Preliminary Water Quality Management Plan

For:

CITRUS INDUSTRIAL DEVELOPMENT

EAST OF CITRUS AVENUE,

BETWEEN SLOVER AVENUE AND BOYLE AVENUE,

CITY OF FONTANA, CA

APN: 0251-151-03 TO 07, 09, 10, 14 TO 16, 18 TO 22, 39 TO 44

WQMP: 22-000059

PM: 16055

DRP: 22-000049

Prepared for:

CHIPT Fontana Citrus Boyle, L.P.

527 W. 7th Street, Suite 200

Los Angeles, CA 90014

909.358.7715

Prepared by:

Langan Engineering & Environmental Services, Inc.

11801 Piece Street

Riverside, CA 92505

951.710.3000

Submittal Date: 04/21/2023

Revision Date: Insert Current Revision Date

Approval Date:_____

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Crow Holding Industrial by Langan Engineering & Environmental Services, Inc. The WQMP is intended to comply with the requirements of the City of Fontana 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):	WQMP: 22-000059 DRP: 22-000049	Grading Permit Number(s):	
Tract/Parcel Map Number(s):	PM: 16055	Building Permit Number(s):	
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0251-151-03 TO 07, 09, 10, 14 TO 16, 18 TO 22, 39 TO 44

Owner's Signature			
Owner Name: Jorge A. Garcia			
Title	Development Associate		
Company	CHIPT Fontana Citrus Boyle, L.P.		
Address	527 W. 7th Street, Suite 200 Los Angeles CA 90014		
Email	jagarcia@crowholdings.com		
Telephone #	909.358.7715		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	WQMP: 22-000059 DRP: 22-000049	Grading Permit Number(s):	
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"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: Michael Golias		PE Stamp Below
Title	Principal	
Company	Langan Engineering & Environmental Services, Inc.	
Address	11801 Piece Street	
Email	mgolias@langan.com	
Telephone #	949.561.9215	
Signature		
Date		

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Forms

Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name	Citrus Industrial Development				
Project Owner Contact Name:	Jorge Garcia				
Mailing Address:	527 W. 7th Street, Suite 200, Los Angeles, CA 90014	E-mail Address:	jgarcia@crowholdings.com	Telephone:	909.358.7715
Permit/Application Number(s):	WQMP: 22-000059 DRP: 22-000049	Tract/Parcel Map Number(s):	PM: 16055		
Additional Information/ Comments:					
Description of Project:	The project is located in the City of Fontana, east of Citrus Avenue and between Slover Avenue and Boyle Avenue. The proposed development will demolish the existing buildings and other site improvements and to be replaced with an industrial warehouse building. The project area is approximately 16.12 acres. Typical site improvements for the warehouse building include loading docks, trailer parking, and vehicular parking. Landscaping is proposed around the perimeter of the site and adjacent to the building where it is appropriate. The warehouse building footprint is 359,157 SF in size.				
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 ft² or more of impervious surface on an already developed site	☐ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539	☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more
☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	☒ Parking lots of 5,000 ft² or more exposed to storm water	☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day

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

2 Project Area (ft2):	702,187 SF (16.12 acres)	**3** Number of Dwelling Units:		**4** SIC Code:	4225

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:

Crow Holdings Industrial
527 W. 7th Street, Suite 200
Los Angeles, CA 90014

The property owner will maintain onsite WQMP stormwater facilities.

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 ☐	Bacteria indicators are routinely detected in pavement runoff. Including petroleum hydrocarbons.
Nutrients - Phosphorous	E ☒	N ☐	Expected pollutants if landscaping exists on site.
Nutrients - Nitrogen	E ☒	N ☐	Expected pollutants if landscaping exists on site.
Noxious Aquatic Plants	E ☒	N ☐	Expected pollutants if landscaping exists on site.
Sediment	E ☒	N ☐	Expected pollutants if landscaping exists on site.
Metals	E ☒	N ☐	
Oil and Grease	E ☒	N ☐	
Trash/Debris	E ☒	N ☐	
Pesticides / Herbicides	E ☒	N ☐	
Organic Compounds	E ☒	N ☐	Expected pollutants if landscaping exists on site.
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits

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

Form 2.4-1 Water Quality Credits

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

Section 3 Site and Watershed Description

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

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.06427	Longitude -117.44969	Thomas Bros Map page

1 San Bernardino County climatic region: ☒ Valley ☐ Mountain

2 Does the site have more than one drainage area (DA): Yes☒ No☐ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
DA1 To Outlet 1	All drainage will be captured by the proposed on-site storm systems and discharged into a proposed underground infiltration chamber (A).
DA2 to Outlet 2	All drainage will be captured by the proposed on-site storm systems and discharged into a proposed underground infiltration chamber (B).

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
For Drainage Area 1's sub-watershed DMA, provide the following characteristics	DMA A			
1 DMA drainage area (ft^2)	104,544			
2 Existing site impervious area (ft^2)	9,377			
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	HSG A			
5 Longest flowpath length (ft)	565			
6 Longest flowpath slope (ft/ft)	0.012			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	SFR			
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* *See Appendix A-Google Aerial Photo*	Poor			

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 2				
For Drainage Area 2's sub-watershed DMA, provide the following characteristics	DMA B			
1 DMA drainage area (ft^2)	598,078			
2 Existing site impervious area (ft^2)	118,474			
3 Antecedent moisture condition *For desert areas, use* *http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	AMC II			
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	HSG A			
5 Longest flowpath length (ft)	1,005			
6 Longest flowpath slope (ft/ft)	0.012			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	SFR			
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*	San Sevaine Channel Santa Ana River, Reach 3 Prado Dam Santa Ana River, Reach 2 Santa Ana River, Reach 1 Pacific Ocean
Applicable TMDLs *Refer to Local Implementation Plan*	San Sevaine Channel: None Santa Ana River, Reach 3: Pathogens, Nitrate Prado Dam: Pathogens Santa Ana River, Reach 2: None Santa Ana River, Reach 1: None Pacific Ocean: None
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/ and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	San Sevaine Channel: None Santa Ana River, Reach 3: Copper, Indicator Bacteria, Lead Prado Dam: pH Santa Ana River, Reach 2: None Santa Ana River, Reach 1: None Pacific Ocean: None
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	N/A
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://permitrack.sbcounty.gov/wap/*	
Hydrologic Conditions of Concern	☐ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☒ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

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

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

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Owner/tenant shall be familiarized with the educational materials in the attachment and the contents of the WQMP
N2	Activity Restrictions	☒	☐	Activities shall be restricted to that allowed by local governing agencies.
N3	Landscape Management BMPs	☒	☐	Irrigation shall be consistent with San Bernardino's Water Conservation Ordinance. Fertilizer and pesticide usage will be consistent with County Management Guidelines for Use of Fertilizer and Pesticides. Landscape will be inspected and maintained weekly by a qualified contractor and all landscape waste will be disposed of properly.
N4	BMP Maintenance	☒	☐	BMP shall be inspected and maintained in accordance with manufacturer's recommendations. BMPs shall be maintained in accordance with the WQMP Operations and Maintenance Plan.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	No hazardous waste expected to be kept on site.
N6	Local Water Quality Ordinances	☒	☐	Owner/tenant shall comply with the requirements of the Local Water Quality Ordinances.
N7	Spill Contingency Plan	☒	☐	Owner/tenant shall have site specific Spill Contingency Plan consistent with the site usage and potential for spills.
N8	Underground Storage Tank Compliance	☒	☐	Owner/tenant shall comply with the requirements for the underground storage tank compliance.
N9	Hazardous Materials Disclosure Compliance	☐	☒	No hazardous materials expected to be stored on site.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☒	☐	Owner shall comply with Article 80 of the Uniform Fire Code as enforced by the local fire protection agency.
N11	Litter/Debris Control Program	☒	☐	A litter/debris control program shall be implemented as part of the site regularly scheduled maintenance.
N12	Employee Training	☒	☐	The owner will ensure that tenants are also familiar with onsite BMPs and necessary maintenance required of the tenants. Employees shall be trained to clean up minor spills and participate in ongoing maintenance.
N13	Housekeeping of Loading Docks	☒	☐	Loading docks should be kept in a clean and orderly condition through a regular program of sweeping and litter control and immediate cleanup of spills and broken containers. Cleanup procedures should minimize or eliminate the use of water. If wash water is used, it must be disposed of in an approved manner and not discharged to the storm drain system.
N14	Catch Basin Inspection Program	☒	☐	At least 80 percent of drainage facilities shall be inspected, cleaned and maintained on an annual basis with 100 percent of the facilities included in a two-year period. Cleaning should take place in the late summer/early fall prior to the start of the rainy season. Drainage facilities include catch basins (storm drain inlets), detention or retention basins, and infiltration system.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	Driveways, and parking lots are required to be swept on a regular frequency based usage and field observations of waste accumulation, using a vacuum assisted sweeper. All paved areas of a business shall be swept, in late summer or early fall, prior to the start of the rainy season or equivalent, as required by the governing jurisdiction.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not a public agency project.

N17	Comply with all other applicable NPDES permits	☒	☐	Will comply with Construction General Permit.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	"No Dumping – Drains to Ocean" stencils will be applied. Legibility of stencil will be inspected annually for legibility and corrected as necessary, and at a minimum re-applied at least once every 5 years.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☒	☐	Outdoor storage areas shall be paved and sufficiently impervious to leaks and spills.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Outdoor trash and waste storage areas shall be paved with impervious material, and trash bins shall have solid covered lids.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	Irrigation systems shall include shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines. Timers will be used to avoid over watering and watering cycles and duration shall be adjusted seasonally by the landscape maintenance contractor. The landscaping areas will be grouped with plants that have similar water requirements. Native or drought tolerant species shall also be used where appropriate to reduce excess irrigation runoff and promote surface filtration.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Landscape areas will be depressed at a minimum 1" below top of curb or sidewalk.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☐	☒	No onsite channels or slopes to protect.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☒	☐	Dock areas shall be maintained and swept in accordance to the site's regularly scheduled maintenance program. Debris and trash shall be picked up, and disposed.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	No maintenance bays onsite.

S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No vehicle wash areas onsite.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	No outdoor processing areas onsite.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	No equipment wash areas onsite.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	No fueling areas onsite.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	No hillside onsite.
S14	Wash water control for food preparation areas	☐	☒	No food preparation onsite.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	No community wash racks onsite.

4.1.2 Preventative LID Site Design Practices

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

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

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

Form 4.1-3 Preventative LID Site Design Practices Checklist

Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☐ No ☒ Explanation: Infiltration BMP will be used to infiltrate the design capture volume (DCV).
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: Infiltration system shall be designed with sufficient base surface areas that will drawdown the design capture volume within 48-hrs. Unnecessary compaction of soil shall be minimized.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Post-development drainage patterns will mimic pre-development conditions to the extent feasible. The infiltration facilities will assist in maintaining the existing time of concentration.
Disconnect impervious areas: Yes ☐ No ☒ Explanation:
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: The project site is a developed site. No vegetation or sensitive areas to protect.
Re-vegetate disturbed areas: Yes ☐ No ☒ Explanation: Not applicable, development consists of a light industrial facility. Most of the disturbed areas will be paved; landscape will be provided throughout the site.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Heavy construction vehicles will be prohibited from unnecessary soil compaction around the infiltration facilities.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Underground piping is located underneath paved areas that could not be substituted with vegetated swales.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Where feasible, landscaped areas will be staked to minimize unnecessary compaction during construction.

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

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

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

1 Project area DA 1 (ft^2): 358,070	**2** Imperviousness after applying preventative site design practices (Imp%): 88.5	**3** Runoff Coefficient (Rc): 0.709 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.533 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.79 *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): 32,766 *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 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 2)

1 Project area DA 1 (ft^2): 332,956	**2** Imperviousness after applying preventative site design practices (Imp%): 88.4	**3** Runoff Coefficient (Rc): 0.707 *$R_c = 0.858(Imp\%)^{\wedge 3} - 0.78(Imp\%)^{\wedge 2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.533 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.79 *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): 30,393 *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** *Form 4.2-3 Item 12*	**2** *Form 4.2-4 Item 13*	**3** *Form 4.2-5 Item 10*
Post-developed	**4** *Form 4.2-3 Item 13*	**5** *Form 4.2-4 Item 14*	**6** *Form 4.2-5 Item 14*
Difference	**7** *Item 4 – Item 1*	**8** *Item 2 – Item 5*	**9** *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** % *Item 7 / Item 1*	**11** % *Item 8 / Item 2*	**12** % *Item 9 / Item 3*

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

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

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

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

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

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

14 Volume Reduction needed to meet HCOC Requirement, (ft^3):
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

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

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

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

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

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*							
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*							
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*							
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*							
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

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

4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

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

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

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is "Yes," provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

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

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

Form 4.3-1 Infiltration BMP Feasibility (DA 1 and DA2)

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 1 DMA A BMP Type Infiltration Chamber	DA DMA BMP Type *(Use additional forms for more BMPs)*	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)	316,873		
3 Ratio of pervious area receiving runoff to impervious area	41,197/316,873 = 0.13		
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*	1,716		
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 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: 1,716 *Sum of Items 5, 13, 20, 25 and 29*

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

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 2 DMA B BMP Type Infiltration Chamber	DA DMA BMP Type *(Use additional forms for more BMPs)*	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Total impervious area draining to pervious area (ft^2)	294,396		
3 Ratio of pervious area receiving runoff to impervious area	38,560/294,396= 0.13		
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*	1,607		
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 cont. Site Design Hydrologic Source Control BMPs (DA2)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒	DA DMA BMP Type	DA DMA BMP Type	DA DMA

If yes, complete Items 15-20. If no, proceed to Item 21			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: 1,607 *Sum of Items 5, 13, 20, 25 and 29*			

4.3.2 Infiltration BMPs

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

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

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

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

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 31,050 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA A BMP Type Infiltration Chamber	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*	15.9		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	7.95		
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*	5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	5		
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*	4,689		
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*	1.75		
12 Gravel porosity	0.4		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	55,818		
16 Total Retention Volume from LID Infiltration BMPs: 55,818 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA2)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 28,786 *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 2 DMA B BMP Type Infiltration Chamber	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*	15.9		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	7.95		
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*	5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	5		
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*	4,350		
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*	1.75		
12 Gravel porosity	0.4		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	0		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	55,818		

16 Total Retention Volume from LID Infiltration BMPs: 55,818 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.3 Harvest and Use BMP

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

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

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

1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3):
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 detention facility			
3 Storage volume for proposed detention type (ft^3) *Volume of cistern*			
4 Landscaped area planned for use of harvested stormwater (ft^2)			
5 Average wet season daily irrigation demand (in/day) Use local values, typical ~ 0.1 in/day			
6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*			
7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*			
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*			

9 Total Retention Volume (ft^3) from Harvest and Use BMP *Sum of Item 8 for all harvest and use BMP included in plan*

10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest & use BMPs? Yes ☐ No ☐
If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.

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)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume*	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *Form 4.3-6 Item 15 + Form 4.3-7 Item 13*	**4** 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.*		

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} *= Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Amended soil porosity, *n*			
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
12 Gravel porosity, *n*			
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*			
14 Biotreated Volume (ft^3) $V_{biotreated}$ *= Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*			
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: *Sum of Item 14 for all volume-based BMPs included in this form*			

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

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	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)*				

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 TGD for WQMP for reference to BMP design details*			
4 Manning's roughness coefficient			
5 Bottom width (ft) b_w *= (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2^1.67 * Item 3^0.5)*			
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
7 Cross sectional area (ft^2) *A = (Item 5 * Item 2) + (Item 6 * Item 2^2)*			
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*			
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*			
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*			
11 Water surface area at water quality flow depth (ft^2) SA_{top} *= (Item 5 + (2 * Item 2 * Item 6)) * Item 10*			

4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

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

1 Total LID DCV for the Project DA-1 (ft^3): 32,766 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 1,716 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 55,818 *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

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA 2)

1 Total LID DCV for the Project DA-1 (ft^3): 30,393 *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): 1,607 *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): 55,818 *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): *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): *Sum of Form 4.3-9 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*

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

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

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

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☐
  BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the 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

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

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

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

6.2 Electronic Data Submittal

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

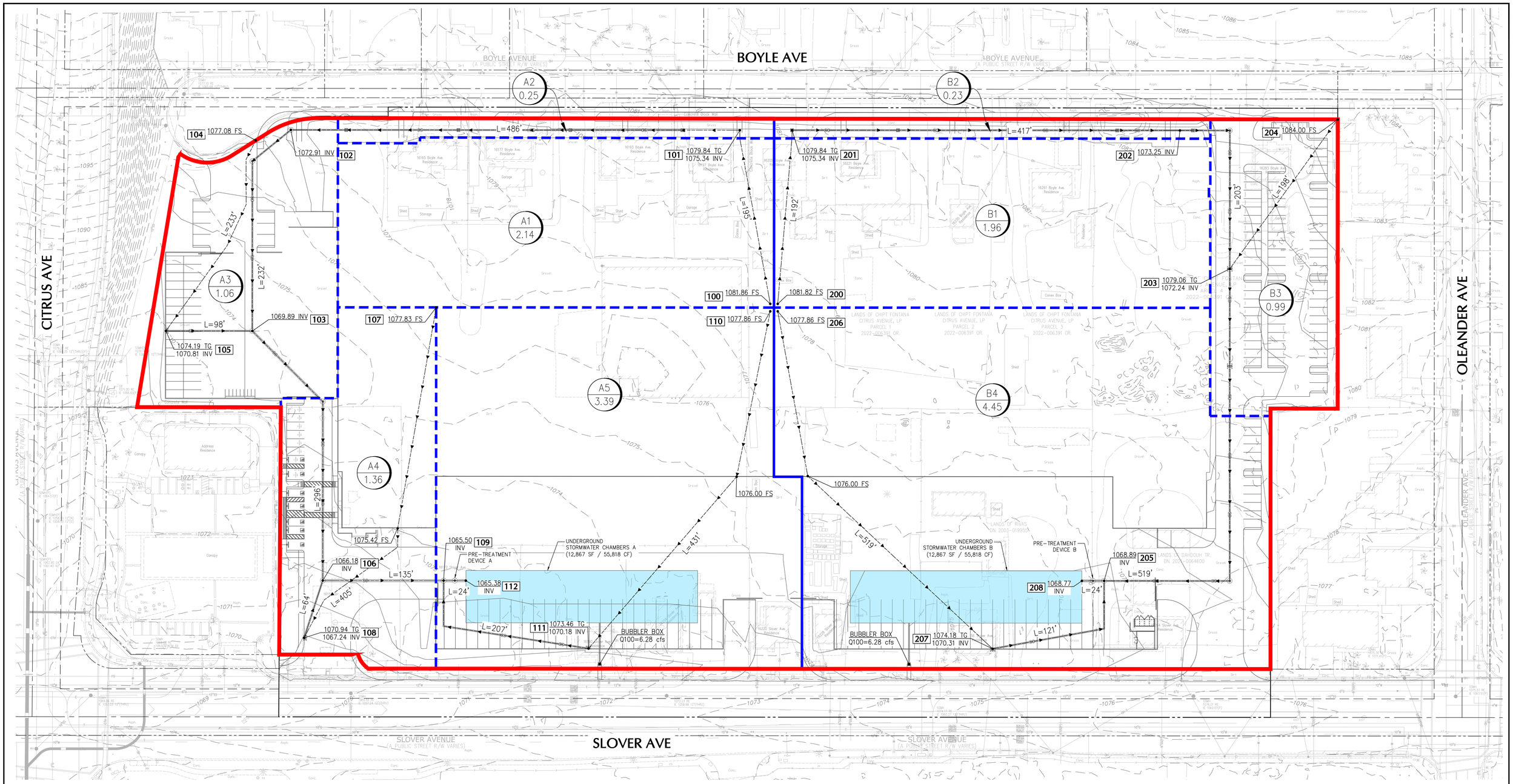
6.3 Post Construction

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

6.4 Other Supporting Documentation

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

6.1. Site Plan and Drainage Plan



LEGEND

- PROJECT AREA BOUNDARY
- BASIN DRAINAGE AREA BOUNDARY
- BASIN DRAINAGE SUB-AREA BOUNDARY
- FLOW PATH
- DRAINAGE SUB-AREA ID
- ID / AREA — DRAINAGE SUB-AREA (ACRE)
- ### — NODE ID
- PROPOSED UNDERGROUND INFILTRATION CHAMBERS FOOTPRINT
- PROPOSED BUILDING AREA

GENERAL NOTES

1. SEE PRELIMINARY HYDROLOGY REPORT, PREPARED BY LANGAN, FOR COMPLETE PRE-DEVELOPMENT HYDROLOGY CALCULATIONS.
2. CALCULATIONS WERE BASED ON THE REQUIREMENTS OF THE SAN BERNARDINO HYDROLOGY MANUAL FOR THE 100-YEAR STORM EVENT.
3. PROPOSED ON-SITE DRAINAGE SYSTEM LAYOUT IS PRELIMINARY.
4. ALL EXISTING ELEVATIONS AND INVERT ELEVATIONS ARE APPROXIMATE.

40 0 10 25 40
SCALE 1 INCH = 40 FEET

Date	Description	No.
Revisions		

Signature Date

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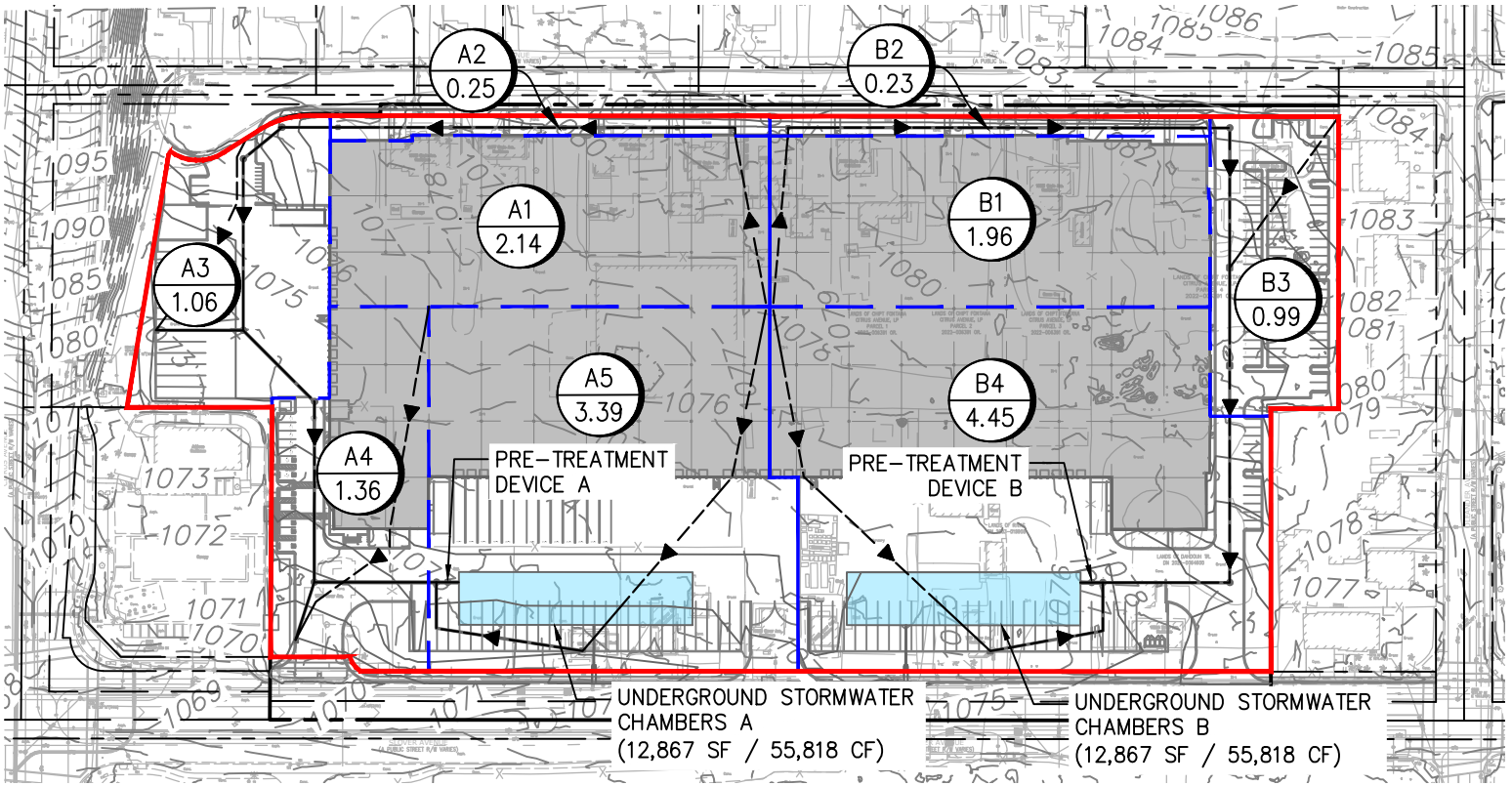
Project: CITRUS
CITY OF FONTANA
SAN BERNARDINO COUNTY CALIFORNIA

Drawing Title: **WQMP EXHITBIT**

Project No. 722012201
Date 05/12/2023
Drawn By DMB
Checked By MRG

Figure No. 1
Sheet 1 of 1

Date: 5/12/2023 Time: 12:48 User: aliu Style Table: Langan.stb Layout: 4 Document Code: 722012201-0201-CA104-0102



LEGEND

- PROJECT AREA BOUNDARY
- BASIN DRAINAGE AREA BOUNDARY
- BASIN DRAINAGE SUB-AREA BOUNDARY
- FLOW PATH
- ID / AREA — DRAINAGE SUB-AREA ID / DRAINAGE SUB-AREA (ACRE)
- PROPOSED UNDERGROUND INFILTRATION CHAMBERS FOOTPRINT
- PROPOSED BUILDING AREA

GENERAL NOTES

1. SEE PRELIMINARY HYDROLOGY REPORT, PREPARED BY LANGAN, FOR COMPLETE PRE-DEVELOPMENT HYDROLOGY CALCULATIONS.
2. CALCULATIONS WERE BASED ON THE REQUIREMENTS OF THE SAN BERNARDINO HYDROLOGY MANUAL FOR THE 100-YEAR STORM EVENT.
3. PROPOSED ON-SITE DRAINAGE SYSTEM LAYOUT IS PRELIMINARY.
4. ALL EXISTING ELEVATIONS AND INVERT ELEVATIONS ARE APPROXIMATE.

200 0 100 200

SCALE: 1 INCH = 200 FEET

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NEW JERSEY NEW YORK CONNECTICUT PENNSYLVANIA OHIO VIRGINIA WEST VIRGINIA WASHINGTON DC FLORIDA TEXAS ARIZONA CALIFORNIA
ABU DHABI ATHENS DOHA DUBAI ISTANBUL PANAMA
Langan Engineering & Environmental Services, Inc.

Project	CITRUS CITY OF FONTANA SAN BERNARDINO COUNTY CALIFORNIA
Figure Title	WQMP EXHIBIT
Project No.	722012201
Date	05/12/2023
Scale	1: 200
Drawn By	KL
Figure No.	2

6.2. Electronic Data Submittal

6.3. Post Construction

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

6.4. Other Supporting Documentation

6.4.1 Vicinity Map

LANGAN

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NEW JERSEY NEW YORK CONNECTICUT PENNSYLVANIA
WASHINGTON DC VIRGINIA WEST VIRGINIA OHIO FLORIDA
TEXAS ARIZONA CALIFORNIA

ABU DHABI ATHENS DOHA
DUBAI ISTANBUL LONDON PANAMA

Langan Engineering & Environmental Services, Inc.

Project

CITRUS

CITY OF FONTANA

SAN BERNARDINO COUNTY CALIFORNIA

Drawing Title

VICINITY MAP

Project No.	722012201
Date	04/21/2023
Scale	1:500
Drawn By	KL

Figure

3

6.4.2 Treatment BMP Factsheet

Infiltration Trench

Infiltration trenches are long, narrow, rock-filled areas with an underground reservoir that stores runoff. Runoff is stored in the void spaces and infiltrates through the bottom and sides of the trench into the soil matrix. If infiltration is not feasible, an underdrain may be provided near the trench invert. Infiltration trenches with an underdrain provide moderate treatment/removal of metals, particulates, oil and grease. Infiltration trenches without underdrains remove 100% of the pollutant load, as infiltration is a volume reduction which results in complete pollutant removal.

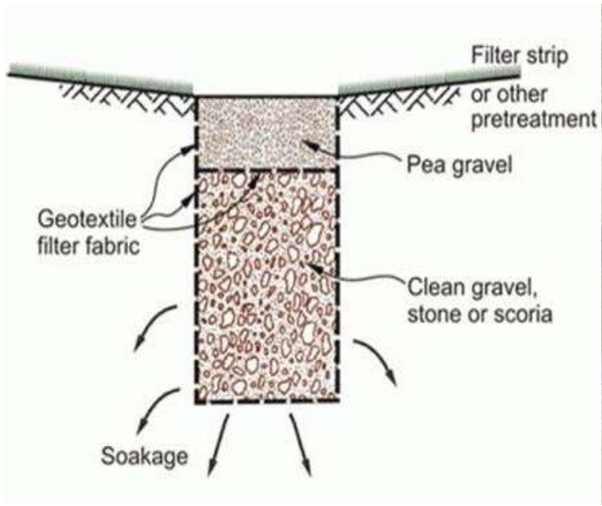
Design Criteria and Constraints

Design Parameter	Design Criteria
Design drawdown time	48 hours (without underdrain)
Maximum drainage area	10 acres
Maximum trench depth	8 feet (1 foot maximum ponding)
Maximum filter strip slope	1%
Minimum filter strip width	5 feet in the direction of flow for all areas draining to trench
Historic high groundwater mark setback	> 10 feet below invert (without underdrain) > 4 feet below surface (with underdrain)
Bedrock/impermeable layer setback	> 5 feet below invert (without underdrain)
Tree setback	Mature tree drip line must not overhang trench
Well/tank/spring setback	> 100 feet horizontally from trench

Note: Infiltration trenches with underdrain perforated pipes should have minimum diameter of 6 inches, minimum lateral spacing of 10 feet, and minimum slope of 0.5%

Material Specifications

Design Parameter	Design Criteria
Reservoir rock material	AASHTO #3 or 57 material or a clean, washed aggregate 1-3 inches in diameter
Filter strip material	Mulch or grasses
Trench lining material	As recommended in Geotechnical Report



Operation

1. Sediment control: pretreatment is required, as infiltration trenches have the risk of becoming clogged over time
2. Observation wells: observation wells must be provided every 50 feet to serve as cleanouts
3. Overflow system: an overflow route is needed to redirect excessive flows to downstream conveyance system in the event of clogging or large storm event
4. Slope: invert slope effects storage volume; no slope ensures storage volume is calculated properly

Maintenance

Maintenance Activities	Suggested Frequency
Remove sediment, trash, debris, grass clippings, trees, and other larger vegetation	Every two weeks, or standard maintenance as needed
Check for surface ponding and observation well for ponding. If ponded, remove and wash or replace pea gravel layer.	48 hours after a significant rainfall event

Infiltration/Vegetated Basin

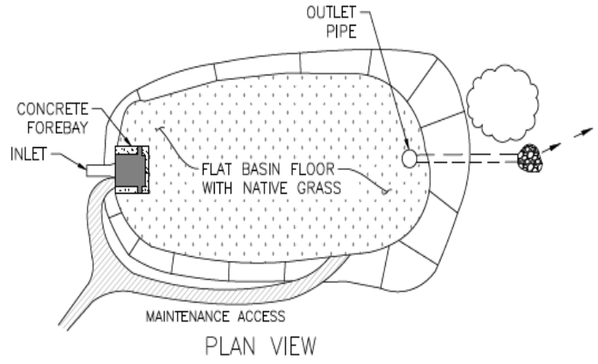
Infiltration basins consist of an earthen basin with a flat floor constructed in naturally pervious soils. Infiltration basins are designed to capture runoff and infiltrate it back into the soil matrix, thus contributing to groundwater recharge. Infiltration basins can be earthen or vegetated.

Design Criteria and Constraints

Design Parameter	Design Criteria
Design drawdown time	48 hours
Maximum treatment area	50 acres
Maximum depth	5 feet
Minimum freeboard	1 foot
Minimum height of concrete forebay splashwall	1 foot
Forebay volume	≥ 0.5% of design volume
Basin slope	0%
Historic high groundwater mark setback	> 10 feet below invert
Bedrock/impermeable layer setback	> 5 feet below invert
Tree setback	Mature tree drip line must not overhang the basin
Well/tank/spring horizontal setback	> 100 feet horizontally from basin

Material Specifications

Design Parameter	Design Criteria
Basin vegetation	Native grasses able to withstand periods of inundation and long term drought



Operation

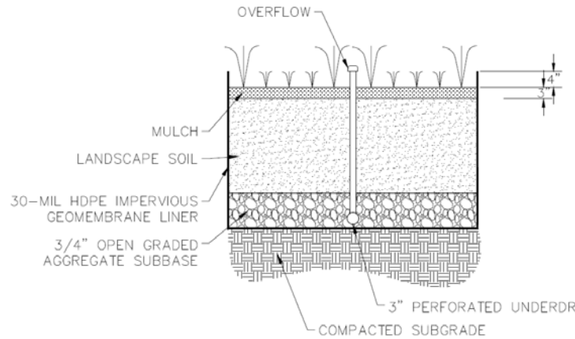
1. Forebay: a concrete forebay must be provided to reduce sediment clogging and erosion
2. Overflow system: an overflow route is needed to redirect excessive flows to a downstream conveyance system in the event of clogging or a large storm event
3. Accaccessibility: the basin invert must be accessible so the required maintenance can be performed
4. Post-construction (vegetated basins): regularly water during the first three months as vegetation establishes roots, and check the swale drains within the design drawdown time
5. Slope: invert slope effects storage volume; no slope ensures storage volume is calculated properly

Maintenance

Maintenance Activities	Suggested Frequency
Maintain vegetation and re-vegetate as needed	Ongoing
Remove sediment, trash, and debris to minimize clogging	Ongoing standard maintenance as-needed before annual storm seasons and following rainfall events
Check basin for sediment deposits and clean as needed	Annually
Check for long term standing water and correct for drainage deficiencies if necessary	48 hours after a significant rainfall event

Bioretention/Planter Box

Bioretention/planter boxes are shallow, vegetated depressions underlain by an engineered soil media. Bioretention/planter boxes can be used when infiltration is determined to be infeasible by including an underdrain or used without an underdrain to promote infiltration. When an underdrain is included, flows are captured and discharged once they have been treated through the media matrix. Bioretention/planter boxes with underdrains provide excellent treatment of metals, nutrients, and particulates. Bioretention/planter boxes without underdrains remove 100% of the pollutant load, as infiltration is a volume reduction which results in complete pollutant removal.



Design Criteria and Constraints

Design Parameter	Design Criteria
Drainage area	1-10 acres
Design drawdown time	48 hours (without underdrain)
Maximum ponding depth	18 inches (6 inches minimum)
Maximum pounding area side slope	3:1 (vertical allowed if perpendicular to walkways/parking stalls)
Depth of mulch layer above bioretention	2-3 inches
Minimum depth of engineered soil media	18 inches
Minimum depth gravel layer	12 inches

Note: Bioretention/planter boxes with underdrain perforated pipes should have minimum diameter of 6 inches, minimum lateral spacing of 5 feet, and minimum slope of 0.5%. Historic high groundwater mark, bedrock, tree, and well/tank/spring horizontal setbacks identified for other infiltration BMPs apply if an underdrain is not proposed.

Material Specifications

Design Parameter	Design Criteria
Planter box structure	Stone, concrete, brick, and other stable materials
Vegetation for bioretention/planter box	Native grasses, shrubs, and small trees
Engineered soil mix	85% mineral component (sandy loam with the following specifications: 70-80% sand, 15-20% silt, 5-10% clay) and 15% organic component

Operation

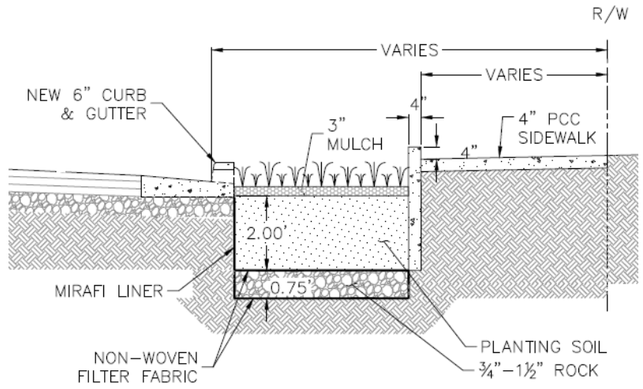
1. Post-construction: regularly water during the first three months as vegetation establishes roots, and check the swale drains within the design drawdown time
2. Curb cuts: curb cuts or inlets should be placed approximately every 10 feet around the perimeter of the bioretention/planter box to allow runoff into the box and must include erosion control (curb cut must be at least 1 foot wide and include local depression)
3. Overflow system: an overflow route is needed to redirect excessive flows to a downstream conveyance system in case of clogging or a large storm event
4. Observation wells: observation wells must be provided every 50 feet to serve as cleanouts if underdrains are used
5. Slope: invert slope effects storage volume; no slope ensures storage volume is calculated properly

Maintenance

Maintenance Activities	Suggested Frequency
Remove trash and debris	Ongoing standard maintenance as needed
Replace surface mulch layers	Maintain required depth of 2-3 inches
Check for ponding	48 hours after a significant rainfall event
Inspect/clean inlets and outlets	Annually before the storm season (October)

Vegetated Swale/Bioswale

Vegetated swales, or referred to as bioswales, are broad, shallow channels with dense vegetation covering the side slope and bottom. The vegetation in the swale provides pollutant removal though settling and filtration. Vegetated swales can potentially eliminate the need for curbs, gutters, and storm drains and are typically designed with an underdrain, but can also be used without to promote infiltration. Vegetated swales/bioswales are often used along roadways to capture street runoff. Vegetated swales with an underdrain provide moderate treatment/removal of metals, particulates, oil and grease. Vegetated swales/bioswales without underdrains remove 100% of the pollutant load, as infiltration is a volume reduction which results in complete pollutant removal.



Design Criteria and Constraints

Design Parameter	Design Criteria
Design drawdown time	48 hours
Drainage area	1-10 acres
Maximum swale bottom width	2 feet
Vegetation height	4-6 inches
Historic high groundwater mark setback	> 10 feet below invert (without underdrain) > 4 feet below surface (with underdrain)
Bedrock/impermeable layer setback	> 5 feet below invert (without underdrain)
Building foundations setback	10-100 feet
Well/tank/spring horizontal setback	> 100 feet horizontally from swale (without underdrain)

Note: Vegetated swales/bioswales with underdrain perforated pipes should have minimum diameter of 6 inches and minimum slope of 0.5%

Material Specifications

Design Parameter	Design Criteria
Swale vegetation	Fine, close-growing, water-resistant grasses, shrubs, and small trees
Engineered soil mix	85% mineral component (sandy loam with the following specifications: 70-80% sand, 15-20% silt, 5-10% clay) and 15% organic component

Operation

1. Post-construction: regularly water during the first three months as vegetation establishes roots, and check the swale drains within the design drawdown time
2. Curb cuts: curb cuts or inlets should be placed approximately every 10 feet around the perimeter of the vegetated swale/bioswale to allow runoff into the box and must include erosion control (curb cut must be at least 1 foot wide and include local depression)
3. Overflow system: an overflow route is needed to redirect excessive flows to a downstream conveyance system in case of clogging or a large storm event
4. Observation wells: observation wells must be provided every 50 feet to serve as cleanouts if underdrains are used
5. Slope: invert slope effects storage volume; no slope ensures storage volume is calculated properly

Maintenance

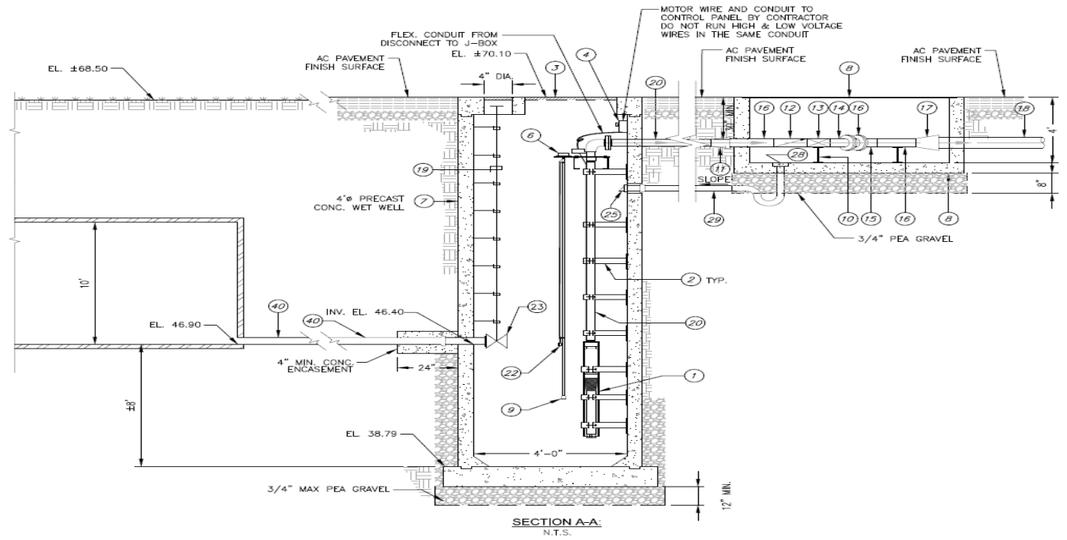
Maintenance Activities	Suggested Frequency
Check the erosion and damage to vegetation	Semi-annually, or beginning and end of rainy season
Remove debris, trash, and accumulated sediment	Semi-annually, or beginning and end of rainy season
Mow and re-plant grass to maintain vegetation height	As needed, and remove litter prior to mowing

Capture and Use

Capture and use systems include storage facilities, irrigation pumps, and distribution lines. The collected runoff is temporarily stored and can be plumbed for irrigation, industrial processes, and other non-potable uses on a case-by case basis and as determined by regional restrictions. Capture and use BMPs remove 100% of the pollutant load, as they provide a volume reduction which results in complete pollutant removal.

Design Criteria and Constraints

Design Parameter	Design Criteria
Drainage area	Limited by the cistern/detention storage size and Estimated Applied Water Use (ETWU)
Maximum distance between access points	50 feet
Minimum diameter of access entry covers at storage system	36 inches



Material Specifications

Design Parameter	Design Criteria
Cistern/detention structure	Concrete, steel, and/or high-density polyethylene (HDPE)

Operation

1. Underground detention facilities: cisterns should be installed on consolidated and stable native soil, but if not, a geotechnical analysis should be performed to ensure stability
2. Pretreatment: proper pretreatment measure must be provided to prevent sediment accumulation
3. Plumbing system: plumbing systems should be installed in accordance with California Building and Plumbing Codes
4. Make up water system must be provided unless parallel irrigation systems are installed (consult local Health Department and/or water department for cross connection requirements)
5. Overflow system: an overflow route is needed to redirect excessive flows to a downstream conveyance system in case of clogging or a large storm event

Maintenance

Maintenance Activities	Suggested Frequency
Remove debris and sediment from pretreatment and storage system	Annually before wet season
Verify proper operation of all pumps	Annually
Check locking mechanisms on entry covers	Annually before wet season
Check mosquito screens (if applicable)	Annually before wet season

Note: Maintenance specifications from vendors for proprietary systems must be considered

Underground Infiltration Chamber

Underground infiltration chambers often include a vault or chamber with an open bottom that is used to store and infiltrate runoff. Alternatively, perforated pipes can also be used. Durable prefabricated structures are offered by a number of vendors. Retention volume provided by underground infiltration chambers is a function of the infiltrating surface area. Underground infiltration chambers remove pollutants infiltrated through the system, as infiltration is a volume reduction which results in a 100% pollutant load reduction.

Design Criteria and Constraints

Design Parameter	Design Criteria
Maximum drawdown time	48 hours
Maximum drainage area	50 acres
Maximum distance between cleanouts	50 feet
Minimum diameter of access entry covers	36 inches
Historic high groundwater mark setback	> 10 feet below invert of system
Bedrock/impermeable layer setback	> 5 feet below invert of system
Well/tank/spring setback	> 100 feet horizontally from system

Note: Sizing for an underground infiltration chamber is similar to that of infiltration basins

Material Specifications

Design Parameter	Design Criteria
Chamber Structure	Concrete, steel, plastics, and other stable materials

Operation

1. Siting consideration: underground infiltration chamber are not permitted near steep slopes or existing soil contamination areas
2. Pretreatment: pretreatment should be provided upstream of the infiltration chamber to mitigate the risk of groundwater contamination
3. Overflow system: an overflow route is needed to redirect excessive flows to a downstream conveyance system in case of clogging or a large storm event

Maintenance

Maintenance Activities	Suggested Frequency
Remove sediment, trash, and debris from pretreatment facilities and storage chambers	Ongoing standard maintenance as needed
Check inlets/outlets and clean as needed	Ongoing standard maintenance as needed
Check access points and maintain	Annually before the wet season

Note: Maintenance specifications from vendors for proprietary systems must be considered

Dry Well

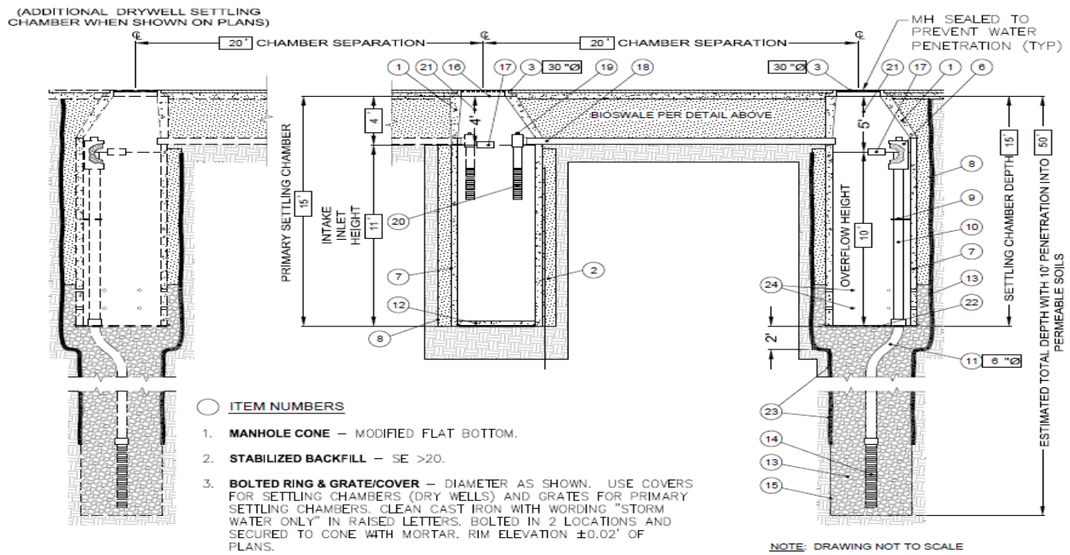
Dry wells, similar to infiltration trenches in design and function, are underground, open-bottomed chambers used to infiltrate runoff into the surrounding soil for groundwater recharge. Dry wells have a great depth to footprint ratio and can be installed at relatively large depths. A dry well can be a small excavated pit filled with aggregate or a prefabricated storage chamber or pipe segment.

Design Criteria and Constraints

Design Parameter	Design Criteria
Maximum drawdown time	48 hours
Infiltration rate of soils	Must be checked at various depths, including the invert of the proposed dry well
Maximum diameter of dry well	12 feet
Depth of dry well	As approved by a geotechnical professional
Historic high groundwater mark setback	> 10 feet below invert of dry well
Bedrock/impermeable layer setback	> 5 feet below invert of dry well
Well/tank/spring setback	> 100 feet horizontally from dry well
Building foundation setback	> 100 feet horizontally from dry well

Material Specifications

Design Parameter	Design Criteria
Dry well structure	Pipe, concrete, or approved proprietary device
Backfill/fill material	AASHTO #2/3, or double-washed rock with diameter range of 1.5 to 3 inches



Operation

1. Access: dry wells should have a direct access path for maintenance activities
2. Pretreatment: dry wells require pretreatment to prevent sediment and trash accumulation from clogging the well in areas with high sediment loads
3. Overflow system: dry wells should be constructed to operate offline, and an overflow route is needed to redirect excessive flows to downstream conveyance system

Maintenance

Maintenance Activities	Suggested Frequency
Remove sediment, trash, and debris	Ongoing standard maintenance as needed
Drain well via pumping	If the dry well has not drained within 48 hours after the end of a storm, clean perforated piping and gravel media

Note: Maintenance specifications from vendors for proprietary systems must be considered

Bulb-outs

Bulb-outs, also referred to as curb-extensions, extend the sidewalk into the parking lane and may include planters to address stormwater runoff. Bulb-outs enhance pedestrian safety by slowing vehicles. Bulb-outs can be used to promote infiltration or if infiltration rates are insufficient an underdrain may be included. Bulb-outs are most effective on wide streets with on-street parking. The cross section within the bulb-out should mimic bioretention/planter boxes. Bulb-outs with an underdrain provide moderate treatment/removal of metals, particulates, oil and grease. Bulb-outs without underdrains remove 100% of the pollutant load, as infiltration is a volume reduction which results in complete pollutant removal.

Design Criteria and Constraints

Design Parameter	Design Criteria
Drainage area	1-10 acres
Maximum drawdown time	48 hours (without underdrain)
Maximum ponding depth	18 inches (6 inches minimum)
Depth of mulch layer	2-3 inches
Minimum depth of engineered soil media	18 inches
Minimum depth gravel layer	12 inches (with underdrain)
Historic high groundwater mark setback	> 10 feet below invert (without underdrain) > 4 feet below surface (with underdrain)
Bedrock/impermeable layer setback	> 5 feet below invert
Well/tank/spring horizontal setback	> 100 feet horizontally (without underdrain)

Note: Bulb-outs with underdrain perforated pipes should have minimum diameter of 6 inches, minimum lateral spacing of 10 feet, and minimum slope of 0.5%

Material Specifications

Design Parameter	Design Criteria
Swale vegetation	Fine, close-growing, water-resistant grasses, shrubs, and small trees
Engineered soil mix	85% mineral component (sandy loam with the following specifications: 70-80% sand, 15-20% silt, 5-10% clay) and 15% organic component

Operation

1. Post-construction: regularly water during the first three months as vegetation establishes roots, and check the swale drains within the design drawdown time
2. Curb cuts: curb cuts or inlets should be placed on the upstream side of the bulb-out and approximately every 10 feet around the perimeter to capture runoff and must include erosion control (curb cut must be at least 1 foot wide and include local depression)
3. Overflow system: an overflow route is needed to redirect excessive flows to a downstream conveyance system in case of clogging or a large storm event
4. Observation wells: observation wells must be provided every 50 feet to serve as cleanouts if underdrains are used
5. Slope: invert slope effects storage volume; no slope ensures storage volume is calculated properly

Maintenance

Maintenance Activities	Suggested Frequency
Remove trash and debris	Ongoing standard maintenance as needed
Replace surface mulch layers	Maintain required depth of 2-3 inches
Check for ponding	48 hours after a significant rainfall event
Inspect/clean inlets and outlets	Annually before the storm season (October)

6.4.3 Manufacturer's Specification and Details

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

SiteAssist™
FOR STORMTECH
INSTALLATION INSTRUCTIONS
VISIT OUR APP

CITRUS CHAMBERS 55K

FONTANA, CA, USA

STORMWATER CHAMBERS A AND B

MC-7200 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-7200.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-7200 CHAMBER SYSTEM

1. STORMTECH MC-7200 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-7200 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-7200 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE SHALL BE BROUGHT UP EVENLY AROUND CHAMBERS SO AS NOT TO DISTORT THE CHAMBER SHAPE. STONE DEPTHS SHOULD NEVER DIFFER BY MORE THAN 12" (300 mm) BETWEEN ADJACENT CHAMBER ROWS.
10. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
11. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIAL BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
12. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-7200 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-7200 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-7200 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-7200 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-7200 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

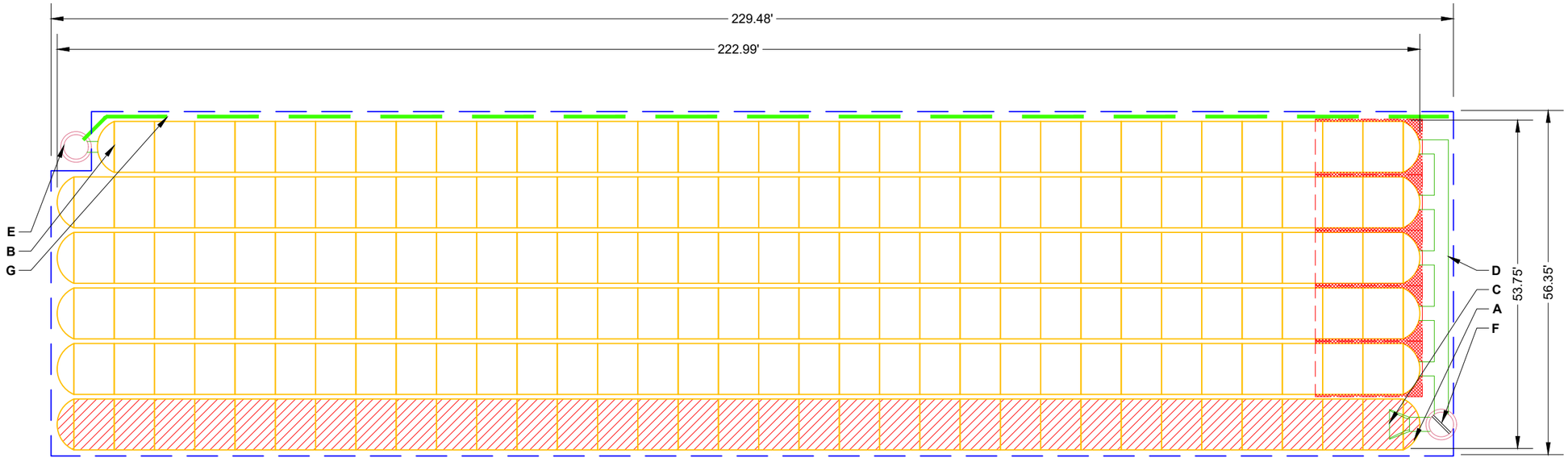
USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

PROPOSED LAYOUT		PROPOSED ELEVATIONS	
197	STORMTECH MC-7200 CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	1076.75
12	STORMTECH MC-7200 END CAPS	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	1072.25
12	STONE ABOVE (in)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	1071.75
9	STONE BELOW (in)	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	1071.75
40	STONE VOID	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	1071.75
55818	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)	TOP OF STONE:	1070.75
		TOP OF MC-7200 CHAMBER:	1069.75
		24" x 24" BOTTOM MANIFOLD INVERT:	1064.94
		24" ISOLATOR ROW PLUS INVERT:	1064.94
12867	SYSTEM AREA (SF)	18" BOTTOM CONNECTION INVERT:	1064.91
571.7	SYSTEM PERIMETER (ft)	BOTTOM OF MC-7200 CHAMBER:	1064.75
		UNDERDRAIN INVERT:	1064.00
		BOTTOM OF STONE:	1064.00

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	24" BOTTOM PARTIAL CUT END CAP, PART#: MC7200IEPP24B / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	2.26"	
PREFABRICATED END CAP	B	18" BOTTOM PARTIAL CUT END CAP, PART#: MC7200IEPP18B / TYP OF ALL 18" BOTTOM CONNECTIONS	1.97"	
FLAMP	C	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MCFLAMP		
MANIFOLD	D	24" x 24" BOTTOM MANIFOLD, ADS N-12	2.26"	
CONCRETE STRUCTURE	E	OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS)		4.0 CFS OUT
CONCRETE STRUCTURE W/WEIR	F	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		41.5 CFS IN
UNDERDRAIN	G	6" ADS N-12 DUAL WALL PERFORATED HDPE UNDERDRAIN		



ISOLATOR ROW PLUS
(SEE DETAIL)

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING
THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

CITRUS CHAMBERS 55K
FONTANA, CA, USA
DATE:
DRAWN: DB
CHECKED: N/A
PROJECT #:

DESCRIPTION	DRW	CHK	DATE

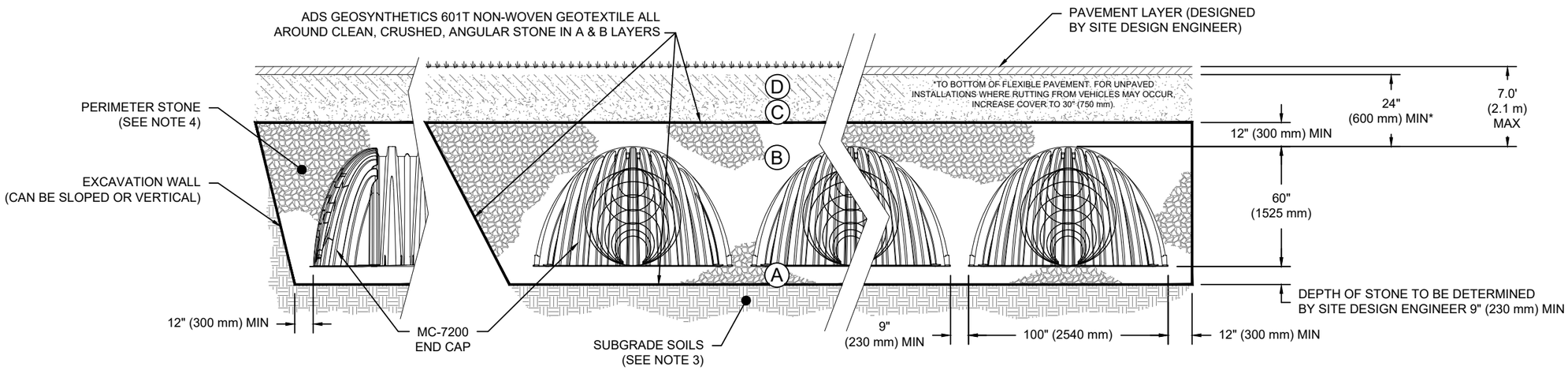
StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

0 20 40

ACCEPTABLE FILL MATERIALS: STORMTECH MC-7200 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101
2. MC-7200 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

CITRUS CHAMBERS 55K
FONTANA, CA, USA
DATE: DRAWN: DB CHECKED: N/A
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

StormTech® Chamber System
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4640 TRUEMAN BLVD
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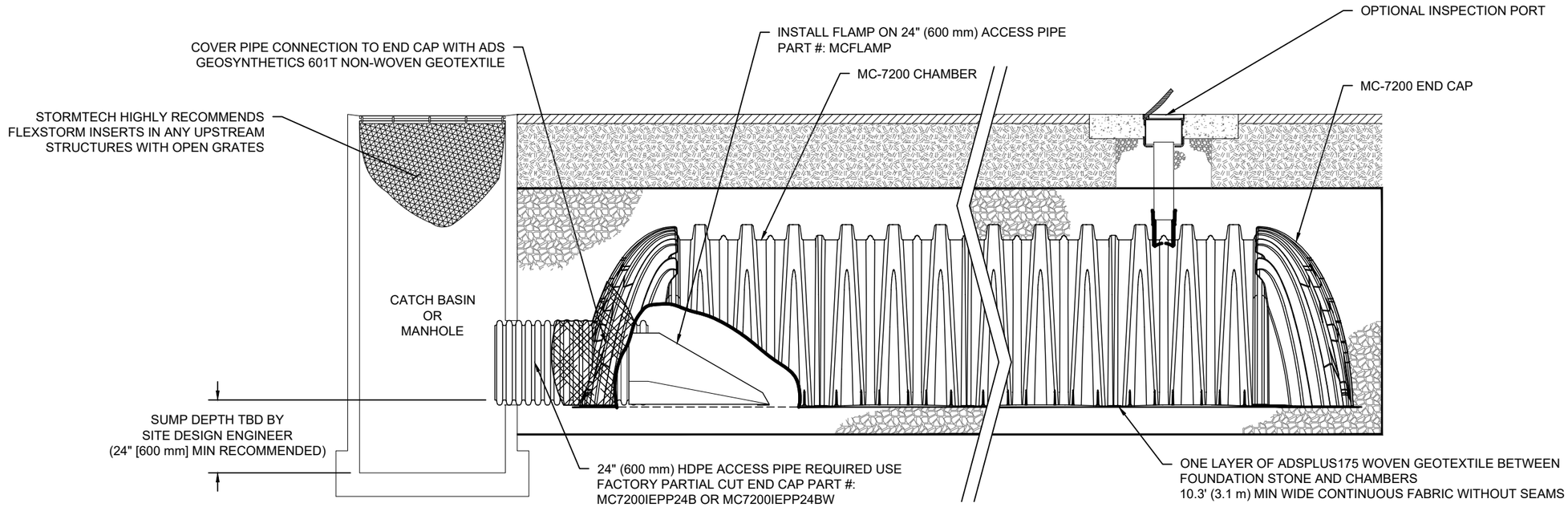
SHEET
3 OF 5



MC-7200 ISOLATOR ROW PLUS DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

CITRUS CHAMBERS 55K
FONTANA, CA, USA
DATE: DRAWN: DB
PROJECT #: CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

StormTech® Chamber System
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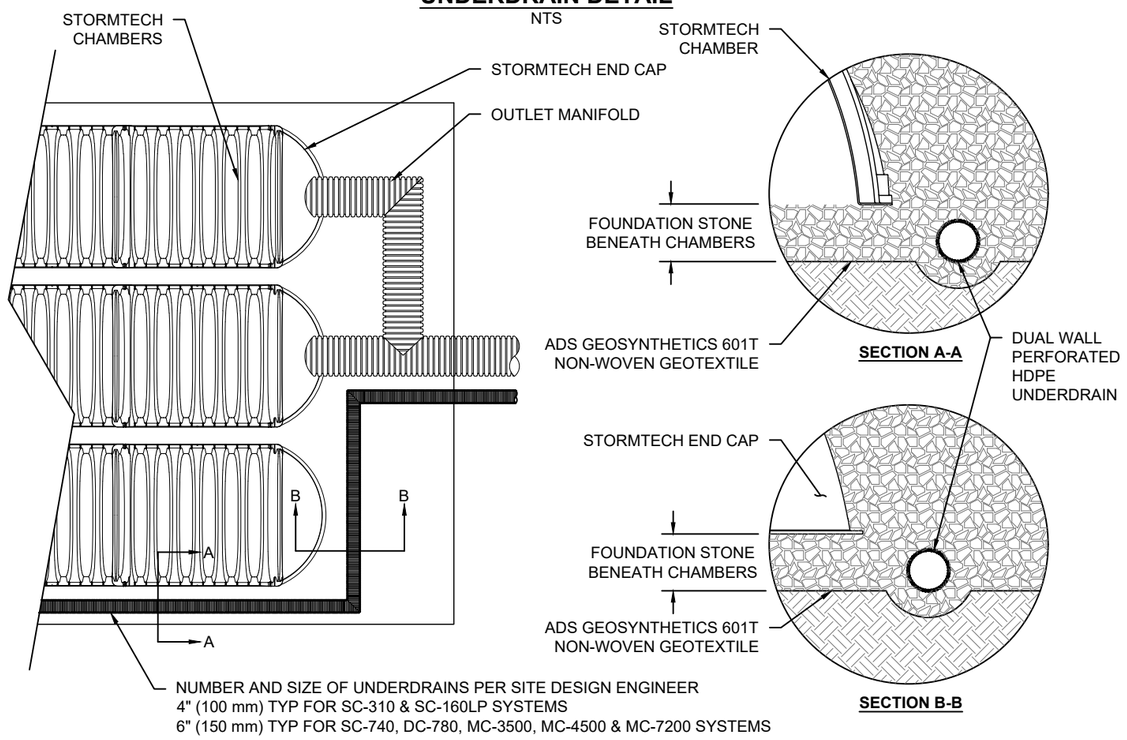
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

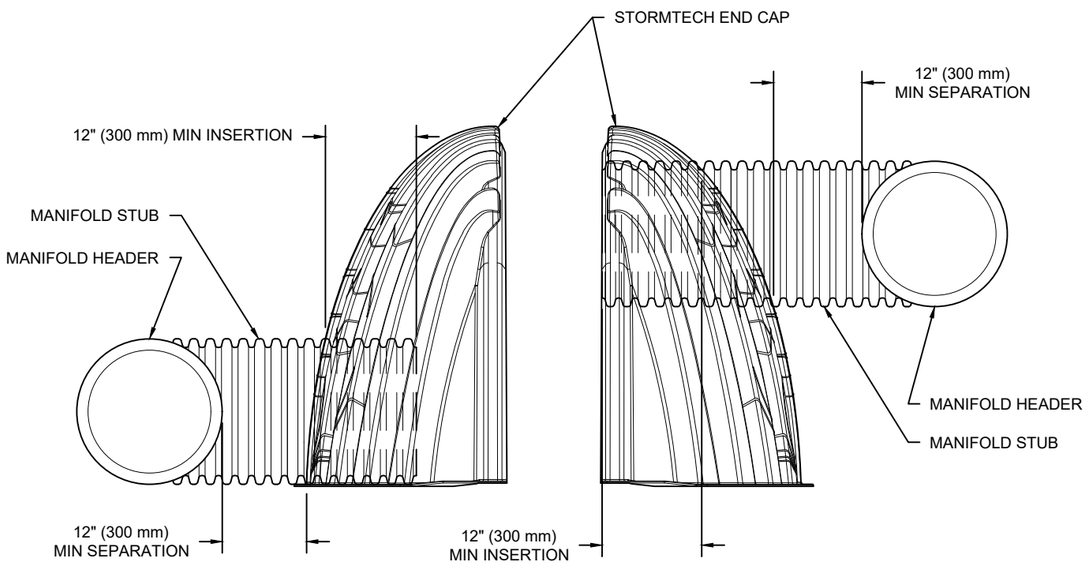
UNDERDRAIN DETAIL

NTS



MC-SERIES END CAP INSERTION DETAIL

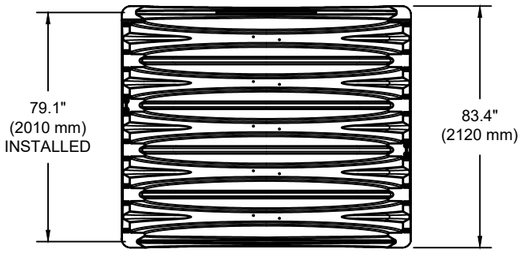
NTS

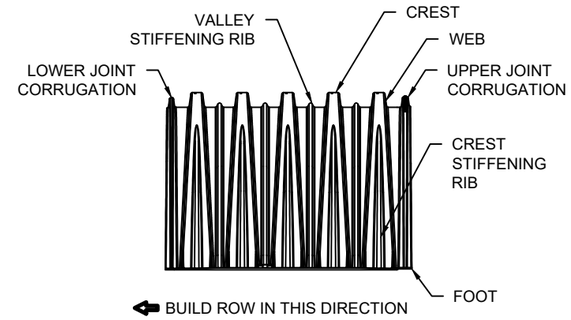


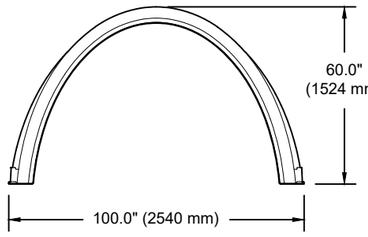
NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

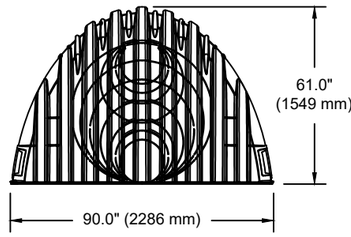
MC-7200 TECHNICAL SPECIFICATION

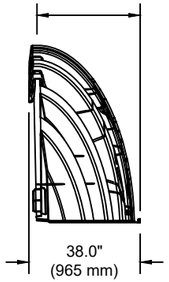
NTS











NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	100.0" X 60.0" X 79.1"	(2540 mm X 1524 mm X 2010 mm)
CHAMBER STORAGE	175.9 CUBIC FEET	(4.98 m³)
MINIMUM INSTALLED STORAGE*	267.3 CUBIC FEET	(7.56 m³)
WEIGHT (NOMINAL)	205 lbs.	(92.9 kg)

NOMINAL END CAP SPECIFICATIONS

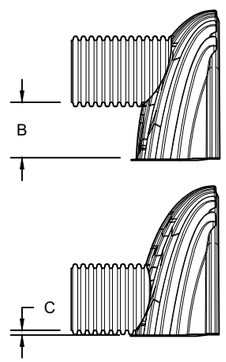
SIZE (W X H X INSTALLED LENGTH)	90.0" X 61.0" X 32.8"	(2286 mm X 1549 mm X 833 mm)
END CAP STORAGE	39.5 CUBIC FEET	(1.12 m³)
MINIMUM INSTALLED STORAGE*	115.3 CUBIC FEET	(3.26 m³)
WEIGHT (NOMINAL)	90 lbs.	(40.8 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION AND BETWEEN CHAMBERS, 12" (305 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

PARTIAL CUT HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
PARTIAL CUT HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC7200IEPP06T	6" (150 mm)	42.54" (1081 mm)	---
MC7200IEPP06B		---	0.86" (22 mm)
MC7200IEPP08T	8" (200 mm)	40.50" (1029 mm)	---
MC7200IEPP08B		---	1.01" (26 mm)
MC7200IEPP10T	10" (250 mm)	38.37" (975 mm)	---
MC7200IEPP10B		---	1.33" (34 mm)
MC7200IEPP12T	12" (300 mm)	35.69" (907 mm)	---
MC7200IEPP12B		---	1.55" (39 mm)
MC7200IEPP15T	15" (375 mm)	32.72" (831 mm)	---
MC7200IEPP15B		---	1.70" (43 mm)
MC7200IEPP18T	18" (450 mm)	29.36" (746 mm)	---
MC7200IEPP18TW			
MC7200IEPP18B		---	1.97" (50 mm)
MC7200IEPP18BW			
MC7200IEPP24T	24" (600 mm)	23.05" (585 mm)	---
MC7200IEPP24TW			
MC7200IEPP24B		---	2.26" (57 mm)
MC7200IEPP24BW			
MC7200IEPP30BW	30" (750 mm)	---	2.95" (75 mm)
MC7200IEPP36BW	36" (900 mm)	---	3.25" (83 mm)
MC7200IEPP42BW	42" (1050 mm)	---	3.55" (90 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PREFABRICATED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-7200 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

CITRUS CHAMBERS 55K
FONTANA, CA, USA
DATE: DRAWN: DB CHECKED: N/A
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

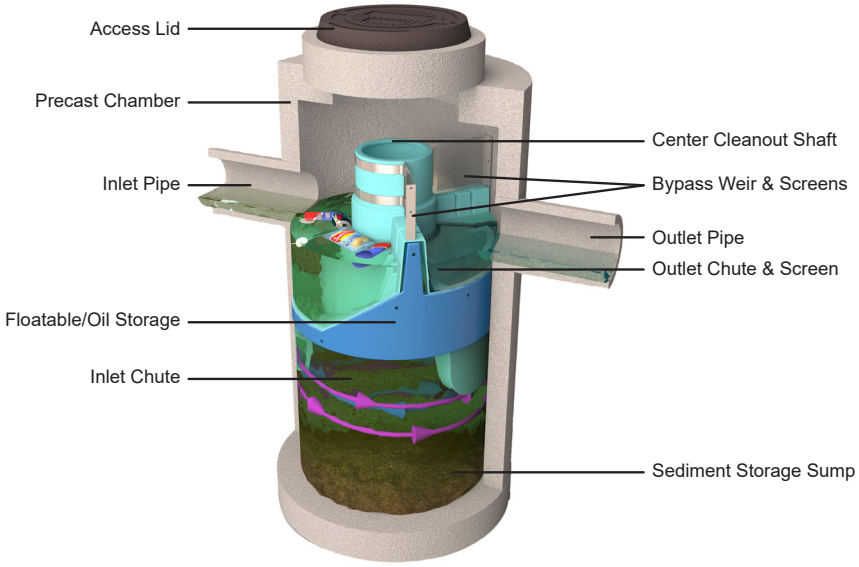
First Defense® FTC

Full Trash Capture Hydrodynamic Separator

Product Summary

First Defense Full Trash Capture (FTC) is an advanced hydrodynamic separator that combines enhanced vortex technology for total suspended solids (TSS) removal with a 5mm screen to meet full trash capture requirements set by the California Water Boards.*

Features



*One-hour, one-year design storm.

Applications

- Removal of Total Suspended Solids (TSS), floatable trash, and petroleum products from stormwater runoff
- New construction or redevelopment of commercial and residential sites
- Pre-treatment for green infrastructure and ponds
- Pollutant hotspots such as maintenance yards, parking lots, gas stations, streets, highways, airports and transportation hubs
- LEED® development projects
- Retrofitting existing systems

How It Works

1. Stormwater enters the Inlet Chute, where water is directed downwards and into a rotational motion around the Sediment Storage Sump.
2. Free floating trash is retained in the Inlet Chute area. Sediment and other settleable solids are retained in the Sediment Storage Sump as water follows a rotational path to the screened Outlet Chute.
3. Water then exits upward in the Outlet Chute where a horizontal screen prevents the loss of any suspended debris larger than 5mm. High flows can bypass directly to the outlet via the Bypass Weirs.
4. Two Bypass Screens continue to treat and retain the free floating debris. In extreme events water can crest the bypass screen and go directly to the outlet to prevent upstream flooding.

Model Number	Diameter	Maximum Pipe Diameter[1]	Trash Storage Capacity[2]	Flow Rate (cfs) for Screen Blinding Percentage[3]				Bypass Capacity	Typical TSS Treatment Rates
Model	(ft / m)	(in / mm)	(yd^3 / m^3)	0%	25%	50%	75%	(cfs)	(cfs / L/s)
FD-4 FTC	4 / 1.2	24 / 600	0.83 / 0.63	7.94	7.10	5.27	3.43	18	1.88 / 53.2
FD-5 FTC	5 / 1.5	24 / 600	1.54 / 1.18	13.02	10.51	7.87	6.07	20	2.94 / 83.2
FD-6 FTC	6 / 1.8	30 / 750	2.22 / 1.70	25.60	21.50	16.01	10.66	32	4.23 / 119.8
FD-8 FTC	8 / 2.4	48 / 1219	5.28 / 4.00	34.16	33.75	26.29	16.88	50	7.52 / 212.9

[1]Contact Hydro International when larger pipe sizes are required.
[2]Trash storage volume estimated as half the chamber volume from the base of the Inlet Chute to top of Bypass Weirs (not bypass screens). Actual volume of material stored will vary with size, density, and type. Larger volumes of trash may be retained.
[3]Calculated using HydroCAD modelling. A lower blinding factor can be applied to sites with lower anticipated loads.

For Pre-Treatment Device B

For Pre-Treatment Device A

Hydro International, 94 Hutchins Drive, Portland, ME 04102
Tel: (207) 756-6200
Email: stormwaterinquiry@hydro-int.com
Web: www.hydro-int.com/firstdefense

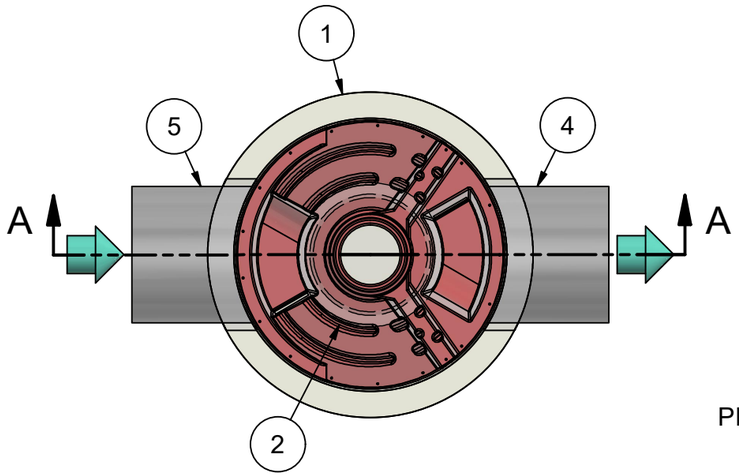
FD-FTC_SS_E_2110

Download Drawings:

→ hydro-int.com/fddrawings

Operation & Maintenance Manual:

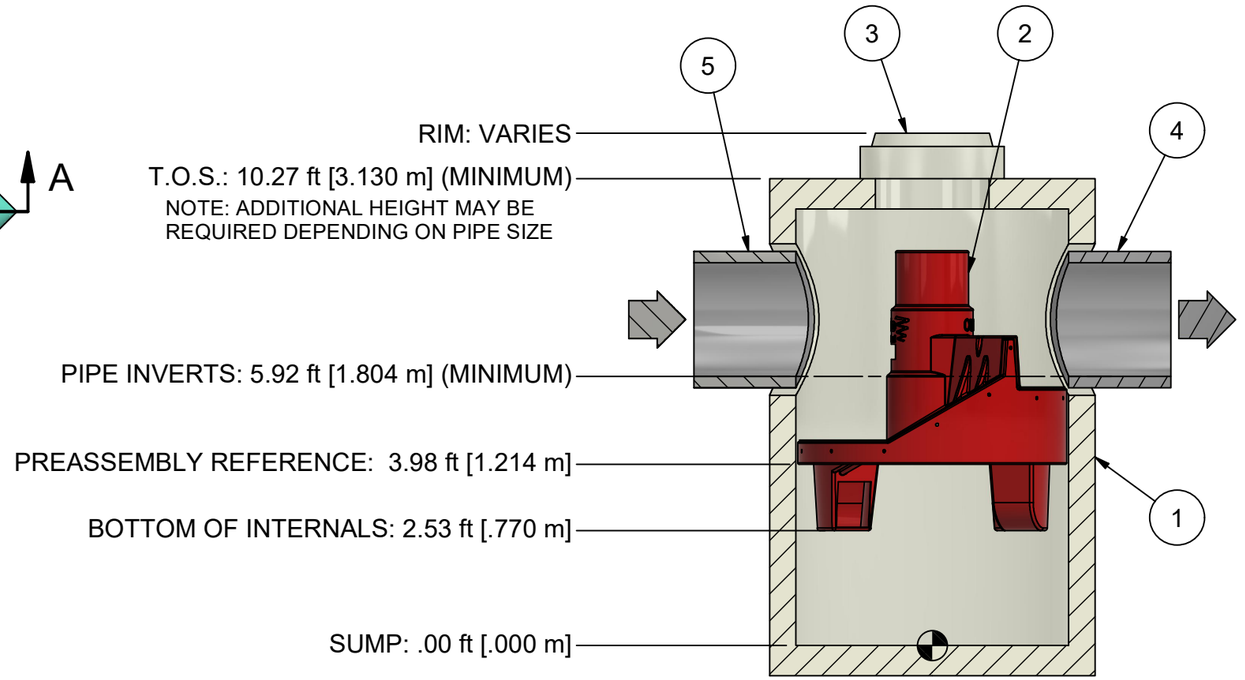
→ hydro-int.com/fd-om



PLAN VIEW

HYDRO FRAME AND COVER (INCLUDED)

GRADE RINGS BY OTHERS AS REQUIRED



SECTION A-A
SCALE 1:40

1. MANHOLE WALL AND SLAB THICKNESSES ARE NOT TO SCALE.

2. CONTACT HYDRO INTERNATIONAL FOR A BOTTOM OF STRUCTURE ELEVATION PRIOR TO SETTING FIRST DEFENSE MANHOLE.

3. CONTRACTOR TO CONFIRM RIM, PIPE INVERTS, PIPE DIA. AND PIPE ORIENTATION PRIOR TO RELEASE OF UNIT TO FABRICATION.

PROJECTION

IF IN DOUBT ASK

DATE:	SCALE:
11/2/2021	1:40

DRAWN BY:	CHECKED BY:	APPROVED BY
ER	MRJ	

Title
6-ft DIAMETER
FIRST DEFENSE
FOR PRE-TREAMENT DEVICE B
GENERAL ARRANGEMENT

Hydro International®
hydro-int.com
HYDRO INTERNATIONAL

WEIGHT:	MATERIAL:

STOCK NUMBER: 1

DRAWING NO.: FD GA-6

SHEET SIZE:	SHEET:	Rev:
B	1 OF 1	-

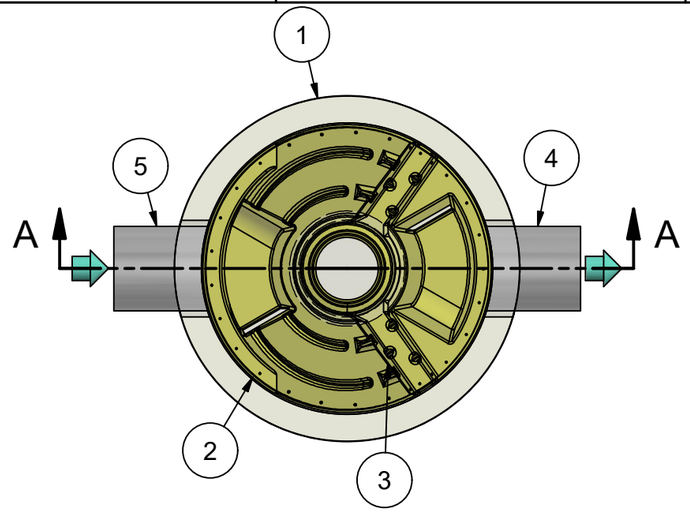
PRODUCT SPECIFICATION:

1. Peak Hydraulic Flow: 32.0 cfs (906 l/s)
2. Min Sediment Storage Capacity: 1.6 cu. yd. (1.2 cu. m.)
3. Maximum Inlet/Outlet Pipe Diameters: 30 in. (750 mm)
4. The treatment system shall use an induced vortex to separate pollutants from stormwater runoff.
5. For more product information including regulatory acceptances, please visit https://hydro-int.com/en/products/first-defense

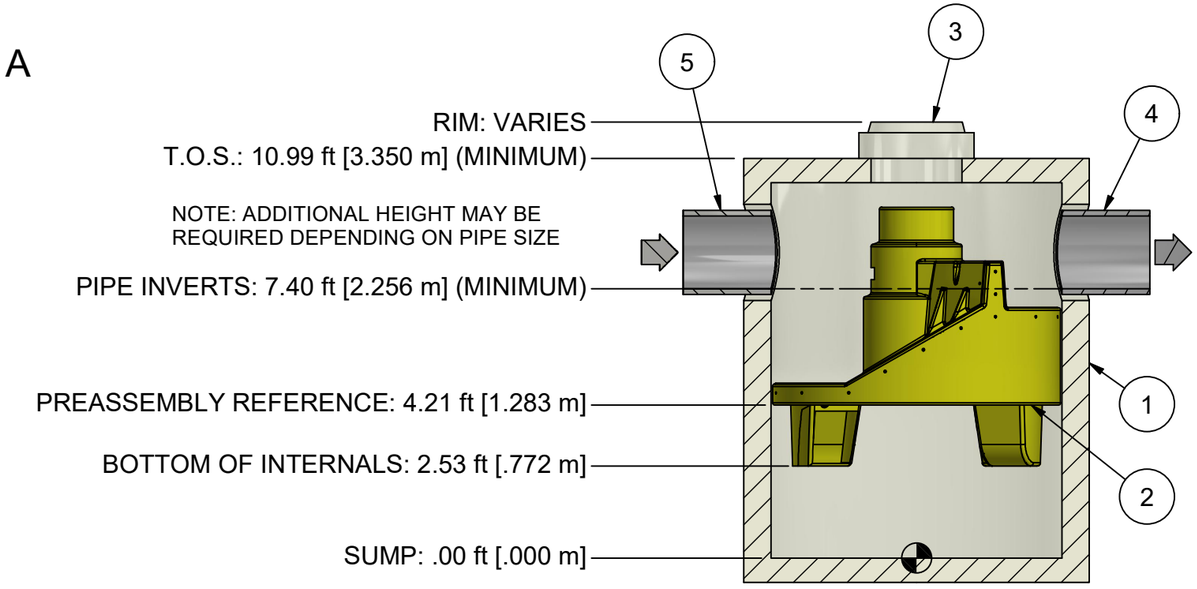
GENERAL NOTES:
1. General Arrangement drawings only. Contact Hydro International for site specific drawings.
2. The diameter of the inlet and outlet pipes may be no more than 30".
3. Multiple inlet pipes possible (refer to project plan).
4. Inlet/outlet pipe angle can vary to align with drainage network (refer to project plans).
5. Peak flow rate and minimum height limited by available cover and pipe diameter.
6. Larger sediment storage capacity may be provided with a deeper sump depth.

PARTS LIST

ITEM	QTY	SIZE (in)	SIZE (mm)	DESCRIPTION
1	1	72	1800	I.D. PRECAST MANHOLE
2	1			INTERNAL COMPONENTS (PRE-INSTALLED)
3	1	30	750	FRAME AND COVER (ROUND)
4	1	30 (MAX)	750 (MAX)	OUTLET PIPE (BY OTHERS)
5	1	30 (MAX)	750 (MAX)	INLET PIPE (BY OTHERS)



PLAN VIEW



SECTION A-A

HYDRO FRAME AND COVER (INCLUDED)

GRADE RINGS BY OTHERS AS REQUIRED

PRODUCT SPECIFICATION:

1. Peak Hydraulic Flow: 50.0 cfs (1415 l/s)
2. Min Sediment Storage Capacity: 2.8 cu. yd. (2.1 cu. m.)
3. Maximum Inlet/Outlet Pipe Diameters: 48 in. (1200 mm)
4. The treatment system shall use an induced vortex to separate pollutants from stormwater runoff.
5. For more product information including regulatory acceptances, please visit https://hydro-int.com/en/products/first-defense

GENERAL NOTES:
1. General Arrangement drawings only. Contact Hydro International for site specific drawings.
2. The diameter of the inlet and outlet pipes may be no more than 48".
3. Multiple inlet pipes possible (refer to project plan).
4. Inlet/outlet pipe angle can vary to align with drainage network (refer to project plans).
5. Peak flow rate and minimum height limited by available cover and pipe diameter.
6. Larger sediment storage capacity may be provided with a deeper sump depth.

PARTS LIST

ITEM	QTY	SIZE (in)	SIZE (mm)	DESCRIPTION
1	1	96	2400	I.D. PRECAST MANHOLE
2	1			INTERNAL COMPONENTS (PRE-INSTALLED)
3	1	30	750	FRAME AND COVER (ROUND)
4	1	48 (MAX)	1200 (MAX)	OUTLET PIPE (BY OTHERS)
5	1	48 (MAX)	1200 (MAX)	INLET PIPE (BY OTHERS)

1. MANHOLE WALL AND SLAB THICKNESSES ARE NOT TO SCALE.

2. CONTACT HYDRO INTERNATIONAL FOR A BOTTOM OF STRUCTURE ELEVATION PRIOR TO SETTING FIRST DEFENSE MANHOLE.

3. CONTRACTOR TO CONFIRM RIM, PIPE INVERTS, PIPE DIA. AND PIPE ORIENTATION PRIOR TO RELEASE OF UNIT TO FABRICATION.

PROJECTION

IF IN DOUBT ASK

DATE:	SCALE:
11/2/2021	1:50

DRAWN BY:	CHECKED BY:	APPROVED BY
ER	MRJ	

Title
8-ft DIAMETER
FIRST DEFENSE
FOR PRE-TREAMENT DEVICE A
GENERAL ARRANGEMENT

Hydro International®
hydro-int.com
HYDRO INTERNATIONAL

WEIGHT:	MATERIAL:

STOCK NUMBER:

DRAWING NO.: FD GA-8

SHEET SIZE:	SHEET:	Rev:
B	1 OF 1	-

6.4.4 NOAA Atlas 14 Rainfall Data

NOAA Atlas 14, Volume 6, Version 2
Location name: Fontana, California, USA*
Latitude: 34.0638°, Longitude: -117.4517°
Elevation: m/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	**0.107** (0.089-0.130)	**0.140** (0.117-0.170)	**0.186** (0.154-0.226)	**0.225** (0.185-0.276)	**0.280** (0.223-0.356)	**0.326** (0.253-0.423)	**0.373** (0.283-0.497)	**0.425** (0.313-0.583)	**0.499** (0.352-0.714)	**0.560** (0.381-0.830)
10-min	**0.153** (0.128-0.186)	**0.201** (0.167-0.244)	**0.266** (0.221-0.324)	**0.322** (0.265-0.396)	**0.402** (0.320-0.511)	**0.467** (0.363-0.606)	**0.535** (0.406-0.713)	**0.609** (0.449-0.835)	**0.715** (0.505-1.02)	**0.802** (0.546-1.19)
15-min	**0.185** (0.154-0.225)	**0.243** (0.202-0.295)	**0.322** (0.267-0.392)	**0.390** (0.321-0.478)	**0.486** (0.387-0.618)	**0.564** (0.439-0.733)	**0.647** (0.491-0.862)	**0.737** (0.543-1.01)	**0.865** (0.610-1.24)	**0.970** (0.661-1.44)
30-min	**0.277** (0.231-0.336)	**0.364** (0.303-0.442)	**0.483** (0.400-0.587)	**0.584** (0.480-0.716)	**0.728** (0.579-0.925)	**0.845** (0.657-1.10)	**0.969** (0.735-1.29)	**1.10** (0.813-1.51)	**1.30** (0.914-1.85)	**1.45** (0.989-2.15)
60-min	**0.407** (0.339-0.493)	**0.533** (0.444-0.647)	**0.707** (0.587-0.861)	**0.856** (0.704-1.05)	**1.07** (0.849-1.36)	**1.24** (0.964-1.61)	**1.42** (1.08-1.89)	**1.62** (1.19-2.22)	**1.90** (1.34-2.72)	**2.13** (1.45-3.16)
2-hr	**0.609** (0.507-0.738)	**0.788** (0.656-0.957)	**1.03** (0.854-1.25)	**1.23** (1.01-1.51)	**1.51** (1.20-1.91)	**1.73** (1.34-2.24)	**1.95** (1.48-2.60)	**2.19** (1.62-3.01)	**2.53** (1.79-3.62)	**2.80** (1.91-4.15)
3-hr	**0.775** (0.646-0.940)	**0.999** (0.832-1.21)	**1.30** (1.08-1.58)	**1.54** (1.27-1.89)	**1.87** (1.49-2.38)	**2.13** (1.66-2.77)	**2.40** (1.82-3.19)	**2.68** (1.97-3.67)	**3.06** (2.16-4.38)	**3.36** (2.29-4.99)
6-hr	**1.11** (0.923-1.34)	**1.43** (1.19-1.73)	**1.84** (1.53-2.24)	**2.17** (1.79-2.66)	**2.62** (2.08-3.33)	**2.96** (2.30-3.84)	**3.30** (2.51-4.40)	**3.66** (2.69-5.01)	**4.13** (2.92-5.91)	**4.50** (3.06-6.67)
12-hr	**1.47** (1.22-1.78)	**1.90** (1.59-2.31)	**2.46** (2.04-2.99)	**2.90** (2.38-3.56)	**3.48** (2.77-4.42)	**3.91** (3.04-5.08)	**4.34** (3.29-5.78)	**4.78** (3.52-6.55)	**5.35** (3.78-7.66)	**5.78** (3.94-8.57)
24-hr	**1.98** (1.75-2.28)	**2.60** (2.30-3.00)	**3.39** (2.99-3.93)	**4.01** (3.51-4.68)	**4.82** (4.08-5.81)	**5.42** (4.50-6.67)	**6.01** (4.87-7.57)	**6.59** (5.19-8.53)	**7.36** (5.57-9.92)	**7.93** (5.80-11.1)
2-day	**2.38** (2.11-2.74)	**3.21** (2.84-3.70)	**4.26** (3.76-4.93)	**5.09** (4.46-5.94)	**6.19** (5.24-7.46)	**7.01** (5.81-8.62)	**7.81** (6.33-9.84)	**8.63** (6.80-11.2)	**9.69** (7.33-13.1)	**10.5** (7.68-14.6)
3-day	**2.57** (2.28-2.96)	**3.52** (3.12-4.07)	**4.75** (4.19-5.49)	**5.73** (5.01-6.68)	**7.03** (5.95-8.47)	**8.01** (6.64-9.85)	**8.99** (7.28-11.3)	**9.98** (7.87-12.9)	**11.3** (8.55-15.2)	**12.3** (9.00-17.2)
4-day	**2.76** (2.44-3.18)	**3.83** (3.39-4.42)	**5.21** (4.60-6.03)	**6.32** (5.53-7.38)	**7.81** (6.62-9.42)	**8.95** (7.42-11.0)	**10.1** (8.17-12.7)	**11.2** (8.86-14.6)	**12.8** (9.68-17.2)	**14.0** (10.2-19.5)
7-day	**3.13** (2.77-3.60)	**4.43** (3.92-5.11)	**6.13** (5.41-7.10)	**7.52** (6.58-8.77)	**9.40** (7.96-11.3)	**10.8** (8.99-13.3)	**12.3** (9.96-15.5)	**13.8** (10.9-17.9)	**15.8** (12.0-21.4)	**17.4** (12.7-24.3)
10-day	**3.38** (2.99-3.89)	**4.84** (4.28-5.59)	**6.77** (5.97-7.84)	**8.35** (7.31-9.74)	**10.5** (8.90-12.7)	**12.2** (10.1-15.0)	**13.9** (11.3-17.5)	**15.7** (12.4-20.3)	**18.1** (13.7-24.4)	**20.0** (14.6-27.9)
20-day	**4.03** (3.57-4.65)	**5.86** (5.18-6.76)	**8.31** (7.33-9.62)	**10.4** (9.07-12.1)	**13.2** (11.2-15.9)	**15.5** (12.9-19.1)	**17.8** (14.5-22.5)	**20.3** (16.0-26.3)	**23.8** (18.0-32.1)	**26.6** (19.4-37.1)
30-day	**4.76** (4.21-5.49)	**6.89** (6.09-7.95)	**9.81** (8.65-11.4)	**12.3** (10.7-14.3)	**15.8** (13.4-19.0)	**18.6** (15.4-22.9)	**21.5** (17.4-27.1)	**24.7** (19.5-32.0)	**29.1** (22.1-39.3)	**32.8** (24.0-45.7)
45-day	**5.65** (5.01-6.52)	**8.07** (7.13-9.31)	**11.4** (10.1-13.2)	**14.3** (12.5-16.7)	**18.4** (15.6-22.2)	**21.8** (18.1-26.8)	**25.4** (20.6-32.0)	**29.3** (23.1-38.0)	**34.9** (26.4-47.1)	**39.6** (28.9-55.2)
60-day	**6.69** (5.92-7.71)	**9.36** (8.28-10.8)	**13.1** (11.6-15.2)	**16.4** (14.3-19.1)	**21.1** (17.9-25.5)	**25.1** (20.8-30.8)	**29.3** (23.7-36.9)	**34.0** (26.8-44.0)	**40.7** (30.8-54.9)	**46.4** (33.9-64.7)

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

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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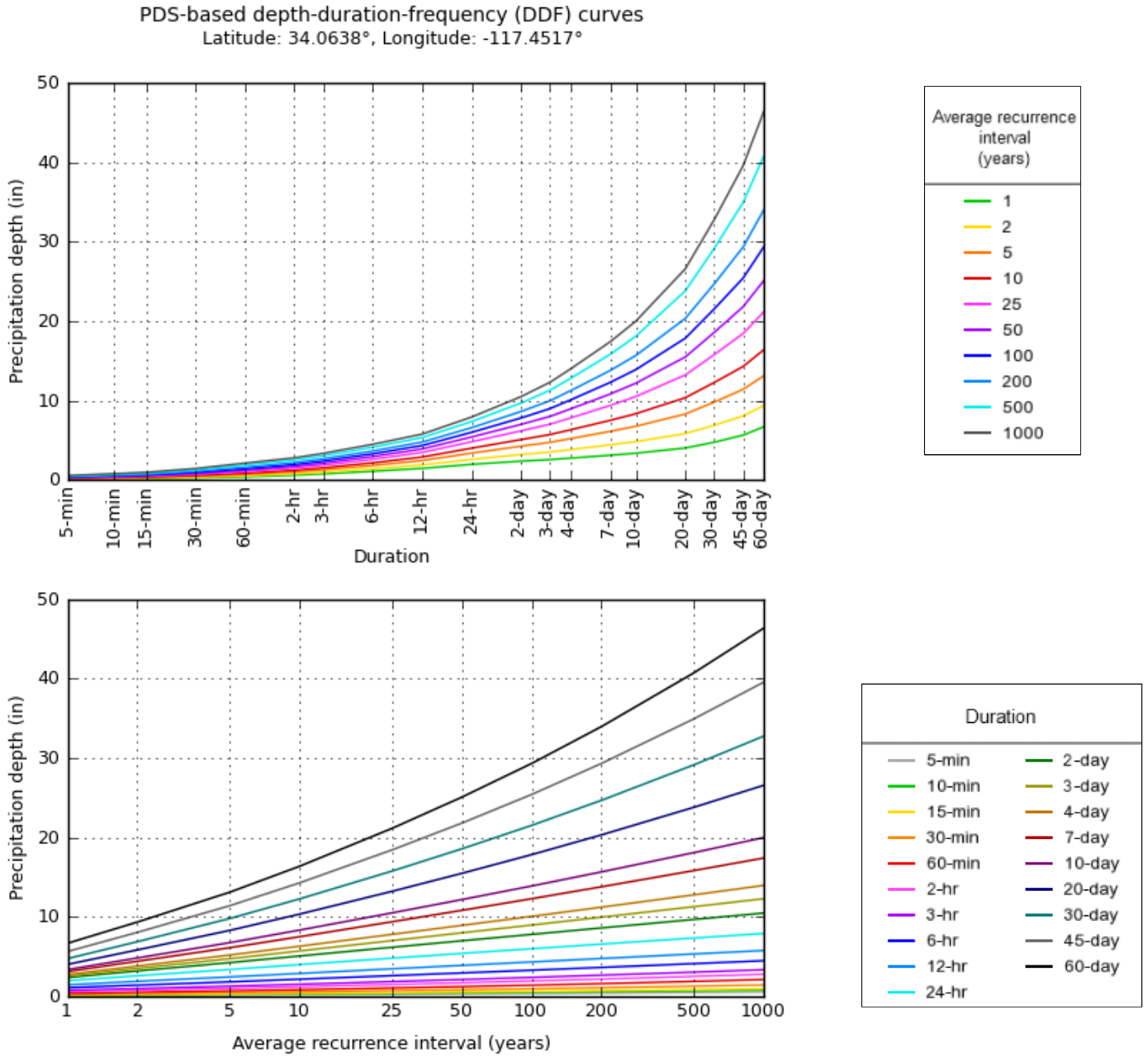
PF graphical



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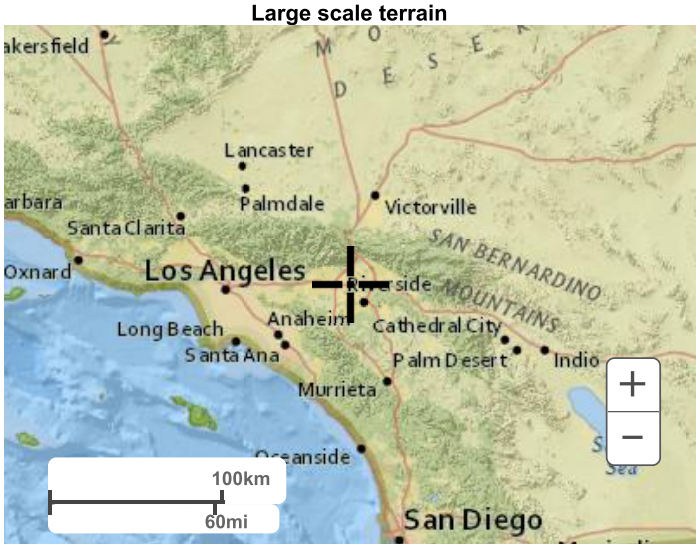
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map

Large scale aerial

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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: Fontana, California, USA*
Latitude: 34.0638°, Longitude: -117.4517°
Elevation: m/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	**1.28** (1.07-1.56)	**1.68** (1.40-2.04)	**2.23** (1.85-2.71)	**2.70** (2.22-3.31)	**3.36** (2.68-4.27)	**3.91** (3.04-5.08)	**4.48** (3.40-5.96)	**5.10** (3.76-7.00)	**5.99** (4.22-8.57)	**6.72** (4.57-9.96)
10-min	**0.918** (0.768-1.12)	**1.21** (1.00-1.46)	**1.60** (1.33-1.94)	**1.93** (1.59-2.38)	**2.41** (1.92-3.07)	**2.80** (2.18-3.64)	**3.21** (2.44-4.28)	**3.65** (2.69-5.01)	**4.29** (3.03-6.14)	**4.81** (3.28-7.13)
15-min	**0.740** (0.616-0.900)	**0.972** (0.808-1.18)	**1.29** (1.07-1.57)	**1.56** (1.28-1.91)	**1.94** (1.55-2.47)	**2.26** (1.76-2.93)	**2.59** (1.96-3.45)	**2.95** (2.17-4.04)	**3.46** (2.44-4.95)	**3.88** (2.64-5.75)
30-min	**0.554** (0.462-0.672)	**0.728** (0.606-0.884)	**0.966** (0.800-1.17)	**1.17** (0.960-1.43)	**1.46** (1.16-1.85)	**1.69** (1.31-2.19)	**1.94** (1.47-2.58)	**2.21** (1.63-3.02)	**2.59** (1.83-3.71)	**2.90** (1.98-4.31)
60-min	**0.407** (0.339-0.493)	**0.533** (0.444-0.647)	**0.707** (0.587-0.861)	**0.856** (0.704-1.05)	**1.07** (0.849-1.36)	**1.24** (0.964-1.61)	**1.42** (1.08-1.89)	**1.62** (1.19-2.22)	**1.90** (1.34-2.72)	**2.13** (1.45-3.16)
2-hr	**0.304** (0.254-0.369)	**0.394** (0.328-0.478)	**0.514** (0.427-0.626)	**0.614** (0.506-0.754)	**0.753** (0.598-0.957)	**0.863** (0.671-1.12)	**0.976** (0.740-1.30)	**1.10** (0.808-1.50)	**1.26** (0.892-1.81)	**1.40** (0.952-2.07)
3-hr	**0.258** (0.215-0.313)	**0.333** (0.277-0.404)	**0.431** (0.358-0.525)	**0.512** (0.422-0.629)	**0.623** (0.496-0.792)	**0.710** (0.552-0.922)	**0.799** (0.606-1.06)	**0.891** (0.657-1.22)	**1.02** (0.719-1.46)	**1.12** (0.763-1.66)
6-hr	**0.185** (0.154-0.224)	**0.238** (0.198-0.289)	**0.307** (0.255-0.373)	**0.362** (0.298-0.445)	**0.437** (0.348-0.555)	**0.494** (0.384-0.642)	**0.552** (0.418-0.735)	**0.610** (0.450-0.837)	**0.690** (0.487-0.987)	**0.751** (0.512-1.11)
12-hr	**0.122** (0.102-0.148)	**0.158** (0.132-0.192)	**0.204** (0.169-0.248)	**0.241** (0.198-0.295)	**0.289** (0.229-0.367)	**0.325** (0.253-0.422)	**0.360** (0.273-0.480)	**0.396** (0.292-0.543)	**0.444** (0.313-0.635)	**0.480** (0.327-0.712)
24-hr	**0.082** (0.073-0.095)	**0.108** (0.096-0.125)	**0.141** (0.125-0.164)	**0.167** (0.146-0.195)	**0.201** (0.170-0.242)	**0.226** (0.187-0.278)	**0.250** (0.203-0.315)	**0.275** (0.216-0.356)	**0.306** (0.232-0.413)	**0.330** (0.242-0.461)
2-day	**0.050** (0.044-0.057)	**0.067** (0.059-0.077)	**0.089** (0.078-0.103)	**0.106** (0.093-0.124)	**0.129** (0.109-0.155)	**0.146** (0.121-0.179)	**0.163** (0.132-0.205)	**0.180** (0.142-0.233)	**0.202** (0.153-0.272)	**0.219** (0.160-0.305)
3-day	**0.036** (0.032-0.041)	**0.049** (0.043-0.056)	**0.066** (0.058-0.076)	**0.080** (0.070-0.093)	**0.098** (0.083-0.118)	**0.111** (0.092-0.137)	**0.125** (0.101-0.157)	**0.139** (0.109-0.179)	**0.157** (0.119-0.212)	**0.171** (0.125-0.238)
4-day	**0.029** (0.025-0.033)	**0.040** (0.035-0.046)	**0.054** (0.048-0.063)	**0.066** (0.058-0.077)	**0.081** (0.069-0.098)	**0.093** (0.077-0.115)	**0.105** (0.085-0.132)	**0.117** (0.092-0.152)	**0.133** (0.101-0.180)	**0.146** (0.107-0.203)
7-day	**0.019** (0.016-0.021)	**0.026** (0.023-0.030)	**0.037** (0.032-0.042)	**0.045** (0.039-0.052)	**0.056** (0.047-0.067)	**0.065** (0.054-0.079)	**0.073** (0.059-0.092)	**0.082** (0.065-0.106)	**0.094** (0.071-0.127)	**0.104** (0.076-0.145)
10-day	**0.014** (0.012-0.016)	**0.020** (0.018-0.023)	**0.028** (0.025-0.033)	**0.035** (0.030-0.041)	**0.044** (0.037-0.053)	**0.051** (0.042-0.062)	**0.058** (0.047-0.073)	**0.065** (0.051-0.085)	**0.075** (0.057-0.102)	**0.083** (0.061-0.116)
20-day	**0.008** (0.007-0.010)	**0.012** (0.011-0.014)	**0.017** (0.015-0.020)	**0.022** (0.019-0.025)	**0.028** (0.023-0.033)	**0.032** (0.027-0.040)	**0.037** (0.030-0.047)	**0.042** (0.033-0.055)	**0.050** (0.038-0.067)	**0.055** (0.040-0.077)
30-day	**0.007** (0.006-0.008)	**0.010** (0.008-0.011)	**0.014** (0.012-0.016)	**0.017** (0.015-0.020)	**0.022** (0.019-0.026)	**0.026** (0.021-0.032)	**0.030** (0.024-0.038)	**0.034** (0.027-0.044)	**0.040** (0.031-0.055)	**0.045** (0.033-0.063)
45-day	**0.005** (0.005-0.006)	**0.007** (0.007-0.009)	**0.011** (0.009-0.012)	**0.013** (0.012-0.015)	**0.017** (0.014-0.021)	**0.020** (0.017-0.025)	**0.024** (0.019-0.030)	**0.027** (0.021-0.035)	**0.032** (0.024-0.044)	**0.037** (0.027-0.051)
60-day	**0.005** (0.004-0.005)	**0.006** (0.006-0.008)	**0.009** (0.008-0.011)	**0.011** (0.010-0.013)	**0.015** (0.012-0.018)	**0.017** (0.014-0.021)	**0.020** (0.016-0.026)	**0.024** (0.019-0.031)	**0.028** (0.021-0.038)	**0.032** (0.024-0.045)

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

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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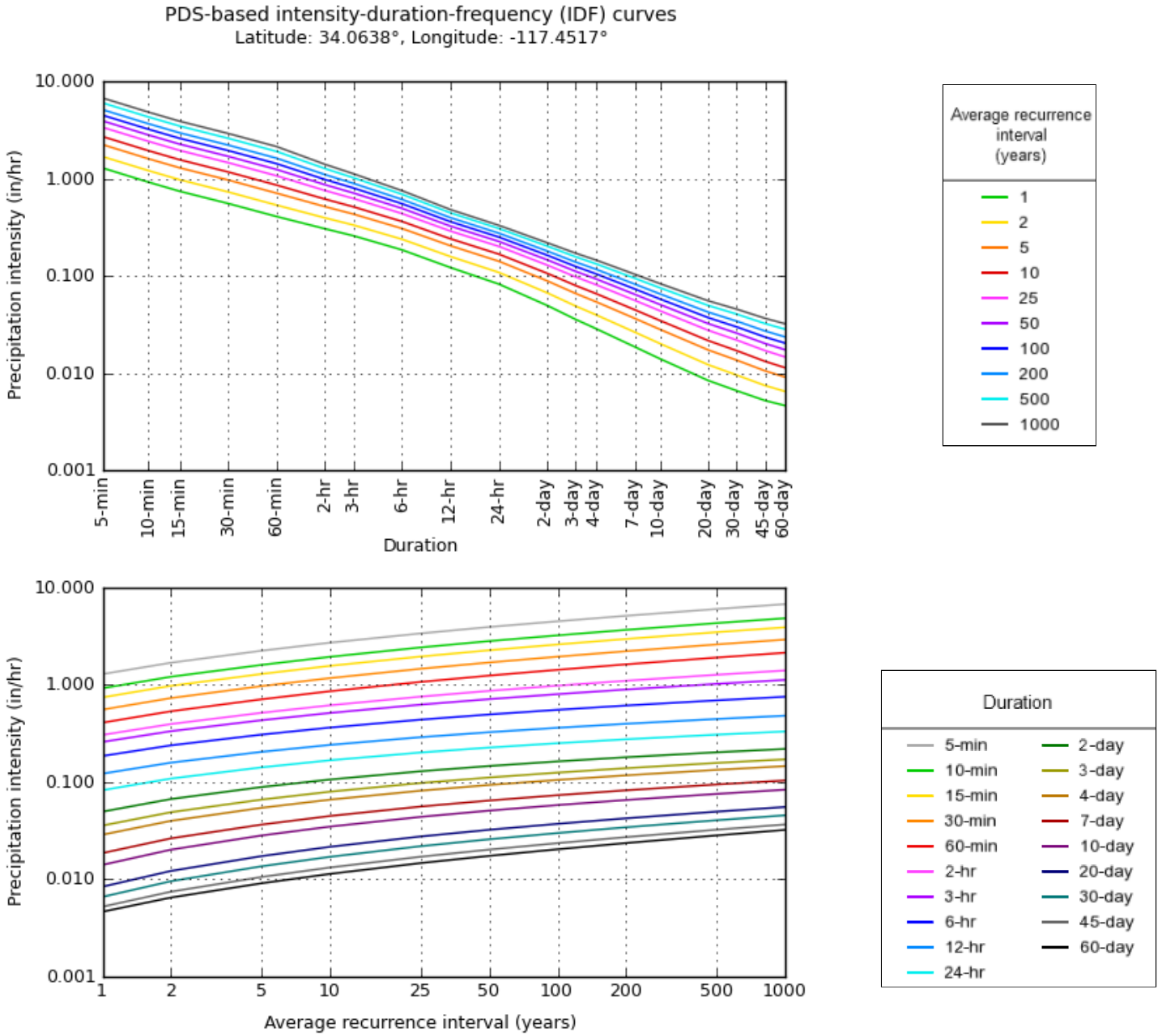
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Apr 12 21:07:05 2023

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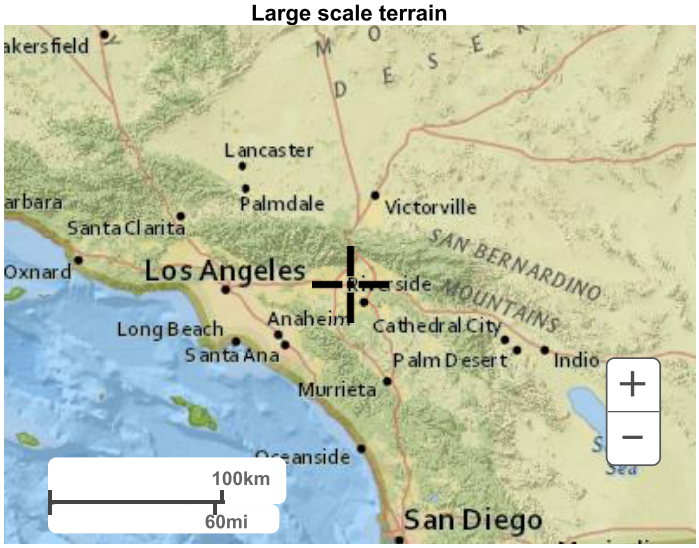
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map

Large scale aerial

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National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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6.4.5 Factor of Safety Worksheet

Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	1	0.25
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	1	0.25
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.0
B	Design	Tributary area size	0.25	2	0.5
		Level of pretreatment/ expected sediment loads	0.25	2	0.5
		Redundancy	0.25	2	0.5
		Compaction during construction	0.25	2	0.5
		Design Safety Factor, $S_B = \Sigma p$			2.0
Combined Safety Factor, $S_{TOT} = S_A \times S_B$					2.0
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)					
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} / K_M$					

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Note: The minimum combined adjustment factor shall not be less than 2.0 and the maximum combined adjustment factor shall not exceed 9.0.