Water Quality Management Plan

For:

2175 S Willow Avenue Rialto, CA

APN: 0258-041-28-0000, 0258-041-29-0000

Prepared for:

Donlon Builders

2681 Saturn St.

Brea, CA 9821

(714) 528-0800

Prepared by:

Kimley-Horn and Associates, Inc.

1100 Town and Country Road, Suite 700

Orange, CA 92868

(714) 939-1030

Submittal Date: 11/25/2024

Revision Date:

Approval Date:

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Donlon Builders by Kimley-Horn and Associates. 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."

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: 0258-041-28-0000, 0258-041-29-0000

Owner's Signature			
Owner Name:			
Title			
Company	Outour Storage		
Address			
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: 0258-041-28-0000, 0258-041-29-0000

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: Jacob Glaze		PE Stamp Below
Title	Civil Engineer	
Company	Kimley-Horn and Associates	
Address	1100 Town & Country Rd, Suite 700 Orange, CA 92868	
Email	jacob.glaze@kimley-horn.com	
Telephone #	(714) 939-1030	
Signature		
Date	8/12/2025	

Table of Contents

Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name					
Project Owner Contact Name:					
Mailing Address:		E-mail Address:		Telephone:	
Permit/Application Number(s):		Tract/Parcel Map Number(s): Parcel Map No. 4711, P.M. 43/84		APN: 0258-041-28-0000, 0258-041-29-0000	
Additional Information/ Comments:					
Description of Project:	The project site is located on 2175 S Willow Ave and is bounded by S Willow Ave to the west, and industrial businesses to the north, east, and south. The entire project site measures approximately 4.04 acres. The existing project site consists of developed land with asphalt paving, parking areas, and two existing buildings. The soils have a hydrologic soil group classification of "A", and the topography along the project shows that runoff within the site primarily drains to the eastern property line. Runoff leaves the property to enter an existing concrete channel on the adjacent property before ultimately discharging into the Santa Ana River. The proposed site is considered an industrial redevelopment and intends to develop approximately 4.04 acres into a truck repair and parking facility. One of the existing buildings is to remain. The site will be repaved with new asphalt and proposed new parking areas, sidewalk, trash enclosure, and landscape areas. Runoff will sheet flow to a catch basin where it will be routed to a hydrodynamic separator for pre-treatment and be conveyed to an underground infiltration system. Excess runoff from the site will match existing conditions and enter the concrete channel on the adjacent property before discharging into Santa Ana River.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	N/A				

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 ft^2 or more of impervious surface on an already developed site	☐ New development involving the creation of 10,000 ft^2 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 ft^2 or more
☐ Hillside developments of 5,000 ft^2 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 ft^2 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 ft^2 or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft^2 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):	175,959	**3** Number of Dwelling Units:	N/A	**4** SIC Code:	7699

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 property owner (Owner), Outour Storage, will be responsible for the long-term operations and maintenance of all WQMP stormwater facilities within the project site. The point of contact of the Owner is Outour Storage, with full contact information located under Section 1 of this WQMP.

The Owner will also be responsible for the implementation, long-term operations and maintenance, and funding of the WQMP stormwater facilities described hereon, and will amend this WQMP as needed to reflect any changes to the hydrologic conditions of the property. In addition, the Owner accepts full responsibility for the interim operation and maintenance of the WQMP stormwater facilities.

This WQMP will be reviewed with the facility operator, facility supervisors, employees, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity.

No onsite public facilities will be installed for this development but connection to existing public utilities will require the following publicly maintained offsite facilities:

Water

Sanitary Sewer

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 ☐	Pavement Runoff
Nutrients - Phosphorous	E ☒	N ☐	Primary sources of nutrients are fertilizers and eroded soils
Nutrients - Nitrogen	E ☒	N ☐	Primary source of nutrients are fertilizers and eroded soils
Noxious Aquatic Plants	E ☒	N ☐	Source: Landscaping exists on site
Sediment	E ☒	N ☐	Source: Construction and grading at landscaped areas
Metals	E ☒	N ☐	Source: Brake pad dust and tire tread wear from vehicle traffic
Oil and Grease	E ☒	N ☐	Source: Vehicular Traffic
Trash/Debris	E ☒	N ☐	Public waste, and general waste products on landscape
Pesticides / Herbicides	E ☒	N ☐	At landscape areas only
Organic Compounds	E ☒	N ☐	At landscape areas only
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: N/A			
☐ 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 % *(Total all credit percentages up to a maximum allowable credit of 50 percent)*			
Description of Water Quality Credit Eligibility (if applicable)			

Section 3 Site and Watershed Description

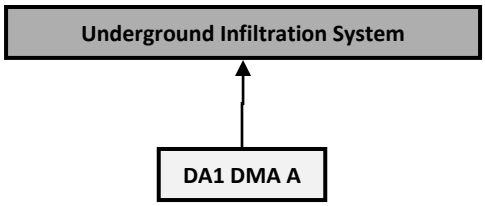
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and 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° 3' 42.4332'N	Longitude 117° 22' 24.636"	Thomas Bros Map page 605

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 A to Underground Infiltration System	Stormwater runoff sheet flows to the center of the eastern property line and enters into a nearby catch basin where it is conveyed to an underground infiltration system for treatment.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A	DMA B	DMA C	DMA D
1 DMA drainage area (ft^2)	175,959			
2 Existing site impervious area (ft^2)	175,959			
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	II			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	A			
5 Longest flowpath length (ft)	655			
6 Longest flowpath slope (ft/ft)	2.2			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Poor Grass			
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*	Poor			

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 thru 1
Applicable TMDLs *Refer to Local Implementation Plan*	**Santa Ana River, Reach 4** Indicator bacteria **Santa Ana River, Reach 3** Nitrate and pathogens **Santa Ana River, Reach 1 and 2** None **Prado Basin** pH
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 4** Pathogens (Bacterial Indicators/Virus) **Santa Ana River, Reach 3** Pathogens (Bacterial Indicators/Virus), Metals, Indicator Bacteria, Copper and Lead **Santa Ana River, Reach 1 and 2** None **Prado Basin** pH
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* *http://permitrack.sbcounty.gov/wap/*	The project is not within an ESA
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool –* *http://permitrack.sbcounty.gov/wap/*	Santa Ana River
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	☒	☐	The developer will provide educated pamphlets published by California State Regional Water Quality Control Boards – Santa Ana Region, or other appropriate sources.
N2	Activity Restrictions	☒	☐	The types of activities allowed within the project will be limited to those allowed by the City of Rialto codes, regulations, and ordinances.
N3	Landscape Management BMPs	☒	☐	Landscape plans will be consistent with the City of Rialto requirements for water conservation vegetation. Utilizing programmable irrigation systems, and/or rain shut off sensors.
N4	BMP Maintenance	☒	☐	Per Owner's Certification and Management Agreement.
N5	Title 22 CCR Compliance (How development will comply)	☒	☐	Project will comply with Title 22 CCR.
N6	Local Water Quality Ordinances	☒	☐	Owners to abide by the State, County, and Local Water Ordinances, provide with the educational material and pamphlets.
N7	Spill Contingency Plan	☒	☐	Any spill of chemical shall be properly cleaned up and the waste properly disposed of per all State, County, and Local requirements. See SC-11.
N8	Underground Storage Tank Compliance	☐	☒	No storage tanks to be allowed for this project.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials to be allowed for this 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	
N10	Uniform Fire Code Implementation	☒	☐	As required per San Bernardino County/City of Rialto Fire Department.
N11	Litter/Debris Control Program	☒	☐	Private parking lot will be maintained by the Owner/Tenants. Public streets will be maintained by the City of Rialto.
N12	Employee Training	☒	☐	Provide ongoing educational material.
N13	Housekeeping of Loading Docks	☐	☒	Project does not feature any loading docks.
N14	Catch Basin Inspection Program	☒	☐	Inspection by property owner and per Maintenance Agreement.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Parking lots, drive aisles, and storage areas of the project sire shall be vacuum swept and cleared monthly by the owner's contractor.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not a public agency.
N17	Comply with all other applicable NPDES permits	☒	☐	As required.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	SD stenciling will be provided by the developer and maintained only for on-site private storm drains.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	Not featured per this project.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash bins have permanent covers inside the trash 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)	☒	☐	Landscape to be designed per state guidelines.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Landscape shall comply with depressed grading requirements by finish grading to a minimum of 1” below pavement grades or top of curb.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	Not featured per this project.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Not featured per this project.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Not featured per this project.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not featured per this project.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Not featured per this project.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not featured per this project.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Not featured per this project.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Not featured per this project.
S14	Wash water control for food preparation areas	☐	☒	Not featured per this project.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Not featured per this project.

4.1.2 Preventative LID Site Design Practices

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

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

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

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: This is addressed in the project site plan through the optimized design of the proposed hardscape, which will allow for maximum area of propose landscaping within the property.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: Proposed landscape areas maximize the natural infiltration capacity.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Some alterations were made to site drainage patterns but general path still follows existing pattern.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: Proposed landscaping at the perimeter of the site.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: This site does not have sensitive areas or existing vegetation.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: Any areas that are disturbed will be stabilized prior to project completion.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Compaction surrounding the retention/infiltration basin will be avoided per Geotechnical Report specifications.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Utilization of vegetated drainage swales is not feasible for the proposed development due to the proposed site plan and grading.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Landscaping areas will be staked off after rough grading has been completed to prevent excessive compaction.

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 mi²), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for 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): 175,959	**2** Imperviousness after applying preventative site design practices (Imp%): 0.90	**3** Runoff Coefficient (Rc): 0.69 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
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): 15,384 *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	**1** 7,170 *Form 4.2-3 Item 12*	**2** 15.01 *Form 4.2-4 Item 13*	**3** 2.18 *Form 4.2-5 Item 10*
Post-developed	**4** 32,809 *Form 4.2-3 Item 13*	**5** 9.07 *Form 4.2-4 Item 14*	**6** 5.53 *Form 4.2-5 Item 14*
Difference	**7** *25,639* *Item 4 – Item 1*	**8** *5.94* *Item 2 – Item 5*	**9** *3.35* *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** *358%* *Item 7 / Item 1*	**11** *39.6%* *Item 8 / Item 2*	**12** 117% *Item 9 / Item 3*

HCOC Calculation Summary Table

	$TC_{2\text{-}YR}$ (min)	$Q_{2\text{-}YR}$ (cfs)	$V_{2\text{-}YR}$ (cf)
Pre-Development	15.01	2.18	7,170
Post-Development	9.07	5.53	32,809
HCOC Requirement (0.95*Post-Pre)	5.19 *(Additional time that must be provided)*	3.07 *(Amount of runoff to mitigate)*	23,999 *(Required Retention)*

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 (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*			
5 Sum of retention volume achieved from impervious area dispersion (ft^3):		$V_{retention}$ *=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 (ft^2)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) $V_{retention}$ *= (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3):		$V_{retention}$ *=Sum of Item 12 for all BMPs*	

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

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, typical ~ 0.1*			
17 Daily ET demand (ft^3/day) *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).

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): 15,384 *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 A DMA 1 BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	16.7		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	3.5		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	4.8		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	9		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	9		
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*	3,600		
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*	N/A		
10 Amended soil porosity	N/A		
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*	1		
12 Gravel porosity	0.40		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	N/A		
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))]*	N/A		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	25,093		

16 Total Retention Volume from LID Infiltration BMPs: 25,093 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 163% *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): *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	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Describe cistern or runoff			
3 Storage volume for propos *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): *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)*	☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ 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** Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): *Item 1 – Item 3*	**5** 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)*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
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} *= Minimu… 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*			

Not Applicable

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.*	DA DMA BMP Type		DA DMA BMP Type *(Use additional forms for more BMPs)*	
	Forebay	Basin	Forebay	Basin
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)*				

Not Applicable

Form 4.3-8 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DA DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
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*			
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 T design details*			
4 Manning's roughness coefficie			
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*			

Not Applicable

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): 15,384 *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): 25,093 *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): 23,999 *(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): 25,093 *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): 0 *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): N/A *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 addition time of concentration requirement in Form 4.2-4 Item 15)
- 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).

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
Landscape Maintenance	Owner	Maintain landscape are vegetation, slope protection and grades adjacent to hardscape, and prevent discharge of landscape maintenance waste into storm drains.	Weekly
Litter Control	Owner	Maintain roofed waste collection areas and vacuum-sweep drive aisles and parking areas to remove potential stormwater contamination before anticipated storm events.	Weekly/Monthly
Vacuum Sweep Private Streets and Parking Lots	Owner	Streets, parking areas and alleyways within the project shall be vacuum swept at a minimum frequency monthly.	Monthly
Trash Enclosure Design and Maintenance	Owner	Trash enclosure shall be constructed with a solid canopy style roof and shall be set on a raised concrete pad, to prevent stormwater runon and the enclosure shall be swept at least once per week. Always maintain area clear of trash and debris.	Weekly
Irrigation System	Owner	Check and repair the irrigation system. Verify there are no leaks or runoff from landscape areas. Adjust irrigation heads and system run times as necessary to prevent overwater of vegetation, overspray or run-off from landscape areas and to ensure the health and aesthetic quality of the landscape.	Weekly
Onsite storm drain catch basins	Owner	Onsite catch basins shall be inspected monthly for debris buildup and evidence of illegal dumping and shall be cleaned whenever debris/sediment accumulates. Removal can be accomplished by vac-truck or other equally effective methods.	Monthly
Anti-Dumping Stenciling & Signage	Owner	Visual inspection and replacement of damaged or illegible stenciling and signage over on-site catch basins.	Annually

Underground Infiltration System	Owner	Regular inspections of system via the access manholes to determine sediment build up and infiltration capacity. Cleaning of accumulated trash, debris, and sediments as determined by inspections. Cleaning is recommended during dry weather. See manufacturer recommendations for additional maintenance activities.	Monthly within 48 hours following a significant storm event to verify if there is standing water in the chambers

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

- 6.4.1 Vicinity Map
- 6.4.2 NOAA Precipitation Data
- 6.4.3 WAP Report
- 6.4.4 HCOC Calculations
- 6.4.5 BMP Sizing Calculations
- 6.4.6 Geotechnical Report
- 6.4.7 Educational Materials

Section 6.1 Site and Drainage Plan

CITY OF RIALTO

POST-DEVELOPMENT WQMP EXHIBIT

FOR

2175 S WILLOW AVE.

HYDROLOGY INFORMATION

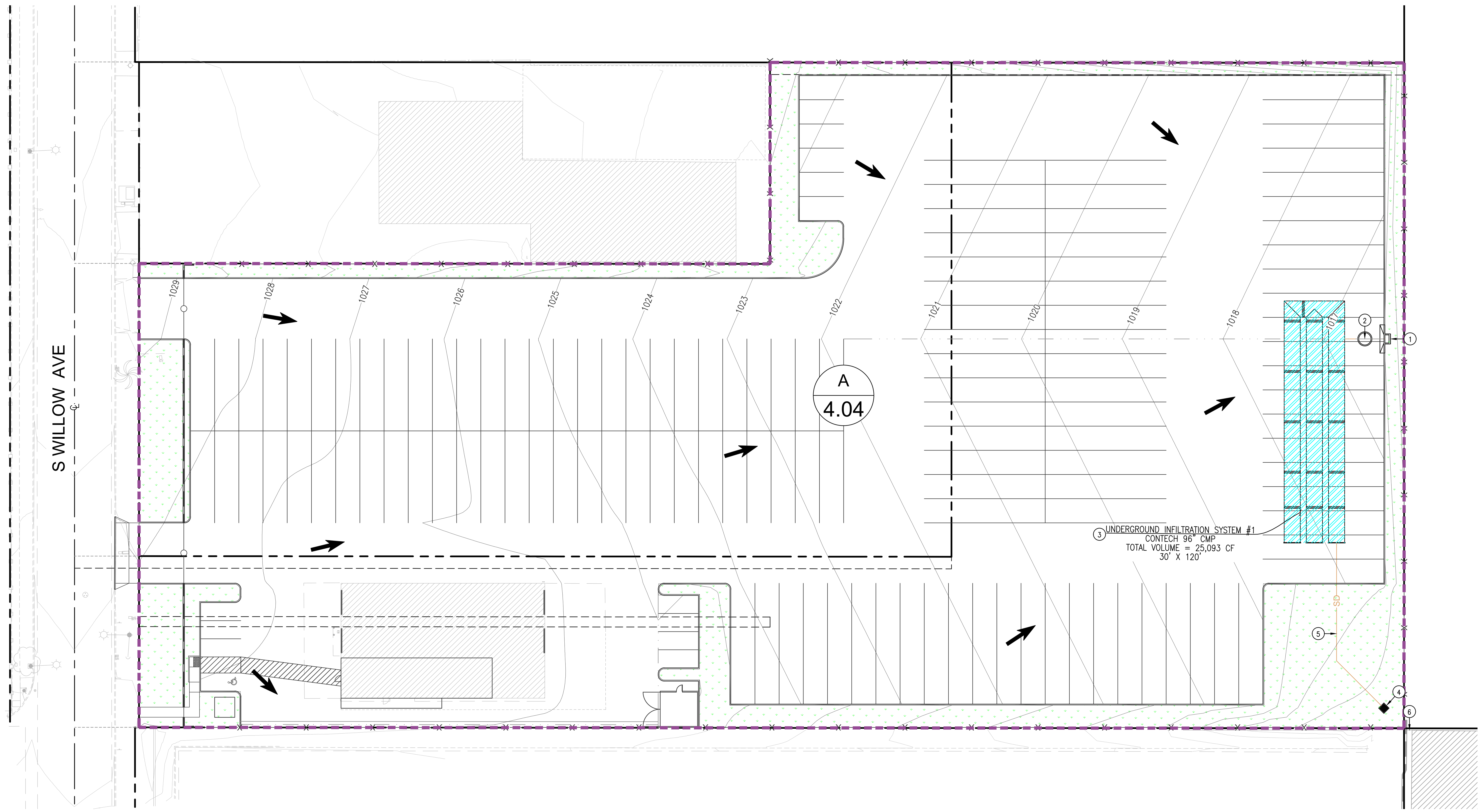
SITE AREA:	4.04 ACRES	
SOIL TYPE:	A	(NRCS WEB SOIL SURVEY)
IMPERVIOUS:	87%	(PER CALCULATIONS)
ISOHYETALS:	0.521 INCH	(2-YEAR, 1-HR STORM EVENT)
	1.27 INCH	(100-YEAR, 1-HR STORM EVENT)
CURVE NUMBER	32	(SOIL GROUP A)
FREQUENCY:	2-YEAR	(FOR STORMWATER QUALITY)
	100-YEAR	(FOR STORM DRAIN DESIGN)
METHOD:	SAN BERNARDINO COUNTY HYDROLOGY MANUAL	

LEGEND:

- DRAINAGE AREA BOUNDARY
- FLOW PATH
- PROPOSED STORM DRAIN PIPE
- PROPOSED FLOW DIRECTION ARROW
- X / X.XX — DRAINAGE AREA DESIGNATION / AREA (AC)
- 1.1 — STREAM #
- 1 — NODE

DRAINAGE NOTES:

1. PROPOSED CATCH BASIN WITH FILTER INSERT
2. PROPOSED BMP - HYDRODYNAMIC SEPARATOR
3. PROPOSED BMP - UNDERGROUND INFILTRATION BASIN
4. PROPOSED BUBBLER SYSTEM
5. PROPOSED STORM DRAIN PIPE PRIVATE MAINTAINED
6. EXISTING CONCRETE CHANNEL



WQMP SUMMARY

DRAINAGE AREA NO.	TRIBUTARY AREA (SF)	TRIBUTARY AREA (AC)	IMPERVIOUS RATIO	DCV (CF)	V_{HCOC} (CF)	Q_2 ALLOWABLE (CFS)	RETENTION PROVIDED (CF)
A	175,959	4.04	0.87	15,384	23,999	2.18 (NATURAL GROUND)	25,093 (UNDERGROUND INFILTRATION SYSTEM #1)

NORTH

GRAPHIC SCALE IN FEET

0 15 30 60

SCALE: 1" = 30'
WHEN PRINTED AT FULL
SIZE 24"X36"

PREPARED BY:

Kimley»Horn

1100 W TOWN AND COUNTRY ROAD,SUITE 700,
ORANGE, CA 92868
PHONE: 714-939-1030 FAX: 714-938-9488
WWW.KIMLEY-HORN.COM

2175 S WILLOW AVE

POST-DEVELOPMENT WQMP EXHIBIT

OUTOUR

CITY OF RIALTO

DATE: DEC 2024

SHEET 1 OF 1

12/04/2024

Section 6.2 Electronica Data Submittal

Section 6.3 Post Construction

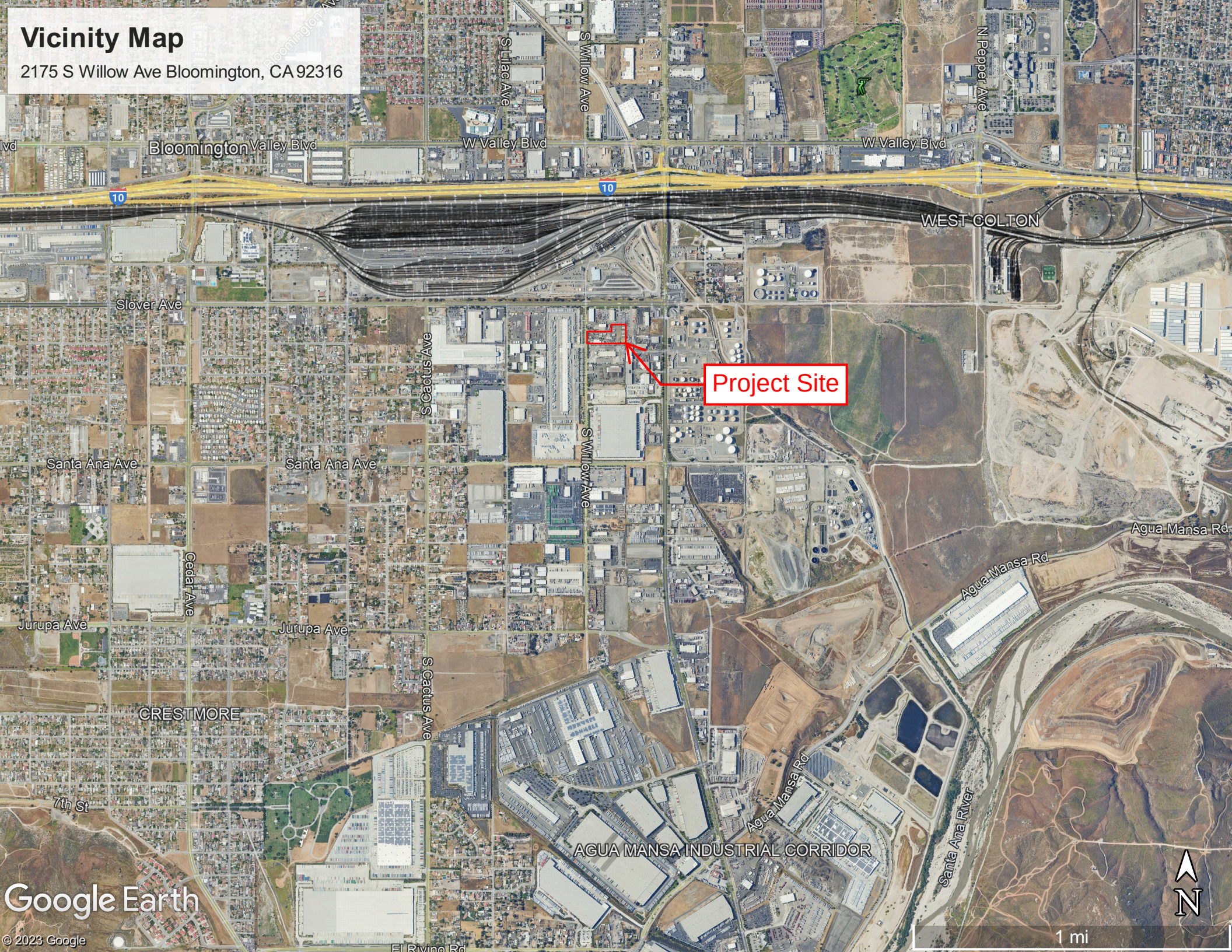
Section 6.4 Other Supporting Documentation

6.4.1 Vicinity Map
6.4.2 NOAA Precipitation Data
6.4.3 WAP Report
6.4.4 HCOC Calculations
6.4.5 BMP Sizing Calculations
6.4.6 Geotechnical Report
6.4.7 Educational Materials

Section 6.4.1 Vicinity Map

Vicinity Map

2175 S Willow Ave Bloomington, CA 92316



6.4.2 NOAA Precipitation Data

NOAA Atlas 14, Volume 6, Version 2
Location name: Bloomington, California, USA*
Latitude: 34.0617°, Longitude: -117.3731°
Elevation: 1023 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 (0.572-1.24)
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 (0.785-1.26)	1.13 (0.878-1.46)	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 (1.10-1.77)	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 (1.08-1.58)	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 (3.06-5.38)	4.48 (3.30-6.14)	5.07 (3.58-7.26)	5.54 (3.77-8.21)
24-hr	1.81 (1.60-2.09)	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 (4.82-7.93)	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 (3.98-5.31)	5.56 (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 (4.04-5.31)	5.56 (4.86-6.48)	6.89 (5.84-8.30)	7.94 (6.58-9.76)	9.01 (7.30-11.4)	10.1 (7.99-13.1)	11.7 (8.84-15.8)	12.9 (9.45-18.0)
7-day	2.89 (2.56-3.33)	3.94 (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)	5.86 (5.17-6.79)	7.15 (6.26-8.34)	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)

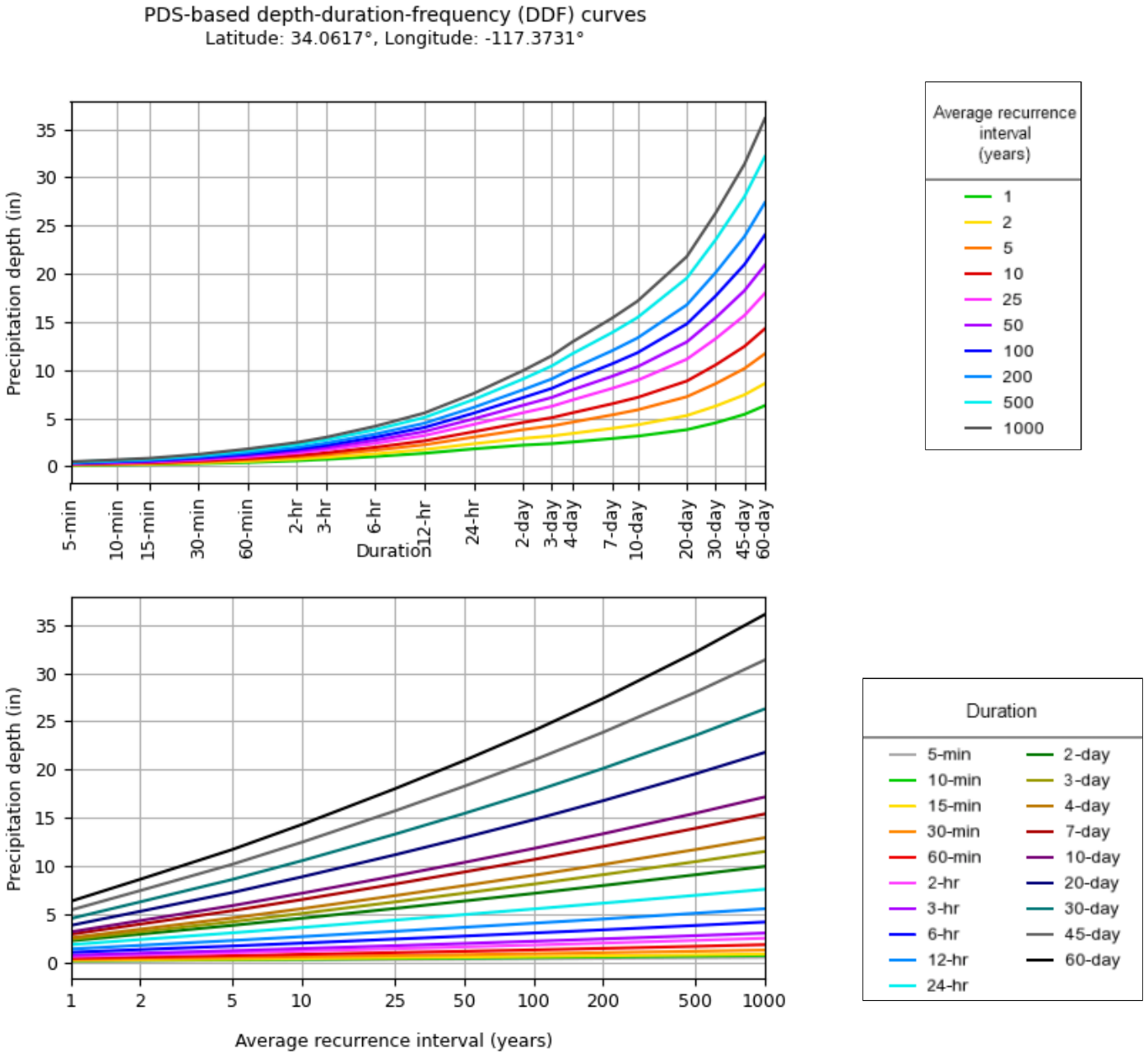
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

PF graphical



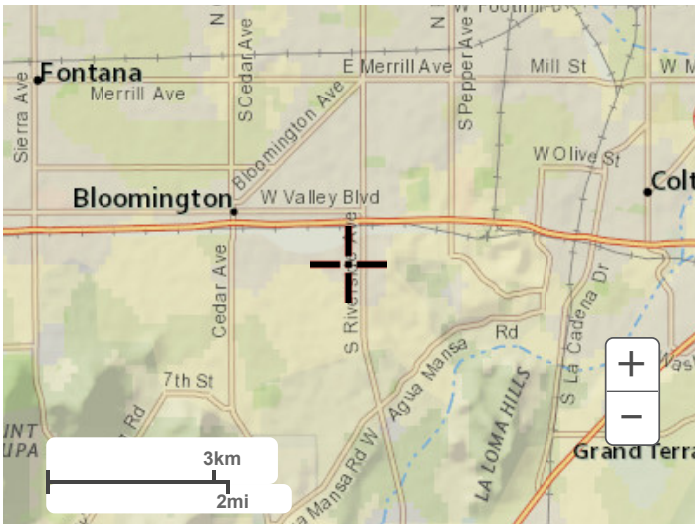
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Nov 13 23:01:13 2024

Back to Top

Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

NOAA Atlas 14, Volume 6, Version 2
Location name: Bloomington, California, USA*
Latitude: 34.0617°, Longitude: -117.3731°
Elevation: 1023 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 (0.785-1.26)	1.13 (0.878-1.46)	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 (0.312-0.455)	0.483 (0.401-0.589)	0.573 (0.471-0.703)	0.695 (0.552-0.883)	0.790 (0.614-1.03)	0.887 (0.673-1.18)	0.989 (0.729-1.36)	1.13 (0.797-1.62)	1.24 (0.845-1.84)
3-hr	0.241 (0.201-0.293)	0.309 (0.257-0.375)	0.397 (0.330-0.483)	0.469 (0.386-0.576)	0.568 (0.451-0.722)	0.644 (0.501-0.837)	0.722 (0.548-0.962)	0.803 (0.592-1.10)	0.915 (0.646-1.31)	1.00 (0.683-1.49)
6-hr	0.170 (0.141-0.206)	0.217 (0.181-0.264)	0.279 (0.232-0.340)	0.330 (0.271-0.405)	0.398 (0.316-0.506)	0.451 (0.351-0.586)	0.504 (0.382-0.672)	0.560 (0.412-0.768)	0.635 (0.448-0.909)	0.695 (0.473-1.03)
12-hr	0.112 (0.093-0.136)	0.144 (0.120-0.175)	0.186 (0.154-0.226)	0.219 (0.180-0.269)	0.265 (0.210-0.337)	0.300 (0.233-0.389)	0.335 (0.254-0.446)	0.371 (0.273-0.509)	0.421 (0.297-0.602)	0.459 (0.313-0.681)
24-hr	0.075 (0.066-0.087)	0.097 (0.086-0.112)	0.126 (0.111-0.146)	0.149 (0.131-0.174)	0.181 (0.153-0.218)	0.205 (0.170-0.252)	0.230 (0.186-0.289)	0.255 (0.201-0.330)	0.288 (0.218-0.389)	0.315 (0.230-0.439)
2-day	0.045 (0.040-0.052)	0.060 (0.053-0.069)	0.079 (0.070-0.091)	0.094 (0.083-0.110)	0.115 (0.098-0.139)	0.132 (0.109-0.162)	0.148 (0.120-0.187)	0.165 (0.130-0.214)	0.188 (0.142-0.254)	0.207 (0.151-0.288)
3-day	0.032 (0.028-0.037)	0.043 (0.038-0.050)	0.058 (0.051-0.067)	0.070 (0.061-0.081)	0.086 (0.073-0.104)	0.099 (0.082-0.122)	0.112 (0.091-0.141)	0.126 (0.099-0.163)	0.144 (0.109-0.195)	0.159 (0.116-0.222)
4-day	0.026 (0.023-0.030)	0.035 (0.031-0.041)	0.047 (0.042-0.055)	0.057 (0.050-0.067)	0.071 (0.060-0.086)	0.082 (0.068-0.101)	0.093 (0.076-0.118)	0.105 (0.083-0.136)	0.121 (0.092-0.164)	0.134 (0.098-0.187)
7-day	0.017 (0.015-0.019)	0.023 (0.020-0.027)	0.031 (0.028-0.036)	0.038 (0.033-0.045)	0.048 (0.040-0.058)	0.055 (0.046-0.068)	0.063 (0.051-0.079)	0.071 (0.056-0.092)	0.082 (0.062-0.111)	0.091 (0.067-0.127)
10-day	0.013 (0.011-0.015)	0.017 (0.015-0.020)	0.024 (0.021-0.028)	0.029 (0.026-0.034)	0.037 (0.031-0.044)	0.043 (0.035-0.053)	0.049 (0.039-0.061)	0.055 (0.043-0.071)	0.064 (0.048-0.086)	0.071 (0.052-0.099)
20-day	0.007 (0.007-0.009)	0.010 (0.009-0.012)	0.015 (0.013-0.017)	0.018 (0.016-0.021)	0.023 (0.019-0.027)	0.026 (0.022-0.033)	0.030 (0.024-0.038)	0.034 (0.027-0.045)	0.040 (0.030-0.054)	0.045 (0.033-0.063)
30-day	0.006 (0.005-0.007)	0.008 (0.007-0.010)	0.011 (0.010-0.013)	0.014 (0.012-0.017)	0.018 (0.015-0.022)	0.021 (0.017-0.026)	0.024 (0.019-0.030)	0.027 (0.022-0.036)	0.032 (0.024-0.044)	0.036 (0.026-0.050)
45-day	0.005 (0.004-0.005)	0.006 (0.006-0.007)	0.009 (0.008-0.010)	0.011 (0.010-0.013)	0.014 (0.012-0.017)	0.016 (0.014-0.020)	0.019 (0.015-0.024)	0.022 (0.017-0.028)	0.025 (0.019-0.034)	0.029 (0.021-0.040)
60-day	0.004 (0.003-0.005)	0.005 (0.005-0.006)	0.008 (0.007-0.009)	0.009 (0.008-0.011)	0.012 (0.010-0.015)	0.014 (0.012-0.017)	0.016 (0.013-0.021)	0.019 (0.014-0.024)	0.022 (0.016-0.030)	0.025 (0.018-0.034)

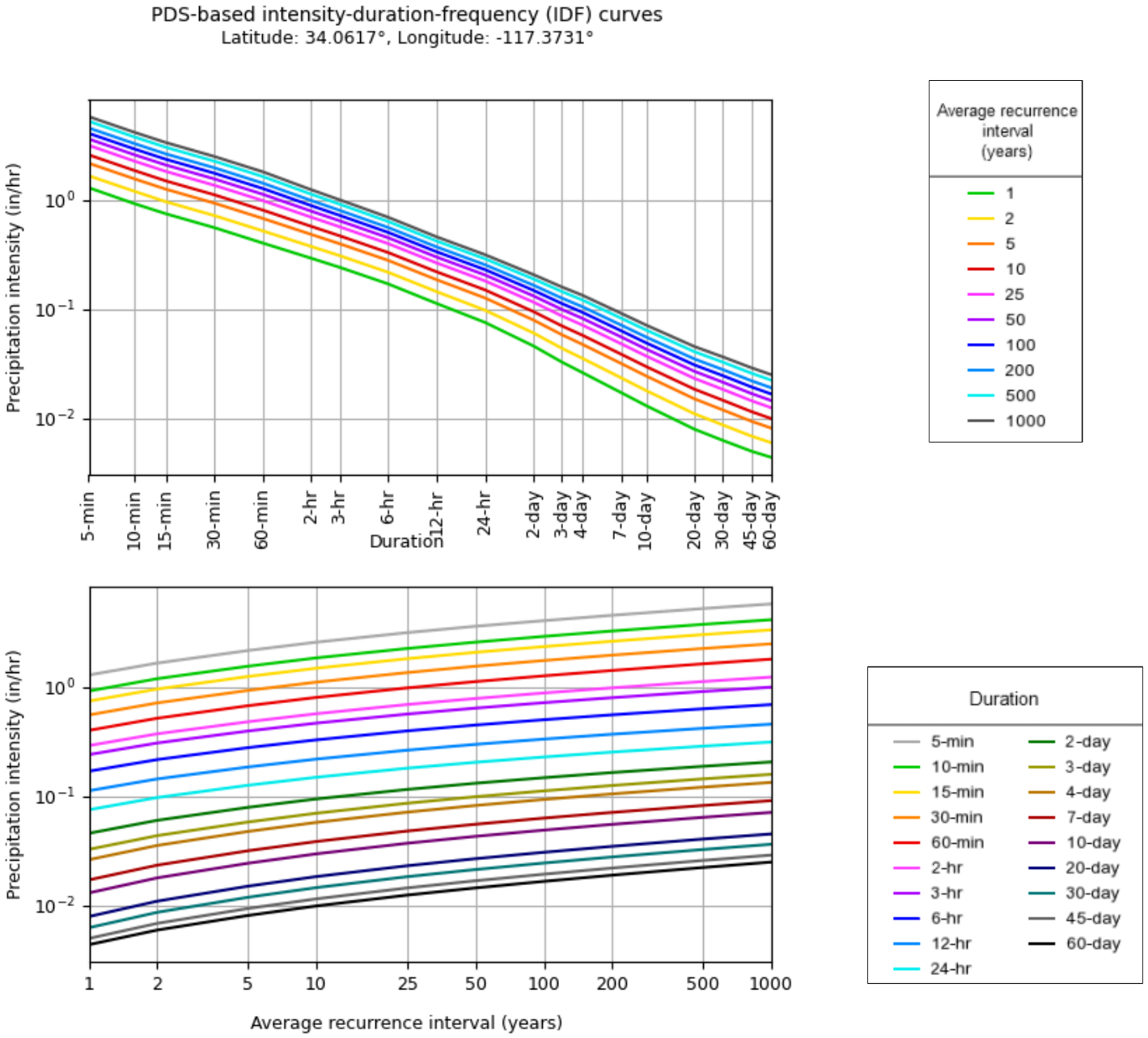
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

PF graphical



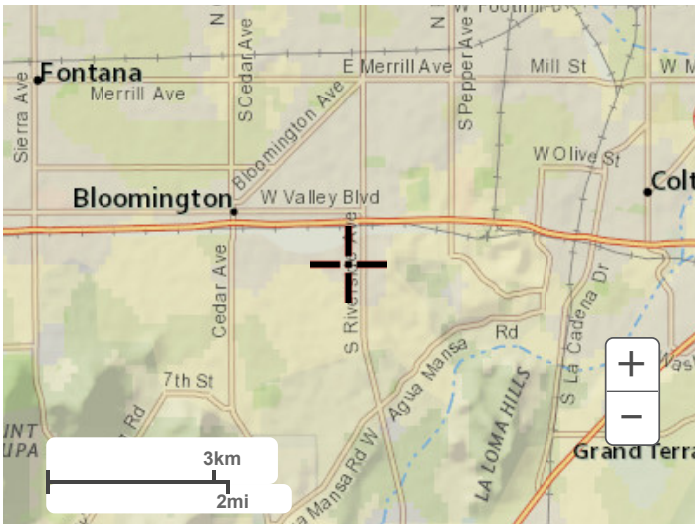
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Nov 13 22:56:48 2024

Back to Top

Maps & aerials

Small scale terrain



Large scale terrain

Large scale map

Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

6.4.3 WAP Report

WQMP Project Report - San Bernardino Co. Stormwater Program

Area of Interest (AOI) Information

Area : 237,086.23 ft²

Nov 18 2024 14:34:39 Pacific Standard Time

Project Site Parcel Numbers

#	ParcelNumber	Acreage	Area(ft²)
1	025819113	0.45	155.28
2	025804139	2.68	5,881.47
3	025804109	4.73	6,383.00
4	025804111	4.04	12,126.39
5	025804123	0.72	31,308.35
6	025804128	1.55	67,558.93
7	025804129	2.49	108,463.64

Drainage Segment Details

#	System Number	Facility Name	Closest channel segment's susceptibility to Hydromodification	Highest downstream hydromodification susceptibility	Is this drainage segment subject to TMDLs?
1	2-120-1C	Rialto Channel	EHM	High	No

#	Are there downstream drainage segments subject to TMDLs?	Is this drainage segment a 303d listed stream?	Are there 303d listed streams downstream?	Area(ft²)
1	No	No	Yes	237,086.27

Onsite Soil Groups

#	Onsite Soils Group	Soil Type	Soil Type Abbreviation	Area(ft²)
1	Soils - Hydro Group B	HaC HANFORD COARSE SANDY LOAM, 2 TO 9 PERCENT SLO*	HANFORD COARSE SANDY LOAM	237,086.23

Studies and Reports Related to Project Site

#	Report Link	Source	Date	Area(ft²)
1	SBVMWD_High_Groundwater_/_Pressure_Zone_Area	USGS & San Bern Valley Municipal Water District	2005	237,086.23
2	CSDP_3_CALC_SHEET_FOR_HYDRO	San Bernardino County Flood Control District	April 1973	237,086.23
3	CSDP_3-3_Rialto_Channel_Drainage_Area_Volume_I	James M. Montgomery	April 1988	237,086.23
4	CSDP_3-3_Rialto_Channel_Drainage_Area_Volume_II	James M. Montgomery	April 1988	237,086.23
5	CSDP_3-3_Rialto_Channel_Drainage_Area_Volume_III	James M. Montgomery	April 1988	237,086.23
6	CSDP_3-3_Rialto_Channel_Drainage_Area_Volume_I	James M. Montgomery	April 1988	237,086.23
7	CSDP_3-3_Rialto_Channel_Drainage_Area_Volume_IV	James M. Montgomery	April 1988	237,086.23
8	CSDP_3-3_Rialto_Channel_Drainage_Area_Volume_V	James M. Montgomery	April 1988	237,086.23
9	Rialto_MPD_Vol1	Hall & Foreman, Inc	February 2009	237,086.23
10	Rialto_MPD_Vol_II	Hall & Foreman, Inc	February 2009	237,086.23
11	RS-Rialto_Map_Book-FINAL_Layout2	Hall & Foreman, Inc	February 2009	237,086.23
12	CSDP_3-3_Rialto_Channel_Drain_Area_Draft	James M. Montgomery	January 1987	237,086.23
13	Cactus_Basin	San Bernardino County Flood Control District	October 1985	237,086.23

6.4.4 HCOC Calculations

HCOC Summary
2-Year Pre-Development (Natural Conditions) Rational Method Calculations
2-Year Post Development Rational Method Calculations
2-Year Pre-Development (Natural Conditions) Unit Hydrograph Calculations
2-Year Post-Development Unit Hydrograph Calculations

6.4.4 HCOC Calculations

HCOC Summary

6.4.4 HCOC Calculations

2-Year Pre-Development (Natural Conditions) Rational Method Calculations

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
            Ver. 23.0  Release Date: 07/01/2016  License ID 1499

                          Analysis prepared by:




 ************************* DESCRIPTION OF STUDY *************************
* 2175 S WILLOW                                                        *
* RATIONAL METHOD                                                      *
* UNDEVELOPED CONDITIONS, 2-YEAR, DA A                                 *
 ************************************************************************

  FILE NAME: RAT2PR.DAT
  TIME/DATE OF STUDY: 11:08 11/18/2024
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.5210

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

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      1.10 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   655.11
  ELEVATION DATA: UPSTREAM(FEET) =   1029.41  DOWNSTREAM(FEET) =   1014.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.013
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.196
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL POOR COVER
  "GRASS"                    A        4.04      0.60     1.000    67   15.01
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.60
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      2.18
  TOTAL AREA(ACRES) =      4.04   PEAK FLOW RATE(CFS) =      2.18
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.0  TC(MIN.) =     15.01
  EFFECTIVE AREA(ACRES) =      4.04  AREA-AVERAGED Fm(INCH/HR)=  0.60
  AREA-AVERAGED Fp(INCH/HR) =  0.60  AREA-AVERAGED Ap = 1.000
  PEAK FLOW RATE(CFS)   =       2.18
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

6.4.4 HCOC Calculations

2-Year Post-Development Rational Method Calculations

```
**************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1499

                          Analysis prepared by:




 ************************ DESCRIPTION OF STUDY ************************
* 2175 S WILLOW                                                       *
* RATIONAL METHOD                                                     *
* POST DEVELOPMENT CONDITIONS, 2-YEAR, DA A                           *
 **********************************************************************

  FILE NAME: RAT2PO.DAT
  TIME/DATE OF STUDY: 12:13 11/21/2024
==========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.5210

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

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**************************************************************************
  FLOW PROCESS FROM NODE      1.10 TO NODE      1.20 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   711.88
  ELEVATION DATA: UPSTREAM(FEET) =   1027.86  DOWNSTREAM(FEET) =   1013.42

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.171
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.608
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        4.04      0.98     0.100    32    9.17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      5.49
  TOTAL AREA(ACRES) =      4.04   PEAK FLOW RATE(CFS) =      5.49
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.0  TC(MIN.) =      9.17
  EFFECTIVE AREA(ACRES) =      4.04  AREA-AVERAGED Fm(INCH/HR)=  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.97  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =       5.49
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

6.4.4 HCOC Calculations

2-Year Pre-Development (Natural Conditions) Unit Hydrograph Calculations

```
*****************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
=============================================================================
         (C) Copyright 1989-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1499

                              Analysis prepared by:




*****************************************************************************
-----------------------------------------------------------------------------

 Problem Descriptions:
  2175 S WILLOW
  UNIT HYDROGRAPH
  UNDEVELOPED CONDITIONS,  2-YEAR, DA A
-----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.35
    TOTAL CATCHMENT AREA(ACRES) =    4.04
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.598
    LOW LOSS FRACTION = 0.874
    TIME OF CONCENTRATION(MIN.) = 15.01
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.14
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.36
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.52
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.93
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.30
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.35

-----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.16
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.63

*****************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
-----------------------------------------------------------------------------
  0.24      0.0003      0.03  Q         .         .         .         .
  0.49      0.0009      0.03  Q         .         .         .         .
  0.74      0.0015      0.03  Q         .         .         .         .
  0.99      0.0021      0.03  Q         .         .         .         .
  1.24      0.0027      0.03  Q         .         .         .         .
  1.49      0.0033      0.03  Q         .         .         .         .
  1.74      0.0040      0.03  Q         .         .         .         .
  1.99      0.0046      0.03  Q         .         .         .         .
  2.24      0.0052      0.03  Q         .         .         .         .
  2.49      0.0059      0.03  Q         .         .         .         .
  2.74      0.0065      0.03  Q         .         .         .         .
  2.99      0.0072      0.03  Q         .         .         .         .
  3.24      0.0079      0.03  Q         .         .         .         .
  3.49      0.0085      0.03  Q         .         .         .         .
  3.74      0.0092      0.03  Q         .         .         .         .
  3.99      0.0099      0.03  Q         .         .         .         .
  4.24      0.0106      0.03  Q         .         .         .         .
  4.49      0.0113      0.03  Q         .         .         .         .
  4.74      0.0120      0.03  Q         .         .         .         .
  4.99      0.0128      0.04  Q         .         .         .         .
  5.24      0.0135      0.04  Q         .         .         .         .
```

5.49	0.0142	0.04	Q	.	.	.	.
5.74	0.0150	0.04	Q	.	.	.	.
5.99	0.0158	0.04	Q	.	.	.	.
6.24	0.0165	0.04	Q	.	.	.	.
6.49	0.0173	0.04	Q	.	.	.	.
6.74	0.0181	0.04	Q	.	.	.	.
6.99	0.0189	0.04	Q	.	.	.	.
7.24	0.0198	0.04	Q	.	.	.	.
7.49	0.0206	0.04	Q	.	.	.	.
7.74	0.0214	0.04	Q	.	.	.	.
7.99	0.0223	0.04	Q	.	.	.	.
8.24	0.0232	0.04	Q	.	.	.	.
8.49	0.0241	0.04	Q	.	.	.	.
8.75	0.0250	0.04	Q	.	.	.	.
9.00	0.0259	0.05	Q	.	.	.	.
9.25	0.0269	0.05	Q	.	.	.	.
9.50	0.0279	0.05	Q	.	.	.	.
9.75	0.0288	0.05	Q	.	.	.	.
10.00	0.0299	0.05	Q	.	.	.	.
10.25	0.0309	0.05	Q	.	.	.	.
10.50	0.0320	0.05	Q	.	.	.	.
10.75	0.0330	0.05	Q	.	.	.	.
11.00	0.0342	0.05	Q	.	.	.	.
11.25	0.0353	0.06	Q	.	.	.	.
11.50	0.0365	0.06	Q	.	.	.	.
11.75	0.0377	0.06	Q	.	.	.	.
12.00	0.0390	0.06	Q	.	.	.	.
12.25	0.0404	0.07	Q	.	.	.	.
12.50	0.0419	0.08	Q	.	.	.	.
12.75	0.0435	0.08	Q	.	.	.	.
13.00	0.0451	0.08	Q	.	.	.	.
13.25	0.0468	0.09	Q	.	.	.	.
13.50	0.0486	0.09	Q	.	.	.	.
13.75	0.0505	0.09	Q	.	.	.	.
14.00	0.0525	0.10	Q	.	.	.	.
14.25	0.0547	0.11	Q	.	.	.	.
14.50	0.0571	0.12	Q	.	.	.	.
14.75	0.0597	0.13	Q	.	.	.	.
15.00	0.0625	0.14	Q	.	.	.	.
15.25	0.0656	0.16	Q	.	.	.	.
15.50	0.0692	0.18	Q	.	.	.	.
15.75	0.0735	0.24	Q	.	.	.	.
16.00	0.0791	0.31	.Q	.	.	.	.
16.25	0.1048	2.18	.	Q	.	.	.
16.50	0.1294	0.20	Q	.	.	.	.
16.75	0.1330	0.15	Q	.	.	.	.
17.00	0.1359	0.13	Q	.	.	.	.
17.25	0.1382	0.10	Q	.	.	.	.
17.50	0.1402	0.09	Q	.	.	.	.
17.75	0.1420	0.08	Q	.	.	.	.
18.00	0.1437	0.08	Q	.	.	.	.
18.25	0.1451	0.06	Q	.	.	.	.
18.50	0.1464	0.06	Q	.	.	.	.
18.75	0.1475	0.06	Q	.	.	.	.
19.00	0.1487	0.05	Q	.	.	.	.
19.25	0.1497	0.05	Q	.	.	.	.
19.50	0.1507	0.05	Q	.	.	.	.
19.75	0.1517	0.05	Q	.	.	.	.
20.00	0.1526	0.04	Q	.	.	.	.
20.25	0.1535	0.04	Q	.	.	.	.
20.50	0.1544	0.04	Q	.	.	.	.
20.75	0.1552	0.04	Q	.	.	.	.
21.00	0.1560	0.04	Q	.	.	.	.
21.25	0.1568	0.04	Q	.	.	.	.
21.50	0.1576	0.04	Q	.	.	.	.
21.75	0.1583	0.04	Q	.	.	.	.
22.00	0.1591	0.03	Q	.	.	.	.
22.25	0.1598	0.03	Q	.	.	.	.
22.50	0.1605	0.03	Q	.	.	.	.

22.75	0.1611	0.03	Q	.	.	.	.
23.00	0.1618	0.03	Q	.	.	.	.
23.25	0.1624	0.03	Q	.	.	.	.
23.51	0.1631	0.03	Q	.	.	.	.
23.76	0.1637	0.03	Q	.	.	.	.
24.01	0.1643	0.03	Q	.	.	.	.
24.26	0.1646	0.00	Q	.	.	.	.

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1441.0
10%	45.0
20%	15.0
30%	15.0
40%	15.0
50%	15.0
60%	15.0
70%	15.0
80%	15.0
90%	15.0

6.4.4 HCOC Calculations

2-Year Post-Development Unit Hydrograph Calculations

```
******************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
==============================================================================
         (C) Copyright 1989-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1499

                              Analysis prepared by:




******************************************************************************
------------------------------------------------------------------------------

 Problem Descriptions:
  2175 S WILLOW
  UNIT HYDROGRAPH
  POST DEVELOPMENT CONDITIONS, 2-YEAR, DA A
------------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 1.20
    TOTAL CATCHMENT AREA(ACRES) =    4.04
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.123
    LOW LOSS FRACTION = 0.211
    TIME OF CONCENTRATION(MIN.) =  9.17
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.14
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.36
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.52
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.93
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.30
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.35

------------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.75
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04

******************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
------------------------------------------------------------------------------
  0.11      0.0010      0.16  Q         .         .         .         .
  0.26      0.0030      0.16  Q         .         .         .         .
  0.41      0.0051      0.16  Q         .         .         .         .
  0.56      0.0071      0.16  Q         .         .         .         .
  0.72      0.0092      0.16  Q         .         .         .         .
  0.87      0.0112      0.16  Q         .         .         .         .
  1.02      0.0133      0.17  Q         .         .         .         .
  1.18      0.0154      0.17  Q         .         .         .         .
  1.33      0.0175      0.17  Q         .         .         .         .
  1.48      0.0196      0.17  Q         .         .         .         .
  1.63      0.0218      0.17  Q         .         .         .         .
  1.79      0.0239      0.17  Q         .         .         .         .
  1.94      0.0261      0.17  Q         .         .         .         .
  2.09      0.0282      0.17  Q         .         .         .         .
  2.24      0.0304      0.17  Q         .         .         .         .
  2.40      0.0326      0.17  Q         .         .         .         .
  2.55      0.0348      0.18  Q         .         .         .         .
  2.70      0.0371      0.18  Q         .         .         .         .
  2.86      0.0393      0.18  Q         .         .         .         .
  3.01      0.0416      0.18  Q         .         .         .         .
  3.16      0.0438      0.18  Q         .         .         .         .
```

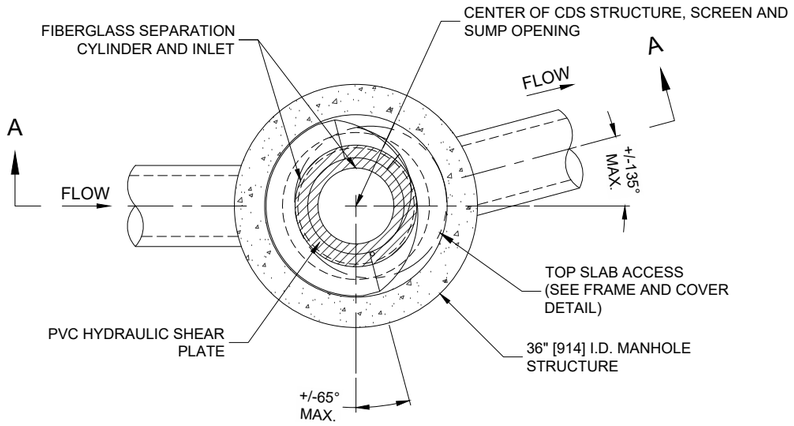
3.31	0.0461	0.18	Q	.	.	.	.
3.47	0.0484	0.18	Q	.	.	.	.
3.62	0.0507	0.18	Q	.	.	.	.
3.77	0.0531	0.19	Q	.	.	.	.
3.93	0.0554	0.19	Q	.	.	.	.
4.08	0.0578	0.19	Q	.	.	.	.
4.23	0.0602	0.19	Q	.	.	.	.
4.38	0.0626	0.19	Q	.	.	.	.
4.54	0.0650	0.19	Q	.	.	.	.
4.69	0.0674	0.19	Q	.	.	.	.
4.84	0.0699	0.20	Q	.	.	.	.
5.00	0.0724	0.20	Q	.	.	.	.
5.15	0.0748	0.20	Q	.	.	.	.
5.30	0.0774	0.20	Q	.	.	.	.
5.45	0.0799	0.20	Q	.	.	.	.
5.61	0.0825	0.20	Q	.	.	.	.
5.76	0.0850	0.21	Q	.	.	.	.
5.91	0.0876	0.21	Q	.	.	.	.
6.07	0.0903	0.21	Q	.	.	.	.
6.22	0.0929	0.21	Q	.	.	.	.
6.37	0.0956	0.21	Q	.	.	.	.
6.52	0.0983	0.21	Q	.	.	.	.
6.68	0.1010	0.22	Q	.	.	.	.
6.83	0.1037	0.22	Q	.	.	.	.
6.98	0.1065	0.22	Q	.	.	.	.
7.14	0.1093	0.22	Q	.	.	.	.
7.29	0.1121	0.22	Q	.	.	.	.
7.44	0.1150	0.23	Q	.	.	.	.
7.59	0.1178	0.23	Q	.	.	.	.
7.75	0.1208	0.23	Q	.	.	.	.
7.90	0.1237	0.23	Q	.	.	.	.
8.05	0.1267	0.24	Q	.	.	.	.
8.21	0.1297	0.24	Q	.	.	.	.
8.36	0.1327	0.24	Q	.	.	.	.
8.51	0.1358	0.25	Q	.	.	.	.
8.66	0.1389	0.25	Q	.	.	.	.
8.82	0.1420	0.25	.Q	.	.	.	.
8.97	0.1452	0.25	.Q	.	.	.	.
9.12	0.1484	0.26	.Q	.	.	.	.
9.28	0.1517	0.26	.Q	.	.	.	.
9.43	0.1550	0.26	.Q	.	.	.	.
9.58	0.1583	0.27	.Q	.	.	.	.
9.73	0.1617	0.27	.Q	.	.	.	.
9.89	0.1652	0.27	.Q	.	.	.	.
10.04	0.1687	0.28	.Q	.	.	.	.
10.19	0.1722	0.28	.Q	.	.	.	.
10.35	0.1758	0.29	.Q	.	.	.	.
10.50	0.1794	0.29	.Q	.	.	.	.
10.65	0.1831	0.30	.Q	.	.	.	.
10.80	0.1869	0.30	.Q	.	.	.	.
10.96	0.1907	0.31	.Q	.	.	.	.
11.11	0.1946	0.31	.Q	.	.	.	.
11.26	0.1986	0.32	.Q	.	.	.	.
11.41	0.2026	0.32	.Q	.	.	.	.
11.57	0.2067	0.33	.Q	.	.	.	.
11.72	0.2109	0.33	.Q	.	.	.	.
11.87	0.2152	0.34	.Q	.	.	.	.
12.03	0.2195	0.35	.Q	.	.	.	.
12.18	0.2243	0.41	.Q	.	.	.	.
12.33	0.2295	0.41	.Q	.	.	.	.
12.48	0.2348	0.42	.Q	.	.	.	.
12.64	0.2402	0.43	.Q	.	.	.	.
12.79	0.2457	0.44	.Q	.	.	.	.
12.94	0.2513	0.45	.Q	.	.	.	.
13.10	0.2571	0.47	.Q	.	.	.	.
13.25	0.2631	0.47	.Q	.	.	.	.
13.40	0.2692	0.49	.Q	.	.	.	.
13.55	0.2755	0.50	. Q	.	.	.	.
13.71	0.2820	0.52	. Q	.	.	.	.

13.86	0.2886	0.54	. Q	.	.	.	.
14.01	0.2956	0.56	. Q	.	.	.	.
14.17	0.3030	0.61	. Q	.	.	.	.
14.32	0.3109	0.66	. Q	.	.	.	.
14.47	0.3193	0.67	. Q	.	.	.	.
14.62	0.3281	0.72	. Q	.	.	.	.
14.78	0.3374	0.74	. Q	.	.	.	.
14.93	0.3471	0.80	. Q	.	.	.	.
15.08	0.3574	0.84	. Q	.	.	.	.
15.24	0.3686	0.92	. Q	.	.	.	.
15.39	0.3806	0.98	. Q	.	.	.	.
15.54	0.3941	1.15	. Q	.	.	.	.
15.69	0.4094	1.27	. Q	.	.	.	.
15.85	0.4279	1.67	. Q	.	.	.	.
16.00	0.4519	2.14	. Q	.	.	.	.
16.15	0.5000	5.49	.	.	.Q	.	.
16.31	0.5437	1.42	. Q	.	.	.	.
16.46	0.5593	1.06	. Q	.	.	.	.
16.61	0.5716	0.88	. Q	.	.	.	.
16.76	0.5820	0.77	. Q	.	.	.	.
16.92	0.5912	0.70	. Q	.	.	.	.
17.07	0.5996	0.64	. Q	.	.	.	.
17.22	0.6071	0.55	. Q	.	.	.	.
17.38	0.6139	0.51	. Q	.	.	.	.
17.53	0.6202	0.48	.Q	.	.	.	.
17.68	0.6261	0.46	.Q	.	.	.	.
17.83	0.6318	0.44	.Q	.	.	.	.
17.99	0.6372	0.42	.Q	.	.	.	.
18.14	0.6421	0.37	.Q	.	.	.	.
18.29	0.6465	0.34	.Q	.	.	.	.
18.45	0.6507	0.33	.Q	.	.	.	.
18.60	0.6548	0.31	.Q	.	.	.	.
18.75	0.6587	0.30	.Q	.	.	.	.
18.90	0.6624	0.29	.Q	.	.	.	.
19.06	0.6661	0.28	.Q	.	.	.	.
19.21	0.6696	0.28	.Q	.	.	.	.
19.36	0.6730	0.27	.Q	.	.	.	.
19.52	0.6764	0.26	.Q	.	.	.	.
19.67	0.6797	0.26	.Q	.	.	.	.
19.82	0.6828	0.25	Q	.	.	.	.
19.97	0.6859	0.24	Q	.	.	.	.
20.13	0.6890	0.24	Q	.	.	.	.
20.28	0.6920	0.23	Q	.	.	.	.
20.43	0.6949	0.23	Q	.	.	.	.
20.58	0.6977	0.22	Q	.	.	.	.
20.74	0.7005	0.22	Q	.	.	.	.
20.89	0.7033	0.22	Q	.	.	.	.
21.04	0.7059	0.21	Q	.	.	.	.
21.20	0.7086	0.21	Q	.	.	.	.
21.35	0.7112	0.20	Q	.	.	.	.
21.50	0.7138	0.20	Q	.	.	.	.
21.65	0.7163	0.20	Q	.	.	.	.
21.81	0.7187	0.19	Q	.	.	.	.
21.96	0.7212	0.19	Q	.	.	.	.
22.11	0.7236	0.19	Q	.	.	.	.
22.27	0.7260	0.19	Q	.	.	.	.
22.42	0.7283	0.18	Q	.	.	.	.
22.57	0.7306	0.18	Q	.	.	.	.
22.72	0.7329	0.18	Q	.	.	.	.
22.88	0.7351	0.18	Q	.	.	.	.
23.03	0.7373	0.17	Q	.	.	.	.
23.18	0.7395	0.17	Q	.	.	.	.
23.34	0.7416	0.17	Q	.	.	.	.
23.49	0.7438	0.17	Q	.	.	.	.
23.64	0.7459	0.17	Q	.	.	.	.
23.79	0.7480	0.16	Q	.	.	.	.
23.95	0.7500	0.16	Q	.	.	.	.
24.10	0.7521	0.16	Q	.	.	.	.
24.25	0.7531	0.00	Q	.	.	.	.

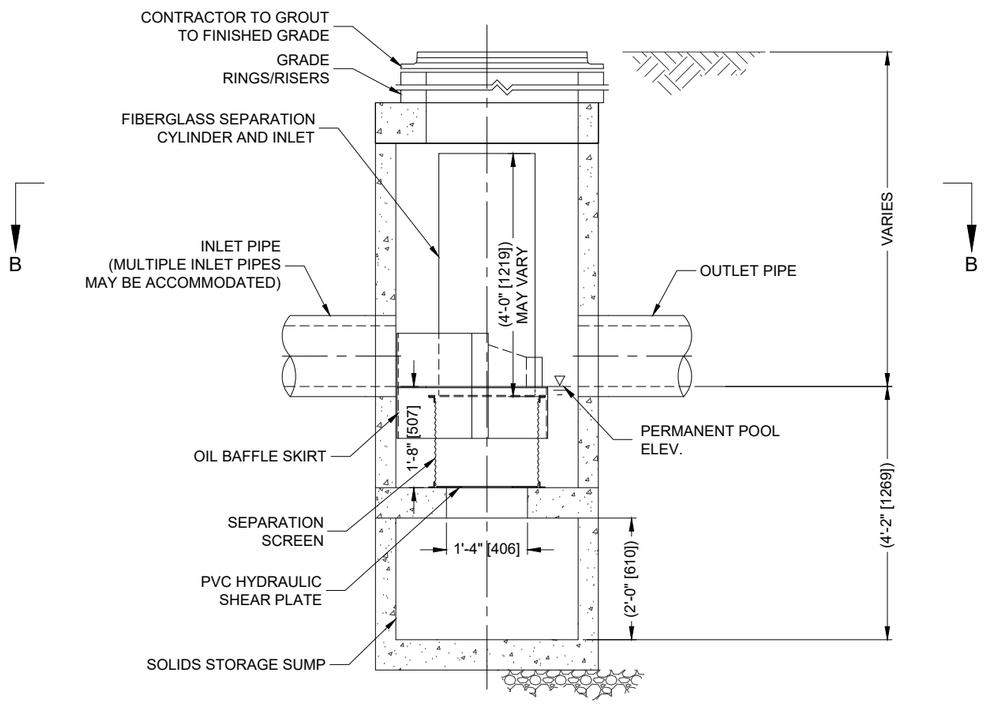
TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1448.9
10%	201.7
20%	55.0
30%	27.5
40%	9.2
50%	9.2
60%	9.2
70%	9.2
80%	9.2
90%	9.2

6.4.5 BMP Sizing Calculations



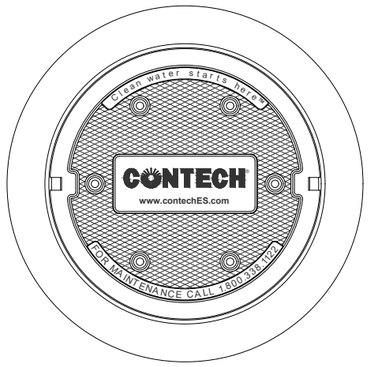
PLAN VIEW B-B
N.T.S.



ELEVATION A-A
N.T.S.

CDS1515-3-C DESIGN NOTES

THE STANDARD CDS1515-3-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS1515-3-C
ONLINE CDS
STANDARD DETAIL

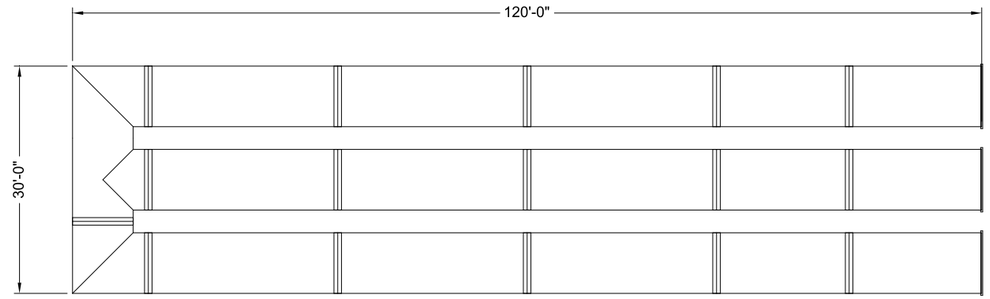
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 366 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = 25,000 CF
- PIPE STORAGE VOLUME = 18,397 CF
- BACKFILL STORAGE VOLUME = 6,696 CF
- TOTAL STORAGE PROVIDED = 25,093 CF

PIPE DETAILS
- DIAMETER = 96"
- CORRUGATION = 5x1
- GAGE = 16
- COATING = ALT2
- WALL TYPE = SOLID
- BARREL SPACING = 36"

BACKFILL DETAILS
- WIDTH AT ENDS = 12"
- ABOVE PIPE = 6"
- WIDTH AT SIDES = 12"
- BELOW PIPE = 6"



NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE. ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE $2\frac{2}{3}$" x $\frac{1}{2}$" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- BAND TYPE TO BE DETERMINED UPON FINAL DESIGN.
- THE PROJECT SUMMARY IS REFLECTIVE OF THE DYODS DESIGN, QUANTITIES ARE APPROX. AND SHOULD BE VERIFIED UPON FINAL DESIGN AND APPROVAL. FOR EXAMPLE, TOTAL EXCAVATION DOES NOT CONSIDER ALL VARIABLES SUCH AS SHORING AND ONLY ACCOUNTS FOR MATERIAL WITHIN THE ESTIMATED EXCAVATION FOOTPRINT.
- THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.

ASSEMBLY
SCALE: 1" = 20'

DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO63472 2175 S Willow
Basin #1
West Covina, CA
DETENTION SYSTEM

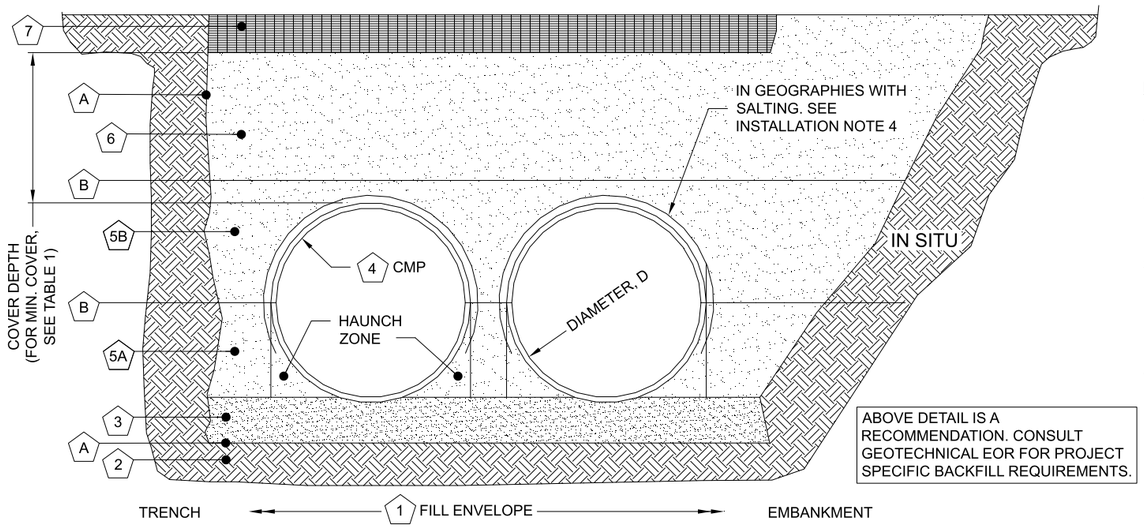
PROJECT No.:	SEQ. No.:	DATE:
45078	63472	11/22/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

C:\EXPORTS\TEMPLATES\CMP_V10.DWG 10/18/2019 10:02 AM

TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT
- ULTRAFLO ALSO AVAILABLE FOR SIZES 18" - 120" WITH 3/4"x 3/4"x 7 1/2" CORRUGATION



MINIMUM WIDTH DEPENDS ON SITE CONDITIONS AND ENGINEERING JUDGEMENT

INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. BACKFILL USING CONTROLLED LOW-STRENGTH MATERIAL (CLSM, "FLASH FILL" OR "FLOWABLE FILL") MAY BE USED WHEN THE SPACING BETWEEN THE PIPES WILL NOT ALLOW FOR PLACEMENT AND ADEQUATE COMPACTION OF THE BACKFILL. CONTACT CONTECH FOR FURTHER EVALUATION.
4. IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED OVER THE UPPER HALF OF THE PIPE. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

TABLE 2: SOLID STANDARD

CMP DETENTION AND CMP DRAINAGE STANDARD BACKFILL SPECIFICATIONS

	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	**AASHTO 26.5.2** OR PER ENGINEER OF RECORD	PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	**AASHTO M 43: 3, 357, 4, 467, 5, 56, 57** (APPROVED REGIONAL EQUIVALENTS INCLUDE CA-7)	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE FOUNDATION SOILS CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.8.1	
4	CORRUGATED METAL PIPE			
5A	CRITICAL BACKFILL	**AASHTO M 145: A-1, A-2, A-3** *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A THREE LIFT (24") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WELL GRADED GRANULAR MATERIAL WHICH MAY CONTAIN SMALL AMOUNTS OF SILT OR CLAY AND MAXIMUM PARTICLE SIZE OF 3" (PER AASHTO 26.3.8.1 AND 12.4-1.3).	
5B	BACKFILL	**AASHTO M 145: A-1, A-2, A-3**		
6	COVER MATERIAL	UP TO MIN. COVER - SEE 5A AND 5B ABOVE ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROAD BASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	OPTIONAL GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.

* APPROVED REGIONAL EQUIVALENTS FOR SECTION 5A INCLUDE CA-7, CODOT #67, MIDOT 2G, 34G, OR 21AA STONE OR GRAVEL; #8; #57; MIDOT 6A, 2G, 3G, 34G.

MANUFACTURER RECOMMENDED BACKFILL

NOT TO SCALE

DATE	REVISION DESCRIPTION	BY

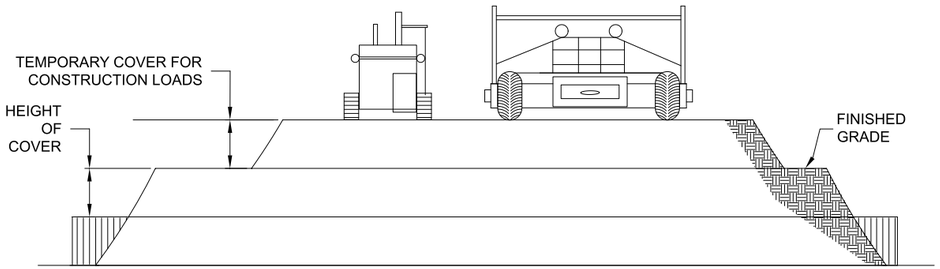
CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO63472 2175 S Willow
Basin #1
West Covina, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
45078	63472	11/22/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

C:\EXPORTS\TEMPLATES\CMP_V10.DWG 10/18/2019 10:02 AM



CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

SCALE: N.T.S.

SPECIFICATION FOR DESIGNED DETENTION SYSTEM:

SCOPE
THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE DESIGNED DETENTION SYSTEM DETAILED IN THE PROJECT PLANS.

MATERIAL
THE MATERIAL SHALL CONFORM TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

THE GALVANIZED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-218 OR ASTM A-929.

THE POLYMER COATED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-246 OR ASTM A-742.

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE OF AASHTO M-197 OR ASTM B-744.

CONSTRUCTION LOADS
CONSTRUCTION LOADS MAY BE HIGHER THAN FINAL LOADS. FOLLOW THE MANUFACTURER'S OR NCSPA GUIDELINES.

PIPE
THE PIPE SHALL BE MANUFACTURED IN ACCORDANCE TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2: AASHTO M-36 OR ASTM A-760

GALVANIZED: AASHTO M-36 OR ASTM A-760

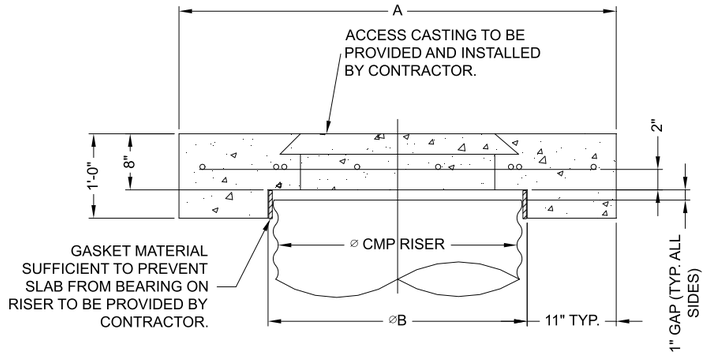
APPLICABLE POLYMER COATED: AASHTO M-245 OR ASTM A-762

ALUMINUM: AASHTO M-196 OR ASTM B-745

APPLICABLE
HANDLING AND ASSEMBLY
SHALL BE IN ACCORDANCE WITH NCSP'S (NATIONAL CORRUGATED STEEL PIPE ASSOCIATION) FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL. SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS FOR ALUMINUM PIPE.
REQUIREMENTS
INSTALLATION
SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II DIVISION II OR ASTM A-798 (FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL) OR ASTM B-788 (FOR ALUMINUM PIPE) AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

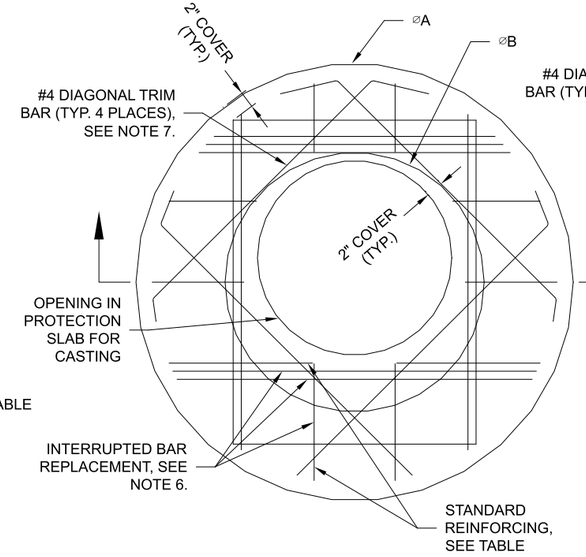
NOTE:
THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.



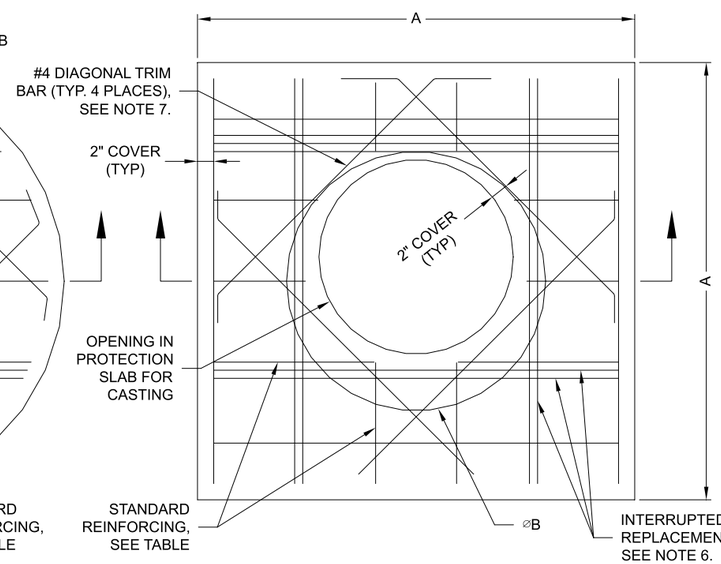
SECTION VIEW

REINFORCING TABLE				
⌀ CMP RISER	A	⌀ B	REINFORCING	**BEARING PRESSURE (PSF)
24"	⌀ 4' 4'X4'	26"	#5 @ 12" OCEW #5 @ 12" OCEW	2,410 1,780
30"	⌀ 4'-6" 4'-6" X 4'-6"	32"	#5 @ 12" OCEW #5 @ 12" OCEW	2,120 1,530
36"	⌀ 5' 5' X 5'	38"	#5 @ 10" OCEW #5 @ 10" OCEW	1,890 1,350
42"	⌀ 5'-6" 5'-6" X 5'-6"	44"	#5 @ 10" OCEW #5 @ 9" OCEW	1,720 1,210
48"	⌀ 6' 6' X 6'	50"	#5 @ 9" OCEW #5 @ 8" OCEW	1,600 1,100

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 3,500 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERING, BINGHAMTON, NY.

MANHOLE CAP DETAIL

SCALE: N.T.S.

DATE	REVISION DESCRIPTION	BY

CONTECH® ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH® CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO63472 2175 S Willow
Basin #1
West Covina, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
45078	63472	11/22/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

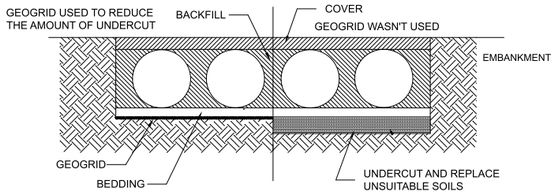
CMP DETENTION INSTALLATION GUIDE

PROPER INSTALLATION OF A FLEXIBLE UNDERGROUND DETENTION SYSTEM WILL ENSURE LONG-TERM PERFORMANCE. THE CONFIGURATION OF THESE SYSTEMS OFTEN REQUIRES SPECIAL CONSTRUCTION PRACTICES THAT DIFFER FROM CONVENTIONAL FLEXIBLE PIPE CONSTRUCTION. CONTECH ENGINEERED SOLUTIONS STRONGLY SUGGESTS SCHEDULING A PRE-CONSTRUCTION MEETING WITH YOUR LOCAL SALES ENGINEER TO DETERMINE IF ADDITIONAL MEASURES, NOT COVERED IN THIS GUIDE, ARE APPROPRIATE FOR YOUR SITE.

FOUNDATION

CONSTRUCT A FOUNDATION THAT CAN SUPPORT THE DESIGN LOADING APPLIED BY THE PIPE AND ADJACENT BACKFILL WEIGHT AS WELL AS MAINTAIN ITS INTEGRITY DURING CONSTRUCTION.

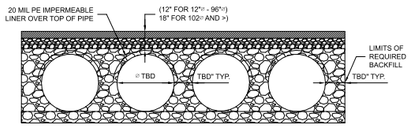
IF SOFT OR UNSUITABLE SOILS ARE ENCOUNTERED, REMOVE THE POOR SOILS DOWN TO A SUITABLE DEPTH AND THEN BUILD UP TO THE APPROPRIATE ELEVATION WITH A COMPETENT BACKFILL MATERIAL. THE STRUCTURAL FILL MATERIAL GRADATION SHOULD NOT ALLOW THE MIGRATION OF FINES, WHICH CAN CAUSE SETTLEMENT OF THE DETENTION SYSTEM OR PAVEMENT ABOVE. IF THE STRUCTURAL FILL MATERIAL IS NOT COMPATIBLE WITH THE UNDERLYING SOILS AN ENGINEERING FABRIC SHOULD BE USED AS A SEPARATOR. IN SOME CASES, USING A STIFF REINFORCING GEOGRID REDUCES OVER EXCAVATION AND REPLACEMENT FILL QUANTITIES.



GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING SATURATION OF THE SUBGRADE.

GEOMEMBRANE BARRIER

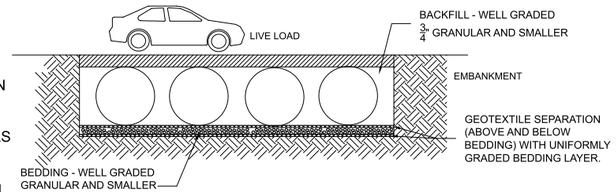
THE RESISTIVITY OF A PROJECT SITE MAY CHANGE OVER TIME DUE TO THE USE OF VARIOUS SALTING, DE-ICING, AND AGRICULTURAL AGENTS APPLIED ON OR NEAR THE AREA. TO MITIGATE THE POTENTIAL IMPACT OF THESE AGENTS, AN HDPE MEMBRANE LINER WILL BE INSTALLED ON THE CROWN OF EACH PIPE, CREATING AN IMPERMEABLE BARRIER. THIS MEASURE IS DESIGNED TO PROTECT THE SYSTEM FROM ENVIRONMENTAL CHANGES THAT COULD LEAD TO PREMATURE CORROSION AND REDUCE THE OVERALL SERVICE LIFE.



IN-SITU TRENCH WALL

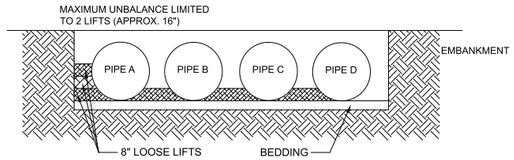
IF EXCAVATION IS REQUIRED, THE TRENCH WALL NEEDS TO BE CAPABLE OF SUPPORTING THE LOAD THAT THE PIPE SHEDS AS THE SYSTEM IS LOADED. IF SOILS ARE NOT CAPABLE OF SUPPORTING THESE LOADS, THE PIPE CAN DEFLECT. PERFORM A SIMPLE SOIL PRESSURE CHECK USING THE APPLIED LOADS TO DETERMINE THE LIMITS OF EXCAVATION BEYOND THE SPRING LINE OF THE OUTER MOST PIPES.

IN MOST CASES THE REQUIREMENTS FOR A SAFE WORK ENVIRONMENT AND PROPER BACKFILL PLACEMENT AND COMPACTION TAKE CARE OF THIS CONCERN.



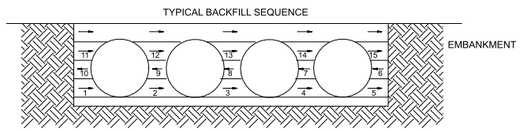
BACKFILL PLACEMENT

MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS.

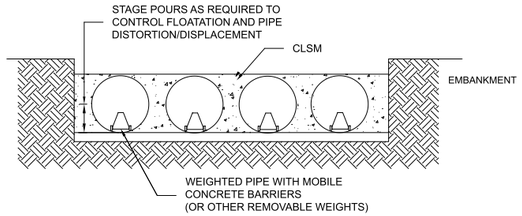


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE LEVEL OF COMPACTION.

FOR LARGE SYSTEMS, CONVEYOR SYSTEMS, BACKHOES WITH LONG REACHES OR DRAGLINES WITH STONE BUCKETS MAY BE USED TO PLACE BACKFILL. ONCE MINIMUM COVER FOR CONSTRUCTION LOADING ACROSS THE ENTIRE WIDTH OF THE SYSTEM IS REACHED, ADVANCE THE EQUIPMENT TO THE END OF THE RECENTLY PLACED FILL, AND BEGIN THE SEQUENCE AGAIN UNTIL THE SYSTEM IS COMPLETELY BACKFILLED. THIS TYPE OF CONSTRUCTION SEQUENCE PROVIDES ROOM FOR STOCKPILED BACKFILL DIRECTLY BEHIND THE BACKHOE, AS WELL AS THE MOVEMENT OF CONSTRUCTION TRAFFIC. MATERIAL STOCKPILES ON TOP OF THE BACKFILLED DETENTION SYSTEM SHOULD BE LIMITED TO 8- TO 10-FEET HIGH AND MUST PROVIDE BALANCED LOADING ACROSS ALL BARRELS. TO DETERMINE THE PROPER COVER OVER THE PIPES TO ALLOW THE MOVEMENT OF CONSTRUCTION EQUIPMENT SEE TABLE 1, OR CONTACT YOUR LOCAL CONTECH SALES ENGINEER.



WHEN FLOWABLE FILL IS USED, YOU MUST PREVENT PIPE FLOATATION. TYPICALLY, SMALL LIFTS ARE PLACED BETWEEN THE PIPES AND THEN ALLOWED TO SET-UP PRIOR TO THE PLACEMENT OF THE NEXT LIFT. THE ALLOWABLE THICKNESS OF THE CLSM LIFT IS A FUNCTION OF A PROPER BALANCE BETWEEN THE UPLIFT FORCE OF THE CLSM, THE OPPOSING WEIGHT OF THE PIPE, AND THE EFFECT OF OTHER RESTRAINING MEASURES. THE PIPE CAN CARRY LIMITED FLUID PRESSURE WITHOUT PIPE DISTORTION OR DISPLACEMENT, WHICH ALSO AFFECTS THE CLSM LIFT THICKNESS. YOUR LOCAL CONTECH SALES ENGINEER CAN HELP DETERMINE THE PROPER LIFT THICKNESS.

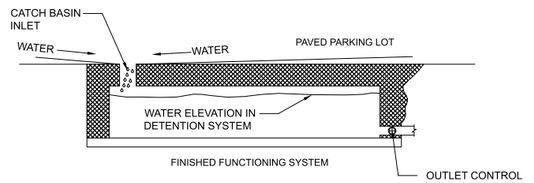


CONSTRUCTION LOADING

TYPICALLY, THE MINIMUM COVER SPECIFIED FOR A PROJECT ASSUMES H-20 LIVE LOAD. BECAUSE CONSTRUCTION LOADS OFTEN EXCEED DESIGN LIVE LOADS, INCREASED TEMPORARY MINIMUM COVER REQUIREMENTS ARE NECESSARY. SINCE CONSTRUCTION EQUIPMENT VARIES FROM JOB TO JOB, IT IS BEST TO ADDRESS EQUIPMENT SPECIFIC MINIMUM COVER REQUIREMENTS WITH YOUR LOCAL CONTECH SALES ENGINEER DURING YOUR PRE-CONSTRUCTION MEETING.

ADDITIONAL CONSIDERATIONS

BECAUSE MOST SYSTEMS ARE CONSTRUCTED BELOW-GRADE, RAINFALL CAN RAPIDLY FILL THE EXCAVATION; POTENTIALLY CAUSING FLOATATION AND MOVEMENT OF THE PREVIOUSLY PLACED PIPES. TO HELP MITIGATE POTENTIAL PROBLEMS, IT IS BEST TO START THE INSTALLATION AT THE DOWNSTREAM END WITH THE OUTLET ALREADY CONSTRUCTED TO ALLOW A ROUTE FOR THE WATER TO ESCAPE. TEMPORARY DIVERSION MEASURES MAY BE REQUIRED FOR HIGH FLOWS DUE TO THE RESTRICTED NATURE OF THE OUTLET PIPE.



CMP DETENTION SYSTEM INSPECTION AND MAINTENANCE

UNDERGROUND STORMWATER DETENTION AND INFILTRATION SYSTEMS MUST BE INSPECTED AND MAINTAINED AT REGULAR INTERVALS FOR PURPOSES OF PERFORMANCE AND LONGEVITY.

INSPECTION

INSPECTION IS THE KEY TO EFFECTIVE MAINTENANCE OF CMP DETENTION SYSTEMS AND IS EASILY PERFORMED. CONTECH RECOMMENDS ONGOING, ANNUAL INSPECTIONS. SITES WITH HIGH TRASH LOAD OR SMALL OUTLET CONTROL ORIFICES MAY NEED MORE FREQUENT INSPECTIONS. THE RATE AT WHICH THE SYSTEM COLLECTS POLLUTANTS WILL DEPEND MORE ON SITE SPECIFIC ACTIVITIES RATHER THAN THE SIZE OR CONFIGURATION OF THE SYSTEM.

INSPECTIONS SHOULD BE PERFORMED MORE OFTEN IN EQUIPMENT WASHDOWN AREAS, IN CLIMATES WHERE SANDING AND/OR SALTING OPERATIONS TAKE PLACE, AND IN OTHER VARIOUS INSTANCES IN WHICH ONE WOULD EXPECT HIGHER ACCUMULATIONS OF SEDIMENT OR ABRASIVE/ CORROSIVE CONDITIONS. A RECORD OF EACH INSPECTION IS TO BE MAINTAINED FOR THE LIFE OF THE SYSTEM

MAINTENANCE

CMP DETENTION SYSTEMS SHOULD BE CLEANED WHEN AN INSPECTION REVEALS ACCUMULATED SEDIMENT OR TRASH IS CLOGGING THE DISCHARGE ORIFICE.

ACCUMULATED SEDIMENT AND TRASH CAN TYPICALLY BE EVACUATED THROUGH THE MANHOLE OVER THE OUTLET ORIFICE. IF MAINTENANCE IS NOT PERFORMED AS RECOMMENDED, SEDIMENT AND TRASH MAY ACCUMULATE IN FRONT OF THE OUTLET ORIFICE. MANHOLE COVERS SHOULD BE SECURELY SEATED FOLLOWING CLEANING ACTIVITIES. CONTECH SUGGESTS THAT ALL SYSTEMS BE DESIGNED WITH AN ACCESS/INSPECTION MANHOLE SITUATED AT OR NEAR THE INLET AND THE OUTLET ORIFICE. SHOULD IT BE NECESSARY TO GET INSIDE THE SYSTEM TO PERFORM MAINTENANCE ACTIVITIES, ALL APPROPRIATE PRECAUTIONS REGARDING CONFINED SPACE ENTRY AND OSHA REGULATIONS SHOULD BE FOLLOWED.

ANNUAL INSPECTIONS ARE BEST PRACTICE FOR ALL UNDERGROUND SYSTEMS. DURING THIS INSPECTION, IF EVIDENCE OF SALTING/DE-ICING AGENTS IS OBSERVED WITHIN THE SYSTEM, IT IS BEST PRACTICE FOR THE SYSTEM TO BE RINSED, INCLUDING ABOVE THE SPRING LINE SOON AFTER THE SPRING THAW AS PART OF THE MAINTENANCE PROGRAM FOR THE SYSTEM.

MAINTAINING AN UNDERGROUND DETENTION OR INFILTRATION SYSTEM IS EASIEST WHEN THERE IS NO FLOW ENTERING THE SYSTEM. FOR THIS REASON, IT IS A GOOD IDEA TO SCHEDULE THE CLEANOUT DURING DRY WEATHER.

THE FOREGOING INSPECTION AND MAINTENANCE EFFORTS HELP ENSURE UNDERGROUND PIPE SYSTEMS USED FOR STORMWATER STORAGE CONTINUE TO FUNCTION AS INTENDED BY IDENTIFYING RECOMMENDED REGULAR INSPECTION AND MAINTENANCE PRACTICES. INSPECTION AND MAINTENANCE RELATED TO THE STRUCTURAL INTEGRITY OF THE PIPE OR THE SOUNDNESS OF PIPE JOINT CONNECTIONS IS BEYOND THE SCOPE OF THIS GUIDE.

DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS

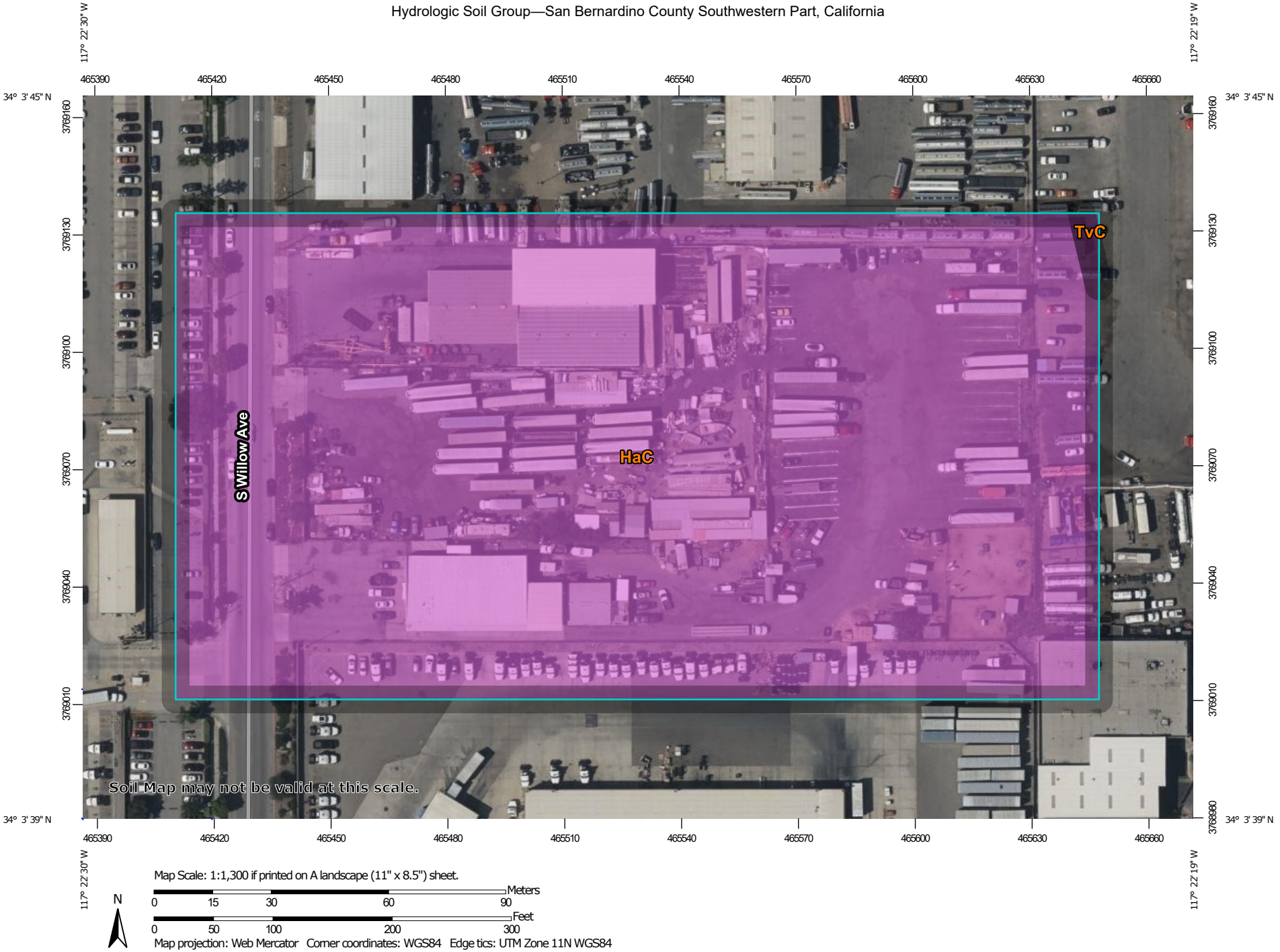
CONTECH **DYODS** DRAWING

DYO63472 2175 S Willow
Basin #1
West Covina, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
45078	63472	11/22/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

C:\EXPORTS\TEMPLATES\CMP_V10.DWG 10/18/2019 10:02 AM

6.4.6 Geotechnical Report



Map Scale: 1:1,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

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 16, Aug 30, 2024

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

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

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
HaC	Hanford coarse sandy loam, 2 to 9 percent slopes	A	7.3	99.9%
TvC	Tujunga gravelly loamy sand, 0 to 9 percent slopes	A	0.0	0.1%
Totals for Area of Interest			**7.3**	**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

Sladden Engineering

45090 Golf Center Parkway, Suite F, Indio, CA. 92201 (760) 863-0713 Fax (760) 863-0847
6782 Stanton Avenue, Suite C, Buena Park, CA. 90621 (714) 523-0952 Fax (714) 523-1369
450 Egan Avenue, Beaumont, CA. 92223 (951) 845-7743 Fax (951) 845-8863
www.SladdenEngineering.com

November 14, 2024
(Revised November 18, 2024)

Project No. 444-24084
24-11-067

Outour Storage Acquisitions, LLC
800 Brickell Avenue, Suite 904
Miami, Florida 33131

Project: Proposed Truckyard/ IOS Facility
2175 South Willow Avenue
Rialto, California

Subject: Percolation/Infiltration Testing for On-Site Stormwater Management

In accordance with your request, we have performed percolation testing on the subject site to evaluate the infiltration potential of the near surface soil to assist in storm water management system design. It is our understanding that on-site stormwater retention including infiltration is planned for the proposed project.

Percolation testing was performed within two (2) test holes excavated on the site. Testing was performed at a depth of approximately 10 feet below the existing ground surface. The approximate locations of the test holes are presented on the attached Exploration Location Plan (Figure 3). Testing was performed by placing water within the test bores and recording the drop in the water surface with time. Testing was performed in general accordance with the *United States Bureau of Reclamation (BOR) Procedure 7300-89 (1999)*. Test results are summarized in the following table.

PERCOLATION TEST RESULTS

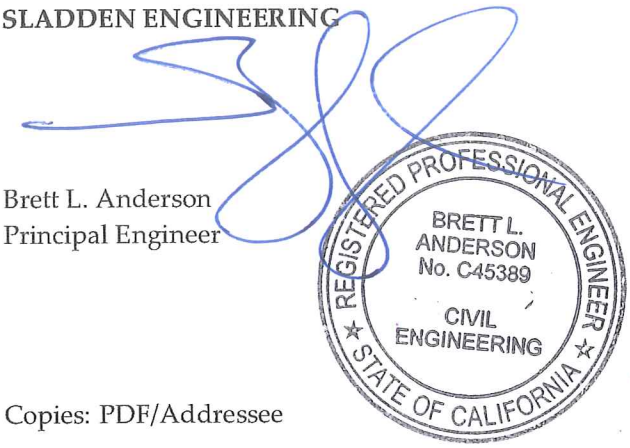
Test No.	Depth (Ft)	USCS	Percolation Rate (in/hr)	Infiltration Rate (in/hr)
BH-7/P-1	10.00	SM	109.50	17.01
BH-3/P-2	10.00	SM	107.25	16.42

The percolation rates determined represent the ultimate field rates that do not include a safety factor. The corresponding infiltration rates were calculated using the Porchet Method. An appropriate safety factor should be incorporated into retention/infiltration system design. Testing indicates a rapid infiltration rate within the test holes which is consistent with the highly permeable native sandy soil encountered below a depth of approximately 5 feet. Infiltration systems should extend through the silty surface soil into the sandy native soil.

Groundwater was not encountered within our exploratory boreholes. Based upon our review of groundwater levels within the vicinity of the site[1], it is our opinion that groundwater should not be a controlling factor in stormwater retention/infiltration system design.

If you have any questions regarding this memo or the testing summarized herein, please contact the undersigned.

Respectfully submitted,
SLADDEN ENGINEERING

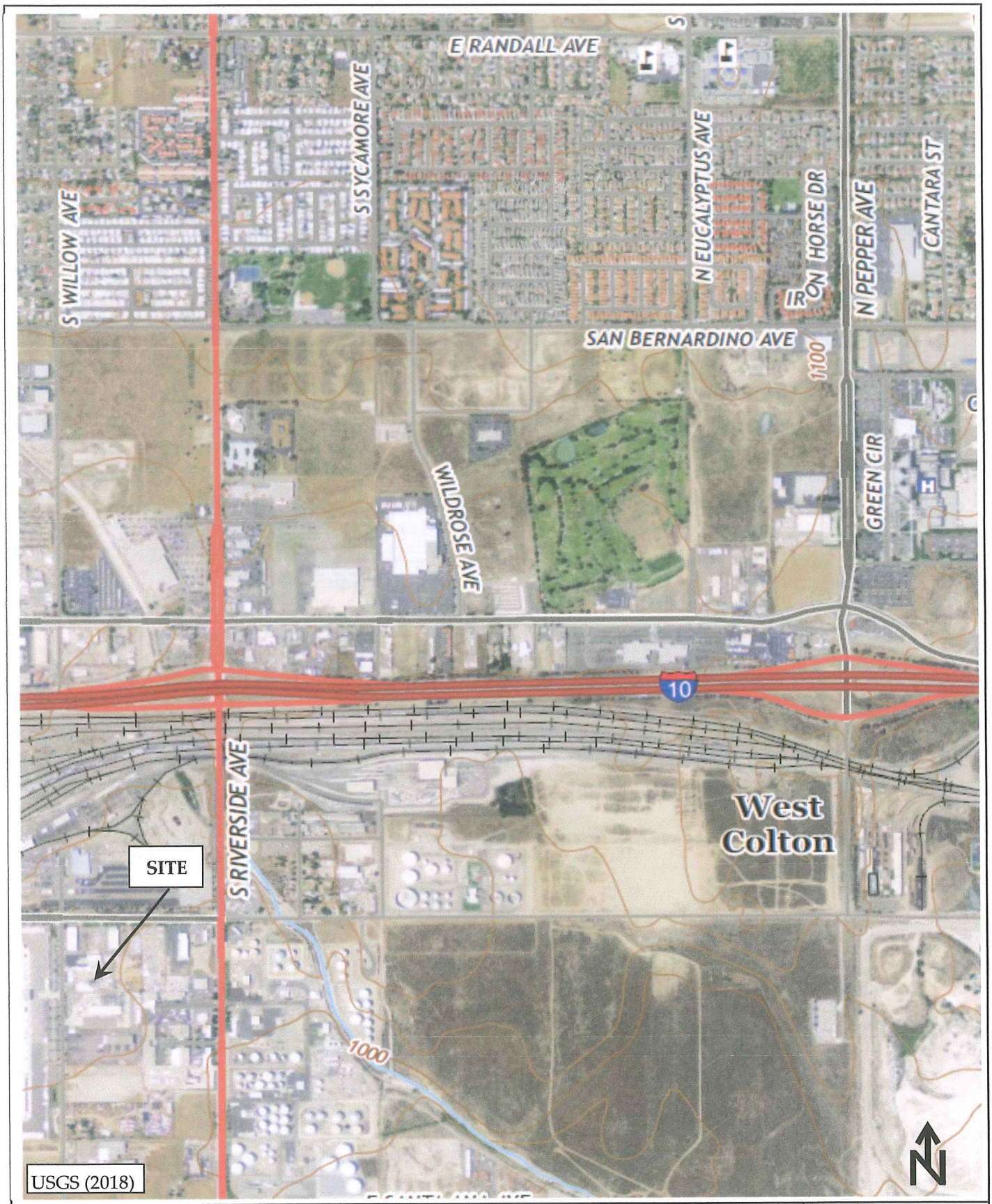


Brett L. Anderson
Principal Engineer

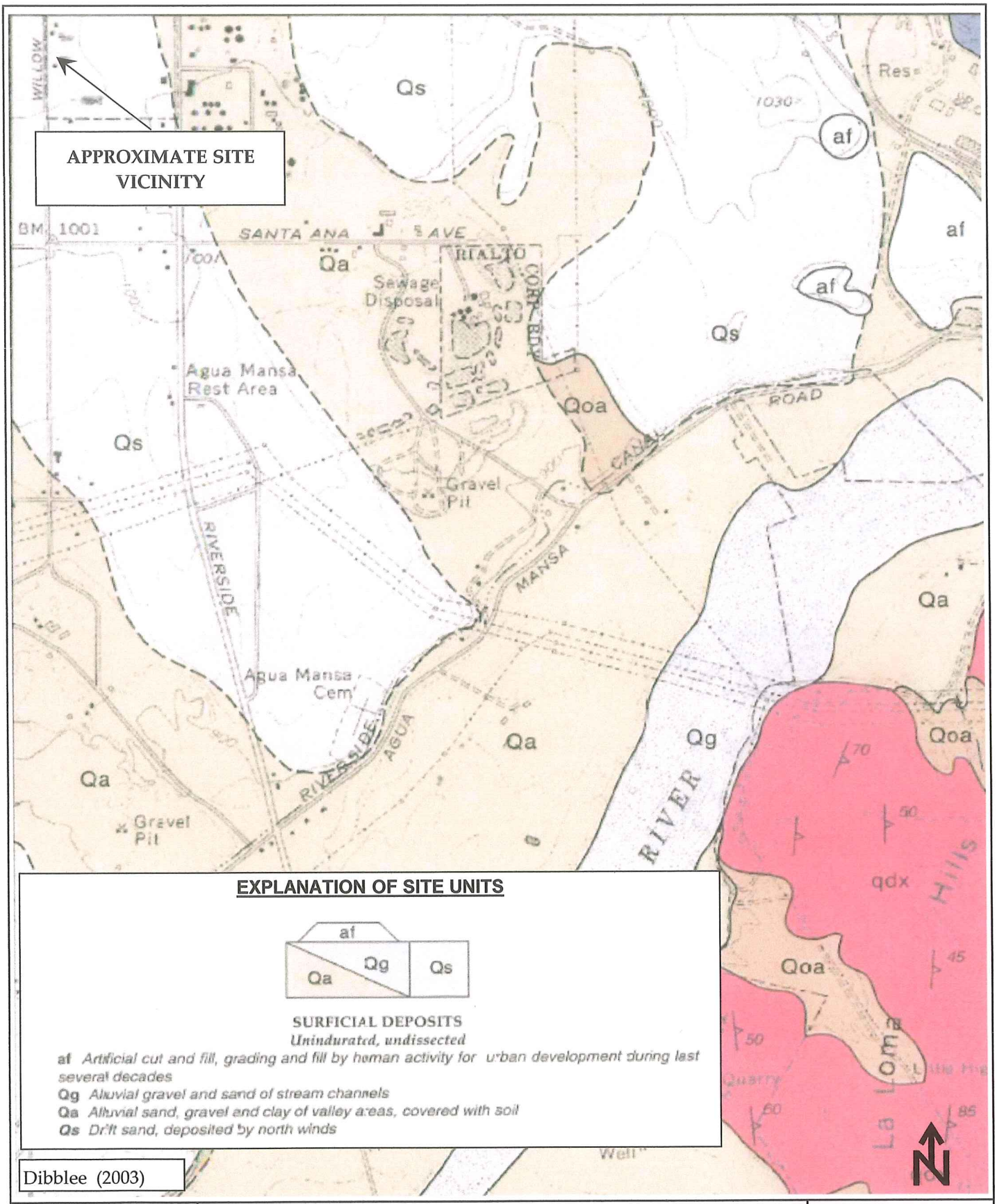
Copies: PDF/Addressee

[1] California Department of Water Resources, 2024, Water Data Library; available at: http://wdl.water.ca.gov/waterdatalibrary/

SITE LOCATION MAP
REGIONAL GEOLOGIC MAP
EXPLORATION LOCATION PLAN



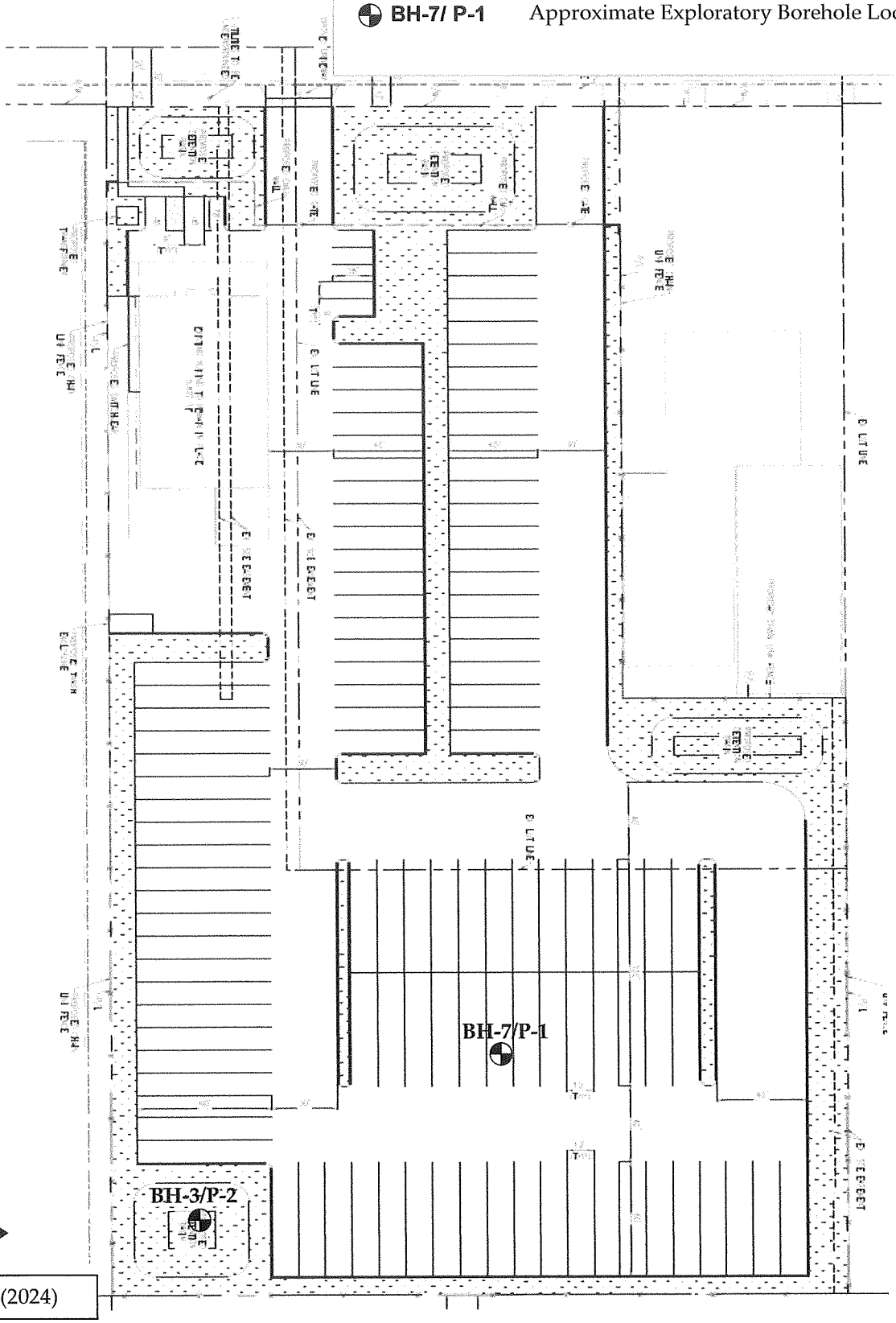
Sladden Engineering	SITE LOCATION MAP		FIGURE 1
	Project Number:	444-24084	
	Report Number:	24-11-067	
	Date:	November 18, 2024	



Sladden Engineering	REGIONAL GEOLOGIC MAP	FIGURE 2
	Project Number: 444-24084	
	Report Number: 24-11-067	
	Date: November 18, 2024	

LEGEND

BH-7/ P-1 Approximate Exploratory Borehole Location/



Kimley Horn (2024)

Sladden Engineering	EXPLORATION LOCATION PLAN		FIGURE 3
	Project Number:	444-24084	
	Report Number:	24-11-067	
	Date:	November 18, 2024	

BORELOGS

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	11/18/2024
Elevation:	1020 Feet (MSL)	Boring No:	BH-7/P-1

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
							2		Sandy Silt/ Silty Sand (ML/SM); yellowish brown, slightly moist, low plasticity with trace gravel (Fill).
							4		
							6		Silty Sand (SM); yellowish brown, slightly moist, fine- to coarse-grained with coarse gravel (Qs).
							8		
							10		
							12		Terminated at ~10.0 Feet bgs. No Bedrock Encountered. No Groundwater or Seepage Encountered. Borehole Cased with Perforated Pipe for Percolation Testing.
							14		
							16		
							18		
							20		
							22		
							24		
							26		
							28		
							30		
							32		
							34		
							36		
							38		
							40		
							42		
							44		
							46		
							48		
							50		

Completion Notes:

PROPOSED TRUCK YARD/ IOS FACILITY
2175 SOUTH WILLOW AVENUE, RIALTO

Project No: 444-24084
Report No: 24-11-067

SLADDEN ENGINEERING

BORE LOG

Drill Rig:	Mobil B-61	Date Drilled:	11/13/2024
Elevation:	1020 Feet (MSL)	Boring No:	BH-3/P-2

Sample	Blow Counts	Bulk Sample	Expansion Index	% Minus #200	% Moisture	Density, pcf	Depth (Feet)	Graphic Lithology	Description
							0–2		Sandy Silt/ Silty Sand (ML/SM); yellowish brown, slightly moist, low plasticity with trace gravel (Fill).
							2–10		Silty Sand (SM); yellowish brown, slightly moist, fine- to coarse-grained with coarse gravel (Qs).
							10–50		Terminated at ~10.0 Feet bgs. No Bedrock Encountered. No Groundwater or Seepage Encountered. Borehole Cased with Perforated Pipe for Percolation Testing.

Completion Notes:

PROPOSED TRUCK YARD/ IOS FACILITY
2175 SOUTH WILLOW AVENUE, RIALTO

Project No: 444-24084
Report No: 24-11-067

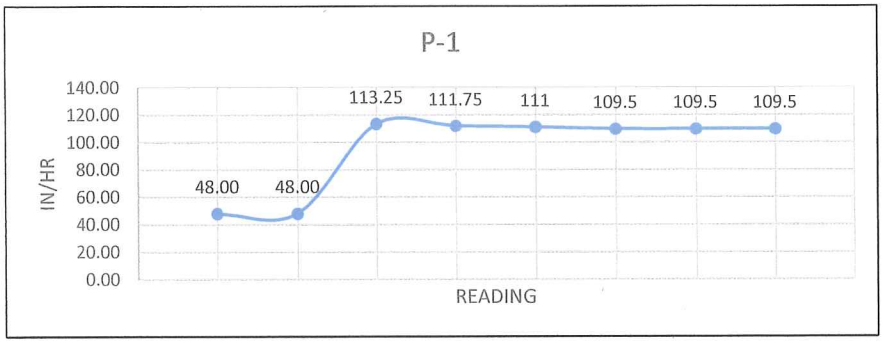
STORMWATER TESTING DATA SHEETS

STORMWATER PERCOLATION SHEET (LESS THAN 10 FT)

Project:	2175 South Willow Ave., Rialto	Depth (ft):	10.00
Job No. :	444-24084	USCS Soil Class:	SM
Date:	4/18/2024	Sandy Soil:	J.M.
Test Hole #:	P-1	Tested By:	J.M.

READING	TIME (min)	DEPTH (ft)	INITIAL W (in)	FINAL W (in)	ΔW (in)	IN/HR
A	25.00	10.00	20	0	20	48.00
B	25.00	10.00	20	0	20	48.00

READING	TIME (min)	DEPTH (ft)	INITIAL W (in)	FINAL W (in)	ΔW (in)	IN/HR
1	10.00	10.00	20	1 1/8	18 7/8	113.25
2	10.00	10.00	20	1 3/8	18 5/8	111.75
3	10.00	10.00	20	1 4/8	18 4/8	111
4	10.00	10.00	20	1 6/8	18 2/8	109.5
5	10.00	10.00	20	1 6/8	18 2/8	109.5
6	10.00	10.00	20	1 6/8	18 2/8	109.5



PERCOLATION RATE CONVERSION (PORCHET METHOD)

$$I_{t=} \quad \frac{\Delta H\ 60\ R}{\Delta t(r+2H_{avg})}$$

Δt =	10.00
D_f =	118.25
r =	4.00
D_0 =	100
D_t =	120.00
H_0 =	20
H_f =	1.75
ΔH =	18.25
H_{avg} =	10.88

Δt (minutes)
D_f (Final Depth to water)
r (hole radius in inches)
D_0 (Initial Depth to water)
D_t (Total Depth of test hole)
H_0 (initial height of water at selected time interval)

$$H_0 = D_t - D_0$$

H_f (final height of water at the selected time interval)

$$H_f = D_t - D_f$$

ΔH (change in head over the time interval)

$$\Delta H = H_0 - H_f$$

H_{avg} (average head height over the time interval)

$$H_{avg} = (H_0 + H_f)/2$$

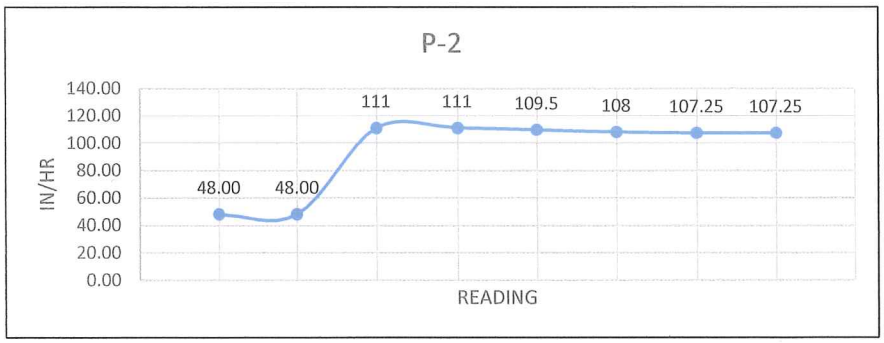
Field Rate:	109.5 in/hr
Infiltration Rate:	17.01 in/hr

STORMWATER PERCOLATION SHEET (LESS THAN 10 FT)

Project:	2175 South Willow Ave., Rialto	Depth (ft):	10.00
Job No. :	444-24084	USCS Soil Class:	SM
Date:	4/18/2024	Sandy Soil:	J.M.
Test Hole #:	P-2	Tested By:	J.M.

READING	TIME (min)	DEPTH (ft)	INITIAL W (in)	FINAL W (in)	ΔW (in)	IN/HR
A	25.00	10.00	20	0	20	48.00
B	25.00	10.00	20	0	20	48.00

READING	TIME (min)	DEPTH (ft)	INITIAL W (in)	FINAL W (in)	ΔW (in)	IN/HR
1	10.00	10.00	20	1 4/8	18 4/8	111
2	10.00	10.00	20	1 4/8	18 4/8	111
3	10.00	10.00	20	1 6/8	18 2/8	109.5
4	10.00	10.00	20	2	18	108
5	10.00	10.00	20	2 1/8	17 7/8	107.25
6	10.00	10.00	20	2 1/8	17 7/8	107.25



PERCOLATION RATE CONVERSION (PORCHET METHOD)

$$I_{t=} \quad \frac{\Delta H\ 60\ R}{\Delta t(r+2H_{avg})}$$

Δt =	10.00
D_f =	117.88
r =	4.00
D_0 =	100
D_t =	120.00
H_0 =	20
H_f =	2.125
ΔH =	17.88
H_{avg} =	11.06

Δt (minutes)

D_f (Final Depth to water)

r (hole radius in inches)

D_0 (Initial Depth to water)

D_t (Total Depth of test hole)

H_0 (initial height of water at selected time interval)

$$H_0 = D_t - D_0$$

H_f (final height of water at the selected time interval)

$$H_f = D_t - D_f$$

ΔH (change in head over the time interval)

$$\Delta H = H_0 - H_f$$

H_{avg} (average head height over the time interval)

$$H_{avg} = (H_0 + H_f)/2$$

Field Rate: 107.25 in/hr

Infiltration Rate: 16.42 in/hr

6.4.7 Educational Materials

CONTECH®
ENGINEERED SOLUTIONS

Hydrodynamic Separation

The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

Removing Pollutants using Hydrodynamic Separation

Utilize high-performance hydrodynamic separation to effectively remove finer sediment, oil and grease, and floating and sinking debris.

CASCADE separator™

CDS®

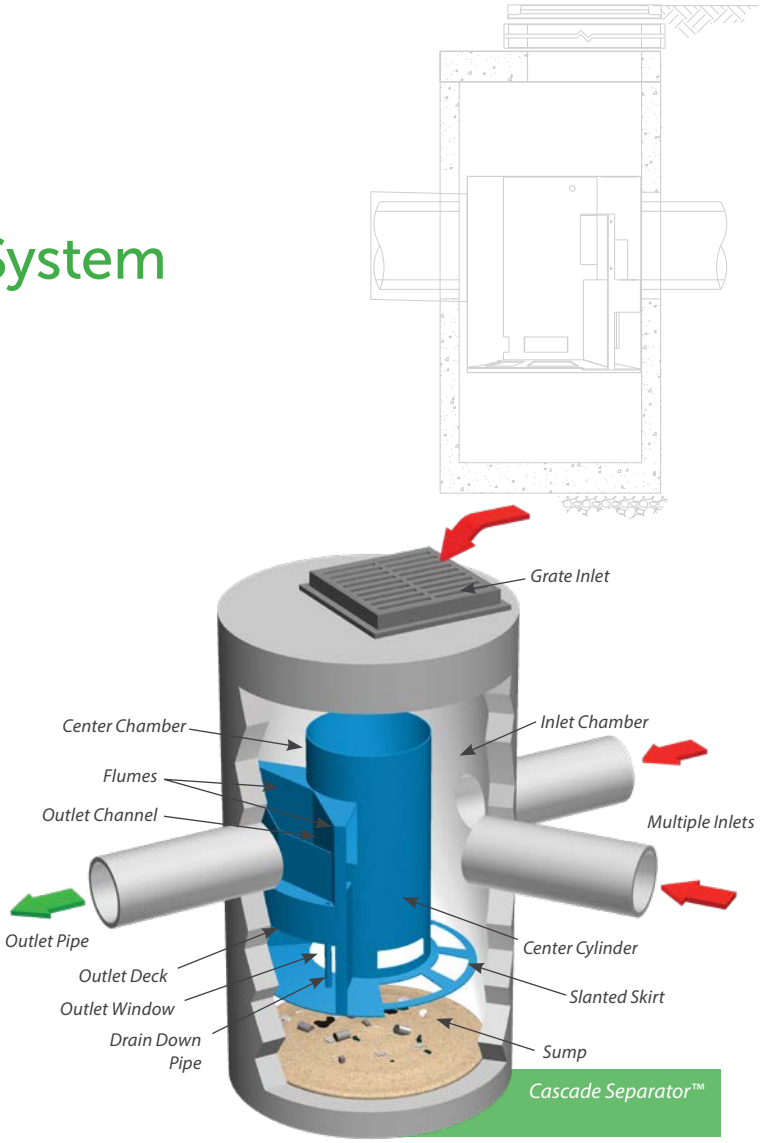
Vortechs®

HDS systems play a vital role in protecting our waterways by removing high levels of sediment, trash, debris, and hydrocarbons from stormwater runoff.

Frequently used as end-of-pipe solutions, they are also used to provide stormwater quality treatment in places where space is limited.

HDS systems capture and retain a variety of stormwater pollutants and are very easy to maintain. These two key benefits have resulted in new uses for HDS technologies, such as pretreating detention, Low Impact Development, and green infrastructure practices, as well as other land-based stormwater treatment systems.

The Cascade Separator™ System



Advanced Sediment Capture Technology ...

The Cascade Separator™ is the newest innovation in stormwater treatment from Contech. The Cascade Separator was developed by Contech's stormwater experts using advanced modeling tools and Contech's industry leading stormwater laboratory.

This innovative hydrodynamic separator excels at sediment capture and retention while also removing hydrocarbons, trash, and debris from stormwater runoff. What makes the Cascade Separator unique is the use of opposing vortices that enhance particle settling and a unique skirt design that allows for sediment transport into the sump while reducing turbulence and resuspension of previously captured material. These two factors allow the Cascade Separator to treat high flow rates in a small footprint, resulting in an efficient and economical solution for any site.

FEATURE	BENEFIT
Unique skirt design & opposing vortices	Superior TSS removal; reduced system size and costs
Inlet area accepts wide range of inlet pipe angles	Design and installation flexibility
Accepts multiple inlet pipes	Eliminates the need for separate junction structure
Grate inlet option	Eliminates the need for a separate grate inlet structure
Internal bypass	Eliminates the need for a separate bypass structure
Clear access to sump and stored pollutants	Fast, easy maintenance

Learn More:
www.ContechES.com/cascade

SELECT CASCADE APPROVALS

- New Jersey Department of Environmental Protection Certification (NJDEP)

CASCADE MAINTENANCE

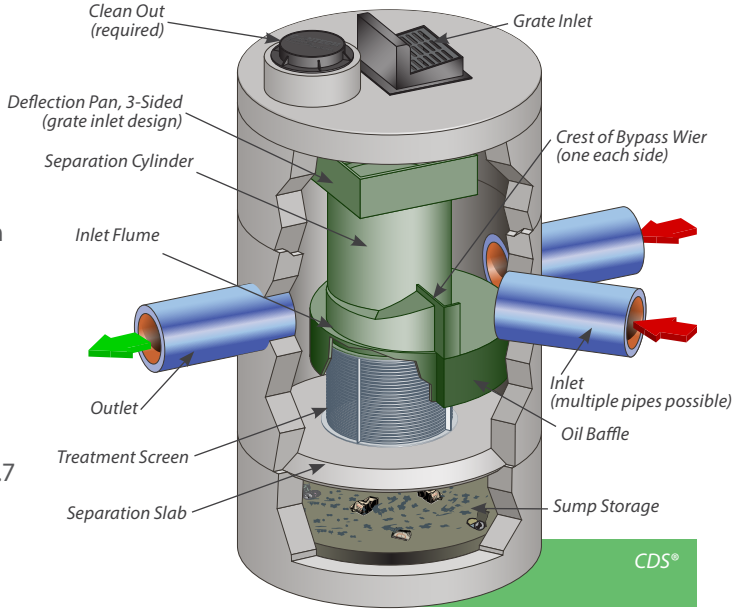
Cascade provides unobstructed access to stored pollutants, making it easy to maintain using a vacuum truck, with no requirement to enter the unit.

The CDS® System

Superior Trash Removal ...

The CDS is a hybrid technology that uses a combination of swirl concentration and indirect screening to separate and trap trash, debris, sediment, and hydrocarbons from stormwater runoff.

At the heart of the CDS system is a unique screening technology used to capture and retain trash and debris. The screen face is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder. This results in a screen that is self-cleaning and provides 100% removal of floatables and neutrally buoyant material debris 4.7 mm or larger, without blinding.



FEATURE	BENEFIT
Captures and retains 100% of floatables and neutrally buoyant debris 4.7 mm or larger	Superior trash removal
Self-cleaning screen	Ease of maintenance
Isolated storage sump eliminates scour potential	Excellent pollutant retention
Internal bypass	Eliminates the need for additional structures
Multiple pipe inlets and 90-180° angles	Design flexibility
Clear access to sump and stored pollutants	Fast, easy maintenance

Learn More:
www.ContechES.com/cds

SELECT CDS APPROVALS

- Washington Department of Ecology (GULD) – Pretreatment
- New Jersey Department of Environmental Protection Certification (NJDEP)
- Canadian Environmental Technology Verification (ETV)
- California Statewide Trash Amendments Full Capture System Certified*

** The CDS System has been certified by the California State Water Resources Control Board as a Full Capture System provided that it is sized to treat the peak flow rate from the region specific 1-year, 1-hour design storm, or the peak flow capacity of the corresponding storm drain, whichever is less.*

The Vortechs® System

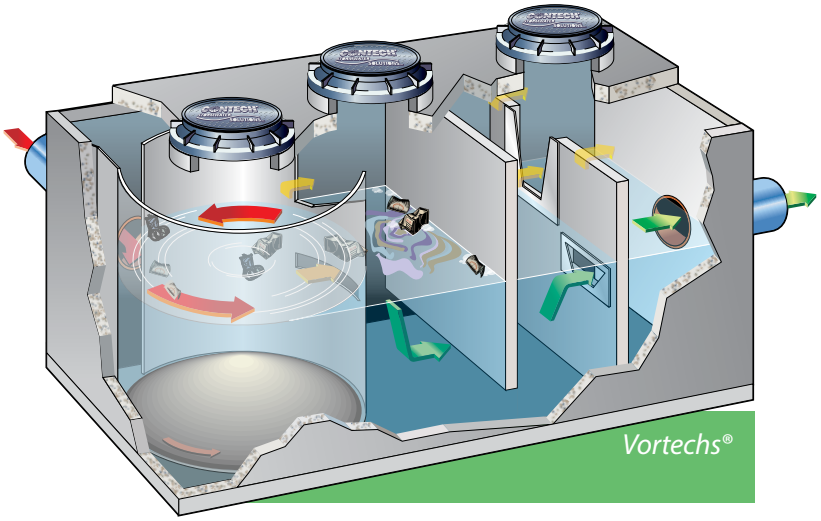
Stormwater Treatment in a Shallow Footprint ....

Vortechs combines swirl concentration and flow controls into a single treatment unit that captures and retains trash, debris, sediment, and hydrocarbons from stormwater runoff.

The Vortechs system's large swirl chamber and flow controls work together to create a low energy environment, ideal for capturing and retaining particles down to 50 microns.

Vortechs is the ideal solution for sites with high groundwater, bedrock, utility conflicts, or sites with a large volume runoff.

The Vortechs System is approved by the Washington Department of Ecology (GULD) - Pretreatment.



SELECT VORTECHS APPROVALS

- Washington Department of Ecology (GULD) – Pretreatment

Learn More:
www.ContechES.com/vortechs

FEATURE	BENEFIT
Large swirl chamber	Fine particle removal down to 50 microns
Shallow profile – Typical depth below pipe invert is only 3 feet.	Can be used on sites with high groundwater, bedrock, or utility conflicts
Unobstructed access to stored pollutants	Fast, easy maintenance

The ideal solution for sites with high groundwater

Design Your Own Hydrodynamic Separator (DYOHDS™)

Learn More:
www.ContechES.com/dyohds

Quickly prepare designs for estimates and project meetings ...

Engineers are always looking for new ways to quickly prepare designs for estimates and project meetings. Contech has developed an online tool to help with the hydrodynamic separation product selection process… the Design Your Own Hydrodynamic Separator (DYOHDS™) tool.

This free, online tool fully automates the layout process for identifying the proper hydrodynamic separator for your site. You can create multiple systems for each project while saving all project information for future use.

- Multiple sizing methods available.
- Site-specific questions ensure the selected unit will comply with site constraints.
- Multiple treatment options may be available based on regulations and site parameters.
- Follow up reports contain a site-specific design, sizing summary, standard detail, and specification.

A free, online tool to aid in the selection of a hydrodynamic separation solution.

A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

TAKE THE NEXT STEP

For more information: www.ContechES.com

CONTECH® ENGINEERED SOLUTIONS

Get social with us:

800-338-1122 | www.ContechES.com

CONTECH®
ENGINEERED SOLUTIONS

Corrugated Metal Pipe
Detention & Infiltration

The experts you need to solve your stormwater challenges

Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

Your Contech Team

STORMWATER CONSULTANT

It's my job to recommend the best solution to meet permitting requirements.

STORMWATER DESIGN ENGINEER

I work with consultants to design the best approved solution to meet your project's needs.

REGULATORY MANAGER

I understand the local stormwater regulations and what solutions will be approved.

SALES ENGINEER

I make sure our solutions meet the needs of the contractor during construction.

Contech is your partner in stormwater management solutions

CMP Infiltration is used at Long Beach City College in Long Beach, California.

Subsurface Infiltration as a Stormwater Management Strategy

The only sure way to eliminate stormwater pollution is to eliminate stormwater runoff. In recognition of this fact, Green Infrastructure and Low Impact Development based stormwater management regulations prioritizing runoff reduction have proliferated throughout the United States.

Where site conditions allow, infiltration is typically the most cost effective and reliable runoff reduction approach. In urban environments where there are competing demands for land, subsurface infiltration can provide many of the benefits of landscape based systems but without requiring dedicated land area.

Infiltration systems are commonly comprised of a pretreatment component designed to remove sediment, trash, and oil, followed by plastic, metal or concrete storage units surrounded by permeable stone creating a high voids storage gallery.

Infiltration systems are typically designed to support vehicular loading and to withstand lateral pressures from surrounding soil that allows the overlying land to be used for virtually any non-building application.

Corrugated Metal Pipe
The “Go To” Material for Stormwater Detention

For the majority of applications, corrugated metal pipe (CMP) is the “go to” material for stormwater detention and infiltration. With its low cost, a wide variety of diameters, layout configurations and coatings, no other material can match CMP’s flexibility and versatility.

- NCSPA service life guidance of 75+ years for certain materials in recommended environments. Please refer to the Corrugated Metal Pipe Detention Design Guide for additional information.
- Various pipe coatings and materials are available to accommodate site-specific needs: Aluminized Steel Type 2 (ALT2), Galvanized, CORLIX® Aluminum, and Polymeric.
- Wide range of gages, corrugations, and shapes, diameters 12”– 144”
- Pipe can be fully or partially perforated for infiltration or groundwater recharge applications
- Custom risers and manifolds provide direct access for maintenance
- Outlet control devices can be incorporated within the system, eliminating the need for a separate structure
- Customizable - a variety of fittings allow CMP to match most layout configurations
- May be designed for heavy loading and high maximum cover
- Contributes to LEED points
- Available locally; quick turnaround time
- The most economical installed solution

No other material can match the flexibility and versatility of CMP

Service Life for Corrugated Metal Pipe

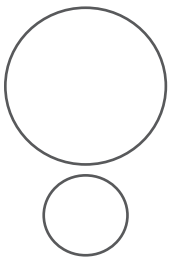
The durability of steel ...

Some engineers are hesitant to use corrugated metal pipe (CMP) for infiltration because they have heard about CMP drainage culverts that have corroded due to abrasion. Factors affecting longevity differ between culvert and infiltration applications. Culverts experience high velocity flows carrying abrasive sediment, which can wear off galvanized coatings used in older CMP culverts. Infiltration systems are designed for storage rather than conveyance, so velocity and abrasive forces are minimized. In addition, improved CMP coatings, such as Aluminized Type 2 (ALT2), are more abrasion resistant and have demonstrated superior in-ground performance against abrasion in long-term durability studies. Field studies also have indicated that ALT2 coating may extend service life in wider pH and resistivity ranges than galvanized coatings. Confirming and maintaining recommended environmental conditions helps ensure system longevity projected by the long term studies. Finally, properly designed infiltration systems include pretreatment, flow control and a stone backfill envelope that can reduce exposure to abrasion

Learn More:
www.ncspa.org

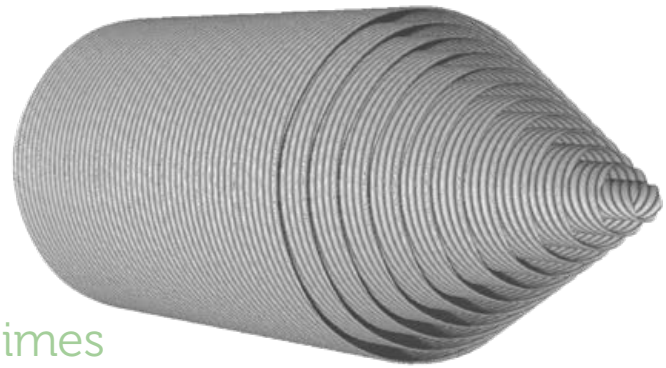
Maximizing Vertical Space: Every Inch Counts

One of the most overlooked advantages of CMP is its ability to maximize vertical storage space. Increasing the depth of a CMP infiltration system allows for more water storage in the same footprint. For example, doubling the diameter of pipe yields four times as much storage volume in the pipe. This provides a significant cost savings per cubic foot of storage. In addition, more vertical storage space means a smaller footprint, less excavation, and lower project costs.



96" diameter - 50.2 ft^3/ft

48" diameter - 12.5 ft^3/ft



Twice the diameter provides four times the storage space.

System Sizing

APPLICATION TIPS

- Use the largest diameter pipe possible to maximize vertical storage space and minimize the overall footprint. Doing so will reduce material, excavation, and backfill costs.
- Single manifold systems are most cost effective as they reduce the amount of fabrication needed.
- Incorporating flow controls into the CMP system can reduce costs by eliminating the need for additional concrete structures.
- The Contech MOBILE PIPE® mill can be delivered to remote locations and assembled on-site for fast and cost effective steel pipe manufacturing.

DIAMETER (IN)	VOLUME (FT^3/FT)	MIN. COVER HEIGHT
6	0.20	12″
8	0.35	12″
10	0.55	12″
12	0.78	12″
15	1.22	12″
18	1.76	12″
21	2.40	12″
24	3.14	12″
30	4.90	12″
36	7.10	12″
42	9.60	12″
48	12.60	12″
54	15.90	12″
60	19.60	12″
66	23.80	12″
72	28.30	12″
78	33.20	12″
84	38.50	12″
90	44.20	12″
96	50.30	12″
102	56.80	18″
108	63.60	18″
114	70.90	18″
120	78.50	18″
126	86.60	18″
132	95.00	18″
138	103.90	18″
144	113.10	18″

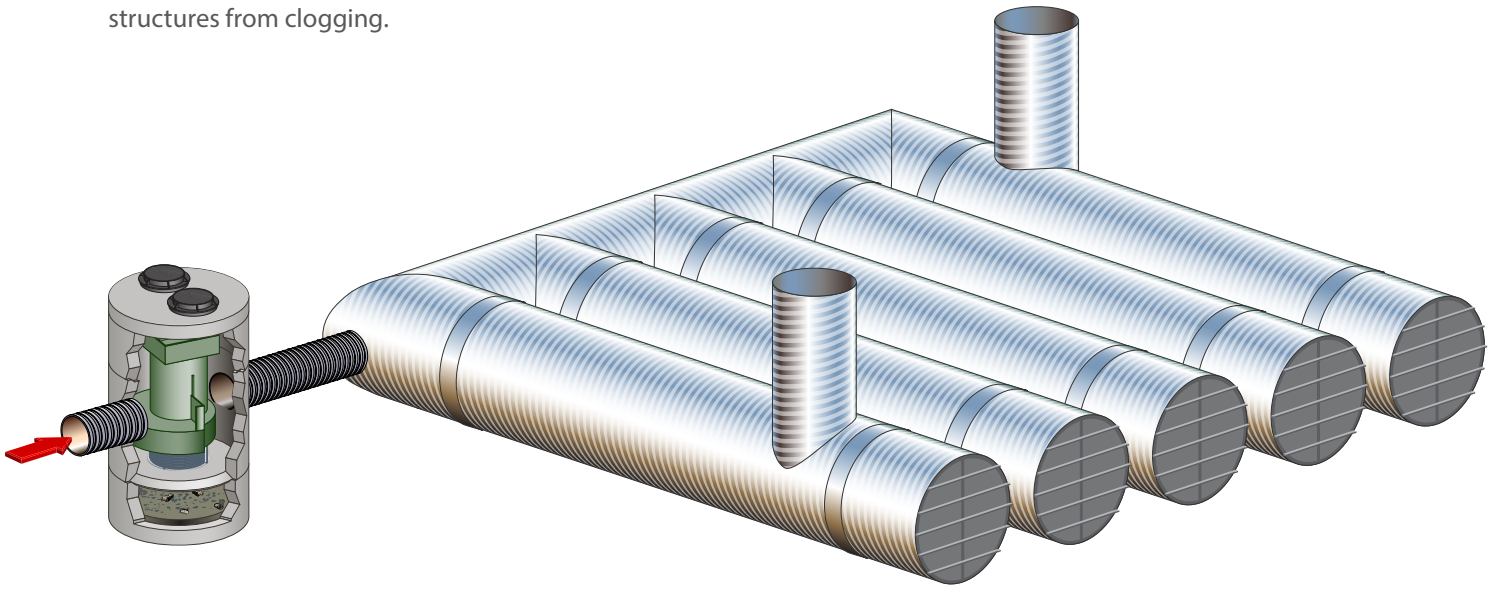
Because of its low cost and flexible configurations, CMP is the ‘go to’ material for stormwater detention and filtration.

Contech’s CMP Detention systems maximize vertical storage space

The Need for Effective Pretreatment

Infiltration systems have multiple components, and one of the most important is pretreatment. The purpose of a pretreatment device is to prolong the life of the infiltration system by removing debris and sediment that can collect on the invert and within the stone backfill voids. Pretreatment will maintain the efficiency of an infiltration system as well as extend the life cycle, therefore preventing a premature replacement. Pretreatment also offers these additional benefits:

- Easier to clean and maintain compared to the infiltration system itself.
- Cost savings due to the extended service life of the system.
- Removing trash and debris protects downstream outlet control structures from clogging.



Pretreatment systems that are easy to maintain and do not rely on the use of geotextile fabric are preferred.

Pretreatment Design Considerations

When choosing a pretreatment system, consider the following ...

- Downstream outlet control structures may require protection from a pretreatment device that screens trash and debris.
- Pretreatment system selection depends on pollutant targets. Trash, debris, and larger particles can be removed with hydrodynamic separators. Removing high percentages of fine particles and associated heavy metals and nutrients requires filtration.
- Reduced long term maintenance or replacement cost of the infiltration system can help justify pretreatment construction costs.
- Inlet and pipe layout will influence the number and type of pretreatment systems used. A combination of different systems may be appropriate for the various inlet locations and flows.

The CDS® provides direct access to cleaning, using a combination of swirl concentration and indirect screening.

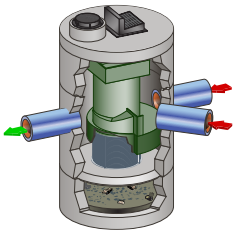
Learn More:
www.ContechES.com/cmp-detention

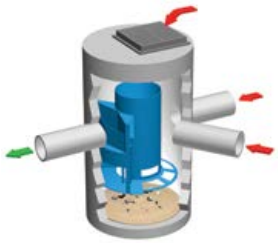
Reduce long term maintenance of an infiltration system with pretreatment.

Pretreatment options extend the life of subsurface infiltration

Pretreatment Options

Contech offers a number of pretreatment options, all of which will extend the life of subsurface infiltration systems and improve water quality. The type of system chosen will depend on a number of factors including footprint, soil conditions, local regulations, and the desired level of pretreatment.





Hydrodynamic Separation

Hydrodynamic Separation (HDS) provides a basic level of pretreatment by capturing and retaining trash and debris, sediment, and oil from stormwater runoff.

CDS®

CDS provides superior trash and sediment removal, and is much easier to clean and maintain compared to the infiltration system itself.

Cascade Separator™

The Cascade Separator uses advanced sediment capture technology to provide the highest sediment removal efficiency to protect the stone backfill voids of infiltration systems, thus extending the life of the system.

Filtration

Filtration provides a higher level of pretreatment and improved water quality by removing trash and debris, oil, fine solids, and dissolved pollutants such as metals, hydrocarbons, and nutrients.

Filterra® Bioretention System

Filterra is an engineered bioretention system that has been optimized for high volume/flow treatment and high pollutant removal.

The Stormwater Management StormFilter®

The StormFilter system is comprised of a structure that houses rechargeable, media-filled cartridges. The media can be customized to target site-specific pollutants.

Jellyfish® Filter

The Jellyfish filter uses membrane filtration in a compact footprint to remove a high level and a wide variety of stormwater pollutants such as fine particulates, oil, trash and debris, metals, and nutrients.

Alternative Materials for Subsurface Infiltration

There may be instances where alternative materials are needed for subsurface infiltration due to site specific needs ...

Plastic Chambers

Plastic chambers are best suited to shallow depth applications; minimum cover is 18 inches, and maximum cover is 96 inches. Some benefits of chambers are:

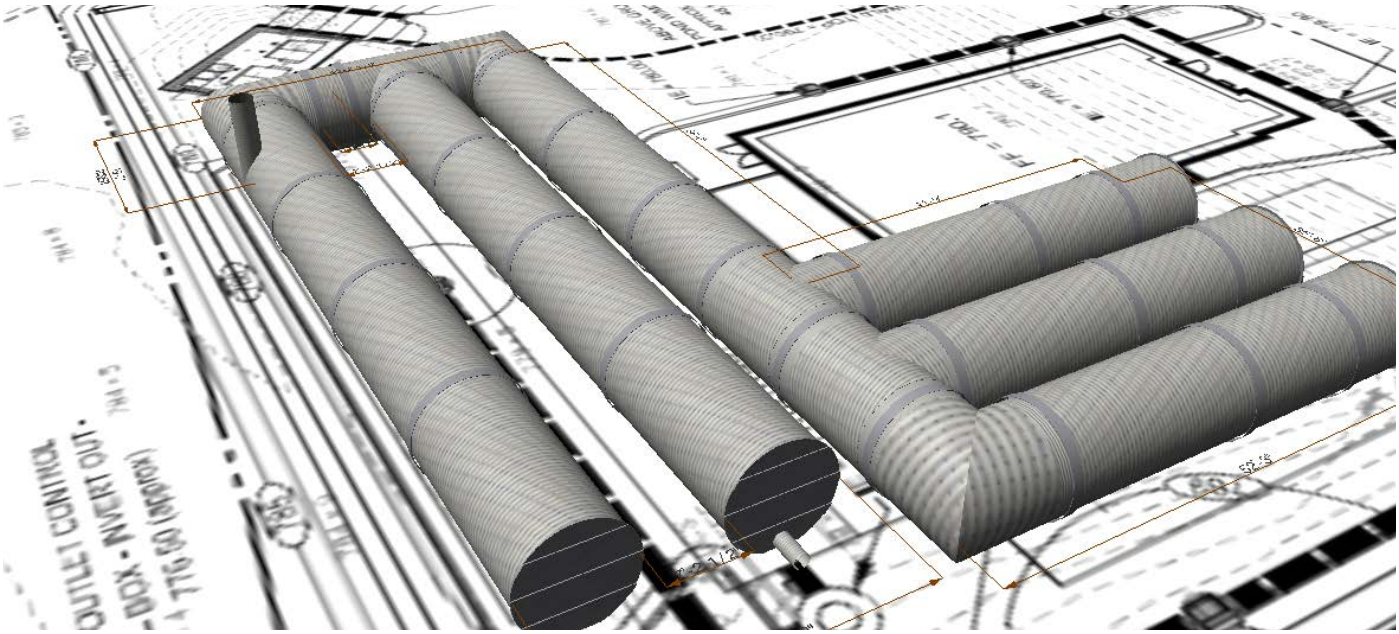
- Chambers may be beneficial for sites with limited vertical storage.
- Lightweight and installed by hand.
- Heavy equipment is not required to set units into place.
- Centralized stocking locations for short lead times.

Concrete Structures/Vaults

Some concrete structures and vaults are best suited for high loading applications such as railroads or airports. Concrete units are also ideal in corrosive environments or areas with high salinity. Some benefits of concrete structures are:

- Wide range of spans and heights.
- Greater underground infiltration storage in a smaller footprint.
- Ample and easy maintenance access.
- Fast installation.

Design Your Own Detention System (DYODS®)



Learn More:
www.ContechES.com/designcenter

Quickly prepare designs for estimates and project meetings ...

Engineers are always looking for new ways to quickly prepare designs for estimates and project meetings. We have a tool that does just that… the Design Your Own Detention System (DYODS®) tool.

Part of the Contech Design Center, this free, online tool fully automates the layout process for stormwater detention and infiltration systems. The tool allows you to design systems using corrugated metal pipe (CMP), ChamberMaxx® plastic chambers, or DuroMaxx® steel reinforced polyethylene (SRPE). You can also create multiple systems for each project while saving all project information for future use.

- "Drag and drop" feature allows users to customize layout
- A 2D/3D design environment with high-resolution graphics including BIM model output
- Optimize designs for the storage requirement or maximize storage for a given footprint
- Import a PDF site plan, scale and design a system over the plan and view the overlay in 2D
- Instant access to customized, project specific drawings, and CAD files
- Ability to co-workers or Contech design engineers to your project with the new Collaborator feature

CONTECH® DESIGNCENTER
DESIGN MADE EASY

A free, online tool that fully automates the layout process for stormwater detention systems.

A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

TAKE THE NEXT STEP

For more information: www.ContechES.com

CONTECH® ENGINEERED SOLUTIONS

Get social with us:

800-338-1122 | www.ContechES.com