Preliminary

Water Quality Management Plan (PWQMP)

Project Name:

HARVARD AVENUE/MICHELSON DRIVE INTERSECTION IMPROVEMENT PROJECT

HARVARD AVENUE & MICHELSON DRIVE

PLANNING AREA NO. 19

Prepared for:

CITY OF IRVINE

ONE CIVIC CENTER PLAZA

IRVINE, CA 92606-5208

(949) 724-6000

Prepared by:

STANTEC CONSULTING SERVICES, INC.

Engineer PHILLIP M. JONES, P.E. **Registration No.** C44010

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IRVINE, CA 92618-5312

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MARCH 2020

CITY OF IRVINE
BUILDING AND SAFETY DIVISION
WATER QUALITY MANAGEMENT PLAN

It is unlawful to make any changes or alterations on these plans without written permission from the City of Irvine Building and Safety Division. The approval of this plan & specifications SHALL NOT be held to permit or be an approval of the violation of any provisions of any City Ordinance or State Law, as may be found during field inspection.

Approved By –

DATE 6/24/2020

Preliminary Water Quality Management Plan (WQMP)

This Water Quality Management Plan (WQMP) has been prepared for the City of Irvine by Stantec Consulting Services, Inc. The WQMP is intended to comply with the requirements of the local NPDES Stormwater Program requiring the preparation of the plan.

This project is a street, road, highway or freeway of 5,000 square feet or more of paved surface or an above ground linear lined drainage project. Above ground linear lined drainage projects typically consist of lined vertical or trapezoidal channels. These projects may result in the creation of more than 10,000 square feet of impervious surface and have BMP implementation constraints similar to streets, roads, highways and freeways and must implement similar practices.

City of Irvine is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region. An appropriate number of approved and signed copies of this document shall be available on the subject site in perpetuity.

Public Agency Responsible Manager:			
Name/ Title	Steven Carrillo, Manager of Engineering/City Engineer		
Address	P.O. Box 19575, Irvine, CA 92623-9575		
Email	scarrillo@cityofirvine.org		
Telephone #	(949) 724-7325		
Signature	Steve Carrillo	Date	3/11/2020

Contents

Page No.

Section I Discretionary Permit(s) and Water Quality Conditions

Provide discretionary permit and water quality information. *Refer to Section 2.1 in the Technical Guidance Document (TGD) available from the Orange County Stormwater Program (ocwatersheds.com).*

Project Infomation	
CIP /Project No.	311906
Additional Information/ Comments:	Harvard Avenue & Michelson Drive Intersection Improvements
Water Quality Conditions	
Water Quality Conditions (list verbatim)	N/A
Watershed-Based Plan Conditions	
Provide applicable conditions from watershed - based plans including WIHMPs and TMDLS.	N/A

Section II Project Description

II.1 Project Description

Provide a detailed project description including:

- Project areas;
- Land uses;
- Land cover;
- Design elements;
- A general description not broken down by drainage management areas (DMAs).

Include attributes relevant to determining applicable source controls. *Refer to Section 2.2 in the TGD for information that must be included in the project description.*

Description of Proposed Project	
Development Category (Verbatim from WQMP):	Street Improvement
Project Area (ft^2): 110,400	SIC Code: N/A
Narrative Project Description:	The Harvard Avenue/Michelson Drive Intersection Improvements Project is located at the intersection of Harvard Avenue and Michelson Drive in the City of Irvine (Project). See Figure No. 1. The intersection is bounded by Boomers to the northwest, the University Synagogue to the southwest, Rancho San Joaquin Golf Course to the southeast and the Park West Apartment Homes to the northeast. Land uses within the project area are zoned for Commercial Recreation and Medium-High Density Residential. The subject intersection is bounded mainly by non-native landscaping strips with the exception of the east side of Harvard Avenue which is a landscaped slope down to an OCFCD, open-channel Flood Control Facility No. F14, San Joaquin Channel. The land cover is predominately asphalt and concrete with small to moderate landscaping to the southwest, north west, and north east. The southeast corner however is the F14 channel and the San Joaquin Hills Golf Course. There are a significant number of eucalyptus trees lining the southeast side of Harvard Avenue. The proposed intersection improvement is one of the mitigation projects identified in both the 2010 and 2015 Irvine Business Complex (IBC) Vision Plan Traffic Studies. The proposed project will provide capacity enhancements and improve circulation to the intersection.

<table>
<tr><td></td><td colspan="4">The intersection is bounded by Boomers to the northwest, the University Synagogue to the southwest, Rancho San Joaquin Golf Course to the southeast and the Park West Apartment Homes to the northeast.

The City of Irvine conducted a Traffic Analysis for the subject intersection which identified Alternative 1B as the preferred alternative which would provide a change in Level of Service (LOS) from E to D and accommodate future traffic demands. Alternative 1B consists of providing a second southbound left-turn lane on Harvard Avenue, removal of the existing "pork-chop" splitter island on the southwest corner to provide a conventional dedicated eastbound right-turn lane on Michelson Drive. Alternative 1B also includes the removal of the existing right-turn lane into the Irvine Lanes driveway and provides a seven-foot wide striped on-street bike lane with a three-foot wide buffer on the northwest corner. Also proposed is restriping the northbound approach on Harvard Avenue to provide a "defacto" right-turn lane and extending the left-turn lane on northbound Harvard Avenue from 245 feet to 295 feet. See Figure No. 2</td></tr>
<tr><td rowspan="2">Project Area</td><td colspan="2">Pervious</td><td colspan="2">Impervious</td></tr>
<tr><td>Area
(acres or sq ft)</td><td>Percentage</td><td>Area
(acres or sq ft)</td><td>Percentage</td></tr>
<tr><td>Pre-Project Conditions</td><td>32,800 SF</td><td>29.7%</td><td>77,600 SF</td><td>70.3%</td></tr>
<tr><td>Post-Project Conditions</td><td>22,200</td><td>20.1%</td><td>88,200</td><td>79.9%</td></tr>
<tr><td>Drainage Patterns/Connections</td><td colspan="4">Generally, the existing runoff drains in the southerly direction. The runoff is separated into three Drainage Management Areas (DMAs) as shown in Figure No. 3:

The proposed project drainage pattern will match the existing drainage pattern which is described as follows:

DMA No. 1 extends from the centerline of Harvard Avenue over the I-405 Freeway to the centerline of Michelson Drive and flows into a catch basin inlet located on the northwest corner of intersection.

DMA No. 2 consists mainly of the westerly slope along Harvard Avenue and flows into an existing CMP riser located 120 feet north of the aforementioned catch basin inlet within DMA No. 1. The CMP riser and catch basin inlet are connected by an 18-inch underground RCP storm drain which flows into the San Joaquin Channel (OCFCD Facility No.</td></tr>
</table>

	F14) just southerly of Michelson Drive. The San Joaquin Channel confluences with San Diego Creek (OCFCD Facility No. F05) approximately 1,000 feet downstream of the centerline of Michelson Drive. DMA No. 3 is located on the south side of Michelson Drive westerly of the intersection with Harvard Avenue. The portion of DMA No. 3 disturbed by this project flows in an easterly towards the intersection, then southerly to a catch basin inlet located on west side of Harvard Avenue approximately 360 feet south of the Harvard/Michelson Intersection centerline.

Figure No. 1
Location Map

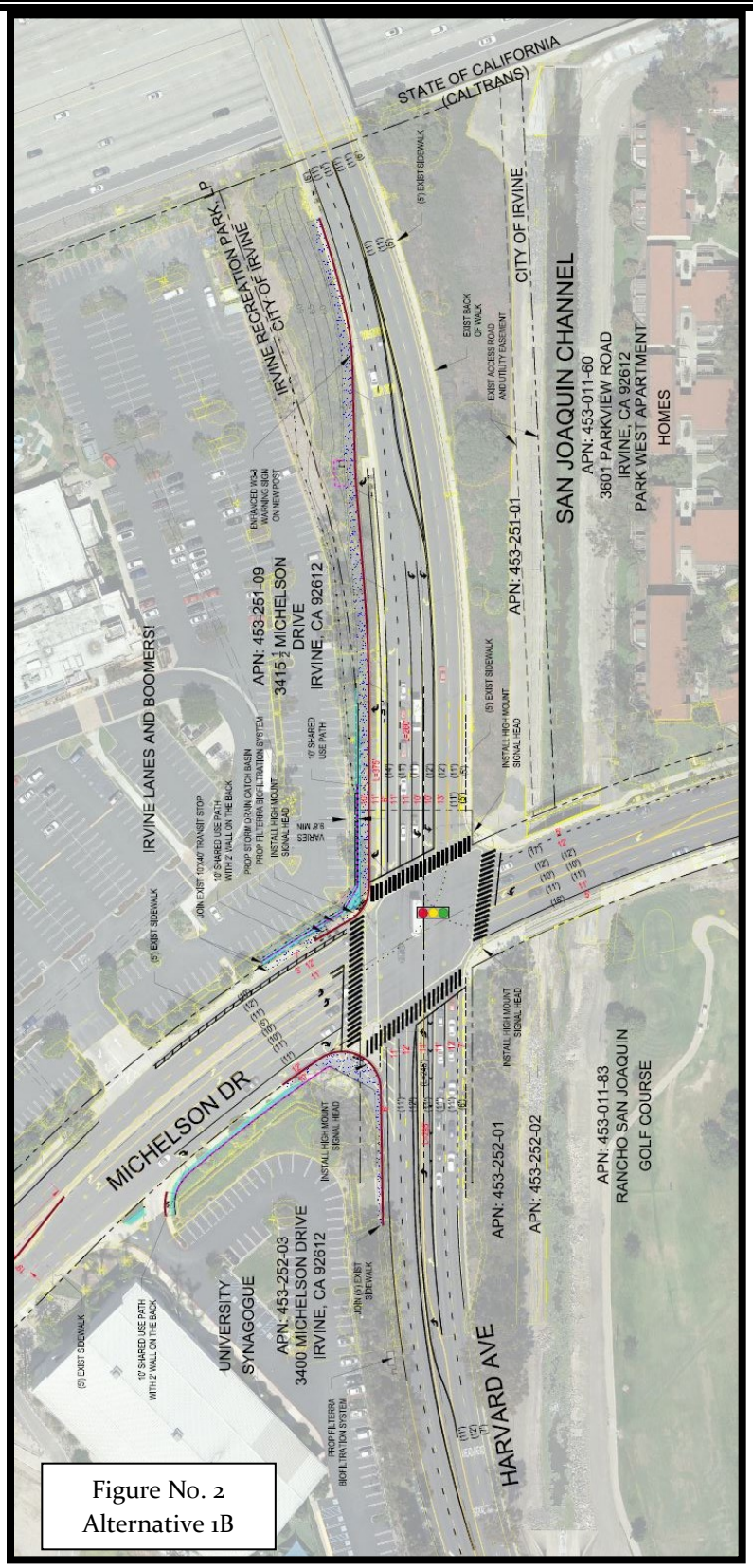


Figure No. 2
Alternative 1B

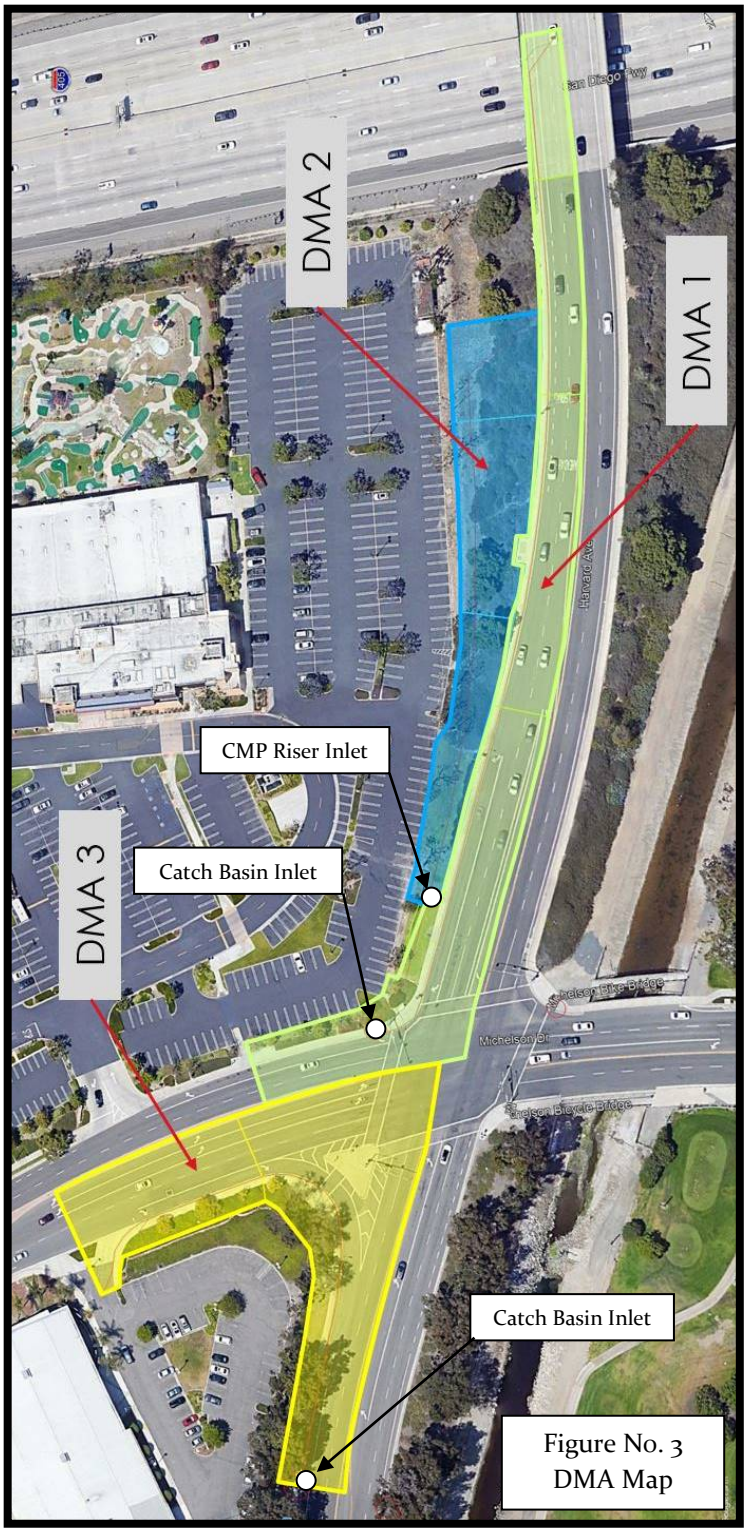


Figure No. 3
DMA Map

II.2 Potential Stormwater Pollutants

Determine and list expected stormwater pollutants based on land uses and site activities. *Refer to Section 2.2.2 and Table 2.1 in the TGD for guidance.*

Pollutants of Concern			
Pollutant	Circle One: E=Expected to be of concern N=Not Expected to be of concern		Additional Information and Comments
Suspended-Solid/ Sediment	(E)	N	
Nutrients	(E)	N	
Heavy Metals	(E)	N	
Pathogens (Bacteria/Virus)	(E)	N	
Pesticides	(E)	N	
Oil and Grease	(E)	N	
Toxic Organic Compounds	(E)	N	
Trash and Debris	(E)	N	

II.3 Hydrologic Conditions of Concern

Determine if streams located downstream from the project area are determined to be potentially susceptible to hydromodification impacts. *Refer to Section 2.2.3.1 in the TGD.*

☐ No – Show map

☒ Yes – Describe applicable hydrologic conditions of concern below. *Refer to Section 2.2.3 in the TGD.*

Per Figure No. XVI.3, "North Orange County Hydromodification Susceptibility Maps, Figure No. 4," of the Orange County Technical Guidance Document (OCTGD), the entire San Diego Creek watershed has been described as a *Potential Area of Erosion, Habitat, and Physical Structure Susceptibility*. See Figure No. 4. Therefore, the increased volume between the existing condition and the post-project condition must be mitigated.

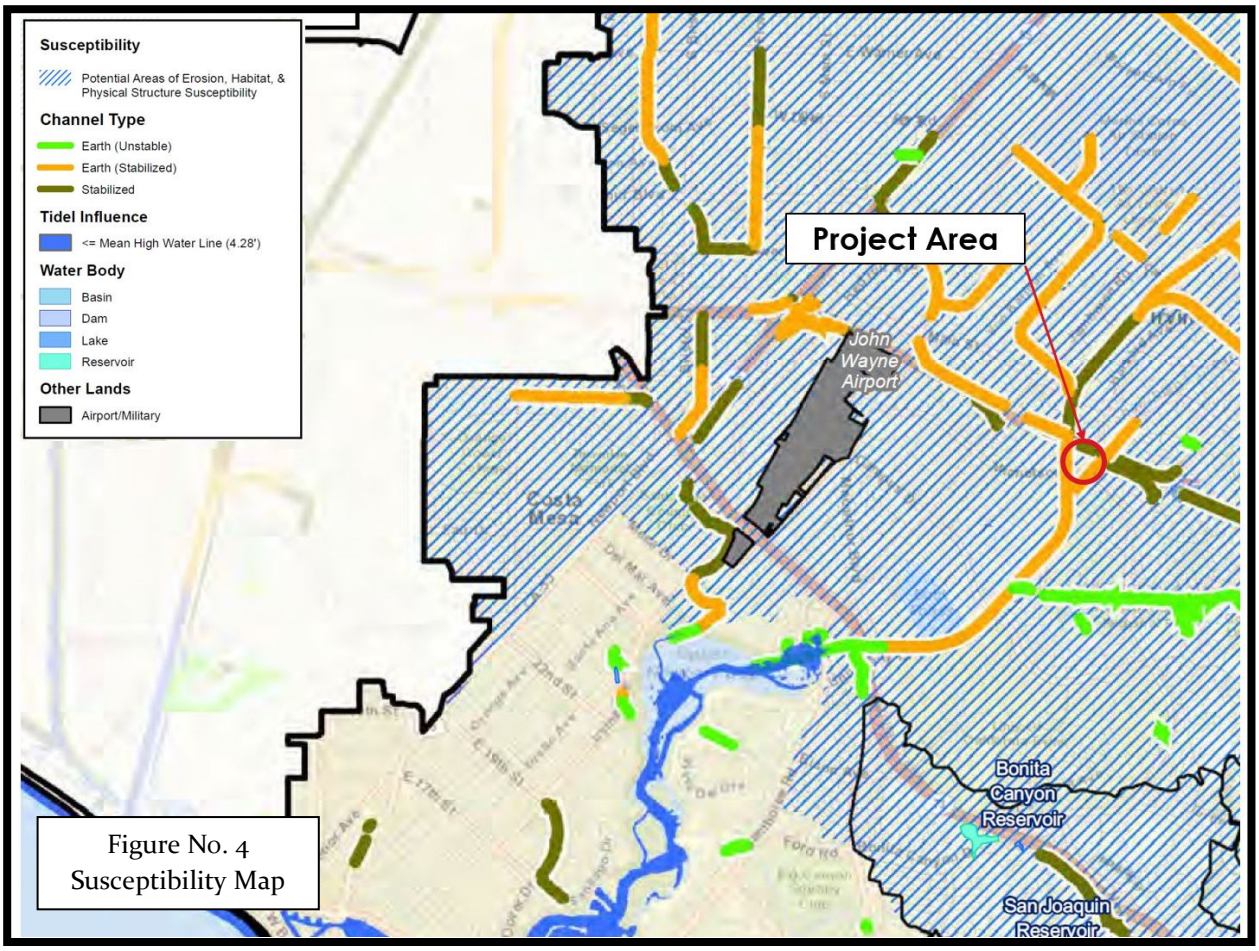


Figure No. 4
Susceptibility Map

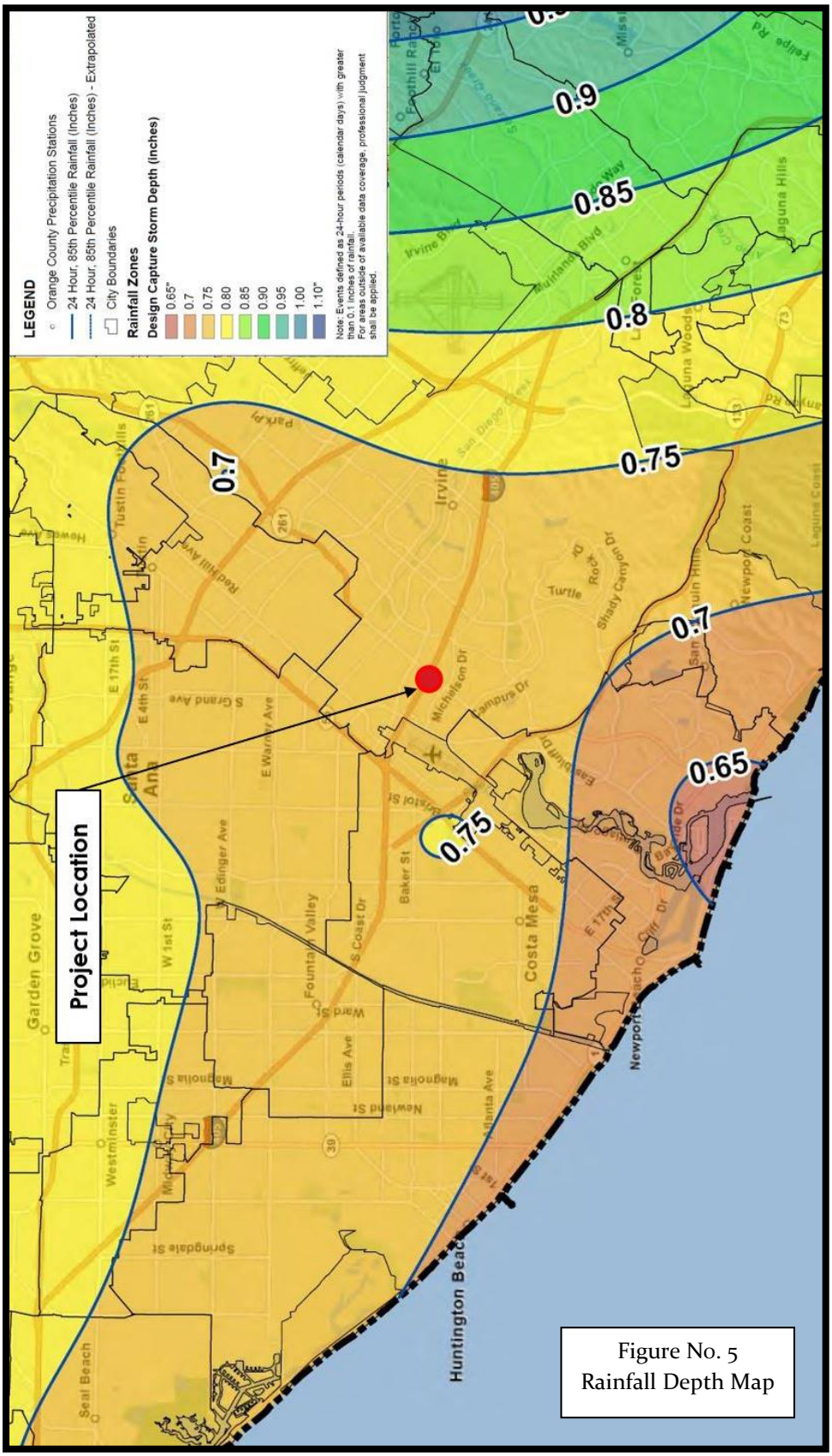


Figure No. 5
Rainfall Depth Map

	Drainage Area (Acres)		Time of Concentration (min.)		Runoff Volume (Acre-Feet)	
Drainage Area Description	Pre-Project	Post-Project	Pre-Project	Post-Project	Pre-Project	Post-Project
DMA 1	1.1	1.2	8.07	8.21	0.13	0.14
DMA 2	0.5	0.4	11.52	13.88	0.02	0.01
DMA 3	1.0	1.0	13.71	15.06	0.09	0.08
Totals	2.6	2.6	33.30	37.15	0.24	0.23

The total pre-Project 2-year 24-hour volume is 0.24 ac-ft; the post-Project 2-year 24-hour volume is 0.23 ac-ft. The total pre-Project 2-year 24-hour Tc is 33.30 minutes; the post-Project 2-year 24-hour Tc is 37.15 minutes.

$(V_{2\text{-yr, POST}} / V_{2\text{-yr, PRE}}) = 0.23 / 0.24 = 0.96 < 1.05$

$(Tc_{2\text{-yr, PRE}} / Tc_{2\text{-yr, POST}}) = 33.30/37.15 = 0.90 < 1.05$

Since the post-Project condition runoff volume does not exceed and time of concentration does not decrease from the pre-project condition by more than 5%, HCOCs do not exist for this project.

II.4 Post Development Drainage Characteristics

Describe post development drainage characteristics. *Refer to Section 2.2.4 in the TGD.*

The runoff generated from Harvard Avenue improvements north of Michelson Drive will flow in the southerly direction and are captured by an existing catch basin inlet located at the northwest corner of the Harvard/Michelson intersection. The runoff generated from the Michelson Drive improvements west of Harvard Avenue will flow in the easterly direction (towards the intersection) and will turn the southwest corner and head south along the west side of Harvard Avenue to be captured by an existing catch basin inlet along Harvard Avenue located approximately 360 feet south of the Harvard/Michelson intersection centerline.

The runoff from combined DMA 1 & 2 (1.6 acres of drainage area) will be treated by two proposed Filterra Bioretention Systems (1- 12′ x 6′ and 1 – 8′ x 6′) located at the northwest corner of the Harvard/Michelson intersection. The runoff from DMA 3 (1.0 acres of drainage area) will be treated by a proposed Filterra Bioretention System (1- 12′x6′) located on Harvard Avenue approximately 360 feet south of the Harvard/Michelson intersection centerline. The runoff captured by the existing catch basins will be discharged into San Joaquin Channel/San Diego Creek via the existing storm drain system.

Section III Site Description

III.1 Physical Setting

Fill out table with relevant information. *Refer to Section 2.3.1 in the TGD.*

Planning Area/ Community Name	Planning Area 19, Rancho San Joaquin
Location/Address	Intersection of Harvard Avenue and Michelson Drive
Land Use	Public Facility
Zoning	Street
Acreage	2.6 acres
Predominant Soil Type	Type D

III.2 Site Characteristics

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. Refer to Section 2.7.1 in the TGD.

Ownership of Land Adjacent to Right of Ways	*City of Irvine*
Topography/Longitudinal Slope	*Existing Public Roadway, slope ranges from 0.5% - 3% along Jeffrey RoadHarvard*
Grade differential between road surface and storm drain system.	*6'*
Soil Type, Geology, and Infiltration Properties	*Soil Types A, C & D*

III.3 Watershed Description

Fill out table with relevant information and include information regarding BMP sizing, suitability, and feasibility, as applicable. *Refer to Section 2.3.3 in the TGD.*

Receiving Waters	San Diego Creek Reach 1, Newport Bay, Pacific Ocean
303(d) Listed Impairments	San Diego Creek Reach 1 - Benthic Communities effectsChlordane, Copper, DDT (Dichlorodiphenyltrichloroethane), Indicator bacteria, Nutrients, PCBs (Polychlorinated biphenyls), Pesticides, Sediment Toxicity, Metals, Sedimentation/Siltation, Fecal Coliforms, Selenium and Toxaphene Upper Newport Bay – Chlordane, Copper, DDT, Indicator Bacteria, Malathion, Nutrients, PCBs, Sedimentation/Siltation, and Toxicity Lower Newport Bay – Chlordane, Copper, DDT, Indicator Bacteria, Nutrients, PCBs, and Toxicity.
Applicable TMDLs	San Diego Creek Reach 1 – Metals, Selenium, Nutrients, Pesticides, and Siltation Upper Newport Bay – Metals, Nutrients, Pathogens, Pesticides, PCBs, and Siltation Lower San Diego Creek – Metals, Nutrients, Pathogens, Pesticides, Priority Organics, and Siltation
Pollutants of Concern for the Project	Suspended Solid/Sediments, Nutrients, Heavy Metals, Pathogens (Bacteria/Virus), Pesticides, Oil & Grease, Toxic Organic Compounds and Trash & Debris
Environmentally Sensitive and Special Biological Significant Areas	The project site is not located within 200 feet or adjacent to an Environmentally Sensitive Area (ESA). Also, there is no Area of Special Biological Significance. The project is not adjacent to an area of Special Biological Significance per the State Water Resources Control Board Website Map: https://www.waterboards.ca.gov/water_issues/programs/ocean/asbs_map.shtml

Section IV Best Management Practices (BMPs)

IV. 1 Project Performance Criteria

The Project will incorporate United States Environmental Protection Agency (USEPA) guidance, "Managing Wet Weather with Green Infrastructure: Green Streets" as described in the **Model WQMP Appendix B,** in a manner consistent with the maximum extent practicable (MEP) standard. This approach includes:

- Selecting LID BMPs that integrate with both the opportunities and constraints of the project site and to attempt to address pollutants of concern and HCOCs,
- Developing innovative stormwater management configurations integrating "green" with "grey" infrastructure,
- Sizing BMPs opportunistically to provide stormwater pollution reduction to the MEP, accounting for the many competing considerations in right of ways.

Describe project performance criteria. This includes:

- If applicable, determine applicable hydromodification control performance criteria. *Refer to Section 7.II-2.4.2.2 of the Model WQMP*
- The standard LID hierarchy described in Section 7.II-2.4.3 of the Model WQMP is not applicable to this project and is replaced by considering all feasible LID approaches listed in the Green Streets manual.
- Calculate the target LID design storm capture volume for the project. The target is that Priority Projects infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume) *to Section 7.II-2.4.3 of the Model WQMP*

Project Performance Criteria (continued)	
If HCOC exists, list applicable hydromodification control performance criteria (Section 7.II-2.4.2.2 in MWQMP)	The Tc (time of concentration) is greater and runoff volume is less than the existing condition; therefore, HCOCs do not exist for this site. As such, the DCV runoff volume, below, will govern the design of LID features.
Calculate target LID design storm capture volume for Project (Section 7.II-2.4.3 from MWQMP).	**Total Area DCV:** DCV = C x d x A x 43,560 x 12 D = 0.75 from OCTGD Figure XVI-1 as shown in Figure No. 5 of this report C = 0.75 x Imp. + 0.15 = 0.75 x (88,200/110,400) + 0.15 = 0.75 x 0.80 + 0.15 = 0.75 DCV = 0.75 x 0.75 x 2.6 x 43,560 x 12 = 5,310 cu.ft.

	Combined DMA 1 & 2 DCV & Q_{LID}: Percent Impervious for the Post-Project condition: 1.2acres/1.6acres = 0.75 C = 0.75 x 0.75 +0.15 = 0.71 $DCV_{OCTGD\ Eq.\ III.2}$ = C x d x A x 43,560/12 = 0.71 x 0.75 x 1.6 x 43,560/12 = 3,093 cu.ft. Figure III.4 of the OC TGD: Design Intensity = 0.2375 in/hr corresponding to a Tc = 8.21 minutes. $Q_{LID\ (OCTGD\ Eq.\ III.3)}$ = C x I x A = 0.71 x 0.2375 x 1.6 = 0.27 cfs Filterra Quick Sizing Guide for Western Zones, Commercial: Based on the manufacturer's suggested 0.0023148 cfs per sq ft design flow: 0.27/0.0023148 = 116.6 sq.ft., Filterra Size 12 x 6 and 8 x 6 has an Expected Flow Rate of 0.278 cfs **DMA 3 DCV & Q_{LID}:** C = 0.75 x 0.80 + 0.15 = 0.75 DCV = 0.75 x 0.75 x 1.0 x 43,560/12 = 2,042 cu.ft. Figure III.4 of the OC TGD: Design Intensity = 0.2125 in/hr corresponding to a Tc = 15.06 minutes Q_{LID} = C x I x A = 0.75 x 0.2125 x 1.0 = 0.16 cfs Filterra Quick Sizing Guide for Western Zones, Commercial: Based on the manufacturer's suggested 0.0023148 cfs per sq ft design flow: 0.16/0.0023148 = 69.1 sq.ft., Filterra Size 6 x 12 has an Expected Flow Rate of 0.168 cfs

IV.2. SITE DESIGN AND DRAINAGE PLAN

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 is designed to allow BMPs to be incorporated to the MEP.
- A table of DMA characteristics and list of LID BMPs proposed in each DMA.
- Reference to the WQMP plot plan.
- A listing of GIS coordinates for LID BMPs (unless not required by local jurisdiction).

Refer to Section 2.4.2 in the TGD.

Harvard/Michelson Intersection Improvement Project is located at the intersection of Harvard Avenue and Michelson Drive in the City of Irvine (Project). The street improvement includes providing a second southbound left-turn lane on Harvard Avenue, removal of the existing "pork-chop" splitter island on the southwest corner to provide a conventional dedicated eastbound right-turn lane on Michelson Drive. The improvements also include the removal of the existing right-turn lane into the Irvine Lanes driveway and provides a seven-foot wide striped on-street bike lane with a three-foot wide buffer on the northwest corner. Also proposed is restriping the northbound approach on Harvard Avenue to provide a "defacto" right-turn lane and extending

the left-turn lane on northbound Harvard Avenue from 245 feet to 295 feet. See Figure No. 2.

The Project, which is a public roadway improvement, is mostly paved, therefore; site design opportunities were limited. Existing and Proposed landscaped areas within the project area are along the westerly slope of Harvard Avenue north of Michelson and along the eastbound lane of Michelson Drive west of Harvard (along the northerly University Synagogue parking area). The proposed improvements increased runoff within DMA1 by increasing the width of the roadway along southbound Harvard. The area increase in DMA1 caused a decrease in overall area in DMA2 which resulted in a post-project off-set in runoff. In addition, the loss of the porkchop right-turn island and reconfiguration of the intersection, resulted in an increase of pervious area in DMA3 and subsequent decrease in runoff volume. The resulting site design was an over-all decrease in runoff in the post-project condition.

There was nothing new within the proposed site design that enabled greater viability for use of the proposed BMPs. The pre-project layout was just as suitable for implementation of the proposed BMPs as the post-project site design.

Drainage Management Area (DMA)	Proposed BMP (see BMP Exhibit for location layout)
1 & 2	12 x 6 Filterra Unit (33°40'14.66'N, 117°50'00.52"W) 8 x 6 Filterra Units (33°40'14.68'N, 117°50'00.67"W) United Storm Water - Connector Pipe Screen (Full Trash Capture Device) – (33°40'14.68'N, 117°50'00.60"W)
3	6 x 12 Filterra Units (33°40'11.61'N, 117°50'03.33"W) United Storm Water - Connector Pipe Screen (Full Trash Capture Device) - (33°40'11.52'N, 117°50'03.37"W)

IV.3 LID BMP SELECTION AND PROJECT CONFORMANCE ANALYSIS

IV.3.1 Green Street / Linear Project BMPs

The following is a list of potential BMPs that may be applicable. Check the BMPs included. *Refer to 2.7.2 in the TGD.*

Name	Included?
Street trees (canopy interception)	☐
Stormwater Curb Extensions / Stormwater Planters	☐
Bioretention Areas	☐
Permeable Pavement	☐
Permeable Friction Course Overlays	☐
Vegetated Swales (compost amended were possible)	☐
Filter strips (amended road shoulder)	☐
Proprietary Biotreatment	☒
Infiltration Trench	☐
Cartridge Media Filters	☐
WSDOT Media Filter Drains	☐
Other: Bio-Clean BIO-GRATE-FULL-24-24-24 – Catch Basin Inlet Filter	☒
Other:	☐
Other:	☐

LID BMPs

Proprietary Biotreatment

Filterra Bioretention System will be utilized as the green street BMP for the project. The design of the BMP is based on the calculated DCV & Q_{LID} found in Section IV. City of Irvine will inspect and clean out the Filterra Bioretention System annually. Before the start of the rainy season, debris and trash will be removed and mulch will be replaced. City of Irvine will also verify the infiltration rate of the biofiltration media and amend/replace soil material as necessary.

Describe how the selected BMPs conform to the North Orange County Permit requirement to implement Green Streets in a manner consistent with the MEP standard. Show calculations below to demonstrate how much of the LID Design Capture Volume can be met with the selected BMPs. Where the BMPs cannot be designed to capture the entire DCV, provide a narrative explanation(s) of constraining factors that prevented full capture from being achieved.

The project site has limited right-of-way which prohibits the installation of street trees and the use of curb extensions, planters, bioretention areas, swales, filter strips and infiltration trenches. The use of permeable pavement and permeable friction course overlays, in conjunction with the high traffic volume and the high axle loads anticipated within the project area, would be inappropriate. Proprietary Biotreatment was chosen as the more suitable BMP for this project site. Filterra Bioretention Filtration Systems have high removal efficiencies for many pollutants from highly developed sites such as landscaped areas, green space and streetscapes. It is an urban solution for Low Impact Development.

Based on the manufacturer's suggested 0.0023148 cfs per sq ft design flow and our calculated water quality design flow of 0.27 cfs for the combined drainage area associated with DMA 1 and 2, the required square footage to be treated is 116.6 sq ft. Two Filterra Bioretention Systems consisting of a 12′ x 6′ and a 8′ x 6′ model have been proposed to be installed and will remove potential pollutants equivalent to the project area. Based on the manufacturer's suggested 0.0023148 cfs per sq ft design flow and our calculated water quality design flow of 0.16 cfs for the drainage area associated with DMA 3, the required square footage to be treated is 69.1 sq ft. A Filterra Bioretention System consisting of one (6′ x 12′ / 12′ x 6′ model) has been proposed to be installed and will remove potential pollutants equivalent to the project area.

Required Square Footage to be treated = Water Quality Design Flow / Manufacturer's Design Flow per sq ft. for DMA 1 & 2 = 0.27 cfs / 0.0023148 cfs/sq ft. = 116.6 sq ft.

One – 12′ x 6′ model FTIBC1206 & 1 – 8′ x 6′ model FTIBC0806 = 120 sq ft.

Total Sq Ft. of Filterra Bioretention System for DMA 1 & 2 = 120 sq ft.

The proposed Filterra Bioretention System will be adequate and satisfies the required square footage to be treated.

Required Square Footage to be treated = Water Quality Design Flow / Manufacturer's Design Flow per sq ft. for DMA 3 = 0.16 cfs / 0.0023148 cfs/sq ft. = 69.1 sq ft.

One – 12′ x 6′ model FTIBC1206 = 72 sq ft.

Total Sq Ft. of Filterra Bioretention System for DMA 3 = 72 sq ft.

The proposed Filterra Bioretention System will be adequate and satisfies the required square footage to be treated.

DMA 1 & 2:

The expected flow rate for a 12′x 6′ model FTIBC1206 and an 8′ x 6′ FTIBC0806 is 0.278 cfs. The proposed Filterra Bioretention System has a sufficient total of 0.278 cfs expected flow rate that will withstand the 0.27 cfs design flow.

DMA 3:

The expected flow rate for a 12′ x 6′ model FTIBC1206is 0.168 cfs. The proposed Filterra Bioretention System has a sufficient total of 0.168 cfs expected flow rate that will withstand the 0.16 cfs design flow.

The tributary area to the Filterra Bioretention System associated with DMA 1 & 2 is approximately 1.6 acres and the tributary area to the Filterra Bioretention System associated with DMA 3 is approximately 1.0 acres for a total drainage area of 2.6 acres, which exceeds the total project disturbed area. The Filterra Bioretention Systems on Michelson will be located at approximately 33° 40′ 14.66″ N, 117° 50′ 00.52″ W (12x6) and 33°40′14.68′N, 117°50′00.67″W (8x6), and the Filterra Bioretention System along Harvard will be located approximately at 33° 40′ 11.61″ N, 117° 50′ 03.37″ W. The placement of the Filterra Bioretention Systems will be placed immediately upstream of the existing and proposed catch basin inlets. In addition, to comply with recent trash amendment requirements, each catch basin inlet will be fitted with a United Storm Water - Connector Pipe Screen (Full Trash Capture Device) which is certified by the California Regional Water Quality Control Board to comply with the trash amendment.

IV.3.2 Hydromodification Control BMPs

Describe hydromodification control BMPs. *See Section 5 TGD*. Include sections for selection, suitability, sizing, and infeasibility, as applicable. Detail compliance with Prior Conditions of Approval.

Hydromodification Control BMPs	
BMP Name	**BMP Description**
Filterra Bioretention System	Proprietary – Tree-in-Box – Treatment System

IV.3.3 Non-structural Source Control BMPs

Fill out non-structural source control check box forms or provide a brief narrative explaining if non-structural source controls were not used.

Non-Structural Source Control BMPs				
Identifier	**Name**	**Check One**		**If not applicable, state brief reason**
		Included	**Not Applicable**	
N3	Right-of-Way Landscape Management	☒	☐	
N4	BMP Maintenance	☒	☐	
N11	Right-of-Way Litter Control	☒	☐	
N12	Employee Training	☒	☐	
N14	Right-of-Way Catch Basin Inspection	☒	☐	
N15	Street Sweeping	☒	☐	

Non-Structural BMPs

Right-of-Way Landscape Management

City of Irvine will perform monthly and as needed maintenance that will be consistent with the County Water Conservation Resolution or the City of Irvine equivalent, and fertilizer and pesticide

usage will be consistent with County Management Guidelines for Use of Fertilizers (DAMP Section 5.5). See also, efficient irrigation systems under structural controls.

BMP Maintenance

City of Irvine will be responsible for all BMPs. See Section V below for frequency of maintenance and additional information.

Right-of-Way Litter Control

City of Irvine will conduct litter patrol on a weekly basis.

Employee Training

Environmental awareness education materials will be provided to the employees of the City of Irvine. Training courses on storm water pollution will be given to new employees annually.

Right-of-Way Catch Basin Inspection

City of Irvine will conduct inspections and clean out of catch basins and catch basin filters as described in Section V below.

Street Sweeping

City of Irvine will street sweep and maintain streets to be free of debris monthly and as needed.

IV.3.4 Structural Source Control BMPs

Fill out structural source control check box forms or provide a brief narrative explaining if structural source controls were not used.

Structural Source Control BMPs

Identifier	Name	Check One		If not applicable, state brief reason
		Included	Not Applicable	
S1	Provide storm drain system stenciling and signage	☒	☐	
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control	☒	☐	
S12	Hillside landscaping	☒	☐	
Filterra	Filterra Bioretention System	☒	☐	See Appendix A
Bio-Clean	United Storm Water - Connector Pipe Screen (Full Trash Capture Device)	☒	☐	See Appendix A

Structural BMPs

Storm Drain Stenciling and Signage

The phrase "No Dumping – Drains to Ocean" shall be stenciled on catch basins in maintenance areas to alert the public and employees of the City of Irvine to the destination of pollutants discharged into the storm drain system. The locations of these catch basins are shown on the attached Site Plan (Figure 3A) located in Section VI of this WQMP. Inspection of stencil legibility will be performed annually or as needed. Re-stenciling will be performed as necessary, but no less than once every 5 years.

Efficient Irrigation Systems & Landscape Design, Water Conservation, Smart Controller and Source Control

Irrigation systems shall be installed and programmed to apply proper volume of water and avoid excess runoff. A landscape plan shall be implemented to verify the following at a minimum:

- Water sensors are functioning properly (make adjustments as necessary)
- Irrigation heads are adjusted properly to eliminate over-spray of hardscape areas;
- Irrigation timing and cycle lengths are adjusted in accordance with water demands, time of year, weather, and day or nighttime temperatures; and
- Plants with similar water requirements are grouped together.

The timing and application methods of irrigation water in common areas will minimize the runoff of excess irrigation water into the storm water conveyance system. The IRWD has an aggressive

block rate structure for water use that encourages conservation. This block rate structure will be applied to the project. Inspections, replacements, repairs and adjustments will be performed bi-weekly by the City of Irvine.

Hillside Landscaping

Hillside areas that are disturbed by project development shall be landscaped with deep-rooted, drought tolerant plants species selected for erosion control, satisfactory to the local permitting authority.

Section V Inspection/Maintenance Responsibility for BMPs

Fill out information in table below. Prepare and attach an Operation and Maintenance Plan. Identify the mechanism through which BMPs will be maintained. Inspection and maintenance records must be kept for a minimum of five years for inspection by the regulatory agencies. *Refer to Section 7.II 4.0 in the Model WQMP.*

BMP Inspection/Maintenance

BMP	Reponsible Department / Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Right-of-Way Landscape Management	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Maintain Right-of-Way Landscape	Monthly and as needed
Right-of-Way Litter Control	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Inspection and Control Litter	Weekly
Employee Training	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Training courses for new employees on storm water pollution	Annually
Catch Basin Inspection	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Inspect and clean out catch basins & catch basin filters (See Bio-Clean Filters below)	Annually and as needed

***City funds will be used for the inspection and maintenance of BMPs.**

BMP Inspection/Maintenance

BMP	Reponsible Department/ Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Street Sweeping	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Sweep streets and maintain free from debris	Monthly and as needed
Catch Basin Stenciling & Signage	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Inspection of stencil legibility. Re-stencil as necessary, but no less than once every 5 years.	Annually and as needed
Efficient Irrigation & Landscape Design	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Inspection of sprinkler heads and irrigation timing cycle, and replacing, repairing or adjusting as necessary.	Bi-weekly
Filterra Bioretention Systems	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Inspect and clean out filtration system. Remove any debris and trash and replace mulch before the start of the rainy season. Verify infiltration rate of biofiltration media and amend/replace soil material as necessary.	Annually/Ongoing
United Storm Water - Connector Pipe Screen (Full Trash Capture Device)	City of Irvine, Street & Right-of-Way Maintenance Division, 1 Civic Centre Plaza, Irvine, CA 92606-5207, (949)724-7600*	Inspect and Clean to remove trash and debris monthly and after every rainstorm.	Monthly and as-needed

***City funds will be used for the inspection and maintenance of BMPs.**

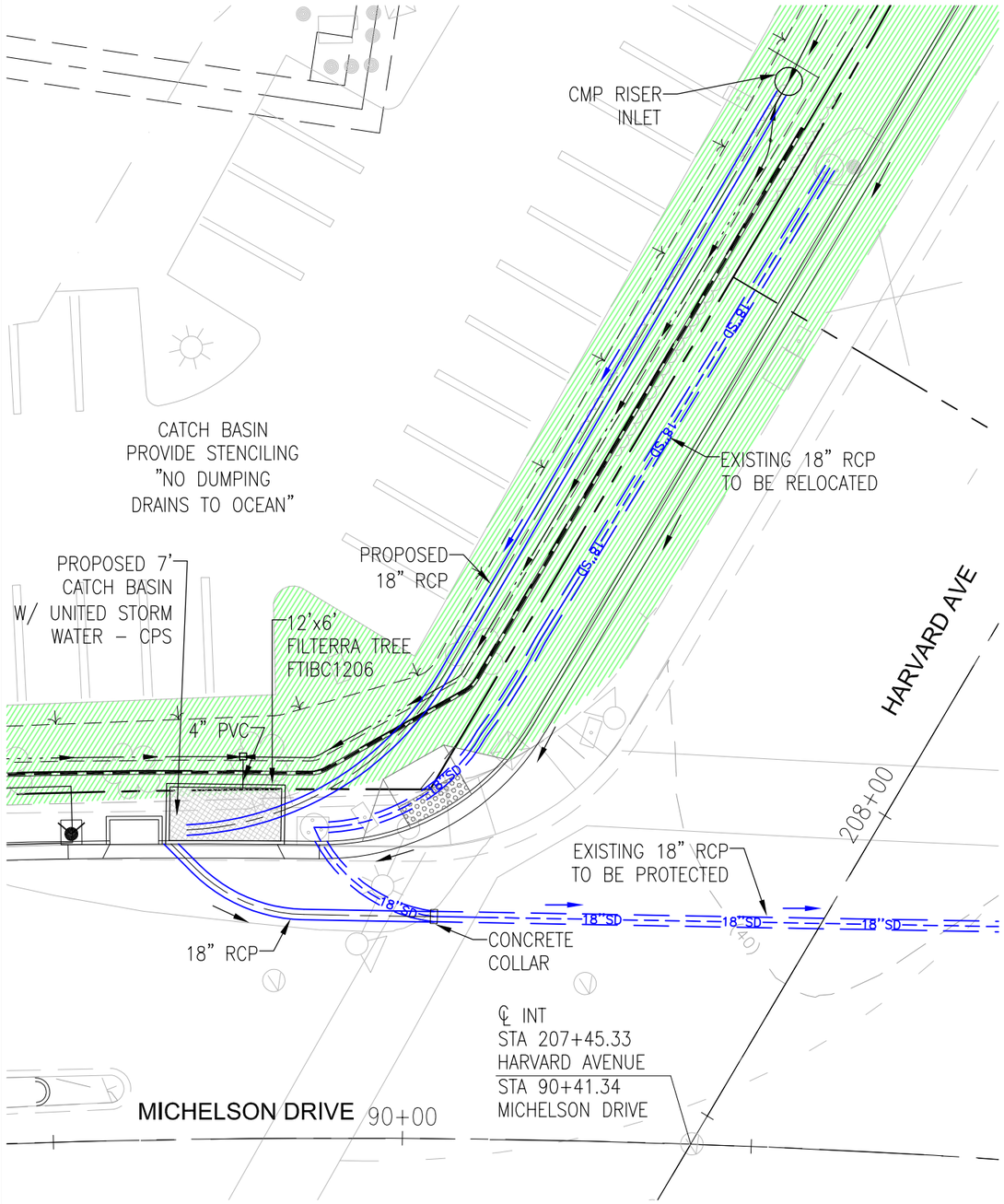
Section VI Site Plan and Drainage Plan

VI.1 SITE PLAN AND DRAINAGE PLAN

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

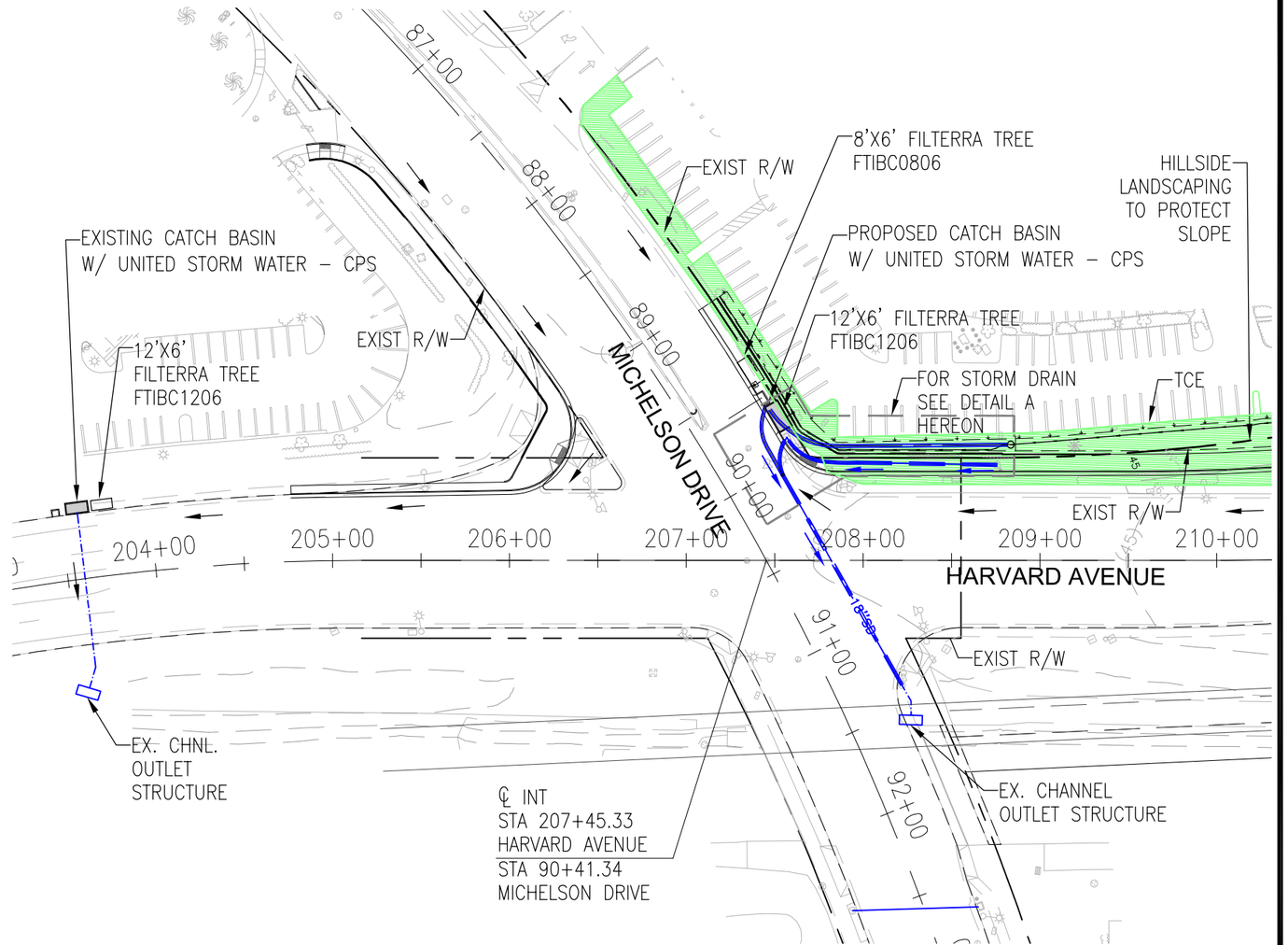
- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural BMP locations
- Drainage delineations and flow information
- Drainage connections
- BMP details

See Exhibit No. 1 - BMP Site Plan (Attached hereto)



DETAIL A

SCALE 1"=20'



SITE PLAN

LEGEND

- SURFACE FLOW DIRECTION
- STORM DRAIN FLOW DIRECTION
- LANDSCAPE AREA

GRAPHIC SCALE

40 0 40 80 160

(IN FEET)
1 inch = 80 ft.

PREPARED BY:

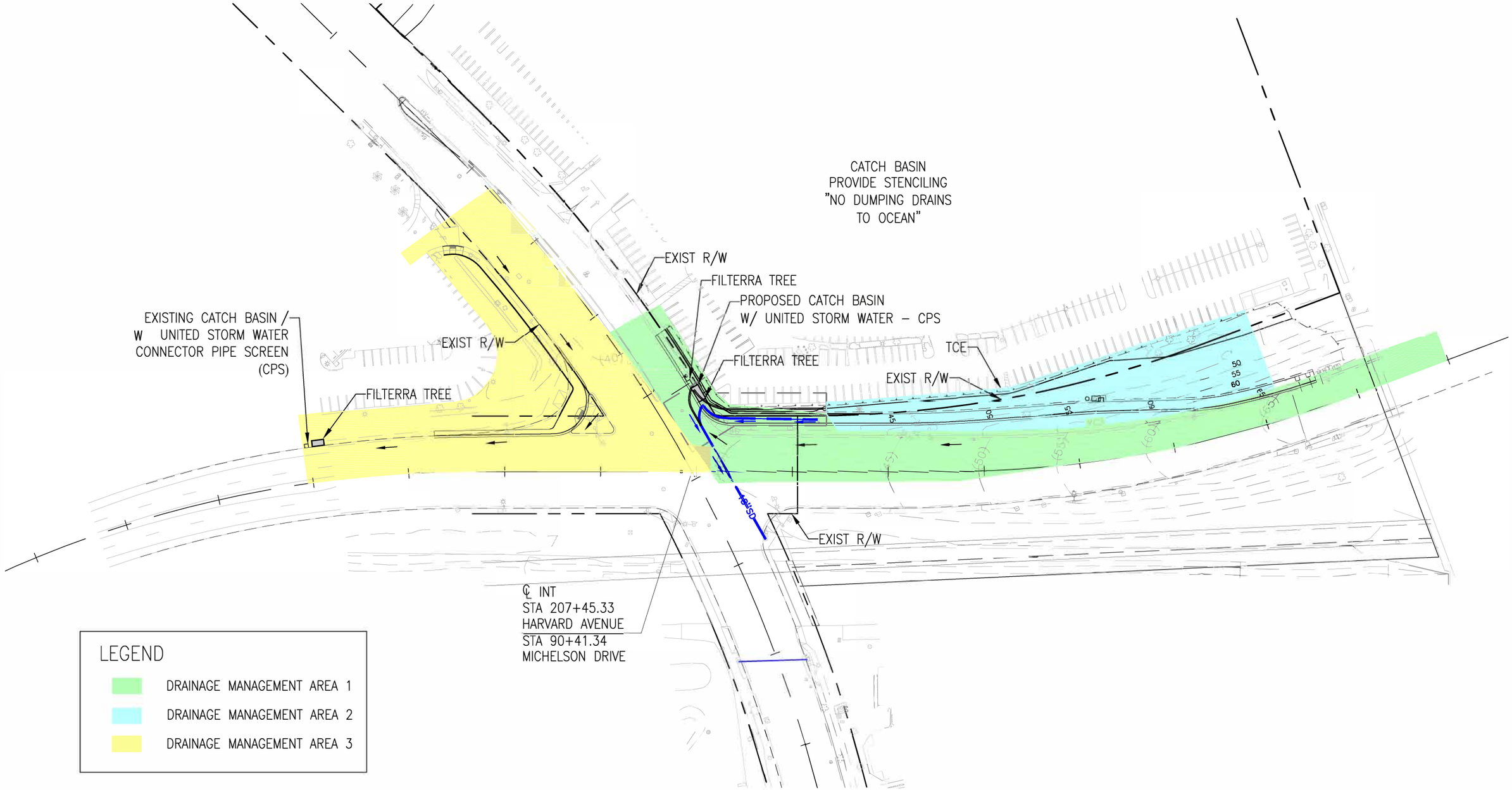
Stantec
38 TECHNOLOGY DRIVE, SUITE 100
IRVINE, CA 92618
949.923.6000 stantec.com

HARVARD AND MICHELSON WQMP EXHIBIT

DATE: 11/2019

SHEET 1 OF 2

JOB NO. 2042557300



LEGEND

- DRAINAGE MANAGEMENT AREA 1
- DRAINAGE MANAGEMENT AREA 2
- DRAINAGE MANAGEMENT AREA 3

GRAPHIC SCALE

50 0 50 100 200

(IN FEET)
1 inch = 100 ft.

SITE PLAN

PREPARED BY:
Stantec
38 TECHNOLOGY DRIVE, SUITE 100
IRVINE, CA 92618
949.923.6000 stantec.com

HARVARD AND MICHELSON
WQMP EXHIBIT

DATE: **11/2019**

SHEET **2** OF **2**

JOB NO. **2042557300**

Section VII Educational Materials

Refer to the Orange County Stormwater Program (ocwatersheds.com) for a library of materials available. For the copy submitted to the Permittee, only attach the educational materials specifically applicable to the project. Other materials specific to the project may be included as well and must be attached.

Education Materials	
Residential Material (http://www.ocwatersheds.com)	**Check If Applicable**
The Ocean Begins at Your Front Door	☒
Tips for the Home Mechanic	☐
Homeowners Guide for Sustainable Water Use	☐
Household Tips	☐
Proper Disposal of Household Hazardous Waste	☐
Recycle at Your Local Used Oil Collection Center (Central County)	☐
Responsible Pest Control	☒
Sewer Spill	☒
Tips for the Home Improvement Projects	☐
Tips for Landscaping and Gardening	☒
Tips for Pet Care	☐
Tips for Pool Maintenance	☐
Tips for Residential Pool, Landscape and Hardscape Drains	☐
Tips for Projects Using Paint	☐

The Ocean Begins at Your Front Door

Even if you live miles from the Pacific Ocean, you may be unknowingly polluting it.

Did You Know?

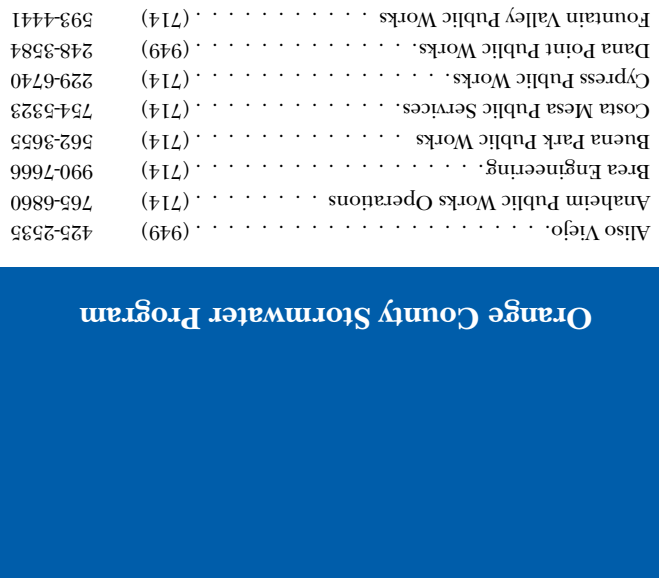
- Most people believe that the largest source of water pollution in urban areas comes from specific sources such as factories and sewage treatment plants. In fact, the largest source of water pollution comes from city streets, neighborhoods, construction sites and parking lots. This type of pollution is sometimes called “non-point source” pollution.
- There are two types of non-point source pollution: stormwater and urban runoff pollution.
- Stormwater runoff results from rainfall. When rainstorms cause large volumes of water to rinse the urban landscape, picking up pollutants along the way.
- Urban runoff can happen any time of the year when excessive water use from irrigation, vehicle washing and other sources carries trash, lawn clippings and other urban pollutants into storm drains.

Where Does It Go?

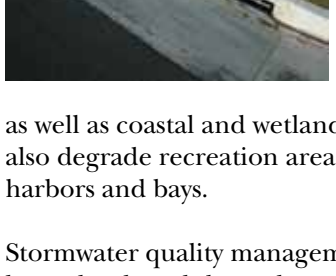
- Anything we use outside homes, vehicles and businesses – like motor oil, paint, pesticides, fertilizers and cleaners – can be blown or washed into storm drains.
- A little water from a garden hose or rain can also send materials into storm drains.
- Storm drains are separate from our sanitary sewer systems; unlike water in sanitary sewers (from sinks or toilets), water in storm drains is not treated before entering our waterways.

Sources of Non-Point Source Pollution

- Automotive leaks and spills.
- Improper disposal of used oil and other engine fluids.
- Metals found in vehicle exhaust, weathered paint, rust, metal plating and tires.
- Pesticides and fertilizers from lawns, gardens and farms.
- Improper disposal of cleaners, paint and paint removers.
- Soil erosion and dust debris from landscape and construction activities.
- Litter, lawn clippings, animal waste, and other organic matter.
- Oil stains on parking lots and paved surfaces.



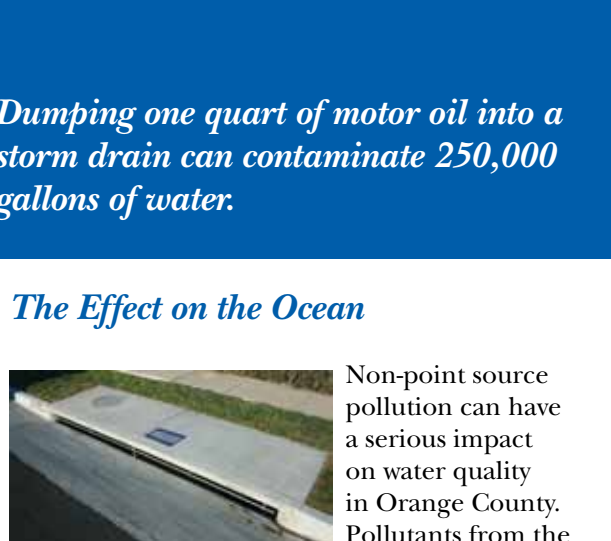
The Effect on the Ocean



Non-point source pollution can have a serious impact on water quality in Orange County. Pollutants from the storm drain system can harm marine life as well as coastal and wetland habitats. They can also degrade recreation areas such as beaches, harbors and bays.

Stormwater quality management programs have been developed throughout Orange County to educate and encourage the public to protect water quality, monitor runoff in the storm drain system, investigate illegal dumping and maintain storm drains.

Support from Orange County residents and businesses is needed to improve water quality and reduce urban runoff pollution. Proper use and disposal of materials will help stop pollution before it reaches the storm drain and the ocean.



Dumping one quart of motor oil into a storm drain can contaminate 250,000 gallons of water.

For More Information

California Environmental Protection Agency
www.calepa.ca.gov

- **Air Resources Board**
  www.arb.ca.gov
- **Department of Pesticide Regulation**
  www.cdpr.ca.gov
- **Department of Toxic Substances Control**
  www.dtsc.ca.gov
- **Integrated Waste Management Board**
  www.ciwmb.ca.gov
- **Office of Environmental Health Hazard Assessment**
  www.oehha.ca.gov
- **State Water Resources Control Board**
  www.waterboards.ca.gov

Earth 911 - Community-Specific Environmental Information 1-800-cleanup or visit www.1800cleanup.org

Health Care Agency’s Ocean and Bay Water Closure and Posting Hotline
(714) 433-6400 or visit www.ocbeachinfo.com

Integrated Waste Management Dept. of Orange County (714) 834-6752 or visit www.oclandfills.com for information on household hazardous waste collection centers, recycling centers and solid waste collection

O.C. Agriculture Commissioner
(714) 447-7100 or visit www.ocagcomm.com

Stormwater Best Management Practice Handbook
Visit www.cabmphandbooks.com

UC Master Gardener Hotline
(714) 708-1646 or visit www.uccemg.com

The Orange County Stormwater Program has created and moderates an electronic mailing list to facilitate communications, take questions and exchange ideas among its users about issues and topics related to stormwater and urban runoff and the implementation of program elements. To join the list, please send an email to ocstormwaterinfo-join@list.ocwatersheds.com

Aliso Viejo	(949)	425-2535
Anaheim Public Works Operations	(714)	765-6860
Brea Engineering	(714)	990-7666
Buena Park Public Works	(714)	562-3655
Costa Mesa Public Services	(714)	754-5323
Cypress Public Works	(714)	229-6740
Dana Point Public Works	(949)	248-3584
Fountain Valley Public Works	(714)	593-4441
Fullerton Engineering Dept.	(714)	738-6853
Garden Grove Public Works	(714)	741-5956
Huntington Beach Public Works	(714)	536-5431
Irvine Public Works	(949)	724-6315
La Habra Public Services	(562)	905-9792
La Palma Public Works	(714)	690-3310
Laguna Beach Water Quality	(949)	497-0378
Laguna Hills Public Services	(949)	707-2650
Laguna Niguel Public Works	(949)	362-4337
Laguna Woods Public Works	(949)	639-0500
Lake Forest Public Works	(949)	461-3480
Los Alamitos Community Dev.	(562)	431-3538
Mission Viejo Public Works	(949)	470-3056
Newport Beach, Code & Water Quality Enforcement	(949)	644-3215
Orange Public Works	(714)	532-6480
Placentia Public Works	(714)	993-8245
Rancho Santa Margarita	(949)	635-1800
San Clemente Environmental Programs	(949)	361-6143
San Juan Capistrano Engineering	(949)	234-4413
Santa Ana Public Works	(714)	647-3380
Seal Beach Engineering	(562)	431-2527 x317
Stanton Public Works	(714)	379-9222 x204
Tustin Public Works/Engineering	(714)	573-3150
Villa Park Engineering	(714)	998-1500
Westminster Public Works/Engineering	(714)	898-3311 x446
Yorba Linda Engineering	(714)	961-7138
Orange County Stormwater Program	(877)	897-7455

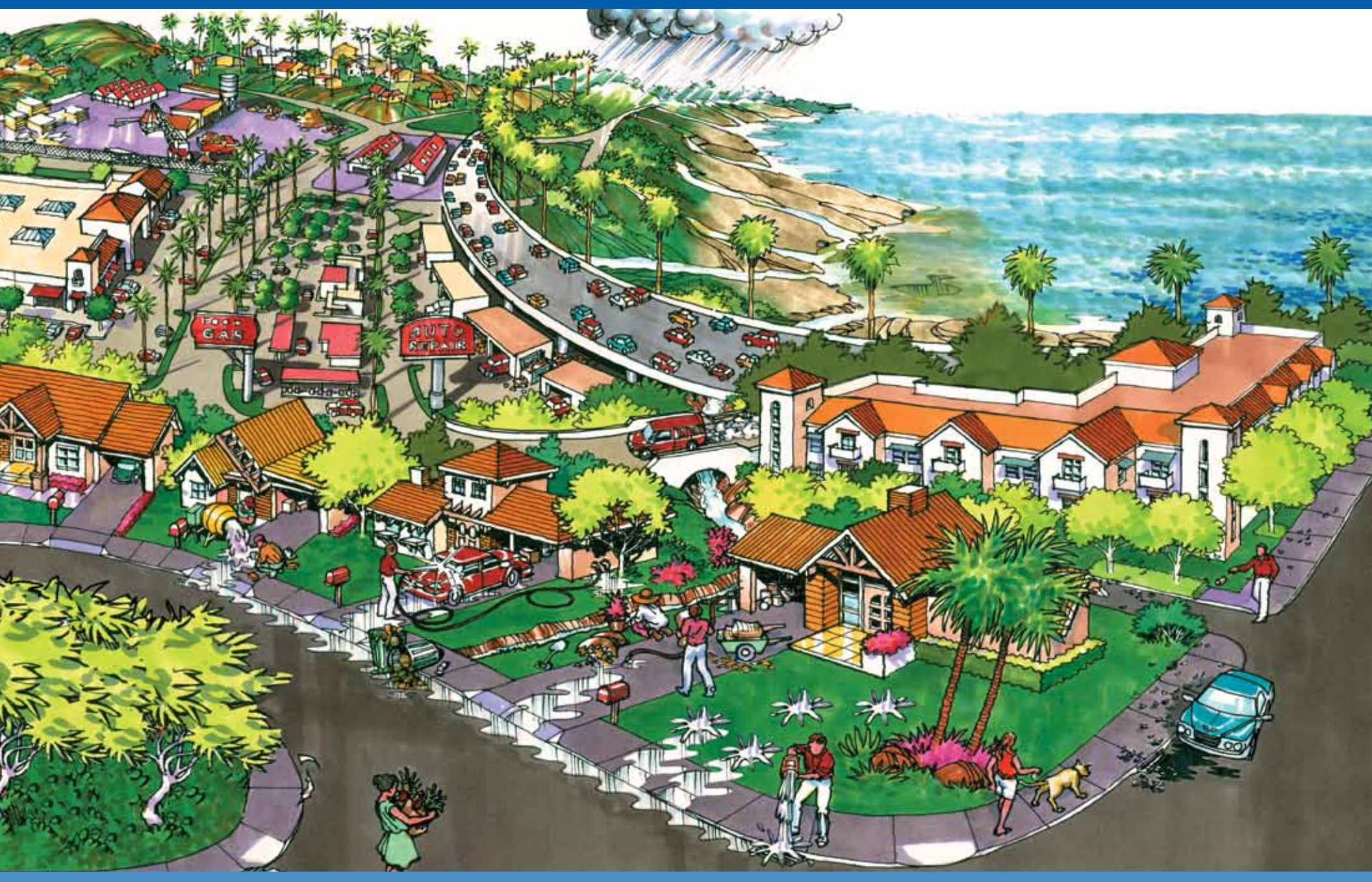
Orange County 24-Hour
Water Pollution Problem Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

On-line Water Pollution Problem Reporting Form
www.ocwatersheds.com

Printed on Recycled Paper

Orange County Stormwater Program

The Ocean Begins at Your Front Door



Never allow pollutants to enter the street, gutter or storm drain!

Follow these simple steps to help reduce water pollution:

Household Activities

- Do not rinse spills with water. Use dry cleanup methods such as applying cat litter or another absorbent material, sweep and dispose of in the trash. Take items such as used or excess batteries, oven cleaners, automotive fluids, painting products and cathode ray tubes, like TVs and computer monitors, to a Household Hazardous Waste Collection Center (HHWCC).
- For a HHWCC near you call (714) 834-6752 or visit www.oclandfills.com.
- Do not hose down your driveway, sidewalk or patio to the street, gutter or storm drain. Sweep up debris and dispose of it in the trash.

Automotive

- Take your vehicle to a commercial car wash whenever possible. If you wash your vehicle at home, choose soaps, cleaners, or detergents labeled non-toxic, phosphate- free or biodegradable. Vegetable and citrus-based products are typically safest for the environment.
- Do not allow washwater from vehicle washing to drain into the street, gutter or storm drain. Excess washwater should be disposed of in the sanitary sewer (through a sink or toilet) or onto an absorbent surface like your lawn.
- Monitor your vehicles for leaks and place a pan under leaks. Keep your vehicles well maintained to stop and prevent leaks.
- Never pour oil or antifreeze in the street, gutter or storm drain. Recycle these substances at a service station, a waste oil collection center or used oil recycling center. For the nearest Used Oil Collection Center call 1-800-CLEANUP or visit www.1800cleanup.org.

Pool Maintenance

- Pool and spa water must be dechlorinated and free of excess acid, alkali or color to be allowed in the street, gutter or storm drain.
- When it is not raining, drain dechlorinated pool and spa water directly into the sanitary sewer.
- Some cities may have ordinances that do not allow pool water to be disposed of in the storm drain. Check with your city.

Landscape and Gardening

- Do not over-water. Water your lawn and garden by hand to control the amount of water you use or set irrigation systems to reflect seasonal water needs. If water flows off your yard onto your driveway or sidewalk, your system is over-watering. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of waste by composting, hauling it to a permitted landfill, or as green waste through your city's recycling program.
- Follow directions on pesticides and fertilizer, (measure, do not estimate amounts) and do not use if rain is predicted within 48 hours.
- Take unwanted pesticides to a HHWCC to be recycled. For locations and hours of HHWCC, call (714) 834-6752 or visit www.oclandfills.com.

Trash

- Place trash and litter that cannot be recycled in securely covered trash cans.
- Whenever possible, buy recycled products.
- Remember: Reduce, Reuse, Recycle.

Pet Care

- Always pick up after your pet. Flush waste down the toilet or dispose of it in the trash. Pet waste, if left outdoors, can wash into the street, gutter or storm drain.
- If possible, bathe your pets indoors. If you must bathe your pet outside, wash it on your lawn or another absorbent/permeable surface to keep the washwater from entering the street, gutter or storm drain.
- Follow directions for use of pet care products and dispose of any unused products at a HHWCC.

Common Pollutants

Home Maintenance

- Detergents, cleaners and solvents
- Oil and latex paint
- Swimming pool chemicals
- Outdoor trash and litter

Lawn and Garden

- Pet and animal waste
- Pesticides
- Clippings, leaves and soil
- Fertilizer

Automobile

- Oil and grease
- Radiator fluids and antifreeze
- Cleaning chemicals
- Brake pad dust

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities such as pest control can lead to water pollution if you're not careful. Pesticide treatments must be planned and applied properly to ensure that pesticides do not enter the street, gutter or storm drain. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never dump pesticides into the ocean, so don't let it enter the storm drains. Pesticides can cause significant damage to our environment if used improperly. If you are thinking of using a pesticide to control a pest, there are some important things to consider.

For more information,
please call
University of California Cooperative
Extension Master Gardeners at
(714) 708-1646
or visit these Web sites:
www.uccemg.org
www.ipm.ucdavis.edu

For instructions on collecting a specimen sample visit the Orange County Agriculture Commissioner's website at:
http://www.ocagcomm.com/ser_lab.asp

To report a spill, call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
at 1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

Information From:
Cheryl Wilen, Area IPM Advisor; Darren Haver, Watershed Management Advisor; Mary Louise Flint, IPM Education and Publication Director; Pamela M. Geisel, Environmental Horticulture Advisor; Carolyn L. Unruh, University of California Cooperative Extension staff writer. Photos courtesy of the UC Statewide IPM Program and Darren Haver.

Funding for this brochure has been provided in full or in part through an agreement with the State Water Resources Control Board (SWRCB) pursuant to the Costa-Machado Water Act of 2000 (Prop. 13).

Printed on Recycled Paper

Help Prevent Ocean Pollution:

Responsible Pest Control

Tips for Pest Control

Key Steps to Follow:

Step 1: Correctly identify the pest (insect, weed, rodent, or disease) and verify that it is actually causing the problem.

Three life stages of the common lady beetle, a beneficial insect.

This is important because beneficial insects are often mistaken for pests and sprayed with pesticides needlessly.

Consult with a Certified Nursery Professional at a local nursery or garden center or send a sample of the pest to the Orange County Agricultural Commissioner's Office.

Determine if the pest is still present – even though you see damage, the pest may have left.

Step 2: Determine how many pests are present and causing damage.

Small pest populations may be controlled more safely using non-pesticide techniques. These include removing food sources, washing off leaves with a strong stream of water, blocking entry into the home using caulking and replacing problem plants with ones less susceptible to pests.

Integrated Pest Management (IPM) usually combines several least toxic pest control methods for long-term prevention and management of pest problems without harming you, your family, or the environment.

UC CE University of California Cooperative Extension

Step 3: If a pesticide must be used, choose the least toxic chemical.

Obtain information on the least toxic pesticides that are effective at controlling the target pest from the UC Statewide Integrated Pest Management (IPM) Program's Web site at www.ipm.ucdavis.edu.

Seek out the assistance of a Certified Nursery Professional at a local nursery or garden center when selecting a pesticide. Purchase the smallest amount of pesticide available.

Apply the pesticide to the pest during its most vulnerable life stage. This information can be found on the pesticide label.

Step 4: Wear appropriate protective clothing.

Follow pesticide labels regarding specific types of protective equipment you should wear. Protective clothing should always be washed separately from other clothing.

Step 5: Continuously monitor external conditions when applying pesticides such as weather, irrigation, and the presence of children and animals.

Never apply pesticides when rain is predicted within the next 48 hours. Also, do not water after applying pesticides unless the directions say it is necessary.

Apply pesticides when the air is still; breezy conditions may cause the spray or dust to drift away from your targeted area.

In case of an emergency call 911 and/or the regional poison control number at (714) 634-5988 or (800) 544-4404 (CA only).

For general questions you may also visit www.calpoison.org.

Step 6: In the event of accidental spills, sweep up or use an absorbent agent to remove any excess pesticides. Avoid the use of water.

Be prepared. Have a broom, dust pan, or dry absorbent material, such as cat litter, newspapers or paper towels, ready to assist in cleaning up spills.

Contain and clean up the spill right away. Place contaminated materials in a doubled plastic bag. All materials used to clean up the spill should be properly disposed of according to your local Household Hazardous Waste Disposal site.

Step 7: Properly store and dispose of unused pesticides.

Purchase Ready-To-Use (RTU) products to avoid storing large concentrated quantities of pesticides.

Store unused chemicals in a locked cabinet.

Unused pesticide chemicals may be disposed of at a Household Hazardous Waste Collection Center.

Empty pesticide containers should be triple rinsed prior to disposing of them in the trash.

Household Hazardous Waste Collection Center
(714) 834-6752
www.oclandfills.com

PROJECT Pollution PREVENTION

Sewage Spill Regulatory Requirements

Allowing sewage to discharge to a gutter or storm drain may subject you to penalties and/or out-of-pocket costs to reimburse cities or public agencies for clean-up efforts.

Here are the pertinent codes, fines, and agency contact information that apply.

Orange County Stormwater Program
24 Hour Water Pollution Reporting Hotline
1-877-89-SPILL (1-877-897-7455)

- County and city water quality ordinances prohibit discharges containing pollutants.

Orange County Health Care Agency Environmental Health
(714) 433-6419

California Health and Safety Code, Sections 5410-5416

- No person shall discharge raw or treated sewage or other waste in a manner that results in contamination, pollution or a nuisance.
- Any person who causes or permits a sewage discharge to any state waters:
  - must immediately notify the local health agency of the discharge.
  - shall reimburse the local health agency for services that protect the public's health and safety (water-contact receiving waters).
  - who fails to provide the required notice to the local health agency is guilty of a misdemeanor and shall be punished by a fine (between $500–$1,000) and/or imprisonment for less than one year.

Regional Water Quality Control Board
Santa Ana Region (951) 782-4130
San Diego Region (858) 467-2952

- Requires the prevention, mitigation, response to and reporting of sewage spills.

California Office of Emergency Services
(800) 852-7550

California Water Code, Article 4, Chapter 4, Sections 13268-13271
California Code of Regulations, Title 23, Division 3, Chapter 9.2, Article 2, Sections 2250-2260

- Any person who causes or permits sewage in excess of 1,000 gallons to be discharged to state waters **shall immediately notify the Office of Emergency Services.**
- Any person who fails to provide the notice required by this section is **guilty of a misdemeanor** and shall be punished by a fine (less than $20,000) and/or imprisonment for not more than one year.

DTP113 Rev 4/06
printed on recycled paper

Sewage Spill
Reference Guide

Your Responsibilities as a Private Property Owner

Residences
Businesses
Homeowner/Condominium Associations
Federal and State Complexes
Military Facilities

Orange County Sanitation District

Health Care Agency
Environmental Health

PROJECT Pollution PREVENTION
www.ocwatersheds.com

This brochure was designed courtesy of the Orange County Sanitation District (OCSD). For additional information, call (714) 962-2411, or visit their website at www.ocsd.com

What is a Sewage Spill?

Sewage spills occur when the wastewater being transported via underground pipes overflows through a manhole, cleanout or broken pipe. Sewage spills can cause health hazards, damage to homes and businesses, and threaten the environment, local waterways and beaches.

Common Causes of Sewage Spills

Grease builds up inside and eventually blocks sewer pipes. Grease gets into the sewer from food establishments, household drains, as well as from poorly maintained commercial grease traps and interceptors.

Structure problems caused by tree roots in the lines, broken/cracked pipes, missing or broken cleanout caps or undersized sewers can cause blockages.

Infiltration and inflow (I/I) impacts pipe capacity and is caused when groundwater or rainwater enters the sewer system through pipe defects and illegal connections.

You Are Responsible for a Sewage Spill Caused by a Blockage or Break in Your Sewer Lines!

Time is of the essence in dealing with sewage spills. You are required to **immediately**:

Control and minimize the spill. Keep spills contained on private property and out of gutters, storm drains and public waterways by shutting off or not using the water.

Use sandbags, dirt and/or plastic sheeting to prevent sewage from entering the storm drain system.

Clear the sewer blockage. Always wear gloves and wash your hands. It is recommended that a plumbing professional be called for clearing blockages and making necessary repairs.

Always notify your city sewer/public works department or public sewer district of sewage spills. If the spill enters the storm drains also notify the Health Care Agency. In addition, if it exceeds 1,000 gallons notify the Office of Emergency Services. Refer to the numbers listed in this brochure.

Overflowing cleanout pipe located on private property

You Could Be Liable

Allowing sewage from your home, business or property to discharge to a gutter or storm drain may subject you to penalties and/or out-of-pocket costs to reimburse cities or public agencies for clean-up and enforcement efforts. See Regulatory Codes & Fines section for pertinent codes and fines that apply.

What to Look For

Sewage spills can be a very noticeable gushing of water from a manhole or a slow water leak that may take time to be noticed. Don't dismiss unaccounted-for wet areas.

Look for:

- Drain backups inside the building.
- Wet ground and water leaking around manhole lids onto your street.
- Leaking water from cleanouts or outside drains.
- Unusual odorous wet areas: sidewalks, external walls or ground/landscape around a building.

Caution

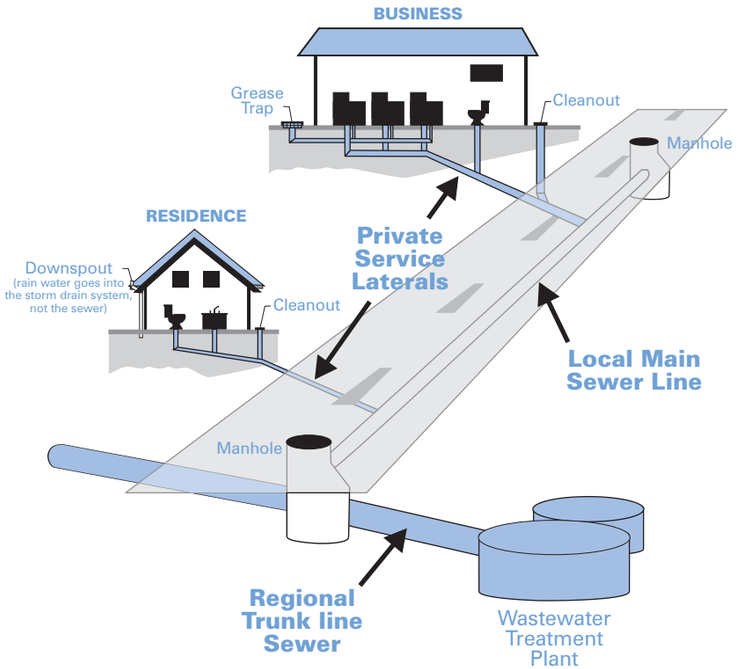
Keep people and pets away from the affected area. Untreated sewage has high levels of disease-causing viruses and bacteria. Call your local health care agency listed on the back for more information.

If You See a Sewage Spill Occurring, Notify Your City Sewer/Public Works Department or Public Sewer District IMMEDIATELY!

How a Sewer System Works

A property owner's sewer pipes are called service laterals and are connected to larger local main and regional trunk lines. Service laterals run from the connection at the home to the connection with the public sewer (including the area under the street). These laterals are the responsibility of the property owner and must be maintained by the property owner. Many city agencies have adopted ordinances requiring maintenance of service laterals. Check with your city sewer/local public works department for more information.

Operation and maintenance of **local and regional sewer lines** are the responsibility of the city sewer/public works departments and public sewer districts.



How You Can Prevent Sewage Spills

1. **Never put grease down garbage disposals, drains or toilets.**
2. **Perform periodic cleaning to eliminate grease, debris and roots in your service laterals.**
3. **Repair any structural problems in your sewer system and eliminate any rainwater infiltration/inflow leaks into your service laterals.**

Preventing Grease Blockages

The drain is not a dump! Recycle or dispose of grease properly and never pour grease down the drain.

Homeowners should mix fats, oils and grease with absorbent waste materials such as paper, coffee grounds, or kitty litter and place it in the trash. Wipe food scraps from plates and pans and dump them in the trash.

Restaurants and commercial food service establishments should always use "Kitchen Best Management Practices." These include:

- Collecting all cooking grease and liquid oil from pots, pans and fryers in covered grease containers for recycling.
- Scraping or dry-wiping excess food and grease from dishes, pots, pans and fryers into the trash.
- Installing drain screens on all kitchen drains.
- Having spill kits readily available for cleaning up spills.
- Properly maintaining grease traps or interceptors by having them serviced regularly. Check your local city codes.

Orange County Agency Responsibilites

- **City Sewer/Public Works Departments—** Responsible for protecting city property and streets, the local storm drain system, sewage collection system and other public areas.
- **Public Sewer/Sanitation District—** Responsible for collecting, treating and disposing of wastewater.
- **County of Orange Health Care Agency—** Responsible for protecting public health by closing ocean/bay waters and may close food-service businesses if a spill poses a threat to public health.
- **Regional Water Quality Control Boards—** Responsible for protecting State waters.
- **Orange County Stormwater Program—** Responsible for preventing harmful pollutants from being discharged or washed by stormwater runoff into the municipal storm drain system, creeks, bays and the ocean.

You Could Be Liable for Not Protecting the Environment

Local and state agencies have legal jurisdiction and enforcement authority to ensure that sewage spills are remedied.

They may respond and assist with containment, relieving pipe blockages, and/or clean-up of the sewage spill, especially if the spill is flowing into storm drains or onto public property.

A property owner may be charged for costs incurred by these agencies responding to spills from private properties.

Report Sewage Spills!

City Sewer/Public Works Departments

Aliso Viejo	(949) 425-2500
Anaheim	(714) 765-6860
Brea	(714) 990-7691
Buena Park	(714) 562-3655
Costa Mesa	(949) 645-8400
Cypress	(714) 229-6760
Dana Point	(949) 248-3562
Fountain Valley	(714) 593-4600
Fullerton	(714) 738-6897
Garden Grove	(714) 741-5375
Huntington Beach	(714) 536-5921
Irvine	(949) 453-5300
Laguna Beach	(949) 497-0765
Laguna Hills	(949) 707-2650
Laguna Niguel	(949) 362-4337
Laguna Woods	(949) 639-0500
La Habra	(562) 905-9792
Lake Forest	(949) 461-3480
La Palma	(714) 690-3310
Los Alamitos	(562) 431-3538
Mission Viejo	(949) 831-2500
Newport Beach	(949) 644-3011
Orange	(714) 532-6480
Orange County	(714) 567-6363
Placentia	(714) 993-8245
Rancho Santa Margarita	(949) 635-1800
San Clemente	(949) 366-1553
San Juan Capistrano	(949) 443-6363
Santa Ana	(714) 647-3380
Seal Beach	(562) 431-2527
Stanton	(714) 379-9222
Tustin	(714) 962-2411
Villa Park	(714) 998-1500
Westminster	(714) 893-3553
Yorba Linda	(714) 961-7170

Public Sewer/Water Districts

Costa Mesa Sanitary District	(714) 393-4433/ (949) 645-8400
El Toro Water District	(949) 837-0660
Emerald Bay Service District	(949) 494-8571
Garden Grove Sanitary District	(714) 741-5375
Irvine Ranch Water District	(949) 453-5300
Los Alamitos/Rossmoor Sewer District	(562) 431-2223
Midway City Sanitary District (Westminster)	(714) 893-3553
Moulton Niguel Water District	(949) 831-2500
Orange County Sanitation District	(714) 962-2411
Santa Margarita Water District	(949) 459-6420
South Coast Water District	(949) 499-4555
South Orange County Wastewater Authority	(949) 234-5400
Sunset Beach Sanitary District	(562) 493-9932
Trabuco Canyon Sanitary District	(949) 858-0277
Yorba Linda Water District	(714) 777-3018

Other Agencies

Orange County Health Care Agency	(714) 433-6419
Office of Emergency Services	(800) 852-7550

Clean beaches and healthy creeks, rivers, bays and ocean are important to Orange County. However, many common activities can lead to water pollution if you're not careful. Fertilizers, pesticides and other chemicals that are left on yards or driveways can be blown or washed into storm drains that flow to the ocean. Overwatering lawns can also send materials into storm drains. Unlike water in sanitary sewers (from sinks and toilets), water in storm drains is not treated before entering our waterways.

You would never pour gardening products into the ocean, so don't let them enter the storm drains. Follow these easy tips to help prevent water pollution.

For more information,
please call the
Orange County Stormwater Program
at **1-877-89-SPILL** (1-877-897-7455)
or visit
www.ocwatersheds.com

UCCE Master Gardener Hotline:
(714) 708-1646

To report a spill,
call the
Orange County 24-Hour
Water Pollution Problem
Reporting Hotline
1-877-89-SPILL (1-877-897-7455).

For emergencies, dial 911.

The tips contained in this brochure provide useful information to help prevent water pollution while landscaping or gardening. If you have other suggestions, please contact your city's stormwater representatives or call the Orange County Stormwater Program.

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Help Prevent Ocean Pollution:

Tips for Landscape & Gardening

The Ocean Begins at Your Front Door

PROJECT Pollution PREVENTION

Tips for Landscape & Gardening

Never allow gardening products or polluted water to enter the street, gutter or storm drain.

General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.
- Plant native vegetation to reduce the amount of water, fertilizers, and pesticide applied to the landscape.

- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.

Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro spray systems. Periodically inspect and fix leaks and misdirected sprinklers.
- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.

- Use slow-release fertilizers to minimize leaching, and use organic fertilizers.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.

- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting. For more information, visit **www.ipm.ucdavis.edu**.
- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Hazardous Waste Collection Center to be recycled. Locations are provided below.

Household Hazardous Waste Collection Centers

Anaheim:	1071 N. Blue Gum St.
Huntington Beach:	17121 Nichols St.
Irvine:	6411 Oak Canyon
San Juan Capistrano:	32250 La Pata Ave.

For more information, call (714) 834-6752 or visit www.oclandfills.com

Section VIII WQ Design & HCOC Calculations

Project Area	Pervious		Impervious	
	Area (acres or sq ft)	Percentage	Area (acres or sq ft)	Percentage
Pre-Project Conditions	32,800 SF	29.7%	77,600 SF	70.3%
Post-Project Conditions	22,200	20.1%	88,200	79.9%

	Drainage Area (Acres)		Time of Concentration (min.)		Runoff Volume (Acre-Feet)	
Drainage Area Description	Pre-Project	Post-Project	Pre-Project	Post-Project	Pre-Project	Post-Project
DMA 1	1.1	1.2	8.07	8.21	0.13	0.14
DMA 2	0.5	0.4	11.52	13.88	0.02	0.01
DMA 3	1.0	1.0	11.14	15.06	0.09	0.08
Totals	2.6	2.6	30.73	37.15	0.24	0.23

The total pre-Project 2-year 24-hour volume is 0.24 ac-ft; the post-Project 2-year 24-hour volume is 0.23 ac-ft. The total pre-Project 2-year 24-hour Tc is 30.73 minutes; the post-Project 2-year 24-hour Tc is 37.15 minutes.

$(V_{2\text{-yr, POST}} / V_{2\text{-yr, PRE}}) = 0.23 / 0.24 = 0.96 < 1.05$

$(Tc_{2\text{-yr, PRE}} / Tc_{2\text{-yr, POST}}) = 30.73/37.15 = 0.83 < 1.05$

Total Area DCV:

DCV = C x d x A x 43,560 x 12

D = 0.75 from OCTGD Figure XVI-1 as shown below

C = 0.75 x Imp. + 0.15 = 0.75 x (88,200/110,400) + 0.15 = 0.75 x 0.80 + 0.15 = 0.75

DCV = 0.75 x 0.75 x 2.6 x 43,560 x 12 = 5,310 cu.ft.

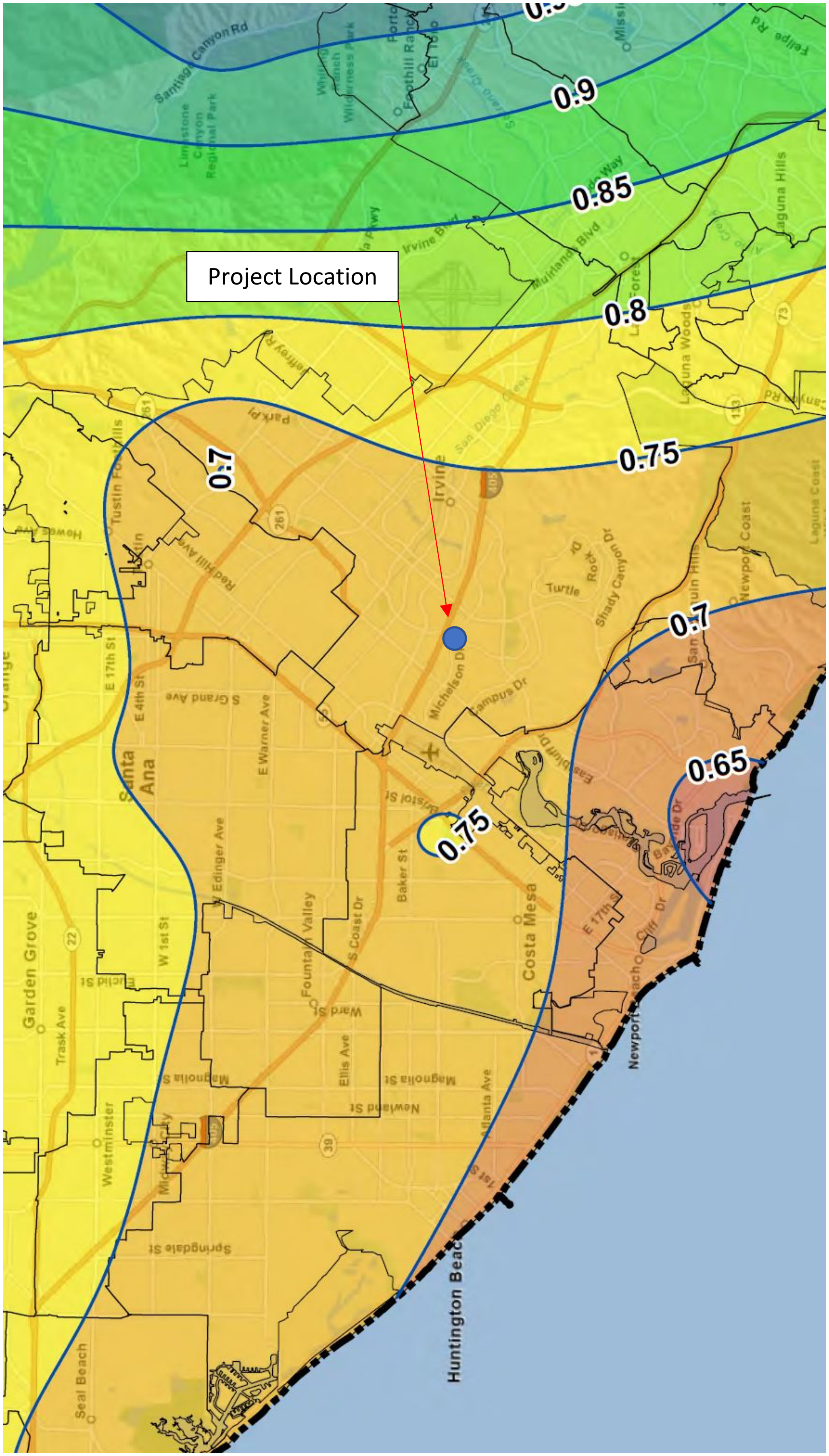
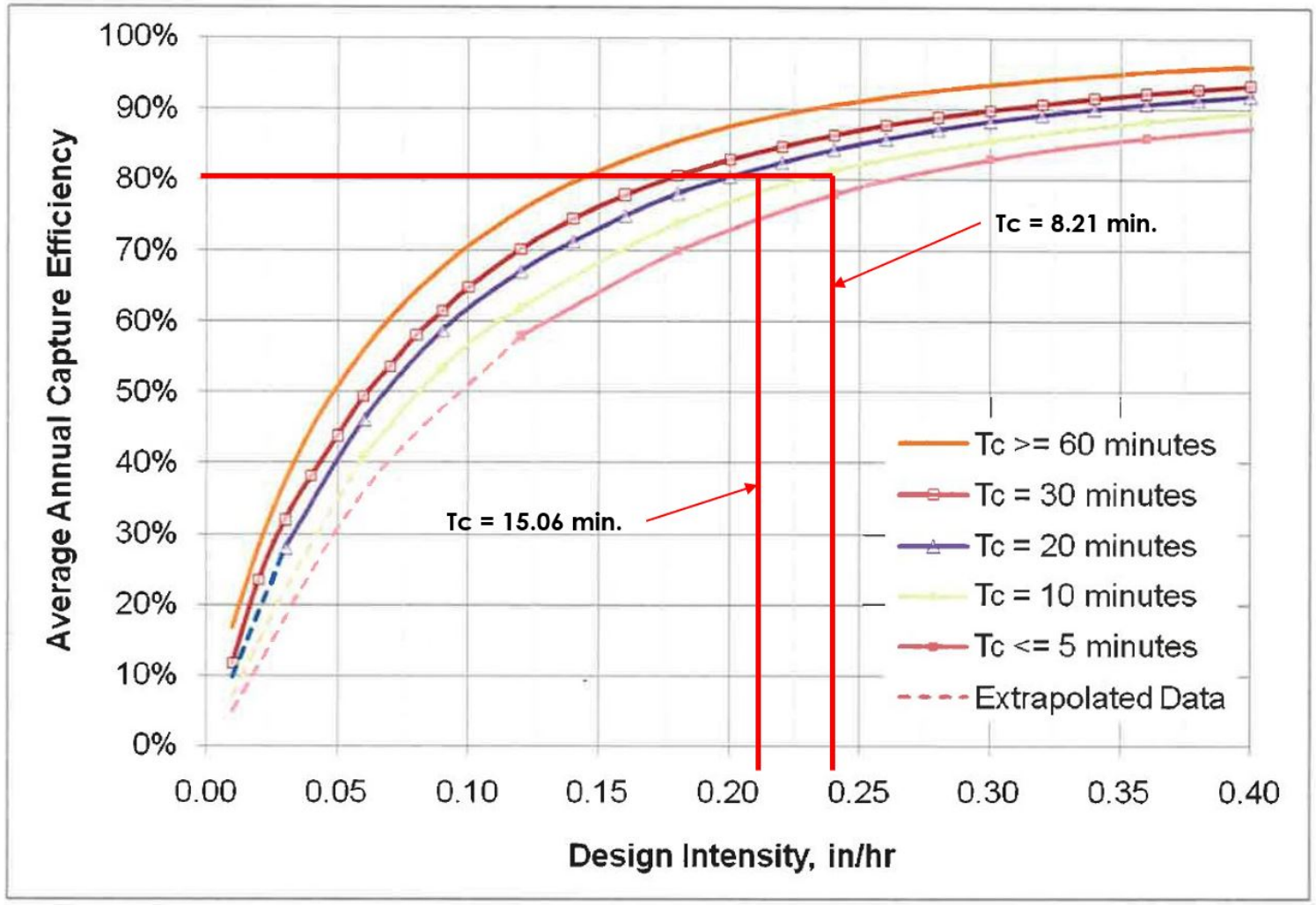

Project Location
0.9
0.85
0.8
0.75
0.7
0.75
0.7
0.65
0.75
Irvine
Santa Ana
Costa Mesa
Garden Grove
Westminster
Seal Beach
Huntington Beach
Newport Beach

Figure III.4. Capture Efficiency Nomograph for Off-line Flow-based Systems in Orange County



Combined DMA 1 & 2 DCV & Q_{LID}:

Percent Impervious for the Post-Project condition:

1.2acres/1.6acres = 0.75

C = 0.75 x 0.75 +0.15 = 0.71

DCVOCTGD Eq. III.2 = C x d x A x 43,560/12 = 0.71 x 0.75 x 1.6 x 43,560/12 = 3,093 cu.ft.

Figure III.4 of the OC TGD: Design Intensity = 0.2375 in/hr corresponding to a Tc = 8.21 minutes. QLID (OCTGD Eq. III.3) = C x I x A = 0.71 x 0.2375 x 1.6 = 0.27 cfs

Filterra Quick Sizing Guide for Western Zones, Commercial:

Based on the manufacturer's suggested 0.0023148 cfs per sq ft design flow:

0.27/0.0023148 = 116.6 sq.ft., Filterra Size 12 x 6 and 8 x 6 has an Expected Flow Rate of 0.278 cfs

DMA 3 DCV & Q_{LID}:

C = 0.75 x 0.80 + 0.15 = 0.75

DCV = 0.75 x 0.75 x 1.0 x 43,560/12 = 2,042 cu.ft.

Figure III.4 of the OC TGD: Design Intensity = 0.2125 in/hr corresponding to a Tc = 15.06 minutes

Q_{LID} = C x I x A = 0.75 x 0.2125 x 1.0 = 0.16 cfs

Filterra Quick Sizing Guide for Western Zones, Commercial:

Based on the manufacturer's suggested 0.0023148 cfs per sq ft design flow:

0.16/0.0023148 = 69.1 sq.ft., Filterra Size 6 x 12 has an Expected Flow Rate of 0.168 cfs

Section IX Appendix A

2-Year Rational Method Analysis
For the
Pre-Project (Existing Condition)

City of Irvine, Harvard/Michelson Intersection Improvements
Pre-Project Hydrology Map

Legend:

- D — Soil Group
- Soil Group Boundary
- 1.3 — Hydrologic Node
- Flow Path
- Elev. 40.0 — Node Elevation
- Subarea Boundary

DMA 1 & 2

Legend:

- D — Soil Group
- 1.3 — Hydrologic Node
- Elev. 40.0 — Node Elevation
- Flow Path
- Subarea Boundary
- Catch Basin Inlet Location

DMA 3

```
**************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
          (c) Copyright 1983-2016 Advanced Engineering Software (aes)
              Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                  Stantec



  ************************* DESCRIPTION OF STUDY *************************
 * Harvard - Michelson Intersection Improvements: Project No. 2042557300
*
 * 2-Year Rational Method Hydrology for DMA 1 pre-project condition
*
 * Phil Jones, August 20, 2019
*
  **************************************************************************

   FILE NAME: HARVARD2.DAT
   TIME/DATE OF STUDY: 10:48 08/20/2019

==========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

==========================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =    2.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   *DATA BANK RAINFALL USED*
   *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

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

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

```
****************************************************************************
   FLOW PROCESS FROM NODE      1.10 TO NODE      1.20 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   128.00
   ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     68.00

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
   SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
(MIN.)
   COMMERCIAL                  C        0.07      0.25     0.100    50
5.00
   COMMERCIAL                  A        0.03      0.40     0.100    17
5.00
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
   SUBAREA RUNOFF(CFS) =      0.20
   TOTAL AREA(ACRES) =      0.10   PEAK FLOW RATE(CFS) =      0.20


****************************************************************************
   FLOW PROCESS FROM NODE      1.20 TO NODE      1.30 IS CODE =  62
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<

============================================================================
   UPSTREAM ELEVATION(FEET) =   68.00  DOWNSTREAM ELEVATION(FEET) =   62.50
   STREET LENGTH(FEET) =   173.00   CURB HEIGHT(INCHES) =  8.0
   STREET HALFWIDTH(FEET) = 30.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.018
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.32
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.20
     HALFSTREET FLOOD WIDTH(FEET) =    2.00
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.87
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.77
   STREET FLOW TRAVEL TIME(MIN.) =   0.74   Tc(MIN.) =    5.74
```

```
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.090
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 C        0.01      0.25      0.100    50
COMMERCIAL                 A        0.12      0.40      0.100    17
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
SUBAREA AREA(ACRES) =    0.13      SUBAREA RUNOFF(CFS) =    0.24
EFFECTIVE AREA(ACRES) =      0.23    AREA-AVERAGED Fm(INCH/HR) =  0.03
AREA-AVERAGED Fp(INCH/HR) =  0.35  AREA-AVERAGED Ap =  0.10
TOTAL AREA(ACRES) =        0.2         PEAK FLOW RATE(CFS) =       0.43

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
FLOW VELOCITY(FEET/SEC.) =  3.87   DEPTH*VELOCITY(FT*FT/SEC.) =   0.77
LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.30 =     301.00 FEET.


****************************************************************************
FLOW PROCESS FROM NODE      1.30 TO NODE      1.40 IS CODE =  62
 ----------------------------------------------------------------------------
-
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  1 USED)<<<<<

============================================================================
UPSTREAM ELEVATION(FEET) =   62.50  DOWNSTREAM ELEVATION(FEET) =   50.00
STREET LENGTH(FEET) =   252.00   CURB HEIGHT(INCHES) =  8.0
STREET HALFWIDTH(FEET) = 30.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.018
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.62
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.20
  HALFSTREET FLOOD WIDTH(FEET) =    2.00
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.84
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.96
STREET FLOW TRAVEL TIME(MIN.) =   0.87   Tc(MIN.) =    6.61
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.928
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
COMMERCIAL                 A        0.03      0.40      0.100    17
COMMERCIAL                 D        0.20      0.20      0.100    57
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
SUBAREA AREA(ACRES) =    0.23      SUBAREA RUNOFF(CFS) =    0.39
EFFECTIVE AREA(ACRES) =      0.46    AREA-AVERAGED Fm(INCH/HR) =  0.03
```

```
   AREA-AVERAGED Fp(INCH/HR) =  0.29  AREA-AVERAGED Ap =  0.10
   TOTAL AREA(ACRES) =        0.5        PEAK FLOW RATE(CFS) =       0.79

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
   FLOW VELOCITY(FEET/SEC.) =  4.84   DEPTH*VELOCITY(FT*FT/SEC.) =   0.96
   LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.40 =     553.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE      1.40 TO NODE      1.50 IS CODE =  62
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<

============================================================================
   UPSTREAM ELEVATION(FEET) =   50.00  DOWNSTREAM ELEVATION(FEET) =   39.00
   STREET LENGTH(FEET) =   302.00   CURB HEIGHT(INCHES) =  8.0
   STREET HALFWIDTH(FEET) = 30.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.018
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.20
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.24
     HALFSTREET FLOOD WIDTH(FEET) =    4.16
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.45
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.82
   STREET FLOW TRAVEL TIME(MIN.) =   1.46   Tc(MIN.) =    8.07
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.719
   SUBAREA LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   COMMERCIAL                 D        0.54      0.20      0.100    57
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
   SUBAREA AREA(ACRES) =    0.54      SUBAREA RUNOFF(CFS) =    0.83
   EFFECTIVE AREA(ACRES) =      1.00    AREA-AVERAGED Fm(INCH/HR) =  0.02
   AREA-AVERAGED Fp(INCH/HR) =  0.24  AREA-AVERAGED Ap =  0.10
   TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       1.53

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.26   HALFSTREET FLOOD WIDTH(FEET) =   5.22
   FLOW VELOCITY(FEET/SEC.) =  3.49   DEPTH*VELOCITY(FT*FT/SEC.) =   0.89
   LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.50 =     855.00 FEET.

============================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =        1.0  TC(MIN.) =      8.07
```

```
   EFFECTIVE AREA(ACRES) =      1.00  AREA-AVERAGED Fm(INCH/HR)=  0.02
   AREA-AVERAGED Fp(INCH/HR) =  0.24  AREA-AVERAGED Ap = 0.100
   PEAK FLOW RATE(CFS)   =       1.53

================================================================================

================================================================================
   END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
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              Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                 Stantec



  ************************* DESCRIPTION OF STUDY *************************
 * Harvard - Michelson Intersection Improvements, Project No. 2042557300
*
 * 2-Year Rational Method Analysis for DMA 2 pre-project condition
*
 * Phil Jones, August 20, 2019
*
  **************************************************************************

   FILE NAME: HARVDMA2.DAT
   TIME/DATE OF STUDY: 11:05 08/20/2019

==========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

==========================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =    2.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   *DATA BANK RAINFALL USED*
   *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

   *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
      HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:
MANNING
      WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
 NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
 ===  =====  =========  =================  ======  ===== ====== =====
=======
   1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

```
****************************************************************************
   FLOW PROCESS FROM NODE      2.10 TO NODE      2.20 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   111.00
   ELEVATION DATA: UPSTREAM(FEET) =     65.50  DOWNSTREAM(FEET) =     45.00

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
   SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
(MIN.)
   PUBLIC PARK               C        0.08      0.25     0.850    50
5.00
   PUBLIC PARK               A        0.06      0.40     0.850    17
5.00
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.31
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
   SUBAREA RUNOFF(CFS) =      0.25
   TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.25


****************************************************************************
   FLOW PROCESS FROM NODE      2.20 TO NODE      2.30 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     45.00  DOWNSTREAM(FEET) =     43.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   156.00   CHANNEL SLOPE =  0.0128
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   3.000
   MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   3.00
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.801
   SUBAREA LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   PUBLIC PARK               C        0.02      0.25     0.850    50
   PUBLIC PARK               A        0.04      0.40     0.850    17
   PUBLIC PARK               D        0.14      0.20     0.850    57
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.40
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.06
   AVERAGE FLOW DEPTH(FEET) =   0.11   TRAVEL TIME(MIN.) =   2.44
   Tc(MIN.) =    7.44
   SUBAREA AREA(ACRES) =     0.20       SUBAREA RUNOFF(CFS) =    0.29
   EFFECTIVE AREA(ACRES) =      0.34     AREA-AVERAGED Fm(INCH/HR) =   0.23
   AREA-AVERAGED Fp(INCH/HR) =   0.27  AREA-AVERAGED Ap =   0.85
```

```
   TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       0.48

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   1.12
   LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.30 =     267.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE      2.30 TO NODE      2.40 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     43.00  DOWNSTREAM(FEET) =     40.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   236.00   CHANNEL SLOPE =  0.0127
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   3.000
   MANNING'S FACTOR = 0.050   MAXIMUM DEPTH(FEET) =   3.00
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.402
   SUBAREA LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   PUBLIC PARK                D        0.19      0.20     0.850    57
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.59
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.96
   AVERAGE FLOW DEPTH(FEET) =   0.17   TRAVEL TIME(MIN.) =   4.08
   Tc(MIN.) =   11.52
   SUBAREA AREA(ACRES) =     0.19       SUBAREA RUNOFF(CFS) =    0.21
   EFFECTIVE AREA(ACRES) =      0.53     AREA-AVERAGED Fm(INCH/HR) =   0.21
   AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.85
   TOTAL AREA(ACRES) =        0.5         PEAK FLOW RATE(CFS) =       0.57

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.17   FLOW VELOCITY(FEET/SEC.) =   0.94
   LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.40 =     503.00 FEET.

============================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =        0.5  TC(MIN.) =     11.52
   EFFECTIVE AREA(ACRES) =      0.53  AREA-AVERAGED Fm(INCH/HR)=  0.21
   AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.850
   PEAK FLOW RATE(CFS)   =       0.57

============================================================================

============================================================================
   END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
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                        Analysis prepared by:

                               Stantec



 ************************* DESCRIPTION OF STUDY *************************
* Harvard - Michelson Intersection Improvements, Project No. 2042557300    *
* 2-Year Rational Method Analysis for DMA 3 Pre-Project Conditions         *
* Phil Jones, December 3, 2019                                             *
 ************************************************************************

  FILE NAME: HARVDMA3.DAT
  TIME/DATE OF STUDY: 09:57 12/03/2019
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

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

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

************************************************************************
  FLOW PROCESS FROM NODE      3.10 TO NODE      3.20 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   196.00
  ELEVATION DATA: UPSTREAM(FEET) =     40.50  DOWNSTREAM(FEET) =     39.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.690
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.768
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```
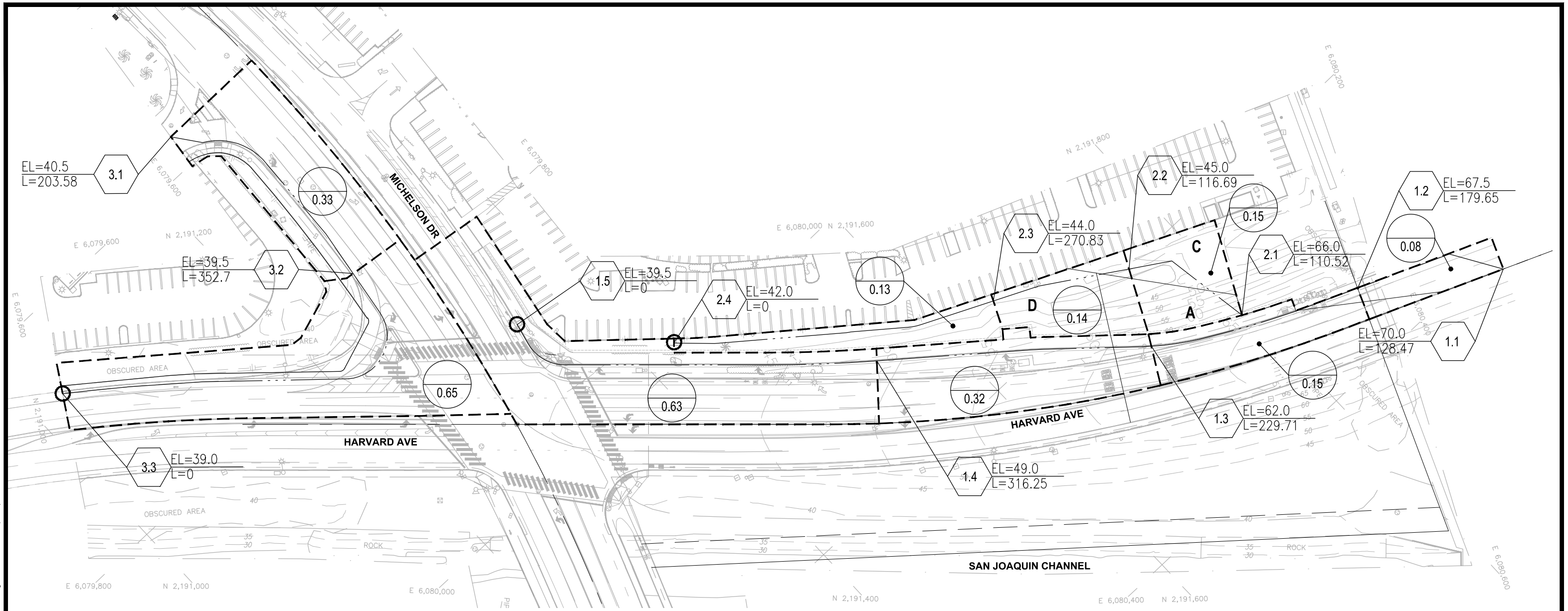

```
  APARTMENTS                  D        0.33      0.20     0.200    57    7.69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      0.51
  TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      0.51

****************************************************************************
  FLOW PROCESS FROM NODE      3.20 TO NODE      3.30 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   39.50  DOWNSTREAM ELEVATION(FEET) =   39.00
  STREET LENGTH(FEET) =   313.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.90
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.34
    HALFSTREET FLOOD WIDTH(FEET) =    9.72
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.87
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.29
  STREET FLOW TRAVEL TIME(MIN.) =   6.02   Tc(MIN.) =   13.71
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.269
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                  D        0.69      0.20     0.200    57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    0.69      SUBAREA RUNOFF(CFS) =    0.76
  EFFECTIVE AREA(ACRES) =      1.02    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       1.13

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.36   HALFSTREET FLOOD WIDTH(FEET) =  10.82
  FLOW VELOCITY(FEET/SEC.) =  0.91   DEPTH*VELOCITY(FT*FT/SEC.) =   0.32
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.30 =     509.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.0  TC(MIN.) =     13.71
  EFFECTIVE AREA(ACRES) =      1.02  AREA-AVERAGED Fm(INCH/HR)=  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.200
  PEAK FLOW RATE(CFS)   =       1.13
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

2-Year Rational Method Analysis
For the
Post-Project (Proposed Condition)



LEGEND

77.20 — AREA (AC)	D — SOIL GROUP
NODE DESIGNATION	CATCH BASIN LOCATION
1.00 EL=100 L=1000 — ELEVATION	SOIL AREA BOUNDARY
DOWNSTREAM LENGTH	SUBAREA DRAINAGE AREA BOUNDARY
	FLOWPATH

GRAPHIC SCALE

40 0 40 80 160

(IN FEET)
1 inch = 80 ft.

PREPARED BY:
Stantec
38 TECHNOLOGY DRIVE, SUITE 100
IRVINE, CA 92618
949.923.6000 stantec.com

HARVARD AND MICHELSON RATIONAL METHOD HYDROLOGY MAP

DATE: 08/27/2019

SHEET 1 OF 1

JOB NO. 2042557300

```
**************************************************************************
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                          Analysis prepared by:

                                  Stantec



  ************************* DESCRIPTION OF STUDY *************************
 * Harvard - Michelson Intersection Improvements, Project No. 2042557300
*
 * 2-Year Rational Method Analysis for DMA 1 Post-Project Condition
*
 * Phil Jones, August 21, 2019
*
  **************************************************************************

   FILE NAME: HARPOST1.DAT
   TIME/DATE OF STUDY: 09:26 08/21/2019

==========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =    2.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   *DATA BANK RAINFALL USED*
   *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

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

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

```
****************************************************************************
   FLOW PROCESS FROM NODE      1.10 TO NODE      1.20 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   128.00
   ELEVATION DATA: UPSTREAM(FEET) =     70.00  DOWNSTREAM(FEET) =     67.50

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
   SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
(MIN.)
   COMMERCIAL                   -        0.08      0.27     0.850     0
5.00
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.27
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
   SUBAREA RUNOFF(CFS) =      0.15
   TOTAL AREA(ACRES) =      0.08   PEAK FLOW RATE(CFS) =      0.15


****************************************************************************
   FLOW PROCESS FROM NODE      1.20 TO NODE      1.30 IS CODE =  62
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<

============================================================================
   UPSTREAM ELEVATION(FEET) =   67.50  DOWNSTREAM ELEVATION(FEET) =   62.00
   STREET LENGTH(FEET) =   180.00   CURB HEIGHT(INCHES) =  8.0
   STREET HALFWIDTH(FEET) = 30.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.018
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.26
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.20
     HALFSTREET FLOOD WIDTH(FEET) =    2.00
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.80
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.75
   STREET FLOW TRAVEL TIME(MIN.) =   0.79   Tc(MIN.) =    5.79
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.081
   SUBAREA LOSS RATE DATA(AMC  I ):
```

```
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
USER-DEFINED                -        0.15      0.39      0.850     -
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.39
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
SUBAREA AREA(ACRES) =    0.15      SUBAREA RUNOFF(CFS) =    0.24
EFFECTIVE AREA(ACRES) =      0.23    AREA-AVERAGED Fm(INCH/HR) =  0.30
AREA-AVERAGED Fp(INCH/HR) =  0.35  AREA-AVERAGED Ap =  0.85
TOTAL AREA(ACRES) =        0.2        PEAK FLOW RATE(CFS) =       0.37

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
FLOW VELOCITY(FEET/SEC.) =  3.80   DEPTH*VELOCITY(FT*FT/SEC.) =   0.75
LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.30 =     308.00 FEET.


****************************************************************************
FLOW PROCESS FROM NODE      1.30 TO NODE      1.40 IS CODE =  62
 ----------------------------------------------------------------------------
-
>>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>(STREET TABLE SECTION #  1 USED)<<<<<

============================================================================
UPSTREAM ELEVATION(FEET) =   62.00  DOWNSTREAM ELEVATION(FEET) =   49.00
STREET LENGTH(FEET) =   230.00   CURB HEIGHT(INCHES) =  8.0
STREET HALFWIDTH(FEET) = 30.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.018
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.61
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.20
  HALFSTREET FLOOD WIDTH(FEET) =    2.00
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.16
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.02
STREET FLOW TRAVEL TIME(MIN.) =   0.74   Tc(MIN.) =    6.53
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.942
SUBAREA LOSS RATE DATA(AMC  I ):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
USER-DEFINED                -        0.31      0.22      0.850     -
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.22
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
SUBAREA AREA(ACRES) =    0.31      SUBAREA RUNOFF(CFS) =    0.49
EFFECTIVE AREA(ACRES) =      0.54    AREA-AVERAGED Fm(INCH/HR) =  0.23
AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  0.85
TOTAL AREA(ACRES) =        0.5        PEAK FLOW RATE(CFS) =       0.83

END OF SUBAREA STREET FLOW HYDRAULICS:
```

```
   DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
   FLOW VELOCITY(FEET/SEC.) =  5.16   DEPTH*VELOCITY(FT*FT/SEC.) =   1.02
   LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.40 =     538.00 FEET.


****************************************************************************
   FLOW PROCESS FROM NODE      1.40 TO NODE      1.50 IS CODE =  62
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<

============================================================================
   UPSTREAM ELEVATION(FEET) =   49.00  DOWNSTREAM ELEVATION(FEET) =   39.50
   STREET LENGTH(FEET) =   316.00   CURB HEIGHT(INCHES) =  8.0
   STREET HALFWIDTH(FEET) = 30.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.018
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.27
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.25
     HALFSTREET FLOOD WIDTH(FEET) =    4.84
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.14
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.78
   STREET FLOW TRAVEL TIME(MIN.) =   1.68   Tc(MIN.) =    8.21
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.703
   SUBAREA LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   USER-DEFINED               -        0.63      0.20     0.850     -
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
   SUBAREA AREA(ACRES) =    0.63      SUBAREA RUNOFF(CFS) =    0.87
   EFFECTIVE AREA(ACRES) =      1.17    AREA-AVERAGED Fm(INCH/HR) =  0.20
   AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap =  0.85
   TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       1.58

   END OF SUBAREA STREET FLOW HYDRAULICS:
   DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   5.78
   FLOW VELOCITY(FEET/SEC.) =  3.22   DEPTH*VELOCITY(FT*FT/SEC.) =   0.86
   LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.50 =     854.00 FEET.

============================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =        1.2  TC(MIN.) =      8.21
   EFFECTIVE AREA(ACRES) =      1.17  AREA-AVERAGED Fm(INCH/HR)=  0.20
   AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap = 0.850
   PEAK FLOW RATE(CFS)   =       1.58
```

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END OF RATIONAL METHOD ANALYSIS

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**************************************************************************
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              Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                  Stantec



  ************************* DESCRIPTION OF STUDY *************************
 * Harvard - Michelson Intersection Improvements, Project No. 2042557300
*
 * 2-Year Rational Method Analysis for DMA 2 Post -Project Condition
*
 * Phil Jones, August 21, 2019
*
  **************************************************************************

   FILE NAME: HARPOST2.DAT
   TIME/DATE OF STUDY: 09:34 08/21/2019

==========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

==========================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =    2.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   *DATA BANK RAINFALL USED*
   *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

   *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
      HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:
MANNING
      WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
 NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
 ===  =====  =========  =================  ======  ===== ====== =====
=======
   1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

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

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****************************************************************************
   FLOW PROCESS FROM NODE      2.10 TO NODE      2.20 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   111.00
   ELEVATION DATA: UPSTREAM(FEET) =     66.00  DOWNSTREAM(FEET) =     45.00

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.264
   SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
(MIN.)
   PUBLIC PARK                -        0.14      0.31     1.000     0
5.00
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.31
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
   SUBAREA RUNOFF(CFS) =      0.25
   TOTAL AREA(ACRES) =      0.14   PEAK FLOW RATE(CFS) =      0.25


****************************************************************************
   FLOW PROCESS FROM NODE      2.20 TO NODE      2.30 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     45.00  DOWNSTREAM(FEET) =     44.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   117.00   CHANNEL SLOPE =  0.0085
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   3.000
   MANNING'S FACTOR = 0.035   MAXIMUM DEPTH(FEET) =   3.00
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.833
   SUBAREA LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   USER-DEFINED               -        0.14      0.25     1.000     -
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.35
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.88
   AVERAGE FLOW DEPTH(FEET) =   0.12   TRAVEL TIME(MIN.) =   2.22
   Tc(MIN.) =    7.22
   SUBAREA AREA(ACRES) =     0.14       SUBAREA RUNOFF(CFS) =    0.20
   EFFECTIVE AREA(ACRES) =      0.28     AREA-AVERAGED Fm(INCH/HR) =   0.28
   AREA-AVERAGED Fp(INCH/HR) =   0.28  AREA-AVERAGED Ap =   1.00
   TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       0.39

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   0.91
```

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   LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.30 =     228.00 FEET.

****************************************************************************
   FLOW PROCESS FROM NODE      2.30 TO NODE      2.40 IS CODE =  51
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =     44.00  DOWNSTREAM(FEET) =     42.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   271.00   CHANNEL SLOPE =  0.0074
   CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   3.000
   MANNING'S FACTOR = 0.055   MAXIMUM DEPTH(FEET) =   3.00
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.260
   SUBAREA LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
        LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
   USER-DEFINED               -        0.13      0.20     1.000     -
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
   TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.45
   TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.68
   AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   6.66
   Tc(MIN.) =   13.88
   SUBAREA AREA(ACRES) =     0.13       SUBAREA RUNOFF(CFS) =    0.12
   EFFECTIVE AREA(ACRES) =      0.41     AREA-AVERAGED Fm(INCH/HR) =   0.25
   AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   1.00
   TOTAL AREA(ACRES) =        0.4          PEAK FLOW RATE(CFS) =       0.39
   NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

   END OF SUBAREA CHANNEL FLOW HYDRAULICS:
   DEPTH(FEET) =  0.17   FLOW VELOCITY(FEET/SEC.) =   0.64
   LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.40 =     499.00 FEET.

============================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =     13.88
   EFFECTIVE AREA(ACRES) =      0.41  AREA-AVERAGED Fm(INCH/HR)=  0.25
   AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 1.000
   PEAK FLOW RATE(CFS)   =       0.39

============================================================================

============================================================================
   END OF RATIONAL METHOD ANALYSIS
```

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**************************************************************************
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                          Analysis prepared by:

                                 Stantec



  ************************* DESCRIPTION OF STUDY *************************
 * Harvard - Michelson Intersection Improvements, Project No. 2042557300
*
 * 2-Year Rational Method Analysis for DMA 3 Post-Project Conditions
*
 * Phil Jones, August 22, 2019
*
  **************************************************************************

   FILE NAME: HARPOST3.DAT
   TIME/DATE OF STUDY: 12:42 08/22/2019

==========================================================================
   USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

==========================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

   USER SPECIFIED STORM EVENT(YEAR) =    2.00
   SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
   SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
   *DATA BANK RAINFALL USED*
   *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

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

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

```
****************************************************************************
   FLOW PROCESS FROM NODE      3.10 TO NODE      3.20 IS CODE =  21
 ----------------------------------------------------------------------------
-
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
   >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

============================================================================
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   204.00
   ELEVATION DATA: UPSTREAM(FEET) =     40.50  DOWNSTREAM(FEET) =     39.50

   Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
   SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.876
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.744
   SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
    DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
        LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
(MIN.)
   APARTMENTS                  D        0.33      0.20     0.200    57
7.88
   SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
   SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
   SUBAREA RUNOFF(CFS) =      0.51
   TOTAL AREA(ACRES) =      0.33   PEAK FLOW RATE(CFS) =      0.51


****************************************************************************
   FLOW PROCESS FROM NODE      3.20 TO NODE      3.30 IS CODE =  62
 ----------------------------------------------------------------------------
-
   >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>(STREET TABLE SECTION #  1 USED)<<<<<

============================================================================
   UPSTREAM ELEVATION(FEET) =   39.50  DOWNSTREAM ELEVATION(FEET) =   39.00
   STREET LENGTH(FEET) =   353.00   CURB HEIGHT(INCHES) =  8.0
   STREET HALFWIDTH(FEET) = 30.00

   DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
   INSIDE STREET CROSSFALL(DECIMAL) =  0.018
   OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

   SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
   STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
   Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
   Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

     **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.85
     STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
     STREET FLOW DEPTH(FEET) =  0.34
     HALFSTREET FLOOD WIDTH(FEET) =    9.72
     AVERAGE FLOW VELOCITY(FEET/SEC.) =    0.82
     PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.28
   STREET FLOW TRAVEL TIME(MIN.) =   7.18   Tc(MIN.) =   15.06
   *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.202
   SUBAREA LOSS RATE DATA(AMC  I ):
```

```
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
APARTMENTS                  D        0.65      0.20      0.200    57
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
SUBAREA AREA(ACRES) =    0.65      SUBAREA RUNOFF(CFS) =    0.68
EFFECTIVE AREA(ACRES) =      0.98    AREA-AVERAGED Fm(INCH/HR) =  0.04
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.20
TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       1.03

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.35   HALFSTREET FLOOD WIDTH(FEET) =  10.66
FLOW VELOCITY(FEET/SEC.) =  0.85   DEPTH*VELOCITY(FT*FT/SEC.) =   0.30
LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.30 =     557.00 FEET.

============================================================================
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)     =        1.0  TC(MIN.) =     15.06
EFFECTIVE AREA(ACRES) =      0.98  AREA-AVERAGED Fm(INCH/HR)=  0.04
AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap = 0.200
PEAK FLOW RATE(CFS)   =       1.03

============================================================================

============================================================================
END OF RATIONAL METHOD ANALYSIS
```

2-Year Small Area Hydrograph Analysis
For the
Pre-Project (Existing Condition)

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**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL

==========================================================================
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                          Analysis prepared by:

                                 Stantec




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  Problem Descriptions:
   Harvard-Michelson Intersection Improvements, Project No. 2042557300
   2-Year Small Area Hydrograph Analysis for DMA 1 Pre-Project Condition
   Phil Jones, August 21, 2019
 ------------------------------------------------------------------------
-


     RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
     TOTAL CATCHMENT AREA(ACRES) =    1.00
     SOIL-LOSS RATE, Fm,(INCH/HR) =  0.020
     LOW LOSS FRACTION = 0.253
     TIME OF CONCENTRATION(MIN.) =  8.07
     SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
     ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
     RETURN FREQUENCY(YEARS) =   2
        5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
       30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
        1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
        3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
        6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
       24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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-

     TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.13
     TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04


**************************************************************************
   TIME      VOLUME        Q    0.         2.5        5.0        7.5       10.0
  (HOURS)     (AF)       (CFS)
 ------------------------------------------------------------------------
-
```

0.13	0.0001	0.02	Q	.	.	.	.
0.26	0.0004	0.02	Q	.	.	.	.
0.40	0.0006	0.02	Q	.	.	.	.
0.53	0.0008	0.02	Q	.	.	.	.
0.67	0.0011	0.02	Q	.	.	.	.
0.80	0.0013	0.02	Q	.	.	.	.
0.94	0.0016	0.02	Q	.	.	.	.
1.07	0.0018	0.02	Q	.	.	.	.
1.21	0.0021	0.02	Q	.	.	.	.
1.34	0.0023	0.02	Q	.	.	.	.
1.47	0.0026	0.02	Q	.	.	.	.
1.61	0.0028	0.02	Q	.	.	.	.
1.74	0.0031	0.02	Q	.	.	.	.
1.88	0.0033	0.02	Q	.	.	.	.
2.01	0.0036	0.02	Q	.	.	.	.
2.15	0.0039	0.02	Q	.	.	.	.
2.28	0.0041	0.02	Q	.	.	.	.
2.42	0.0044	0.02	Q	.	.	.	.
2.55	0.0046	0.02	Q	.	.	.	.
2.68	0.0049	0.02	Q	.	.	.	.
2.82	0.0052	0.02	Q	.	.	.	.
2.95	0.0054	0.02	Q	.	.	.	.
3.09	0.0057	0.02	Q	.	.	.	.
3.22	0.0060	0.02	Q	.	.	.	.
3.36	0.0063	0.02	Q	.	.	.	.
3.49	0.0065	0.02	Q	.	.	.	.
3.63	0.0068	0.03	Q	.	.	.	.
3.76	0.0071	0.03	Q	.	.	.	.
3.90	0.0074	0.03	Q	.	.	.	.
4.03	0.0077	0.03	Q	.	.	.	.
4.16	0.0079	0.03	Q	.	.	.	.
4.30	0.0082	0.03	Q	.	.	.	.
4.43	0.0085	0.03	Q	.	.	.	.
4.57	0.0088	0.03	Q	.	.	.	.
4.70	0.0091	0.03	Q	.	.	.	.
4.84	0.0094	0.03	Q	.	.	.	.
4.97	0.0097	0.03	Q	.	.	.	.
5.11	0.0100	0.03	Q	.	.	.	.
5.24	0.0103	0.03	Q	.	.	.	.
5.37	0.0106	0.03	Q	.	.	.	.
5.51	0.0109	0.03	Q	.	.	.	.
5.64	0.0112	0.03	Q	.	.	.	.
5.78	0.0115	0.03	Q	.	.	.	.
5.91	0.0119	0.03	Q	.	.	.	.
6.05	0.0122	0.03	Q	.	.	.	.
6.18	0.0125	0.03	Q	.	.	.	.
6.32	0.0128	0.03	Q	.	.	.	.
6.45	0.0131	0.03	Q	.	.	.	.
6.59	0.0135	0.03	Q	.	.	.	.
6.72	0.0138	0.03	Q	.	.	.	.
6.85	0.0141	0.03	Q	.	.	.	.
6.99	0.0145	0.03	Q	.	.	.	.
7.12	0.0148	0.03	Q	.	.	.	.
7.26	0.0152	0.03	Q	.	.	.	.
7.39	0.0155	0.03	Q	.	.	.	.
7.53	0.0159	0.03	Q	.	.	.	.
7.66	0.0162	0.03	Q	.	.	.	.

7.80	0.0166	0.03	Q	.	.	.	.
7.93	0.0169	0.03	Q	.	.	.	.
8.06	0.0173	0.03	Q	.	.	.	.
8.20	0.0177	0.03	Q	.	.	.	.
8.33	0.0180	0.03	Q	.	.	.	.
8.47	0.0184	0.03	Q	.	.	.	.
8.60	0.0188	0.03	Q	.	.	.	.
8.74	0.0192	0.03	Q	.	.	.	.
8.87	0.0196	0.04	Q	.	.	.	.
9.01	0.0200	0.04	Q	.	.	.	.
9.14	0.0204	0.04	Q	.	.	.	.
9.27	0.0208	0.04	Q	.	.	.	.
9.41	0.0212	0.04	Q	.	.	.	.
9.54	0.0216	0.04	Q	.	.	.	.
9.68	0.0220	0.04	Q	.	.	.	.
9.81	0.0224	0.04	Q	.	.	.	.
9.95	0.0229	0.04	Q	.	.	.	.
10.08	0.0233	0.04	Q	.	.	.	.
10.22	0.0238	0.04	Q	.	.	.	.
10.35	0.0242	0.04	Q	.	.	.	.
10.49	0.0247	0.04	Q	.	.	.	.
10.62	0.0251	0.04	Q	.	.	.	.
10.75	0.0256	0.04	Q	.	.	.	.
10.89	0.0261	0.04	Q	.	.	.	.
11.02	0.0266	0.04	Q	.	.	.	.
11.16	0.0271	0.04	Q	.	.	.	.
11.29	0.0276	0.05	Q	.	.	.	.
11.43	0.0281	0.05	Q	.	.	.	.
11.56	0.0286	0.05	Q	.	.	.	.
11.70	0.0291	0.05	Q	.	.	.	.
11.83	0.0297	0.05	Q	.	.	.	.
11.97	0.0302	0.05	Q	.	.	.	.
12.10	0.0308	0.06	Q	.	.	.	.
12.23	0.0315	0.07	Q	.	.	.	.
12.37	0.0323	0.07	Q	.	.	.	.
12.50	0.0330	0.07	Q	.	.	.	.
12.64	0.0338	0.07	Q	.	.	.	.
12.77	0.0346	0.07	Q	.	.	.	.
12.91	0.0355	0.08	Q	.	.	.	.
13.04	0.0363	0.08	Q	.	.	.	.
13.18	0.0372	0.08	Q	.	.	.	.
13.31	0.0381	0.08	Q	.	.	.	.
13.44	0.0391	0.09	Q	.	.	.	.
13.58	0.0400	0.09	Q	.	.	.	.
13.71	0.0410	0.09	Q	.	.	.	.
13.85	0.0421	0.09	Q	.	.	.	.
13.98	0.0432	0.10	Q	.	.	.	.
14.12	0.0443	0.10	Q	.	.	.	.
14.25	0.0455	0.11	Q	.	.	.	.
14.39	0.0468	0.12	Q	.	.	.	.
14.52	0.0481	0.13	Q	.	.	.	.
14.65	0.0495	0.13	Q	.	.	.	.
14.79	0.0510	0.14	Q	.	.	.	.
14.92	0.0526	0.15	Q	.	.	.	.
15.06	0.0543	0.16	Q	.	.	.	.
15.19	0.0562	0.17	Q	.	.	.	.
15.33	0.0582	0.19	Q	.	.	.	.

15.46	0.0603	0.19	Q	.	.	.	.
15.60	0.0626	0.21	Q	.	.	.	.
15.73	0.0651	0.24	Q	.	.	.	.
15.87	0.0685	0.36	.Q	.	.	.	.
16.00	0.0733	0.50	.Q	.	.	.	.
16.13	0.0846	1.53	.	Q	.	.	.
16.27	0.0947	0.29	.Q	.	.	.	.
16.40	0.0974	0.19	Q	.	.	.	.
16.54	0.0995	0.18	Q	.	.	.	.
16.67	0.1013	0.15	Q	.	.	.	.
16.81	0.1029	0.13	Q	.	.	.	.
16.94	0.1043	0.12	Q	.	.	.	.
17.08	0.1056	0.11	Q	.	.	.	.
17.21	0.1068	0.10	Q	.	.	.	.
17.34	0.1078	0.09	Q	.	.	.	.
17.48	0.1088	0.08	Q	.	.	.	.
17.61	0.1097	0.08	Q	.	.	.	.
17.75	0.1106	0.07	Q	.	.	.	.
17.88	0.1114	0.07	Q	.	.	.	.
18.02	0.1121	0.07	Q	.	.	.	.
18.15	0.1128	0.05	Q	.	.	.	.
18.29	0.1133	0.05	Q	.	.	.	.
18.42	0.1139	0.05	Q	.	.	.	.
18.56	0.1144	0.05	Q	.	.	.	.
18.69	0.1149	0.04	Q	.	.	.	.
18.82	0.1154	0.04	Q	.	.	.	.
18.96	0.1158	0.04	Q	.	.	.	.
19.09	0.1163	0.04	Q	.	.	.	.
19.23	0.1167	0.04	Q	.	.	.	.
19.36	0.1171	0.04	Q	.	.	.	.
19.50	0.1175	0.04	Q	.	.	.	.
19.63	0.1180	0.04	Q	.	.	.	.
19.77	0.1183	0.04	Q	.	.	.	.
19.90	0.1187	0.03	Q	.	.	.	.
20.03	0.1191	0.03	Q	.	.	.	.
20.17	0.1195	0.03	Q	.	.	.	.
20.30	0.1198	0.03	Q	.	.	.	.
20.44	0.1202	0.03	Q	.	.	.	.
20.57	0.1205	0.03	Q	.	.	.	.
20.71	0.1209	0.03	Q	.	.	.	.
20.84	0.1212	0.03	Q	.	.	.	.
20.98	0.1215	0.03	Q	.	.	.	.
21.11	0.1219	0.03	Q	.	.	.	.
21.25	0.1222	0.03	Q	.	.	.	.
21.38	0.1225	0.03	Q	.	.	.	.
21.51	0.1228	0.03	Q	.	.	.	.
21.65	0.1231	0.03	Q	.	.	.	.
21.78	0.1234	0.03	Q	.	.	.	.
21.92	0.1237	0.03	Q	.	.	.	.
22.05	0.1240	0.03	Q	.	.	.	.
22.19	0.1243	0.03	Q	.	.	.	.
22.32	0.1246	0.03	Q	.	.	.	.
22.46	0.1248	0.02	Q	.	.	.	.
22.59	0.1251	0.02	Q	.	.	.	.
22.73	0.1254	0.02	Q	.	.	.	.
22.86	0.1257	0.02	Q	.	.	.	.
22.99	0.1259	0.02	Q	.	.	.	.

23.13	0.1262	0.02	Q	.	.	.	.
23.26	0.1264	0.02	Q	.	.	.	.
23.40	0.1267	0.02	Q	.	.	.	.
23.53	0.1269	0.02	Q	.	.	.	.
23.67	0.1272	0.02	Q	.	.	.	.
23.80	0.1274	0.02	Q	.	.	.	.
23.94	0.1277	0.02	Q	.	.	.	.
24.07	0.1279	0.02	Q	.	.	.	.
24.20	0.1280	0.00	Q	.	.	.	.

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

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1444.5
10%	96.8
20%	24.2
30%	16.1
40%	8.1
50%	8.1
60%	8.1
70%	8.1
80%	8.1
90%	8.1

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                    SMALL AREA UNIT HYDROGRAPH MODEL

==========================================================================
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                          Analysis prepared by:

                                 Stantec




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  Problem Descriptions:
   Harvard-Michelson Intersection Improvements, Project No. 2042557300
   2-Year Small Area Hydrograph Analysis for DMA 2 Pre-Project Condition
   Phil Jones, August 21, 2019
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     RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
     TOTAL CATCHMENT AREA(ACRES) =    0.53
     SOIL-LOSS RATE, Fm,(INCH/HR) =  0.210
     LOW LOSS FRACTION = 0.863
     TIME OF CONCENTRATION(MIN.) = 11.52
     SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
     ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
     RETURN FREQUENCY(YEARS) =   2
        5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
       30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
        1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
        3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
        6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
       24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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     TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.02
     TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.07


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   TIME      VOLUME        Q    0.         2.5        5.0        7.5       10.0
  (HOURS)     (AF)       (CFS)
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0.06	0.0000	0.00	Q	.	.	.	.
0.26	0.0000	0.00	Q	.	.	.	.
0.45	0.0000	0.00	Q	.	.	.	.
0.64	0.0001	0.00	Q	.	.	.	.
0.83	0.0001	0.00	Q	.	.	.	.
1.02	0.0002	0.00	Q	.	.	.	.
1.22	0.0002	0.00	Q	.	.	.	.
1.41	0.0002	0.00	Q	.	.	.	.
1.60	0.0003	0.00	Q	.	.	.	.
1.79	0.0003	0.00	Q	.	.	.	.
1.98	0.0003	0.00	Q	.	.	.	.
2.18	0.0004	0.00	Q	.	.	.	.
2.37	0.0004	0.00	Q	.	.	.	.
2.56	0.0004	0.00	Q	.	.	.	.
2.75	0.0005	0.00	Q	.	.	.	.
2.94	0.0005	0.00	Q	.	.	.	.
3.14	0.0005	0.00	Q	.	.	.	.
3.33	0.0006	0.00	Q	.	.	.	.
3.52	0.0006	0.00	Q	.	.	.	.
3.71	0.0007	0.00	Q	.	.	.	.
3.90	0.0007	0.00	Q	.	.	.	.
4.10	0.0007	0.00	Q	.	.	.	.
4.29	0.0008	0.00	Q	.	.	.	.
4.48	0.0008	0.00	Q	.	.	.	.
4.67	0.0009	0.00	Q	.	.	.	.
4.86	0.0009	0.00	Q	.	.	.	.
5.06	0.0009	0.00	Q	.	.	.	.
5.25	0.0010	0.00	Q	.	.	.	.
5.44	0.0010	0.00	Q	.	.	.	.
5.63	0.0011	0.00	Q	.	.	.	.
5.82	0.0011	0.00	Q	.	.	.	.
6.02	0.0012	0.00	Q	.	.	.	.
6.21	0.0012	0.00	Q	.	.	.	.
6.40	0.0012	0.00	Q	.	.	.	.
6.59	0.0013	0.00	Q	.	.	.	.
6.78	0.0013	0.00	Q	.	.	.	.
6.98	0.0014	0.00	Q	.	.	.	.
7.17	0.0014	0.00	Q	.	.	.	.
7.36	0.0015	0.00	Q	.	.	.	.
7.55	0.0015	0.00	Q	.	.	.	.
7.74	0.0016	0.00	Q	.	.	.	.
7.94	0.0016	0.00	Q	.	.	.	.
8.13	0.0017	0.00	Q	.	.	.	.
8.32	0.0017	0.00	Q	.	.	.	.
8.51	0.0018	0.00	Q	.	.	.	.
8.70	0.0018	0.00	Q	.	.	.	.
8.90	0.0019	0.00	Q	.	.	.	.
9.09	0.0019	0.00	Q	.	.	.	.
9.28	0.0020	0.00	Q	.	.	.	.
9.47	0.0020	0.00	Q	.	.	.	.
9.66	0.0021	0.00	Q	.	.	.	.
9.86	0.0022	0.00	Q	.	.	.	.
10.05	0.0022	0.00	Q	.	.	.	.
10.24	0.0023	0.00	Q	.	.	.	.
10.43	0.0023	0.00	Q	.	.	.	.
10.62	0.0024	0.00	Q	.	.	.	.
10.82	0.0025	0.00	Q	.	.	.	.

11.01	0.0025	0.00	Q	.	.	.	.
11.20	0.0026	0.00	Q	.	.	.	.
11.39	0.0027	0.00	Q	.	.	.	.
11.58	0.0028	0.00	Q	.	.	.	.
11.78	0.0028	0.00	Q	.	.	.	.
11.97	0.0029	0.00	Q	.	.	.	.
12.16	0.0030	0.01	Q	.	.	.	.
12.35	0.0031	0.01	Q	.	.	.	.
12.54	0.0032	0.01	Q	.	.	.	.
12.74	0.0033	0.01	Q	.	.	.	.
12.93	0.0034	0.01	Q	.	.	.	.
13.12	0.0035	0.01	Q	.	.	.	.
13.31	0.0036	0.01	Q	.	.	.	.
13.50	0.0037	0.01	Q	.	.	.	.
13.70	0.0038	0.01	Q	.	.	.	.
13.89	0.0040	0.01	Q	.	.	.	.
14.08	0.0041	0.01	Q	.	.	.	.
14.27	0.0042	0.01	Q	.	.	.	.
14.46	0.0044	0.01	Q	.	.	.	.
14.66	0.0046	0.01	Q	.	.	.	.
14.85	0.0047	0.01	Q	.	.	.	.
15.04	0.0049	0.01	Q	.	.	.	.
15.23	0.0051	0.01	Q	.	.	.	.
15.42	0.0054	0.02	Q	.	.	.	.
15.62	0.0056	0.02	Q	.	.	.	.
15.81	0.0062	0.06	Q	.	.	.	.
16.00	0.0077	0.12	Q	.	.	.	.
16.19	0.0132	0.57	. Q	.	.	.	.
16.38	0.0179	0.03	Q	.	.	.	.
16.58	0.0182	0.01	Q	.	.	.	.
16.77	0.0185	0.01	Q	.	.	.	.
16.96	0.0186	0.01	Q	.	.	.	.
17.15	0.0188	0.01	Q	.	.	.	.
17.34	0.0189	0.01	Q	.	.	.	.
17.54	0.0190	0.01	Q	.	.	.	.
17.73	0.0192	0.01	Q	.	.	.	.
17.92	0.0193	0.01	Q	.	.	.	.
18.11	0.0194	0.01	Q	.	.	.	.
18.30	0.0194	0.00	Q	.	.	.	.
18.50	0.0195	0.00	Q	.	.	.	.
18.69	0.0196	0.00	Q	.	.	.	.
18.88	0.0197	0.00	Q	.	.	.	.
19.07	0.0197	0.00	Q	.	.	.	.
19.26	0.0198	0.00	Q	.	.	.	.
19.46	0.0198	0.00	Q	.	.	.	.
19.65	0.0199	0.00	Q	.	.	.	.
19.84	0.0200	0.00	Q	.	.	.	.
20.03	0.0200	0.00	Q	.	.	.	.
20.22	0.0201	0.00	Q	.	.	.	.
20.42	0.0201	0.00	Q	.	.	.	.
20.61	0.0202	0.00	Q	.	.	.	.
20.80	0.0202	0.00	Q	.	.	.	.
20.99	0.0202	0.00	Q	.	.	.	.
21.18	0.0203	0.00	Q	.	.	.	.
21.38	0.0203	0.00	Q	.	.	.	.
21.57	0.0204	0.00	Q	.	.	.	.
21.76	0.0204	0.00	Q	.	.	.	.

21.95	0.0205	0.00	Q	.	.	.	.
22.14	0.0205	0.00	Q	.	.	.	.
22.34	0.0205	0.00	Q	.	.	.	.
22.53	0.0206	0.00	Q	.	.	.	.
22.72	0.0206	0.00	Q	.	.	.	.
22.91	0.0207	0.00	Q	.	.	.	.
23.10	0.0207	0.00	Q	.	.	.	.
23.30	0.0207	0.00	Q	.	.	.	.
23.49	0.0208	0.00	Q	.	.	.	.
23.68	0.0208	0.00	Q	.	.	.	.
23.87	0.0208	0.00	Q	.	.	.	.
24.06	0.0209	0.00	Q	.	.	.	.
24.26	0.0209	0.00	Q	.	.	.	.

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

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1440.0
10%	34.6
20%	23.0
30%	11.5
40%	11.5
50%	11.5
60%	11.5
70%	11.5
80%	11.5
90%	11.5

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==========================================================================
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                         Analysis prepared by:

                               Stantec



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 Problem Descriptions:
  Harvard - Michelson Intersection Improvements, Project No. 2042557300
  2-Year Small Area Hydrograph Analysis for DMA 3 Pre-Project Conditions
  Phil Jones, December 3, 2019 revision
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    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    1.02
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.040
    LOW LOSS FRACTION = 0.982
    TIME OF CONCENTRATION(MIN.) = 13.71
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.09
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.09

**************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.00      0.0000      0.00  Q         .         .         .         .
  0.23      0.0000      0.00  Q         .         .         .         .
  0.46      0.0000      0.00  Q         .         .         .         .
  0.69      0.0000      0.00  Q         .         .         .         .
  0.92      0.0000      0.00  Q         .         .         .         .
  1.15      0.0000      0.00  Q         .         .         .         .
  1.38      0.0001      0.00  Q         .         .         .         .
  1.60      0.0001      0.00  Q         .         .         .         .
  1.83      0.0001      0.00  Q         .         .         .         .
  2.06      0.0001      0.00  Q         .         .         .         .
  2.29      0.0001      0.00  Q         .         .         .         .
  2.52      0.0001      0.00  Q         .         .         .         .
  2.75      0.0001      0.00  Q         .         .         .         .
  2.98      0.0001      0.00  Q         .         .         .         .
  3.20      0.0001      0.00  Q         .         .         .         .
```

3.43	0.0002	0.00	Q	.	.	.	.
3.66	0.0002	0.00	Q	.	.	.	.
3.89	0.0002	0.00	Q	.	.	.	.
4.12	0.0002	0.00	Q	.	.	.	.
4.35	0.0002	0.00	Q	.	.	.	.
4.57	0.0002	0.00	Q	.	.	.	.
4.80	0.0002	0.00	Q	.	.	.	.
5.03	0.0002	0.00	Q	.	.	.	.
5.26	0.0003	0.00	Q	.	.	.	.
5.49	0.0003	0.00	Q	.	.	.	.
5.72	0.0003	0.00	Q	.	.	.	.
5.95	0.0003	0.00	Q	.	.	.	.
6.17	0.0004	0.00	Q	.	.	.	.
6.40	0.0004	0.00	Q	.	.	.	.
6.63	0.0005	0.00	Q	.	.	.	.
6.86	0.0006	0.00	Q	.	.	.	.
7.09	0.0007	0.01	Q	.	.	.	.
7.32	0.0008	0.01	Q	.	.	.	.
7.55	0.0009	0.01	Q	.	.	.	.
7.77	0.0010	0.01	Q	.	.	.	.
8.00	0.0011	0.01	Q	.	.	.	.
8.23	0.0013	0.01	Q	.	.	.	.
8.46	0.0015	0.01	Q	.	.	.	.
8.69	0.0017	0.01	Q	.	.	.	.
8.92	0.0019	0.01	Q	.	.	.	.
9.15	0.0021	0.01	Q	.	.	.	.
9.37	0.0023	0.01	Q	.	.	.	.
9.60	0.0026	0.01	Q	.	.	.	.
9.83	0.0029	0.02	Q	.	.	.	.
10.06	0.0032	0.02	Q	.	.	.	.
10.29	0.0035	0.02	Q	.	.	.	.
10.52	0.0039	0.02	Q	.	.	.	.
10.74	0.0042	0.02	Q	.	.	.	.
10.97	0.0047	0.02	Q	.	.	.	.
11.20	0.0051	0.02	Q	.	.	.	.
11.43	0.0056	0.03	Q	.	.	.	.
11.66	0.0061	0.03	Q	.	.	.	.
11.89	0.0066	0.03	Q	.	.	.	.
12.12	0.0073	0.04	Q	.	.	.	.
12.34	0.0081	0.05	Q	.	.	.	.
12.57	0.0090	0.05	Q	.	.	.	.
12.80	0.0101	0.06	Q	.	.	.	.
13.03	0.0112	0.06	Q	.	.	.	.
13.26	0.0123	0.06	Q	.	.	.	.
13.49	0.0136	0.07	Q	.	.	.	.
13.72	0.0149	0.07	Q	.	.	.	.
13.94	0.0164	0.08	Q	.	.	.	.
14.17	0.0179	0.09	Q	.	.	.	.
14.40	0.0197	0.10	Q	.	.	.	.
14.63	0.0217	0.11	Q	.	.	.	.
14.86	0.0239	0.13	Q	.	.	.	.
15.09	0.0264	0.14	Q	.	.	.	.
15.31	0.0292	0.17	Q	.	.	.	.
15.54	0.0325	0.18	Q	.	.	.	.
15.77	0.0364	0.24	Q	.	.	.	.
16.00	0.0420	0.35	.Q	.	.	.	.
16.23	0.0560	1.12	. Q	.	.	.	.
16.46	0.0684	0.19	Q	.	.	.	.
16.69	0.0716	0.15	Q	.	.	.	.
16.91	0.0741	0.12	Q	.	.	.	.
17.14	0.0761	0.10	Q	.	.	.	.
17.37	0.0777	0.08	Q	.	.	.	.
17.60	0.0790	0.07	Q	.	.	.	.

17.83	0.0802	0.06	Q	.	.	.	.
18.06	0.0812	0.05	Q	.	.	.	.
18.28	0.0820	0.03	Q	.	.	.	.
18.51	0.0826	0.03	Q	.	.	.	.
18.74	0.0830	0.02	Q	.	.	.	.
18.97	0.0834	0.02	Q	.	.	.	.
19.20	0.0838	0.02	Q	.	.	.	.
19.43	0.0841	0.01	Q	.	.	.	.
19.66	0.0844	0.01	Q	.	.	.	.
19.88	0.0846	0.01	Q	.	.	.	.
20.11	0.0848	0.01	Q	.	.	.	.
20.34	0.0849	0.01	Q	.	.	.	.
20.57	0.0851	0.01	Q	.	.	.	.
20.80	0.0852	0.00	Q	.	.	.	.
21.03	0.0852	0.00	Q	.	.	.	.
21.26	0.0853	0.00	Q	.	.	.	.
21.48	0.0853	0.00	Q	.	.	.	.
21.71	0.0854	0.00	Q	.	.	.	.
21.94	0.0854	0.00	Q	.	.	.	.
22.17	0.0854	0.00	Q	.	.	.	.
22.40	0.0854	0.00	Q	.	.	.	.
22.63	0.0854	0.00	Q	.	.	.	.
22.86	0.0854	0.00	Q	.	.	.	.
23.08	0.0854	0.00	Q	.	.	.	.
23.31	0.0854	0.00	Q	.	.	.	.
23.54	0.0854	0.00	Q	.	.	.	.
23.77	0.0855	0.00	Q	.	.	.	.
24.00	0.0855	0.00	Q	.	.	.	.
24.23	0.0855	0.00	Q	.	.	.	.
24.45	0.0855	0.00	Q	.	.	.	.

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

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1453.3
10%	137.1
20%	41.1
30%	27.4
40%	13.7
50%	13.7
60%	13.7
70%	13.7
80%	13.7
90%	13.7

2-Year Small Area Hydrograph Analysis
For the
Post-Project (Proposed Condition)

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                    SMALL AREA UNIT HYDROGRAPH MODEL

==========================================================================
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                          Analysis prepared by:

                                 Stantec




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  Problem Descriptions:
   Harvard-Michelson Intersection Improvements, Project No. 2042557300
   2-Year Small Area Hydrograph Analysis for DMA 1 Post-Project Condition
   Phil Jones, August 21, 2019
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     RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
     TOTAL CATCHMENT AREA(ACRES) =    1.17
     SOIL-LOSS RATE, Fm,(INCH/HR) =  0.200
     LOW LOSS FRACTION = 0.249
     TIME OF CONCENTRATION(MIN.) =  8.21
     SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
     ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
     RETURN FREQUENCY(YEARS) =   2
        5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
       30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
        1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
        3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
        6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
       24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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     TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.14
     TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.06


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   TIME     VOLUME        Q    0.        2.5       5.0       7.5      10.0
  (HOURS)    (AF)       (CFS)
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0.13	0.0001	0.03	Q	.	.	.	.
0.26	0.0004	0.03	Q	.	.	.	.
0.40	0.0007	0.03	Q	.	.	.	.
0.54	0.0010	0.03	Q	.	.	.	.
0.67	0.0013	0.03	Q	.	.	.	.
0.81	0.0016	0.03	Q	.	.	.	.
0.95	0.0019	0.03	Q	.	.	.	.
1.09	0.0022	0.03	Q	.	.	.	.
1.22	0.0025	0.03	Q	.	.	.	.
1.36	0.0028	0.03	Q	.	.	.	.
1.50	0.0031	0.03	Q	.	.	.	.
1.63	0.0034	0.03	Q	.	.	.	.
1.77	0.0037	0.03	Q	.	.	.	.
1.91	0.0040	0.03	Q	.	.	.	.
2.04	0.0043	0.03	Q	.	.	.	.
2.18	0.0046	0.03	Q	.	.	.	.
2.32	0.0049	0.03	Q	.	.	.	.
2.45	0.0052	0.03	Q	.	.	.	.
2.59	0.0056	0.03	Q	.	.	.	.
2.73	0.0059	0.03	Q	.	.	.	.
2.86	0.0062	0.03	Q	.	.	.	.
3.00	0.0065	0.03	Q	.	.	.	.
3.14	0.0069	0.03	Q	.	.	.	.
3.27	0.0072	0.03	Q	.	.	.	.
3.41	0.0075	0.03	Q	.	.	.	.
3.55	0.0078	0.03	Q	.	.	.	.
3.68	0.0082	0.03	Q	.	.	.	.
3.82	0.0085	0.03	Q	.	.	.	.
3.96	0.0088	0.03	Q	.	.	.	.
4.10	0.0092	0.03	Q	.	.	.	.
4.23	0.0095	0.03	Q	.	.	.	.
4.37	0.0099	0.03	Q	.	.	.	.
4.51	0.0102	0.03	Q	.	.	.	.
4.64	0.0106	0.03	Q	.	.	.	.
4.78	0.0109	0.03	Q	.	.	.	.
4.92	0.0113	0.03	Q	.	.	.	.
5.05	0.0116	0.03	Q	.	.	.	.
5.19	0.0120	0.03	Q	.	.	.	.
5.33	0.0124	0.03	Q	.	.	.	.
5.46	0.0127	0.03	Q	.	.	.	.
5.60	0.0131	0.03	Q	.	.	.	.
5.74	0.0135	0.03	Q	.	.	.	.
5.87	0.0139	0.03	Q	.	.	.	.
6.01	0.0142	0.03	Q	.	.	.	.
6.15	0.0146	0.03	Q	.	.	.	.
6.28	0.0150	0.03	Q	.	.	.	.
6.42	0.0154	0.03	Q	.	.	.	.
6.56	0.0158	0.03	Q	.	.	.	.
6.70	0.0162	0.04	Q	.	.	.	.
6.83	0.0166	0.04	Q	.	.	.	.
6.97	0.0170	0.04	Q	.	.	.	.
7.11	0.0174	0.04	Q	.	.	.	.
7.24	0.0178	0.04	Q	.	.	.	.
7.38	0.0182	0.04	Q	.	.	.	.
7.52	0.0186	0.04	Q	.	.	.	.
7.65	0.0191	0.04	Q	.	.	.	.
7.79	0.0195	0.04	Q	.	.	.	.

7.93	0.0199	0.04	Q	.	.	.	.
8.06	0.0204	0.04	Q	.	.	.	.
8.20	0.0208	0.04	Q	.	.	.	.
8.34	0.0213	0.04	Q	.	.	.	.
8.47	0.0217	0.04	Q	.	.	.	.
8.61	0.0222	0.04	Q	.	.	.	.
8.75	0.0226	0.04	Q	.	.	.	.
8.88	0.0231	0.04	Q	.	.	.	.
9.02	0.0236	0.04	Q	.	.	.	.
9.16	0.0240	0.04	Q	.	.	.	.
9.30	0.0245	0.04	Q	.	.	.	.
9.43	0.0250	0.04	Q	.	.	.	.
9.57	0.0255	0.04	Q	.	.	.	.
9.71	0.0260	0.04	Q	.	.	.	.
9.84	0.0265	0.05	Q	.	.	.	.
9.98	0.0270	0.05	Q	.	.	.	.
10.12	0.0276	0.05	Q	.	.	.	.
10.25	0.0281	0.05	Q	.	.	.	.
10.39	0.0286	0.05	Q	.	.	.	.
10.53	0.0292	0.05	Q	.	.	.	.
10.66	0.0298	0.05	Q	.	.	.	.
10.80	0.0303	0.05	Q	.	.	.	.
10.94	0.0309	0.05	Q	.	.	.	.
11.07	0.0315	0.05	Q	.	.	.	.
11.21	0.0321	0.05	Q	.	.	.	.
11.35	0.0327	0.05	Q	.	.	.	.
11.48	0.0333	0.06	Q	.	.	.	.
11.62	0.0339	0.06	Q	.	.	.	.
11.76	0.0346	0.06	Q	.	.	.	.
11.90	0.0352	0.06	Q	.	.	.	.
12.03	0.0359	0.06	Q	.	.	.	.
12.17	0.0366	0.07	Q	.	.	.	.
12.31	0.0374	0.08	Q	.	.	.	.
12.44	0.0383	0.08	Q	.	.	.	.
12.58	0.0392	0.08	Q	.	.	.	.
12.72	0.0401	0.08	Q	.	.	.	.
12.85	0.0410	0.08	Q	.	.	.	.
12.99	0.0419	0.08	Q	.	.	.	.
13.13	0.0429	0.09	Q	.	.	.	.
13.26	0.0439	0.09	Q	.	.	.	.
13.40	0.0449	0.09	Q	.	.	.	.
13.54	0.0459	0.09	Q	.	.	.	.
13.67	0.0470	0.10	Q	.	.	.	.
13.81	0.0481	0.10	Q	.	.	.	.
13.95	0.0492	0.10	Q	.	.	.	.
14.08	0.0504	0.11	Q	.	.	.	.
14.22	0.0516	0.11	Q	.	.	.	.
14.36	0.0530	0.12	Q	.	.	.	.
14.49	0.0543	0.12	Q	.	.	.	.
14.63	0.0558	0.13	Q	.	.	.	.
14.77	0.0573	0.14	Q	.	.	.	.
14.91	0.0588	0.14	Q	.	.	.	.
15.04	0.0605	0.16	Q	.	.	.	.
15.18	0.0623	0.16	Q	.	.	.	.
15.32	0.0643	0.18	Q	.	.	.	.
15.45	0.0664	0.19	Q	.	.	.	.
15.59	0.0686	0.20	Q	.	.	.	.

15.73	0.0710	0.23	Q	.	.	.	.
15.86	0.0742	0.33	.Q	.	.	.	.
16.00	0.0786	0.45	.Q	.	.	.	.
16.14	0.0901	1.59	.	Q	.	.	.
16.27	0.1006	0.27	.Q	.	.	.	.
16.41	0.1031	0.18	Q	.	.	.	.
16.55	0.1051	0.17	Q	.	.	.	.
16.68	0.1069	0.15	Q	.	.	.	.
16.82	0.1085	0.13	Q	.	.	.	.
16.96	0.1100	0.12	Q	.	.	.	.
17.09	0.1113	0.11	Q	.	.	.	.
17.23	0.1125	0.10	Q	.	.	.	.
17.37	0.1136	0.09	Q	.	.	.	.
17.51	0.1146	0.09	Q	.	.	.	.
17.64	0.1156	0.08	Q	.	.	.	.
17.78	0.1166	0.08	Q	.	.	.	.
17.92	0.1174	0.08	Q	.	.	.	.
18.05	0.1183	0.07	Q	.	.	.	.
18.19	0.1191	0.06	Q	.	.	.	.
18.33	0.1197	0.06	Q	.	.	.	.
18.46	0.1203	0.05	Q	.	.	.	.
18.60	0.1209	0.05	Q	.	.	.	.
18.74	0.1215	0.05	Q	.	.	.	.
18.87	0.1221	0.05	Q	.	.	.	.
19.01	0.1226	0.05	Q	.	.	.	.
19.15	0.1232	0.05	Q	.	.	.	.
19.28	0.1237	0.05	Q	.	.	.	.
19.42	0.1242	0.04	Q	.	.	.	.
19.56	0.1247	0.04	Q	.	.	.	.
19.69	0.1252	0.04	Q	.	.	.	.
19.83	0.1256	0.04	Q	.	.	.	.
19.97	0.1261	0.04	Q	.	.	.	.
20.11	0.1265	0.04	Q	.	.	.	.
20.24	0.1270	0.04	Q	.	.	.	.
20.38	0.1274	0.04	Q	.	.	.	.
20.52	0.1278	0.04	Q	.	.	.	.
20.65	0.1282	0.04	Q	.	.	.	.
20.79	0.1286	0.04	Q	.	.	.	.
20.93	0.1290	0.03	Q	.	.	.	.
21.06	0.1294	0.03	Q	.	.	.	.
21.20	0.1298	0.03	Q	.	.	.	.
21.34	0.1302	0.03	Q	.	.	.	.
21.47	0.1306	0.03	Q	.	.	.	.
21.61	0.1309	0.03	Q	.	.	.	.
21.75	0.1313	0.03	Q	.	.	.	.
21.88	0.1316	0.03	Q	.	.	.	.
22.02	0.1320	0.03	Q	.	.	.	.
22.16	0.1323	0.03	Q	.	.	.	.
22.29	0.1327	0.03	Q	.	.	.	.
22.43	0.1330	0.03	Q	.	.	.	.
22.57	0.1333	0.03	Q	.	.	.	.
22.70	0.1336	0.03	Q	.	.	.	.
22.84	0.1340	0.03	Q	.	.	.	.
22.98	0.1343	0.03	Q	.	.	.	.
23.12	0.1346	0.03	Q	.	.	.	.
23.25	0.1349	0.03	Q	.	.	.	.
23.39	0.1352	0.03	Q	.	.	.	.

23.53	0.1355	0.03	Q	.	.	.	.
23.66	0.1358	0.03	Q	.	.	.	.
23.80	0.1361	0.03	Q	.	.	.	.
23.94	0.1364	0.03	Q	.	.	.	.
24.07	0.1367	0.03	Q	.	.	.	.
24.21	0.1368	0.00	Q	.	.	.	.

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

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1445.0
10%	90.3
20%	24.6
30%	8.2
40%	8.2
50%	8.2
60%	8.2
70%	8.2
80%	8.2
90%	8.2

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                    SMALL AREA UNIT HYDROGRAPH MODEL

==========================================================================
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                          Analysis prepared by:

                                 Stantec




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  Problem Descriptions:
   Harvard - Michelson Intersection Improvements, Project No. 2042557300
   2-Year Small Area Hydrograph Analysis for DMA 2 Post-Project Condition
   Phil Jones, August 23, 2019
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     RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
     TOTAL CATCHMENT AREA(ACRES) =    0.41
     SOIL-LOSS RATE, Fm,(INCH/HR) =  0.250
     LOW LOSS FRACTION = 0.894
     TIME OF CONCENTRATION(MIN.) = 13.88
     SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
     ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
     RETURN FREQUENCY(YEARS) =   2
        5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
       30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
        1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
        3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
        6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
       24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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     TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.01
     TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.06


**************************************************************************
   TIME      VOLUME        Q    0.        2.5       5.0       7.5      10.0
  (HOURS)     (AF)       (CFS)
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0.04	0.0000	0.00	Q	.	.	.	.
0.27	0.0000	0.00	Q	.	.	.	.
0.50	0.0000	0.00	Q	.	.	.	.
0.73	0.0001	0.00	Q	.	.	.	.
0.96	0.0001	0.00	Q	.	.	.	.
1.19	0.0001	0.00	Q	.	.	.	.
1.43	0.0001	0.00	Q	.	.	.	.
1.66	0.0002	0.00	Q	.	.	.	.
1.89	0.0002	0.00	Q	.	.	.	.
2.12	0.0002	0.00	Q	.	.	.	.
2.35	0.0002	0.00	Q	.	.	.	.
2.58	0.0003	0.00	Q	.	.	.	.
2.81	0.0003	0.00	Q	.	.	.	.
3.05	0.0003	0.00	Q	.	.	.	.
3.28	0.0003	0.00	Q	.	.	.	.
3.51	0.0004	0.00	Q	.	.	.	.
3.74	0.0004	0.00	Q	.	.	.	.
3.97	0.0004	0.00	Q	.	.	.	.
4.20	0.0005	0.00	Q	.	.	.	.
4.43	0.0005	0.00	Q	.	.	.	.
4.66	0.0005	0.00	Q	.	.	.	.
4.90	0.0005	0.00	Q	.	.	.	.
5.13	0.0006	0.00	Q	.	.	.	.
5.36	0.0006	0.00	Q	.	.	.	.
5.59	0.0006	0.00	Q	.	.	.	.
5.82	0.0007	0.00	Q	.	.	.	.
6.05	0.0007	0.00	Q	.	.	.	.
6.28	0.0007	0.00	Q	.	.	.	.
6.52	0.0008	0.00	Q	.	.	.	.
6.75	0.0008	0.00	Q	.	.	.	.
6.98	0.0008	0.00	Q	.	.	.	.
7.21	0.0009	0.00	Q	.	.	.	.
7.44	0.0009	0.00	Q	.	.	.	.
7.67	0.0009	0.00	Q	.	.	.	.
7.90	0.0010	0.00	Q	.	.	.	.
8.13	0.0010	0.00	Q	.	.	.	.
8.37	0.0010	0.00	Q	.	.	.	.
8.60	0.0011	0.00	Q	.	.	.	.
8.83	0.0011	0.00	Q	.	.	.	.
9.06	0.0012	0.00	Q	.	.	.	.
9.29	0.0012	0.00	Q	.	.	.	.
9.52	0.0012	0.00	Q	.	.	.	.
9.75	0.0013	0.00	Q	.	.	.	.
9.99	0.0013	0.00	Q	.	.	.	.
10.22	0.0014	0.00	Q	.	.	.	.
10.45	0.0014	0.00	Q	.	.	.	.
10.68	0.0015	0.00	Q	.	.	.	.
10.91	0.0015	0.00	Q	.	.	.	.
11.14	0.0015	0.00	Q	.	.	.	.
11.37	0.0016	0.00	Q	.	.	.	.
11.60	0.0016	0.00	Q	.	.	.	.
11.84	0.0017	0.00	Q	.	.	.	.
12.07	0.0018	0.00	Q	.	.	.	.
12.30	0.0018	0.00	Q	.	.	.	.
12.53	0.0019	0.00	Q	.	.	.	.
12.76	0.0020	0.00	Q	.	.	.	.
12.99	0.0020	0.00	Q	.	.	.	.

13.22	0.0021	0.00	Q	.	.	.	.
13.46	0.0022	0.00	Q	.	.	.	.
13.69	0.0023	0.00	Q	.	.	.	.
13.92	0.0024	0.00	Q	.	.	.	.
14.15	0.0025	0.01	Q	.	.	.	.
14.38	0.0026	0.01	Q	.	.	.	.
14.61	0.0027	0.01	Q	.	.	.	.
14.84	0.0028	0.01	Q	.	.	.	.
15.07	0.0030	0.01	Q	.	.	.	.
15.31	0.0031	0.01	Q	.	.	.	.
15.54	0.0033	0.01	Q	.	.	.	.
15.77	0.0035	0.02	Q	.	.	.	.
16.00	0.0043	0.06	Q	.	.	.	.
16.23	0.0085	0.37	.Q	.	.	.	.
16.46	0.0121	0.01	Q	.	.	.	.
16.69	0.0123	0.01	Q	.	.	.	.
16.93	0.0124	0.01	Q	.	.	.	.
17.16	0.0125	0.01	Q	.	.	.	.
17.39	0.0126	0.00	Q	.	.	.	.
17.62	0.0127	0.00	Q	.	.	.	.
17.85	0.0128	0.00	Q	.	.	.	.
18.08	0.0129	0.00	Q	.	.	.	.
18.31	0.0129	0.00	Q	.	.	.	.
18.54	0.0130	0.00	Q	.	.	.	.
18.78	0.0130	0.00	Q	.	.	.	.
19.01	0.0131	0.00	Q	.	.	.	.
19.24	0.0131	0.00	Q	.	.	.	.
19.47	0.0132	0.00	Q	.	.	.	.
19.70	0.0132	0.00	Q	.	.	.	.
19.93	0.0132	0.00	Q	.	.	.	.
20.16	0.0133	0.00	Q	.	.	.	.
20.40	0.0133	0.00	Q	.	.	.	.
20.63	0.0133	0.00	Q	.	.	.	.
20.86	0.0134	0.00	Q	.	.	.	.
21.09	0.0134	0.00	Q	.	.	.	.
21.32	0.0134	0.00	Q	.	.	.	.
21.55	0.0135	0.00	Q	.	.	.	.
21.78	0.0135	0.00	Q	.	.	.	.
22.01	0.0135	0.00	Q	.	.	.	.
22.25	0.0136	0.00	Q	.	.	.	.
22.48	0.0136	0.00	Q	.	.	.	.
22.71	0.0136	0.00	Q	.	.	.	.
22.94	0.0136	0.00	Q	.	.	.	.
23.17	0.0137	0.00	Q	.	.	.	.
23.40	0.0137	0.00	Q	.	.	.	.
23.63	0.0137	0.00	Q	.	.	.	.
23.87	0.0137	0.00	Q	.	.	.	.
24.10	0.0138	0.00	Q	.	.	.	.
24.33	0.0138	0.00	Q	.	.	.	.

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

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1443.5
10%	27.8
20%	13.9
30%	13.9
40%	13.9
50%	13.9
60%	13.9
70%	13.9
80%	13.9
90%	13.9

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**************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL

==========================================================================
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              Ver. 23.0  Release Date: 07/01/2016  License ID 1535

                          Analysis prepared by:

                                  Stantec




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  Problem Descriptions:
   Harvard - Michelson Intersection Improvements, Project No. 2042557300
   2-Year Small Hydrograph Analysis for DMA 3 Post-Project Conditions
   Phil Jones, August 26, 2019
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     RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
     TOTAL CATCHMENT AREA(ACRES) =    1.00
     SOIL-LOSS RATE, Fm,(INCH/HR) =  0.040
     LOW LOSS FRACTION = 0.982
     TIME OF CONCENTRATION(MIN.) = 15.06
     SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
     ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
     RETURN FREQUENCY(YEARS) =   2
        5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
       30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
        1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
        3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
        6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
       24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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     TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.08
     TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.09


**************************************************************************
   TIME      VOLUME        Q    0.        2.5       5.0       7.5      10.0
  (HOURS)     (AF)       (CFS)
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-
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0.19	0.0000	0.00	Q	.	.	.	.
0.44	0.0000	0.00	Q	.	.	.	.
0.69	0.0000	0.00	Q	.	.	.	.
0.94	0.0000	0.00	Q	.	.	.	.
1.19	0.0000	0.00	Q	.	.	.	.
1.44	0.0001	0.00	Q	.	.	.	.
1.69	0.0001	0.00	Q	.	.	.	.
1.94	0.0001	0.00	Q	.	.	.	.
2.19	0.0001	0.00	Q	.	.	.	.
2.45	0.0001	0.00	Q	.	.	.	.
2.70	0.0001	0.00	Q	.	.	.	.
2.95	0.0001	0.00	Q	.	.	.	.
3.20	0.0001	0.00	Q	.	.	.	.
3.45	0.0002	0.00	Q	.	.	.	.
3.70	0.0002	0.00	Q	.	.	.	.
3.95	0.0002	0.00	Q	.	.	.	.
4.20	0.0002	0.00	Q	.	.	.	.
4.45	0.0002	0.00	Q	.	.	.	.
4.70	0.0002	0.00	Q	.	.	.	.
4.96	0.0002	0.00	Q	.	.	.	.
5.21	0.0002	0.00	Q	.	.	.	.
5.46	0.0003	0.00	Q	.	.	.	.
5.71	0.0003	0.00	Q	.	.	.	.
5.96	0.0003	0.00	Q	.	.	.	.
6.21	0.0004	0.00	Q	.	.	.	.
6.46	0.0004	0.00	Q	.	.	.	.
6.71	0.0005	0.00	Q	.	.	.	.
6.96	0.0006	0.00	Q	.	.	.	.
7.21	0.0007	0.01	Q	.	.	.	.
7.47	0.0008	0.01	Q	.	.	.	.
7.72	0.0009	0.01	Q	.	.	.	.
7.97	0.0011	0.01	Q	.	.	.	.
8.22	0.0013	0.01	Q	.	.	.	.
8.47	0.0014	0.01	Q	.	.	.	.
8.72	0.0016	0.01	Q	.	.	.	.
8.97	0.0019	0.01	Q	.	.	.	.
9.22	0.0021	0.01	Q	.	.	.	.
9.47	0.0024	0.01	Q	.	.	.	.
9.73	0.0027	0.01	Q	.	.	.	.
9.98	0.0030	0.02	Q	.	.	.	.
10.23	0.0033	0.02	Q	.	.	.	.
10.48	0.0037	0.02	Q	.	.	.	.
10.73	0.0041	0.02	Q	.	.	.	.
10.98	0.0045	0.02	Q	.	.	.	.
11.23	0.0050	0.02	Q	.	.	.	.
11.48	0.0055	0.03	Q	.	.	.	.
11.73	0.0061	0.03	Q	.	.	.	.
11.98	0.0067	0.03	Q	.	.	.	.
12.23	0.0075	0.05	Q	.	.	.	.
12.49	0.0085	0.05	Q	.	.	.	.
12.74	0.0096	0.05	Q	.	.	.	.
12.99	0.0107	0.06	Q	.	.	.	.
13.24	0.0120	0.06	Q	.	.	.	.
13.49	0.0133	0.07	Q	.	.	.	.
13.74	0.0147	0.07	Q	.	.	.	.
13.99	0.0163	0.08	Q	.	.	.	.
14.24	0.0181	0.09	Q	.	.	.	.

14.49	0.0201	0.10	Q	.	.	.	.
14.74	0.0223	0.11	Q	.	.	.	.
15.00	0.0248	0.13	Q	.	.	.	.
15.25	0.0277	0.15	Q	.	.	.	.
15.50	0.0311	0.18	Q	.	.	.	.
15.75	0.0352	0.22	Q	.	.	.	.
16.00	0.0408	0.32	.Q	.	.	.	.
16.25	0.0550	1.04	.	Q	.	.	.
16.50	0.0676	0.17	Q	.	.	.	.
16.75	0.0708	0.14	Q	.	.	.	.
17.00	0.0734	0.11	Q	.	.	.	.
17.26	0.0753	0.08	Q	.	.	.	.
17.51	0.0769	0.07	Q	.	.	.	.
17.76	0.0783	0.06	Q	.	.	.	.
18.01	0.0794	0.05	Q	.	.	.	.
18.26	0.0803	0.03	Q	.	.	.	.
18.51	0.0809	0.03	Q	.	.	.	.
18.76	0.0814	0.02	Q	.	.	.	.
19.01	0.0818	0.02	Q	.	.	.	.
19.26	0.0822	0.02	Q	.	.	.	.
19.51	0.0825	0.01	Q	.	.	.	.
19.77	0.0828	0.01	Q	.	.	.	.
20.02	0.0830	0.01	Q	.	.	.	.
20.27	0.0832	0.01	Q	.	.	.	.
20.52	0.0834	0.01	Q	.	.	.	.
20.77	0.0835	0.00	Q	.	.	.	.
21.02	0.0836	0.00	Q	.	.	.	.
21.27	0.0836	0.00	Q	.	.	.	.
21.52	0.0837	0.00	Q	.	.	.	.
21.77	0.0837	0.00	Q	.	.	.	.
22.02	0.0837	0.00	Q	.	.	.	.
22.27	0.0837	0.00	Q	.	.	.	.
22.53	0.0837	0.00	Q	.	.	.	.
22.78	0.0837	0.00	Q	.	.	.	.
23.03	0.0837	0.00	Q	.	.	.	.
23.28	0.0838	0.00	Q	.	.	.	.
23.53	0.0838	0.00	Q	.	.	.	.
23.78	0.0838	0.00	Q	.	.	.	.
24.03	0.0838	0.00	Q	.	.	.	.
24.28	0.0838	0.00	Q	.	.	.	.

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

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1445.8
10%	150.6
20%	45.2
30%	30.1
40%	15.1
50%	15.1

60%	15.1
70%	15.1
80%	15.1
90%	15.1

Low Loss Rate Fraction
Calculations
For the
Small Area Hydrograph Analysis

Area Average Low Loss Rate Fraction Calculations

S = (1000/CN) - 10
Ia = 0.2 S
Y = [(P24 - Ia)^2] / [(P24 - 0.8 S) P24]
Y bar = 1 - Y

P24	2-year	10-year	25-year	100-year
Valley	2.05	3.68	4.49	5.63
enter P24 here =	2.05			

CN	S	Ia	Y	Y bar
95	0.526315789	0.1052632	0.746596289	0.253404

Landuse	Area Fraction	Soil Group	CN	S	Y

Pavement CN = 98 AMC 1 = 95

TABLE C.1. CURVE NUMBER RELATIONSHIPS

CN for AMC Condition II	Corresponding CN for AMC Condition I	III
100	100	100
95	87	99
90	78	98
85	70	97
80	63	94
75	57	91
70	51	87
65	45	83
60	40	79
55	35	75
50	31	70
45	27	65
40	23	60
35	19	55
30	15	50
25	12	45
20	9	39
15	7	33
10	4	26
5	2	17
0	0	0

Area Average Low Loss Rate Fraction Calculations

S = (1000/CN) - 10
Ia = 0.2 S
Y = [(P24 - Ia)^2] / [(P24 - Ia + S) P24]
Y bar = 1 - Y

P24	2-year	10-year	25-year	100-year
Valley	2.05	3.68	4.49	5.63
enter P24 here =	2.05			

CN	S	Ia	Y	Y bar
95	0.526315789	0.105263158	0.746596289	0.253404

Landuse	Area (ac.)	Area Fraction	Soil Group	AMC II CN	AMC I Adj. CN	S	Ia	Y	Y-fraction
Landscaping(poor)	0.08	0.150943396	C	83	66	5.151515	1.030303	0.08219	0.012406
	0.06	0.113207547	A	58	37	17.02703	3.405405	0.057183	0.006474
Landscaping(poor)	0.02	0.037735849	C	83	66	5.151515	1.030303	0.08219	0.003102
	0.04	0.075471698	A	32	17	48.82353	9.764706	0.706236	0.053301
	0.14	0.264150943	D	87	73	3.69863	0.739726	0.167197	0.044165
Landscaping(good)	0.19	0.358490566	D	79	62	6.129032	1.225806	0.047656	0.017084
Total Area	0.53	1						Y total	0.136531
								Y bar	0.863469

Pavement CN = 98 AMC 1 = 95

TABLE C.1. CURVE NUMBER RELATIONSHIPS

CN for AMC Condition II	Corresponding CN for AMC Condition I	III
100	100	100
95	87	99
90	78	98
85	70	97
80	63	94
75	57	91
70	51	87
65	45	83
60	40	79
55	35	75
50	31	70
45	27	65
40	23	60
35	19	55
30	15	50
25	12	45
20	9	39
15	7	33
10	4	26
5	2	17
0	0	0

Area Average Low Loss Rate Fraction Calculations

S = (1000/CN) - 10
Ia = 0.2 S
Y = [(P24 - Ia)^2] / [(P24 - Ia + S) P24]
Y bar = 1 - Y

P24	2-year	10-year	25-year	100-year
Valley	2.05	3.68	4.49	5.63
enter P24 here =	2.05			

CN	S	Ia	Y	Y bar
95	0.526315789	0.105263158	0.746596289	0.253404

Landuse	Area (ac.)	Area Fraction	Soil Group	AMC II CN	AMC I Adj. CN	S	Ia	Y	Y-fraction
Grass	0.08	0.2	C	79	62	6.129032	1.225806	0.047656	0.009531
Grass	0.06	0.15	A	50	31	22.25806	4.451613	0.141694	0.021254
Grass	0.01	0.025	C	79	62	6.129032	1.225806	0.047656	0.001191
Grass	0.03	0.075	A	50	31	22.25806	4.451613	0.141694	0.010627
Grass	0.1	0.25	D	84	69	4.492754	0.898551	0.114586	0.028647
Grass	0.12	0.3	D	84	69	4.492754	0.898551	0.114586	0.034376
Total Area	0.4	1						Y total	0.105626
								Y bar	0.894374

Pavement CN = 98 AMC 1 = 95

TABLE C.1. CURVE NUMBER RELATIONSHIPS

CN for AMC Condition II	Corresponding CN for AMC Condition I	III
100	100	100
95	87	99
90	78	98
85	70	97
80	63	94
75	57	91
70	51	87
65	45	83
60	40	79
55	35	75
50	31	70
45	27	65
40	23	60
35	19	55
30	15	50
25	12	45
20	9	39
15	7	33
10	4	26
5	2	17
0	0	0

Area Average Low Loss Rate Fraction Calculations

S = (1000/CN) - 10
Ia = 0.2 S
Y = [(P24 - Ia)^2] / [(P24 - Ia + S) P24]
Y bar = 1 - Y

P24	2-year	10-year	25-year	100-year
Valley	2.05	3.68	4.49	5.63
enter P24 here =	2.05			

CN	S	Ia	Y	Y bar
57	7.543859649	1.50877193	0.017673478	0.982327

DMA 3 CN = 57

Pavement CN = 98 AMC 1 = 95

TABLE C.1. CURVE NUMBER RELATIONSHIPS

CN for AMC Condition II	Corresponding CN for AMC Condition I	III
100	100	100
95	87	99
90	78	98
85	70	97
80	63	94
75	57	91
70	51	87
65	45	83
60	40	79
55	35	75
50	31	70
45	27	65
40	23	60
35	19	55
30	15	50
25	12	45
20	9	39
15	7	33
10	4	26
5	2	17
0	0	0

Section IX Appendix A

Appendix A

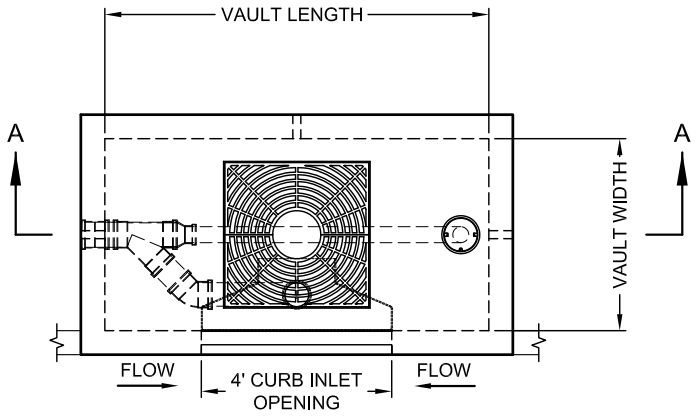
Filterra Bioretention System

&

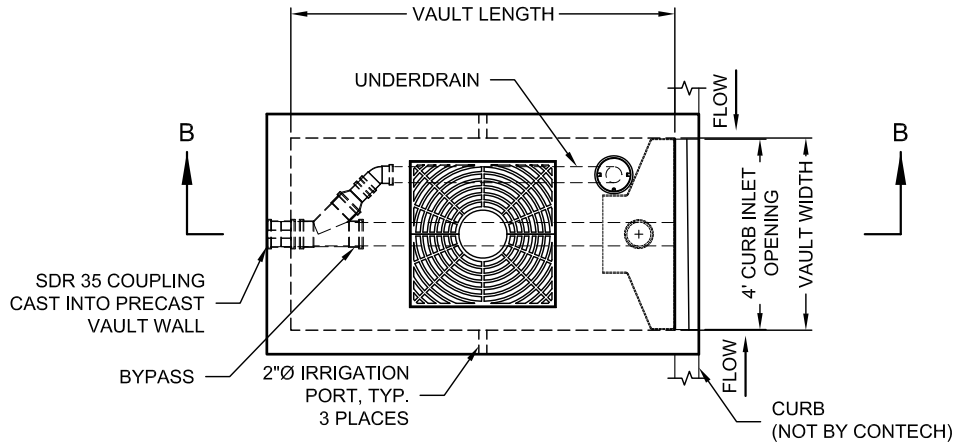
United Storm Water, Inc. – Connector Pipe Screens (CPS)

Filterra Bioretention System

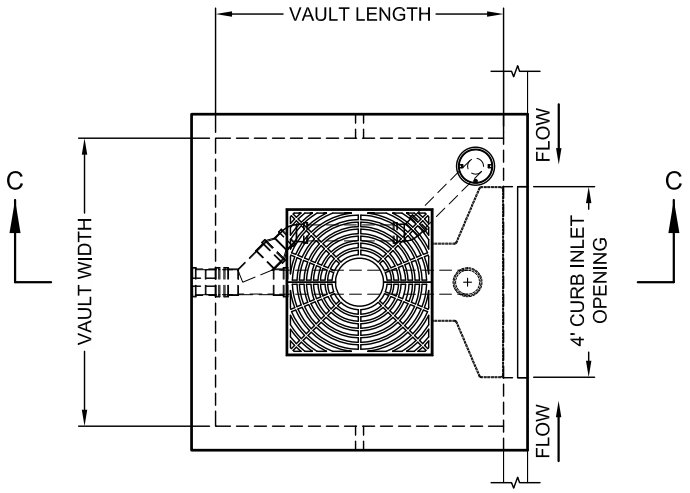
Structural & Construction Details



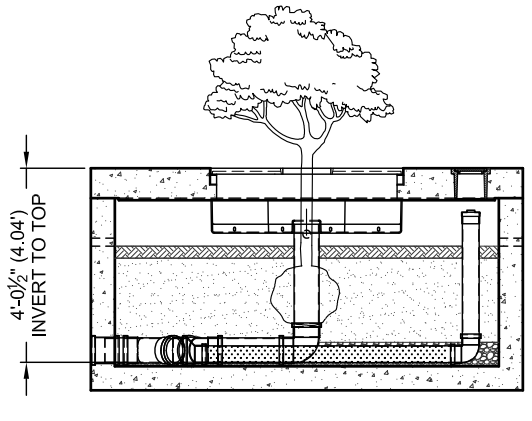
PLAN VIEW



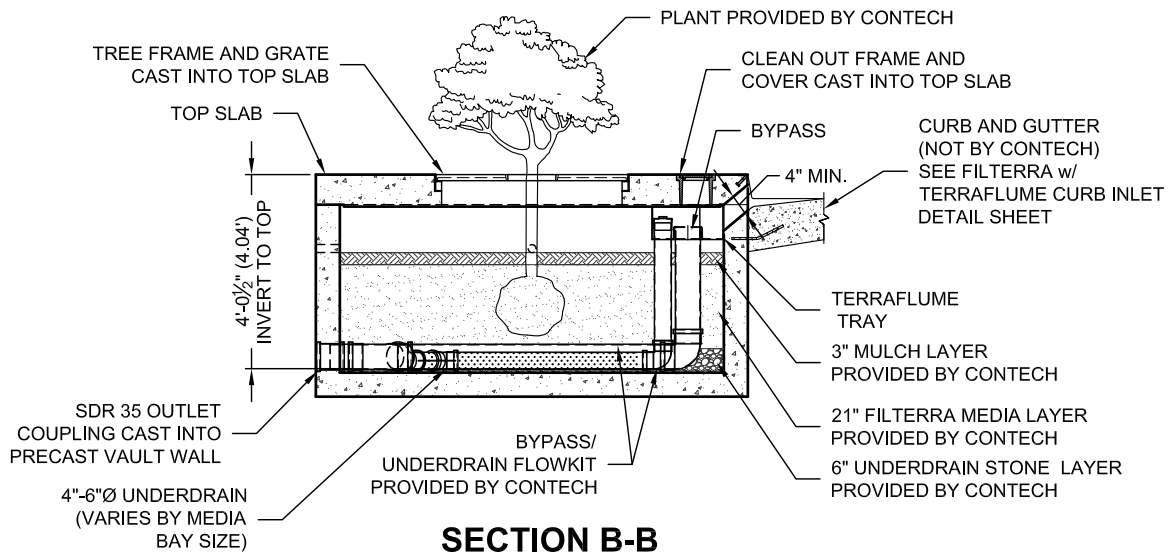
PLAN VIEW



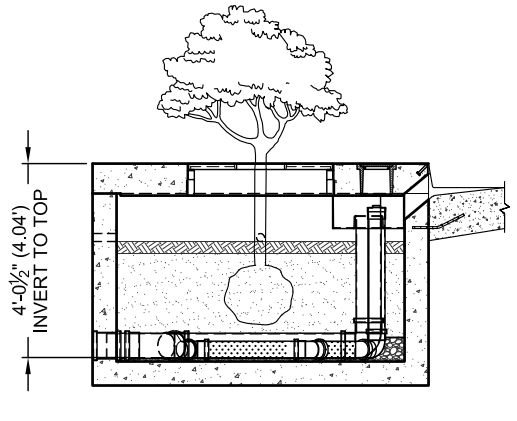
PLAN VIEW



SECTION A-A



SECTION B-B



SECTION C-C

FTIBC LONG SIDE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0604	N/A CA	6 x 4	6 x 4	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC06504	CA ONLY	6.5 x 4	6.5 x 4	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC078045	MID-ATL ONLY	7.83 x 4.5	7.83 x 4.5	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0804	N/A MID-ATL	8 x 4	8 x 4	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0806	ALL	8 x 6	8 x 6	10" SDR 35	2.37	4" SDR 35	(1) 4' x 4'
FTIBC1006	ALL	10 x 6	10 x 6	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
FTIBC1206	ALL	12 x 6	12 x 6	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC1307	ALL	13 x 7	13 x 7	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'

N/A = NOT AVAILABLE

FTIBC SHORT SIDE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0406	N/A CA	4 x 6	4 x 6	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC04065	CA ONLY	4 x 6.5	4 x 6.5	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0408	N/A MID-ATL	4 x 8	4 x 8	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC045078	MID-ATL ONLY	4.5 x 7.83	4.5 x 7.83	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'
FTIBC0608	ALL	6 x 8	6 x 8	10" SDR 35	2.37	4" SDR 35	(1) 4' x 4'
FTIBC0610	ALL	6 x 10	6 x 10	10" SDR 35	2.37	6" SDR 35	(1) 4' x 4'
FTIBC0612	ALL	6 x 12	6 x 12	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'
FTIBC0713	ALL	7 x 13	7 x 13	10" SDR 35	2.37	6" SDR 35	(2) 4' x 4'

N/A = NOT AVAILABLE

FTIBC SQUARE CURB INLET

DESIGNATION	AVAIL-ABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	MAX. OUTLET/ BYPASS PIPE DIA.	MAX. BYPASS FLOW (CFS)	UNDER-DRAIN PIPE DIA. (PERF)	TREE GRATE QTY. & SIZE
FTIBC0404	ALL	4 x 4	4'-0"	6" SDR 35	1.42	4" SDR 35	(1) 3' x 3'
FTIBC0606	ALL	6 x 6	6'-0"	8" SDR 35	1.89	4" SDR 35	(1) 3' x 3'

N/A = NOT AVAILABLE

INTERNAL PIPE CONFIGURATION MAY
VARY DEPENDING ON VAULT SIZE.

filterra®
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 6,277,274; 6,569,321; 7,625,485; 7,425,261; 7,533,412. RELATED FOREIGN PATENTS.

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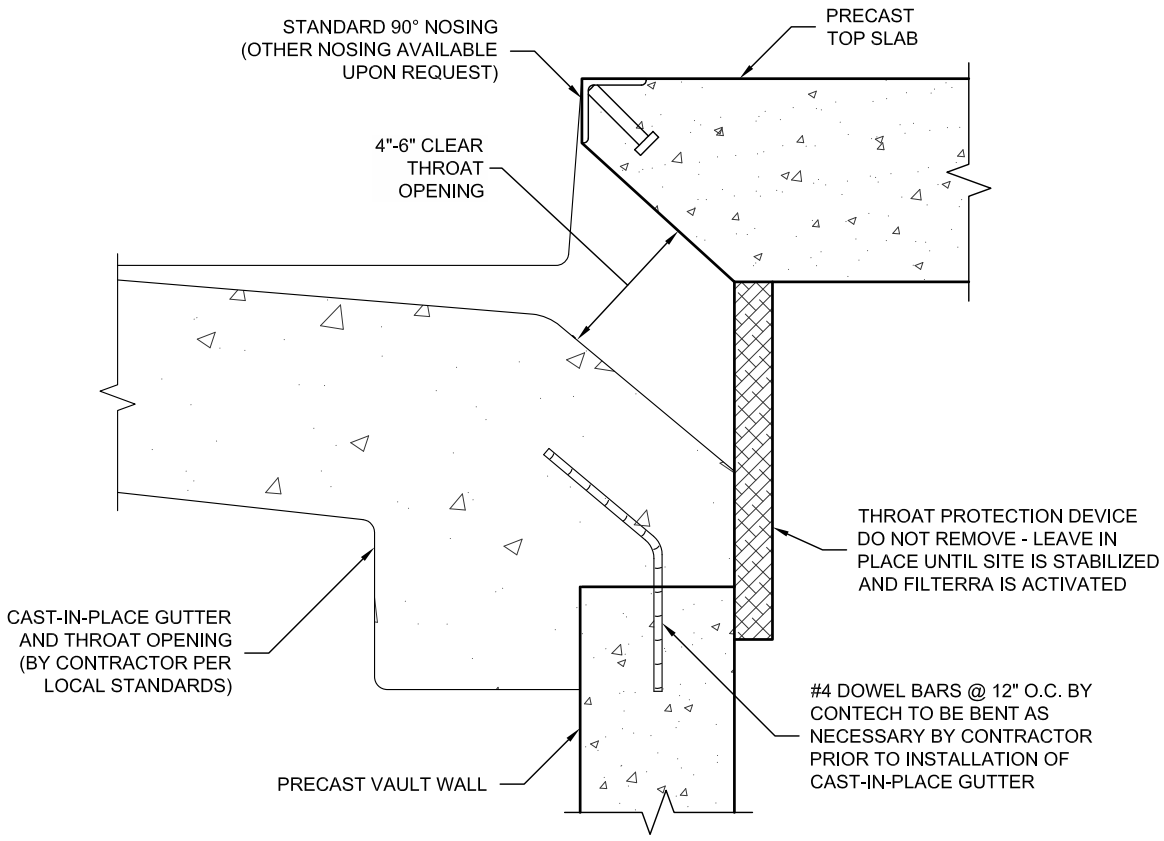
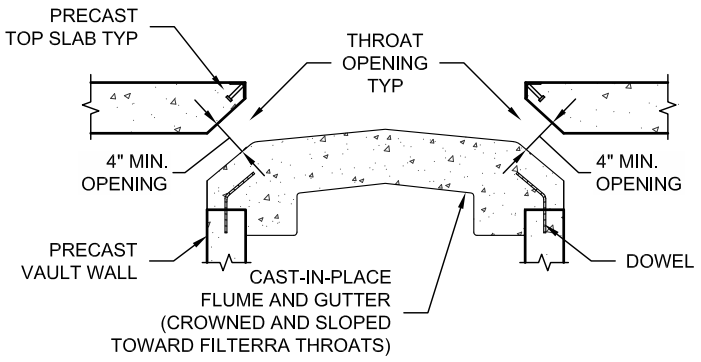
FILTERRA INTERNAL BYPASS CURB (FTIBC) CONFIGURATION DETAIL

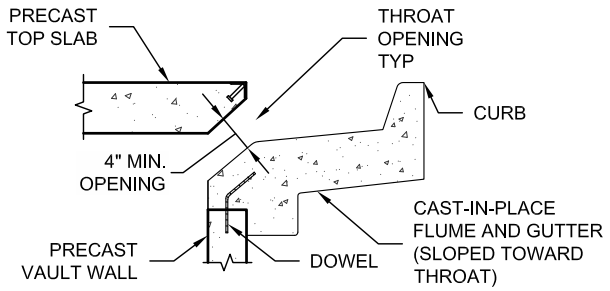


SECTION VIEW

STANDARD THROAT OPENING



CROWNED FLUME



REVERSE FLUME - SLOPED
TOWARDS FILTERRA THROAT

SECTION VIEWS OF TYPICAL FLUME APPLICATIONS

SEE ABOVE FOR DETAILS NOT SHOWN

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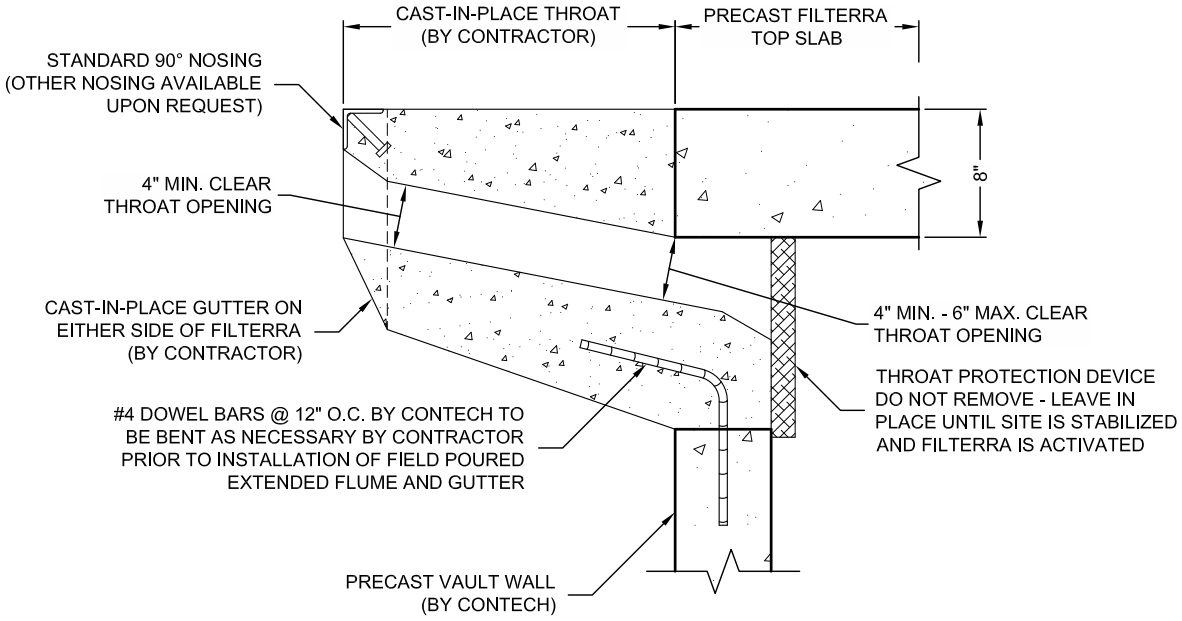
FILTERRA THROAT OPENING DETAILS

DATE: 03/04/15	FILENAME: FILTERRA THROAT OPENING DTL	DRAWN: SCK	CHECKED:



SECTION VIEW

IMPORTANT

FILTERRA FLOWLINE MUST BE AT A HIGHER ELEVATION THAN BYPASS FLOWLINE (DROP INLET OR OTHER)

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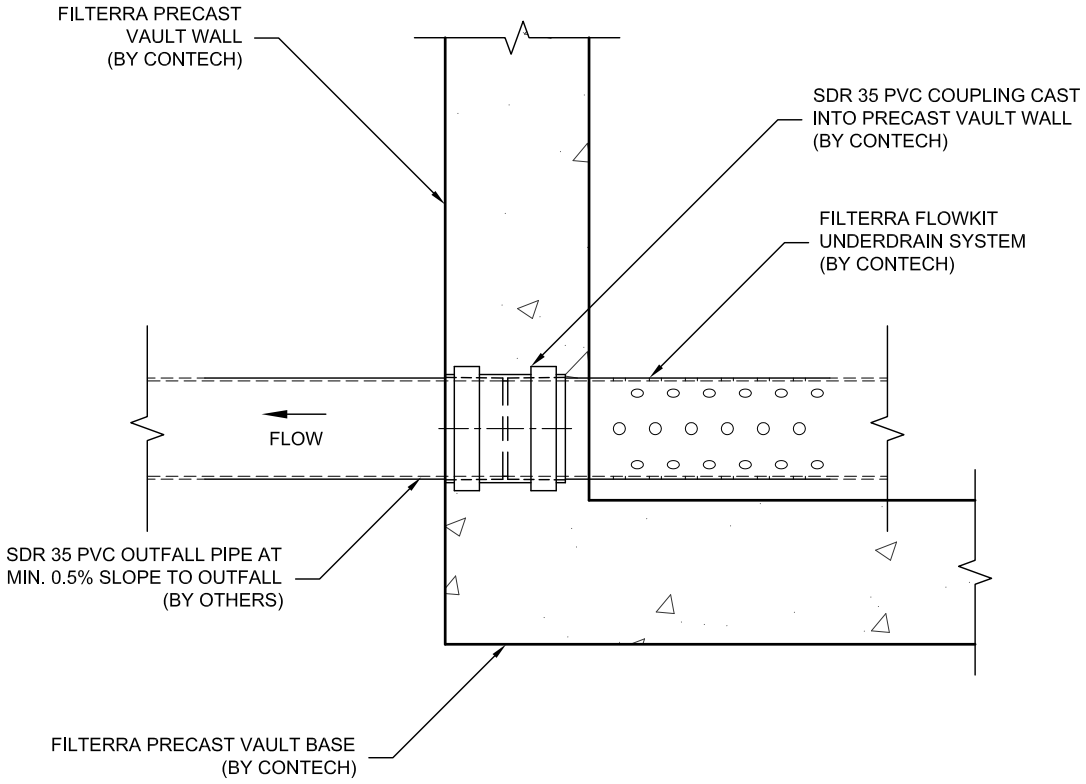
FILTERRA THROAT OPENING WITH EXTENDED FLUME DETAIL

DATE: 04/06/15	FILENAME: FILTERRA THROAT OPENING EXT FLUME DTL	DRAWN: SCK	CHECKED:



SECTION VIEW

SCALE 1 ½" = 1'-0"

(THROUGH PRECAST VAULT WALL
AT OUTFALL PIPE CONNECTION)

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FILTERRA OUTFALL PIPE CONNECTION TO PRECAST VAULT WALL DETAIL

DATE:03-23-15	FILE NAME: FILTERRA OUTFALL PIPE CONNECTION DTL	DRAWN: SCK	CHECKED: XXX

Filterra Bioretention Systems

Installation Manual

CONTECH®
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filterra®
Bioretention Systems

INSTALLATION MANUAL

V02

Support: 800-338-1122 | Fax: 513-645-7993

info@conteches.com | www.ContechES.com/filterra

TABLE OF CONTENTS

FILTERRA® OVERVIEW

STORMWATER BIORETENTION FILTRATION SYSTEM

- Save valuable space with small footprint for urban sites.
- Improve BMP aesthetics with attractive trees or shrubs.
- Reduce lifetime cost with safer and less expensive maintenance.

Remove Pollutants and Comply with NPDES

The Filterra® Bioretention System is well-suited for the urban environment with high removal efficiencies for many pollutants such as petroleum, heavy metals, phosphorus, nitrogen, and TSS. Filterra is similar in concept to bioretention in its function and applications, with the major distinction that Filterra has been optimized for high volume/flow treatment and high pollutant removal. Filterra takes up little space (often 0.2% Filter Surface Area/Drainage Area) and may be used on highly developed sites such a landscaped areas, green spaces, parking lots and streetscapes; it is exceedingly adaptable and is the urban solution for Low Impact Development.

Stormwater runoff flows through a specially designed filter media mixture contained in a landscaped concrete container The filter media captures and immobilizes pollutants; those pollutants are then decomposed, volatilized and incorporated into the biomass of the filterra system's micro-macro fauna and flora. Once the stormwater runoff flows through the media it continues into an underdrain system at the bottom of the container, where the treated water is discharged. higher flows bypass the Filterra via a downstream inlet structure, curb cut or other appropriate relief.

Section A

Installation

Installation Guidelines

Installations Procedure

Filterra Standard Offline Curb Inlet Detail

Filterra with Terraflume Curb Inlet Detail

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info@conteches.com

Installation Guidelines for Filterra®

Delivery & Unloading/Lifting

1. Contech shall deliver the Filterra units to the site in coordination with the Contractor.
2. The Contractor will require spreader bars and chains/cables/straps, as well as lifting hooks to safely and securely lift box sections and top slabs. In some cases, lifting hooks may be available for rental or purchase. Contact your Contech Project Coordinator for more information.
3. The unit and top must be lifted separately.

Inspection

1. Inspection of the Filterra unit and all parts contained in or shipped outside of the unit shall be inspected at time of delivery by the site Engineer/Inspector and the Contractor. Any nonconformance to approved drawings or damage to ay part of the system shall be documented on the Filterra shipping ticket. Damage to the unit during and after unloading shall be corrected at the expense of the Contractor. Any necessary repairs to the Filterra unit shall be made to the acceptance of the Engineer/Inspector.

Site Preparation

1. The contractor is responsible for providing adequate and complete site/inlet protection when the Filterra unit is installed prior to final site stabilization (full landscaping, grass cover, final paving, and street sweeping completed).
2. The contractor shall adhere to all jurisdictional and/or OSHA safety rules in providing temporary shoring of the excavation.
3. The Contractor or Owner is responsible for appropriately barricading the Filterra from traffic (in accordance with local codes).

Installation Guidelines for Filterra®

Installation

1. Installation Procedure for Sump Condition.

    a. Filterra Standard Offline System: The Standard Offline system cannot be used as a standalone inlet. It will need effective bypass during higher intensity rainfall events. To test a proposed location, imagine the Filterra throat is completely blocked (so it would act like a typical curb and gutter). If this results in any ponding or pooling drainage, the placement is inappropriate.

    b. Filterra Internal Bypass - Curb (FTIBC): FTIBC systems incorporating the Terraflume tray can be utilized as a stand-alone inlet and are typically installed in a sump condition.

2. Each unit shall be constructed at the locations and elevations according to the sizes shown on the approved drawings. Any modifications to the elevation or location shall be at the direction of and approved by the Engineer.

3. The unit shall be placed on the compacted sub-grade with a minimum 6-inch gravel base matching the final grade of the curb line in the area of the unit. The unit is to be placed such that the unit and top slab match the grade of the curb in the area of the unit. Compact undisturbed sub-grade materials to 95% of maximum density at +1% to 2% of the optimum moisture. Unsuitable material below sub-grade shall be replaced to site engineer's approval. Contact Contech for guidance where slope exceeds 5%.

4. Once the unit is set, the internal wooden forms and protective silt fabric cover must be left intact. The top lid should be sealed onto the box before backfilling, using a non-shrink grout, butyl rubber or similar waterproof seal. The boards on the top of the lid and boards sealed in the unit's throat must NOT be removed. The Supplier will remove these sections at the time of activation.

5. Outlet connections shall be aligned and sealed to meet the approved drawings with modifications necessary to meet site conditions and local regulations. The correct outlet will be marked on the Filterra box. Do NOT use plugged couplings marked "USE OTHER CONNECTION".

6. Backfilling should be performed in a careful manner, bringing the appropriate fill material up in 6" lifts on all sides. Precast sections shall be set in a manner that will result in a watertight joint. In all instances, installation of the Filterra unit shall conform to ASTM specification C891 "Standard Practice for Installation of Underground Precast Utility Structures" unless specified otherwise in contract documents.

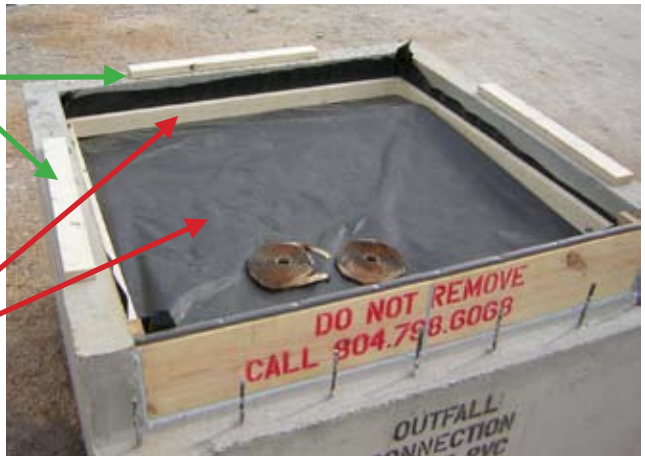
7. It is the responsibility of the Contractor to provide curb and gutter and transition to the Filterra unit for proper stormwater flow into the system through the throat opening. A standard drawing of the throat and gutter detail is available on page 12. However, the plans and contract documents superseded all standard drawings. Flume variations are detailed in Section B of this manual. Effective bypass for the Filterra system is essential for correct operation (i.e. bypass to an overflow at lower elevation).

Installation Procedure

DO NOT remove protective boards or tree grates from the top slab.

Remove the shipping dunnage along the top of the box wall.

DO NOT remove wooden internal bracing or protective silt fabric.



DO NOT remove the protective throat board.

Curb and gutter details are provided on the protective throat board. On Filterra systems incorporating a Terraflume tray, the protective board is installed at the back of the Terraflume to allow runoff to bypass via the internal riser.

The contractor MUST provide all rigging and lifting apparatus, such as cables, chains, straps, and hooks. In some cases, lifting hooks may be available for rental or purchase. Contact your Contech Project Coordinator for more information.

The unit and top slab MUST be lifted separately. At this time you can remove the boards between the box and top.

It is the contractor's responsibility to provide suitable lifting equipment to off load the Filterra unit. Filterra units are designed to be off loaded using the contractor's spreader bar.

1. Unload or Remove Top from Unit

Unload the top slab and set it on the ground.

2. Unload and Set Box

Unload the Filterra box and set into the pre-prepared hole with appropriate sub-grade.*

* Compacted sub-grade with a minimum of six inches of gravel bas which must match the final grade of curb line the area of the unit.

3. Apply Butyl Tape Seal

Apply butyl tape seal along the top of the box section. Butyl tape seal is provided with every unit.

Filterra installed protective throat board and installed silt fabric must be left in place to protect the unit from construction sediment.

4. Set Top on Box

Set the top slab on the box.

5. Connect Outfall Pipe

The correct outlet will be marked on the Filterra box.

DO NOT use plugged couplings marked "USE OTHER CONNECTION".

6. Install Curb and Gutter

It is the responsibility of the Contractor to provide curb and gutter and transition to the Filterra unit for proper flow into the system through a 4" - 6" throat opening. Details for the throat opening on the Filterra Standard Offline system as well as Filterra systems incorporating the Terraflume are included on pages 12 and 13.

7. Provide Inlet Protection

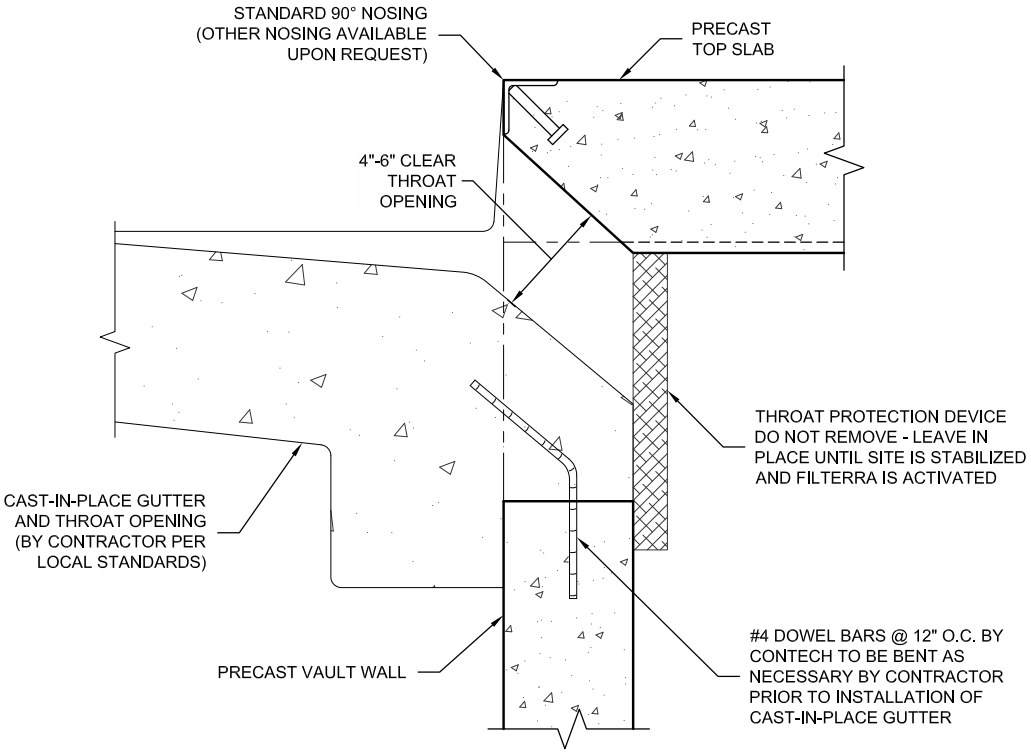
It is the responsibility of the Contractor to provide inlet protection/sediment control and cleaning around each Filterra unit.

8. Activation

Activation is performed ONLY by Contech authorized personnel.

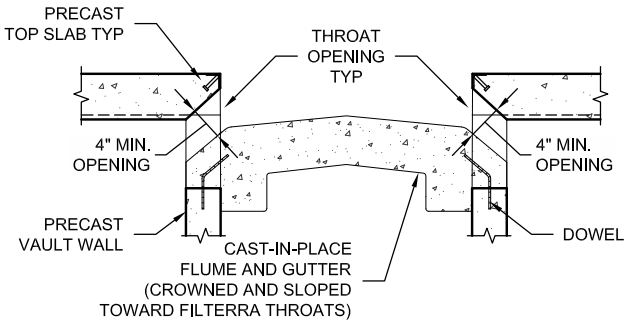
Activation can occur once the project site is fully stabilized (full landscaping, grass cover, final paving and street sweeping completed) and there is 4" - 6" throat opening.

Call 800-338-1122 to schedule your activation.

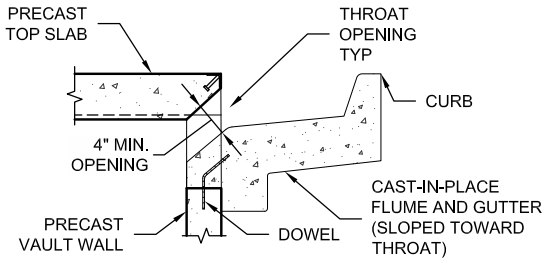


SECTION VIEW

STANDARD OFFLINE CURB INLET



CROWNED FLUME



REVERSE FLUME - SLOPED
TOWARDS FILTERRA THROAT

SECTION VIEWS OF TYPICAL FLUME APPLICATIONS

SEE ABOVE FOR DETAILS NOT SHOWN

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FILTERRA STANDARD OFFLINE
CURB INLET DETAILS

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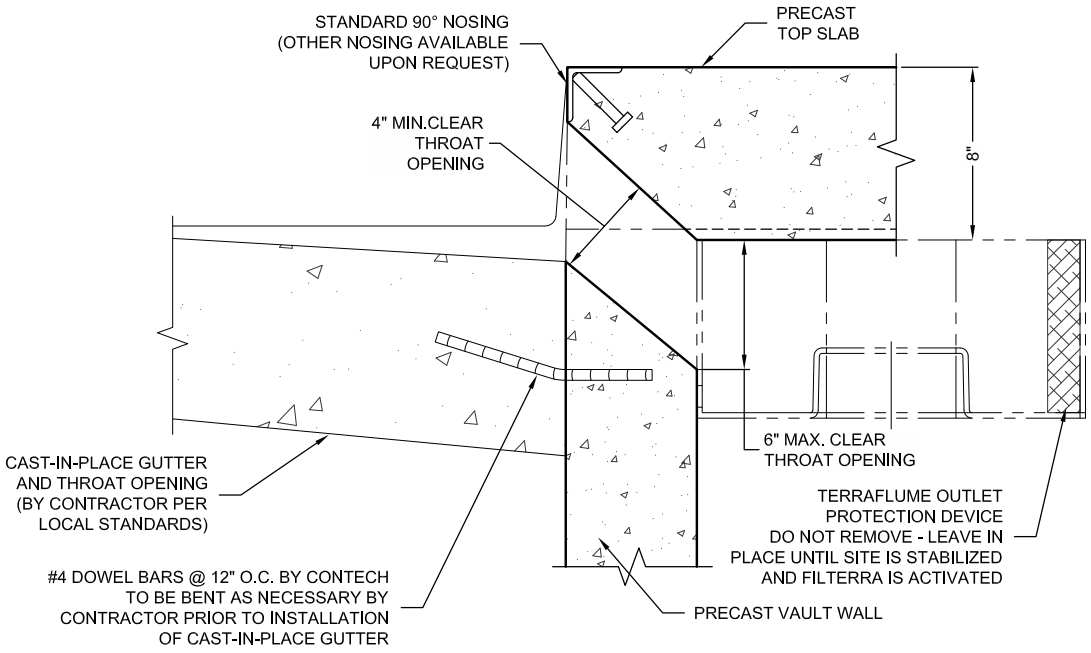

SECTION VIEW

STANDARD CURB INLET WITH TERRAFLUME

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FILTERRA WITH TERRAFLUME
CURB INLET DETAIL

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Section B

Curb and Gutter

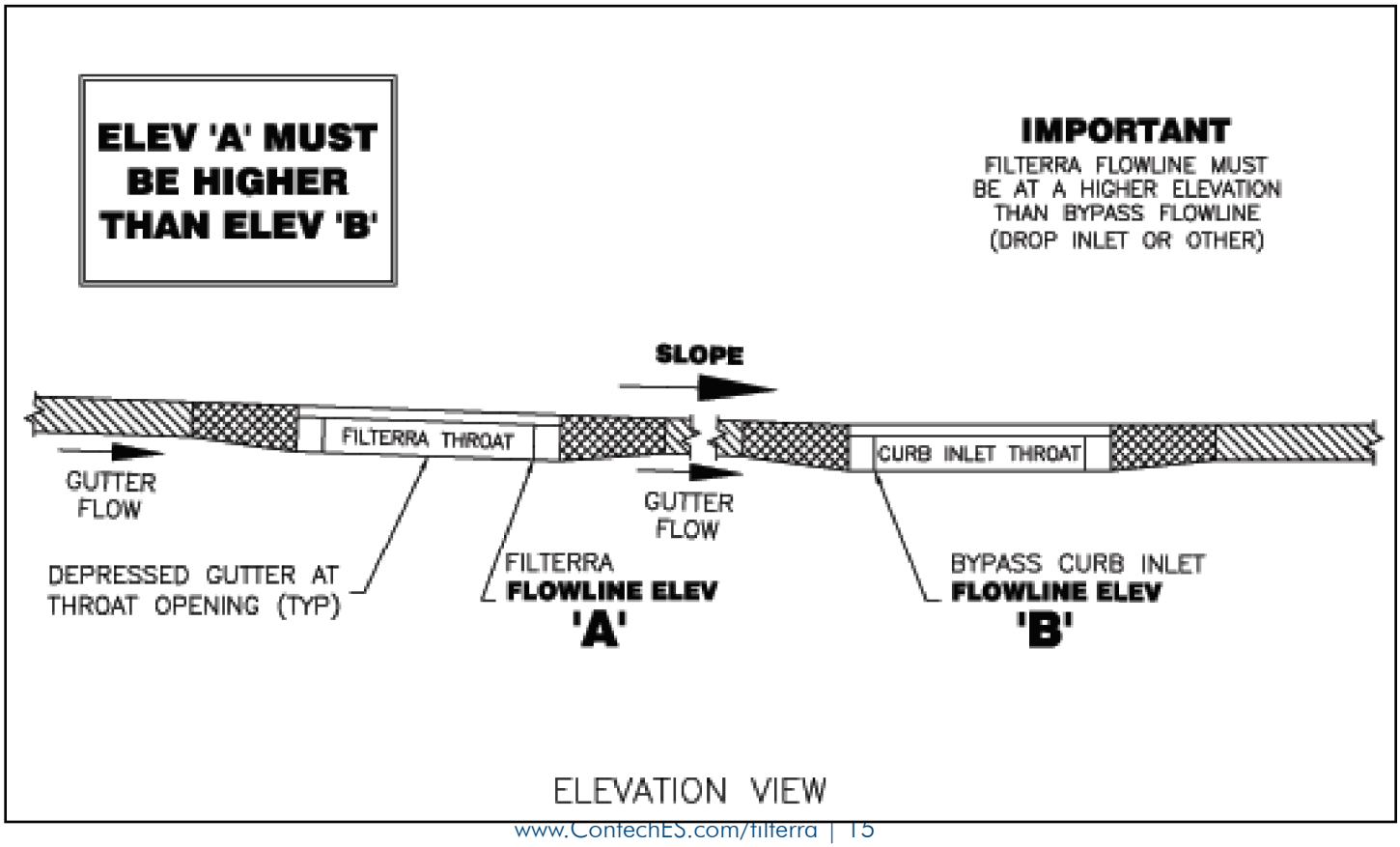
Standard Curb and Gutter with Inlet Bypass

Curb Cut or Grate Inlet Bypass

Single Sided Flume

Double Sided Flume

Standard Curb and Gutter with Inlet Bypass

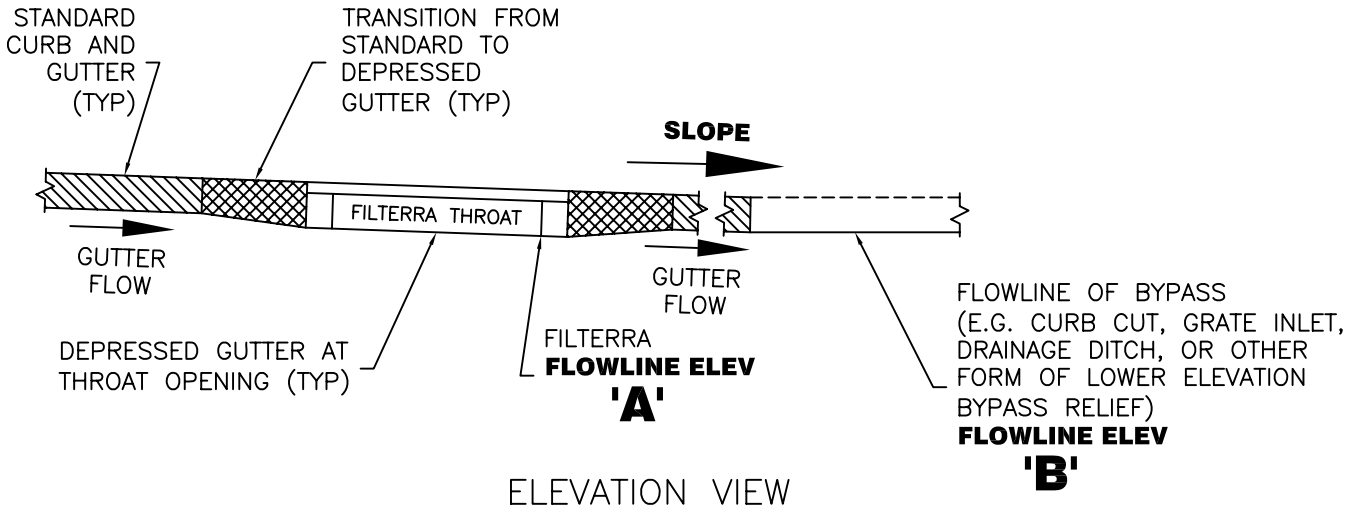


Curb Cut or Grate Inlet Bypass

ELEV 'A' MUST BE HIGHER THAN ELEV 'B'

IMPORTANT

FILTERRA FLOWLINE MUST BE AT A HIGHER ELEVATION THAN BYPASS FLOWLINE (DROP INLET OR OTHER)

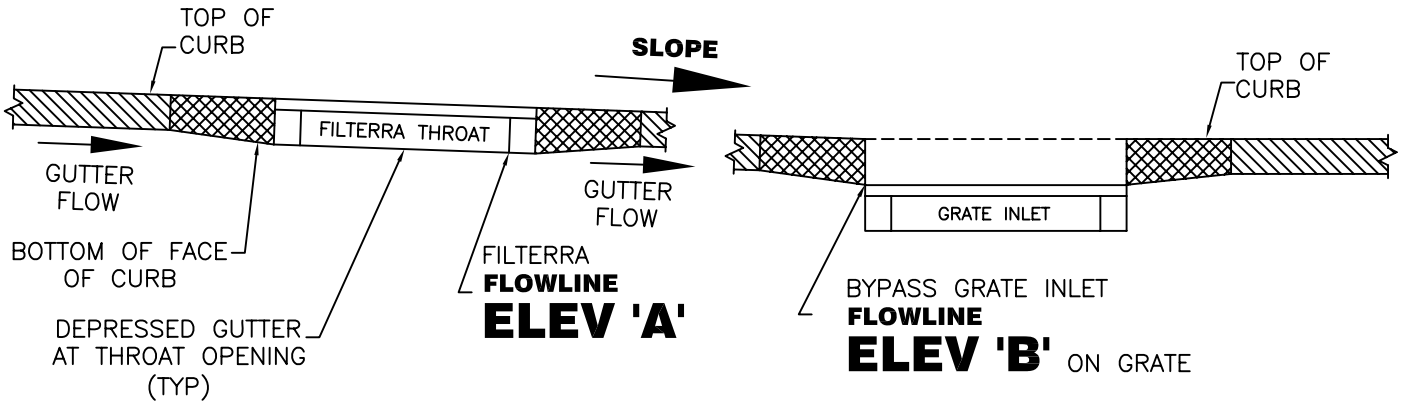


ELEVATION VIEW

Single Side Flume

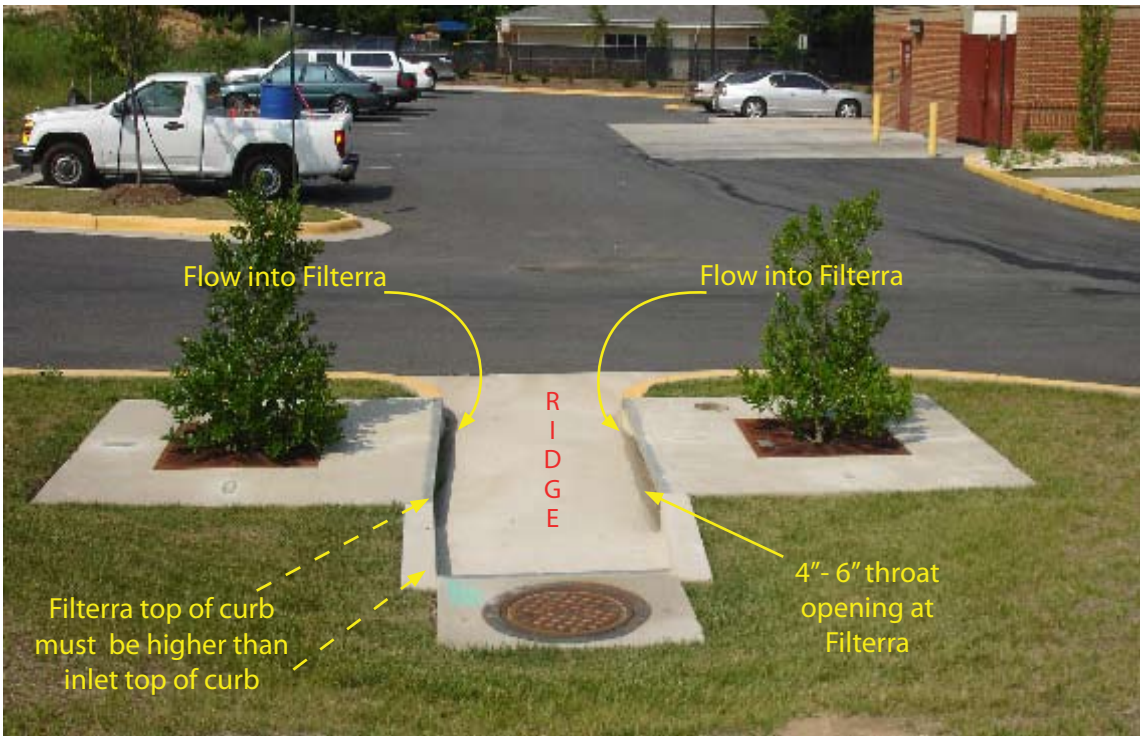
ELEV 'A' MUST BE HIGHER THAN ELEV 'B'

IMPORTANT
FILTERRA FLOWLINE MUST BE AT A HIGHER ELEVATION THAN BYPASS FLOWLINE (DROP INLET OR OTHER)



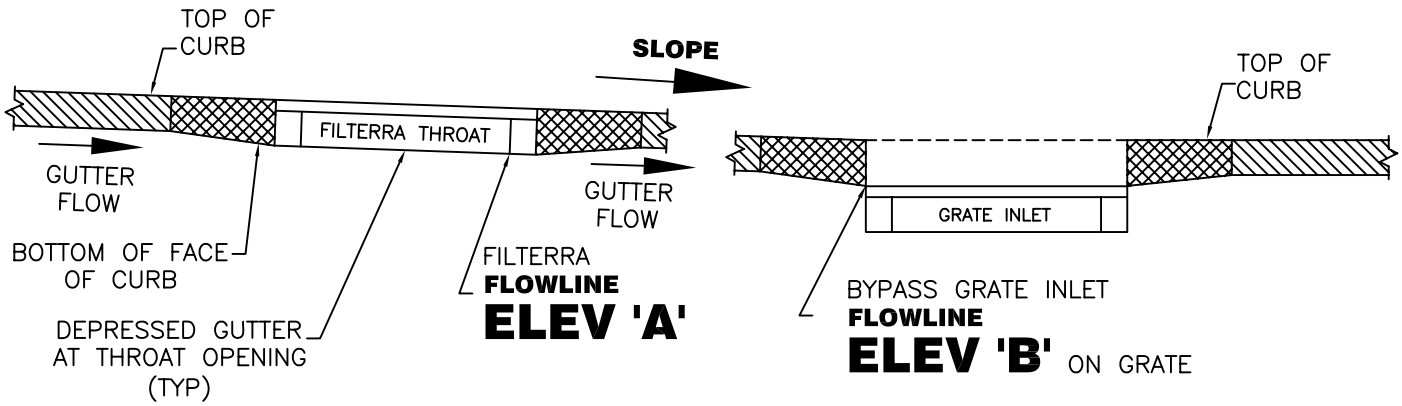
ELEVATION VIEW

Double Side Flume

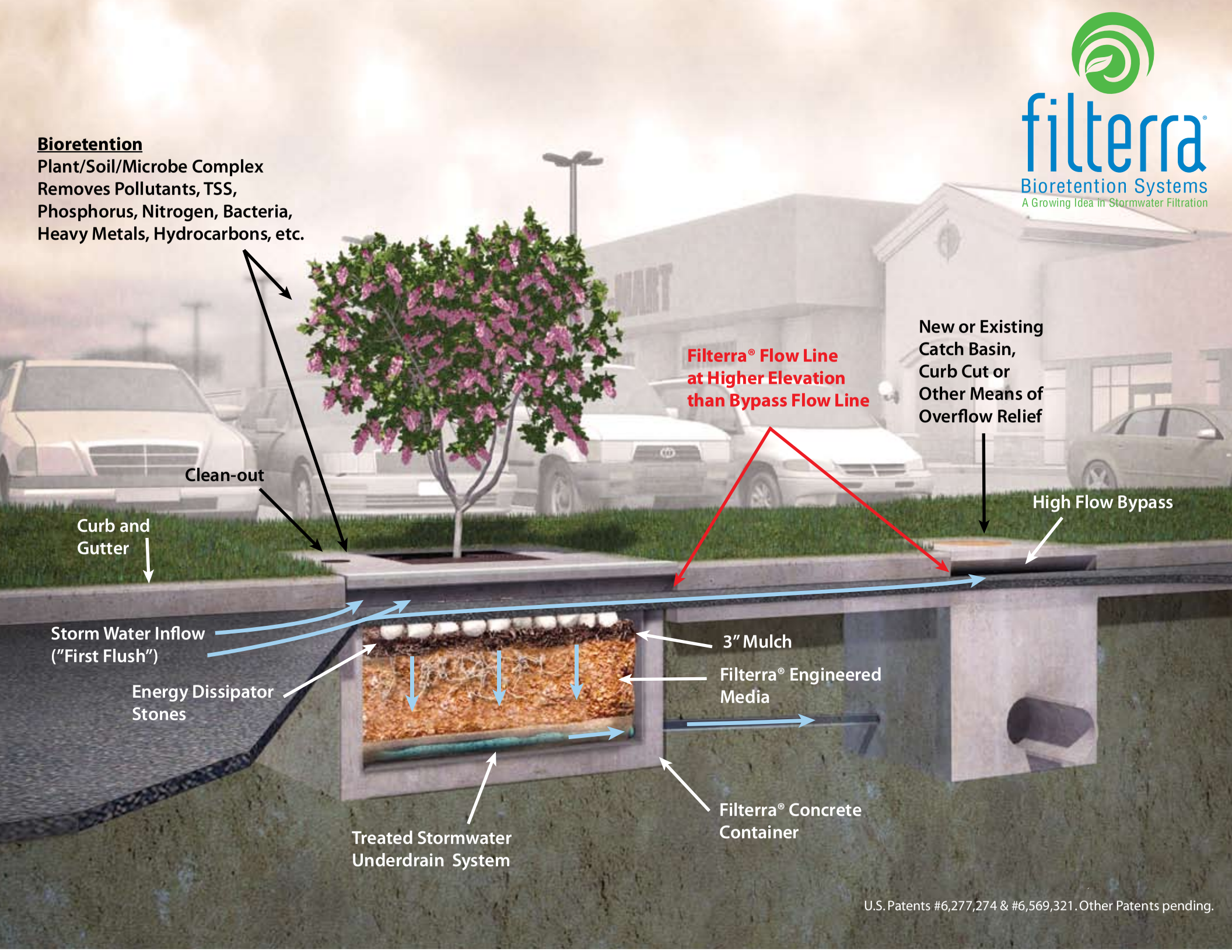


ELEV 'A' MUST BE HIGHER THAN ELEV 'B'

IMPORTANT
FILTERRA FLOWLINE MUST BE AT A HIGHER ELEVATION THAN BYPASS FLOWLINE (DROP INLET OR OTHER)



ELEVATION VIEW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Bioretention Systems
A Growing Idea in Stormwater Filtration
Bioretention
Plant/Soil/Microbe Complex
Removes Pollutants, TSS,
Phosphorus, Nitrogen, Bacteria,
Heavy Metals, Hydrocarbons, etc.
Filterra® Flow Line
at Higher Elevation
than Bypass Flow Line
New or Existing
Catch Basin,
Curb Cut or
Other Means of
Overflow Relief
Clean-out
High Flow Bypass
Curb and
Gutter
Storm Water Inflow
("First Flush")
3" Mulch
Filterra® Engineered
Media
Energy Dissipator
Stones
Treated Stormwater
Underdrain System
Filterra® Concrete
Container
U.S. Patents #6,277,274 & #6,569,321. Other Patents pending.

Filterra Bioretention Systems

Owner's (Maintenance) Manual

Filterra Owner's Manual

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Bioretention Systems

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Bioretention Systems

Table of Contents

Enclosed

Local Area Filterra Plant List

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Introduction

Thank you for your purchase of the Filterra® Bioretention System. Filterra is a specially engineered stormwater treatment system incorporating high performance biofiltration media to remove pollutants from stormwater runoff. The system's biota (vegetation and soil microorganisms) then further breakdown and absorb captured pollutants. All components of the system work together to provide a sustainable long-term solution for treating stormwater runoff.

The Filterra system has been delivered to you with protection in place to resist intrusion of construction related sediment which can contaminate the biofiltration media and result in inadequate system performance. These protection devices are intended as a best practice and cannot fully prevent contamination. It is the purchaser's responsibility to provide adequate measures to prevent construction related runoff from entering the Filterra system.

Included with your purchase is Activation of the Filterra system by the manufacturer as well as a 1-year warranty from delivery of the system and 1-year of routine maintenance (mulch replacement, debris removal, and pruning of vegetation) up to twice during the first year after activation.

Design and Installation

Each project presents different scopes for the use of Filterra systems. Information and help may be provided to the design engineer during the planning process. Correct Filterra box sizing (by rainfall region) is essential to predict pollutant removal rates for a given area. The engineer shall submit calculations for approval by the local jurisdiction. The contractor is responsible for the correct installation of Filterra units as shown in approved plans. A comprehensive installation manual is available at www.ContechES.com.

Activation Overview

Activation of the Filterra system is a procedure completed by the manufacturer to place the system into working condition. This involves the following items:

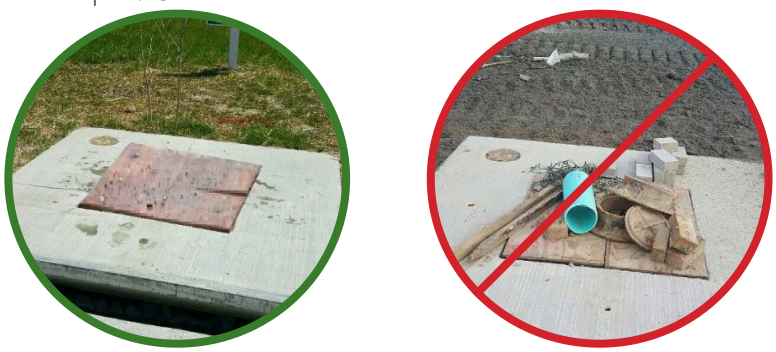
- Removal of construction runoff protection devices
- Planting of the system's vegetation
- Placement of pretreatment mulch layer using mulch certified for use in Filterra systems.

Activation MUST be provided by the manufacturer to ensure proper site conditions are met for Activation, proper installation of the vegetation, and use of pretreatment mulch certified for use in Filterra systems.

Minimum Requirements

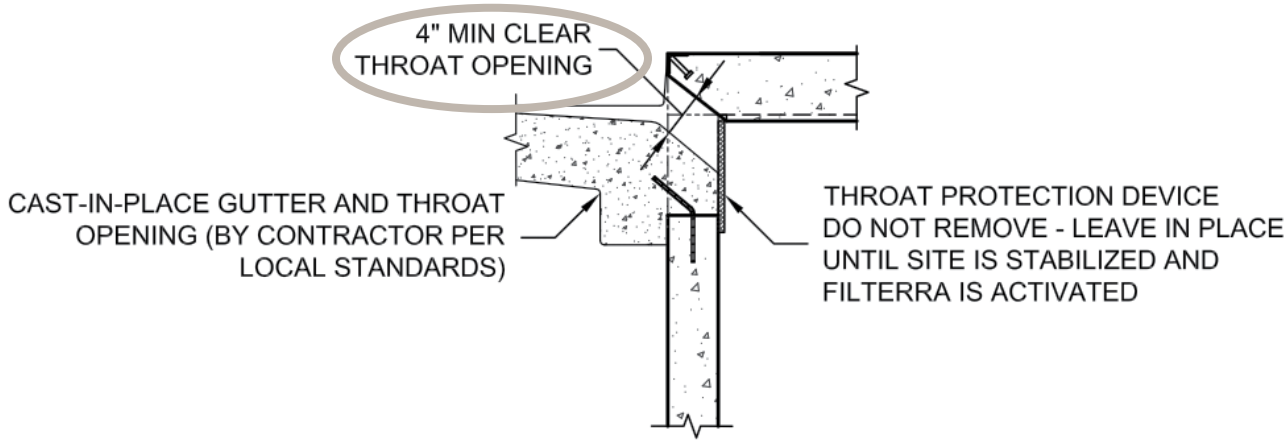
The minimum requirements for Filterra Activation are as follows:

1. The site landscaping must be fully stabilized, i.e. full landscaping installed and some grass cover (not just straw and seed) is required to reduce sediment transport. Construction debris and materials should be removed from surrounding area.



2. Final paving must be completed. Final paving ensures that paving materials will not enter and contaminate the Filterra system during the paving process, and that the plant will receive runoff from the drainage area, assisting with plant survival for the Filterra system.

3. Filterra throat opening should be at least 4" in order to ensure adequate capacity for inflow and debris.



An Activation Checklist is included on page 12 to ensure proper conditions are met for Contech to perform the Activation services. A charge of $500.00 will be invoiced for each Activation visit requested by Customer where Contech determines that the site does not meet the conditions required for Activation.

Filterra Plant Selection Overview

A Plant List has been enclosed with this packet highlighting recommended plants for Filterra systems in your area. Keep in mind that plants are subject to availability due to seasonality and required minimum size for the Filterra system. Plants installed in the Filterra system are container plants (max 15 gallon) from nursery stock and will be immature in height and spread at Activation.

It is the responsibility of the owner to provide adequate irrigation when necessary to the plant of the Filterra system.

The "Planting Requirements for Filterra Systems" document is included as an appendix and discusses proper selection and care of the plants within Filterra systems.

Warranty Overview

Refer to the Contech Engineered Solutions LLC Stormwater Treatment System LIMITED WARRANTY for further information. The following conditions may void the Filterra system's warranty and waive the manufacturer provided Activation and Maintenance services:

- Unauthorized activation or performance of any of the items listed in the activation overview
- Any tampering, modifications or damage to the Filterra system or runoff protection devices
- Removal of any Filterra system components
- Failure to prevent construction related runoff from entering the Filterra system
- Failure to properly store and protect any Filterra components (including media and underdrain stone) that may be shipped separately from the vault

Routine Maintenance Guidelines

With proper routine maintenance, the biofiltration media within the Filterra system should last as long as traditional bioretention media. Routine maintenance is included by the manufacturer on all Filterra systems for the first year after activation. This includes a maximum of 2 visits to remove debris, replace pretreatment mulch, and prune the vegetation. More information is provided in the Operations and Maintenance Guidelines. Some Filterra systems also contain pretreatment or outlet bays. Depending on site pollutant loading, these bays may require periodic removal of debris, however this is not included in the first year of maintenance, and would likely not be required within the first year of operation.

These services, as well as routine maintenance outside of the included first year, can be provided by certified maintenance providers listed on the Contech website. Training can also be provided to other stormwater maintenance or landscape providers.

Why Maintain?

All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding BMP maintenance agreement. Other reasons to maintain are:

- Avoiding legal challenges from your jurisdiction's maintenance enforcement program.
- Prolonging the expected lifespan of your Filterra media.
- Avoiding more costly media replacement.
- Helping reduce pollutant loads leaving your property.

Simple maintenance of the Filterra is required to continue effective pollutant removal from stormwater runoff before discharge into downstream waters. This procedure will also extend the longevity of the living biofilter system. The unit will recycle and accumulate pollutants within the biomass, but is also subjected to other materials entering the inlet. This may include trash, silt and leaves etc. which will be contained above the mulch layer. Too much silt may inhibit the Filterra's flow rate, which is the reason for site stabilization before activation. Regular replacement of the mulch stops accumulation of such sediment.

When to Maintain?

Contech includes a 1-year maintenance plan with each system purchase. Annual included maintenance consists of a maximum of two (2) scheduled visits. Additional maintenance may be necessary depending on sediment and trash loading (by Owner or at additional cost). The start of the maintenance plan begins when the system is activated.

Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands while the fall visit helps the system by removing excessive leaf litter.

It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required; regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency; e.g. some fast food restaurants require more frequent trash removal. Contributing drainage areas which are subject to new development wherein the recommended erosion and sediment control measures have not been implemented may require additional maintenance visits.

Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the Supplier and Owner predict future maintenance frequencies, reflecting individual site conditions.

Owners must promptly notify the (maintenance) Supplier of any damage to the plant(s), which constitute(s) an integral part of the bioretention technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance to the Supplier (i.e. no pruning or fertilizing) during the first year.

Exclusion of Services

Clean up due to major contamination such as oils, chemicals, toxic spills, etc. will result in additional costs and are not covered under the Supplier maintenance contract. Should a major contamination event occur the Owner must block off the outlet pipe of the Filterra (where the cleaned runoff drains to, such as drop inlet) and block off the throat of the Filterra. The Supplier should be informed immediately.

Maintenance Visit Summary

Each maintenance visit consists of the following simple tasks (detailed instructions below).

1. Inspection of Filterra and surrounding area
2. Removal of tree grate and erosion control stones
3. Removal of debris, trash and mulch
4. Mulch replacement
5. Plant health evaluation and pruning or replacement as necessary
6. Clean area around Filterra
7. Complete paperwork

Maintenance Tools, Safety Equipment and Supplies

Ideal tools include: camera, bucket, shovel, broom, pruners, hoe/rake, and tape measure. Appropriate Personal Protective Equipment (PPE) should be used in accordance with local or company procedures. This may include impervious gloves where the type of trash is unknown, high visibility clothing and barricades when working in close proximity to traffic and also safety hats and shoes. A T-Bar or crowbar should be used for moving the tree grates (up to 170 lbs ea.). Most visits require minor trash removal and a full replacement of mulch. See below for actual number of bagged mulch that is required in each media bay size. Mulch should be a double shredded, hardwood variety. Some visits may require additional Filterra engineered soil media available from the Supplier.

Box Length	Box Width	Filter Surface Area (ft^2)	Volume at 3" (ft^3)	# of 2 ft^3 Mulch Bags
4	4	4	4	2
6	4	6	6	3
8	4	8	8	4
6	6	9	9	5
8	6	12	12	6
10	6	15	15	8
12	6	18	18	9
13	7	23	23	12

Maintenance Visit Procedure

Keep sufficient documentation of maintenance actions to predict location specific maintenance frequencies and needs. An example Maintenance Report is included in this manual.

1. Inspection of Filterra and surrounding area

- Record individual unit before maintenance with photograph (numbered). Record on Maintenance Report (see example in this document) the following:

Record on Maintenance Report the following:

Standing Water	yes | no
Damage to Box Structure	yes | no
Damage to Grate	yes | no
Is Bypass Clear	yes | no

If yes answered to any of these observations, record with close-up photograph (numbered).

2. Removal of tree grate and erosion control stones

- Remove cast iron grates for access into Filterra box.
- Dig out silt (if any) and mulch and remove trash & foreign items.

3. Removal of debris, trash and mulch

Record on Maintenance Report the following:

Silt/Clay	yes | no
Cups/ Bags	yes | no
Leaves	yes | no
Buckets Removed	_____

- After removal of mulch and debris, measure distance from the top of the Filterra engineered media soil to the top of the top slab. Compare the measured distance to the distance shown on the approved Contract Drawings for the system. Add Filterra media (not top soil or other) to bring media up as needed to distance indicated on drawings.

Record on Maintenance Report the following:

Distance to Top of Top Slab (inches)	_____
Inches of Media Added	_____

4. Mulch replacement

- Add double shredded mulch evenly across the entire unit to a depth of 3".
- Refer to Filterra Mulch Specifications for information on acceptable sources.
- Ensure correct repositioning of erosion control stones by the Filterra inlet to allow for entry of trash during a storm event.
- Replace Filterra grates correctly using appropriate lifting or moving tools, taking care not to damage the plant.

5. Plant health evaluation and pruning or replacement as necessary

- Examine the plant's health and replace if necessary.
- Prune as necessary to encourage growth in the correct directions

Record on Maintenance Report the following:

Height above Grate	_____ (ft)
Width at Widest Point	_____ (ft)
Health	healthy | unhealthy
Damage to Plant	yes | no
Plant Replaced	yes | no

6. Clean area around Filterra

- Clean area around unit and remove all refuse to be disposed of appropriately.

7. Complete paperwork

- Deliver Maintenance Report and photographs to appropriate location (normally Contech during maintenance contract period).
- Some jurisdictions may require submission of maintenance reports in accordance with approvals. It is the responsibility of the Owner to comply with local regulations.

Maintenance Checklist

Drainage System Failure	Problem	Conditions to Check	Condition that Should Exist	Actions
Inlet	Excessive sediment or trash accumulation.	Accumulated sediments or trash impair free flow of water into Filterra.	Inlet should be free of obstructions allowing free distributed flow of water into Filterra.	Sediments and/or trash should be removed.
Mulch Cover	Trash and floatable debris accumulation.	Excessive trash and/or debris accumulation.	Minimal trash or other debris on mulch cover.	Trash and debris should be removed and mulch cover raked level. Ensure bark nugget mulch is not used.
Mulch Cover	"Ponding" of water on mulch cover.	"Ponding" in unit could be indicative of clogging due to excessive fine sediment accumulation or spill of petroleum oils.	Stormwater should drain freely and evenly through mulch cover.	Recommend contact manufacturer and replace mulch as a minimum.
Vegetation	Plants not growing or in poor condition.	Soil/mulch too wet, evidence of spill. Incorrect plant selection. Pest infestation. Vandalism to plants.	Plants should be healthy and pest free.	Contact manufacturer for advice.
Vegetation	Plant growth excessive.	Plants should be appropriate to the species and location of Filterra.		Trim/prune plants in accordance with typical landscaping and safety needs.
Structure	Structure has visible cracks.	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks.		Vault should be repaired.
Maintenance is ideally to be performed twice annually.				

Filterra Inspection & Maintenance Log

Filterra System Size/Model:_____ **Location:** _____

Date	Mulch & Debris Removed	Depth of Mulch Added	Mulch Brand	Height of Vegetation Above Grate	Vegetation Species	Issues with System	Comments
1/1/17	*5 – 5 gal Buckets*	*3″*	*Lowe's Premium Brown Mulch*	*4′*	*Galaxy Magnolia*	*- Standing water in downstream structure*	*- Removed blockage in downstream structure*

Appendix 1 – Filterra® Activation Checklist

Project Name:______________________________ Company:______________________________

Site Contact Name: ______________________________ Site Contact Phone/Email: ____________________

Site Owner/End User Name:____________________ Site Owner/End User Phone/Email: ____________________

Preferred Activation Date: ______________________________ (provide 2 weeks minimum from date this form is submitted)

Site Designation	System Size	Final Pavement / Top Coat Complete	Landscaping Complete / Grass Emerging	Construction materials / Piles / Debris Removed	Throat Opening Measures 4" Min. Height	Plant Species Requested
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

Attach additional sheets as necessary.

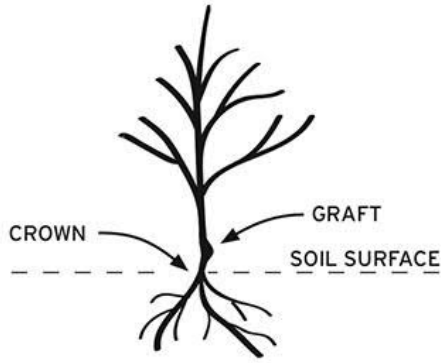
NOTE: A charge of $500.00 will be invoiced for each Activation visit requested by Customer where Contech determines that the site does not meet the conditions required for Activation. ONLY Contech authorized representatives can perform Activation of Filterra systems; unauthorized Activations will void the system warranty and waive manufacturer supplied Activation and 1st Year Maintenance.

____ ______________________

Signature Date

Appendix 2 – Planting Requirements for Filterra® Systems

Plant Material Selection



- Select plant(s) as specified in the engineering plans and specifications.
- Select plant(s) with full root development but not to the point where root bound.
- Use local nursery container plants only. Ball and burlapped plants are not permitted.
- For precast Filterra systems with a tree grate, plant(s) must not have scaffold limbs at least 14 inches from the crown due to spacing between the top of the mulch and the tree grate. Lower branches can be pruned away provided there are sufficient scaffold branches for tree or shrub development.
- For precast Filterra systems with a tree grate, at the time of installation, it is required that plant(s) must be at least 6" above the tree grate opening at installation for all Filterra configurations. This DOES NOT apply to Full Grate Cover designs.
- Plant(s) shall not have a mature height greater than 25 feet.
- For standard 21" media depth, a 7 – 15 gallon container size shall be used. Media less than 21" (Filterra boxes only) will require smaller container plants.
- For precast Filterra systems, plant(s) should have a single trunk at installation, and pruning may be necessary at activation and maintenance for some of the faster growing species, or species known to produce basal sprouts.

Plant Installation

- During transport protect the plant leaves from wind and excessive jostling.
- Prior to removing the plant(s) from the container, ensure the soil moisture is sufficient to maintain the integrity of the root ball. If needed, pre-wet the container plant.
- Cut away any roots which are growing out of the container drain holes. Plants with excessive root growth from the drain holes should be rejected.
- Plant(s) should be carefully removed from the pot by gently pounding on the sides of the container with the fist to loosen root ball. Then carefully slide out. Do not lift plant(s) by trunk as this can break roots and cause soil to fall off. Extract the root ball in a horizontal position and support it to prevent it from breaking apart. Alternatively the pot can be cut away to minimize root ball disturbance.
- Remove any excess soil from above the root flare after removing plant(s) from container.
- Excavate a hole with a diameter 4" greater than the root ball, gently place the plant(s).
- If plant(s) have any circling roots from being pot bound, gently tease them loose without breaking them.
- If root ball has a root mat on the bottom, it should be shaved off with a knife just above the mat line.
- Plant the tree/shrub/grass with the top of the root ball 1" above surrounding media to allow for settling.
- All plants should have the main stem centered in the tree grate (where applicable) upon completion of installation.
- With all trees/shrubs, remove dead, diseased, crossed/rubbing, sharply crotched branches or branches growing excessively long or in wrong direction compared to majority of branches.
- To prevent transplant shock (especially if planting takes place in the hot season), it may be necessary to prune some of the foliage to compensate for reduced root uptake capacity. This is accomplished by pruning away some of the smaller secondary branches or a main scaffold branch if there are too many. Too much foliage relative to the root ball can dehydrate and damage the plant.
- Plant staking may be required.

Mulch Installation

- Only mulch that has been meeting Contech Engineered Solutions' mulch specifications can be used in the Filterra system.
- Mulch must be applied to a depth of 3" evenly over the surface of the media.

Irrigation Requirements

- Each Filterra system must receive adequate irrigation to ensure survival of the living system during periods of drier weather.
- Irrigation sources include rainfall runoff from downspouts and/or gutter flow, applied water through the tree grate or in some cases from an irrigation system with emitters installed during construction.
- At Activation: Apply about one (cool climates) to two (warm climates) gallons of water per inch of trunk diameter over the root ball.
- During Establishment: In common with all plants, each Filterra plant will require more frequent watering during the establishment period. One inch of applied water per week for the first three months is recommended for cooler climates (2 to 3 inches for warmer climates). If the system is receiving rainfall runoff from the drainage area, then irrigation may not be needed. Inspection of the soil moisture content can be evaluated by gently brushing aside the mulch layer and feeling the soil. Be sure to replace the mulch when the assessment is complete. Irrigate as needed**.
- Established Plants: Established plants have fully developed root systems and can access the entire water column in the media. Therefore irrigation is less frequent but requires more applied water when performed. For a mature system assume 3.5 inches of available water within the media matrix. Irrigation demand can be estimated as 1" of irrigation demand per week. Therefore if dry periods exceed 3 weeks, irrigation may be required. It is also important to recognize that plants which are exposed to windy areas and reflected heat from paved surfaces may need more frequent irrigation. Long term care should develop a history which is more site specific.

** Five gallons per square yard approximates 1 inch of water Therefore for a 6' by 6' Filterra approximately 20-60 gallons of water is needed. To ensure even distribution of water it needs to be evenly sprinkled over the entire surface of the filter bed, with special attention to make sure the root ball is completely wetted. NOTE: if needed, measure the time it takes to fill a five gallon bucket to estimate the applied water flow rate then calculate the time needed to irrigate the Filterra. For example, if the flow rate of the sprinkler is 5 gallons/minute then it would take 12 minutes to irrigate a 6' by 6' filter.

Notes

filterra®
Bioretention Systems

CONTECH®
ENGINEERED SOLUTIONS

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West Chester, OH 45069
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www.ContechES.com

Filterra Bioretention Systems

Activation Checklist

Filterra® Activation Checklist

CONTECH ENGINEERED SOLUTIONS

Project Name: ______________________ Company: ______________________

Site Contact Name: ______________________ Site Contact Phone/Email: ______________________

Site Owner/End User Name: ______________________ Site Owner/End User Phone/Email: ______________________

Preferred Activation Date: ______________________ (provide 2 weeks minimum from date this form is submitted)

Site Designation	System Size	Final Pavement / Top Coat Complete	Landscaping Complete / Grass Emerging	Construction materials / Piles / Debris Removed	Throat Opening Measures 4" Min. Height	Plant Species Requested
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	
		☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	

Attach additional sheets as necessary.

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______________________ ______________________

Signature Date

Filterra Bioretention Systems

Bioscape Plant List for Southern California

Filterra Bioscape Plant List - Southern California

Common Name[1,2,8]	Latin Name	Plant Type	Sun	Hardiness Range	Mature Height[5]	Mature Spread[5]	Sizing[7]	Availability[9]	Nativity
Acacia, Sweet	*Acacia smallii*	Deciduous	Full Sun	9A - 11	15' - 25'	15' - 25'	Tree	SoCA	W-US, Central America
Beautyberry	*Callicarpa Americana*	Deciduous	Partial Shade to Full Sun	7A - 10B	4' - 8'	6' - 7'	L	MA, NW, SE, SC, NoCA, SoCA	SE-US, S-US
Blue Palo Verde	*Parkinsonia floridum*	Deciduous	Full Sun	8A - 11	10' - 20'	15'	XL	NW, SC, NoCA, SoCA	US-CA
Ceanothus, Big-pod	*Ceanothus megacarpus*	Deciduous	Partial Shade to Full Sun	7A - 10B	4' - 8'	6' - 7'	L	SoCA	US-CA
Chokeberry, Black	*Aronia melanocarpa*	Deciduous	Full Shade to Full Sun	3B – 8B	3' – 6'	4' – 6'	M	Gl, MA, NE, NW, SE, NoCA, SoCA, E-Can	E-Can, E-US
Chokeberry, Red	*Aronia arbutifolia*	Deciduous	Partial Shade to Full Sun	4B – 9A	6' – 10'	4' – 6'	M	GL, MA, NE, NW, SE, NoCA, SoCA	E-US
Coyote Brush	*Baccharis pilularis ssp. Consanguinea*	Deciduous	Partial Shade to Full Sun	5A - 10A	4' - 6'	6' - 8'	L	NoCA, SoCA	US-HI
Crabapple, American	*Malus coronaria*	Deciduous	Full Sun	3B - 8A	15' - 25'	10' - 25'	Tree	GL, MA, NE, NW, SE, NoCA, SoCA	Midwest-US
Crape Myrtle	*Lagerstoemia indica*	Deciduous	Full Sun	7A - 9A	15' - 25'	15' - 25'	Tree	MA, SE, NoCA, SoCA	Asia
Elderberry, American	*Sambucus canadensis*	Deciduous	Partial Shade to Full Sun	4A – 9B	10' – 15'	6' – 10'	L	GL, GP, MA, NW, SC, SE, NoCA, SoCA	E-US
Elderberry, Mexican	*Sambucus mexican 'Blue Elderberry'*	Deciduous	Partial Shade to Full Sun	7B - 10A	8' - 15'	15'	XL	NoCA, SoCA	W-US
Four-wing Saltbush	*Atriplex canescens*	Deciduous	Partial Shade to Full Sun	8A - 11	4' - 6'	10'	L	SC, SoCA	W-US, Midwest-US
Fringe Tree, Chinese	*Chionanthus retusus*	Deciduous	Full Shade to Full Sun	5B - 9A	15' - 25'	10' - 15'	Tree	GL, MA, NW, NE, SC, SE, NoCA, SoCA	Asia
Holly, Winterberry	*Ilex verticillata*	Deciduous	Partial Shade to Full Sun	3B – 9A	6' – 10'	8' – 15'	L	GL, MA, NW, SC, SE, NoCA, SoCA, E-Can	E-US, E-Can
Lilac, Dwarf	*Syringa meyeri*	Deciduous	Full Sun	3B – 8A	5' – 8'	8' – 10'	L	GL, MA, NE, NW, SC, SE, NoCA, SoCA	Asia
Magnolia, Galaxy	*Magnolia x 'Galaxy'*	Deciduous	Partial Shade to Full Sun	5A - 8B	15' - 20'	15' - 25'	Tree	GL, MA, NE, NW, SC, SE, NoCA, SoCA	Asia
Magnolia, Saucer	*Magnolia x soulangiana*	Deciduous	Partial Shade to Full Sun	5A - 9A	15' - 25'	15' - 25'	Tree	MA, NE, NW, SC, SE, NoCA, SoCA	Asia
Plum, Mexican	*Prunus mexicana*	Deciduous	Partial Shade to Full Sun	6B - 8A	15' - 25'	15' - 25'	Tree	SoCA	S-US
Plum, Purpleleaf	*Prunus cerasifera*	Deciduous	Full Sun	5B - 8A	15' - 25'	15' - 25'	Tree	GL, MA, NE, NW, SE, NoCA, SoCA	Europe, Asia
Plum, Purpleleaf 'Krauter Vesuvius'	*Prunus cerasifera 'Krauter Vesuvius'*	Deciduous	Full Sun	5B - 8A	15' - 25'	15' - 25'	Tree	NW, SoCA	Europe, Asia
Redbud, Eastern	*Cercis canadensis*	Deciduous	Partial Shade to Full Sun	4B - 9A	15' - 25'	15' - 25'	Tree	GL, GP, MA, NE, NW, SE, NoCA, SoCA	E-US, S-US, Mexico
Redbud, Mexican	*Cercis canadensis*	Deciduous	Partial Shade to Full Sun	6B - 8A	15' - 20'	10' - 15'	XL	SC, SoCA	E-US, S-US, Mexico
Sugar Bush, Sugar Sumac	*Rhus ovata*	Deciduous	Partial Shade to Full Sun	8A - 11	8' - 15'	10'	L	NW, NoCA, SoCA	SW-US
Sweetshrub	*Calycanthus floridus*	Deciduous	Full Shade to Full Sun	5B – 10A	6' – 10'	6' – 12'	L	GL, MA, NW, SC, SE, NoCA, SoCA	E-US
Willow, Desert	*Chilopsis linearis*	Deciduous	Full Sun	7A - 11	15' - 25'	15' - 25'	Tree	NoCA, SoCA	SW-US, Mexico

Common Name[1,2,8]	Latin Name	Plant Type	Sun	Hardiness Range	Mature Height[5]	Mature Spread[5]	Sizing[7]	Availability[9]	Nativity
Acacia, Bailey's Purple	*Acacia baileyana 'Purpurea'*	Evergreen	Full Sun	10B - 11	15' - 20'	20' - 30'	Tree	NoCA, SoCA	Australia
Acacia, Catclaw	*Acacia greggi*	Evergreen	Full Sun	9A - 11	15' - 25'	15' - 20'	Tree	SoCA	SW-US
After Dark Peppermint	*Agonis flexuosa "Jervis Bay Afterdark'*	Evergreen	Full Sun	10 - 11	15' - 18'	10' - 15'	XL	SoCA	Australia
Bottlebrush, Lemon	*Callistemon citrinus*	Evergreen	Full Sun	9A - 11	10' - 15'	10' - 15'	XL	SE, SoCA	Australia
Camellia, Japanese	*Camellia japonica*	Evergreen	Partial Shade to Full Sun	7A - 9A	10' - 15'	6' - 10'	L	MA, NW, SC, SE, NoCA, SoCA	Asia
Gold Medallion Shrub Form	*Cassia leptophylla*	Evergreen	Partial Shade	7A - 9A	10' - 15'	6' - 10'	L	SoCA	South America
Hawthorn, Indian	*Raphiolepsis indica*	Evergreen	Partial Shade to Full Sun	8A - 11	4' - 10'	3' - 10'	L	NW, SC, SE, NoCA, SoCA	Asia
Hawthorn, Yedda	*Raphiolepsis umbellata 'Majestic Beauty'*	Evergreen	Partial Shade to Full Sun	8A - 10A	8' - 10'	8' - 10'	L	SC, SE, NoCA, SoCA	Asia
Holly, Chinese	*Ilex cornuta*	Evergreen	Partial Shade to Full Sun	7A - 9A	15' - 25'	15' - 25'	Tree	MA, NE, NW, SE, NoCA, SoCA	Asia
Holly, Foster's	*Ilex x attenuata 'Fosteri'*	Evergreen	Partial Shade to Full Sun	6A - 9A	20' - 25'	6' - 10'	L	MA, NE, NW, SC, SE, NoCA, SoCA	SE-US
Holly, Inkberry	*Ilex glabra*	Evergreen	Partial Shade to Full Sun	6A – 9A	4' – 8'	2' – 4'	S	MA, NE, SC, SE, NoCA, SoCA, E-Can	E-US, E-Can
Holly, Nellie Stevens	*Ilex x*	Evergreen	Partial Shade to Full Sun	6A - 9A	15' - 25'	6' - 10'	L	MA, NE, NW, SC, SE, NoCA, SoCA	Europe/Asia-Developed
Holly, San Jose	*Ilex x aquipernyi*	Evergreen	Full Shade to Full Sun	5B - 9A	15' - 20'	10' - 15'	XL	NW, SC, NoCA, SoCA	Europe/Asia-Developed
Holly, Yaupon	*Ilex vomitoria*	Evergreen	Full Shade to Full Sun	7A - 10A	15' - 18'	10' - 15'	XL	MA, NW, SC, SE, NoCA, SoCA	SE-US
Juniper, California	*Juniperus californica*	Evergreen	Partial Shade to Full Sun	8A - 10A	8' - 12'	6'	L	SC, NoCA, SoCA	US-CA
Lemon Scented Tea	*Leptospermum petersonii*	Evergreen	Full Sun	9B - 10	12 - 20'	8' - 12'	XL	SoCA	Australia
Manzanita, Bigberry	*Arctostaphylos glauca*	Evergreen	Partial Shade to Full Sun	7A - 11	6' - 15'	8' - 10'	L	NoCA, SoCA	US-CA
Manzanita, Del Mar	*Grandulosa ssp. Crassifolia*	Evergreen	Partial Shade to Full Sun	8A - 11	6' - 15'	8' - 10'	L	SC, NoCA, SoCA	US-CA
Manzanita, Eastwood	*Arctostaphylos glandulosa*	Evergreen	Partial Shade to Full Sun	8A - 11	3' - 6'	5' - 6'	M	SC, NoCA, SoCA	US-CA
Manzanita, Howard McMinn	*Arctostaphylos densiflora*	Evergreen	Partial Shade to Full Sun	8A - 11	4' - 6'	6'	M	SC, NoCA, SoCA	US-CA
Mock Orange	*Pittosporum tobira*	Evergreen	Partial Shade to Full Sun	8A - 11	6' - 10'	10' - 15'	XL	NW, SC, NoCA, SoCA	Asia
Narrowleaf Pittosporum	*Pittosporum Phillyreoides*	Evergreen	Partial Shade to Full Sun	9A - 11	20' - 30'	15' - 20'	Tree	NoCA, SoCA	US-CA
Olive, Fruitless	*Olea europaea 'Fruitless'*	Evergreen	Full Sun	8A - 11	15' - 25'	15' - 20'	Tree	SoCA	Europe, Asia
Osmanthus, Sweet	*Osmanthus , fragrams*	Evergreen	Partial Shade to Full Sun	7B - 9A	15' - 25'	15' - 25'	Tree	SoCA	Asia
Palm, Miraguama	*Coccothrinax miraguama*	Evergreen	Partial Shade to Full Sun	9B-11	15' - 20'	6' - 8'	L	SoCA	Caribbean

Common Name[1,2,8]	Latin Name	Plant Type	Sun	Hardiness Range	Mature Height[5]	Mature Spread[5]	Sizing[7]	Availability[9]	Nativity
Palm, Pacific/Fiji Fan	*Pritchardia pacifica*	Evergreen	Partial Sun	10B-11	10' - 20'	5' -10'	L	SoCA	Oceania
Palm, Peaberry	*Thrinax morrisii*	Evergreen	Partial Sun to Full Sun	10B-11	15' - 20'	6' - 8'	L	SoCA	US-FL, Caribbean
Palm, Sea Thatch	*Thrinax radiate*	Evergreen	Partial Sun to Full Sun	10B-11	15' - 20'	8' - 10'	L	SoCA	US-FL, Caribbean
Palm, Thurston	*Pritchardia thurstonii*	Evergreen	Full Sun	10B-11	15' - 25'	8'	L	SoCA	Oceania
Palm, Windmill	*Trachycarpus fortunei*	Evergreen	Partial Sun to Shade	8 - 10	10' - 20'	6' - 10'	L	SoCA	Asia
Palmetto, Dwarf	*Sabal minor*	Evergreen	Partial Sun to Full Sun	8B - 11	4' - 6'	3' - 6'	M	NoCA, SoCA	SE-US
Pittosporum Kohuhu	*Pittosporum tenuifolium*	Evergreen	Partial Shade to Full Sun	9A-10B	12' - 20'	6' - 15'	XL	NoCA, SoCA	Oceania
Powderpuff	*Calliandra haematocephala*	Evergreen	Partial Shade to Full Sun	9B-11	10' - 15'	10' - 15'	XL	SoCA	South America
Powderpuff, Pink	*Calliandra surinamensis*	Evergreen	Partial Shade to Full Sun	10A-11	12' - 15'	12' - 15'	XL	SoCA	South America
Strawberry Tree	*Arbutus unedo*	Evergreen	Partial Shade to Full Sun	7B - 11	15' - 25'	15' - 25'	Tree	SC, SE, NoCA, SoCA	Europe
Sumac, Lemonade Berry	*Rhus, integrifolia*	Evergreen	Partial Shade to Full Sun	9B-11	6' - 10'	10' - 15'	XL	SoCA	US-CA
Toyon	*Heteromeles arbutifolia*	Evergreen	Partial Shade to Full Sun	8B-10B	8' - 15'	15'	XL	SC, NoCA, SoCA	W-US
Trumpet Tree	*Tabebuia impetiginosa*	Evergreen	Full Sun	9B-11	15' - 20'	15' - 20'	Tree	SoCA	Central America, South America
Wax Myrtle, Pacific	*Myrica californica*	Evergreen	Partial Shade to Full Sun	7B - 11	15' - 25'	15' - 25'	Tree	NW, SC, NoCA, SoCA	W-US
Yellow-wood, Long Leafed	*Podocarpus henkelii*	Evergreen	Partial Shade to Full Sun	9A-11	15' - 25'	8' - 15'	XL	SoCA	Africa
Berkeley Sedge	*Carex divulsa*	Grass/Sedge	Partial Shade to Full Sun	5 - 9	12" - 18"	12" - 18"	XS	NW, NoCA, SoCA	Europe
Blue Grama Grass	*Bouteloua gracilis*	Grass/Sedge	Partial Sun to Full Sun	4 - 9	12" - 36"	24" - 36"	S	GP, SC, GL, NoCA, SoCA	W-US
Blue Moor Grass	*Sesleria caerulea*	Grass/Sedge	Partial Sun to Full Sun	5 - 9	12"	12" - 24"	XS	NoCA, SoCA	Europe
Blue Oat Grass	*Helictotrichon sempervirens*	Grass/Sedge	Full sun	4 – 8	20" – 24"	20" – 40"	XS	GL, MA, NW, NoCA, SoCA	Europe
Deer Grass	*Muhlenbergia rigens*	Grass/Sedge	Partial Sun to Full Sun	5 - 11	48" - 60"	48" - 72"	M	NoCA, SoCA	US-CA
Flax Lily	*Dianella caerulea*	Grass/Sedge	Partial Sun to Full Sun	7 - 11	12"- 24"	12" - 24"	XS	NoCA, SoCA, SE	Australia
Foothill Needlegrass	*Nasella lepida*	Grass/Sedge	Partial Sun to Full Sun	6 - 9	12" - 36"	12" - 60"	S	NoCA, SoCA	US-CA
Nyalla Mat Rush	*Lomandra longifolia Nyalla*	Grass/Sedge	Partial Shade to Full Sun	7 - 11	36" - 48"	36" - 48"	S	NoCA, SoCA	Australia
San Diego Sedge	*Carex spissa*	Grass/Sedge	Partial Shade to Partial Sun	6 - 10	36" - 72"	24" - 60"	S	NoCA, SoCA	SW-US
Tropic Belle Mat Rush	*Lomandra hystrix Tropicbelle*	Grass/Sedge	Partial Shade to Full Sun	8 - 11	24" - 36"	24" - 48"	S	SoCA	Australia

Common Name[1,2,8]	Latin Name	Plant Type	Sun	Hardiness Range	Mature Height[5]	Mature Spread[5]	Sizing[7]	Availability[9]	Nativity
Wire Grass	*Juncus patens*	Grass/Sedge	Partial Shade to Full Sun	6 - 10	12" - 24"	12" - 24"	XS	NW, NoCA, SoCA	US-CA

Notes:

1. The species listed are drought tolerant and have applicability to bioretention due to shallow root zones.
2. The species highlighted in green are typically more readily available in the noted regions as the listed species or another similar cultivar.
3. This list is subject to availability and Contech reserves the right to make appropriate substitutions when necessary.
4. For species not listed, please contact Contech for suitability.
5. Mature height and spread do not reflect plant size at planting / system activation. Contact Contech for information on available sizes at activation.
6. Contech promotes the use of non-invasive species in Filterra systems, and has made efforts to maintain a plant list free of invasives. However, always check with local sources, as some species listed (even natives) may be invasive in some regions and not others.
7. All Filterra vault systems incorporate a ponding depth ranging from 12"-36" between finished grade and media surface. For systems with more than 18" from finshed grade to media (FTIBC, FTIBP, FTPD, etc), Contech recommends choosing a species with "Sizing" noted as "XL" or "Tree".
8. The species highlighted in orange are available for an additional charge of $250 per plant required.
9. Availability Key: GL=Great Lakes; GP=Great Plains; MA=Mid-Atlantic; NE=Northeast; NW=Northwest; SW=Southwest; SE=Southeast; SC=South Central; NoCA=Northern CA; SoCA=Southern CA; E-Can=Eastern Canada; W-Can=Western Canada

United Storm Water, Inc. – Connector Pipe Screens (CPS)

&

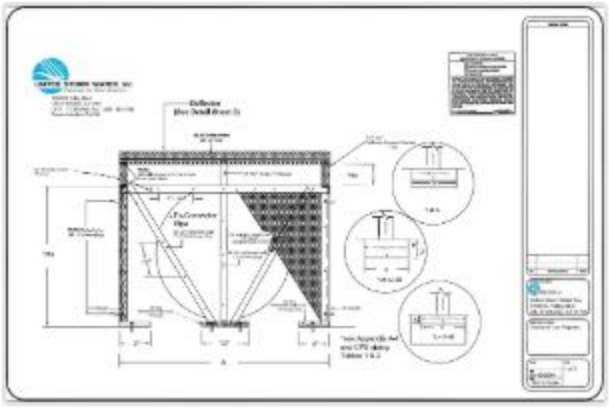
Structural & Construction Details

Connector Pipe Screen (CPS) Unit Specs & Drawings

Listed within the Full Trash Capture Certification Program by both the Los Angeles and the San Francisco Bay Regional Water Quality Control Boards, our Connector Pipe Screen (CPS) has become the BMP of choice for cities as they strive to meet rigorous storm water regulations. This metal screen assembly is installed inside a catch basin, in front of the outlet pipe, for preventing debris from entering the storm drain system. A CPS unit is designed to retain all trash and gross solids larger than 5 mm (0.197 in) inside the catch basin (e.g. cigarette buds), and once in place it also retains large volumes of sediment as well. Therefore, the trash capture and storage capacity of this product is dependent upon the size of the catch basin where it is to be installed. A CPS unit can be used in conjunction with a curb inlet screen cover and/or DrainPac™ Storm Drain Filter Insert for added effectiveness based on the level of trash and debris that commonly accumulates at the site.

CPS Unit Specifications

- Manufactured from S-304 perforated stainless steel having 5 mm diameter holes
- Has a minimum overall vertical height of 2 feet
- Has a deflector to prohibit debris from falling behind the screen
- Has an open area of 50% for overflow bypass
- The perimeter of the insert includes a structural frame for stiffness and a bolting surface to fasten the insert to the catch basin floor and wall
- Has a structural integrity to withstand a force of standing water within the catchment area
- Not recommended for installation in drop inlet type catch basins nor catch basins having connector pipes greater than 42 inches diameter



Connector Pipe Screen Drawings (PDF)

UNITED STORM WATER, Inc.
Protecting Our Water Resources

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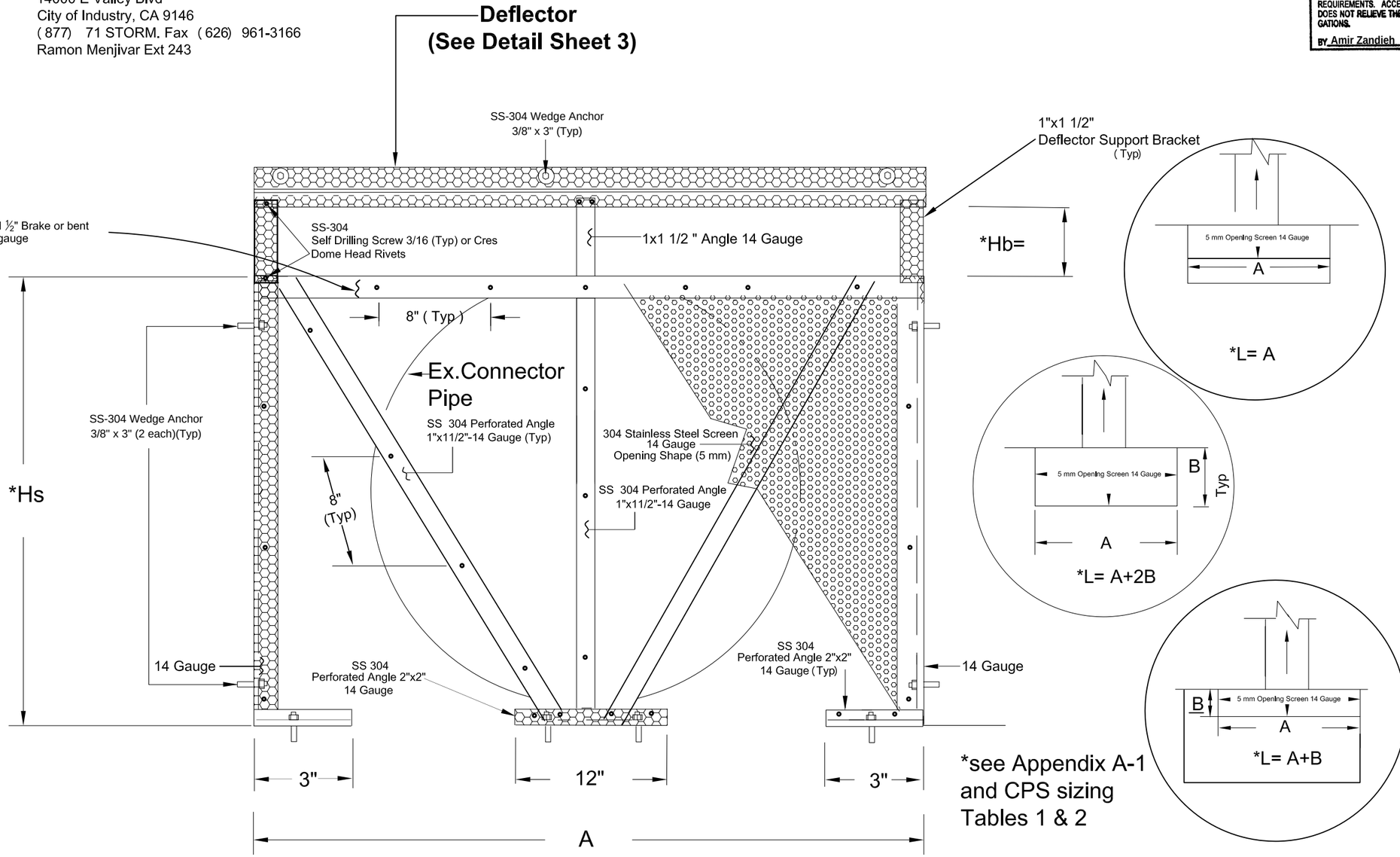
LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS

- [X] ACCEPTED
- [ ] MAKE CORRECTIONS NOTED
- [ ] REVISE CALCULATIONS
- [ ] REJECTED

REVIEW IS PERFORMED BY THE DEPARTMENT TO ENSURE THE CONTRACTOR'S GENERAL CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND GENERAL COMPLIANCE WITH THE SPECIFICATIONS. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE CORRECTNESS OF DIMENSIONS, PROPER CONSTRUCTION AND INSTALLATION METHODS, AND FOR FULFILLING ALL CONTRACTUAL REQUIREMENTS. ACCEPTANCE INDICATED HEREON DOES NOT RELIEVE THE CONTRACTOR OF THESE OBLIGATIONS.

BY Amir Zandieh DATE 06-09-14



*see Appendix A-1
and CPS sizing
Tables 1 & 2

General Notes

No.	Revision/Issue	Date

Firm Name and Address
United Storm Water Inc.
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Project

Date
02-19-2014

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1 of 5

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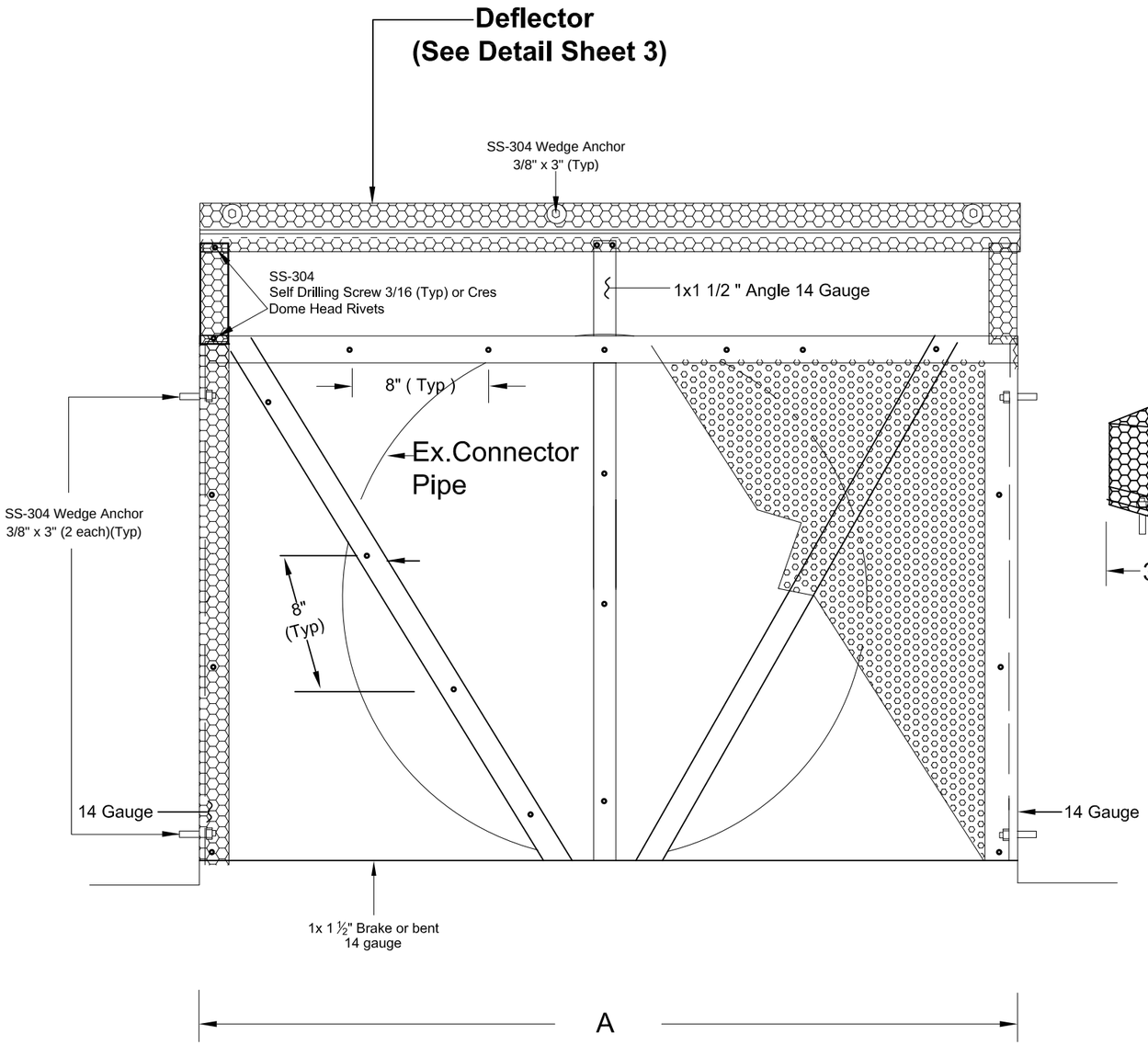

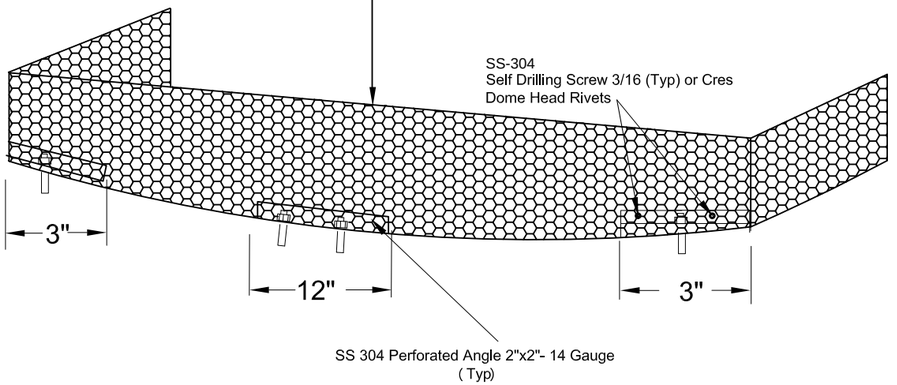

Top View

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Project	Sheet
Date 02-19-2014	2 of 5
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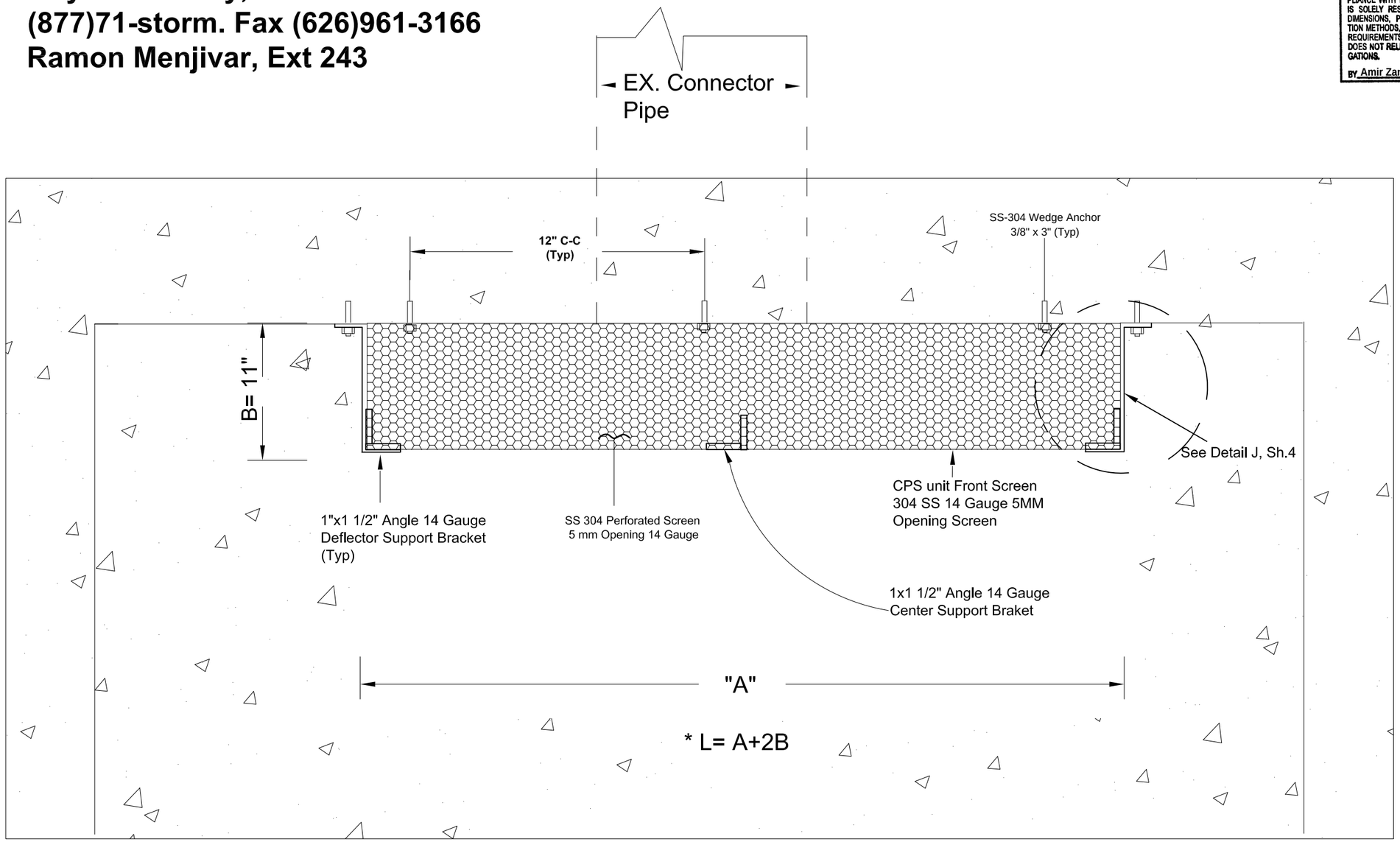

* see Appendix A-1 and CPS Sizing Tables 1 & 2

Deflector Detail
Plain View (Sheet 1)
N.T.S.

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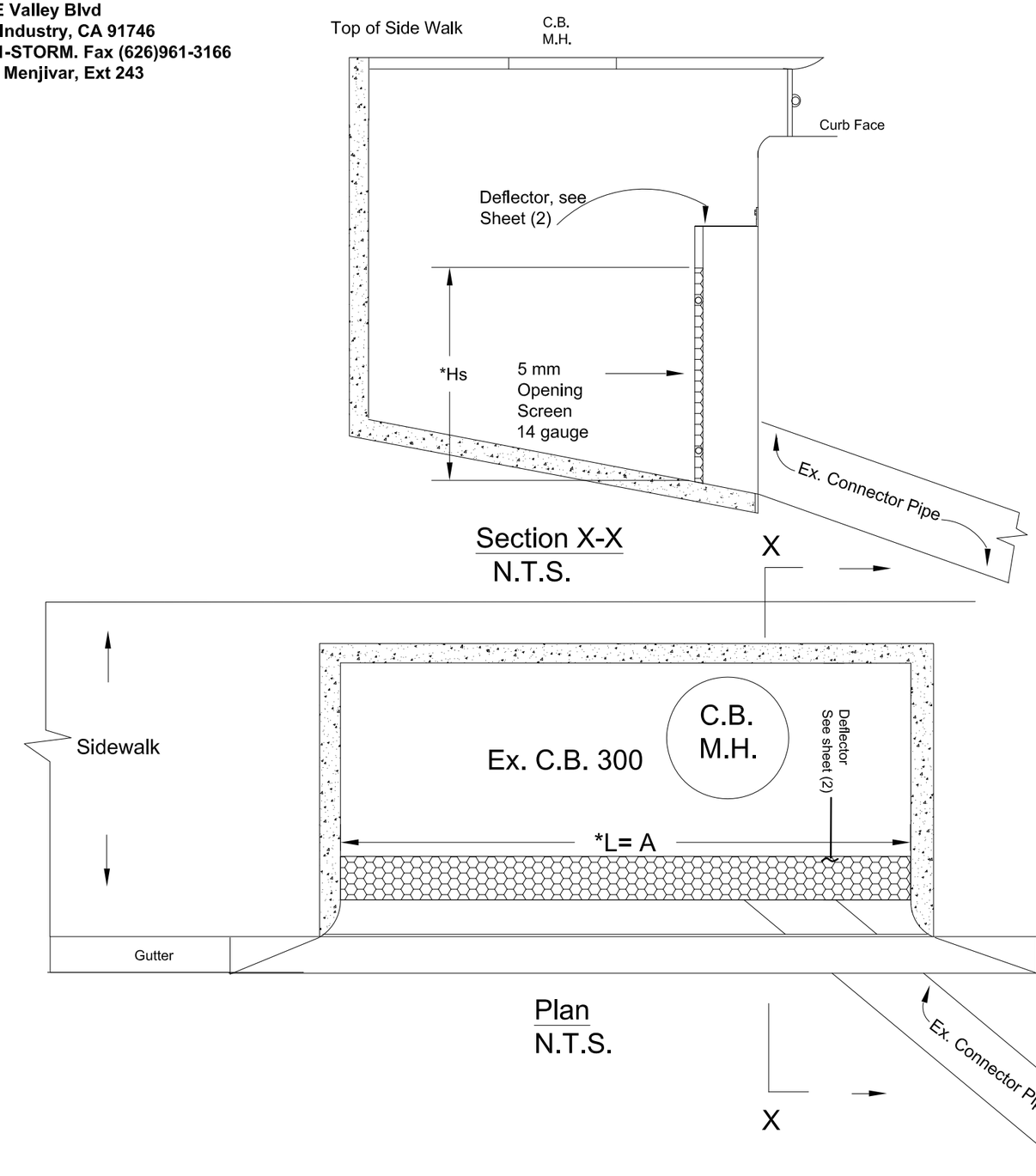

* See Appendix
A-1 and CPS sizing Tables 1 & 2

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Project	Sheet
Date 02-19-2014	4 of 5
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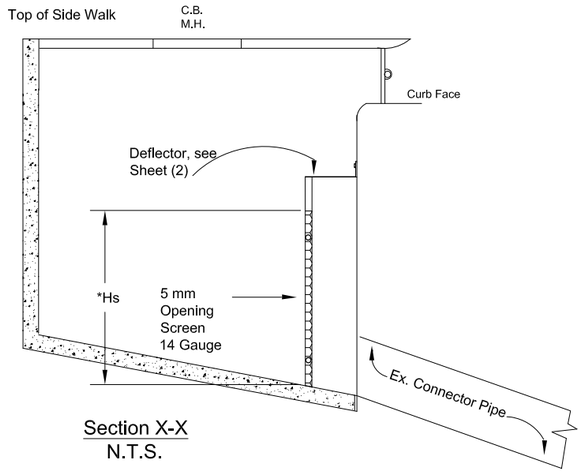

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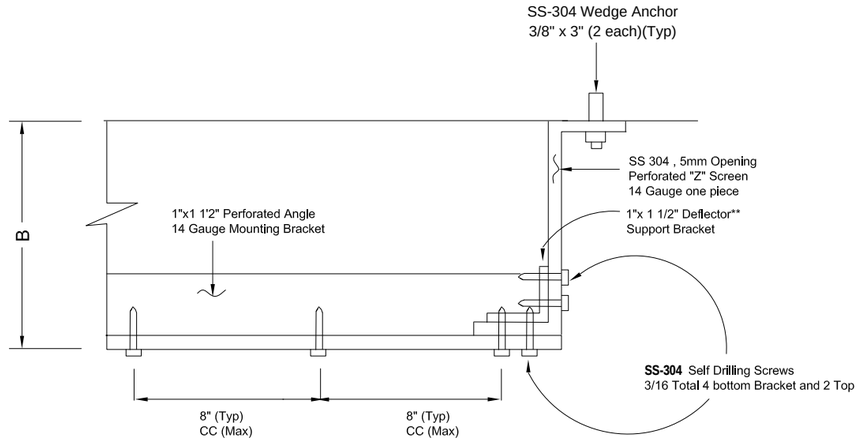

Detail J (Sh.2)
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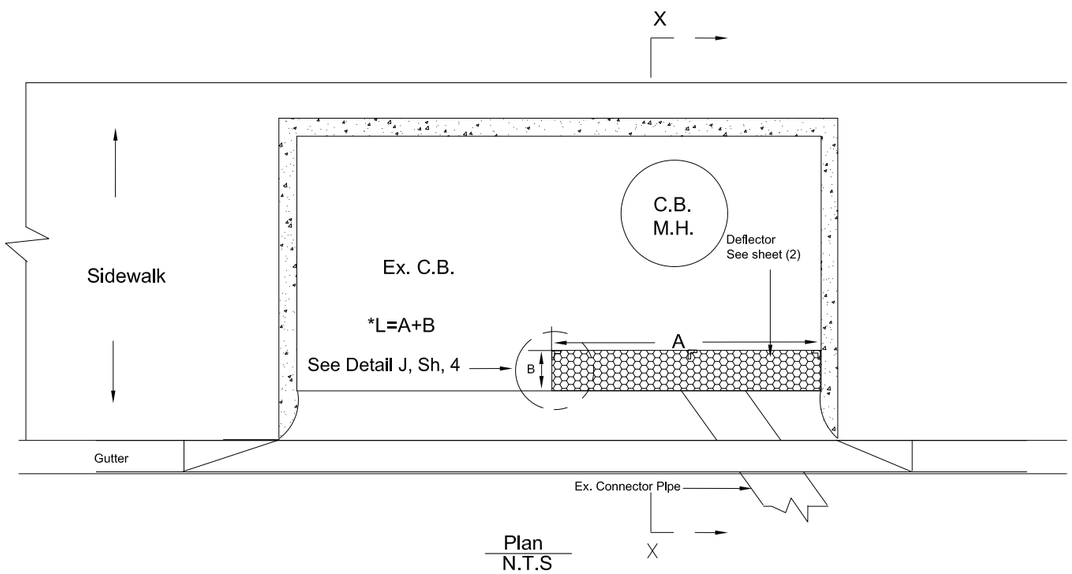

Plan
N.T.S

* See Appendix A-1
and CPS Sizing Tables 1 & 2

** Both legs of Deflector Support Bracket must extend to the top of the Deflector and Also extend at least to the bottom of the Mounting Bracket.

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5 of 5