8.5
HYDROLOGY AND WATER QUALITY REPORTS

This document is designed for double-sided printing to conserve natural resources.

PRIORITY
WATER QUALITY MANAGEMENT PLAN
(WQMP)

For:

Cannon Street & Serrano Avenue Intersection Improvement

Prepared for:
City of Orange
Kevin Yamakawa
300 E Chapman Ave
Orange, CA 92866
(714) 744-5553

Prepared by:
Michael Baker International
Andrew Sidor
5 Hutton Centre, Suite 500
Santa Ana, CA 92707
949-855-5770

June 29, 2020

_____ _____

Public Works Director **Date**

_____ _____

City Engineer **Date**

OWNER'S CERTIFICATION
WATER QUALITY MANAGEMENT PLAN

FOR

Cannon Street & Serrano Avenue Intersection Improvement

This Water Quality Management Plan (WQMP) for the Cannon Street & Serrano Avenue Intersection Improvement Project has been prepared for the City of Orange. This WQMP is intended to comply with the requirements of the Santa Ana Regional Water Quality Control Board Municipal Separate Storm Sewer Systems (MS4) Permit Order No. R8-2009-0030 as amended by Order No. R8-2010-0062.

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the City of Orange Local Implementation Plan (LIP), and the intent of National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for the City of Orange, County of Orange, Orange County Flood Control District and the incorporated Cities of Orange County within the Santa Ana Region.

This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party having responsibility for implementing portions of this WQMP. Maintenance requirements within Section V and Appendix D will be adhered to with particular emphasis on maintaining the BMPs described within Sections IV and V. The Owner's Annual Self Certification Statement along with a BMP maintenance implementation table will be submitted by June 30th every year following project completion. At least one copy of the approved WQMP shall be available on the subject property in perpetuity.

Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend the WQMP. The City of Orange will be notified of the change of ownership and the new owner will submit a new certification.

Signature: _____ Date: _____

Name:	Kevin Yamakawa
Title:	Associate City Engineer
Company:	City of Orange Public Works Engineering & Construction Management
Address:	300 E Chapman Ave Orange, CA 92866
Telephone Number:	(714) 744-5553

Table of Contents

List of Tables

Appendices

I. Discretionary Permit Number(s), Water Quality Condition Number(s) and Conditions of Approval

GPS Coordinate: 33.820263, -117.796004

Water Quality Conditions:
Project specific water quality conditions are not applicable, however, this document was prepared in accordance with the applicable requirements of the California Regional Water Quality Control Board Santa Ana Region Order No. R8-2009-0030, NPDES No. CAS618030, as amended by Order No. R8-2010-0062 dated February 20, 2007; the Orange County Technical Guidance Document (TGD) dated December 20, 2013; and the Orange County Drainage Area Management Plan (DAMP) dated September 24, 2003, including Section 7.6 and Exhibit 7.II of the DAMP.

This project is a redevelopment project that adds or replaces over 5,000 square feet of impervious surface on an already developed area and is therefore considered a Priority Project.

Conditions of Approval:
Not applicable for public roadway.

II. Project Description

Location: Cannon Street & Serrano Avenue

Project Site Area (sq ft): 6,752

Project Disturbed Area (sq ft): 6,752

Percent Change in Impermeable Surfaces: +38

SIC Code: 1611

Project Description
The project is located on an existing street surrounding small residential estates. The existing sidewalk includes a concrete walkway, landscaping, and a horse trail.

Project Purpose and Activities
The proposed street improvements are located at the intersection of Cannon Street and Serrano Avenue. The proposed street improvements include a second right turn lane along Cannon Street before the intersection. The addition of the second right turn lane will require a realignment of the current curb and gutter to accommodate the new lane. The new improvements will also include adding new sidewalk and an ADA compliant curb ramp on the southeast curb return. Improvements along Cannon Street will also remove trees, remove and replace existing utilities, and construct a wooden fence. Improvements along Serrano Avenue will widen the northern portion of the street and realign the existing curb and gutter.

Utility replacements will be restored to their original line and grade, considering this portion of work routine maintenance activities and excluding it from the project disturbed area.

Potential Storm Water Pollutants
Expected pollutants from this project are suspended solids/sediment, heavy metals, pathogens (bacteria, virus), oil and grease, toxic organic compounds, and trash and debris.

Hydrologic Conditions of Concern
III. A Hydrologic Conditions of Concern (HCOC) exists if the post-development runoff volume for the 2-year, 24-hour storm event exceeds the pre-development runoff volume by more than 5%. The 2-year hydrology analysis indicates that there is an increase in flow by approximately 0.01 cfs. This increase of flow exceeds 5% of the existing condition, meaning there is also a volume increase by more than 5%. However, per Section 5.3.1 of the TGD, a further downstream point of compliance can be used to evaluate whether the project will adversely impact the downstream erosion, sedimentation, or stream habitat. The closest susceptible channel segment Santiago

Creek Reach 1, is approximately 0.5 mile away. It can be concluded that the hydrological impacts to the susceptible channel are insignificant.

Refer to Hydrology and Hydraulic Technical Memorandum in Appendix D for more information.

Post-Development Drainage Characteristics
Post-development drainage conditions will not be altered as a result of this project. Runoff from Cannon Street will collect in the gutter and flow into a catch basin further south on Cannon Street by Santiago Creek Trail. Runoff from Serrano Avenue will collect in the gutter and flow into the catch basin located on the northeast corner of the intersection of Cannon Street and Serrano Avenue.

Site Ownership and any Easements
This site is a public roadway within the right of way owned by the City of Orange.

IV. Site Description

Reference Location Map: See Section VI

Site Address: Cannon Street & Serrano Avenue

Zoning: Unzoned

Predominant Soil type: B

Pre-project percent pervious: 38
Pre-project percent impervious: 62
Post-project percent pervious: 0
Post-project percent impervious: 100

Site Characteristics

In its existing condition, the project site consists of AC pavement, concrete sidewalk, miscellaneous landscaping, and a pervious horse trail. Cannon Street and Serrano Avenue have slopes of approximately 4% and 0.4% respectively. Geotechnical testing indicated that the subsurface materials consist of engineered fill, alluvial deposits, and terrace deposits. Groundwater was not encountered during investigation of up to 31 feet below existing grade and is estimated to be deeper than 40 feet below existing ground surface. The project is not located within any fault zone, seismic hazard zone, or plumes. The project is located in a potential area of erosion, habitat, and physical structure susceptibility.

Watershed Characteristics

Watershed: Santiago Creek

Downstream Receiving Waters: Santiago Creek Reach 1, Santa Ana River Reach 1

Water Quality Impairments (if applicable): Santiago Creek – indicator bacteria
Santa Ana River – indicator bacteria, pH

Identify hydromodification susceptibility: Portions of Santiago Creek are earthen and unstabilized making the project susceptible to hydromodification

Identify watershed management priorities: Not applicable

V. Best Management Practices

V.1 Site Design and Drainage Characteristics

Table 1- Site Design BMPs

Technique	Included?		If no, state justification.
	Yes	No	
Minimize Directly Connected Impervious Areas (DCIAs) (C-Factor Reduction)		X	Not applicable with roadway project.
Create Reduced or "Zero Discharge" Areas (Runoff Volume Reduction)[1]		X	Not applicable with roadway project.
Minimize Impervious Area/Maximize Permeability (C-Factor Reduction)[2]		X	Not feasible.
Conserve Natural Areas (C-Factor Reduction)		X	Not feasible.

1 Detention and retention areas incorporated into landscape design provide areas for retaining and detaining stormwater flows, resulting in lower runoff rates and reductions in volume due to limited infiltration and evaporation. Such Site Design BMPs may reduce the size of Treatment Control BMPs.

2 The "C Factor" is a representation of the ability of a surface to produce runoff. Surfaces that produce higher volumes of runoff are represented by higher C Factors. By incorporating more pervious, lower C Factor surfaces into a development, lower volumes of runoff will be produced. Lower volumes and rates of runoff translate directly to lowering treatment requirements.

Site design BMPs could not be implemented for the existing project site.

V.2 Source Control BMPs

V.2.1 Routine Non-Structural BMPs

Table 2 – Routine Non-Structural BMPs

BMP No.	Name	Check One		If not applicable, state brief reason.
		Included	Not Applicable	
N1	Education for Property Owners, Tenants and Occupants		X	Project area is publicly owned by the City of Orange.
N2	Activity Restriction		X	CC&Rs are not applicable.
N3	Common Area Landscape Management		X	Landscaping is not included within project site.
N4	BMP Maintenance	X		
N5	Title 22 CCR Compliance		X	Hazardous materials are not anticipated to be used within the project site.
N6	Local Water Quality Permit Compliance		**X**	This BMP is not applicable. The City of Orange does not issue water quality permits.
N7	Spill Contingency Plan		X	Hazardous spills are not anticipated to occur within the project site.
N8	Underground Storage Tank Compliance		X	Underground storage tanks are not included within project site.
N9	Hazardous Materials Disclosure Compliance		X	Hazardous materials are not anticipated to be used within the project site.
N10	Uniform Fire Code Implementation		X	Hazardous materials are not anticipated to be used within the project site.
N11	Common Area Litter Control		X	Trash receptacles are not included within project site.
N12	Employee Training	X		
N13	Housekeeping of Loading Docks		X	Loading docks are not included within project site.
N14	Common Area Catch Basin Inspection	X		
N15	Street Sweeping Private Streets and Parking Lots	X		

N4 BMP Maintenance – City of Orange will be responsible for maintenance of on-site BMPs at least annually and prior to the start of the rainy season.

N12 Employee Training – City of Orange will implement employee training programs for new hires.

N14 Common Area Catch Basin Inspection – City of Orange is required to have at least 80 percent of drainage facilities inspected, cleaned and maintained on an annual basis with 100 percent of the facilities included in a two-year period. Cleaning should take place in the late summer/early fall prior to the start of the rainy season. Drainage facilities include catch basins (storm drain inlets) detention basins, retention basins, sediment basins, open drainage channels and lift stations. Records should be kept to document the annual maintenance.

N15 Street Sweeping Private Streets and Parking Lots – Streets and parking lots are required to be swept prior to the storm season, in late summer or early fall, prior to the start of the rainy season or equivalent as required by the governing jurisdiction.

V.2.2 Routine Structural BMPs

Table 3 – Routine Structural BMPs

*Name	Check One		If not applicable, state brief reason
	Included	Not Applicable	
Provide storm drain system stenciling and signage- "No Dumping – Drains to Ocean"	X		
Design and construct outdoor material storage areas to reduce pollution introduction		X	Outdoor storage areas are not included within project site.
Design and construct trash and waste storage areas to reduce pollution introduction		X	Trash storage areas are not included within project site.
Use efficient irrigation systems & landscape design		X	Landscape design in not included within project area.
Protect slopes and channels and provide energy dissipation		X	Energy dissipation for slopes are not included within project site.
Incorporate requirements applicable to individual project features			
a. Dock areas		X	Loading docks are not included within project site.
b. Maintenance bays		X	Maintenance bays are not included within project site.
c. Vehicle or community wash areas		X	Vehicle wash areas are not included within project site.
d. Outdoor processing areas		X	Outdoor processing areas are not included within project site.
e. Equipment wash areas		X	Equipment wash areas are not included within project site.
f. Fueling areas		X	Fueling areas are not included within project site.
g. Hillside landscaping		X	Hillside landscaping is not included within project site.
h. Wash water control for food preparation areas		X	Food preparation areas are not included within project site.

S1 Provide Storm Drain System Stenciling and Signage – Storm drain stencils are highly visible source control messages, typically placed directly adjacent to storm drain inlets. The stencils contain a brief statement that prohibits the dumping of improper materials into the municipal storm drain system. Graphical icons, either illustrating anti-dumping symbols or images of receiving water fauna, are effective supplements to the anti-dumping message. Stencils and signs alert the public to the destination of pollutants discharged into stormwater. The following requirements should be included in the project design and shown on the project plans:

1. Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language (such as: “NO DUMPING-DRAINS TO OCEAN”) and/or graphical icons to discourage illegal dumping.
2. Post signs and prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.
3. Maintain legibility of stencils and signs.
4. See CASQA Stormwater Handbook BMP Fact Sheet SD-13 for additional information.

V.3 Low Impact Development BMP Selection

V.3.1 Hydrologic Source Controls

Table 4 – Hydrologic Source Control BMPs

Name	Check If Used
Localized on-lot infiltration	☐
Impervious area dispersion (e.g. roof top disconnection)	☐
Street trees (canopy interception)	☐
Residential rain barrels (not actively managed)	☐
Green roofs/Brown roofs	☐
Blue roofs	☐

Hydrologic source control BMPs are not applicable.

V.3.2 Infiltration BMPs

Table 5 – Infiltration BMPs

Name	Check If Used
Bioretention without underdrains	☐
Rain gardens	☐
Porous landscaping	☐
Infiltration planters	☐
Retention swales	☐
Infiltration trenches	☐
Infiltration basins	☐
Drywells	☐
Subsurface infiltration galleries	☐
French drains	☐
Permeable asphalt	☐
Permeable concrete	☐
Permeable concrete pavers	☐

Infiltration BMPs are not applicable due to the existing soils that are not suitable for infiltration.

V.3.3 Biotreatment BMPs

Table 6 – Biotreatment BMPs

Name	Check If Used
Bioretention with underdrains	☐
Storm water planter boxes with underdrains	☐
Rain gardens with underdrains	☐
Constructed wetlands	☐
Vegetated swales	☐
Vegetated filter strips	☐
Proprietary vegetated biotreatment systems	☒
Wet extended detention basin	☐
Dry extended detention basins	☐

This project qualifies as an applicable USEPA “Green Streets Project” and will implement LID BMPs and WQMP requirements according to MEP standards. This allows treatment of comingled off-site runoff to compensate for the infeasibility and

impracticability of treatment of all areas within the project. The project area consists of 2 locations that total 6,752 square feet.

Due to project constraints and using the MEP standard, volume based BMPs were determined to be infeasible. Flow based BMPs will be used to treat the design flow equivalent to the Design Capture Volume (DCV) as defined as the 85th percentile, 24-hour storm event from the project area. The water quality flow will be determined with an intensity of 0.2625 in/hr using an 80% average annual capture efficiency and a conservative time of concentration of 5 minutes. The water quality flow was calculated to be 0.037 cfs.

Runoff will be collected in the existing storm drain system via the existing curb and gutter. A Filterra unit will be installed upstream of the catch basin to provide LID treatment. The location of the unit was chosen to ensure that the tributary area of the unit and associated catch basin exceeds that of the project area.

The Filterra unit was sized using the sizing tool provided by Contech and included in Attachment A. The project will use one FT0404 Filterra unit. This unit will be able to treat the water quality flow from its entire drainage area.

V.3.4 Hydromodification Control BMPs

Hydromodification control BMPs are not applicable as HCOC does not exist.

V.4 Vector Control

The Filterra media flow through rate is TAPE GULD approved. Vector issues from standing nuisance water is not anticipated.

V.5 Drainage Management Area (DMA)

Describe each DMA used in project, the BMPs in each DMA and the area treated.

DMA Number	BMPs	Area Treated
C-1: 5,136 square feet S-1: 1,616 square feet	FT0404 Filterra unit	20,672 square feet
Total Area: 6,752 square feet		

V.6 Calculations

The follow table summarizes the DCV and the water quality flow of the project. Refer to Appendix A for Contech's sizing tool.

DMA Number	Project Area (sf)	Project Area (ac)	Imp %	C	D (in)	DCV (cf)	i (in/hr)	WQ Flow (cfs)
C-1	5,136	0.12	1.0	0.9	0.85	327	0.2625	0.028
S-1	1,616	0.04	1.0	0.9	0.85	103	0.2625	0.009
	6,752	**0.16**	**1.0**	**0.9**	**0.85**	**430**	**0.2625**	**0.037**

VI. Implementation, Maintenance and Inspection Responsibility for BMPs (O&M Plan)

Responsible Party Information (Local Contact Information)

Name: Kevin Yamakawa Title: Associate City Engineer

Company: City of Orange Phone Number: (714) 744-5553

Table 7 – Frequency Inspection Matrix

BMP	Responsible Party	*Maintenance Activity	*Inspection/Maintenance Frequency
Source Control BMPs (Structural and Non-structural)			
Catch basin	City of Orange	Inspection and cleaning of drainage facilities	Annually prior to the start of the rainy season, or as needed
Street sweeping	City of Orange	Sweep streets for trash and debris with street sweepers	Implement with City's regular street sweeping schedule
Low Impact Development and Treatment BMPs			
Filterra unit	City of Orange	Inspect for obstructions and/ or accumulation of trash and debris and mulch	Biannually (once during dry season and once during wet season)
		Replace Filterra media and mulch	Per manufacturer's recommendation
		Irrigate and trim/ prune plants	With normal landscape maintenance schedule or as needed
		Inspect flow entrances, ponding area, surface overflow for erosion	Biannually (once during dry season and once during wet season)
		Inspect for visible cracks is structure	Biannually (once during dry season and once during wet season)

*Attach in appendix additional inspection, maintenance and operations information if required.

Regulatory Permits

Not applicable.

Funding

Funding for maintenance will be provided by the City of Orange.

OWNER SELF CERTIFICATION STATEMENT

As the owner representative of the Cannon Street & Serrano Avenue Intersection Improvement for which a Water Quality Management Plan (WQMP) was approved by the City, I hereby certify under penalty of law that all Best Management Practices contained within the approved Project WQMP have been maintained and inspected in accordance with the schedule and frequency outlined in the approved WQMP Maintenance Table.

The maintenance activities and inspections conducted are shown in the attached table and have been performed by qualified and knowledgeable individuals. Structural Treatment BMPs have been inspected and certified by a licensed professional engineer.

To the best of my knowledge, the information submitted is true and accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and citations for violating water quality regulations.

Signature: _____ Date: _____

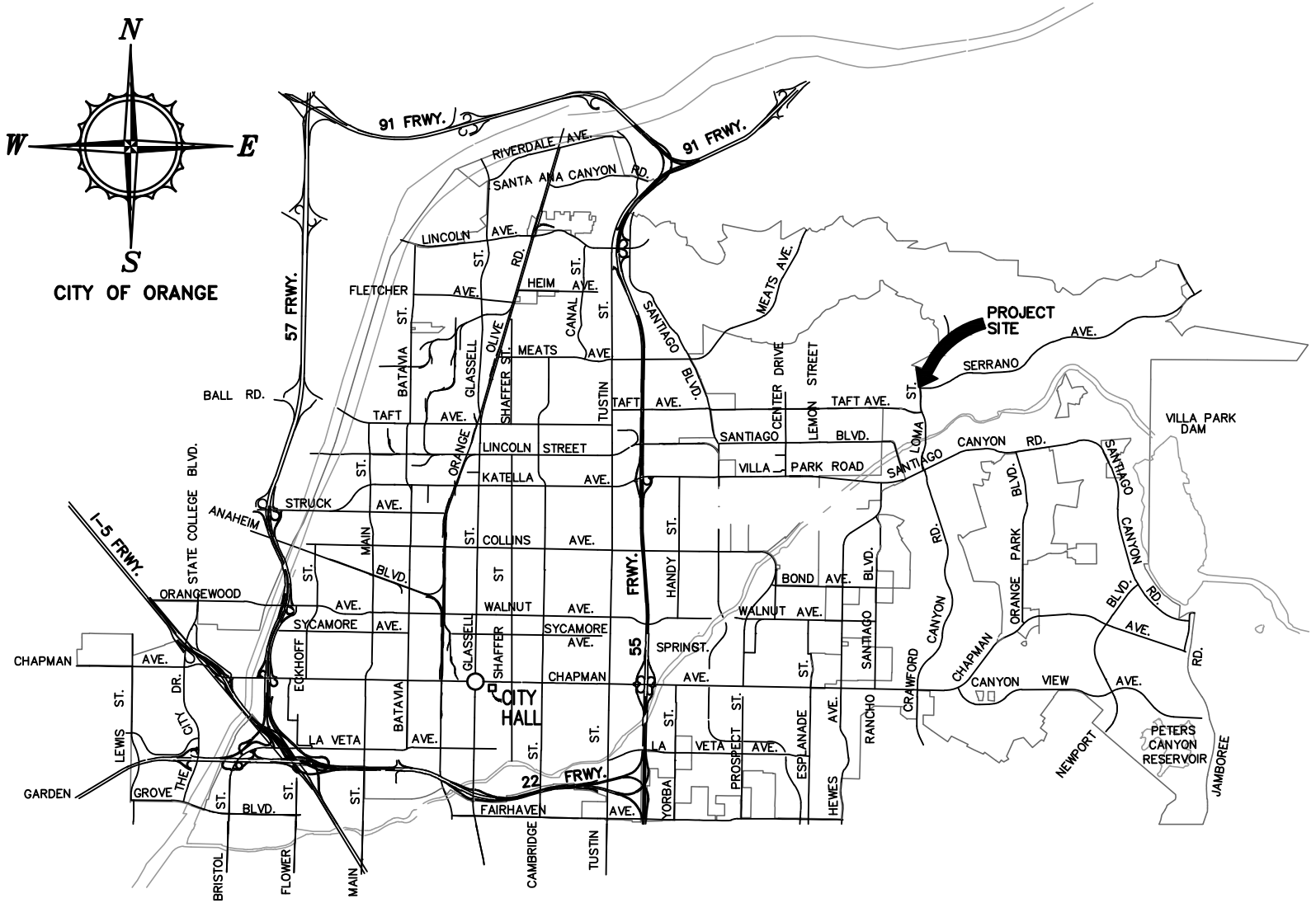
Name:	Kevin Yamakawa
Title:	Associate Civil Engineer
Company:	City of Orange Public Works Engineering & Construction Management
Address:	300 E Chapman Ave Orange, CA 92866
Telephone Number:	(714) 744-5553

Table 8 – BMP Implementation Tracking Table

BMP	Activity	Completion Dates or Frequency	Initial
Source Control BMPs (Structural and Nonstructural)			
Catch basin	Inspection and cleaning of drainage facilities	Annually prior to the start of the rainy season, or as needed	
Street sweeping	Sweep streets for trash and debris with street sweepers	Implement with City's regular street sweeping schedule	
Low Impact Development and Treatment BMPs			
Filterra unit	Inspect for obstructions and/ or accumulation of trash and debris and mulch	Biannually (once during dry season and once during wet season)	
	Replace Filterra media and mulch	Per manufacturer's recommendation	
	Irrigate and trim/ prune plants	With normal landscape maintenance schedule or as needed	
	Inspect flow entrances, ponding area, surface overflow for erosion	Biannually (once during dry season and once during wet season)	
	Inspect for visible cracks is structure	Biannually (once during dry season and once during wet season)	

* This sheet is to be submitted annually with the Owner Self Certification Statement.
** Structural Treatment BMPs should be certified by a Licensed Professional Engineer.

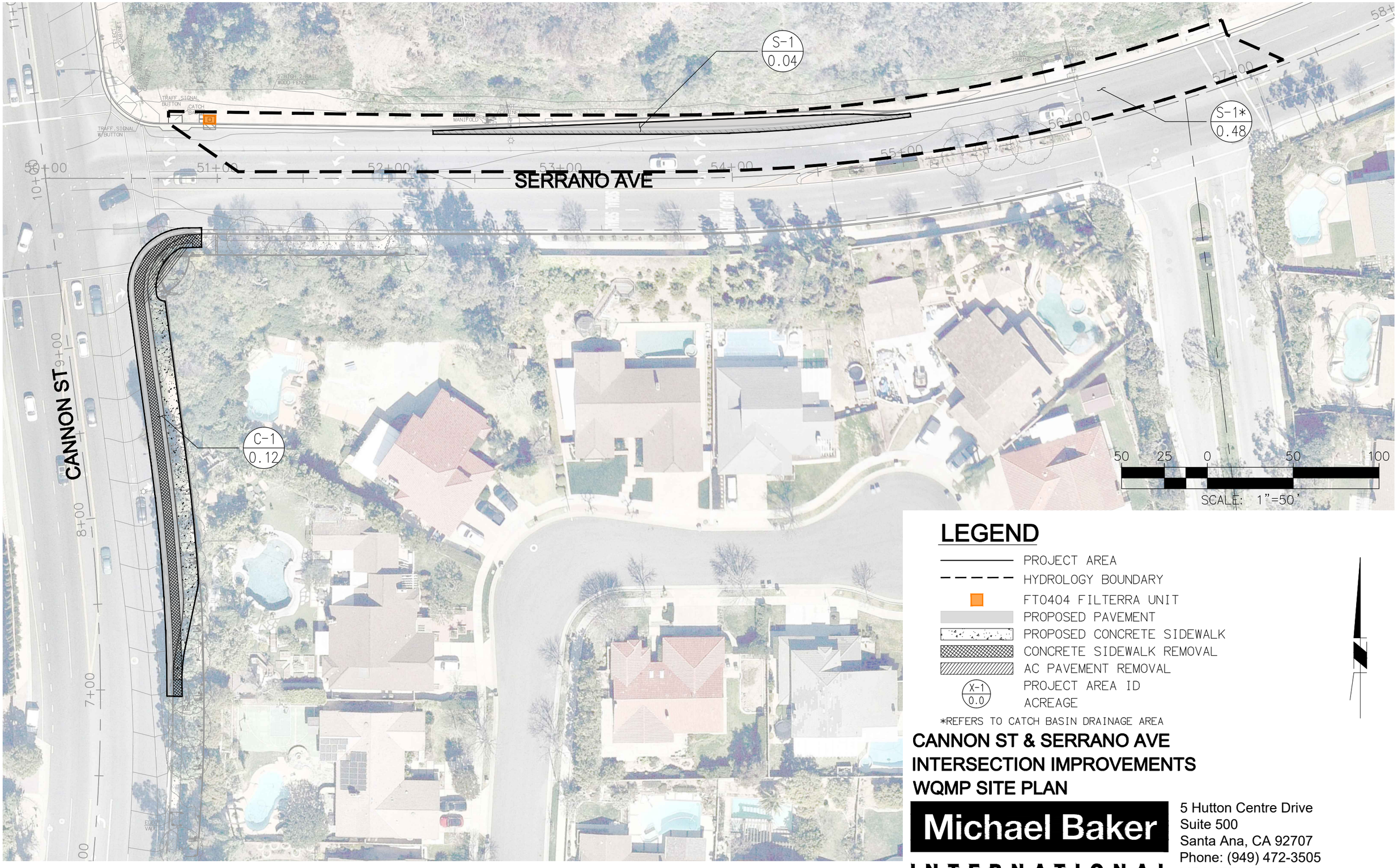
VII. Location Map, Site Plan, and BMP Details



Michael Baker
INTERNATIONAL
5 Hutton Centre Drive, Suite 500, Santa Ana, CA 92707
Phone: (949) 472-3505 · MBAKERINTL.COM

LOCATION MAP
CANNON ST & SERRANO AVE INTERSECTION IMPROVEMENT

H:\pdata\174203\CADD\Strmwater\Exhibits\Location Map.dwg 06/05/20 - 10:22am Connie.Phan



LEGEND

- PROJECT AREA
- HYDROLOGY BOUNDARY
- FT0404 FILTERRA UNIT
- PROPOSED PAVEMENT
- PROPOSED CONCRETE SIDEWALK
- CONCRETE SIDEWALK REMOVAL
- AC PAVEMENT REMOVAL
- X-1 / 0.0 — PROJECT AREA ID / ACREAGE

*REFERS TO CATCH BASIN DRAINAGE AREA

CANNON ST & SERRANO AVE INTERSECTION IMPROVEMENTS WQMP SITE PLAN

Michael Baker INTERNATIONAL
5 Hutton Centre Drive
Suite 500
Santa Ana, CA 92707
Phone: (949) 472-3505
MBAKERINTL.COM

H:\PDATA\174203\CADD\STRMWATER\EXHIBITS\WQMP EXHIBIT.DWG CONNIE.PHAN 6/26/20 9:25 am

Appendix A

BMP Calculations and Details

Filterra Sizing Tool for Southern California

For Final Design please contact:
Noel Thurston - Stormwater Consultant
nthurston@conteches.com
Phone: 619-629-1156

Contact Information

Engineer of Record Name	
Engineer of Record Company Name	
Engineer of Record Office Zip Code	92007

Project Information

Project Name	Cannon St & Serrano Ave Intersection Improvement
Project Location	Cannon St & Serrano Ave
Catchment Name	
Is Project in San Diego Water Board #9?	No
Is Project in LA County?	No

Water Quality Flow Rate Recommendation (Calculate only if unknown)

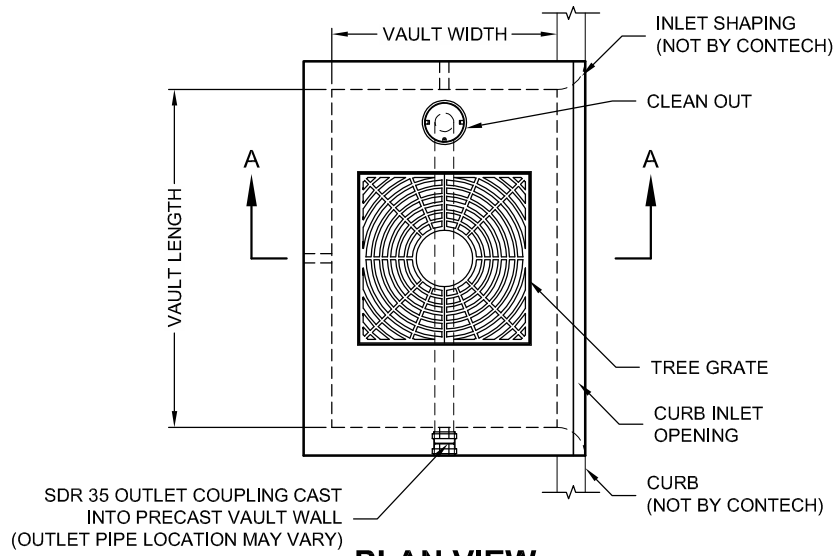
C-value	0.9
i (in/hr)	0.2625
A (acres)	0.48
Recommended Flow Rate (CFS)	**0.1134**

Filterra Unit Type Recommendation

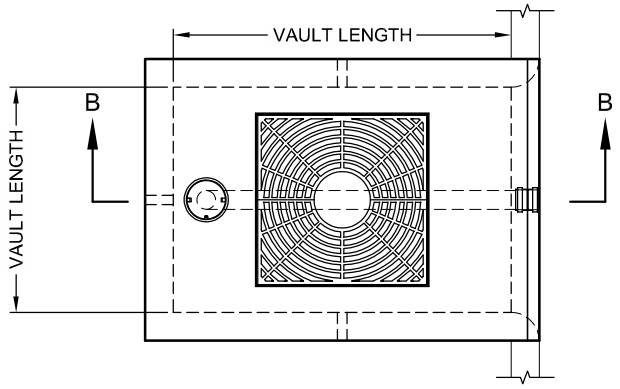
Media Infiltration Rate (in/hr)	100
Water Quality Flow Rate (cfs)	0.1134
Rim Elevation	
Inlet Type	Curb
Inlet Invert Elevation (ft)	
Outlet Invert Elevation (ft)	
Peak Flow Rate (cfs)	0.1134
Include Internal Bypass?	No
Is Open Top Desired?	No
Plants Allowable Above Surface?	Yes
Recommended Model Type	**Offline**

Filterra Size Recommendation

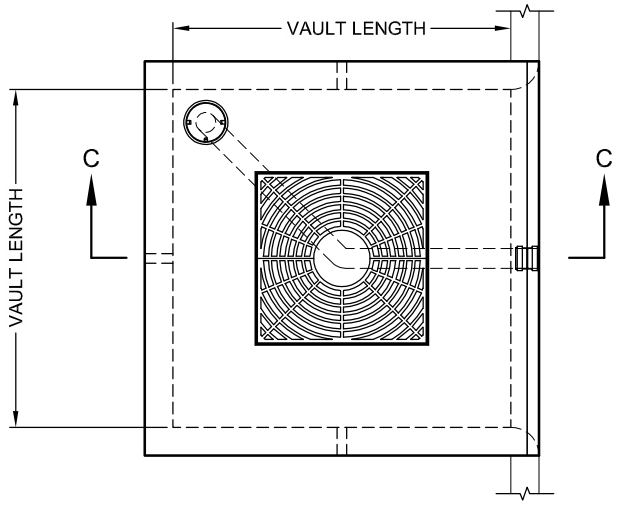
Water Quality Flow Rate (cfs)	0.1134
Filterra Type	Offline
Required Filterra Area (Ft^2)	
Recommended Unit Size	**FT 4x4**



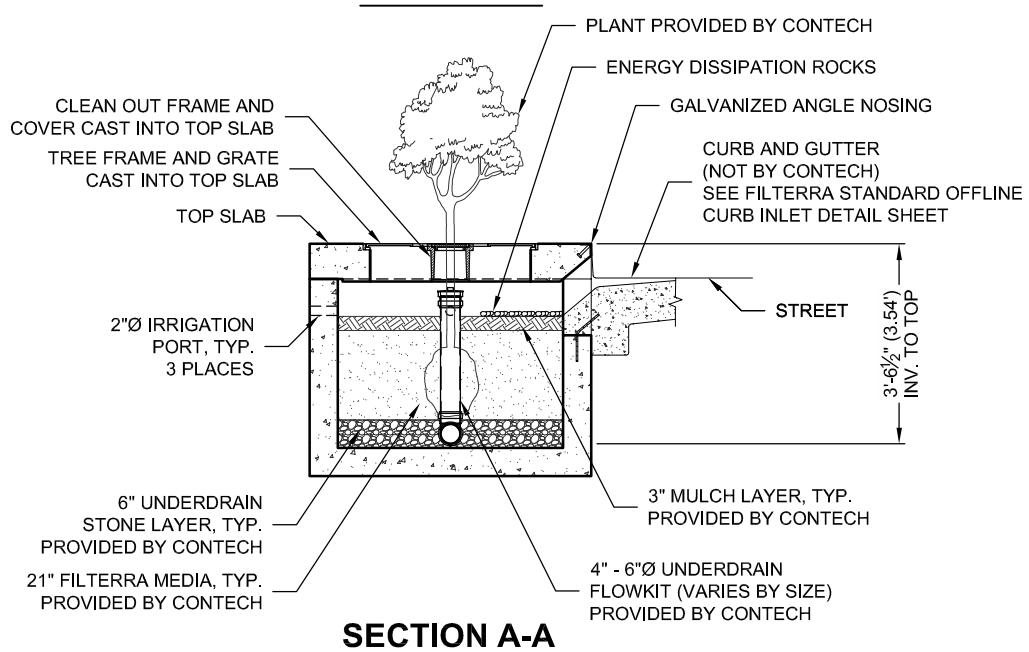
PLAN VIEW



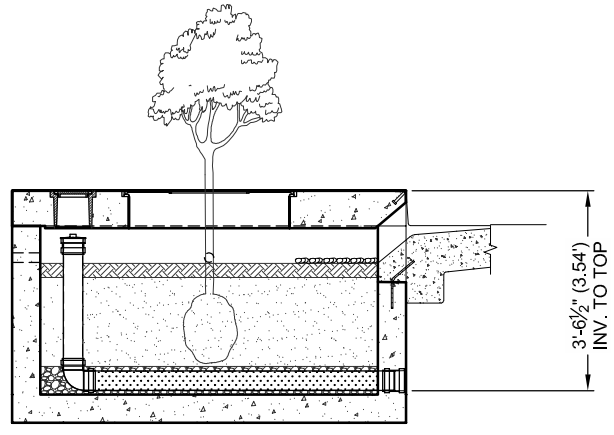
PLAN VIEW



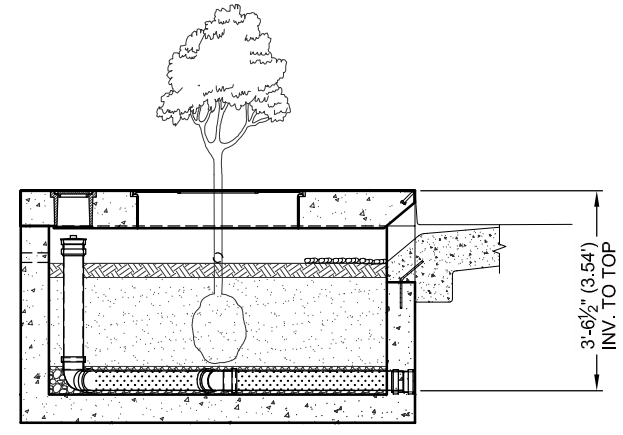
PLAN VIEW



SECTION A-A



SECTION B-B



SECTION C-C

FT LONG SIDE INLET CONFIGURATION

DESIGNATION	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (L x W)	OUTLET PIPE DIA	TREE GRATE QTY & SIZE
FT0604	N/A CA	6 x 4	6 x 4	4" SDR 35	(1) 3' x 3'
FT06504	CA ONLY	6.5 x 4	6.5 x 4	4" SDR 35	(1) 3' x 3'
FT078045	MID-ATL ONLY	7.83 x 4.5	7.83 x 4.5	4" SDR 35	(1) 3' x 3'
FT0804	N/A MID-ATL	8 x 4	8 x 4	4" SDR 35	(1) 3' x 3'
FT0806	ALL	8 x 6	8 x 6	4" SDR 35	(1) 4' x 4'
FT1006	ALL	10 x 6	10 x 6	6" SDR 35	(1) 4' x 4'
FT1206	ALL	12 x 6	12 x 6	6" SDR 35	(2) 4' x 4'
FT1307	ALL	13 x 7	13 x 7	6" SDR 35	(2) 4' x 4'
FT1408	CALL CONTECH	14 x 8	14 x 8	6" SDR 35	(2) 4' x 4'
FT1608	CALL CONTECH	16 x 8	16 x 8	6" SDR 35	(2) 4' x 4'
FT1808	CALL CONTECH	18 x 8	18 x 8	6" SDR 35	(2) 4' x 4'
FT2008	CALL CONTECH	20 x 8	20 x 8	6" SDR 35	(3) 4' x 4'
FT2208	CALL CONTECH	22 x 8	22 x 8	6" SDR 35	(3) 4' x 4'

N/A = NOT AVAILABLE

FT SHORT SIDE INLET CONFIGURATION

DESIGNATION	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	OUTLET PIPE DIA	TREE GRATE QTY & SIZE
FT0406	N/A CA	4 x 6	4 x 6	4" SDR 35	(1) 3' x 3'
FT04065	CA ONLY	4 x 6.5	4 x 6.5	4" SDR 35	(1) 3' x 3'
FT0408	N/A MID-ATL	4 x 8	4 x 8	4" SDR 35	(1) 3' x 3'
FT045078	MID-ATL ONLY	4.5 x 7.83	4.5 x 7.83	4" SDR 35	(1) 3' x 3'
FT0608	ALL	6 x 8	6 x 8	4" SDR 35	(1) 4' x 4'
FT0610	ALL	6 x 10	6 x 10	6" SDR 35	(1) 4' x 4'
FT0612	ALL	6 x 12	6 x 12	6" SDR 35	(2) 4' x 4'
FT0713	ALL	7 x 13	7 x 13	6" SDR 35	(2) 4' x 4'

N/A = NOT AVAILABLE

FT SQUARE INLET CONFIGURATION

DESIGNATION	AVAILABILITY	MEDIA BAY SIZE	VAULT SIZE (W x L)	OUTLET PIPE DIA	TREE GRATE QTY & SIZE
FT0404	ALL	4 x 4	4 x 4	4" SDR 35	(1) 3' x 3'
FT0606	ALL	6 x 6	6 x 6	4" SDR 35	(1) 3' x 3'

N/A = NOT AVAILABLE

INTERNAL PIPE CONFIGURATION MAY VARY
DEPENDING UPON OUTLET LOCATION.

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; 7,833,412; RELATED FOREIGN PATENTS.

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

FILTERRA OFFLINE (FT) CONFIGURATION DETAIL

CONTECH®
ENGINEERED SOLUTIONS

Filterra®
High Performance Bioretention

The experts you need to solve your stormwater challenges

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

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

Your Contech Team

STORMWATER CONSULTANT

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

STORMWATER DESIGN ENGINEER

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

REGULATORY MANAGER

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

SALES ENGINEER

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

Contech is your partner in stormwater management solutions

Low Impact Development in a Small Footprint – Filterra®

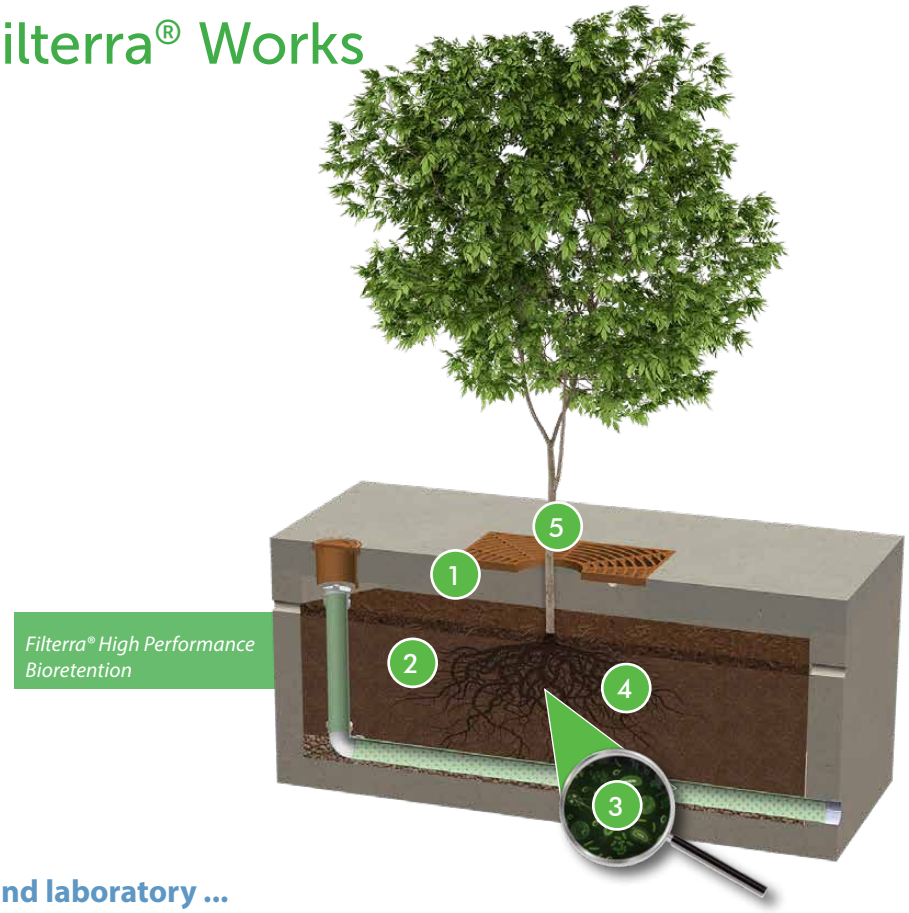
Filterra is an engineered high-performance bioretention system. While it operates similar to traditional bioretention, its high flow media allows for a reduction in footprint of up to 95% versus traditional bioretention practices. Filterra provides a Low Impact Development (LID) solution for tight, highly developed sites such as urban development projects, commercial parking lots, residential streets, and streetscapes. Its small footprint also reduces installation and life cycle costs versus traditional bioretention. Filterra can be configured in many different ways to enhance site aesthetics, integrate with other LID practices, or increase runoff reduction through infiltration below or downstream of the system.

At the Manchester Stormwater Park seen above, the Filterra systems surrounding the central courtyard allowed for the creation of a community space with parking, sidewalks, and benches in a quaint downtown area. A traditional bioretention system treating the same drainage area would have occupied the entire park area leaving no room for these amenities.

filterra®
Bioretention Systems

filterra® Bioscape

How the Filterra® Works



Tested in the field and laboratory ...

1. Stormwater enters the Filterra through a pipe, curb inlet, or sheet flow and ponds over the pretreatment mulch layer, capturing heavy sediment and debris. Organics and microorganisms within the mulch trap and degrade metals and hydrocarbons. The mulch also provides water retention for the system's vegetation.

2. Stormwater flows through engineered Filterra media which filters fine pollutants and nutrients. Organic material in the media removes dissolved metals and acts as a food source for root-zone microorganisms. Treated water exits through an underdrain pipe or infiltrates (if designed accordingly).

3. Rootzone microorganisms digest and transform pollutants into forms easily absorbed by plants.

4. Plant roots absorb stormwater and pollutants that were transformed by microorganisms, regenerating the media's pollutant removal capacity. The roots grow, provide a hospitable environment for the rootzone microorganisms and penetrate the media, maintaining hydraulic conductivity.

5. The plant trunk and foliage utilize nutrients such as Nitrogen and Phosphorus for plant health, sequester heavy metals into the biomass, and provide evapotranspiration of residual water within the system.

Plants and organic material are vital to the long term performance of bioretention systems

Using nature to facilitate Stormwater Management

Filterra® Features and Benefits

FEATURE	BENEFITS
High biofiltration media flow rate (up to 140"/hr+)	Greatly reduced footprint versus traditional bioretention and LID solutions
Filterra system is packaged, including all components necessary for system performance	Quality control for easy, fast and successful installation
Quick and easy maintenance	Low lifecycle costs
Variety of configurations and aesthetic options	Integrates easily into any site or landscape plan
Natural stormwater management processes featuring organics and vegetation	Meets Low Impact Development requirements and ensures long-term performance

The Filterra system can be configured with many different aesthetic options

Select Filterra® Approvals

Filterra is approved through numerous local, state and federal verification programs, including:

- New Jersey Department of Environmental Protection (NJ DEP)
- Washington Department of Ecology (GULD) – Basic, Enhanced, Phosphorus, and Oil
- Maryland Department of the Environment - Environmental Site Design (ESD)
- Texas Commission on Environmental Quality (TCEQ)
- Virginia Department of Environmental Quality (VA DEQ)
- Maine Department of Environmental Protection (ME DEP)
- Atlanta, GA Regional Commission
- Los Angeles County, CA - Alternate to Attachment H
- City of Portland, Oregon Bureau of Environmental Services
- North Carolina Department of Environmental Quality (NC DEQ)

Filterra® Performance Testing Results

APPLICATION TIPS

- The Filterra system has been tested under industry standard protocols and has proven its pollutant removal performance and system longevity.
- Contech invests significant resources in media blending calibration and product testing to ensure our media meets our strict performance specifications every time.
- Keep regulators and owners happy by selecting a product with predictable and proven maintenance longevity.

POLLUTANT OF CONCERN	MEDIAN REMOVAL EFFICIENCY	MEDIAN EFFLUENT CONCENTRATION (MG/L)
Total Suspended Solids (TSS)	86%	3.3
Total Phosphorus - TAPE (TP)	70%	0.05
Total Nitrogen (TN)	34%	0.54
Total Copper (TCu)	55%	0.004
Total Dissolved Copper	43%	0.003
Total Zinc (TZn)	56%	0.04
Total Dissolved Zinc	54%	0.1
Total Zinc (TZn)	56%	0.04
Total Petroleum Hydrocarbons	87%	0.71

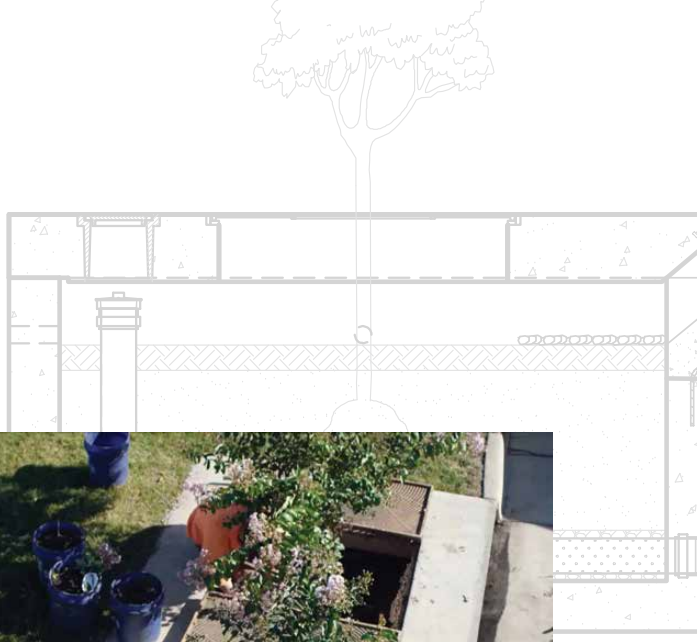
Each batch of Filterra® media has been extensively tested to ensure consistent performance every time.

Sources:
UVA (TARP) Field Study - 2006
Herrera (TAPE) Study - 2009
Herrera (TAPE) Study - 2014
NC State Study - 2015

Note: Some jurisdictions recognize higher removal rates. Contact your Contech Stormwater Consultant for performance expectations.

Field tested and performance verified

Filterra® Maintenance



Activation and first year of maintenance is included with every system.*

With proper routine maintenance, the engineered 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.

Maintenance is low-cost, low-tech and simple:

- Remove trash, sediment, and mulch
- Replace with a fresh 3" layer of mulch
- No confined space entry or special tools
- Easily performed by landscape contractor or facilities maintenance provider

** Some exclusions may apply.*

Filterra offers high performance bioretention for advanced pollutant removal with easy maintenance.

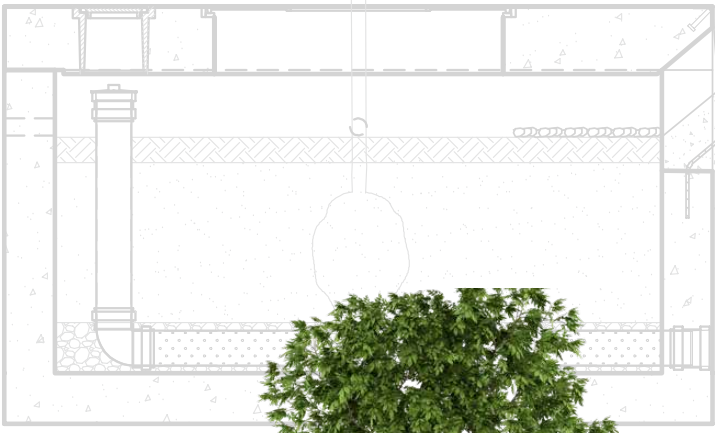
Plant health evaluation and pruning is important to encourage growth.

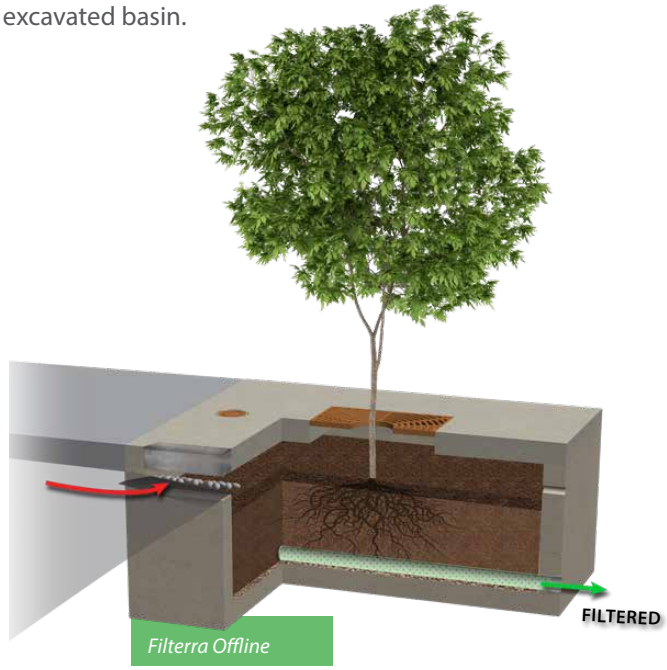
All stormwater treatment systems require maintenance for effective operation.

Filterra® Configurations

Multiple system configurations integrate with site hydraulic design and layout ...

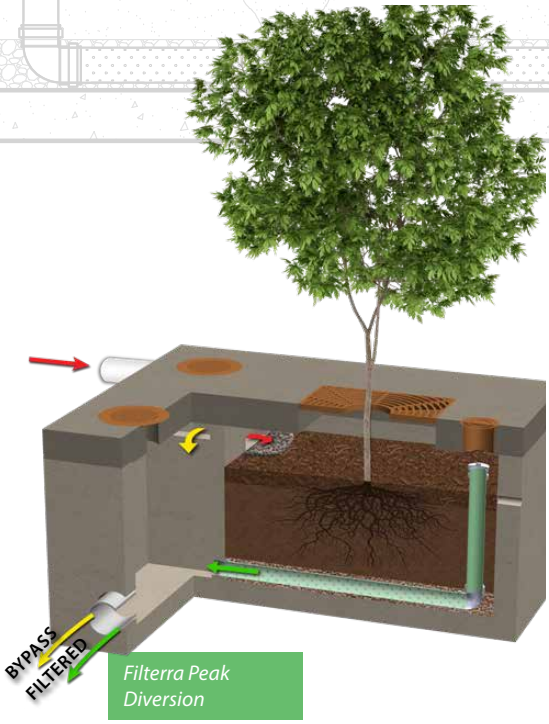
The Filterra is available in a variety of precast configurations as well as Filterra Bioscape, which can be installed directly into an excavated basin.



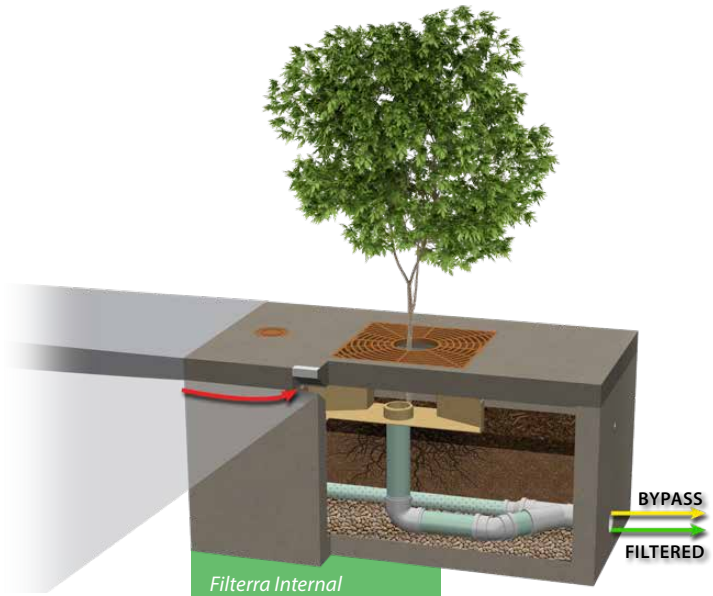


Filterra Offline

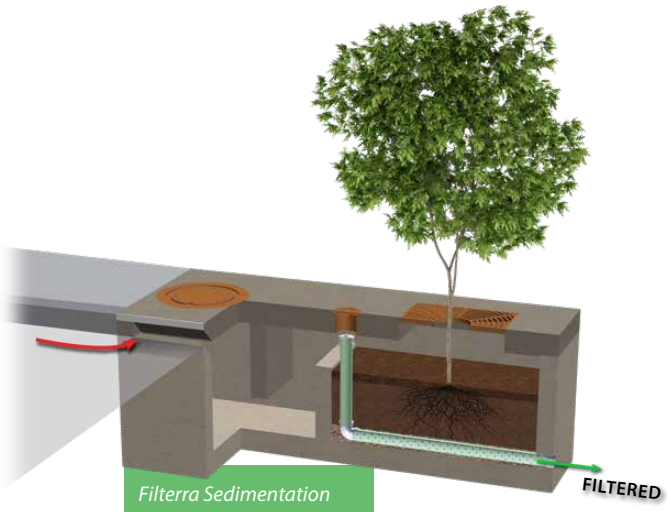
Bypass via downstream catch basin.



Filterra Peak Diversion



Filterra Internal Bypass Curb



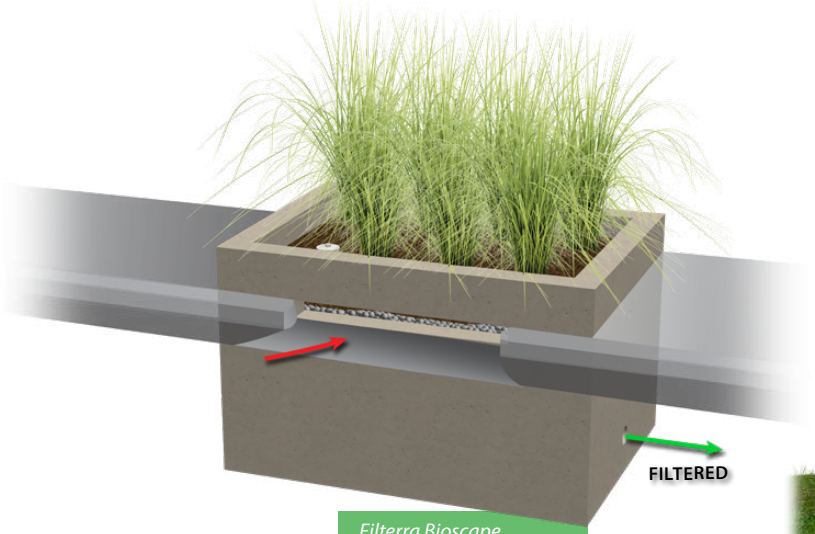
Filterra Sedimentation Chamber

Bypass via downstream catch basin.

**Additional configurations available, including offline - pipe, peak diversion - grate, and internal bypass curb-chamber.*

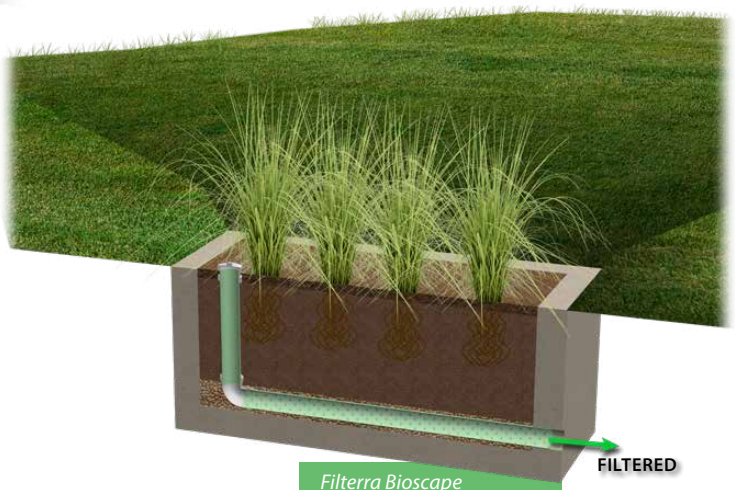
Multiple configurations allow for easy site integration

Filterra® Bioscape® Configurations



Filterra Bioscape Vault Offline

Bypass via downstream catch basin.



Filterra Bioscape Vault Basin

Bypass via upstream structure. Multiple inlet options.

Filterra Bioscape

Bypass via upstream structure. Multiple inlet options.

**Additional configurations available, including bioscape vault offline pipe.*

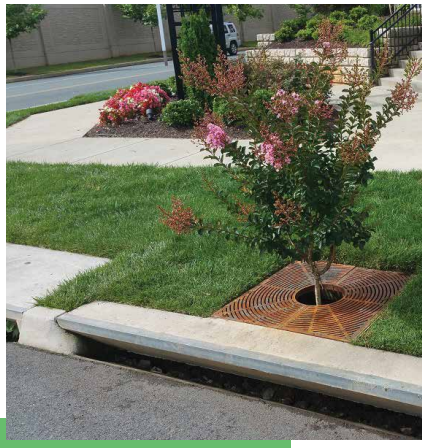
Filterra® Aesthetic Options

Multiple aesthetic options to enhance the appearance and integrate with landscaping ...

Standard Tree Grate

Custom/Decorative Tree Grate

Full Grate with Grasses



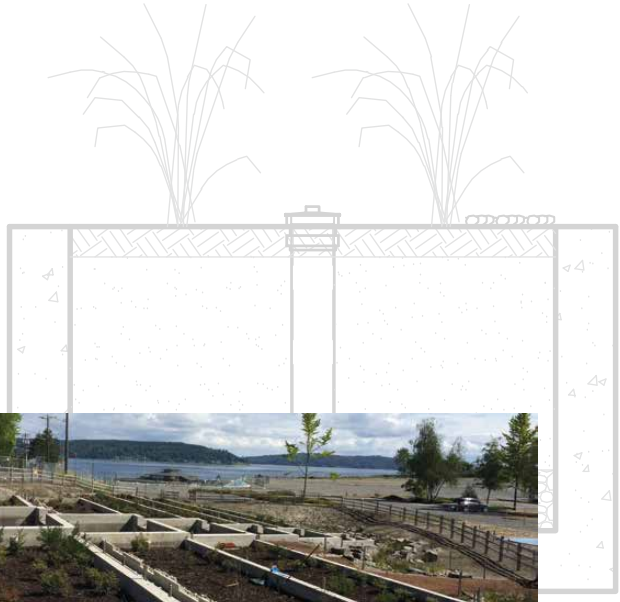
Recessed Top Slab

Open Top Planter - Filterra Bioscape

Street Tree

An aesthetic solution to meet your bioretention needs

Filterra® Bioscape®



Large-scale Filterra that can be customized to your site ...

- Ideal for Filterra systems greater than 300 square feet
- Design with or without containment structure
- Incorporate infiltration directly below the system, where required
- Combine with upstream storage or downstream infiltration
- Use as an alternative to larger regional traditional bioretention systems
- Easily add pretreatment Hydrodynamic Separator for large-scale or heavy pollutant loading applications

A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

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

THE CONTECH WAY

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

TAKE THE NEXT STEP

For more information: www.ContechES.com

CONTECH® ENGINEERED SOLUTIONS

Get social with us:

800-338-1122 | www.ContechES.com

Appendix B:

BMP Maintenance Information

Filterra Owner's Manual

filterra®

Bioretention Systems

CONTECH®

ENGINEERED SOLUTIONS

filterra®
Bioretention Systems

Table of Contents

Enclosed

Local Area Filterra Plant List

CONTECH®
ENGINEERED SOLUTIONS

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:

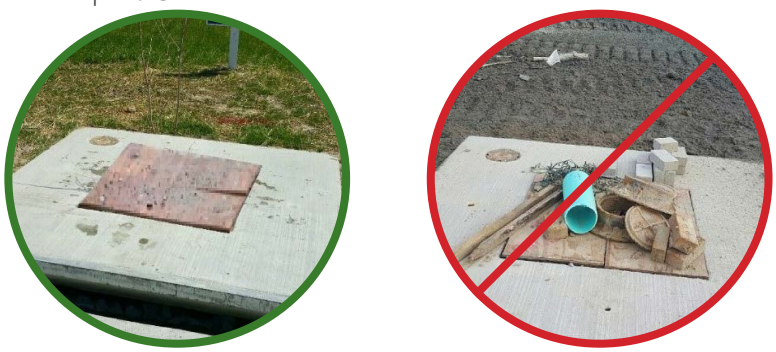
- Removal of construction runoff protection devices
- Planting of the system's vegetation
- Placement of pretreatment mulch layer using mulch certified for use in Filterra systems.

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

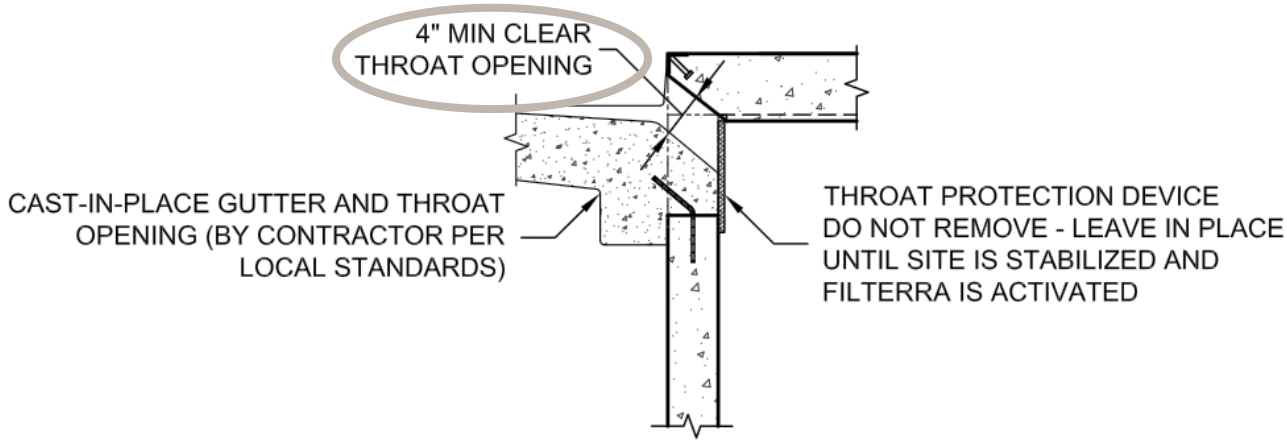
The minimum requirements for Filterra Activation are as follows:

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

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.

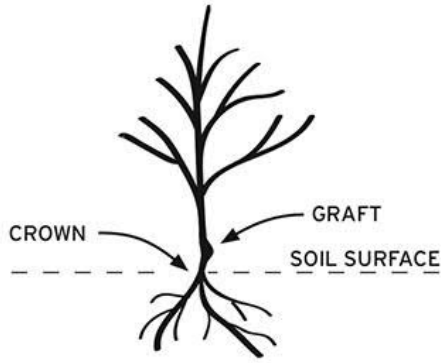
NOTE: A charge of $500.00 will be invoiced for each Activation visit requested by Customer where Contech determines that the site does not meet the conditions required for Activation. ONLY Contech authorized representatives can perform Activation of Filterra systems; unauthorized Activations will void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

9025 Centre Pointe Drive, Suite 400
West Chester, OH 45069
info@conteches.com | 800-338-1122
www.ContechES.com

Appendix C:

Geotechnical Information

Appendix D:

Hydrology Information

Hydrology and Hydraulic Technical Memorandum

Project Name:

Cannon Street & Serrano Avenue Intersection Improvement Plan

Prepared for:

City of Orange

300 E. Chapman Ave

Orange, CA 92866

(714) 744-2225

Prepared by:

Michael Baker International

5 Hutton Centre Drive, Suite 500

Santa Ana, CA 92707

(949) 472-3432

Contacts:

Mauricio M. Iacuelli

Prepared:

June 29, 2020

1.0 INTRODUCTION

The city of Orange has contracted with Michael Baker International to prepare street improvements plans. This technical memorandum describes the purpose, methodology, findings and summary of hydrology and hydraulic investigation to identify the proposed intersection improvements insignificantly impacts the site located at the intersection of Cannon Street and Serrano Avenue in the City of Orange, California.

2.0 PROJECT DESCRIPTION

The project is for street improvements to the intersection of Cannon Street & Serrano Avenue. The proposed street improvements are to include a second right turn lane along Cannon Street at the intersection of Cannon Street and Serrano Avenue. The addition of the second right turn lane will require a realignment of the current curb and gutter to accommodate the new lane. The new improvements will also include adding a new sidewalk and an ADA compliant curb ramp. This portion of the project is increasing its impervious ratio from 46.7% to 100%. The improvements along Cannon Street will also include the removal of trees and realignment of existing utilities. The improvements along Serrano Avenue will widen the northern portion of the street and realign the existing curb and gutter. This portion of the project is increasing its impervious ratio from 43.0% to 75.%. After comparing the existing and proposed improvement it will be shown that these new improvements will insignificantly change the hydraulics and hydrology and the current catch basin downstream will have no impact in the slight Q change from these improvements.

3.0 FIRM PANEL NUMBER / FLOOD PLAIN DESIGNATION

Orange County, California and Incorporated Areas - FIRM Panel: 06059C0158J.

Flood Designation: Zone X

4.0 ANALYSIS PERFORMED

"The Rational Method, Q = CIA, is used for simple hydrology studies. This method produces a peak flow rate and is only applicable to small areas. The Rational Method applies to development of small areas when no storage volume information is required, and overland flow is the primary collection method." (1986 Hydrology Manual1)

Q = CIA
where,

Q = the runoff in cubic feet per second (cfs) from a given area

C = a runoff coefficient representing the ratio of runoff to rainfall

I = the time-averaged rainfall intensity in inches per hour corresponding to the time of concentration

A = drainage area (acres)

The design calculations and worksheet is in accordance with sample calculations is based on the 1986 County of Orange Hydrology Manual for storm water flow estimation by use of the Rational Method

5.0 RESULTS OF ANALYSIS

As shown on the Drainage Map – Existing Site Conditions (Figure 1), the site was divided into two (2) areas. The acreage of each area was determined and is shown on Figure 1. The following assumptions were made to estimate runoff:

- Existing Impervious values were C-1 = 46.7% or 0.467.
  S-1 = 43.0% or 0.430.
- Proposed Impervious values were C-1 = 100% or 1.00.
  S-1 = 75.0% or 0.750.
- I_2 = 0.53 in/hr (From Table B.2 – Orange County Point Precipitation Data)
- I_{10} = 0.95 in/hr (From Table B.2 – Orange County Point Precipitation Data)
- i_{100} = 1.45 in /hr (From Table B.2 – Orange County Point Precipitation Data)
- A 2-year, 10-year and 100-year frequency storm was used to analyze the pre-developed and post developed site conditions
- The time of concentration nomongraph for initial subarea was used to figure out the time of concentrations for the 2 areas.

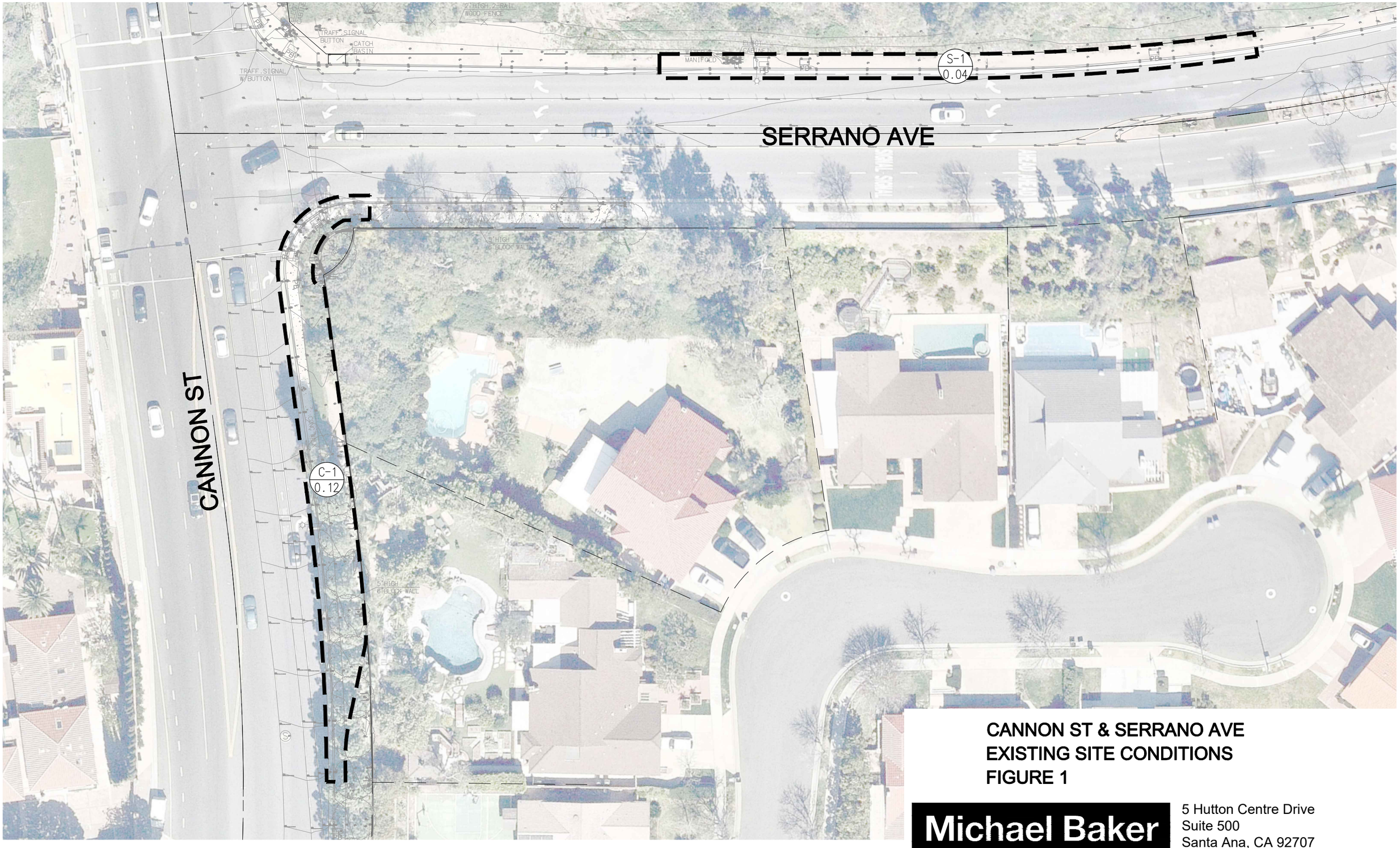
- Once the time of concentration was determined, the mean precipitation intensities were selected and used for non-mountainous areas to determine the intensity in the Q=CIA equation and to calculate the current flow rate of the subarea.

A detailed table summarizes the results from the flow (Q) results. The total peak runoff flow rate for the existing and proposed are shown below.

	Q2 (Existing)	Q10 (Existing)	Q100 (Existing)	Q2 (Proposed)	Q10 (Proposed)	Q100 (Proposed)
Area C1	0.03 CFS	0.05 CFS	0.08 CFS	0.03 CFS	0.11 CFS	0.17 CFS
Area S1	0.01 CFS	0.02 CFS	0.02 CFS	0.02 CFS	0.03 CFS	0.04 CFS

6.0 CONCLUSION

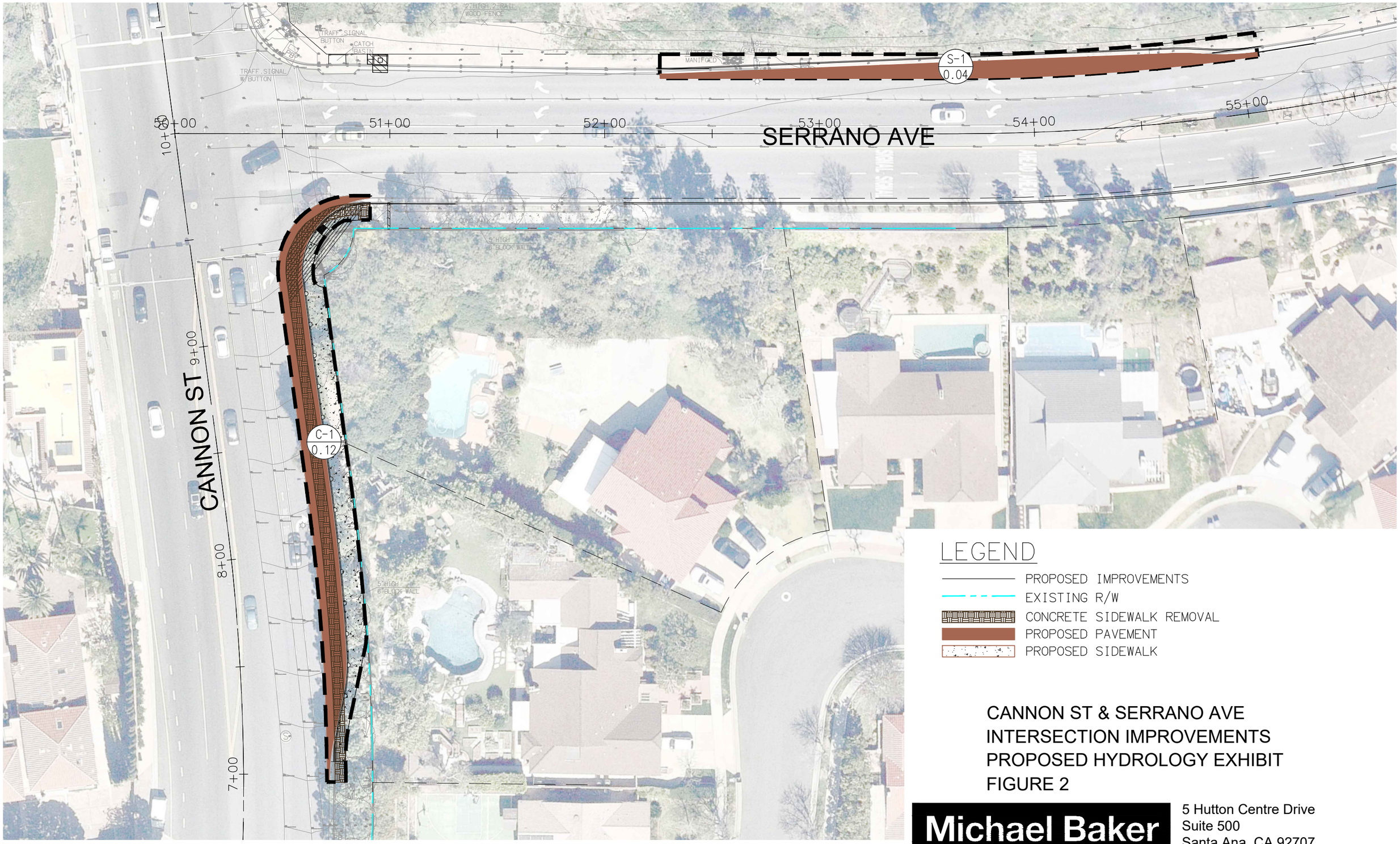
The ultimate drainage for the improvements along Cannon Street is to a catch basin just north of Santiago Creek. The Ultimate drainage for the improvement along Serrano Avenue is to a catch basin at the intersection of Cannon & Serrano. The results from the Rational method show the average Q increase for both improvements are less than a 0.1 cfs of the existing conditions which shows an insignificant change. Therefore, the proposed improvements will not affect the current hydraulics or hydrology of the existing catch basins.



CANNON ST & SERRANO AVE
EXISTING SITE CONDITIONS
FIGURE 1

Michael Baker INTERNATIONAL
5 Hutton Centre Drive
Suite 500
Santa Ana, CA 92707
Phone: (949) 472-3505
MBAKERINTL.COM

H:\PDATA\174203\CADD\TRANSPW\EXHIBITS\HYDRO\EXISTING HYDROLOGY.DWG JARED.BERNARD 6/29/20 8:02 am



LEGEND

- PROPOSED IMPROVEMENTS
- EXISTING R/W
- CONCRETE SIDEWALK REMOVAL
- PROPOSED PAVEMENT
- PROPOSED SIDEWALK

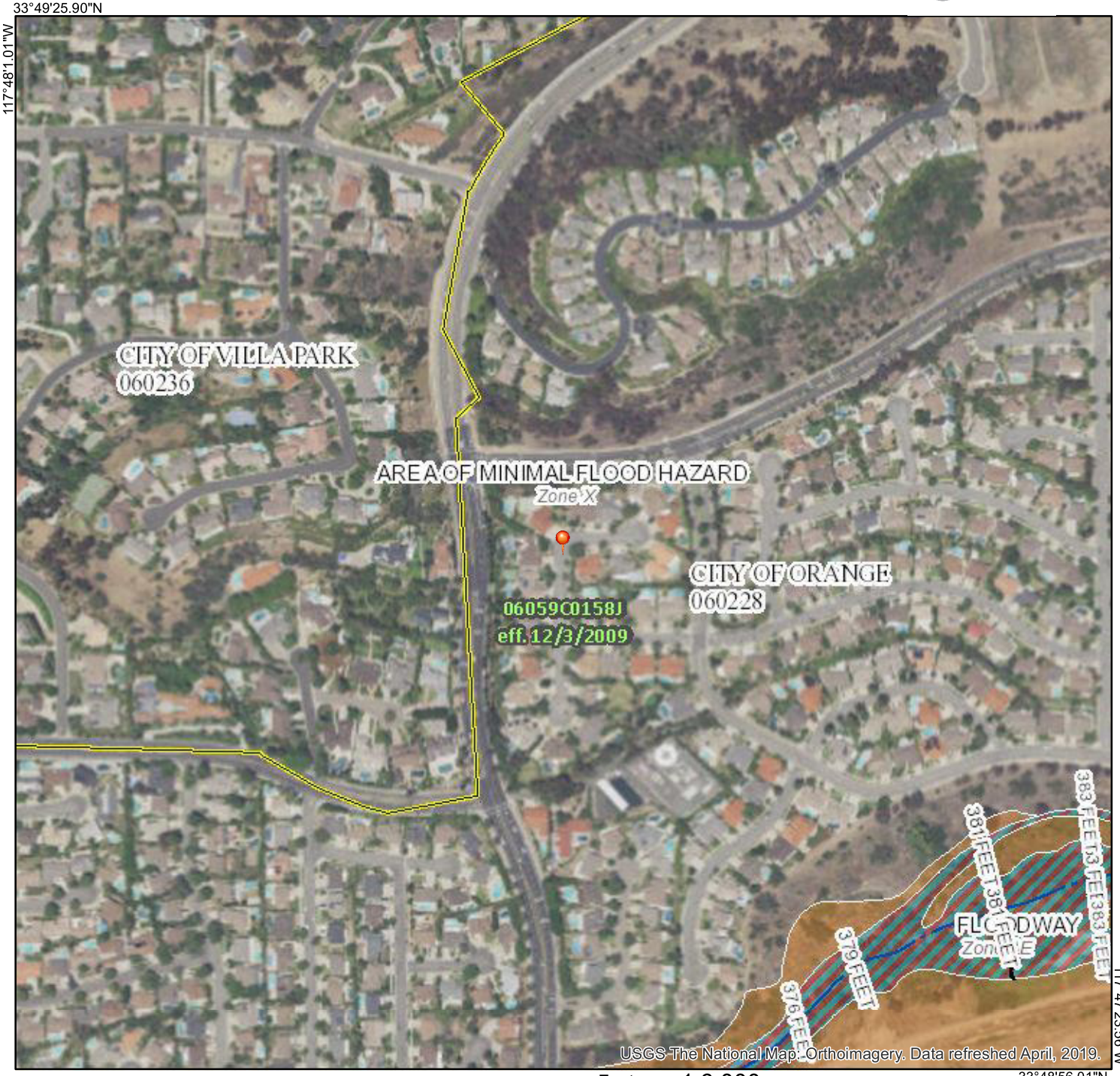
CANNON ST & SERRANO AVE INTERSECTION IMPROVEMENTS PROPOSED HYDROLOGY EXHIBIT FIGURE 2

Michael Baker INTERNATIONAL
5 Hutton Centre Drive
Suite 500
Santa Ana, CA 92707
Phone: (949) 472-3505
MBAKERINTL.COM

H:\PDATA\174203\CADD\TRANSPW\EXHIBITS\HYDRO\PROPOSED HYDROLOGY.DWG HECTOR.GUZMAN 6/24/20 2:04 pm

National Flood Hazard Layer FIRMette

FEMA



Feet
0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/2/2020 at 5:46:54 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.