PRELIMINARY

Water Quality Management Plan

For:

2830 S. Riverside Avenue

APN 0258-121-23, 33, & 34

Prepared for:

Riverside XC, LLC

3010 Old Ranch Parkway, Suite 470

Seal Beach, CA

Prepared by:

Julian Rhoades, PE

Cannon

16842 Von Karman Ave., Suite 150

Irvine, CA 92606

949-753-8111

Submittal Date: 10/26/22

Revision Date: _____

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Riverside XC, LLC by Cannon Corp.. The WQMP is intended to comply with the requirements of the City of Rialto 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."

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Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	TBD	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 0258-121-23, 33, & 34

Owner's Signature		
Owner Name:		
Title		
Company	Riverside XC, LLC	
Address	3010 Old Ranch Parkway, 3010 Old Ranch Parkway, Suite 470, Seal Beach, CA 90470	
Email		
Telephone #		
Signature	Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):		Grading Permit Number(s):	
Tract/Parcel Map Number(s):		Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 0258-041-16, &-17

"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."

Engineer: Julian Rhoades, PE		PE Stamp Below
Title	Asscoiate Engineer	
Company	Cannon Corporation	
Address	16842 Von Karman Ave., Suite 150, Irvine, CA 92606	
Email	JulianR@CannonCorp.us	
Telephone #	949-753-8111	
Signature		
Date		

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Forms

Section 1. Discretionary Permit(s)

Form 1-1 Project Information

Project Name	2830 S Riverside Ave				
Project Owner Contact Name:	Riverside XC, LLC				
Mailing Address:	3010 Old Ranch Parkway, 3010 Old Ranch Parkway, Suite 470, Seal Beach, CA 90470	E-mail Address:		Telephone:	
Permit/Application Number(s):		Tract/Parcel Map Number(s):	Parcel 2 of PM No. 2713, in the City of Rialto, County of San Bernardino, as per Map Recorded in Book 27, Page 1 of Parcel Maps		
Additional Information/ Comments:					
Description of Project:	This project proposes the construction of a warehouse building and associated parking on three lots. The three lots are to be merged into one lot via a tentative parcel map. Two of the 3 existing lots are developed. The total project site area is 9.95 acres.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.					

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.

Form 2.1-1 Description of Proposed Project

1 Development Category (Select all that apply):

☒ Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☐ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more
☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft² 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.	☐ Parking lots of 5,000 ft² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day

☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements*.

2 Project Area (ft2):	433,287 (net)	**3** Number of Dwelling Units:	0	**4** SIC Code:	4255

5 Is Project going to be phased? Yes ☐ No ☒ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*

6 Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP)*

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 owner of the property is Riverside XC, LLC, a California Limited Liability Company. The owner will be solely responsible for all maintenance of WQMP features. Should ownership change, Riverside XC, LLC will relinquish all ownership responsibilities and transfer the responsibility of water quality management feature maintenance over to the new owner of the property.

No infrastructure will be transferred to the public as a part of this project, except as imporved ancillary to the project.

site consists of 433,287 sf of "onsite" area and 8,847 of projected dedication area - a part of which is currently used as right of way.

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).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Expected due to petroleum hydrocarbons from idling cars, pavement runoff.
Nutrients - Phosphorous	E ☒	N ☐	Landscaping proposed onsite, therefore expected.
Nutrients - Nitrogen	E ☒	N ☐	Landscaping proposed onsite, therefore expected.
Noxious Aquatic Plants	E ☒	N ☐	Landscaping proposed onsite, therefore expected.
Sediment	E ☒	N ☐	Landscaping proposed onsite, therefore expected.
Metals	E ☒	N ☐	Expected due to petroleum hydrocarbons from idling cars, pavement runoff.
Oil and Grease	E ☒	N ☐	Proposed warehouse, therefore expected.
Trash/Debris	E ☒	N ☐	Proposed warehouse, therefore expected.
Pesticides / Herbicides	E ☒	N ☐	Landscaping proposed onsite, therefore expected.
Organic Compounds	E ☒	N ☐	Expected due to landscaping, solvents, and petroleum hydrocarbons.
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

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.

Form 2.4-1 Water Quality Credits

1 Project Types that Qualify for Water Quality Credits: *Select all that apply*

☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects ☐ Vertical density [20%] ☐ 7 units/ acre [5%]	☐ 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%]	☐ Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ 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%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]

2 Total Credit % 0 *(Total all credit percentages up to a maximum allowable credit of 50 percent)*

Description of Water Quality Credit Eligibility (if applicable)	None proposed

Section 3. Site and Watershed Description

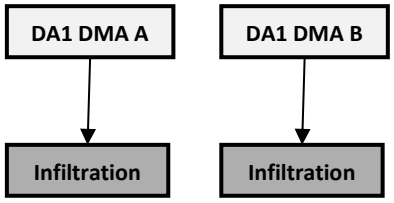
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and 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.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.049481	Longitude -117.370995	Thomas Bros Map page

1 San Bernardino County climatic region: ☒ Valley ☐ Mountain

2 Does the site have more than one drainage area (DA): Yes☐ No☒ *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*



Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 DMA C flows to DA1 DMA A	*Ex. Bioretention overflow to vegetated bioswale with 4' bottom width, 5:1 side slopes and bed slope of 0.01. Conveys runoff for 1000' through DMA 1 to existing catch basin on SE corner of property*
DA1 DMA A to Infiltration	Stormwater will travel overland to inlets and catch basins, and discharge into the proposed sub-surface infiltrtion basin. The infiltratraion basin is sized according to this BMP. Excess stormwater will be discharged via overland release into Riverside Ave.
DA1 DMA B to Infiltration	Stormwater will travel overland to inlets and catch basins, and discharge into the proposed sub-surface infiltrtion basin. The infiltratraion basin is sized according to this BMP. Excess stormwater will be discharged via overland release into Riverside Ave.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B		
1 DMA drainage area (ft^2)	211,764	221,523		
2 Existing site impervious area (ft^2)	65%	65%		
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	2	2		
4 Hydrologic soil group *Refer to Watershed Mapping Tool –* *http://permitrack.sbcounty.gov/wap/*	X	X		
5 Longest flowpath length (ft)	XX	XX		
6 Longest flowpath slope (ft/ft)	XX	XX		
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Developed Industrial	Developed Industrial		
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	XX	XX		

Form 3-3 Watershed Description for Drainage Area

Receiving waters *Refer to Watershed Mapping Tool - http://permitrack.sbcounty.gov/wap/* *See 'Drainage Facilities" link at this website*	Santa Ana River, Reach 4 Santa Ana River, Reach 3 Santa Ana River, Reach 2 Santa Ana River, Reach 1 Pacific Ocean
Applicable TMDLs *Refer to Local Implementation Plan*	None
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	Santa Ana River, Reach: Pathogens Santa Ana River, Reach 3: Copper, Lead, Pathogens Santa Ana River, Reach: Indicator Bacteria
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	None
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	None
Hydrologic Conditions of Concern	☐ 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* ☒ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

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	☒	☐	Owner to educate tenants of stormwater BMPs proposed using education materials provided
N2	Activity Restrictions	☒	☐	Owner to educate tenants of the activity restrictions set forth
N3	Landscape Management BMPs	☒	☐	Landscaping to occur onsite. Irrigation must be consistent with the City's Water Ordinance and pesticides must adhere to County Guidelines.
N4	BMP Maintenance	☒	☐	BMPs proposed require maintenance as shown on the O&M plan of this WQMP
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous materials proposed onsi
N6	Local Water Quality Ordinances	☐	☒	No local water quality ordinances
N7	Spill Contingency Plan	☐	☒	No hazardous materials proposed onsit
N8	Underground Storage Tank Compliance	☐	☒	No underground storage tanks proposed. No hazardous materials proposed onsite
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials proposed onsite

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☒	☐	Project site to comply with all Fire Code requirements set forth. Please see Building plans for additional information.
N11	Litter/Debris Control Program	☒	☐	Promote efficient and safe practices through training programs and as part of landscape maintenance.
N12	Employee Training	☐	☐	Consistently maintain all employees up to date with training. See O&M for additional information.
N13	Housekeeping of Loading Docks	☒	☐	Maintenance of proposed loading docks west of the building by cleaning up spills immediately. Proper inspection of containment after area has been cleaned thoroughly.
N14	Catch Basin Inspection Program	☒	☐	Inspect all inlet catch basins to make sure they are clean. See O&M for additional information.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Vacuuming and street sweeping of proposed lot
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not a public agency project
N17	Comply with all other applicable NPDES permits	☐	☒	No other applicable NPDES permits

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not ap plicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	Storm drain "NO DUMPING" stencil throughout site at all inlet locations
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage proposed
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Promote efficient and safe practices to avoid pollution. Runoff will be diverted away from the trash enclosure as to not have any additional runoff go inside the enclosure.
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)	☒	☐	Efficient irrigation proposed at site, please refer to landscape plans for additional information re: valves, controllers, and timers.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Proposed at all landscaped areas abutting curb
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Slope protection throughout site where applicable
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☒	☐	Docks proposed onsite
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No hazardous materials proposed onsite
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle wash areas proposed onsite
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing proposed areas onsite

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)	☐	☒	No equipment wash areas proposed onsite
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas proposed onsite
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside landscaping.
S14	Wash water control for food preparation areas	☐	☒	No food preparation areas proposed onsite
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle wash areas proposed onsite

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.

Form 4.1-3 Preventative LID Site Design Practices Checklist

Site Design Practices *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*
Minimize impervious areas: Yes ☐ No ☒ Explanation: Proposed BMP will utilize the natural infiltration capacity as much as possible
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: Proposed landscaping and BMP intended to maximize the space utilized for infiltration
Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒ Explanation: Proposed drainage pattern intended for infiltration as opposed to offsite drainage
Disconnect impervious areas: Yes ☐ No ☒ Explanation: Impervious areas are only disconnected by driveways
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: Very little existing vegetation onsite currently
Re-vegetate disturbed areas: Yes ☐ No ☒ Explanation: Disturbed areas not covered by impervious areas are landscaped.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Stormwater retention area separated from proposed buildings in order to minimize unnecessary compaction
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: : No above-ground vegetated drainage swales utilized.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Landscape areas will be staked

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_6 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^2), 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.

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

1 Project area DA 1 (ft^2): 433,287	**2** Imperviousness after applying preventative site design practices (Imp%): 85	**3** Runoff Coefficient (Rc): _0.661 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.521 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.771 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Valley = 1.4807; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 43,346 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-2 Summary of 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://permitrack.sbcounty.gov/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^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed			
Post-developed			
Difference			
Difference (as % of pre-developed)			

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

Weighted Curve Number Determination for: Pre-developed DA								
1a Land Cover type								
2a Hydrologic Soil Group (HSG)								
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4a 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: Post-developed DA								
1b Land Cover type								
2b Hydrologic Soil Group (HSG)								
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*								
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*								

Not applicable

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, S (in): *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN:	**8** Post-developed soil storage capacity, S (in): *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

11 Precipitation for 2 yr, 24 hr storm (in):
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

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

Not applicable

13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*

14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*

15 Additional time of concentration needed to meet HCOC requirement (min): $T_{C\text{-}HCOC}$ = *(Item 13 * 0.95) – Item 14*

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 (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *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)*							
3 Ratio of pervious area to total area *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)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *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)*	DMA A						
	DMA B						
	DMA C						

8 Pre-developed Q_p at T_c for DMA A: *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	**9** Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	**10** Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*		
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*	**12** Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	**13** Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): $Q_{p\text{-}HCOC}$ = *(Item 14 * 0.95) – Item 10*		

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 8 below.

[8] Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒
If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, 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.

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

1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☐ *If yes, complete Items 2-5; If no, proceed to Item 6*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft²)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft³) *V = Item 2 * Item 3 * (0.5/12), where 0.5 is the depth of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft³):		$V_{retention}$ *=Sum of Item 4 for all BMPs*	
6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☐ *If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft²)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft²)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft³) $V_{retention}$ *= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft³):		$V_{retention}$ *=Sum of Item 12 for all BMPs*	

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

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☐ *If yes, complete Items 15-20. If no, proceed to Item 21*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
15 Rooftop area planned for ET BMP (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typi~ 0*			
17 Daily ET deman(ft ay) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) $V_{retention}$ *= Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3): $V_{retention}$ *=Sum of Item 19 for all BMPs*			
21 Implementation of Street Trees: Yes ☐ No ☐ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
22 Number of Street Trees			
23 Average canopy cover over impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) $V_{retention}$ *= Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3): $V_{retention}$ *= Sum of Item 24 for all BMPs*			
26 Implementation of residential rain barrel/cisterns: Yes☐ No ☐ *If yes, complete Items 27-29; If no, proceed to Item 30*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
27 Number of rain barrels/cisterns			
28 Runoff volume retention from rain barrels/cisterns (ft^3) $V_{retention}$ *= Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3): $V_{retention}$ *=Sum of Item 28 for all BMPs*			
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs: *Sum of Items 5, 13, 20, 25 and 29*			

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).

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

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 43,346 *V_{unmet} = Form 4.2-1 Item 7 - 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 A BMP Type 1	DA 1 DMA B BMP Type 1	
2 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*	7.27+11.99/2= 9.63	7.27+11.99/2= 9.63	
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	4	4	
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	2.4075	2.4075	
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	6	6	
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	9.63	9.63	
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	2,300 (Underground)	2,300 (Underground)	
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	0	0	
10 Amended soil porosity	0	0	
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	0	0	
12 Gravel porosity	0	0	
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	0	0	
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0	0	
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	21185	22161	
16 Total Retention Volume from LID Infiltration BMPs: 43,346 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

4.3.3 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).

Form 4.3-4 Harvest and Use BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): 0 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16*			
BMP Type(s) *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*	DA DMA BMP Type		
2 Describe cistern or runoff detention facility			
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*			
4 Landscaped area planned for use of harvested stormwater (ft^2)			
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day			
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*			
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*			
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*			
9 Total Retention Volume (ft^3) from Harvest and Use BMP *Sum of Item 8 for all harvest and use BMP included in plan*			
10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☐ No ☐ *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.*			

Not applicable

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)

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): 0 *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9*	List pollutants of concern *Copy from Form 2.3-1.*	
2 Biotreatment BMP Selected *(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)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume-based biotreatment BMP (ft^3): *Form 4.3-6 Item 15 + Form 4.3-7 Item 13*	**4** Remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *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)*		
7 Metrics for MEP determination: • Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *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.*		

Not applicable

Form 4.3-6 Volume Based Biotreatment (DA 1) – Bioretention and Planter Boxes with Underdrains

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

Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *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.*				
1 Pollutants addressed with BMP forebay and basin *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*				
2 Bottom width (ft)				
3 Bottom length (ft)				
4 Bottom area (ft^2) A_{bottom} = *Item 2 * Item 3*				
5 Side slope (ft/ft)				
6 Depth of storage (ft)				
7 Water surface area (ft^2) $A_{surface}$ =*(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*				
8 Storage volume (ft^3) *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* V =*Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*				
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*				
10 Outflow rate (cfs) Q_{BMP} = *(Item $8_{forebay}$ + Item 8_{basin}) / (Item 9 * 3600)*				
11 Duration of design storm event (hrs)				
12 Biotreated Volume (ft^3) $V_{biotreated}$ = *(Item $8_{forebay}$ + Item 8_{basin}) +(Item 10 * Item 11 * 3600)*				
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(Sum of Item 12 for all BMP included in plan)*				

Form 4.3-8 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*			
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5* Not applicable			
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
5 Bottom width (ft) b_w = *(Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)*			
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) SA_{top} = *(Item 5 + (2 * Item 2 * Item 6)) * 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.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)

1 Total LID DCV for the Project DA-1 (ft^3): 43,346 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 0 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 43,346 *Copy Item 16 in Form 4.3-3*

4 On-site retention with LID harvest and use BMP (ft^3): 0 *Copy Item 9 in Form 4.3-4*

5 On-site biotreatment with volume based biotreatment BMP (ft^3): 0 *Copy Item 3 in Form 4.3-5*

6 Flow capacity provided by flow based biotreatment BMP (cfs): 0 *Copy Item 6 in Form 4.3-5*

7 LID BMP performance criteria are achieved if answer to any of the following is "Yes":

- Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐
  If yes, sum of Items 2, 3, and 4 is greater than Item 1
- Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☐
  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
- 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 ☐ No ☐
  If yes, Form 4.3-1 Items 7 and 8 were both checked yes

8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:

- Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐
  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, V_{alt} *= (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%*
- 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: ☐
  Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed

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.

Form 4.3-10 Hydromodification Control BMPs (DA 1)

1 Volume reduction needed for HCOC performance criteria (ft^3): N/A *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): *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*
3 Remaining volume for HCOC volume capture (ft^3): *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): *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)*

5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*

6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☐

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐

  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 additional time of concentration required in Form 4.3-4 Item 1)

- 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 ☐
- 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 ☐

7 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☐

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☐

  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)

- 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 ☐

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).

Not applicable

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.

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Reponsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Inlets (box & trench grates, inlet filters	Owner	O&M Plan to be included with Final WQMP	Yearly in November, before every rainy season
Underground Retention	Owner	O&M Plan to be included with Final WQMP	Bi-Annually, November and May
Vacuum Sweeping	Owner	Vacuum sweeping of private streets and parking lots	Inspect yearly to make sure stencil is legible.
Storm Drain Stencil	Owner	Provide storm drain system stenciling and signage (CASQA New Development BMP Handbook SD-13	
Efficient Irrigation	Owner	Use efficient irrgation systems and landscape design, water conservation, smart controllers and source control (statewide model landscape ordinance; CASQA New Development BMP Handbook SD-12)	Inspect all landscape systems yearly to make sure all systems are performing properly.
Landscape Finish Grade	Owner	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	Inspect yearly after every rainy season to ensure no erosion/deteriorating.
Oil and grease management	Owner	Maintain Spill Control Readiness	Per CASQA BMP Handbook TC-50

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

Appendix 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

847.17' N0°25'34"W

261.41'

224.47'

583.22' N89°32'01"E

625.72' S71°12'05"W

PARCEL 5
211,764 SF
4.86 AC

PARCEL 4
221,524 SF
5.09 AC

PROJECT SITE = 9.94 ACRES
INFILTRATION RATE (NRCS) = 9.63 IN/HR.
TEST1=7.27, TEST2=11.99, SAFETY FACTOR=4
INFILTRATION IS FEASIBLE
DCV TOTAL: 43,346 CF

PROPOSED CONDITIONS PERVIOUS AREA = 15%
SUB AREA "A" (WEST/REAR)
AREA: 4.86 AC.
DCV: 21,185 CF

SUB AREA "B" (EAST/FRONT)
AREA: 5.09 AC.
DCV: 22,161 CF

PROPERTY LINE

DRAINAGE AREA BOUNDARY

PR . DRAINAGE PATH

PROPOSED CONTOURS

PROPOSED LANDSCAPING

(S1) STORM DRAIN SYSTEM FILTER & STENCILING
(S2) MC3500 STORM DETENTION SYSTEM
(S3) TRASH AND WASTE STORAGE
(S4) EFFICIENT IRRIGATION (NOT SHOWN)

WATER MAIN — W
FIRE WATER LINE — FW
SANITARY SEWER LINE — 4"S
STORM DRAIN LINE — SD
FORCE MAIN LINE

0 30 60
1 INCH = 30 FEET

REV. NO	DATE	DESTROY ALL PRINTS BEARING EARLIER DATE	REV. BY	CK'D BY	APP'D BY
		REVISED			

Cannon
16842 Von Karman Avenue, Suite 150
Irvine, CA 92606
P 909.753.8111 F 909.753.0775

DATE 9/26/22
SCALE 1" = 30'
CA JOB NO. 220139
DRAWN BY SJJ
CHECKED BY

RIVERSIDE XC
2830 S. RIVERSIDE2
WATER QUALITY MANAGEMENT PLAN
2830 S. RIVERSIDE
RIALTO, CA

SHEET
WQ1
OF XX

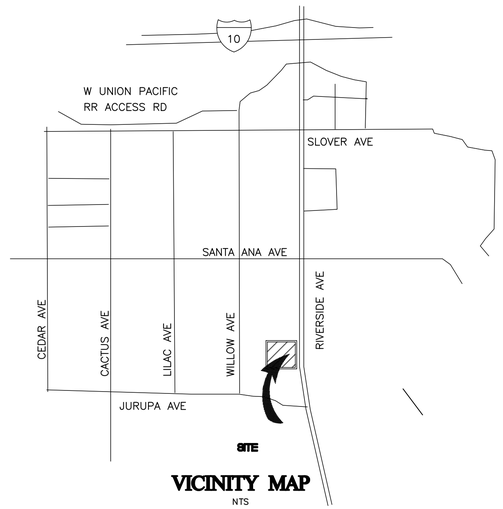
F:\proj\2022\220139\4 Production and Drafting\Const Dwgs\Civil\Exhibits\CX220139000S-WQ1.dwg 10-26-22 09:43:35 AM SamJ

PRELIMINARY GRADING PLAN
2830 RIVERSIDE AVENUE
CITY OF RIALTO, SAN BERNARDINO COUNTY, CALIFORNIA

LEGEND AND ABBREVIATIONS

	EXISTING	PROPOSED
TRACT BOUNDARY		
PROPERTY LINE		
RIGHT-OF-WAY		
EASEMENT/SETBACK		
STREET CENTERLINE		
CURB		
CURB & GUTTER		
ROAD STRIPING		
FENCE	X	X
DAYLIGHT LINE	//	//
100YR FLOODPLAIN BOUNDARY		
FLOWLINE		
DRAINAGE SWALE		
RETAINING WALL		
GRADE BREAK		
SLOPE	TOP OF SLOPE	TOP OF SLOPE
CONTOURS		
WATER MAIN	W	W
RECLAIMED WATER LINE	RW	RW
SANITARY SEWER LINE	SS	SS
STORM DRAIN LINE	SD	SD
GAS LINE	G	G
ELECTRIC LINE	E	E
OVERHEAD WIRES	OH	OH
FIBER OPTICS	FO	FO
TELEPHONE	T	T
JOINT TRENCH	JT	JT
BIOFILTRATION AREA		
FIRE HYDRANT		
STREET LAMP		
STREET LAMP WITH MAST ARM		
STORM DRAIN INLET		
CURB INLET		
TREES		
POWER POLE		
SDMH		
SSMH		
SS CLEANOUT		
RIPRAP PROTECTION AT SD OUTLET		

ASPHALT CONCRETE	AC
BEGINNING CURVE	BC
BEGINNING OF CURB RETURN	BCR
BEGINNING POINT	BP
BEGIN VERTICAL CURVE	BVC
BOTTOM FACE OF CURB	BFC
CENTERLINE	℄ / ℄
CURB RETURN	C.R.
DUCTILE IRON	DI
END CURVE	EC
END OF CURB RETURN	ECR
END POINT	EP
END VERTICAL CURVE	EVC
EXISTING GRADE	EG
EXISTING	(E)
FLOW LINE	FL / ℄
INVERT	INV
MEDIAN	MED
OPEN SPACE	OS
PUBLIC FACILITY	PF
PRIVATE ACCESS EASEMENT	PAE
PROPERTY LINE	PL / ℄
PUBLIC UTILITY EASEMENT	PUE
PUBLIC PEDESTRIAN EASEMENT	PPE
POINT OF REVERSE CURVE	PRC
POINT OF VERTICAL INTERSECTION	PVI
PROPOSED EDGE OF PAVEMENT	PROP. EP
RETAINING WALL	RTW
RECLAIMED WATER	RW
RIGHT OF WAY	ROW
STORM DRAIN	SD
STREET TREE EASEMENT	STE
SANITARY SEWER	SS
VERTICAL CURVE	VC
WATERLINE	WL
TOP OF CURB	TC
TOP OF GRATE	TG
BOTTOM OF WALL	BW
TOP OF WALL	TW
UNLESS NOTED OTHERWISE	U.N.O.



VICINITY MAP
NTS

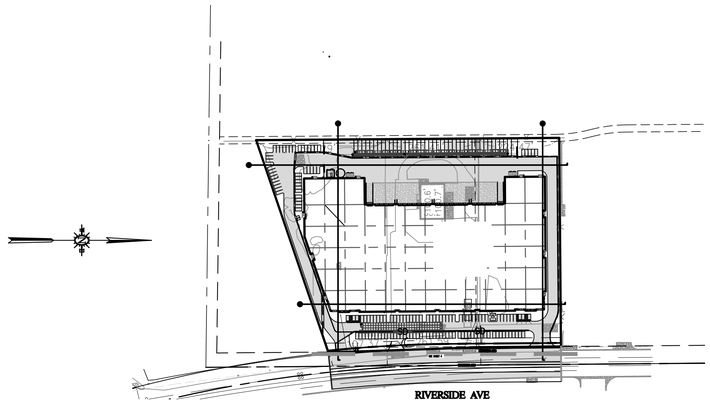
EARTHWORK QUANTITIES:

CUT: 20,029 CY
FIL: 17,195 CY
NET: 2,833 CY EXPORT

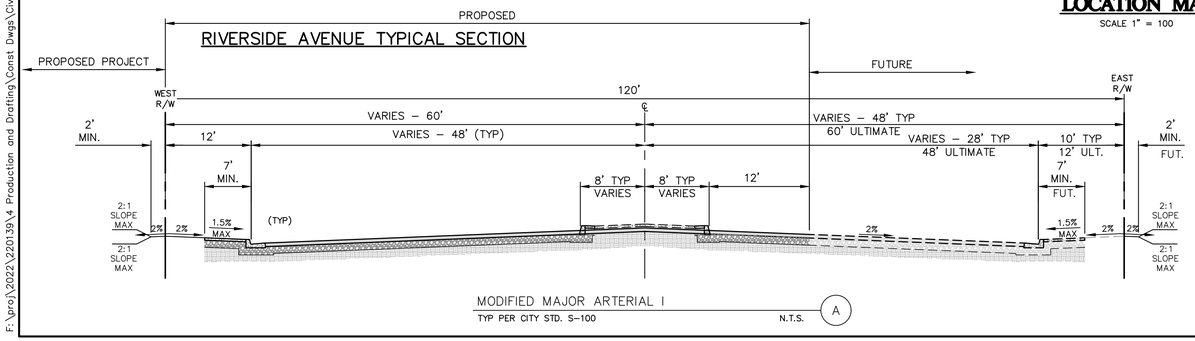
CALCULATIONS TAKEN FROM EXISTING SURFACE (FINISH) TO 6" BELOW PROPOSED FINISH SURFACE. CALCULATIONS DO NOT ACCOUNT FOR SHRINKAGE, EXPANSIION, NOR UTILITY & FOUNDATION SPOILS

REFERENCE DOCUMENTS:

JURUPA AVENUE REALIGNMENT PREPARED BY CASC FOR THE CITY OF RIALTO (ST-1994-05-11)
RIVERSIDE AVENUE STORM DRAIN IMPROVEMENT PLAN BY THEINES ENGINEERING FOR THE CITY OF RIALTO



LOCATION MAP
SCALE 1" = 100



MODIFIED MAJOR ARTERIAL I
TYP PER CITY STD. S-100 N.T.S. (A)

BASED UPON TITLE REPORT NO. 00168960-021-PS4-JC
DATED: FEBRUARY 18, 2022

LEGAL DESCRIPTION:

PARCEL 1 OF PARCEL MAP NO. 2713, IN THE CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 27, PAGE 1, OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

APN: 0258-121-33-0-000

TITLE REPORT EXCEPTIONS:

2 HIGHWAY AND ROAD EASEMENT RECORDED JUNE 7, 1979 IN BOOK 9702, PAGE 1618, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

3 OVERHEAD AND UNDERGROUND ELECTRICAL SUPPLY SYSTEMS AND COMMUNICATION SYSTEMS EASEMENT RECORDED JUNE 11, 1979 IN BOOK 9704, PAGE 1835, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

4 THE LAND DESCRIBED HEREIN IS INCLUDED WITHIN THE CITY OF RIALTO REDEVELOPMENT AGENCY RECORDED JULY 21, 1988 AS INSTRUMENT NO. 88-237223, O.R., JULY 10, 2002 AS INSTRUMENT NO. 2002-0355175, O.R., AND JUNE 20, 2007 AS INSTRUMENT NO. 2007-0367643, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

5 STORM DRAIN AND SANITARY SEWER FACILITIES EASEMENT RECORDED OCTOBER 27, 1989 AS INSTRUMENT NO. 89-404954, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

7 WIRELESS COMMUNICATION EASEMENT RECORDED NOVEMBER 5, 2014 AS INSTRUMENT NO. 2014-0414292, O.R., SEPTEMBER 19, 2019 AS INSTRUMENT NO. 2019-0335918, O.R., & DECEMBER 26, 2019 AS INSTRUMENT NO. 2019-0475030, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

8 INTENTIONALLY DELETED

11 LESSEE'S ASSIGNMENT OF LEASE AND SUBORDINATION RECRDED MAY 20, 2016 AS INSTRUMENT NO. 2016-0198542, O.R., AND MAY 20, 2016 AS INSTRUMENT NO. 2016-0198540, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

TITLE REPORT NO. 00168961-021-PS4-JC
DATED: JANUARY 13, 2022

LEGAL DESCRIPTION:

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

A PORTION OF THE EAST 1/2 OF LOTS 280 AND 291 OF THE SEMI-TROPIC LAND AND WATER COMPANY SUBDIVISION, IN THE CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 11, PAGE 12, OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT THE A POINT IN THE WEST LINE OF RIVERSIDE AVENUE, AS NOW ESTABLISHED BY DEED TO THE COUNTY OF SAN BERNARDINO, RECORDED MAY 19, 1959, IN BOOK 4822, PAGE 274, OFFICIAL RECORDS, 490.31 FEET SOUTH OF THE NORTHEAST CORNER OF LOT 291; THENCE, SOUTH 00° 10' EAST, ALONG SAID WEST LINE OF RIVERSIDE AVENUE, 225.30 FEET, TO THE NORTH LINE OF LAND CONVEYED BY CLAY W. MOORE TO JOSEPH G. STRAUCH; THENCE, SOUTH 89° 50' 32-1/2" WEST, ALONG SAID LINE, 582.65 FEET, TO THE WEST LINE OF THE EAST 1/2 OF LOT 280; THENCE, NORTH, ALONG SAID WEST LINE AND ITS NORTHERLY PROJECTION, 225.30 FEET; THENCE, NORTH 89° 50' 32-1/2" EAST, 582.61 FEET, TO THE POINT OF BEGINNING.

APN: 0258-121-23-0-000

ALSO DESCRIBED AS:

BEGINNING AT THE A POINT IN THE WEST LINE OF RIVERSIDE AVENUE, AS NOW ESTABLISHED BY DEED TO THE COUNTY OF SAN BERNARDINO, RECORDED MAY 19, 1959, IN BOOK 4822, PAGE 274, OFFICIAL RECORDS, 490.31 FEET SOUTH OF THE NORTHEAST CORNER OF LOT 291; THENCE, SOUTH 00° 28'46" EAST, ALONG SAID WEST LINE OF RIVERSIDE AVENUE, 224.22 FEET, TO THE NORTH LINE OF LAND CONVEYED BY CLAY W. MOORE TO JOSEPH G. STRAUCH; THENCE, SOUTH 89° 30' 32" WEST, ALONG SAID LINE, 583.43 FEET, TO THE WEST LINE OF THE EAST 1/2 OF LOT 280; THENCE, NORTH, ALONG SAID WEST LINE AND ITS NORTHERLY PROJECTION, 224.47 FEET; THENCE, NORTH 89° 32' 01" EAST, 583.22 FEET, TO THE POINT OF BEGINNING.

TITLE REPORT EXCEPTIONS:

2 WATER PIPE OR PIPES EASEMENT RECORDED JUNE 4, 1908 IN BOOK 419, PAGE 108 OF DEEDS.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

3 THE LAND DESCRIBED HEREIN IS INCLUDED WITHIN THE CITY OF RIALTO REDEVELOPMENT AGENCY RECORDED JULY 21, 1988 AS INSTRUMENT NO. 88-237223, O.R. AND JULY 10, 2002 AS INSTRUMENT NO. 2002-0355175, O.R., AND JUNE 20, 2007 AS INSTRUMENT NO. 2007-0367643, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

8 STORM DRAIN AND SANITARY SEWER FACILITIES EASEMENT RECORDED OCTOBER 27, 1989 AS INSTRUMENT NO. 89-404954, O.R.
-

OWNER/DEVELOPER:

RIVERSIDE XC, LLC
ATTENTION: DANNY RICKS
3020 OLD RANCH PARKWAY, SUITE 200
SEAL BEACH, CA 90740
714-650-7111

ENGINEER/SURVEYOR:

CANNON
ATTENTION: JULIAN TOCHINAI RHOADES, P.E.
16842 VON KARMAN, SUITE 150
IRVINE, CA 92606
949-777-1591

GEOTECHNICAL REPORT:

GEOTECHNICAL INVESTIGATION REPORT, 2830 S. RIVERSIDE AVENUE, BLOOMINGTON (APN 0258-121-33-0000), 11190 RIVERSIDE AVENUE, RIALTO (APN 0258-121-23-0000) AND 11258 S. RIVERSIDE AVENUE (APN 0258-121-34-0000), BLOOMINGTON, CALIFORNIa
BY: TGR
PROJECT 22-7418
ATTN: SANJAY GOVIL, PHD, PE, GE, 2382
EDWARD L. BURROWS, MS, PG, CEG 1750
3037 SOUTH HARBOR BOULEVARD
SANTA ANA, CA 92704
714-941-7189

UTILITIES:

WATER:	WEST VALLEY WATER DISTRICT	
SEWER:	RIALTO WATER SERVICES	909-820-2546
STORM DRAINAGE:	NONE	
GAS:	SO. CALIFORNIA GAS COMPANY	800-427-2200
ELECTRIC:	SOUTHERN CALIFORNIA EDISON	800-684-8123
TELEPHONE:	AT&T	800-288-2020
CABLE:	TIME WARNER	888-892-2253
TRASH:	EDCO DISPOSAL	909-877-1596
SCHOOL DISTRICT:	RIALTO UNIFIED SCHOOL DISTRICT	909-820-7700
FIRE PROTECTION:	CITY OF RIALTO FIRE DEPT.	909-820-2501

APN:

0258-121-23
0258-121-33
0258-121-34

SITE AREA:

	AREA (AC)
EX. PARCEL 1	3.004 AC
EX. PARCEL 2	3.524 AC
EX. PARCEL 3	3.579 AC
TOTAL	10.107 AC
PR. PARCEL	9.947 AC
VVACATION	0.160 AC
TOTAL	10.107 AC

BASIS OF ELEVATION:

THE BEARINGS SHOWN HEREON ARE BASED UPON THE CALIFORNIA COORDINATE SYSTEM OF 1983, CC83, ZONE 5, (2021.25) IN ACCORDANCE WITH THE CALIFORNIA PUBLIC RESOURCES CODE SECTIONS 8801-8819.

BASIS OF BEARINGS:

THE BEARINGS SHOWN HEREON ARE BASED UPON THE CALIFORNIA COORDINATE SYSTEM OF 1983, CC83, ZONE 5, (2021.25) IN ACCORDANCE WITH THE CALIFORNIA PUBLIC RESOURCES CODE SECTIONS 8801-8819.

FLOOD MAPPING:

ZONE X - AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN
COMMUNITY PANEL NO. 06071C8686H
DATED 08/28/2008

ZONING

AGUA MANSA INDUSTRIAL CORRIDOR SPECIFIC PLAN - HEAVY INDUSTRIAL

TITLE REPORT NO. 00168962-021-PS4-JC
DATED: JANUARY 13, 2022

LEGAL DESCRIPTION:

PARCEL 2 OF PARCEL MAP NO. 2713, IN THE CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 27, PAGE 1, OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

APN: 0258-121-34-0-000

TITLE REPORT EXCEPTIONS:

2 ELECTRIC TRANSMISSION LINE EASEMENT RECORDED FEBRUARY 16, 1946 IN BOOK 1863, PAGE 236, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

3 THE LAND DESCRIBED HEREIN IS INCLUDED WITHIN THE CITY OF RIALTO REDEVELOPMENT AGENCY RECORDED JULY 21, 1988 AS INSTRUMENT NO. 88-237223, O.R. AND JULY 10, 2002 AS INSTRUMENT NO. 2002-0355175, O.R., AND JUNE 20, 2007 AS INSTRUMENT NO. 2007-0367643, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

(4) STORM DRAIN AND SANITARY SEWER FACILITIES EASEMENT RECORDED OCTOBER 27, 1989 AS INSTRUMENT NO. 89-404954, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

REV. NO	DATE	REVISED	REV. BY	CK'D BY	APP'D BY
		DESTROY ALL PRINTS BEARING EARLIER DATE			

Cannon
16842 Von Karman Avenue, Suite 150
Irvine, CA 92606
P 909.753.9111 F 909.753.0775

DATE 10/18/2022
SCALE 1" = 100'
CA JOB NO. 220139
DRAWN BY SJJ
CHECKED BY

RIVERSIDE XC
2830 S. RIVERSIDE
TITLE SHEET
2830 S. RIVERSIDE
RIALTO, CA

SHEET 1 OF 4

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CONSTRUCTION NOTES

1. 6" CURB AND GUTTER
2. 6" CURB ONLY
3. DRIVEWAY WITH ACCESSIBLE CROSSING ONTO RIVERSIDE
4. CONCRETE PAVEMENT
5. DOMESTIC WATER CONNECTION, METER, /BACKFLOW POC
6. SANITARY SEWER CONNECTION/POC
7. ASPHALT CONCRETE PAVEMENT
8. CONCRETE DOCK PER STRUCTURAL
9. PUBLIC SIDEWALK PER CITY STD
10. FIRE CONNECTION/BACKFLOW/POC ONSITE SYSTEM DESIGN-BUILD BY OTHERS
12. TRASH ENCLOSURE PER ARCHITECT
14. GATE PER ARCHITECT
16. DETENTION SYSTEM
17. INLET
18. STORM DRAIN MANHOLE
21. 6' WIDE V-GUTTER
22. STORMWATER FORCE MAIN

FF VARIES
SLOPE=0.5%
NORTH(HI)=980.38
TO
SOUTH(LO)=977.06

PARCEL 1
433,287 SF
9.95 AC

2830 S. RIVERSIDE AVE
SINGLE STORY WAREHOUSE
FF = 976.54 ±
HT = 75' ±

0 30 60
1 INCH = 30 FEET

RIVERSIDE AVE

SEE SHEET 4

RIGHT OF WAY VACATION

1'HIGH WALL 10'

8"WIDE CMU WALL

4' HIGH &

REV. NO	DATE	REVISED	CKD./APRD BY
		DESTROY ALL PRINTS BEARING EARLIER DATE	REV. BY

Cannon
16842 Von Karman Avenue, Suite 150
Irvine, CA 92606
P 909.753.8111 F 909.753.0775

DRAWN BY SJJ
CHECKED BY
DATE 10/18/2022
SCALE 1" = 30'
CA JOB NO. 220139

RIVERSIDE XC
2830 S. RIVERSIDE
CONCEPTUAL GRADING PLAN
2830 S. RIVERSIDE
RIALTO, CA

SHEET 2 OF 4

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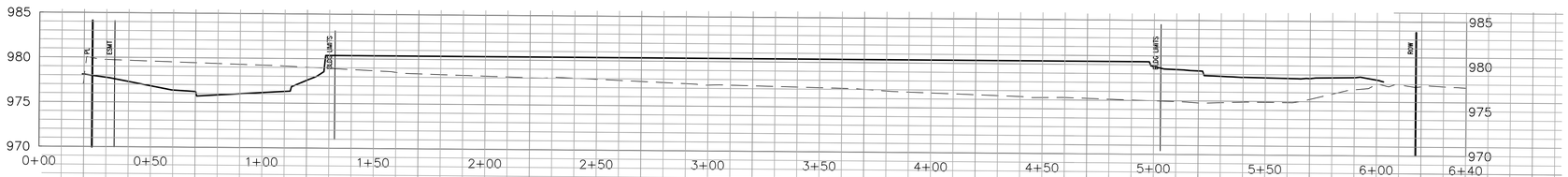
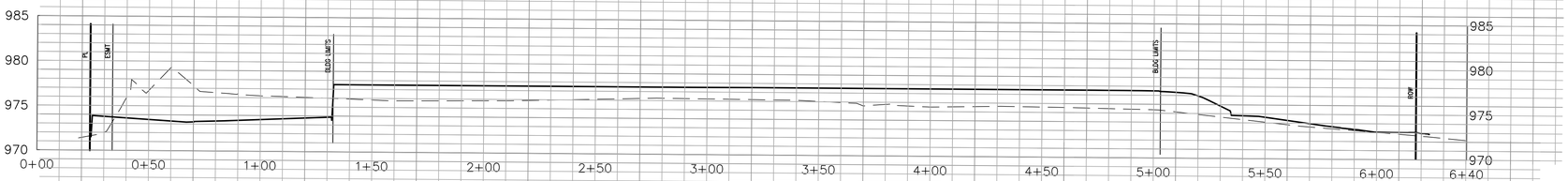


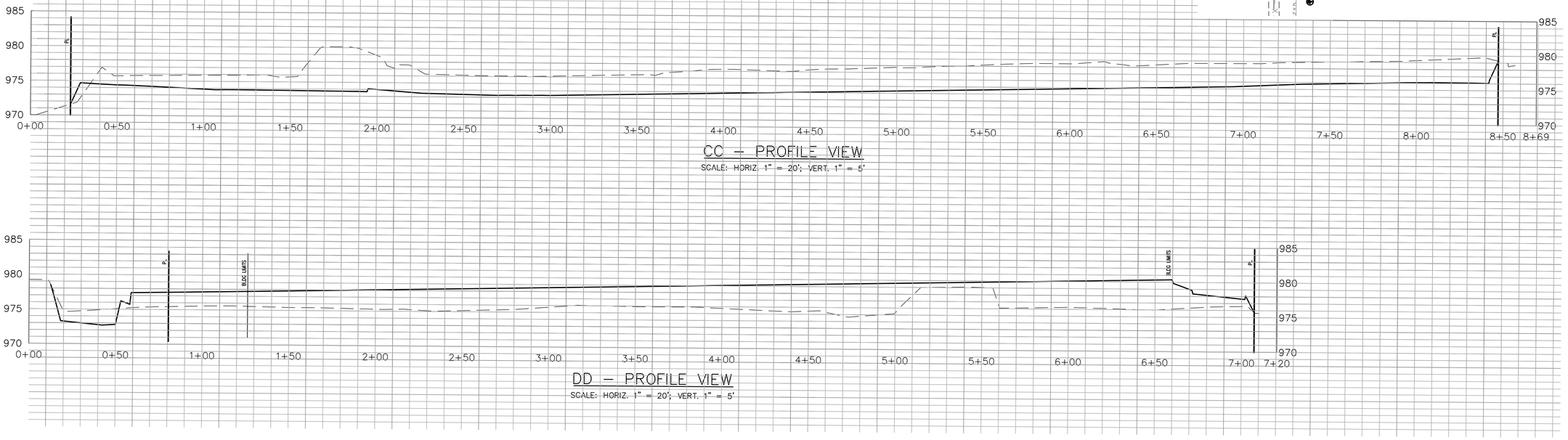
AA – PROFILE VIEW

SCALE: HORIZ. 1" = 20'; VERT. 1" = 5'



BB – PROFILE VIEW

SCALE: HORIZ. 1" = 20'; VERT. 1" = 5'

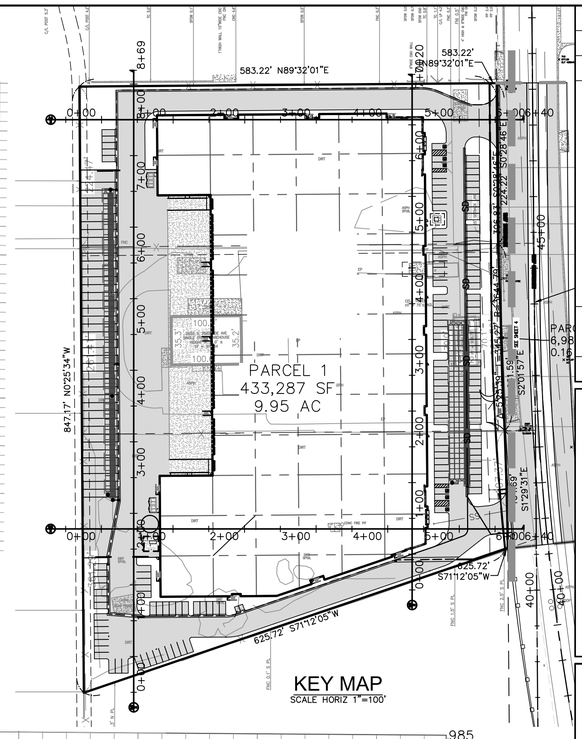


CC – PROFILE VIEW

SCALE: HORIZ. 1" = 20'; VERT. 1" = 5'

DD – PROFILE VIEW

SCALE: HORIZ. 1" = 20'; VERT. 1" = 5'



KEY MAP

SCALE HORIZ 1"=100'

0 100 200

1 INCH =100 FEET

REV. NO	DATE	REVISED	DESTROY ALL PRINTS BEARING EARLIER DATE	REV. BY	CK'D BY	APP'D BY

Cannon

16842 Von Karman Avenue, Suite 150
Irvine, CA 92606
P 909.753.8111 F 909.753.0775

DRAWN BY SJJ

CHECKED BY

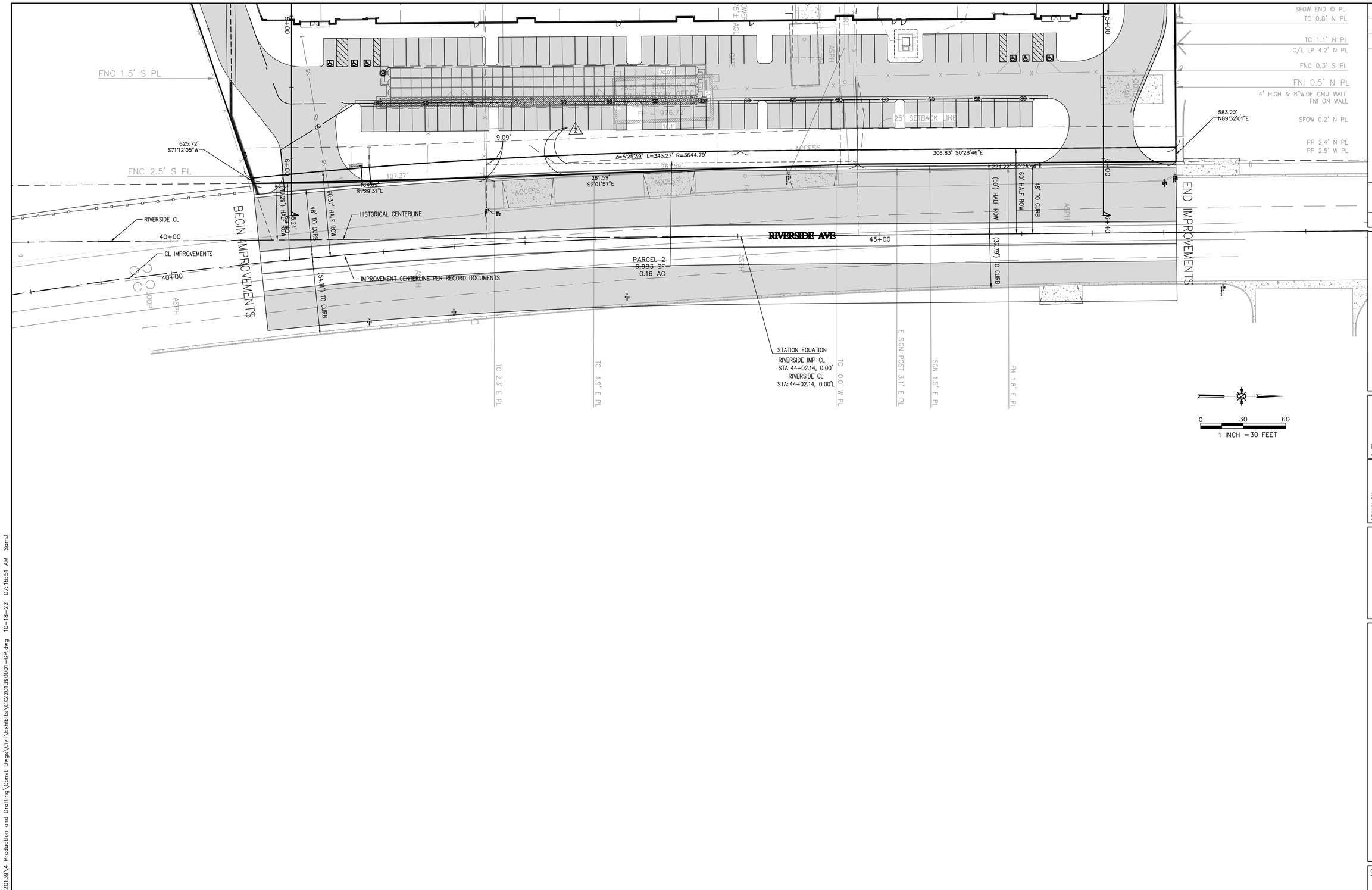
DATE 10/18/2022

SCALE 1" = 100'

CA JOB NO. 220139

RIVERSIDE XC
2830 S. RIVERSIDE
CROSS SECTIONS
2830 S. RIVERSIDE
RIALTO, CA

SHEET 3 OF 4



REV. NO	DATE	REVISED	REV. BY	CK'D. BY	APP'D BY
		DESTROY ALL PRINTS BEARING EARLIER DATE			

Cannon
16842 Von Karman Avenue, Suite 150
Irvine, CA 92606
P 949.753.8111 F 949.753.0775

DRAWN BY	CHECKED BY	DATE	SCALE	CA JOB NO.
SJJ		10/18/2022	1" = 30'	220139

RIVERSIDE XC
2830 S. RIVERSIDE
OFFSITES
2830 S. RIVERSIDE
RIALTO, CA

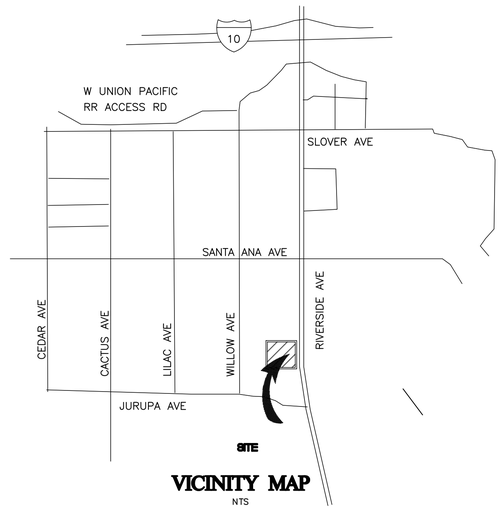
SHEET
4
OF 4

TENTATIVE PARCEL MAP
2830 RIVERSIDE AVENUE
CITY OF RIALTO, SAN BERNARDINO COUNTY, CALIFORNIA

LEGEND AND ABBREVIATIONS

	EXISTING	PROPOSED
TRACT BOUNDARY		
PROPERTY LINE		
RIGHT-OF-WAY		
EASEMENT/SETBACK		
STREET CENTERLINE		
CURB		
CURB & GUTTER		
ROAD STRIPING		
FENCE	X	X
DAYLIGHT LINE	//	//
100YR FLOODPLAIN BOUNDARY		
FLOWLINE		
DRAINAGE SWALE		
RETAINING WALL		
GRADE BREAK		
SLOPE	TOP OF SLOPE	TOP OF SLOPE
CONTOURS		
WATER MAIN	W	W
RECLAIMED WATER LINE	RW	RW
SANITARY SEWER LINE	SS	SS
STORM DRAIN LINE	SD	SD
GAS LINE	G	G
ELECTRIC LINE	E	E
OVERHEAD WIRES	OH	OH
FIBER OPTICS	FO	FO
TELEPHONE	T	T
JOINT TRENCH	JT	JT
BIOFILTRATION AREA		
FIRE HYDRANT		
STREET LAMP		
STREET LAMP WITH MAST ARM		
STORM DRAIN INLET		
CURB INLET		
TREES		
POWER POLE		
SDMH		
SSMH		
SS CLEANOUT		
RIPRAP PROTECTION AT SD OUTLET		

ASPHALT CONCRETE	AC
BEGINNING CURVE	BC
BEGINNING OF CURB RETURN	BCR
BEGINNING POINT	BP
BEGIN VERTICAL CURVE	BVC
BOTTOM FACE OF CURB	BFC
CENTERLINE	CL / ℄
CURB RETURN	C.R.
DUCTILE IRON	DI
END CURVE	EC
END OF CURB RETURN	ECR
END POINT	EP
END VERTICAL CURVE	EVC
EXISTING GRADE	EG
EXISTING	(E)
FLOW LINE	FL / ℄
INVERT	INV
MEDIAN	MED
OPEN SPACE	OS
PUBLIC FACILITY	PF
PRIVATE ACCESS EASEMENT	PAE
PROPERTY LINE	PL / ℄
PUBLIC UTILITY EASEMENT	PUE
PUBLIC PEDESTRIAN EASEMENT	PPE
POINT OF REVERSE CURVE	PRC
POINT OF VERTICAL INTERSECTION	PVI
PROPOSED EDGE OF PAVEMENT	PROP. EP
RETAINING WALL	RTW
RECLAIMED WATER	RW
RIGHT OF WAY	ROW
STORM DRAIN	SD
STREET TREE EASEMENT	STE
SANITARY SEWER	SS
VERTICAL CURVE	VC
WATERLINE	WL
TOP OF CURB	TC
TOP OF GRATE	TG
BOTTOM OF WALL	BW
TOP OF WALL	TW
UNLESS NOTED OTHERWISE	U.N.O.



VICINITY MAP
NTS

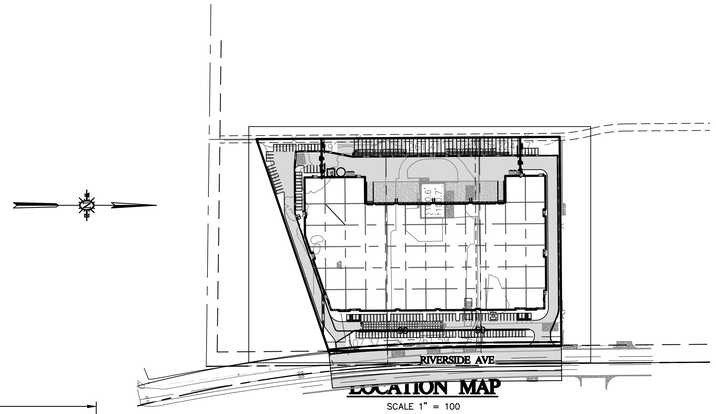
EARTHWORK QUANTITIES:

CUT: 20,029 CY
FIL: 17,195 CY
NET: 2,833 CY EXPORT

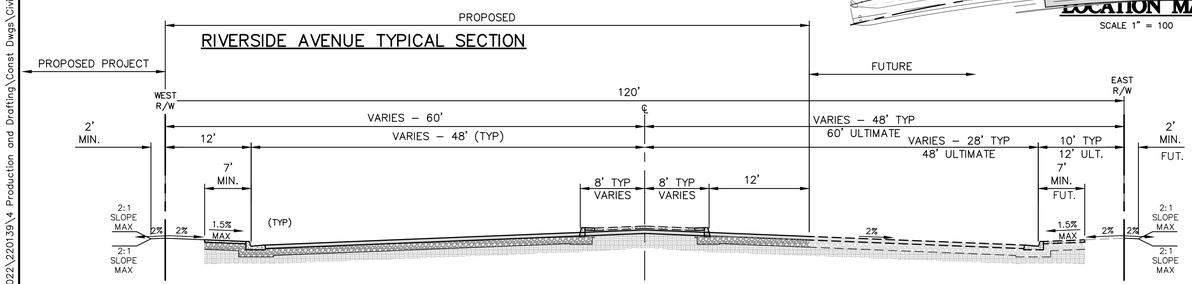
CALCULATIONS TAKEN FROM EXISTING SURFACE (FINISH) TO 6" BELOW PROPOSED FINISH SURFACE. CALCULATIONS DO NOT ACCOUNT FOR SHRINKAGE, EXPANSIION, NOR UTILITY & FOUNDATION SPOILS

REFERENCE DOCUMENTS:

JURUPA AVENUE REALIGNMENT PREPARED BY CASC FOR THE CITY OF RIALTO (ST-1994-05-11)
RIVERSIDE AVENUE STORM DRAIN IMPROVEMENT PLAN BY THEINES ENGINEERING FOR THE CITY OF RIALTO



LOCATION MAP
SCALE 1" = 100



MODIFIED MAJOR ARTERIAL I
TYP PER CITY STD. S-100 N.T.S. (A)

BASED UPON TITLE REPORT NO. 00168960-021-PS4-JC
DATED: FEBRUARY 18, 2022

LEGAL DESCRIPTION:

PARCEL 1 OF PARCEL MAP NO. 2713, IN THE CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 27, PAGE 1, OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

APN: 0258-121-33-0-000

TITLE REPORT EXCEPTIONS:

2 HIGHWAY AND ROAD EASEMENT RECORDED JUNE 7, 1979 IN BOOK 9702, PAGE 1618, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

3 OVERHEAD AND UNDERGROUND ELECTRICAL SUPPLY SYSTEMS AND COMMUNICATION SYSTEMS EASEMENT RECORDED JUNE 11, 1979 IN BOOK 9704, PAGE 1835, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

4 THE LAND DESCRIBED HEREIN IS INCLUDED WITHIN THE CITY OF RIALTO REDEVELOPMENT AGENCY RECORDED JULY 21, 1988 AS INSTRUMENT NO. 88-237223, O.R., JULY 10, 2002 AS INSTRUMENT NO. 2002-0355175, O.R., AND JUNE 20, 2007 AS INSTRUMENT NO. 2007-0367643, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

5 STORM DRAIN AND SANITARY SEWER FACILITIES EASEMENT RECORDED OCTOBER 27, 1989 AS INSTRUMENT NO. 89-404954, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

7 WIRELESS COMMUNICATION EASEMENT RECORDED NOVEMBER 5, 2014 AS INSTRUMENT NO. 2014-0414292, O.R., SEPTEMBER 19, 2019 AS INSTRUMENT NO. 2019-0335918, O.R., & DECEMBER 26, 2019 AS INSTRUMENT NO. 2019-0475030, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

8 INTENTIONALLY DELETED

11 LESSEE'S ASSIGNMENT OF LEASE AND SUBORDINATION RECRDED MAY 20, 2016 AS INSTRUMENT NO. 2016-0198542, O.R., AND MAY 20, 2016 AS INSTRUMENT NO. 2016-0198540, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

TITLE REPORT NO. 00168961-021-PS4-JC
DATED: JANUARY 13, 2022

LEGAL DESCRIPTION:

THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

A PORTION OF THE EAST 1/2 OF LOTS 280 AND 291 OF THE SEMI-TROPIC LAND AND WATER COMPANY SUBDIVISION, IN THE CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 11, PAGE 12, OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT THE A POINT IN THE WEST LINE OF RIVERSIDE AVENUE, AS NOW ESTABLISHED BY DEED TO THE COUNTY OF SAN BERNARDINO, RECORDED MAY 19, 1959, IN BOOK 4822, PAGE 274, OFFICIAL RECORDS, 490.31 FEET SOUTH OF THE NORTHEAST CORNER OF LOT 291; THENCE, SOUTH 00° 10' EAST, ALONG SAID WEST LINE OF RIVERSIDE AVENUE, 225.30 FEET, TO THE NORTH LINE OF LAND CONVEYED BY CLAY W. MOORE TO JOSEPH G. STRAUCH; THENCE, SOUTH 89° 50' 32-1/2" WEST, ALONG SAID LINE, 582.65 FEET, TO THE WEST LINE OF THE EAST 1/2 OF LOT 280; THENCE, NORTH, ALONG SAID WEST LINE AND ITS NORTHERLY PROJECTION, 225.30 FEET; THENCE, NORTH 89° 50' 32-1/2" EAST, 582.61 FEET, TO THE POINT OF BEGINNING.

APN: 0258-121-23-0-000

ALSO DESCRIBED AS:

BEGINNING AT THE A POINT IN THE WEST LINE OF RIVERSIDE AVENUE, AS NOW ESTABLISHED BY DEED TO THE COUNTY OF SAN BERNARDINO, RECORDED MAY 19, 1959, IN BOOK 4822, PAGE 274, OFFICIAL RECORDS, 490.31 FEET SOUTH OF THE NORTHEAST CORNER OF LOT 291; THENCE, SOUTH 00° 28'46" EAST, ALONG SAID WEST LINE OF RIVERSIDE AVENUE, 224.22 FEET, TO THE NORTH LINE OF LAND CONVEYED BY CLAY W. MOORE TO JOSEPH G. STRAUCH; THENCE, SOUTH 89° 30' 32" WEST, ALONG SAID LINE, 583.43 FEET, TO THE WEST LINE OF THE EAST 1/2 OF LOT 280; THENCE, NORTH, ALONG SAID WEST LINE AND ITS NORTHERLY PROJECTION, 224.47 FEET; THENCE, NORTH 89° 32' 01" EAST, 583.22 FEET, TO THE POINT OF BEGINNING.

TITLE REPORT EXCEPTIONS:

2 WATER PIPE OR PIPES EASEMENT RECORDED JUNE 4, 1908 IN BOOK 419, PAGE 108 OF DEEDS.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

3 THE LAND DESCRIBED HEREIN IS INCLUDED WITHIN THE CITY OF RIALTO REDEVELOPMENT AGENCY RECORDED JULY 21, 1988 AS INSTRUMENT NO. 88-237223, O.R. AND JULY 10, 2002 AS INSTRUMENT NO. 2002-0355175, O.R., AND JUNE 20, 2007 AS INSTRUMENT NO. 2007-0367643, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

8 STORM DRAIN AND SANITARY SEWER FACILITIES EASEMENT RECORDED OCTOBER 27, 1989 AS INSTRUMENT NO. 89-404954, O.R.
-

OWNER/DEVELOPER:

RIVERSIDE XC, LLC
ATTENTION: DANNY RICKS
3020 OLD RANCH PARKWAY, SUITE 200
SEAL BEACH, CA 90740
714-650-7111

ENGINEER/SURVEYOR:

CANNON
ATTENTION: JULIAN TOCHINAI RHOADES, P.E.
16842 VON KARMAN, SUITE 150
IRVINE, CA 92606
949-777-1591

GEOTECHNICAL REPORT:

GEOTECHNICAL INVESTIGATION REPORT, 2830 S. RIVERSIDE AVENUE, BLOOMINGTON (APN 0258-121-33-0000), 11190 RIVERSIDE AVENUE, RIALTO (APN 0258-121-23-0000) AND 11258 S. RIVERSIDE AVENUE (APN 0258-121-34-0000), BLOOMINGTON, CALIFORNIa
BY: TGR
PROJECT 22-7418
ATTN: SANJAY GOVIL, PHD, PE, GE, 2382
EDWARD L. BURROWS, MS, PG, CEG 1750
3037 SOUTH HARBOR BOULEVARD
SANTA ANA, CA 92704
714-941-7189

UTILITIES:

WATER:	WEST VALLEY WATER DISTRICT	
SEWER:	RIALTO WATER SERVICES	909-820-2546
STORM DRAINAGE:	NONE	
GAS:	SO. CALIFORNIA GAS COMPANY	800-427-2200
ELECTRIC:	SOUTHERN CALIFORNIA EDISON	800-684-8123
TELEPHONE:	AT&T	800-288-2020
CABLE:	TIME WARNER	888-892-2253
TRASH:	EDCO DISPOSAL	909-877-1596
SCHOOL DISTRICT:	RIALTO UNIFIED SCHOOL DISTRICT	909-820-7700
FIRE PROTECTION:	CITY OF RIALTO FIRE DEPT.	909-820-2501

APN:

0258-121-23
0258-121-33
0258-121-34

SITE AREA:

	AREA (AC)
EX. PARCEL 1	3.004 AC
EX. PARCEL 2	3.524 AC
EX. PARCEL 3	3.579 AC
TOTAL	10.107 AC
PR. PARCEL	9.947 AC
VVACATION	0.160 AC
TOTAL	10.107 AC

BASIS OF ELEVATION:

THE BEARINGS SHOWN HEREON ARE BASED UPON THE CALIFORNIA COORDINATE SYSTEM OF 1983, CC83, ZONE 5, (2021.25) IN ACCORDANCE WITH THE CALIFORNIA PUBLIC RESOURCES CODE SECTIONS 8801-8819.

BASIS OF BEARINGS:

THE BEARINGS SHOWN HEREON ARE BASED UPON THE CALIFORNIA COORDINATE SYSTEM OF 1983, CC83, ZONE 5, (2021.25) IN ACCORDANCE WITH THE CALIFORNIA PUBLIC RESOURCES CODE SECTIONS 8801-8819.

FLOOD MAPPING:

ZONE X - AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN
COMMUNITY PANEL NO. 06071C8686H
DATED 08/28/2008

ZONING

AGUA MANSA INDUSTRIAL CORRIDOR SPECIFIC PLAN - HEAVY INDUSTRIAL

TITLE REPORT NO. 00168962-021-PS4-JC
DATED: JANUARY 13, 2022

LEGAL DESCRIPTION:

PARCEL 2 OF PARCEL MAP NO. 2713, IN THE CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 27, PAGE 1, OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

APN: 0258-121-34-0-000

TITLE REPORT EXCEPTIONS:

2 ELECTRIC TRANSMISSION LINE EASEMENT RECORDED FEBRUARY 16, 1946 IN BOOK 1863, PAGE 236, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

3 THE LAND DESCRIBED HEREIN IS INCLUDED WITHIN THE CITY OF RIALTO REDEVELOPMENT AGENCY RECORDED JULY 21, 1988 AS INSTRUMENT NO. 88-237223, O.R. AND JULY 10, 2002 AS INSTRUMENT NO. 2002-0355175, O.R., AND JUNE 20, 2007 AS INSTRUMENT NO. 2007-0367643, O.R.
-AFFECTS PROPERTY, NOT PLOTTED, BLANKET IN NATURE

(4) STORM DRAIN AND SANITARY SEWER FACILITIES EASEMENT RECORDED OCTOBER 27, 1989 AS INSTRUMENT NO. 89-404954, O.R.
-AFFECTS PROPERTY, PLOTTED AS SHOWN

REV. NO	DATE	REVISED	DESTROY ALL PRINTS BEARING EARLIER DATE	REV. BY	CKD. BY	APPRD BY

Cannon
16842 Von Karman Avenue, Suite 150
Irvine, CA 92606
P 909.753.8111 F 909.753.0775

DATE 9/26/22
SCALE AS SHOWN
CA JOB NO. 220139
DRAWN BY SJJ
CHECKED BY

RIVERSIDE XC
2830 S. RIVERSIDE
TENTATIVE PARCEL MAP
2830 S. RIVERSIDE
RIALTO, CA

SHEET
1 OF 2

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REV. NO	DATE	REVISED	REV. BY	CK'D BY	APPRD BY
		DESTROY ALL PRINTS BEARING EARLIER DATE			

Cannon
16842 Von Karman Avenue, Suite 150
Irvine, CA 92606
P 909.753.8111 F 909.753.0775

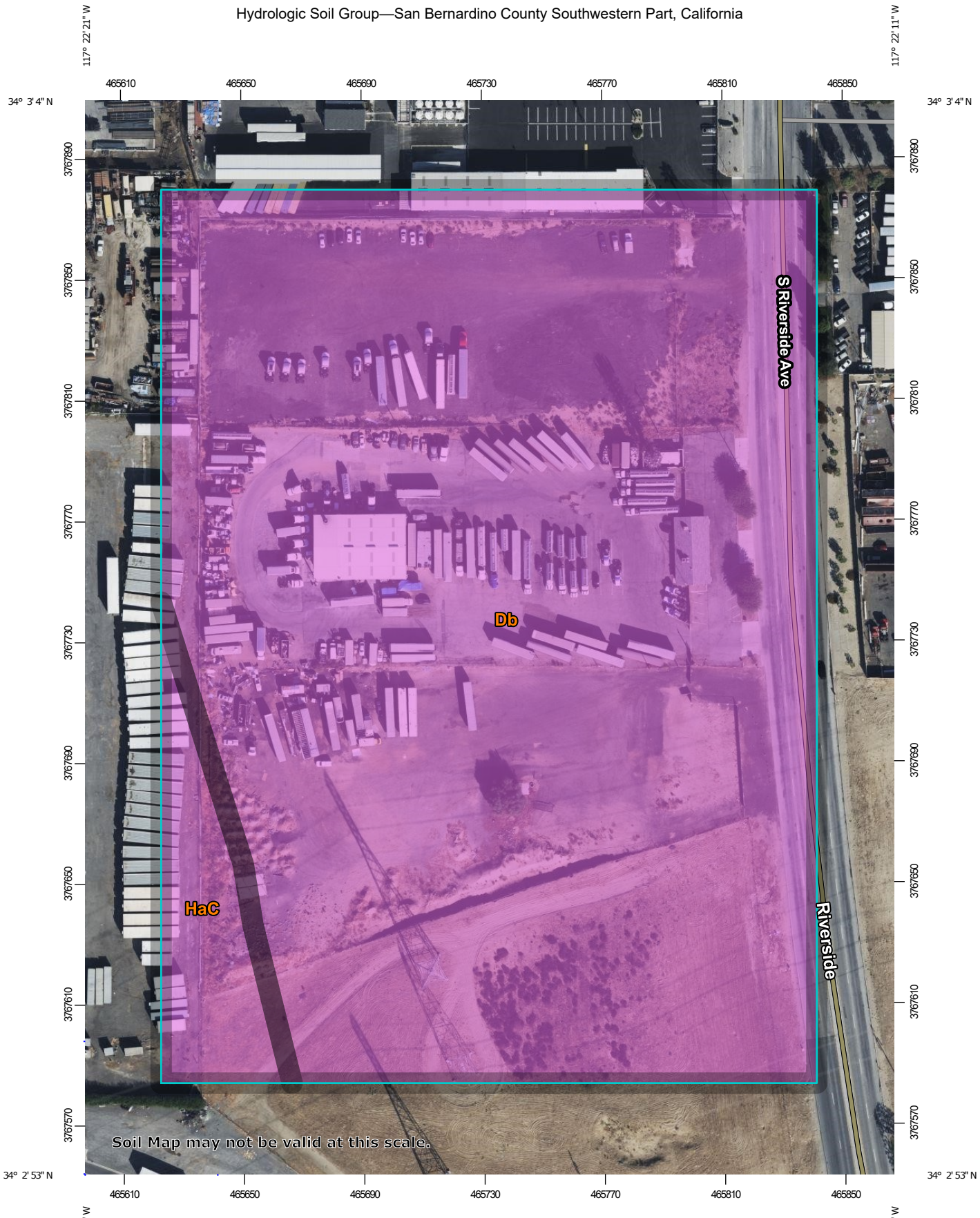
DRAWN BY	CHECKED BY	DATE	SCALE	CA JOB NO.
SJJ		9/26/22	1" = 30'	220139

0 40 80
1 INCH = 40 FEET

RIVERSIDE XC
2830 S. RIVERSIDE
TENTATIVE PARCEL MAP
2830 S. RIVERSIDE
RIALTO, CA

SHEET
2 OF 2

F:\proj\2022\220139\4 Production and Drafting\Const Dwgs\Civil\Exhibits\CX220139006-TPM.dwg 10-18-22 07:17:40 AM SamJ



Map Scale: 1:1,740 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 13, Sep 13, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 11, 2020—Nov 15, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Db	Delhi fine sand	A	15.1	94.3%
HaC	Hanford coarse sandy loam, 2 to 9 percent slopes	A	0.9	5.7%
Totals for Area of Interest			**16.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

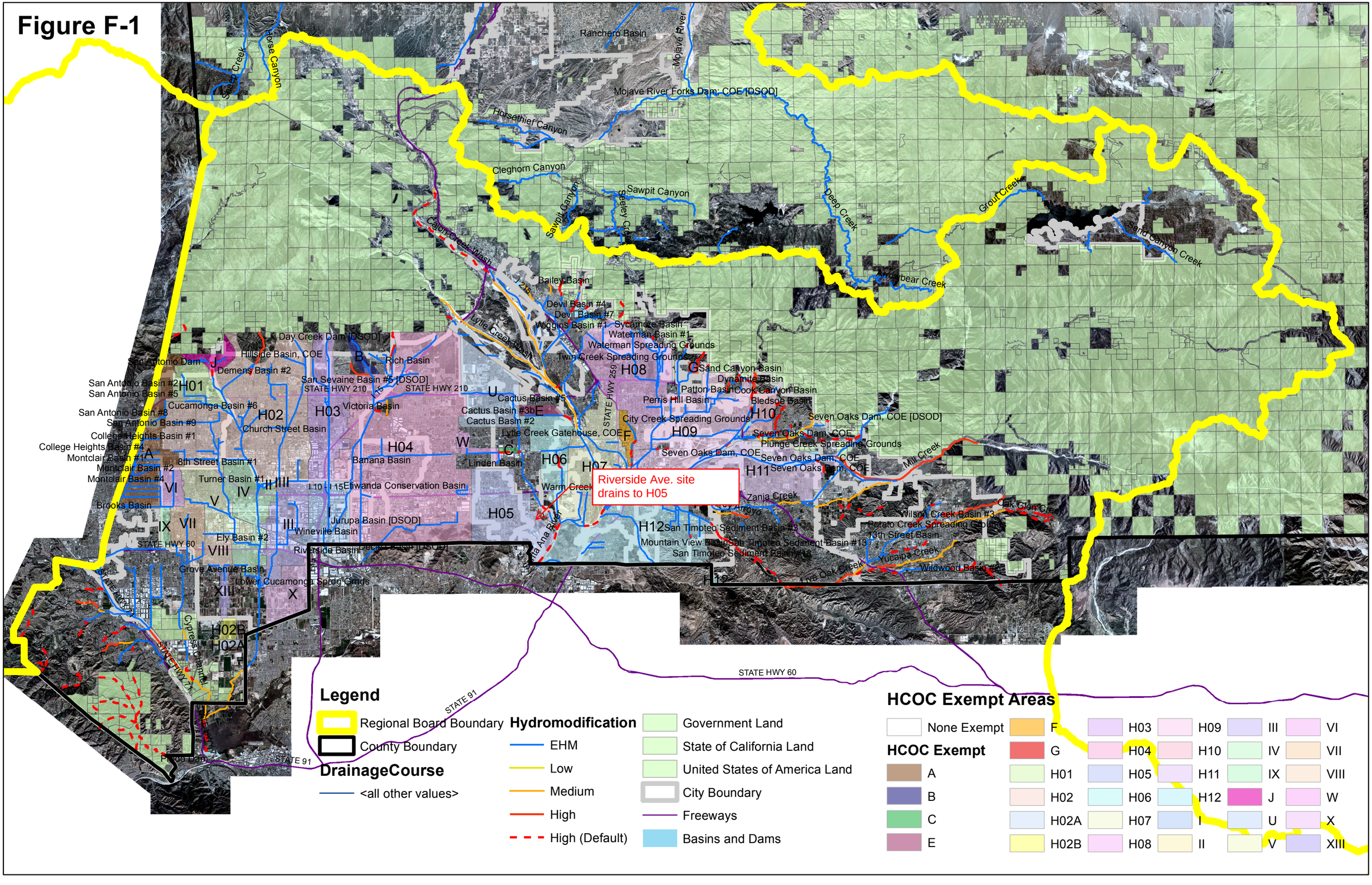
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Figure F-1



Legend

- Regional Board Boundary
- County Boundary

DrainageCourse

- <all other values>

Hydromodification

- EHM
- Low
- Medium
- High
- High (Default)

- Government Land
- State of California Land
- United States of America Land
- City Boundary
- Freeways
- Basins and Dams

HCOC Exempt Areas

- None Exempt

HCOC Exempt

A, B, C, E, F, G, H01, H02, H02A, H02B, H03, H04, H05, H06, H07, H08, H09, H10, H11, H12, I, II, III, IV, V, VI, VII, IX, VIII, J, W, U, X, XIII

NOAA Atlas 14, Volume 6, Version 2
Location name: Bloomington, California, USA*
Latitude: 34.0595°, Longitude: -117.3737°
Elevation: 1019.54 ft**
* source: ESRI Maps
** source: USGS

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_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.108 (0.090-0.131)	0.139 (0.116-0.169)	0.181 (0.150-0.221)	0.216 (0.178-0.265)	0.264 (0.210-0.335)	0.302 (0.235-0.392)	0.340 (0.258-0.453)	0.381 (0.281-0.523)	0.439 (0.310-0.627)	0.484 (0.330-0.718)
10-min	0.154 (0.129-0.187)	0.200 (0.166-0.242)	0.260 (0.215-0.316)	0.310 (0.255-0.380)	0.378 (0.301-0.481)	0.432 (0.336-0.561)	0.488 (0.370-0.650)	0.547 (0.403-0.749)	0.629 (0.444-0.899)	0.694 (0.473-1.03)
15-min	0.187 (0.156-0.226)	0.241 (0.201-0.293)	0.314 (0.261-0.382)	0.374 (0.308-0.460)	0.457 (0.364-0.581)	0.523 (0.407-0.679)	0.590 (0.448-0.786)	0.661 (0.487-0.906)	0.760 (0.537-1.09)	0.840 (0.572-1.25)
30-min	0.279 (0.232-0.338)	0.360 (0.300-0.437)	0.468 (0.389-0.570)	0.558 (0.459-0.685)	0.682 (0.542-0.867)	0.780 (0.606-1.01)	0.880 (0.668-1.17)	0.986 (0.727-1.35)	1.13 (0.800-1.62)	1.25 (0.853-1.86)
60-min	0.403 (0.336-0.489)	0.521 (0.434-0.633)	0.678 (0.563-0.825)	0.808 (0.665-0.992)	0.987 (0.785-1.25)	1.13 (0.878-1.47)	1.27 (0.966-1.70)	1.43 (1.05-1.96)	1.64 (1.16-2.35)	1.81 (1.24-2.69)
2-hr	0.585 (0.488-0.709)	0.750 (0.624-0.911)	0.967 (0.803-1.18)	1.15 (0.943-1.41)	1.39 (1.11-1.77)	1.58 (1.23-2.05)	1.78 (1.35-2.36)	1.98 (1.46-2.71)	2.26 (1.60-3.23)	2.48 (1.69-3.68)
3-hr	0.726 (0.605-0.880)	0.928 (0.772-1.13)	1.19 (0.991-1.45)	1.41 (1.16-1.73)	1.71 (1.36-2.17)	1.94 (1.51-2.51)	2.17 (1.65-2.89)	2.41 (1.78-3.31)	2.75 (1.94-3.93)	3.02 (2.05-4.47)
6-hr	1.02 (0.850-1.24)	1.30 (1.09-1.58)	1.68 (1.39-2.04)	1.98 (1.63-2.43)	2.39 (1.90-3.03)	2.70 (2.10-3.51)	3.02 (2.29-4.03)	3.35 (2.47-4.60)	3.81 (2.69-5.45)	4.16 (2.84-6.17)
12-hr	1.36 (1.13-1.65)	1.74 (1.45-2.12)	2.24 (1.86-2.73)	2.65 (2.18-3.25)	3.20 (2.54-4.06)	3.62 (2.81-4.70)	4.04 (3.07-5.38)	4.48 (3.30-6.14)	5.07 (3.58-7.26)	5.54 (3.77-8.21)
24-hr	1.81 (1.61-2.09)	2.35 (2.08-2.71)	3.04 (2.68-3.52)	3.60 (3.15-4.20)	4.36 (3.69-5.25)	4.93 (4.09-6.07)	5.52 (4.47-6.95)	6.12 (4.83-7.93)	6.94 (5.25-9.35)	7.57 (5.54-10.6)
2-day	2.21 (1.95-2.54)	2.90 (2.57-3.35)	3.81 (3.36-4.41)	4.56 (3.99-5.31)	5.57 (4.71-6.71)	6.34 (5.26-7.80)	7.14 (5.78-8.99)	7.95 (6.27-10.3)	9.07 (6.86-12.2)	9.94 (7.27-13.9)
3-day	2.36 (2.09-2.72)	3.15 (2.79-3.64)	4.20 (3.70-4.86)	5.06 (4.42-5.90)	6.24 (5.28-7.52)	7.16 (5.94-8.80)	8.10 (6.56-10.2)	9.08 (7.16-11.8)	10.4 (7.89-14.1)	11.5 (8.40-16.0)
4-day	2.53 (2.24-2.92)	3.42 (3.02-3.94)	4.59 (4.05-5.31)	5.56 (4.86-6.48)	6.89 (5.84-8.30)	7.94 (6.59-9.76)	9.01 (7.30-11.4)	10.1 (7.99-13.1)	11.7 (8.85-15.8)	12.9 (9.45-18.0)
7-day	2.89 (2.56-3.33)	3.95 (3.49-4.55)	5.34 (4.71-6.18)	6.50 (5.68-7.58)	8.10 (6.86-9.76)	9.35 (7.76-11.5)	10.6 (8.62-13.4)	12.0 (9.46-15.5)	13.9 (10.5-18.7)	15.4 (11.3-21.5)
10-day	3.14 (2.78-3.62)	4.31 (3.81-4.97)	5.87 (5.17-6.79)	7.15 (6.26-8.35)	8.94 (7.57-10.8)	10.3 (8.58-12.7)	11.8 (9.56-14.9)	13.3 (10.5-17.3)	15.5 (11.7-20.8)	17.2 (12.5-23.9)
20-day	3.81 (3.37-4.39)	5.27 (4.66-6.09)	7.23 (6.37-8.36)	8.86 (7.75-10.3)	11.1 (9.42-13.4)	12.9 (10.7-15.9)	14.8 (12.0-18.6)	16.8 (13.2-21.7)	19.5 (14.8-26.4)	21.8 (15.9-30.4)
30-day	4.52 (4.00-5.21)	6.26 (5.53-7.22)	8.59 (7.57-9.94)	10.5 (9.22-12.3)	13.3 (11.2-16.0)	15.4 (12.8-19.0)	17.7 (14.3-22.3)	20.1 (15.9-26.0)	23.5 (17.8-31.7)	26.3 (19.2-36.7)
45-day	5.40 (4.78-6.22)	7.43 (6.57-8.57)	10.2 (8.96-11.8)	12.5 (10.9-14.5)	15.7 (13.3-18.9)	18.2 (15.1-22.4)	21.0 (17.0-26.4)	23.9 (18.8-30.9)	28.0 (21.2-37.8)	31.4 (23.0-43.8)
60-day	6.31 (5.59-7.28)	8.60 (7.61-9.93)	11.7 (10.3-13.5)	14.3 (12.5-16.7)	18.0 (15.2-21.7)	20.9 (17.3-25.7)	24.0 (19.5-30.3)	27.4 (21.6-35.4)	32.2 (24.3-43.4)	36.1 (26.4-50.4)

[1] 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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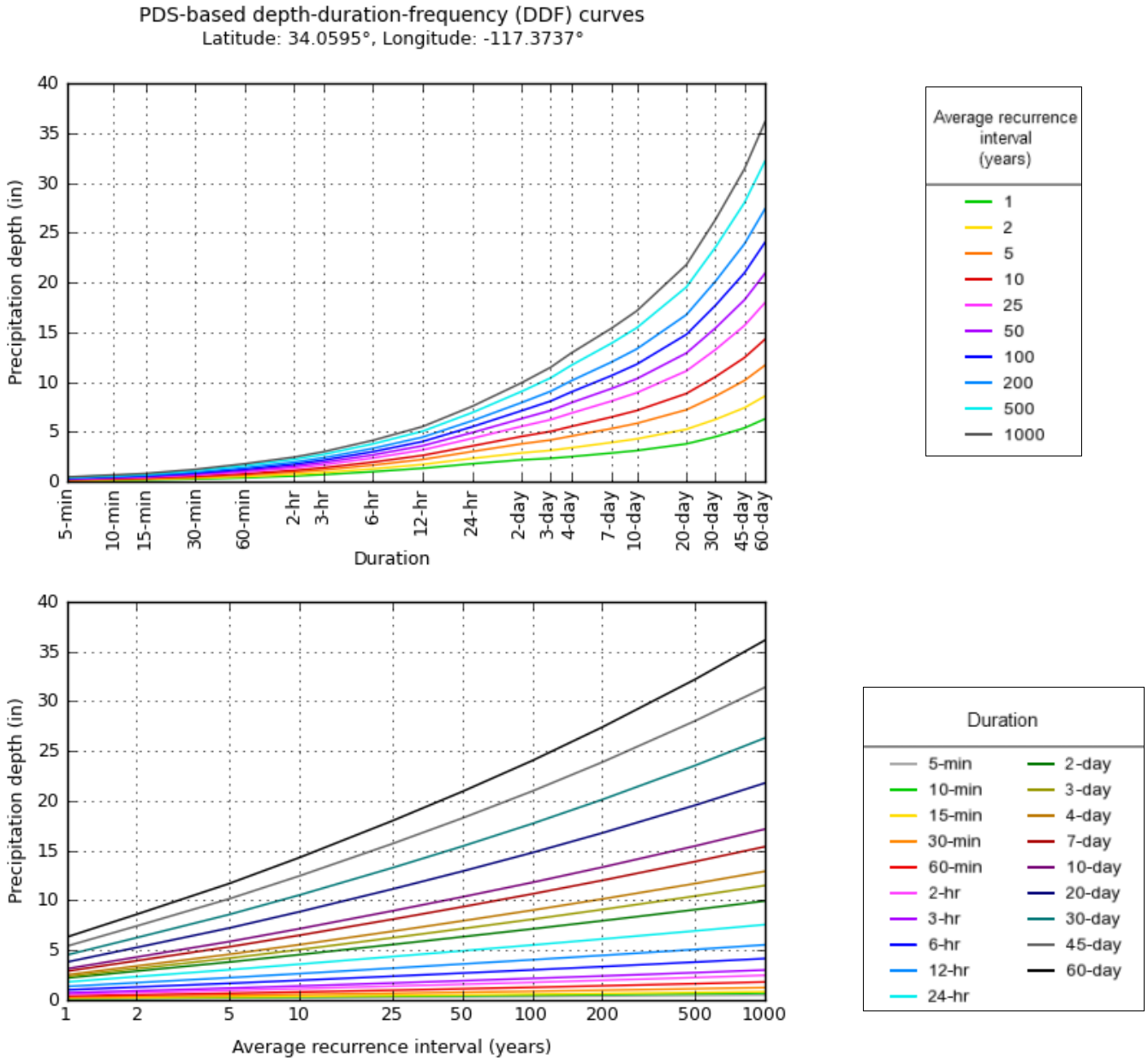
PF graphical



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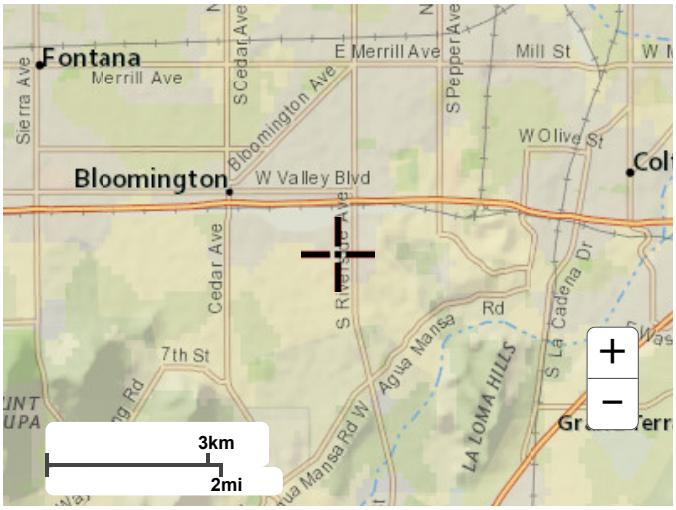
Maps & aerials

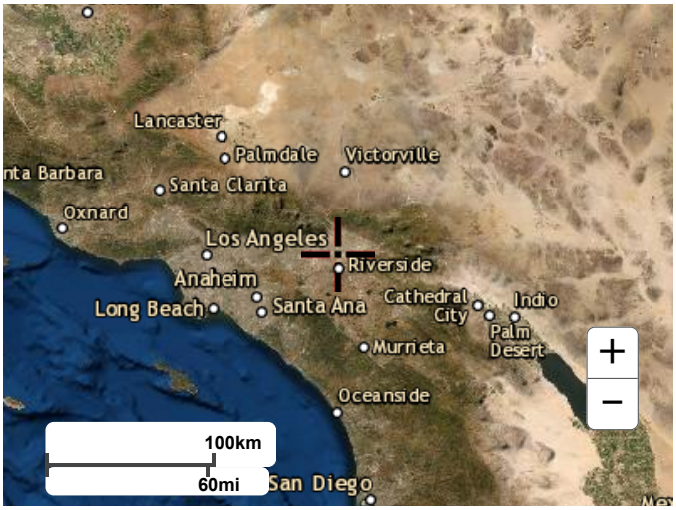
Small scale terrain



Large scale terrain

Large scale map

Large scale aerial



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National Water Center
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NOAA Atlas 14, Volume 6, Version 2
Location name: Bloomington, California, USA*
Latitude: 34.0595°, Longitude: -117.3737°
Elevation: 1019.54 ft**
* source: ESRI Maps
** source: USGS

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_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.30** (1.08-1.57)	**1.67** (1.39-2.03)	**2.17** (1.80-2.65)	**2.59** (2.14-3.18)	**3.17** (2.52-4.02)	**3.62** (2.82-4.70)	**4.08** (3.10-5.44)	**4.57** (3.37-6.28)	**5.27** (3.72-7.52)	**5.81** (3.96-8.62)
10-min	**0.924** (0.774-1.12)	**1.20** (0.996-1.45)	**1.56** (1.29-1.90)	**1.86** (1.53-2.28)	**2.27** (1.81-2.89)	**2.59** (2.02-3.37)	**2.93** (2.22-3.90)	**3.28** (2.42-4.49)	**3.77** (2.66-5.39)	**4.16** (2.84-6.17)
15-min	**0.748** (0.624-0.904)	**0.964** (0.804-1.17)	**1.26** (1.04-1.53)	**1.50** (1.23-1.84)	**1.83** (1.46-2.32)	**2.09** (1.63-2.72)	**2.36** (1.79-3.14)	**2.64** (1.95-3.62)	**3.04** (2.15-4.35)	**3.36** (2.29-4.98)
30-min	**0.558** (0.464-0.676)	**0.720** (0.600-0.874)	**0.936** (0.778-1.14)	**1.12** (0.918-1.37)	**1.36** (1.08-1.73)	**1.56** (1.21-2.02)	**1.76** (1.34-2.34)	**1.97** (1.45-2.70)	**2.27** (1.60-3.24)	**2.50** (1.71-3.71)
60-min	**0.403** (0.336-0.489)	**0.521** (0.434-0.633)	**0.678** (0.563-0.825)	**0.808** (0.665-0.992)	**0.987** (0.785-1.25)	**1.13** (0.878-1.47)	**1.27** (0.966-1.70)	**1.43** (1.05-1.96)	**1.64** (1.16-2.35)	**1.81** (1.24-2.69)
2-hr	**0.292** (0.244-0.354)	**0.375** (0.312-0.456)	**0.484** (0.402-0.589)	**0.573** (0.472-0.704)	**0.696** (0.552-0.884)	**0.790** (0.614-1.03)	**0.888** (0.673-1.18)	**0.989** (0.729-1.36)	**1.13** (0.798-1.62)	**1.24** (0.846-1.84)
3-hr	**0.242** (0.201-0.293)	**0.309** (0.257-0.375)	**0.398** (0.330-0.484)	**0.470** (0.387-0.577)	**0.568** (0.452-0.723)	**0.645** (0.501-0.837)	**0.723** (0.548-0.963)	**0.804** (0.592-1.10)	**0.915** (0.646-1.31)	**1.00** (0.684-1.49)
6-hr	**0.170** (0.142-0.207)	**0.218** (0.181-0.264)	**0.280** (0.232-0.341)	**0.330** (0.272-0.405)	**0.399** (0.317-0.507)	**0.451** (0.351-0.586)	**0.505** (0.383-0.672)	**0.560** (0.413-0.768)	**0.636** (0.449-0.909)	**0.695** (0.473-1.03)
12-hr	**0.113** (0.094-0.137)	**0.145** (0.120-0.176)	**0.186** (0.155-0.227)	**0.220** (0.181-0.270)	**0.265** (0.211-0.337)	**0.300** (0.233-0.390)	**0.335** (0.254-0.447)	**0.372** (0.274-0.510)	**0.421** (0.297-0.603)	**0.460** (0.313-0.682)
24-hr	**0.076** (0.067-0.087)	**0.098** (0.086-0.113)	**0.127** (0.112-0.146)	**0.150** (0.131-0.175)	**0.182** (0.154-0.219)	**0.206** (0.171-0.253)	**0.230** (0.186-0.290)	**0.255** (0.201-0.330)	**0.289** (0.219-0.390)	**0.315** (0.231-0.440)
2-day	**0.046** (0.041-0.053)	**0.060** (0.053-0.070)	**0.079** (0.070-0.092)	**0.095** (0.083-0.111)	**0.116** (0.098-0.140)	**0.132** (0.110-0.163)	**0.149** (0.120-0.187)	**0.166** (0.131-0.214)	**0.189** (0.143-0.255)	**0.207** (0.152-0.289)
3-day	**0.033** (0.029-0.038)	**0.044** (0.039-0.051)	**0.058** (0.051-0.067)	**0.070** (0.061-0.082)	**0.087** (0.073-0.104)	**0.099** (0.082-0.122)	**0.113** (0.091-0.142)	**0.126** (0.099-0.163)	**0.145** (0.110-0.195)	**0.160** (0.117-0.223)
4-day	**0.026** (0.023-0.030)	**0.036** (0.031-0.041)	**0.048** (0.042-0.055)	**0.058** (0.051-0.067)	**0.072** (0.061-0.087)	**0.083** (0.069-0.102)	**0.094** (0.076-0.118)	**0.106** (0.083-0.137)	**0.122** (0.092-0.164)	**0.135** (0.098-0.188)
7-day	**0.017** (0.015-0.020)	**0.023** (0.021-0.027)	**0.032** (0.028-0.037)	**0.039** (0.034-0.045)	**0.048** (0.041-0.058)	**0.056** (0.046-0.068)	**0.063** (0.051-0.080)	**0.071** (0.056-0.093)	**0.083** (0.063-0.111)	**0.092** (0.067-0.128)
10-day	**0.013** (0.012-0.015)	**0.018** (0.016-0.021)	**0.024** (0.022-0.028)	**0.030** (0.026-0.035)	**0.037** (0.032-0.045)	**0.043** (0.036-0.053)	**0.049** (0.040-0.062)	**0.056** (0.044-0.072)	**0.064** (0.049-0.087)	**0.071** (0.052-0.100)
20-day	**0.008** (0.007-0.009)	**0.011** (0.010-0.013)	**0.015** (0.013-0.017)	**0.018** (0.016-0.022)	**0.023** (0.020-0.028)	**0.027** (0.022-0.033)	**0.031** (0.025-0.039)	**0.035** (0.028-0.045)	**0.041** (0.031-0.055)	**0.045** (0.033-0.063)
30-day	**0.006** (0.006-0.007)	**0.009** (0.008-0.010)	**0.012** (0.011-0.014)	**0.015** (0.013-0.017)	**0.018** (0.016-0.022)	**0.021** (0.018-0.026)	**0.025** (0.020-0.031)	**0.028** (0.022-0.036)	**0.033** (0.025-0.044)	**0.037** (0.027-0.051)
45-day	**0.005** (0.004-0.006)	**0.007** (0.006-0.008)	**0.009** (0.008-0.011)	**0.012** (0.010-0.013)	**0.015** (0.012-0.017)	**0.017** (0.014-0.021)	**0.019** (0.016-0.024)	**0.022** (0.017-0.029)	**0.026** (0.020-0.035)	**0.029** (0.021-0.041)
60-day	**0.004** (0.004-0.005)	**0.006** (0.005-0.007)	**0.008** (0.007-0.009)	**0.010** (0.009-0.012)	**0.012** (0.011-0.015)	**0.015** (0.012-0.018)	**0.017** (0.014-0.021)	**0.019** (0.015-0.025)	**0.022** (0.017-0.030)	**0.025** (0.018-0.035)

[1] 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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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
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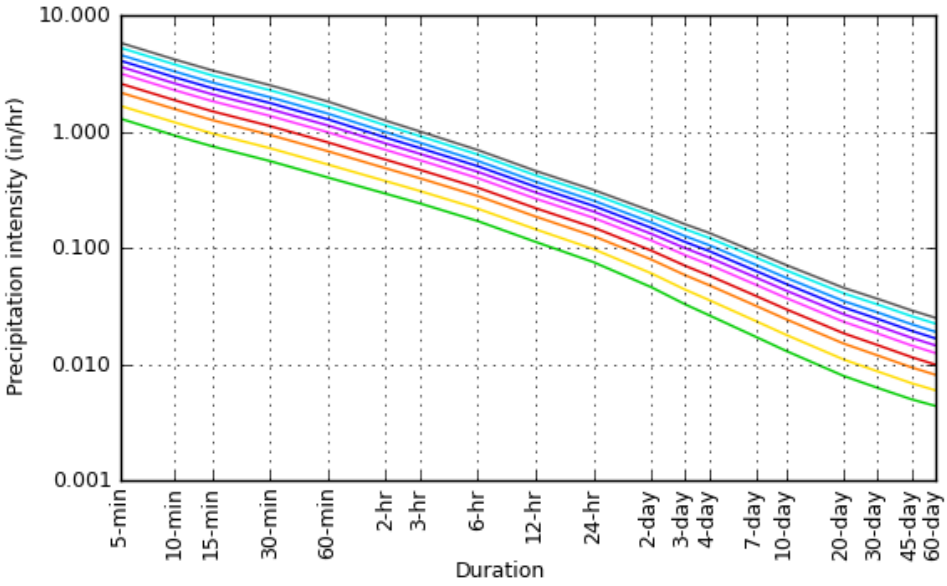

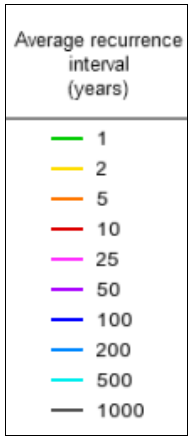

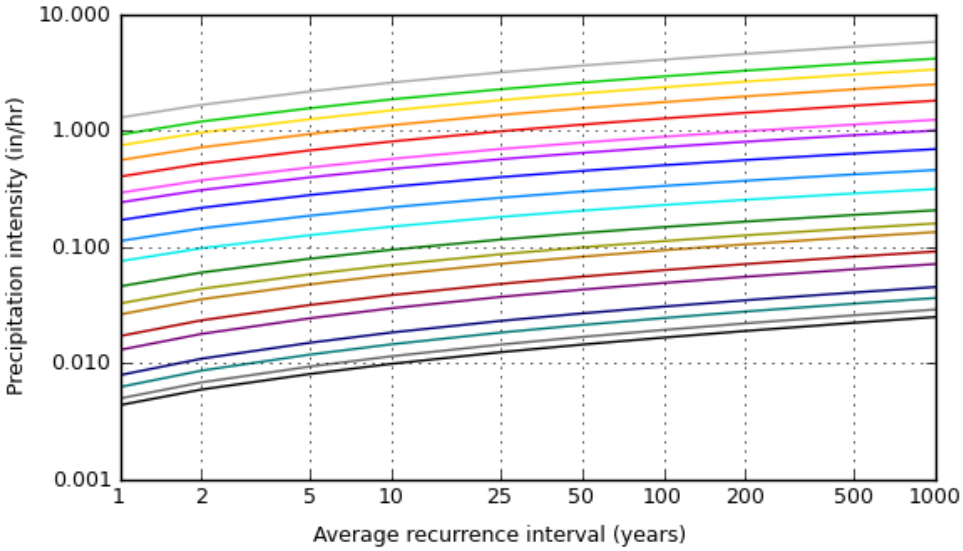

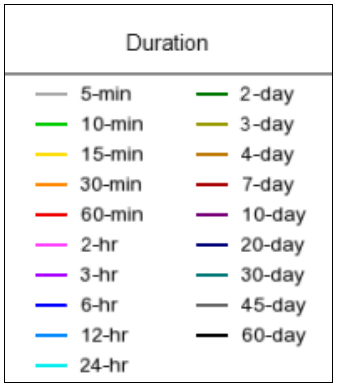

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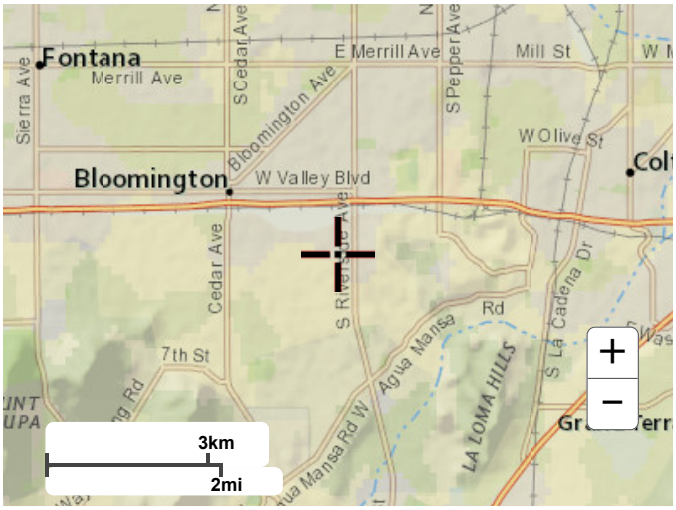
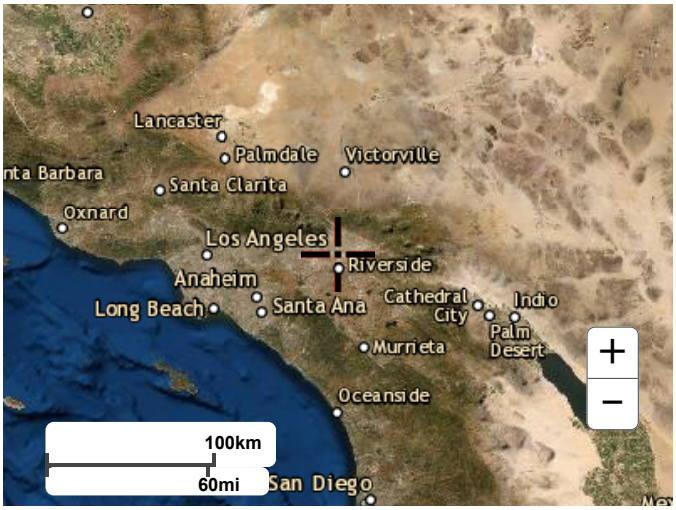
Small scale terrain



Large scale terrain

Large scale map

Large scale aerial



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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Appendix 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.

Appendix 3. Post Construction

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

PROVIDED AT FINAL WQMP SUBMITTAL

Appendix 4. Other Supporting Documentation

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

Housekeeping Practices SC-60

Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

Approach

Pollution Prevention

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.
- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

Suggested Protocols

General

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Dispose of wash water, sweepings, and sediments, properly.
- Recycle or dispose of fluids properly.
- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.
- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).
- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

Objectives

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

Targeted Constituents

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

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- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

Training

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

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

Other Considerations

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

Requirements

Costs

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

Maintenance

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

Supplemental Information

Further Detail of the BMP

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

Examples

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

References and Resources

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Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Mateo STOPPP - (http://stoppp.tripod.com/bmp.html)

Landscape Maintenance SC-73

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- 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 pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

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.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

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

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

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Drainage System Maintenance SC-74

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Description

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

Targeted Constituents

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

Approach

Suggested Protocols

Catch Basins/Inlet Structures

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

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

Storm Drain Conveyance System

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

Pump Stations

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

Open Channel

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

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

Illicit Connections and Discharges

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

Illegal Dumping

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

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

Training

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

Spill Response and Prevention

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

Other Considerations

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

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

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from "environmental fees" or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

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

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

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

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

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

Flow Management

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

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

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

Stream Corridor Planning

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

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

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

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

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

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

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

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

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

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

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

Examples

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

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

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

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Storm Drain Signage SD-13

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

Bioretention

TC-32

Maintenance Concerns, Objectives, and Goals

- Clogged Soil or Outlet Structures
- Invasive Species
- Vegetation/Landscape Maintenance
- Erosion
- Channelization of Flow
- Aesthetics

General Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through a sand bed and is subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

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

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

Inspection/Maintenance Considerations

Bioretention requires frequent landscaping maintenance, including measures to ensure that the area is functioning properly, as well as maintenance of the landscaping on the practice. In many cases, bioretention areas initially require intense maintenance, but less maintenance is needed over time. In many cases, maintenance tasks can be completed by a landscaping contractor, who may already be hired at the site. In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

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Inspection Activities	Suggested Frequency
■ Inspect soil and repair eroded areas.	Monthly
■ Inspect for erosion or damage to vegetation, preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the strips are ready for winter. However, additional inspection after periods of heavy runoff is desirable.	Semi-annual inspection
■ Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket.	
■ Check for debris and litter, and areas of sediment accumulation.	
■ Inspect health of trees and shrubs.	
Maintenance Activities	**Suggested Frequency**
■ Water plants daily for 2 weeks.	At project completion
■ Remove litter and debris.	Monthly
■ Remove sediment.	As needed
■ Remulch void areas.	
■ Treat diseased trees and shrubs.	
■ Mow turf areas.	
■ Repair erosion at inflow points.	
■ Repair outflow structures.	
■ Unclog underdrain.	
■ Regulate soil pH regulation.	
■ Remove and replace dead and diseased vegetation.	Semi-annual
■ Add mulch.	Annual
■ Replace tree stakes and wires.	
■ Mulch should be replaced every 2 to 3 years or when bare spots appear. Remulch prior to the wet season.	Every 2-3 years, or as needed

Additional Information

Landscaping is critical to the function and aesthetic value of bioretention areas. It is preferable to plant the area with native vegetation, or plants that provide habitat value, where possible. Another important design feature is to select species that can withstand the hydrologic regime they will experience. At the bottom of the bioretention facility, plants that tolerate both wet and dry conditions are preferable. At the edges, which will remain primarily dry, upland species will be the most resilient. It is best to select a combination of trees, shrubs, and herbaceous materials.

References

Metropolitan Council, Urban Small Sites Best Management Practices Manual. Available at: http://www.metrocouncil.org/environment/Watershed/BMP/manual.htm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, revised February, 2002.

U.S. Environmental Protection Agency, Post-Construction Stormwater Management in New Development & Redevelopment BMP Factsheets. Available at: cfpub.epa.gov/npdes/stormwater/menuofbmps/bmp_files.cfm

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✓	Oil and Grease	■
✓	Organics	■

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▲ Medium

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■ Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket.	
■ Check for debris and litter, and areas of sediment accumulation.	
■ Inspect health of trees and shrubs.	
Maintenance Activities	**Suggested Frequency**
■ Water plants daily for 2 weeks.	At project completion
■ Remove litter and debris.	Monthly
■ Remove sediment.	As needed
■ Remulch void areas.	
■ Treat diseased trees and shrubs.	
■ Mow turf areas.	
■ Repair erosion at inflow points.	
■ Repair outflow structures.	
■ Unclog underdrain.	
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Ventura Countywide Stormwater Quality Management Program, Technical Guidance Manual for Stormwater Quality Control Measures. July, 2002.

Media Filter TC-40

Design Considerations

- Aesthetics
- Hydraulic Head

Description

Stormwater media filters are usually two-chambered including a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media. As stormwater flows into the first chamber, large particles settle out, and then finer particles and other pollutants are removed as stormwater flows through the filtering media in the second chamber. There are a number of design variations including the Austin sand filter, Delaware sand filter, and multi-chambered treatment train (MCTT).

Targeted Constituents

☑	Sediment	■
☑	Nutrients	●
☑	Trash	■
☑	Metals	■
☑	Bacteria	▲
☑	Oil and Grease	■
☑	Organics	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored five Austin sand filters, two MCTTs, and one Delaware design in southern California. Pollutant removal was very similar for each of the designs; however operational and maintenance aspects were quite different. The Delaware filter and MCTT maintain permanent pools and consequently mosquito management was a critical issue, while the Austin style which is designed to empty completely between storms was less affected. Removal of the top few inches of sand was required at 3 of the Austin filters and the Delaware filter during the third year of operation; consequently, sizing of the filter bed is a critical design factor for establishing maintenance frequency.

Advantages

- Relatively high pollutant removal, especially for sediment and associated pollutants.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency relationships resulting from the increase of impervious cover in a watershed.

Limitations

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- More expensive to construct than many other BMPs.
- May require more maintenance that some other BMPs depending upon the sizing of the filter bed.
- Generally require more hydraulic head to operate properly (minimum 4 feet).
- High solids loads will cause the filter to clog.
- Work best for relatively small, impervious watersheds.
- Filters in residential areas can present aesthetic and safety problems if constructed with vertical concrete walls.
- Certain designs (e.g., MCTT and Delaware filter) maintain permanent sources of standing water where mosquito and midge breeding is likely to occur.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Filter bed sized to discharge the capture volume over a period of 48 hours.
- Filter bed 18 inches thick above underdrain system.
- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.
- A maintenance ramp should be included in the design to facilitate access to the sedimentation and filter basins for maintenance activities (particularly for the Austin design).
- Designs that utilize covered sedimentation and filtration basins should be accessible to vector control personnel via access doors to facilitate vector surveillance and controlling the basins if needed.

Construction/Inspection Considerations

- Tributary area should be completely stabilized before media is installed to prevent premature clogging.

Performance

The pollutant removal performance of media filters and other stormwater BMPs is generally characterized by the percent reduction in the influent load. This method implies a relationship between influent and effluent concentrations. For instance, it would be expected that a device that is reported to achieve a 75% reduction would have an effluent concentration equal to 25% of the influent concentrations. Recent work in California (Caltrans, 2002) on various sand filter designs indicates that this model for characterizing performance is inadequate. Figure 4 presents a graph relating influent and effluent TSS concentrations for the Austin full sedimentation design.

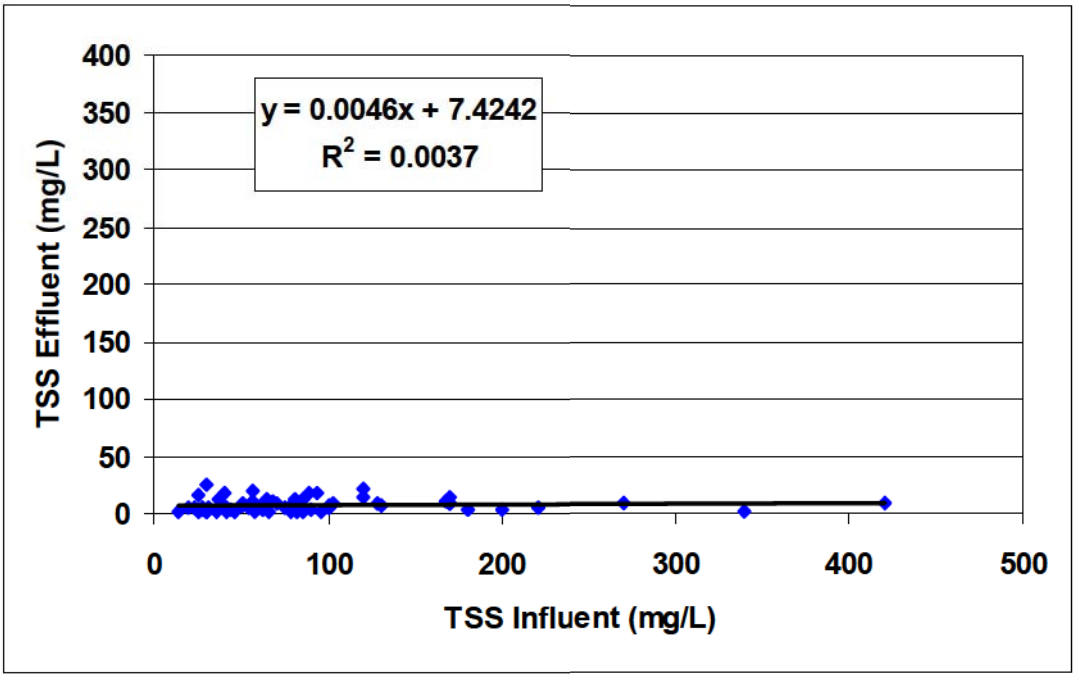

Figure 4
Comparison of Influent and Effluent Concentrations for TSS

It is clearly evident that the effluent concentration is relative constant and independent of influent concentration. Consequently, the performance is more accurately characterized by the effluent concentration, which is about 7.5 mg/L. Constant effluent concentrations also are observed for all other particle related constituents such as particulate metals (total - dissolved) and particulate phosphorus.

The small uncertainty in the estimate of the mean effluent concentration highlights the very consistent effluent quality for TSS produced by sand filters. In addition, it demonstrates that a calculated percent reduction for TSS and other constituents with similar behavior for Austin sand filters is a secondary characteristic of the device and depends primarily on the specific influent concentrations observed. The distinction between a constant effluent quality and a percent reduction is extremely important to recognize if the results are to be used to estimate effluent quality from sand filters installed at other sites with different influent concentrations or for estimating compliance with water quality standards for storms with high concentrations of particulate constituents.

If the conventionally derived removal efficiency (90%) were used to estimate the TSS concentrations in the treated runoff from storms with high influent concentrations, the estimated effluent concentration would be too high. For instance, the storm with the highest observed influent concentration (420 mg/L) would be expected to have a concentration in the treated runoff of 42 mg/L, rather than the 10 mg/L that was measured. In fact, the TSS effluent concentrations for all events with influent concentrations greater than 200 mg/L were 10 mg/L or less.

The stable effluent concentration of a sand filter under very different influent TSS concentrations implies something about the properties of the influent particle size distribution. If one assumes that

only the smallest size fraction can pass through the filter, then the similarity in effluent concentrations suggests that there is little difference in the total mass of the smallest sized particles even when the total TSS concentration varies greatly. Further, the difference in TSS concentration must then be caused by changes in the relative amount of the larger size fractions. Further research is necessary to determine the range of particle size that is effectively removed in the filter and the portion of the size fraction of suspended solids that it represents in urban stormwater.

Sand filters are effective stormwater management practices for pollutant removal. Conventional removal rates for all sand filters and organic filters are presented in Table 1. With the exception of nitrates, which are always exported from filtering systems because of the conversion of ammonia and organic nitrogen to nitrate, they perform relatively well at removing pollutants.

Table 1 Sand filter removal efficiencies (percent)

	Sand Filter (Glick et al, 1998)	Compost Filter System		Multi-Chamber Treatment Train		
		Stewart, 1992	Leif, 1999	Pitt et al., 1997	Pitt, 1996	Greb et al., 1998
TSS	89	95	85	85	83	98
TP	59	41	4	80	-	84
TN	17	-	-	-	-	-
Nitrate	-76	-34	-95	-	14	-
Metals	72-86	61-88	44-75	65-90	91-100	83-89
Bacteria	65	-	-	-	-	-

From the few studies available, it is difficult to determine if organic filters necessarily have higher removal efficiencies than sand filters. The MCTT may have high pollutant removal for some constituents, although an evaluation of these devices by the California Department of Transportation indicated no significant difference for most conventional pollutants.

In addition to the relatively high pollutant removal in media filters, these devices, when sized to capture the channel forming storm volume, are highly effective at attenuating peak flow rates and reducing channel erosion.

Siting Criteria

In general, sand filters are preferred over infiltration practices, such as infiltration trenches, when contamination of groundwater with conventional pollutants is of concern. This usually occurs in areas where underlying soils alone cannot treat runoff adequately - or ground water tables are high. In most cases, sand filters can be constructed with impermeable basin or chamber bottoms, which help to collect, treat, and release runoff to a storm drainage system or directly to surface water with no contact between contaminated runoff and groundwater. In regions where evaporation exceeds rainfall and a wet pond would be unlikely to maintain the required permanent pool, a sand filtration system can be used.

The selection of a sand filter design depends largely on the drainage area's characteristics. For example, the Washington, D.C. and Delaware sand filter systems are well suited for highly impervious areas where land available for structural controls is limited, since both are installed underground. They have been used to treat runoff from parking lots, driveways, loading docks, service stations, garages, airport runways/taxiways, and storage yards. The Austin sand filtration system is more suited for large drainage areas that have both impervious and pervious surfaces. This system is located at grade and is used to treat runoff from any urban land use.

It is challenging to use most sand filters in very flat terrain because they require a significant amount of hydraulic head (about 4 feet), to allow flow through the system. One exception is the perimeter sand filter, which can be applied with as little as 2 feet of head.

Sand filters are best applied on relatively small sites (up to 25 acres for surface sand filters and closer to 2 acres for perimeter or underground filters). Filters have been used on larger drainage areas, of up to 100 acres, but these systems can clog when they treat larger drainage areas unless adequate measures are provided to prevent clogging, such as a larger sedimentation chamber or more intensive regular maintenance.

When sand filters are designed as a stand-alone practice, they can be used on almost any soil because they can be designed so that stormwater never infiltrates into the soil or interacts with the ground water. Alternatively, sand filters can be designed as pretreatment for an infiltration practice, where soils do play a role.

Additional Design Guidelines

Pretreatment is a critical component of any stormwater management practice. In sand filters, pretreatment is achieved in the sedimentation chamber that precedes the filter bed. In this chamber, the coarsest particles settle out and thus do not reach the filter bed. Pretreatment reduces the maintenance burden of sand filters by reducing the potential for these sediments to clog the filter. When pretreatment is not provided designers should increase the size of the filter area to reduce the clogging potential. In sand filters, designers should select a medium sand as the filtering medium. A fine aggregate (ASTM C-33) that is intended for use in concrete is commonly specified.

Many guidelines recommend sizing the filter bed using Darcy's Law, which relates the velocity of fluids to the hydraulic head and the coefficient of permeability of a medium. The resulting equation, as derived by the city of Austin, Texas, (1996), is

$$Af = WQV\ d/[k\ t\ (h+d)]$$

Where:

Af = area of the filter bed (ft^2);

d = depth of the filter bed (ft; usually about 1.5 feet, depending on the design);

k = coefficient of permeability of the filtering medium (ft/day);

t = time for the water quality volume to filter through the system (days; usually assumed to be 1.67 days); and

h = average water height above the sand bed (ft; assumed to be one-half of the maximum head).

Typical values for k, as assembled by CWP (1996), are shown in Table 2.

Table 2 Coefficient of permeability values for stormwater filtering practices (CWP, 1996)

Filter Medium	Coefficient of Permeability (ft/day)
Sand	3.5
Peat/Sand	2.75
Compost	8.7

The permeability of sand shown in Table 2 is extremely conservative, but is widely used since it is incorporated in the design guidelines of the City of Austin. When the sand is initially installed, the permeability is so high (over 100 ft/d) that generally only a portion of the filter area is required to infiltrate the entire volume, especially in a "full sedimentation" Austin design where the capture volume is released to the filter basin over 24 hours.

The preceding methodology results in a filter bed area that is oversized when new and the entire water quality volume is filtered in less than a day with no significant height of water on top of the sand bed. Consequently, the following simple rule of thumb is adequate for sizing the filter area. If the filter is preceded by a sedimentation basin that releases the water quality volume (WQV) to the filter over 24 hours, then

$$Af = WQV/18$$

If no pretreatment is provided then the filter area is calculated more conservatively as:

$$Af = WQV/10$$

Typically, filtering practices are designed as "off-line" systems, meaning that during larger storms all runoff greater than the water quality volume is bypassed untreated using a flow splitter, which is a structure that directs larger flows to the storm drain system or to a stabilized channel. One exception is the perimeter filter; in this design, all flows enter the system, but larger flows overflow to an outlet chamber and are not treated by the practice.

The Austin design variations are preferred where there is sufficient space, because they lack a permanent pool, which eliminates vector concerns. Design details of this variation are summarized below.

Summary of Design Recommendations

(1) Capture Volume - The facility should be sized to capture the required water quality volume, preferably in a separate pretreatment sedimentation basin.

(2) Basin Geometry – The water depth in the sedimentation basin when full should be at least 2 feet and no greater than 10 feet. A fixed vertical sediment depth marker should be installed in the sedimentation basin to indicate when 20% of the basin volume has been lost because of sediment accumulation. When a pretreatment sedimentation basin is provided the minimum average surface area for the sand filter (Af) is calculated from the following equation:

$$Af = WQV/18$$

If no pretreatment is provided then the filter area is calculated as:

$$Af = WQV/10$$

(3) Sand and Gravel Configuration - The sand filter is constructed with 18 inches of sand overlying 6 inches of gravel. The sand and gravel media are separated by permeable geotextile fabric and the gravel layer is situated on geotextile fabric. Four-inch perforated PVC pipe is used to drain captured flows from the gravel layer. A minimum of 2 inches of gravel must cover the top surface of the PVC pipe. Figure 5 presents a schematic representation of a standard sand bed profile.

(4) Sand Properties – The sand grain size distribution should be comparable to that of "washed concrete sand," as specified for fine aggregate in ASTM C-33.

(5) Underdrain Pipe Configuration – In an Austin filter, the underdrain piping should consist of a main collector pipe and two or more lateral branch pipes, each with a minimum diameter of 4 inches. The pipes should have a minimum slope of 1% (1/8 inch per foot) and the laterals should be spaced at intervals of no more than 10 feet. There should be no fewer than two lateral branch pipes. Each individual underdrain pipe should have a cleanout access location. All piping is to be Schedule 40 PVC. The maximum spacing between rows of perforations should not exceed 6 inches.

(6) Flow Splitter - The inflow structure to the sedimentation chamber should incorporate a flow-splitting device capable of isolating the capture volume and bypassing the 25-year peak flow around the facility with the sedimentation/filtration pond full.

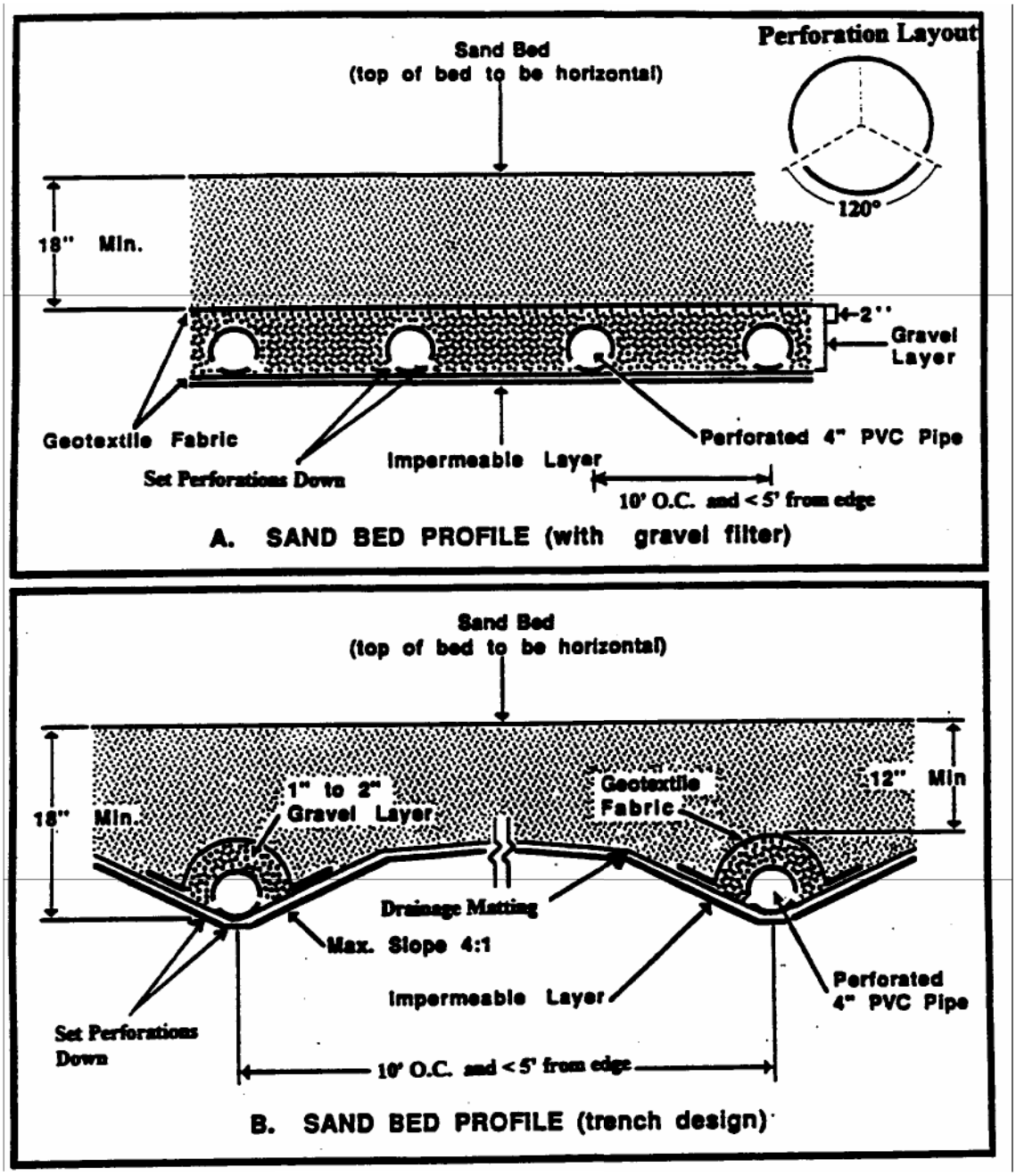

Figure 5
Schematic of Sand Bed Profile

(7) Basin Inlet – Energy dissipation is required at the sedimentation basin inlet so that flows entering the basin should be distributed uniformly and at low velocity in order to prevent resuspension and encourage quiescent conditions necessary for deposition of solids.

(8) Sedimentation Pond Outlet Structure - The outflow structure from the sedimentation chamber should be (1) an earthen berm; (2) a concrete wall; or (3) a rock gabion. Gabion outflow structures should extend across the full width of the facility such that no short-circuiting of flows can occur. The gabion rock should be 4 inches in diameter. The

receiving end of the sand filter should be protected (splash pad, riprap, etc.) such that erosion of the sand media does not occur. When a riser pipe is used to connect the sedimentation and filtration basins (example in Figure 6), a valve should be included to isolate the sedimentation basin in case of a hazardous material spill in the watershed. The control for the valve must be accessible at all times, including when the basin is full. The riser pipe should have a minimum diameter of 6 inches with four 1-inch perforations per row. The vertical spacing between rows should be 4 inches (on centers).

(9) Sand Filter Discharge – If a gabion structure is used to separate the sedimentation and filtration basins, a valve must installed so that discharge from the BMP can be stopped in case runoff from a spill of hazardous material enters the sand filter. The control for the valve must be accessible at all times, including when the basin is full.

Maintenance

Even though sand filters are generally thought of as one of the higher maintenance BMPs, in a recent California study an average of only about 49 hours a year were required for field activities. This was less maintenance than was required by extended detention basins serving comparable sized catchments. Most maintenance consists of routine removal of trash and debris, especially in Austin sand filters where the outlet riser from the sedimentation basin can become clogged.

Most data (i.e. Clark, 2001) indicate that hydraulic failure from clogging of the sand media occurs before pollutant breakthrough. Typically, only the very top of the sand becomes clogged while the rest remains in relative pristine condition as shown in Figure 7. The rate of clogging has been related to the TSS loading on the filter bed (Urbonas, 1999); however, the data are quite variable. Empirical observation of sites treating urban and highway runoff indicates that clogging of the filter occurs after 2 – 10 years of service. Presumably, this is related to differences in the type and amount of sediment in the catchment areas of the various installations. Once clogging occurs the top 2 – 3 inches of filter media is removed, which restores much, but not all, of the lost permeability. This removal of the surface layer can occur several times before the entire filter bed must be replaced. The cost of the removal of the surface layer is not prohibitive, generally ranging between $2,000 (EPA Fact Sheet) and $4,000 (Caltrans, 2002) depending on the size of the filter.

Media filters can become a nuisance due to mosquito and midge breeding in certain designs or if not regularly maintained. "Wet" designs (e.g., MCTT and Delaware filter) are more conducive to vectors than others (e.g., Austin filters) because they maintain permanent sources of standing water where breeding is likely to occur. Caltrans successfully excluded mosquitoes and midges from accessing the permanent water in the sedimentation basin of MCTT installations through use of a tight-fitting aluminum cover to seal vectors out. However, typical wet designs may require routine inspections and treatments by local mosquito and vector control agencies to suppress mosquito production. Vector habitats may also be created in "dry" designs when media filters clog, and/or when features such as level spreaders that hold water over 72 hours are included in the installation. Dry designs such as Austin filters should dewater completely (recommended 72 hour residence time or less) to prevent creating mosquito and other vector habitats. Maintenance efforts to prevent vector breeding in dry designs will need to focus on basic housekeeping practices such as removal of debris accumulations and vegetation management (in filter media) to prevent clogs and/or pools of standing water.

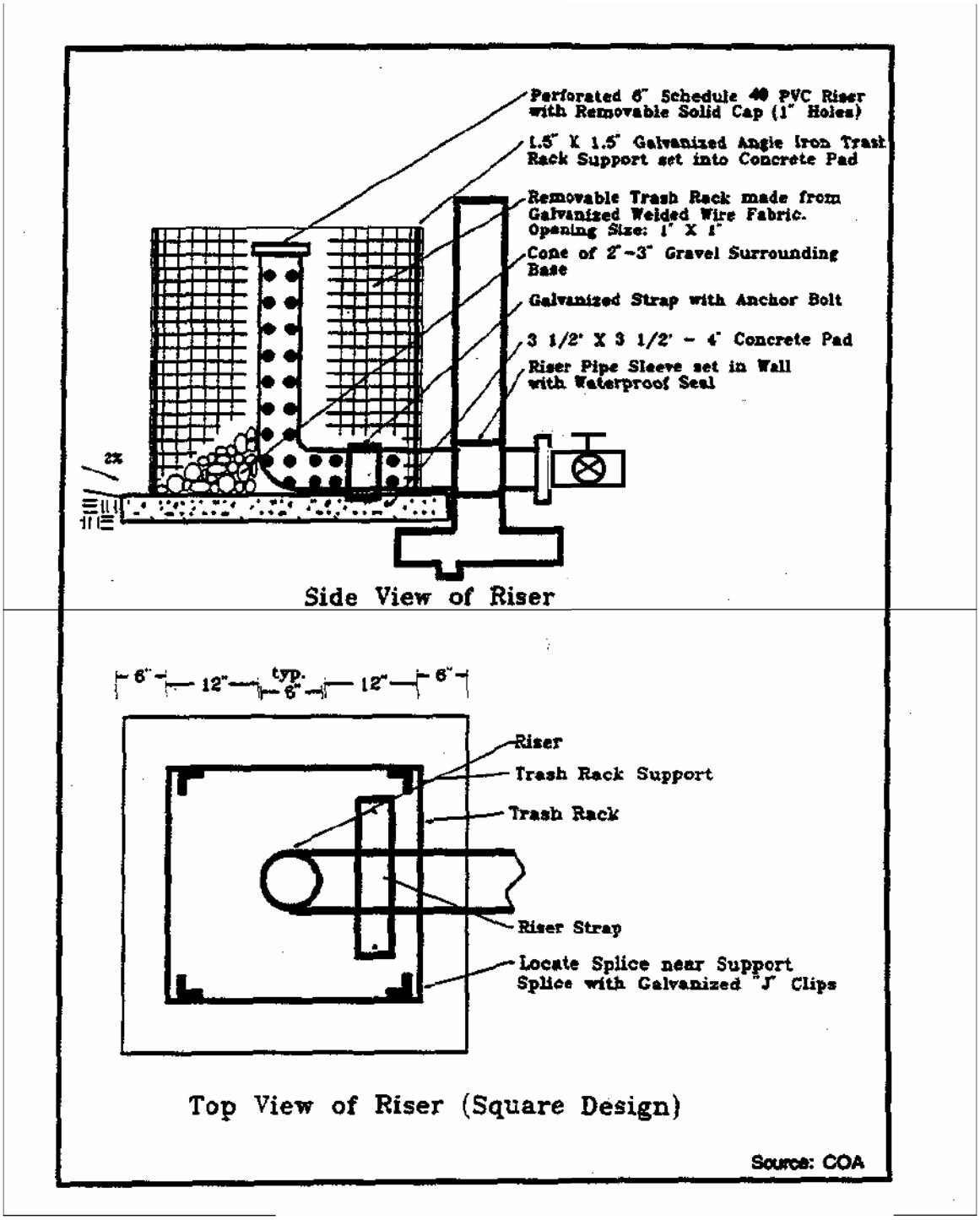

Figure 6
Detail of Sedimentation Riser Pipe

Figure 7
Formation of Clogging Crust on Filter Bed

Recommended maintenance activities and frequencies include:

- Inspections semi-annually for standing water, sediment, trash and debris, and to identify potential problems.
- Remove accumulated trash and debris in the sedimentation basin, from the riser pipe, and the filter bed during routine inspections.
- Inspect the facility once during the wet season after a large rain event to determine whether the facility is draining completely within 72 hr.
- Remove top 50 mm (2 in.) of sand and dispose of sediment if facility drain time exceeds 72 hr. Restore media depth to 450 mm (18 in.) when overall media depth drops to 300 mm (12 in.).
- Remove accumulated sediment in the sedimentation basin every 10 yr or when the sediment occupies 10 percent of the basin volume, whichever is less.

Cost

Construction Cost

There are few consistent published data on the cost of sand filters, largely because, with the exception of Austin, Texas, Alexandria, Virginia, and Washington, D.C., they have not been widely used. Furthermore, filters have such varied designs that it is difficult to assign a cost to filters in general. A study by Brown and Schueler (1997) was unable to find a statistically valid relationship between the volume of water treated in a filter and the cost of the practice. The EPA filter fact sheet indicates a cost for an Austin sand filter at $18,500 (1997 dollars) for a 0.4 hectare- (1 acre-)

drainage area. However, the same design implemented at a 1.1 ha site by the California Department of Transportation, cost $240,000. Consequently, there is a tremendous uncertainty about what the average construction cost might be.

It is important to note that, although underground and perimeter sand filters can be more expensive than surface sand filters, they consume no surface space, making them a relatively cost-effective practice in ultra-urban areas where land is at a premium.

Given the number of facilities installed in the areas that promote their use it should be possible to develop fairly accurate construction cost numbers through a more comprehensive survey of municipalities and developers that have implemented these filters.

Maintenance Cost

Annual costs for maintaining sand filter systems average about 5 percent of the initial construction cost (Schueler, 1992). Media is replaced as needed, with the frequency correlated with the solids loading on the filter bed. Currently the sand is being replaced in the D.C. filter systems about every 2 years, while an Austin design might last 3-10 years depending on the watershed characteristics. The cost to replace the gravel layer, filter fabric and top portion of the sand for D.C. sand filters is approximately $1,700 (1997 dollars).

Caltrans estimated future maintenance costs for the Austin design, assuming a device sized to treat runoff from approximately 4 acres. These estimates are presented in Table 3 and assume a fully burdened hourly rate of $44 for labor. This estimate is somewhat uncertain, since complete replacement of the filter bed was not required during the period that maintenance costs were recorded.

Table 3 Expected Annual Maintenance Costs for an Austin Sand Filter

Activity	Labor Hours	Equipment and Materials ($)	Cost
Inspections	4	0	176
Maintenance	36	125	1,706
Vector Control	0	0	0
Administration	3	0	132
Direct Costs	-	888	888
Total	43	$1,013	**$2,902**

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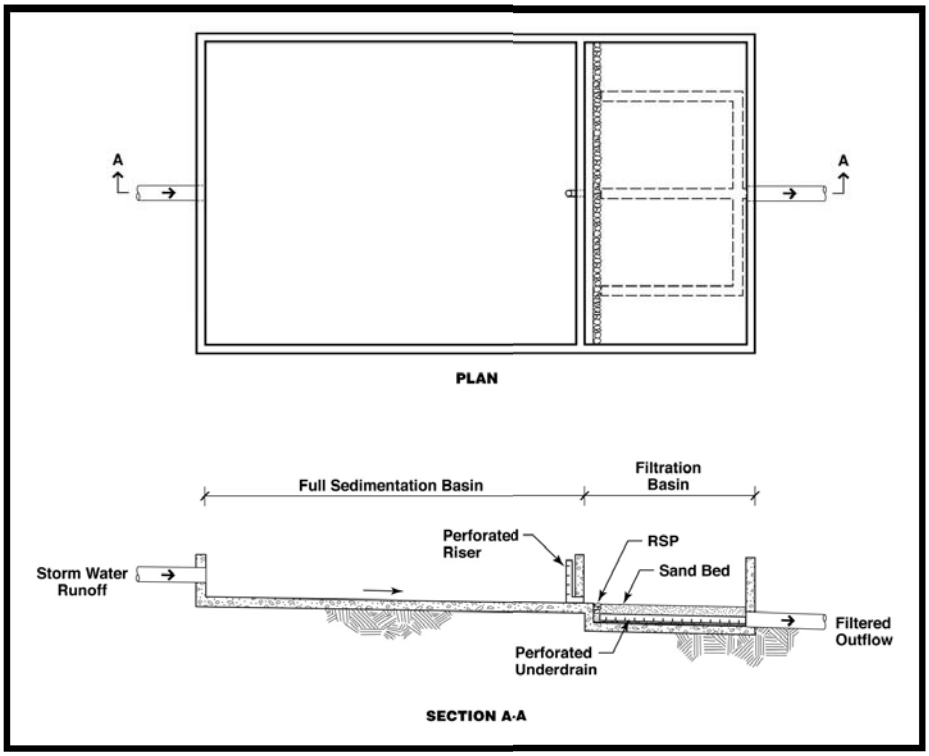
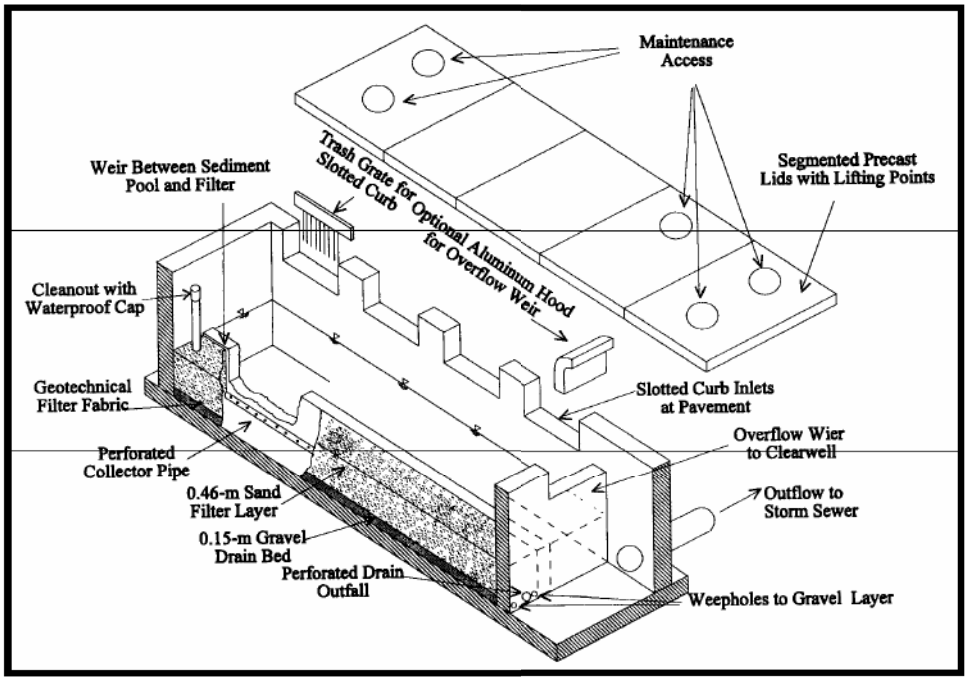
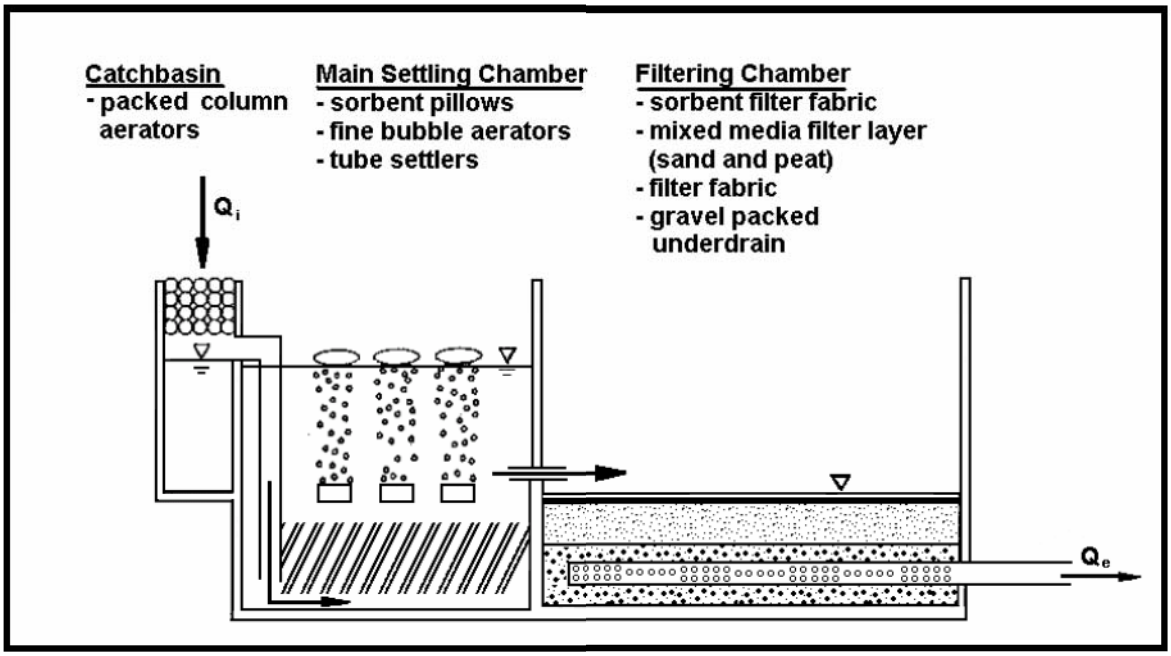


Schematic of the "Full Sedimentation" Austin Sand Filter



Schematic of a Delaware Sand Filter (Young et al., 1996)



Schematic of a MCTT (Robertson et al., 1995)

Multiple Systems TC-60

General Description

A multiple treatment system uses two or more BMPs in series. Some examples of multiple systems include: settling basin combined with a sand filter; settling basin or biofilter combined with an infiltration basin or trench; extended detention zone on a wet pond.

Inspection/Maintenance Considerations

Each of the separate treatment processes will require maintenance as described in the previous fact sheets. For example, multiple system comprises of a biofilter combined with an infiltration basin would require the inspection and maintenance considerations outlined on the fact sheet for each process.

Inspection Activities	Suggested Frequency
■ Refer to individual treatment control factsheets	As needed
Maintenance Activities	**Suggested Frequency**
■ Refer to individual treatment control factsheets	As needed

Maintenance Concerns, Objectives, and Goals

May include some of the following:

- Accumulation of Metals
- Aesthetics
- Channelization of Flow
- Clogged Outlet Structures
- Endangered Species Habitat Creation
- Erosion
- Groundwater Contamination
- Hazardous Waste
- Hydraulic and Removal Efficiency
- Invasive/exotic Plant Species
- Mechanical Malfunction
- Pollutant Breakthrough
- Re-suspension of settled material
- Sediment and Trash Removal
- Sedimentation
- Vector/Pest Control
- Vegetation harvesting
- Vegetation/Landscape Maintenance

Targeted Constituents

✓	Sediment	■
✓	Nutrients	●
✓	Trash	■
✓	Metals	■
✓	Bacteria	▲
✓	Oil and Grease	■
✓	Organics	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

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