Designing Filterra® Biofiltration Systems for Approval Under the LA MS4 Permit

A responsive team with local design expertise

Tamara Mamon

Stormwater Consultant – North LA

I work with you to recommend the best solution to meet permitting requirements

Alexandra (Xan) Dubrock

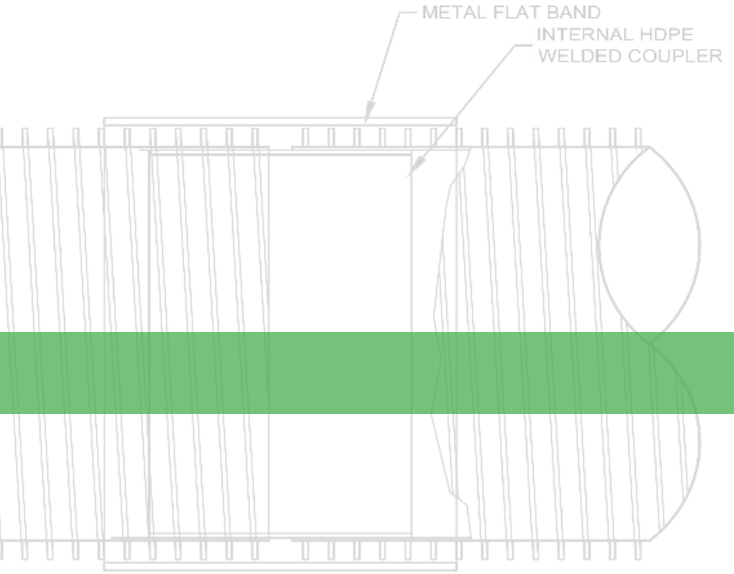
Stormwater Consultant – South LA

I work with you to recommend the best solution to meet permitting requirements

Vaikko Allen

National Regulatory Director

I understand the local regulations and what solutions will be approved



Agenda

- About Contech
- Filterra Overview
- Understand the land saving and maintenance benefits of using Filterra vs Attachment H Bioretention
- Review of Attachment H
- Define the Filterra equivalency and approval process
- Demonstrate how to size a Filterra System
- Resources

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

The Contech Way

Contech 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.

CONTECH ENGINEERED SOLUTIONS

Innovative, cost-effective site solutions across North America

TECHNICAL EXPERTISE

Provide site-specific drawings for proposals, project meetings, and submittals, helping you be more efficient with your time.

SOLUTION DEVELOPMENT

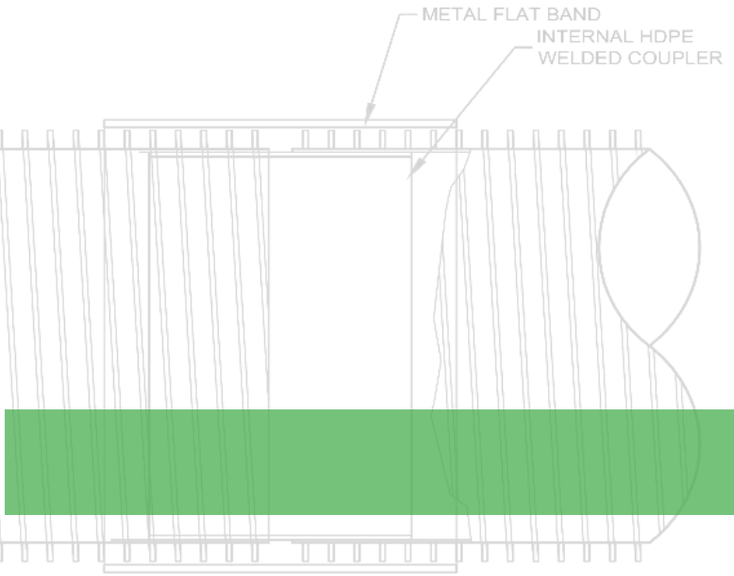
Review your requirements, weigh all options, and recommend the optimal solution to integrate with your site designs.

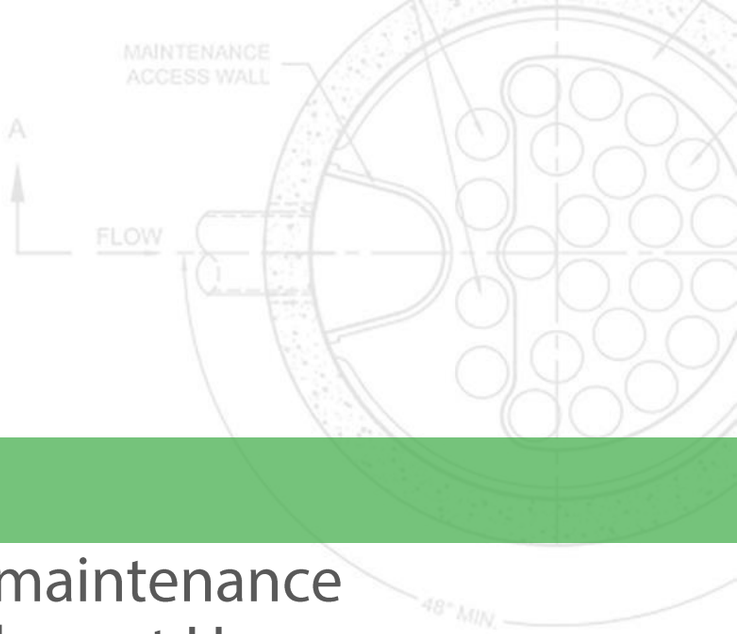
DESIGN GUIDANCE

Provide you with expert advice and assistance on local regulatory requirements, resulting in faster approvals.

INSTALLATION

Provide preconstruction meetings, delivery coordination, and on-site installation support to ensure a timely, smooth installation.





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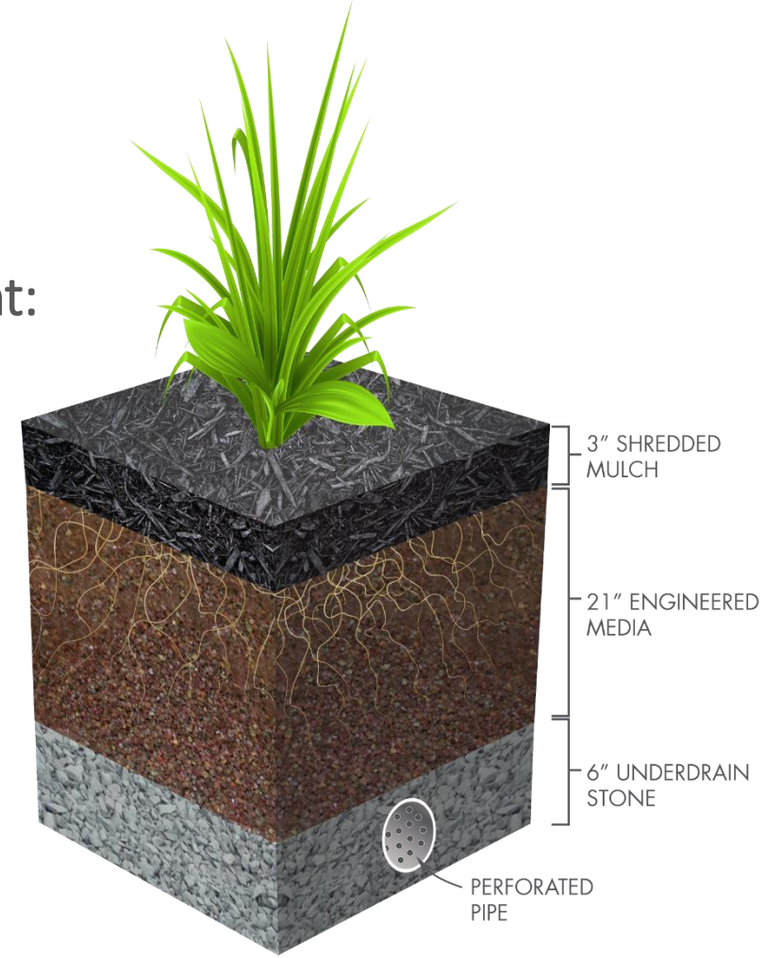
Filterra Overview

Alexandra Dubrock
Stormwater Consultant – South LA

What is Filterra? How Does it Work?

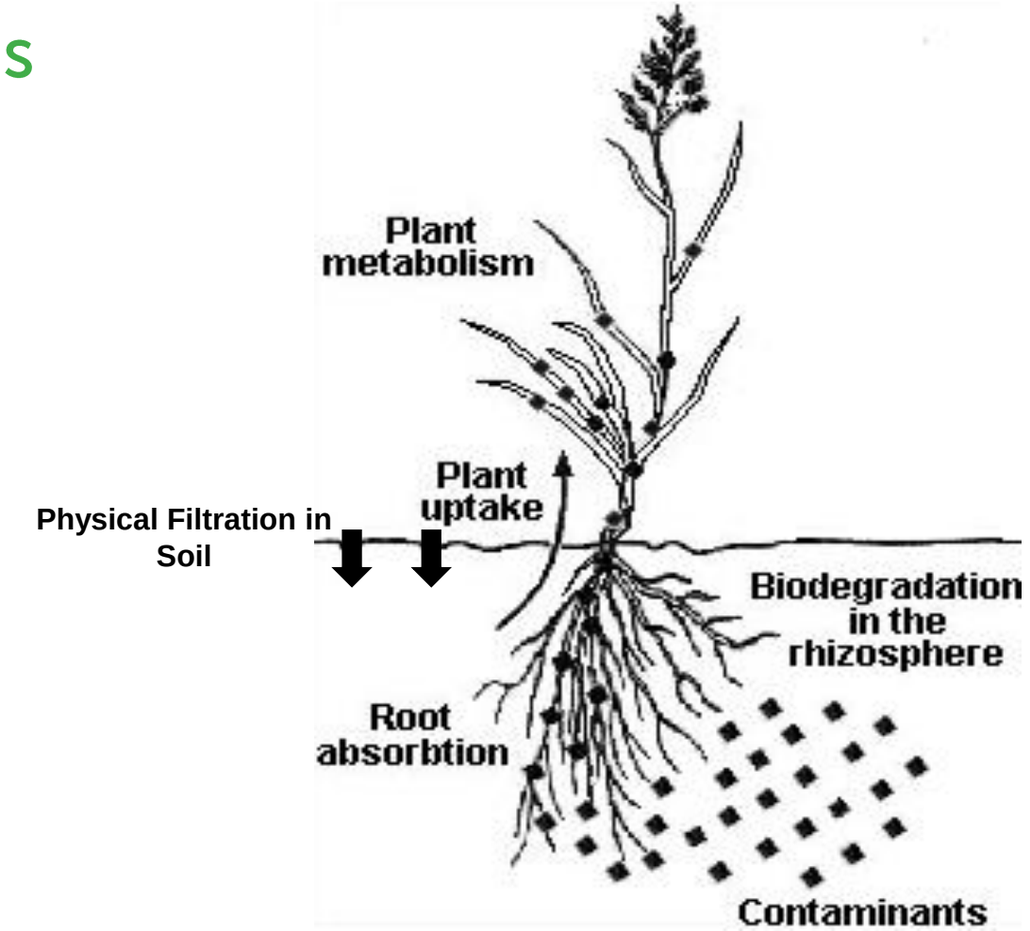
Pre-engineered and pre-packaged stormwater biofiltration treatment:

1. Pretreatment top layer (mulch)
2. Engineered high flow biofiltration Media (140”/hr)
3. Underdrain system
4. Landscape vegetation



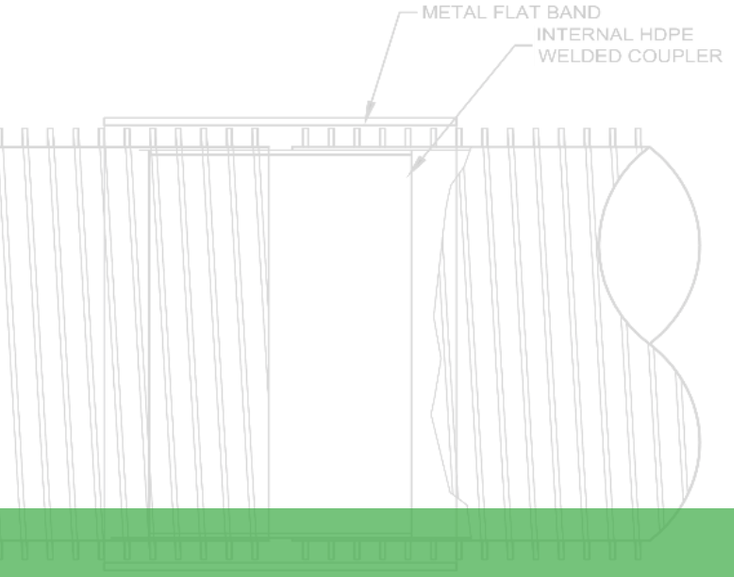
Pollutant Removal Mechanisms

- Physical/chemical processes
  - Filtration
  - Adsorption/absorption
  - Cation/anion exchange
  - Metals complexing
- Biological processes
  - Degradation/decomposition
  - Plant/bacteria uptake



Conventional Biofiltration

- Attachment H Biofilration Media flow = 5-12 in/hr
- 4-6% of contributing impervious drainage area
- Individual components designed by engineer and sourced by contractor:
  - Mulch
  - Soil
  - Stone
  - Underdrain Piping
  - Plants
- Installation by contractor
- Maintenance by landscape crew



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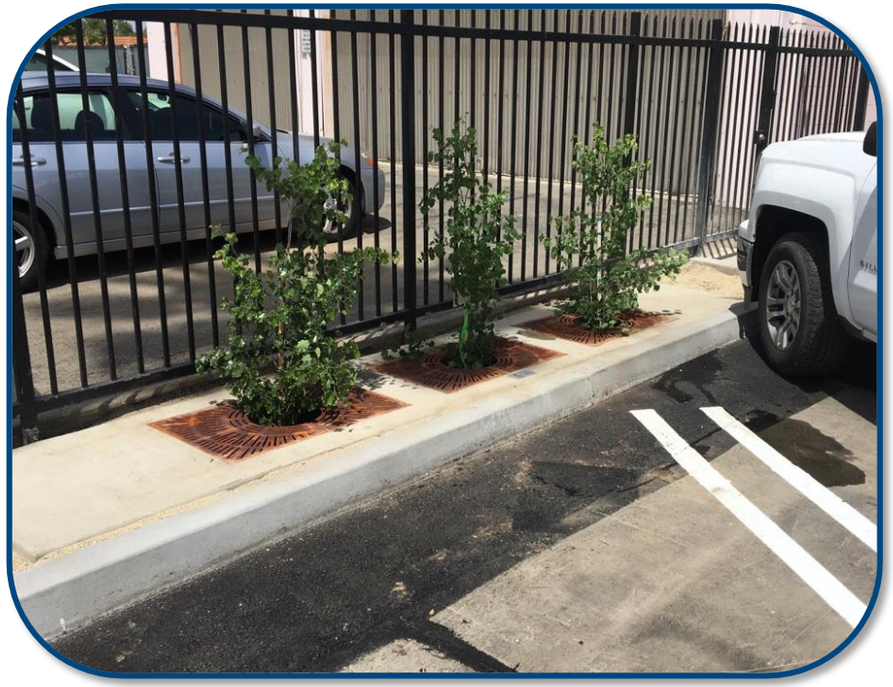
How Is Filterra Different?

- High flow rate = reduced footprint
- High pollutant removals – long term
  - Verified testing
  - Rigorous QA/QC processes
- Packaged design
  - Quality control
  - Easy installation
  - Easy maintenance

Key Benefit #1: Small Footprint

- Filterra typically less than 1% of drainage area
- Full use of land
- Ideal for urban retrofit



Key Benefit #2: Proven Performance

Pollutant	Median Removal Efficiency	Median Effluent Concentration (mg/L)	Third Party Reference Studies*
Total Suspended Solids	86%	3.3	UVA 2006, Herrera 2009, Herrera 2014, NC State 2015
Phosphorus (TAPE)	70%	0.05	Herrera 2014, NC State 2015
Nitrogen	34%	0.54	NC State 2015
Total Copper	55%	0.004	UVA 2006, Herrera 2009
Dissolved Copper	43%	0.003	Herrera 2009
Total Zinc	56%	0.04	UVA 2006, Herrera 2009, NC State 2015
Dissolved Zinc	54%	0.1	Herrera 2009
Total Petroleum Hydrocarbons	87%	0.71	Herrera 2009

*All field studies verified via third party and following nationally recognized protocols such as TAPE or TARP

<u>Media Verification and Quality Control:</u>

- Raw material qualification
- Standardized production techniques
- Longevity Testing

Key Benefit #2: Packaged System

- Stone, underdrain, and media pre-installed and protected
- One or two piece picks = quick and easy install
- Activation of system provided by Contech

Maintenance

- First year maintenance included
- Remove trash/ replace mulch twice a year
- Easy access – no confined space
- No specialized equipment

Step 1: Open grate & inspect

Step 2: Remove mulch & trash

Step 3: Add new mulch

Step 4: Sweep & replace grate

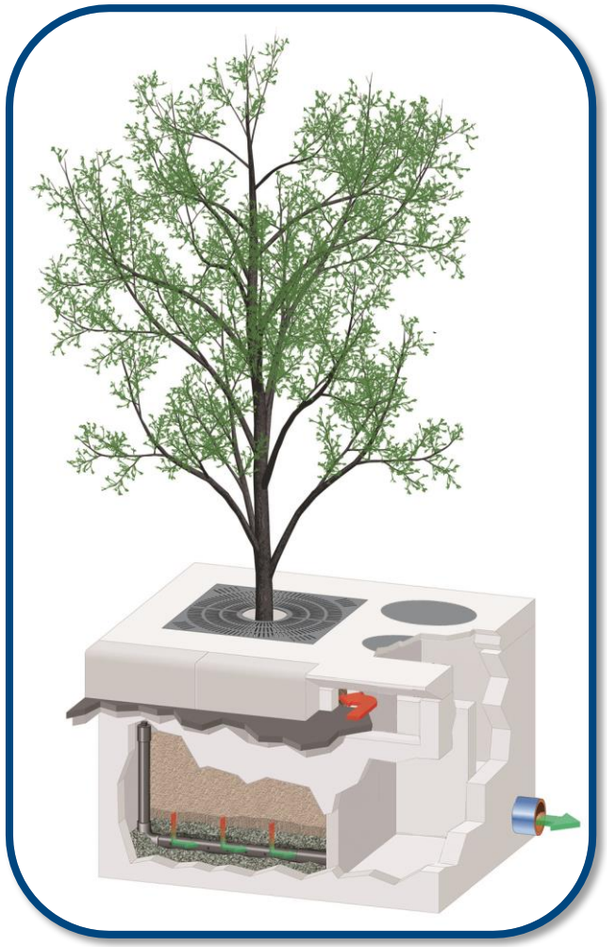
Typically About 1/2 Hour Per Visit Per Plant

(Excluding Travel)

Filterra Configurations

Filterra Offline

Filterra Internal Bypass - Curb



Filterra Peak Diversion

Filterra Internal Bypass - Pipe

Filterra Bioscape Vault

Filterra Bioscape configurations

- Filterra Bioscape
  - Filterra installed in contractor-provided basin or structure
  - Ideal for larger systems >200 sf
  - Unlimited shape designs
  - Contech provides placement of stone, pipe, media, mulch and plants at activation

Filterra Bioscape
Cross Stone Commons – Middletown, MD

Filterra Aesthetic Options

Standard Grate

Decorative Grates

Recessed Top Slab

Full Grates

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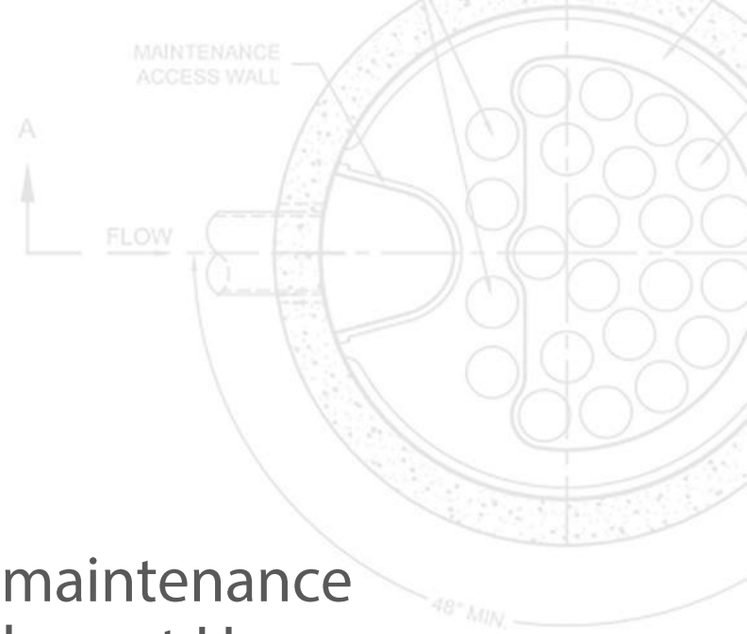
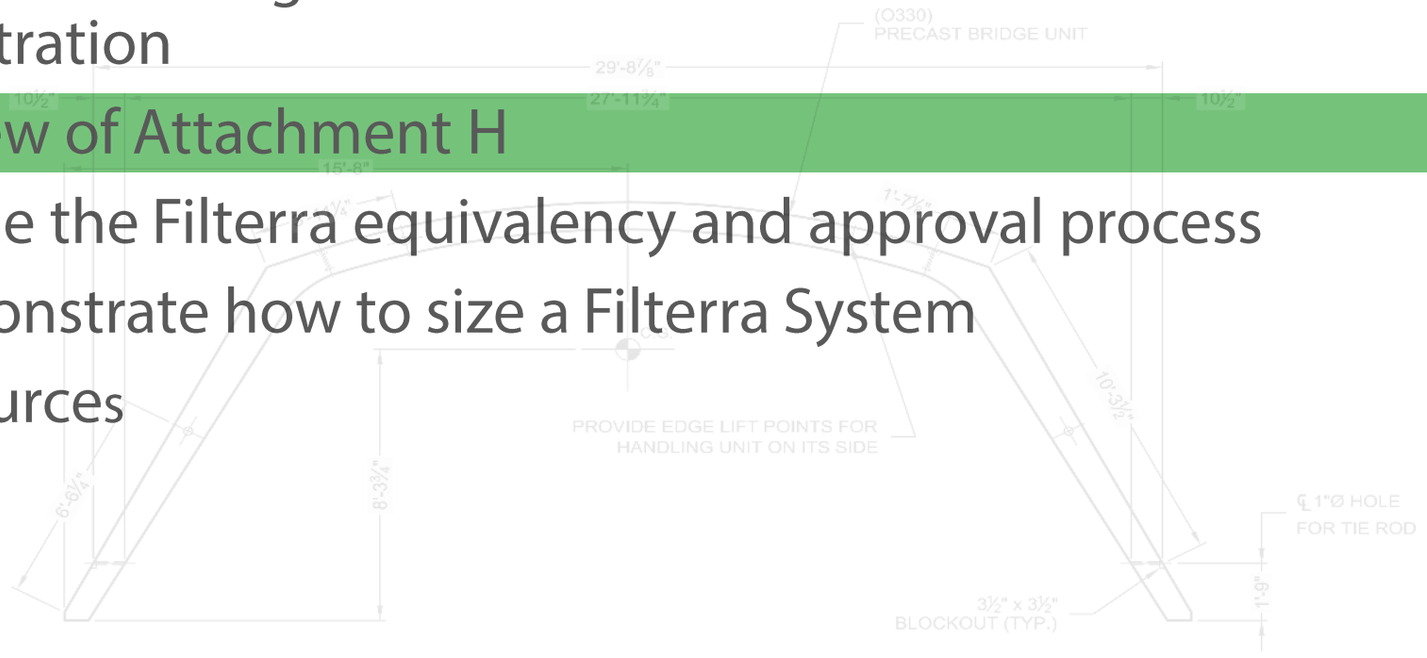




Attachment H Review, Equivalency Process & Approval Process

Vaikko Allen
National Regulatory Director

Los Angeles MS4 Permit

Order R4-2012-0175, Attachment H. Bioretention / Biofiltration Design Criteria

- Includes specific criteria (e.g., 5 to 12 in/hr media) that dictate a traditional design concept
- Specifies a 60 - 80% fine sand and 20 - 40% compost media blend similar to other west coast specifications
- States: "Bioretention and biofiltration systems shall meet the design specifications provided in Attachment H to this Order unless otherwise approved by the Regional Water Board Executive Officer"

BMP Effectiveness

- **Capture efficiency**: The percent of long term stormwater runoff volume that is "captured" and managed by the BMP (i.e., treated or reduced; not overflowed or bypassed).
- **Volume reduction**: The percent of long term stormwater runoff volume that is "lost" or "reduced" in the BMP to infiltration and evapotranspiration.
- **Concentration reduction**: For the volume that is treated and not reduced, the average difference in concentration between the influent volume and the treated effluent volume.

Traditional Biofiltration
Capture Efficiency and Volume Reduction

Site Soil Infiltration Rate, in/hr	Long Term Capture Efficiency (percent of total runoff volume)	Long Term Volume Reduction (percent of total runoff volume) (ET + Infiltration)
0	92 to 94%[1] (93% capture is representative)	4%
0.01		6%
0.05		11%
0.15		22%
0.30[2]		35%

1 - Capture efficiency varies slightly as a function of soil infiltration rate (and associated differences in design profile) and land use imperviousness. These differences are relatively minor and are considered to be less important than the variability in performance that may result from different design approaches and maintenance conditions that may be encountered. Therefore a single baseline value of 93 percent long term capture was used in this analysis.

2 - A maximum soil infiltration rate of 0.3 inches per hour was evaluated because for soil infiltration rates greater than 0.3 inches per hour the MS4 Permit requires that infiltration be evaluated.

Pollutant Treatment Equivalency

▪ Traditional Biofiltration

- International Stormwater BMP Database
  - 28 peer-reviewed studies of bioretention BMPs with underdrains
  - 16 screened to better represent Att H criteria
- Supplemental literature review
  - Four peer-reviewed research studies: SFEI, University of Maryland

• Filterra

- TARP (2004-2005): Yu and Stanford (2006)
- TARP Addendum (2006-2007): ATR Associates (2009)
- Perf. Over Time: Cal's Pizza, Jiffy Lube, Coliseum (2008-2015): Americast (2009b; 2015)
- NCDNR Fayetteville (2013-14): NCSU (2015a)
- TAPE Bellingham (2013): Herrera (2014a)
- TAPE Port of Tacoma (2009): Herrera (2009)

Pollutant Treatment Equivalency

Parameter	Traditional - Screened Data Pairs (20 studies)	Traditional - Unscreened Data Pairs (32 studies)	Filterra (6 studies)
TSS	234	354	165
Total Phosphorus	242	384	146
Total Nitrogen	71	184	34
Total Copper	190	216	112
Total Zinc	200	252	120

Performance Results

Land Use	Pollutant	Units	Median Runoff Quality	Conventional Biofiltration Effluent (Attachment H type)		Filterra® Effluent	
				Median	95th percentile UCL on Median	Median	95th percentile UCL on Median
Commercial	TSS	mg/L	53	12	13.7	4.9	5
	Total Phosphorus	mg/L	0.27	0.46	0.55	0.06	0.08
	Total Nitrogen	mg/L	2.3	1.6	2.9	1	1.6
	Copper	ug/L	22	12	15	10	10
	Zinc	ug/L	192	35	44	70	77

Equivalency report conclusion:

“Filterra are expected to provide similar or better pollutant concentration reduction for all pollutants across the representative site conditions considered”

Geosyntec Consultants. 2015. Filterra Equivalency Analysis and Design Criteria, Pursuant to: Los Angeles County MS4 Permit (Order R4-2012-0175)

Design Process for Equivalency

Part A - Characterize site and determine key attributes

Part B – Determine Filterra design intensity required to achieve equivalent capture efficiency

Part C – Compensate for volume reduction deficit

- Option 1 - Determine supplemental infiltration volume to achieve equivalent volume reduction
- Option 2 – Increase design intensity of Filterra to compensate for volume reduction deficit

Part A - Characterize Site and Determine Key Attributes

1) Delineate the tributary area to each Filterra BMP
2) Estimate the imperviousness of the tributary area
3) Calculate the time of concentration (Tc) for each Filterra tributary area
4) Estimate the long term reliable infiltration rate of the soils underlying each BMP location
5) Determine local 85th percentile, 24-hour precipitation depth for the project
6) Calculate the SWQDv for each Filterra tributary area
7) Calculate the site "Scaling Factor" as the ratio of the project-specific 85th percentile, 24-hour storm event to the LAX 85th percentile, 24-hour storm event (1.02 inches)

Part B – Provide Equivalent Capture Efficiency

Design Table 1 – Filterra Design Chart for Equivalent Long Term Capture Efficiency

Time of Concentration of Tributary Area, minutes	Filterra Design Precipitation Intensity, inches per hour[1]
5	0.41
10	0.38
15	0.36
20	0.34
30	0.32

Part C – Option 1 – Provide Equivalent Volume Reduction

Design Table 2 - Supplemental Infiltration Volume for Equivalent Long Term Volume Reduction

Estimated Long Term Reliable Infiltration Rate below Site, inches per hour	Long Term Volume Reduction Deficit, % of Long Term Runoff	Required Supplemental Infiltration Storage Volume as Fraction of Local SWQDv, unitless
0	3%	Not a feasible option; see Part C, Option 2
0.01	5%	0.15
0.05	10%	0.11
0.15	21%	0.17
0.3	34%	0.26

Part C – Option 2 – Provide Additional Capture to Compensate for Volume Reduction

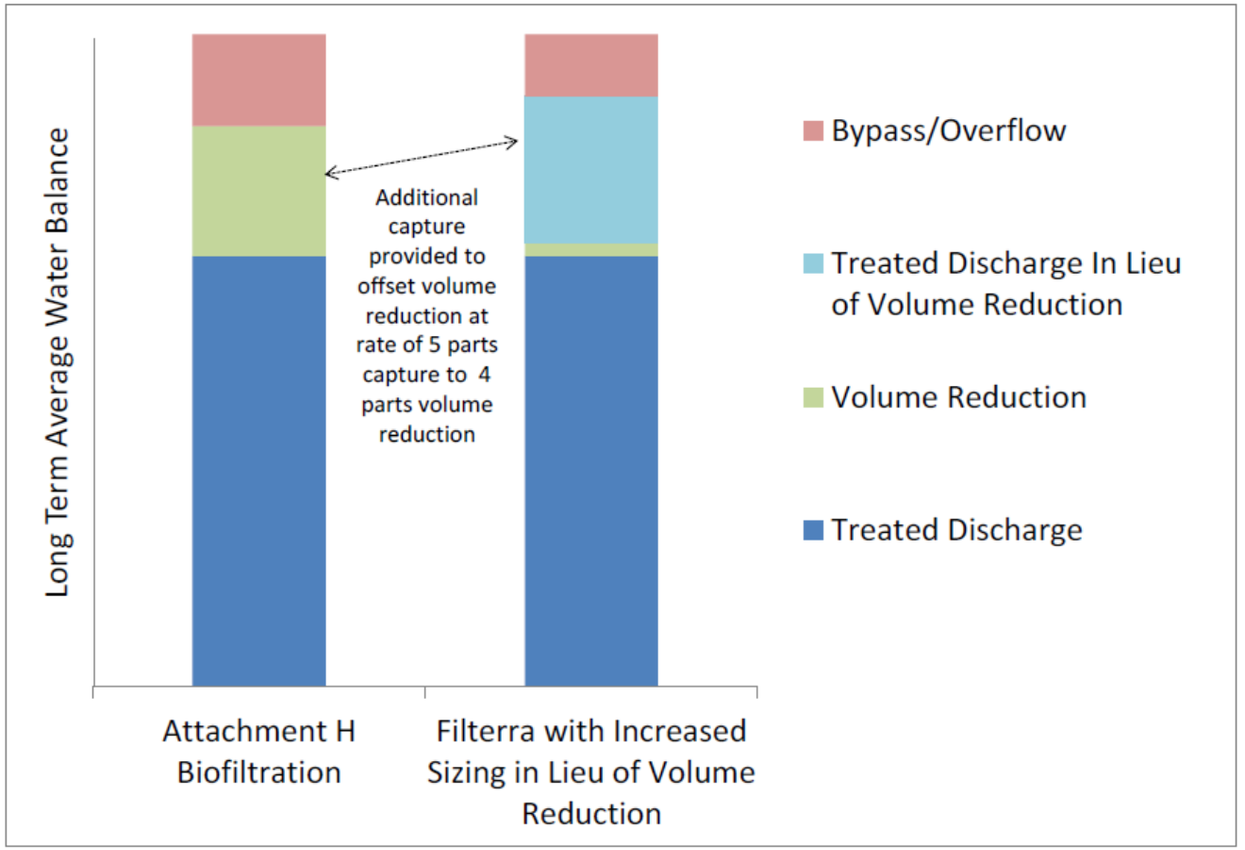


Figure 5. Illustration of Additional Capture In Lieu of Volume Reduction (Not to scale)

Part C – Option 2 – Provide Additional Capture to Compensate for Volume Reduction

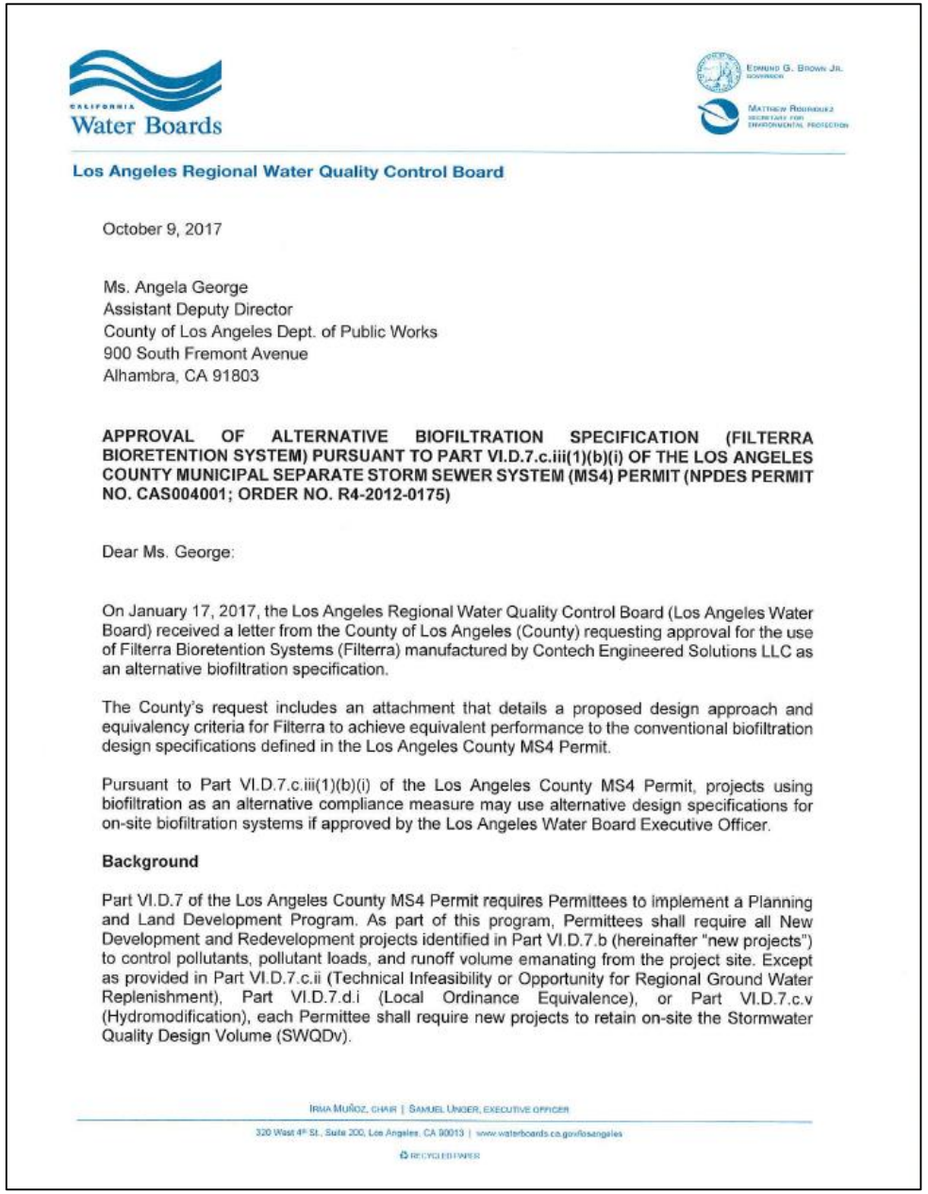
Design Table 3 – Upsizing of Filterra to Provide Additional Capture Efficiency in Lieu of Volume Reduction

Tc of Tributary Area, minutes	Site Infiltration Rate				
	0 in/hr Target Capture Efficiency = 93.8%	0.01 in/hr Capture Efficiency Target = 94.3%	0.05 in/hr Capture Efficiency Target = 95.5%	0.10 in/hr Capture Efficiency Target = 96.9%	0.15 in/hr Capture Efficiency Target = 98.3%
	Adjusted Filterra Design Precipitation Intensities, in/hr				
5	0.44	0.46	0.52	0.66	NA
10	0.41	0.43	0.48	0.58	NA
15	0.39	0.41	0.45	0.53	0.76
20	0.37	0.38	0.43	0.50	0.68
30	0.34	0.35	0.39	0.46	0.56

NA = additional capture is not a viable option to offset volume reduction in these cases.

Filterra Approval Conditions

- Size Filterra systems following Section 4 of the Geosyntec report
- Provide ongoing O&M following Contech guidance
- Filterra media is required. Substitution is not allowed.
- Consider Hydromodification requirements separately



California Water Boards

Los Angeles Regional Water Quality Control Board

October 9, 2017

Ms. Angela George
Assistant Deputy Director
County of Los Angeles Dept. of Public Works
900 South Fremont Avenue
Alhambra, CA 91803

APPROVAL OF ALTERNATIVE BIOFILTRATION SPECIFICATION (FILTERRA BIORETENTION SYSTEM) PURSUANT TO PART VI.D.7.c.iii(1)(b)(i) OF THE LOS ANGELES COUNTY MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) PERMIT (NPDES PERMIT NO. CAS004001; ORDER NO. R4-2012-0175)

Dear Ms. George:

On January 17, 2017, the Los Angeles Regional Water Quality Control Board (Los Angeles Water Board) received a letter from the County of Los Angeles (County) requesting approval for the use of Filterra Bioretention Systems (Filterra) manufactured by Contech Engineered Solutions LLC as an alternative biofiltration specification.

The County's request includes an attachment that details a proposed design approach and equivalency criteria for Filterra to achieve equivalent performance to the conventional biofiltration design specifications defined in the Los Angeles County MS4 Permit.

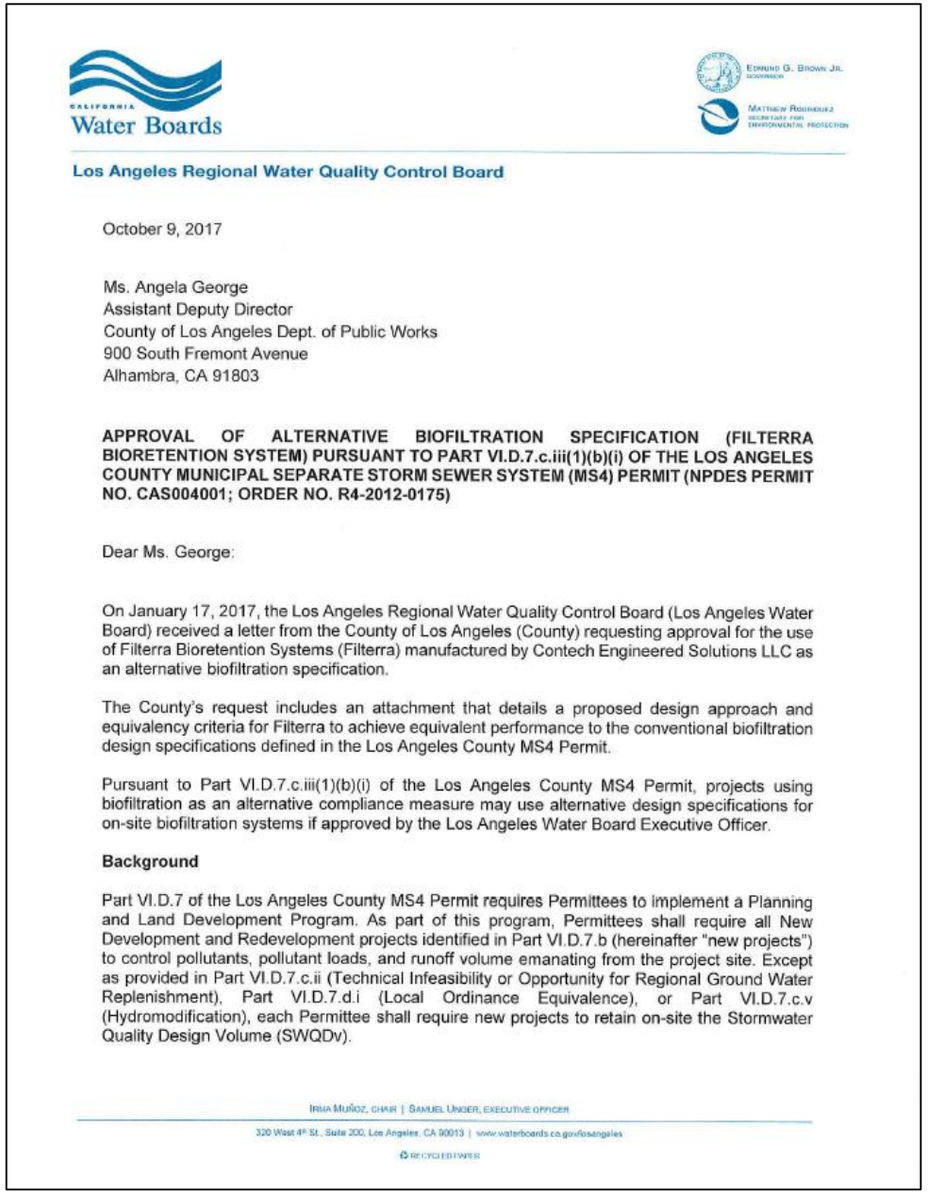
Pursuant to Part VI.D.7.c.iii(1)(b)(i) of the Los Angeles County MS4 Permit, projects using biofiltration as an alternative compliance measure may use alternative design specifications for on-site biofiltration systems if approved by the Los Angeles Water Board Executive Officer.

Background

Part VI.D.7 of the Los Angeles County MS4 Permit requires Permittees to implement a Planning and Land Development Program. As part of this program, Permittees shall require all New Development and Redevelopment projects identified in Part VI.D.7.b (hereinafter "new projects") to control pollutants, pollutant loads, and runoff volume emanating from the project site. Except as provided in Part VI.D.7.c.ii (Technical Infeasibility or Opportunity for Regional Ground Water Replenishment), Part VI.D.7.d.i (Local Ordinance Equivalence), or Part VI.D.7.c.v (Hydromodification), each Permittee shall require new projects to retain on-site the Stormwater Quality Design Volume (SWQDv).

Current Filterra Approvals

- County of Los Angeles
  - Carson
  - Irwindale
  - La Cañada Flintridge
  - Lomita
  - Rolling Hills Estate
  - Westlake Village
- City of Alhambra
- City of Compton
- City of Vernon
- City of Industry
- City of Manhattan Beach
- City of Rolling Hills



California Water Boards

Edmund G. Brown Jr., Governor
Matthew Rodriquez, Secretary for Environmental Protection

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Irma Muñoz, Chair | Samuel Unger, Executive Officer

320 West 4th St., Suite 200, Los Angeles, CA 90013 | www.waterboards.ca.gov/losangeles

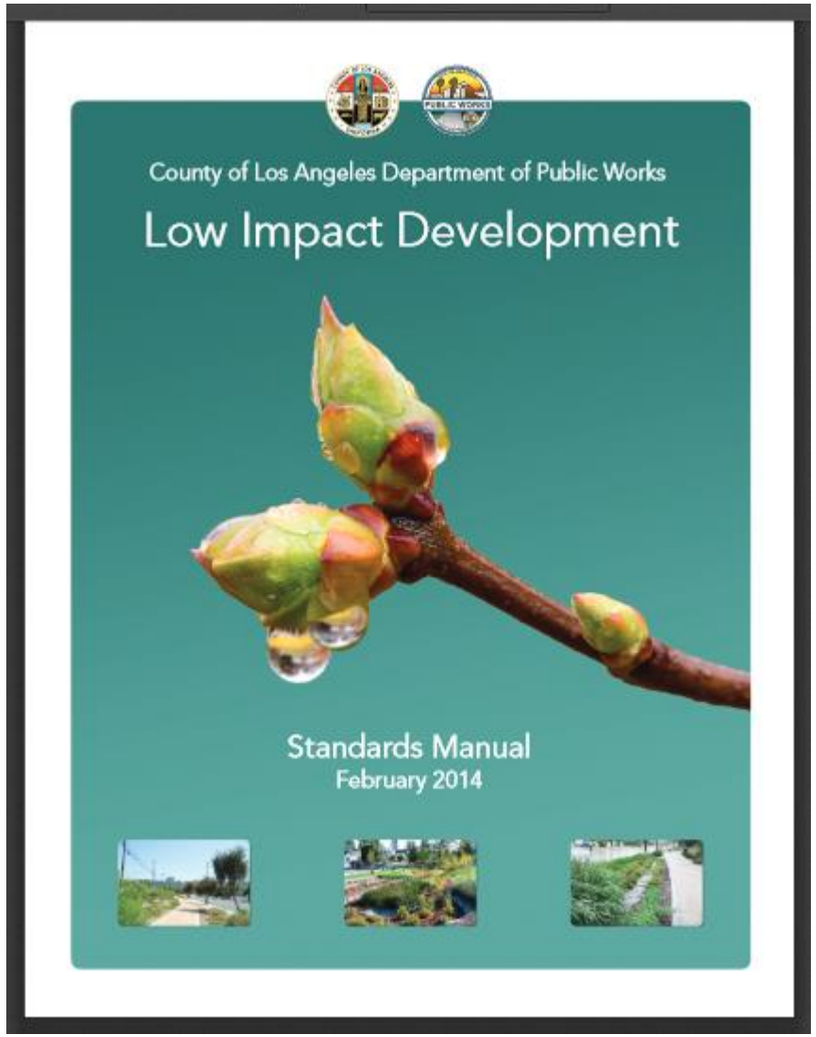
Recycled Paper

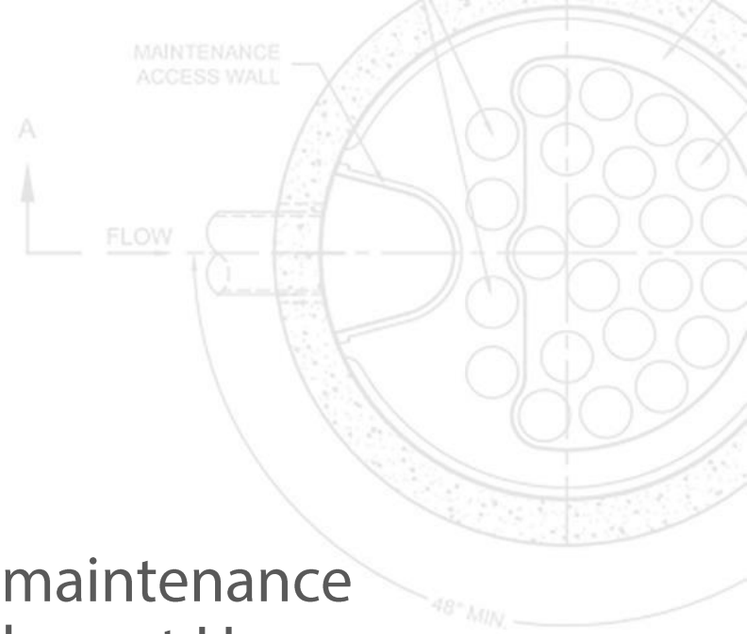
What does this approval mean for your project?

- Filterra can be approved by plan check personnel on projects reviewed by approved permittees
- Water Board application is required for projects reviewed by non-approved permittees
  - Contech can help with permittee applications
  - Turn around time for response is estimated to be 2 months
- Projects not governed by Planning and Land Development program requirements do not need Water Board approval
  - EWMP and WMP projects
  - Other municipal retrofit projects
  - Schools and federal facilities not regulated under Phase I Permit

What changes in the new MS4 permit?

- The current staff working draft eliminates Attachment H and the "alternative biofilter specification" approval process
  - "Biofiltration systems shall meet the design specifications provided in the Los Angeles County LID Manual"
    - Current LA County LID manual likely to be updated
  - Biofiltration only applicable where infiltration or rainwater harvesting is infeasible
  - Must be sized for 1.5x the portion of the SWQDv that is not retained





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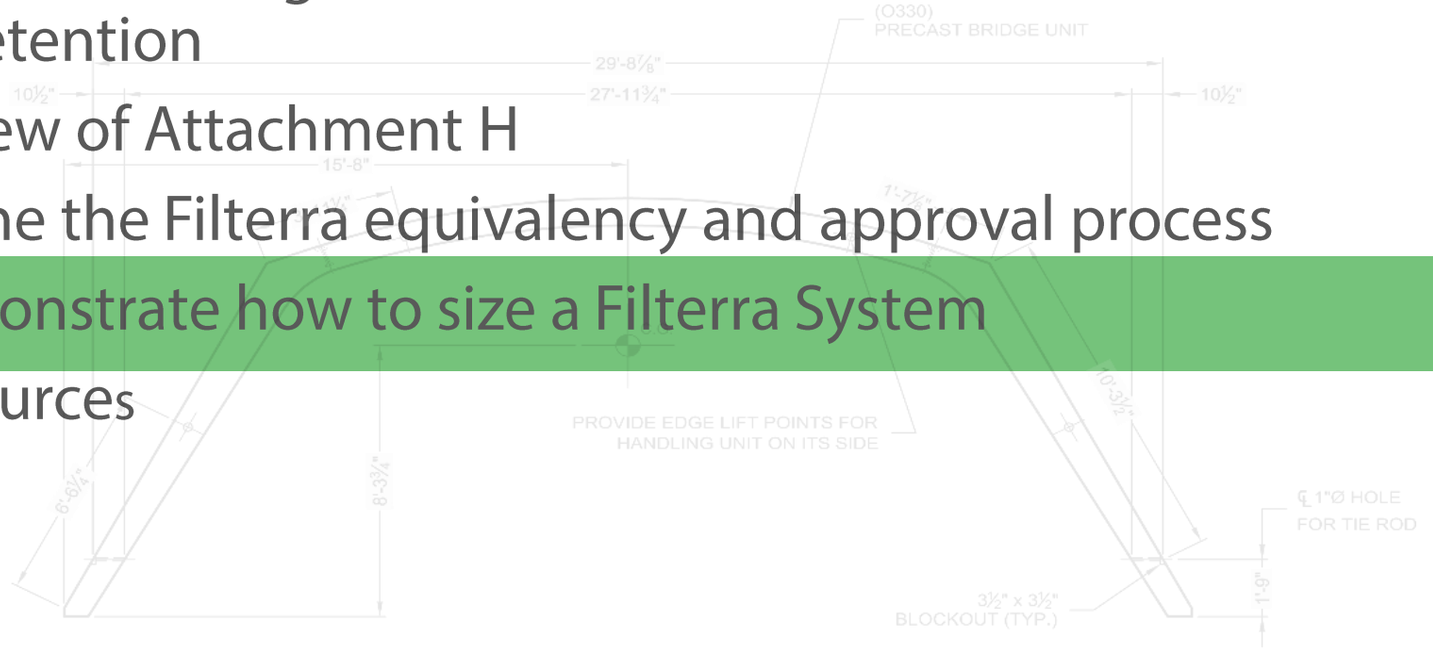


Filterra Sizing Overview

Tamara Mamon
Stormwater Consultant – North LA

Required Design Information

1. Drainage area
2. Runoff coefficient
3. Time of concentration
4. 85th percentile, 24-hr depth
5. Long term reliable infiltration rate (0 in/hr to 0.3 in/hr)

Criteria 1-4 can be found on the 85th percentile, 24 hour Hydrology Report for **EACH SUBAREA** draining to **EACH FILTERRA**

85th Percentile, 24-hr Depth

County of Los Angeles Department of Public Works

Analysis of 85th Percentile 24-hour Rainfall Depth Analysis Within the County of Los Angeles

Summary of Rain Gage Data

		24-hour Rainfall Total						
Gage No.	Gage Name	Mean	50th Percentile	75th Percentile	85th Percentile	90th Percentile	95th Percentile	99th Percentile
5	Calabasas	0.57	0.24	0.74	1.10	1.41	2.07	4.23
6	Topanga Canyon Patrol Station	0.54	0.20	0.69	1.11	1.44	2.10	4.05
13	North Hollywood - Lakeside	0.53	0.23	0.66	1.06	1.40	2.02	3.69
17	Sepulveda Canyon at Mulholland Hwy.	0.44	0.24	0.77	1.26	1.64	2.31	4.31
23	Chatsworth Reservoir	0.47	0.20	0.60	0.94	1.23	1.82	3.34
43	Palos Verdes Estates	0.26	0.13	0.34	0.52	0.67	0.94	1.67
44	Point Vicente Lighthouse	0.28	0.10	0.34	0.55	0.75	1.07	2.00
53	Colby's Sleepy Hollow Ranch	0.70	0.26	0.80	1.36	1.85	2.74	5.63
63	Santa Anita Dam	0.55	0.20	0.69	1.12	1.53	2.20	4.16
82	Table Mountain	0.51	0.23	0.57	0.96	1.26	1.91	4.11
107	Downey Fire Station	0.50	0.28	0.66	0.97	1.25	1.77	3.00
120	Vincent Patrol Station	0.30	0.16	0.39	0.60	0.79	1.13	1.67
125	San Francisquito Canyon Power House #1	0.44	0.20	0.59	0.91	1.20	1.69	3.02
128	Elizabeth Lake - Warm Springs Camp	0.66	0.34	0.90	1.35	1.63	2.32	4.16
156	La Mirada - Standard Oil Company	0.43	0.17	0.45	0.72	0.95	1.43	2.84
172	Duarte	0.66	0.35	0.88	1.32	1.67	2.34	3.77
176	Altadena - Rubio Canyon	0.60	0.25	0.76	1.20	1.61	2.28	3.95
201	Puente Hills - Alta Mira Ranch	0.58	0.30	0.78	1.12	1.40	2.03	3.38
223	Big Dalton	0.50	0.14	0.59	1.00	1.38	2.11	3.82
225	Montana Ranch - Lakewood	0.44	0.24	0.60	0.88	1.10	1.57	2.69
227	San Gabriel - Bruington - Orton	0.56	0.27	0.75	1.15	1.45	2.03	3.58
237	Stone Canyon Reservoir	0.58	0.22	0.77	1.20	1.66	2.35	3.95

Hydrologic Analysis Example

Peak Flow Hydrologic Analysis

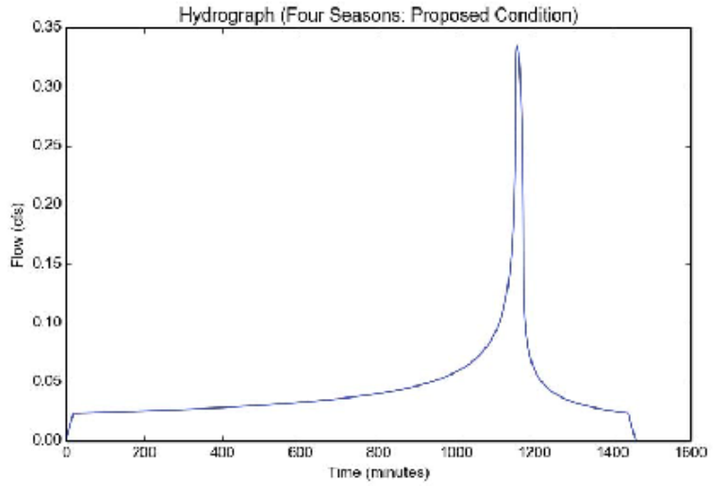
File location:
Version: HydroCalc 1.0.2

Input Parameters

Project Name	
Subarea ID	Proposed Condition
Area (ac)	1.54
Flow Path Length (ft)	280.0
Flow Path Slope (vft/hft)	0.01
85th Percentile Rainfall Depth (in)	1.05
Percent Impervious	0.688
Soil Type	28
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	1.05
Peak Intensity (in/hr)	0.3345
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.6504
Time of Concentration (min)	19.0
Clear Peak Flow Rate (cfs)	0.335
Burned Peak Flow Rate (cfs)	0.335
24-Hr Clear Runoff Volume (ac-ft)	0.0869
24-Hr Clear Runoff Volume (cu-ft)	3786.1258



Convert to sq ft by multiplying by 43,560 sq ft/ac

Long Term Reliable Infiltration Rate = 0 in/hr

Contact Information		**Project Information**	
Engineer of Record Name	Joe Engineer	Project Name	New Project
Engineer of Record Company Name	Engineering Firm A	Project Location	County of Los Angeles
Engineer of Record Office Zip Code	90017	Catchment Name	1A
Drainage Area Inputs			
Drainage Area	**67082**		ft^2
Runoff coefficient	**0.6504**		-
Time of concentration	**19**		min
Long term reliable infiltration rate	**0.00**		in/hr
85th percentile, 24-hour depth (see hyperlink below)	**1.05**		in
LA County Rainfall Depth Analysis			
Filterra Configuration (Select from Drop-Down)	**Offline**		
Refer to "Filterra Configurations" tab for descriptions and detail drawings for download.			
Constants			
LAX Airport 85th Percentile, 24-hour depth (for reference only)	1.02		in
Filterra hydraulic loading capacity	1.45		gpm/ft^2
Outputs			
Stormwater Quality Design Volume	3,818		ft^3
Design Rainfall Intensity for Equivalent Long Term Capture	0.344		in/hr
Site Scaling Factor	1.03		-
Stormwater Quality Design Flow Rate	0.36		cfs
Design Alternatives Available	**Stand Alone Filterra Permitted**		
Design Recommendations			
Primary Recommendation - Stand Alone Filterra			
Adjusted Filterra Design Intensity	0.374		in/hr
Stormwater Quality Design Flow Rate	0.39		cfs
Required Filterra Area	120		ft^2
Filterra Model ID	**FT 16x8**		
Alternative Recommendation - Filterra + Infiltration Storage			
Required Filterra Area	111		ft^2
Filterra Model ID	**FT 14x8**		
ChamberMaxx volume	0		ft^3
ChamberMaxx count	**0**		chambers

Long Term Reliable Infiltration Rate = 0.15 in/hr

Contact Information		Project Information	
Engineer of Record Name	Joe Engineer	Project Name	New Project
Engineer of Record Company Name	Engineering Firm A	Project Location	County of Los Angeles
Engineer of Record Office Zip Code	90017	Catchment Name	1A

Drainage Area Inputs		
Drainage Area	**67082**	ft^2
Runoff coefficient	**0.6504**	-
Time of concentration	**19**	min
Long term reliable infiltration rate	**0.15**	in/hr
85th percentile, 24-hour depth (see hyperlink below)	**1.05**	in
LA County Rainfall Depth Analysis		
Filterra Configuration (Select from Drop-Down)	**Offline**	

Refer to "Filterra Configurations" tab for descriptions and detail drawings for download.

Constants		
LAX Airport 85th Percentile, 24-hour depth (for reference only)	1.02	in
Filterra hydraulic loading capacity	1.45	gpm/ft^2

Outputs		
Stormwater Quality Design Volume	3,818	ft^3
Design Rainfall Intensity for Equivalent Long Term Capture	0.344	in/hr
Site Scaling Factor	1.03	-
Stormwater Quality Design Flow Rate	0.36	cfs
Design Alternatives Available	**Stand Alone Filterra Permitted**	

Design Recommendations

Primary Recommendation - Stand Alone Filterra

Adjusted Filterra Design Intensity	0.696	in/hr
Stormwater Quality Design Flow Rate	0.72	cfs
Required Filterra Area	224	ft^2
Filterra Model ID	**See Note**	

Note: Drainage area is too large for single Filterra system. Consider a different Filterra configuration, utilizing multiple structures, or utilizing Filterra Bioscape. Contact Contech for more info.

Alternative Recommendation - Filterra + Infiltration Storage

Required Filterra Area	111	ft^2
Filterra Model ID	**FT 14x8**	
ChamberMaxx volume	649	ft^3
ChamberMaxx count	**9**	chambers

Long Term Reliable Infiltration Rate = 0.3 in/hr

Contact Information		Project Information	
Engineer of Record Name	Joe Engineer	Project Name	New Project
Engineer of Record Company Name	Engineering Firm A	Project Location	County of Los Angeles
Engineer of Record Office Zip Code	90017	Catchment Name	1A

Drainage Area Inputs		
Drainage Area	67082	ft^2
Runoff coefficient	0.6504	-
Time of concentration	19	min
Long term reliable infiltration rate	0.30	in/hr
85th percentile, 24-hour depth (see hyperlink below)	1.05	in
LA County Rainfall Depth Analysis		
Filterra Configuration (Select from Drop-Down)	Offline	
Refer to "Filterra Configurations" tab for descriptions and detail drawings for download.		

Constants		
LAX Airport 85th Percentile, 24-hour depth (for reference only)	1.02	in
Filterra hydraulic loading capacity	1.45	gpm/ft^2

Outputs		
Stormwater Quality Design Volume	3,818	ft^3
Design Rainfall Intensity for Equivalent Long Term Capture	0.344	in/hr
Site Scaling Factor	1.03	-
Stormwater Quality Design Flow Rate	0.36	cfs
Design Alternatives Available	Filterra + Storage Only	

Design Recommendations		
Primary Recommendation - Stand Alone Filterra		
Adjusted Filterra Design Intensity	N/A	in/hr
Stormwater Quality Design Flow Rate	N/A	cfs
Required Filterra Area	N/A	ft^2
Filterra Model ID	N/A	

Alternative Recommendation - Filterra + Infiltration Storage		
Required Filterra Area	111	ft^2
Filterra Model ID	FT 14x8	
ChamberMaxx volume	993	ft^3
ChamberMaxx count	13	chambers

Long Term Reliable Infiltration Rate = 0 in/hr

Large Drainage Area

Drainage Area Inputs		
Drainage Area	140000	ft^2
Runoff coefficient	0.6504	-
Time of concentration	19	min
Long term reliable infiltration rate	0.00	in/hr
85th percentile, 24-hour depth (see hyperlink below)	1.05	in
LA County Rainfall Depth Analysis		
Filterra Configuration (Select from Drop-Down)	Offline	
Refer to "Filterra Configurations" tab for descriptions and detail drawings for download.		
Constants		
LAX Airport 85th Percentile, 24-hour depth (for reference only)	1.02	in
Filterra hydraulic loading capacity	1.45	gpm/ft^2
Outputs		
Stormwater Quality Design Volume	7,967	ft^3
Design Rainfall Intensity for Equivalent Long Term Capture	0.344	in/hr
Site Scaling Factor	1.03	-
Stormwater Quality Design Flow Rate	0.75	cfs
Design Alternatives Available	Stand Alone Filterra Permitted	
Design Recommendations		
Primary Recommendation - Stand Alone Filterra		
Adjusted Filterra Design Intensity	0.374	in/hr
Stormwater Quality Design Flow Rate	0.81	cfs
Required Filterra Area	251	ft^2
Filterra Model ID	See Note	
Note: Drainage area is too large for single Filterra system. Consider a different Filterra configuration, utilizing multiple structures, or utilizing Filterra Bioscape. Contact Contech for more info.		
Alternative Recommendation - Filterra + Infiltration Storage		
Required Filterra Area	231	ft^2
Filterra Model ID	See Note	
ChamberMaxx volume	0	ft^3
ChamberMaxx count	0	chambers
Note: Drainage area is too large for single Filterra system. Consider a different Filterra configuration, utilizing multiple structures, or utilizing Filterra Bioscape. Contact Contech for more info.		

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Questions?