (30.0-57.2)
60-day	6.86 (6.08-7.91)	9.65 (8.53-11.1)	13.6 (12.0-15.7)	17.0 (14.8-19.8)	21.9 (18.6-26.4)	26.0 (21.6-32.0)	30.5 (24.7-38.4)	35.3 (27.8-45.7)	42.3 (32.0-57.1)	48.2 (35.3-67.3)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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FIGURE 3.1



LEGEND  
 ——— SOIL GROUP BOUNDARY  
 A SOIL GROUP DESIGNATION  
 - - - BOUNDARY OF INDICATED SOURCE

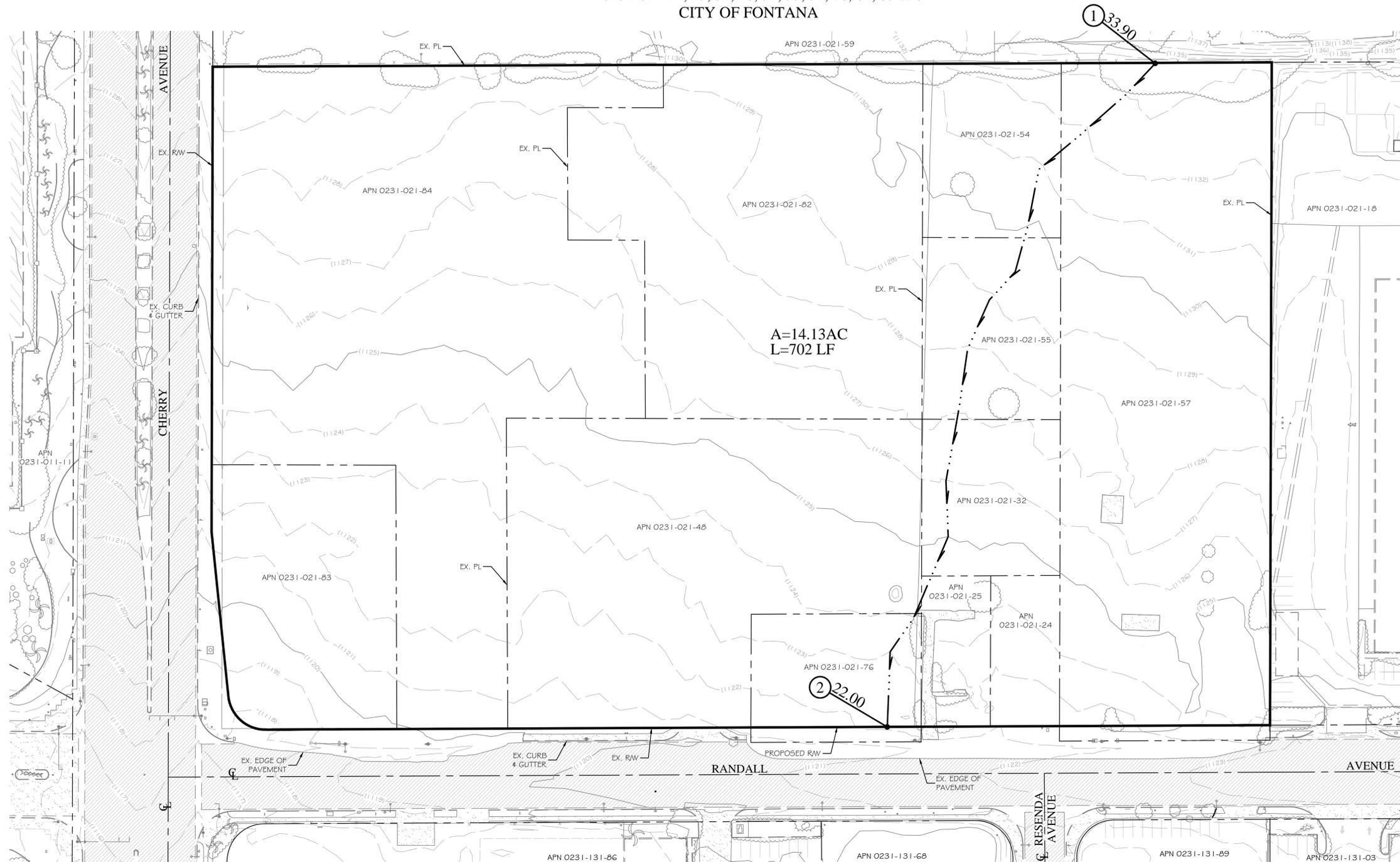
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**SCALE REDUCED BY 1/2**

**FIGURE 3.2**  
 HYDROLOGIC SOILS GROUP MAP  
 FOR  
 SOUTHWEST-A AREA

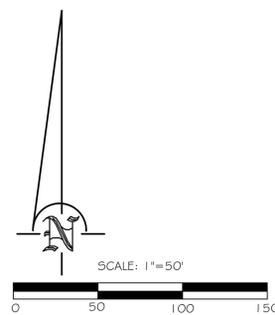
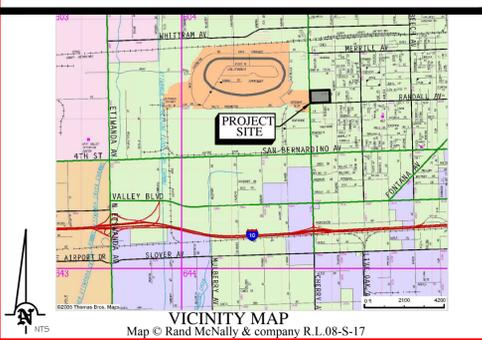
# TRIBUTARY AREA MAP

PRE-DEVELOPMENT

APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83 & 84  
CITY OF FONTANA



TOTAL ON-SITE  
POST-DEVELOPMENT  
FLOWS LEAVING THE SITE  
Q(10) = 16.26 CFS  
Q(25) = 21.73 CFS  
Q(100) = 35.67 CFS



### LEGEND

- ① —●— NODE #
- L=165' FLOWLINE LENGTH
- A=1.44 AC SUB AREA
- — — FLOWLINE

### LEGEND

- AC ASPHALT CONCRETE
- EX. EXISTING
- PCC PORTLAND CEMENT CONCRETE
- PL PROPERTY LINE
- R/W RIGHT-OF-WAY

### PAVING LEGEND

- EXISTING AC PAVING
- EXISTING PCC PAVING

### PREPARED FOR:

TEC EQUIPMENT, INC.  
ATTN: DAVID THOMPSON  
750 NORTH EAST COLUMBIA BLVD.  
FORTLAND, GA 37211  
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FAX: (503) 972-4311

TRIBUTARY AREA MAP  
APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83 & 84  
CITY OF FONTANA

thatcher engineering & associates, inc.  
1461 Ford Street, Suite 105, Redlands, CA 92373

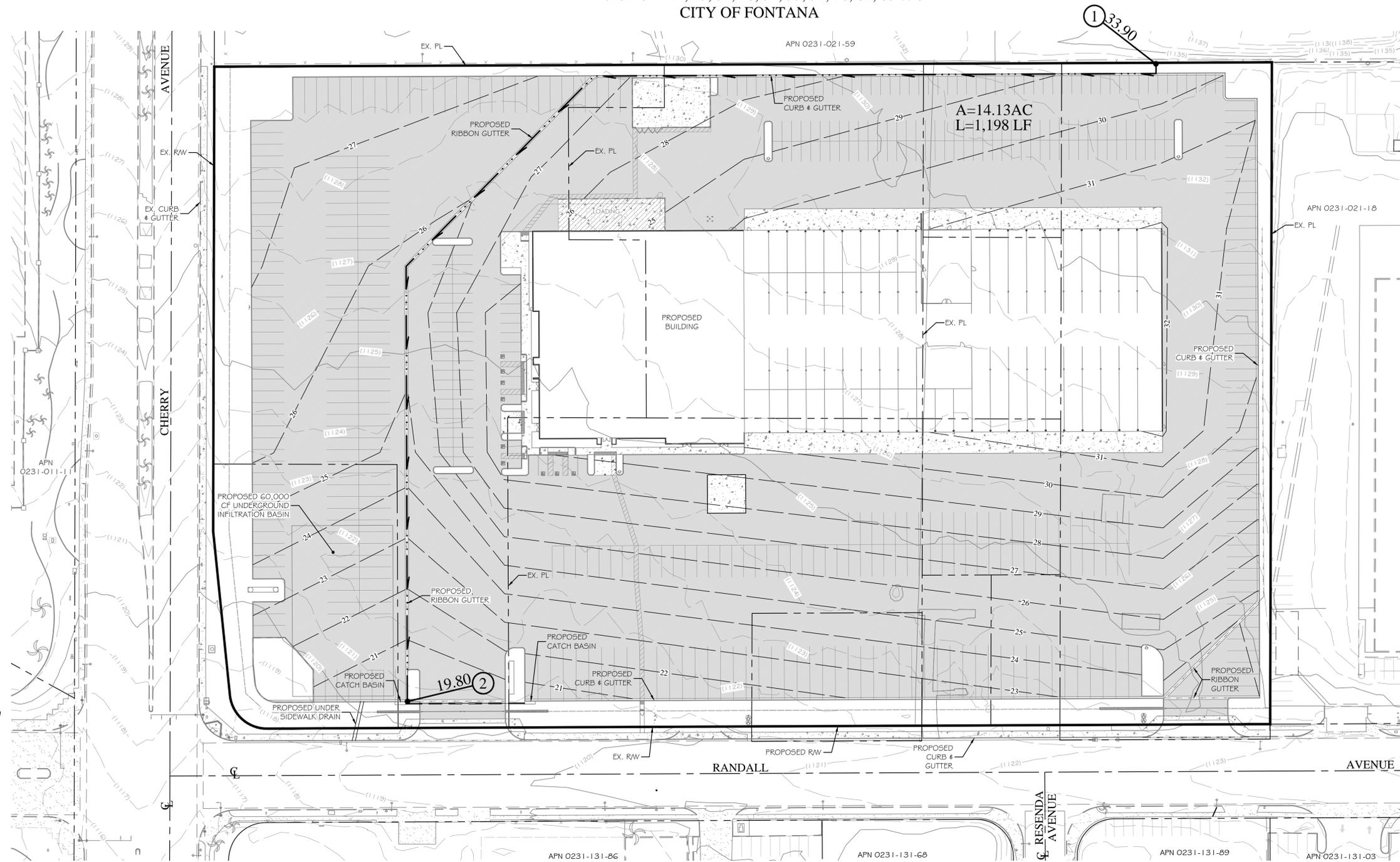
- land planning
- civil engineering
- landscape architecture

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Exp. 1/23/17  
CIVIL

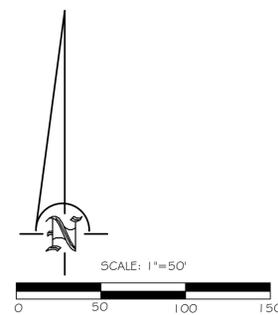
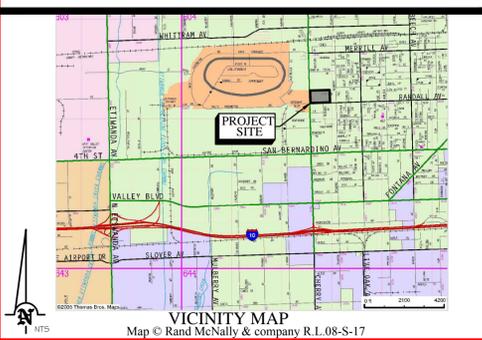
Job No. 56003	Date Prepared 11/12/15	Designed By MWT	Drawn By PF	Reference No. 56003TAM	Sheet No. 1 of 1
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# TRIBUTARY AREA MAP

POST-DEVELOPMENT  
 APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83 & 84  
 CITY OF FONTANA



TOTAL ON-SITE  
 POST-DEVELOPMENT  
 FLOWS LEAVING THE SITE  
 Q(10) = 0.00 CFS  
 Q(25) = 0.00 CFS  
 Q(100) = 0.00 CFS



### LEGEND

- ① —●— NODE #
- L=165' FLOWLINE LENGTH
- A=1.44 AC SUB AREA
- — — FLOWLINE

### LEGEND

- AC ASPHALT CONCRETE
- EX. EXISTING
- PCC PORTLAND CEMENT CONCRETE
- PL PROPERTY LINE
- RW RIGHT-OF-WAY

### PAVING LEGEND

- PROPOSED AC PAVING
- PROPOSED PCC PAVING
- EXISTING PCC PAVING

### PREPARED FOR:

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### TRIBUTARY AREA MAP

APN 0231-021-24, 25, 32, 48, 54, 55, 57, 76, 82, 83 & 84  
 CITY OF FONTANA

**thatcher engineering & associates, inc.**  
 1461 Ford Street, Suite 105, Redlands, CA 92373

• land planning  
 • civil engineering  
 • landscape architecture

Job No. 56003	Date Prepared 11/23/15	Designed By MWT	Drawn By PF	Reference No. 56003TAM	Sheet No. 1 of 1
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