Area A-1 (COMMUNITY LIFE CENTER)

BIO-1: Bioretention w/ Underdrain; Downspout Planter Boxes

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.8	inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, *T* (hours)	T=	5	hours
3	Using Figure III.2, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=	0.35	
4	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	-	inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	-	%
6	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency(Y_2), X_2	X_2=	-	
7	Calculate the fraction of design volume that must be provided by BMP, *fraction* = $X_1 - X_2$	fraction=	0.35	
8	Calculate the resultant design capture storm depth (inches), $d_{fraction}$= *fraction* × *d*	$d_{fraction}$=	0.28	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.61	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.9	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.825	
4	Calculate runoff volume, V_{design}= *(C x $d_{rfraction}$ x A x 43560 x (1/12))*	V_{design}=	512	cu-ft

Supporting Calculations

Provide drawdown time calculations per applicable BMP Fact Sheet:

DD = (d_p / K_{design}) x 12 in/ft
DD = Time to completely drain infiltration basin ponding depth, hours
D_p = Ponding Depth = 1 ft
K_{design} = Infiltration Rate = Assume 2.5 in/hr

DD = (1 ft / 2.5 in/hr) x 12 in/ft = 4.8 hr Round Up to 5 hr

DD = 5.0 hr
From Step 4, Design Volume = fraction of DCV, adjusted for drawdown = 512 cu-ft

To Determine the Basin Infiltration Area Needed, A = Design Volume / dp

A = 512 cu-ft / 1 ft

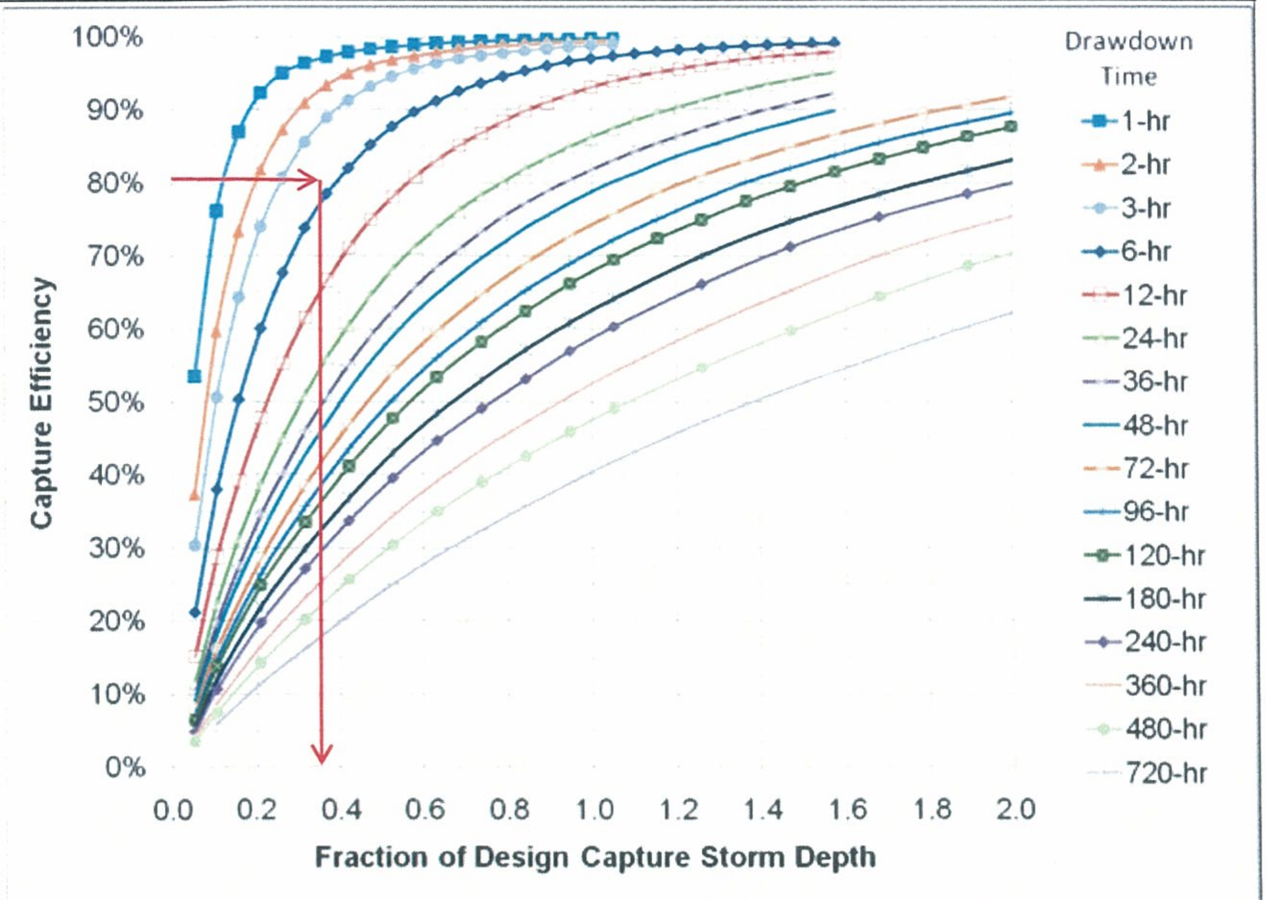
Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Area Needed = 512 square feet

A downspout planter box with underdrain will be located at the north-westerly and southerly side of the Community Life Center where the majority of the roof runoff will drain through a planter box. Footprint area of the BMP is approximately: 128 sf + 350 sf + 110 sf = **588 sf = Area Provided**

588 sf > 512 sf
$A_{provided} > A_{required}$

Graphical Operations



Provide supporting graphical operations. See Example III.6.

Area A-2 (CHRISTIAN EDUCATION BUILDING 2)

BIO-7: Proprietary Biotreatment; Filterra Roofdrain System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

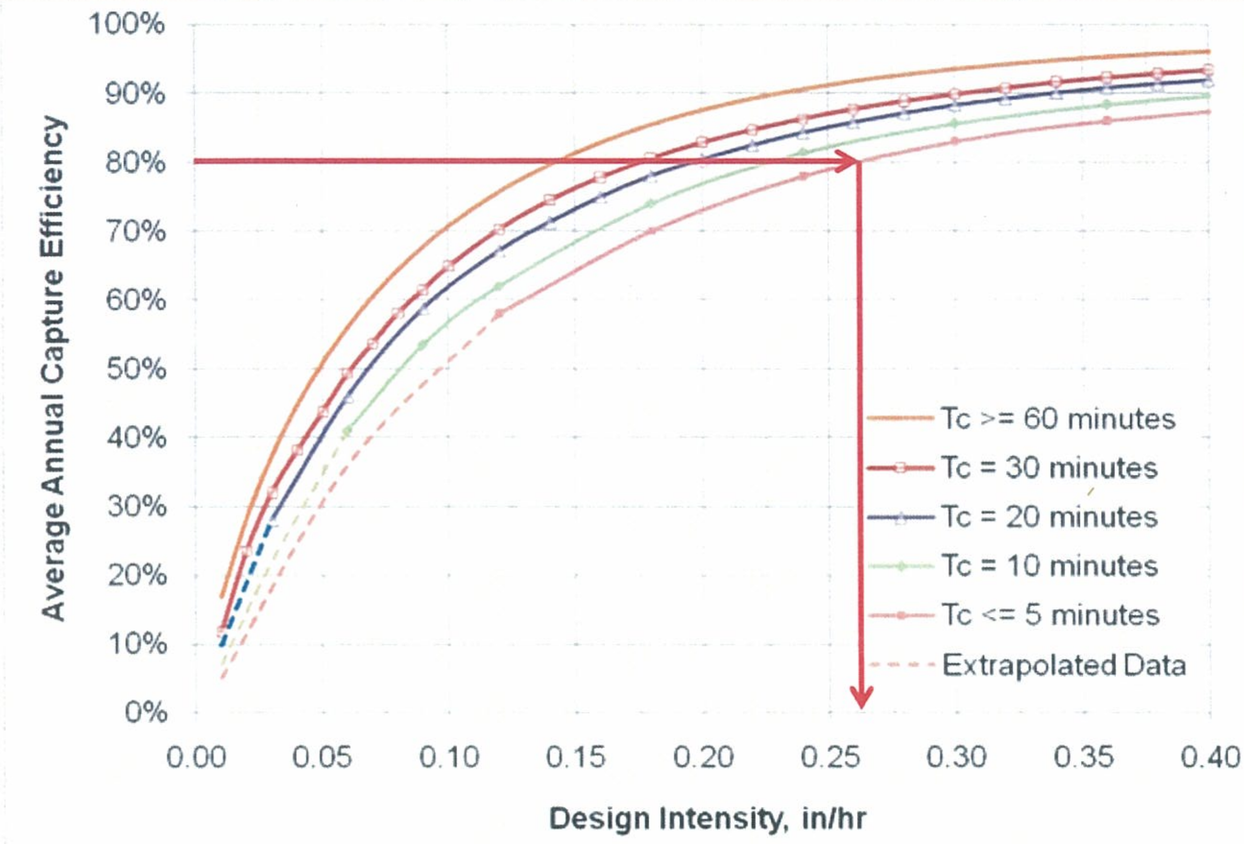
Step 1: Determine the design capture storm depth used for calculating volume				
1	*Enter the time of concentration, T_c (min) (See Appendix IV.2)*	T_c=	5	
2	*Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1*	I_1=	0.26	in/hr
3	*Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)*	d_{HSC}=	-	inches
4	*Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)*	Y_2=	-	%
5	*Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2*	I_2=	-	
6	*Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$*	I_{design}=	0.26	
Step 2: Calculate the design flowrate				
1	*Enter Project area tributary to BMP (s), A (acres)*	A=	0.26	acres
2	*Enter Project Imperviousness, imp (unitless)*	imp=	90%	
3	*Calculate runoff coefficient, C= (0.75 x imp) + 0.15*	C=	0.825	
4	*Calculate design flowrate, Q_{design}= (C x i_{design} x A)*	Q_{design}=	0.056	cfs
Supporting Calculations				
Describe system: *Filterra Bioretention Unit 4' x 6' (Treats up to 0.061 cfs)*				
Provide time of concentration assumptions: *Tc = 5 minutes per Preliminary Hydrology Report calculations.*				

Area A-2 (CHRISTIAN EDUCATION BUILDING 2)

BIO-7: Proprietary Biotreatment; Filterra Roofdrain System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Area A-3 (CHRISTIAN EDUCATION BUILDING 1)

BIO-7: Proprietary Biotreatment; Filterra Roofdrain System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

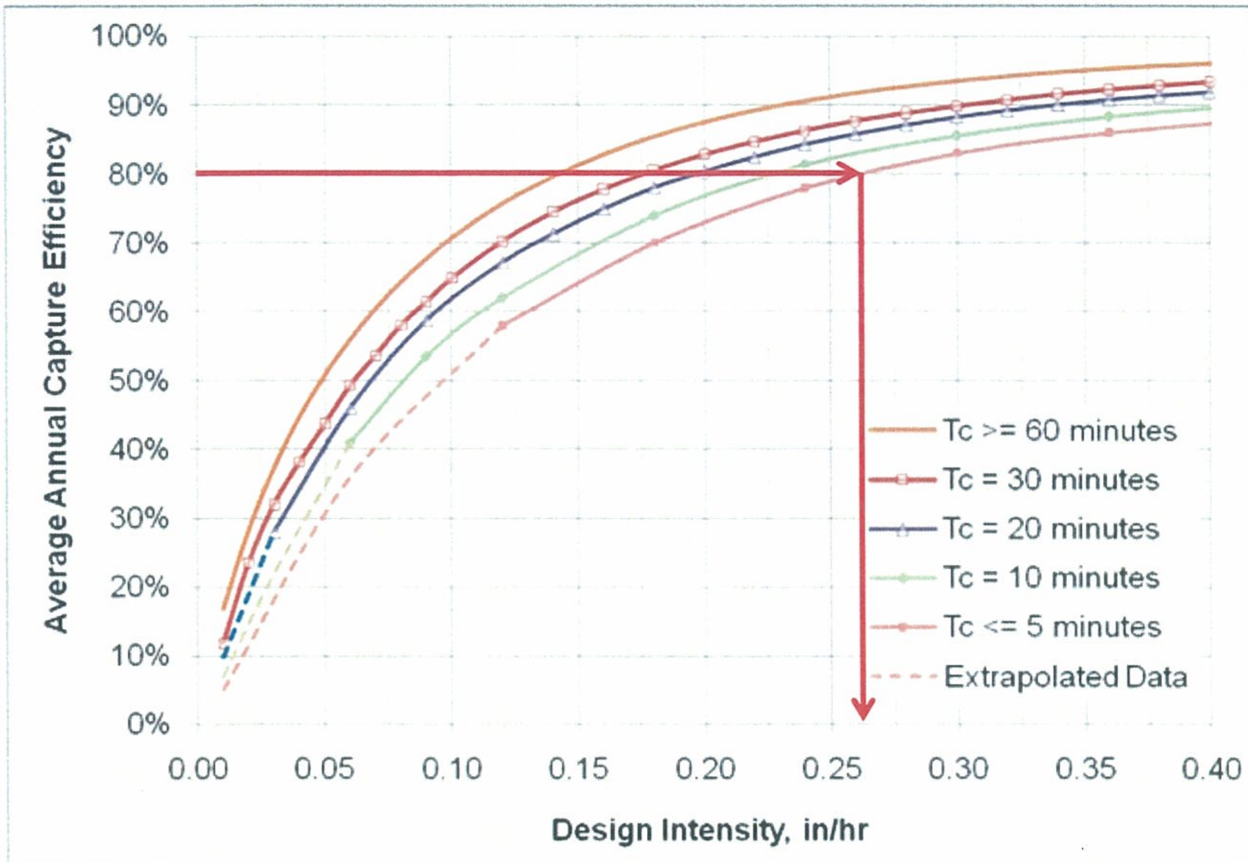
Step 1: Determine the design capture storm depth used for calculating volume				
1	*Enter the time of concentration, T_c (min) (See Appendix IV.2)*	T_c=	5	
2	*Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1*	I_1=	0.26	in/hr
3	*Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)*	d_{HSC}=	-	inches
4	*Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)*	Y_2=	-	%
5	*Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2*	I_2=	-	
6	*Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$*	I_{design}=	0.26	
Step 2: Calculate the design flowrate				
1	*Enter Project area tributary to BMP (s), A (acres)*	A=	0.26	acres
2	*Enter Project Imperviousness, imp (unitless)*	imp=	90%	
3	*Calculate runoff coefficient, C= (0.75 x imp) + 0.15*	C=	0.825	
4	*Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$*	Q_{design}=	0.056	cfs
Supporting Calculations				
Describe system: *Filterra Bioretention Unit 4' x 6' (Treats up to 0.061 cfs)*				
Provide time of concentration assumptions: *Tc = 5 minutes per Preliminary Hydrology Report calculations.*				

Area A-3 (CHRISTIAN EDUCATION BUILDING 1)

BIO-7: Proprietary Biotreatment; Filterra Roofdrain System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Area A-4

BIO-7: Proprietary Biotreatment; Filterra System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	*Enter the time of concentration, T_c (min) (See Appendix IV.2)*	T_c=	7	
2	*Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1*	I_1=	0.25	in/hr
3	*Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)*	d_{HSC}=	-	inches
4	*Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)*	Y_2=	-	%
5	*Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2*	I_2=	-	
6	*Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$*	I_{design}=	0.25	
Step 2: Calculate the design flowrate				
1	*Enter Project area tributary to BMP (s), A (acres)*	A=	0.60	acres
2	*Enter Project Imperviousness, imp (unitless)*	imp=	90%	
3	*Calculate runoff coefficient, C= (0.75 x imp) + 0.15*	C=	0.825	
4	*Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$*	Q_{design}=	0.124	cfs

Supporting Calculations

Describe system:

Filterra Bioretention Unit 6' x 10' (Treats up to 0.140 cfs)

Provide time of concentration assumptions:

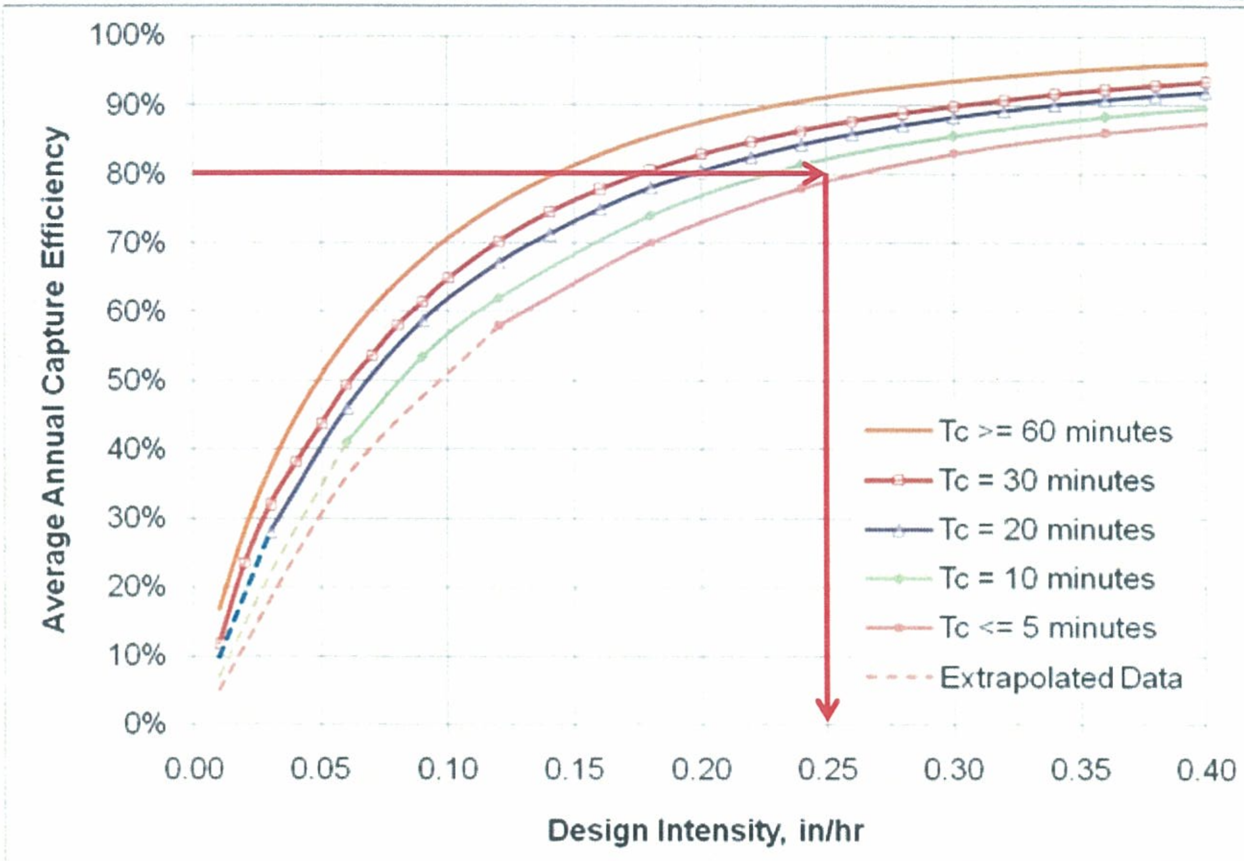
Tc = 7 minutes per Preliminary Hydrology Report calculations.

Area A-4

BIO-7: Proprietary Biotreatment; Filterra System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Area A-5(NORTHERLY PARKING DECK)

Worksheet A: Hydrologic Source Control Calculation Form

Drainage area ID	***A-5***	
Total drainage area	0.5	acres
Total drainage area Impervious Area (IA_{total})	0.4	acres

HSC ID	HSC Type/ Description/ Reference BMP Fact Sheet	Effect of individual HSC_i per criteria in BMP Fact Sheets (XIV.1) $(d_{HSCi})^1$	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
A-5	HCS-2: Impervious Area Dispersion; 0.25 Ratio	0.15"	0.4	0.06
Box 1:		$\sum d_i \times IA_i =$		.06
Box 2:		$IA_{total} =$		.4
[Box 1]/[Box 2]:		$d_{HSC\ total} =$		0.15
		Percent Capture Provided by HSCs (Table III.1)		28.5%

1 - For HSCs meeting criteria to be considered self-retaining, enter the DCV for the project.

Area A-5 (NORTHERLY PARKING DECK)

BIO-2: Vegetated Swale; Biofiltration Swale

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	*Enter the time of concentration, T_c (min) (See Appendix IV.2)*	T_c=	5	
2	*Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1*	I_1=	0.26	in/hr
3	*Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)*	d_{HSC}=	0.15	inches
4	*Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)*	Y_2=	28.5	%
5	*Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2*	I_2=	.04	
6	*Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$*	I_{design}=	0.22	
Step 2: Calculate the design flowrate				
1	*Enter Project area tributary to BMP (s), A (acres)*	A=	0.5	acres
2	*Enter Project Imperviousness, imp (unitless)*	imp=	80%	
3	*Calculate runoff coefficient, C= (0.75 x imp) + 0.15*	C=	0.75	
4	*Calculate design flowrate, Q_{design}= (C x i_{design} x A)*	Q_{design}=	0.0825	cfs
Supporting Calculations				

Area A-5 (NORTHERLY PARKING DECK)

BIO-2: Vegetated Swale; Biofiltration Swale

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

SIZING METHOD FOR VEGETATED SWALES (TGD APPENDIX XIV-55)

Step 1: Determine Design Flowrate (Q)

From Above, Q_{design} = 0.0825 cfs

Step 2: Estimate the Swale Bottom Width

Assume bottom width, b = 3.0'

Calculate design flow depth using assumed bottom width:

$Y = ((Q \times n_{WQ}) / (1.49 \times b \times s^{0.5}))^{0.6}$

Where,

Q = design flowrate, cfs

n_{WQ} = Manning's roughness coefficient for shallow flow conditions, 0.3 assumed for vegetated swale

b = estimated swale bottom width, ft

s = longitudinal slope in flow direction, ft/ft

$Y = ((0.0825 \text{ cfs} \times 0.3) / (1.49 \times 3' \times 0.03125^{0.5}))^{0.6}$

Y = 0.098'

Step 3: Determine Design Flow Velocity

$V_{WQ} = Q / A_{WQ}$

Where,

V_{WQ} = design flow velocity, fps

Q = design flowrate, cfs

$A_{WQ} = by + Zy^2$, cross sectional area of flow at design depth

$V_{WQ} = 0.0825 \text{ cfs} / (3' \times 0.098' + 3 \times 0.098^2)$

V_{WQ} = 0.256 fps < 1.0 fps ∴ velocity meets design parameters

Step 4: Calculate Swale Length

$L = 60 \times t_{HR} \times V_{WQ}$

Where,

L = swale length, ft

t_{HR} = hydraulic residence time, min (minimum 10 minutes)

V_{WQ} = design flow velocity, fps

L = 60 x 10 min. x x 0.256 fps

L = 153.6 ft minimum

$L_{provided}$ = 155' > 153.6'

Provide time of concentration assumptions:

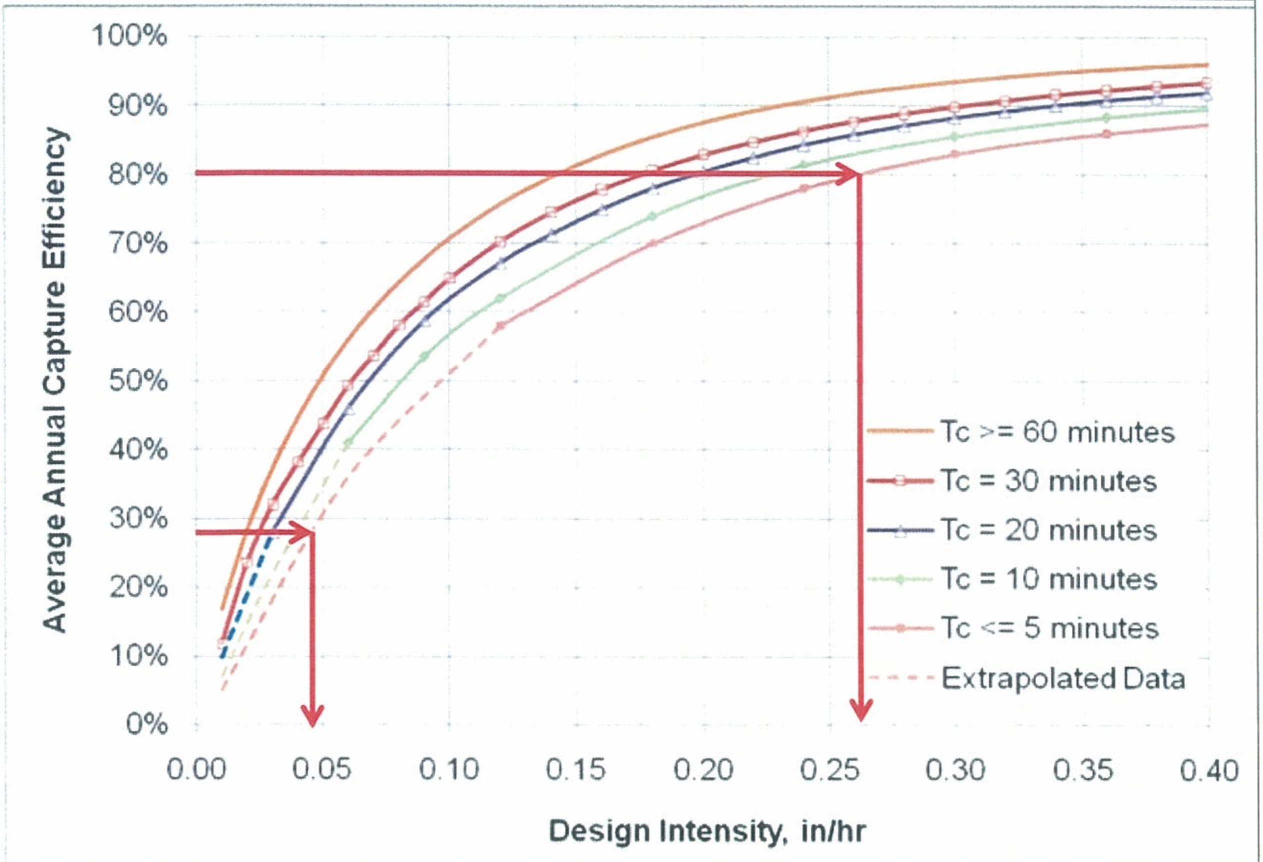
Tc = 5 minutes per Preliminary Hydrology Report calculations.

Area A-5 (NORTHERLY PARKING DECK)

BIO-2: Vegetated Swale; Biofiltration Swale

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Area A-6 (SOUTHERLY PARKING DECK)

BIO-1: BIORETENTION W/ UNDERDRAIN; STORM WATER PLANTER IN TREATMENT TRAIN WITH FILTERRA CATCH BASIN

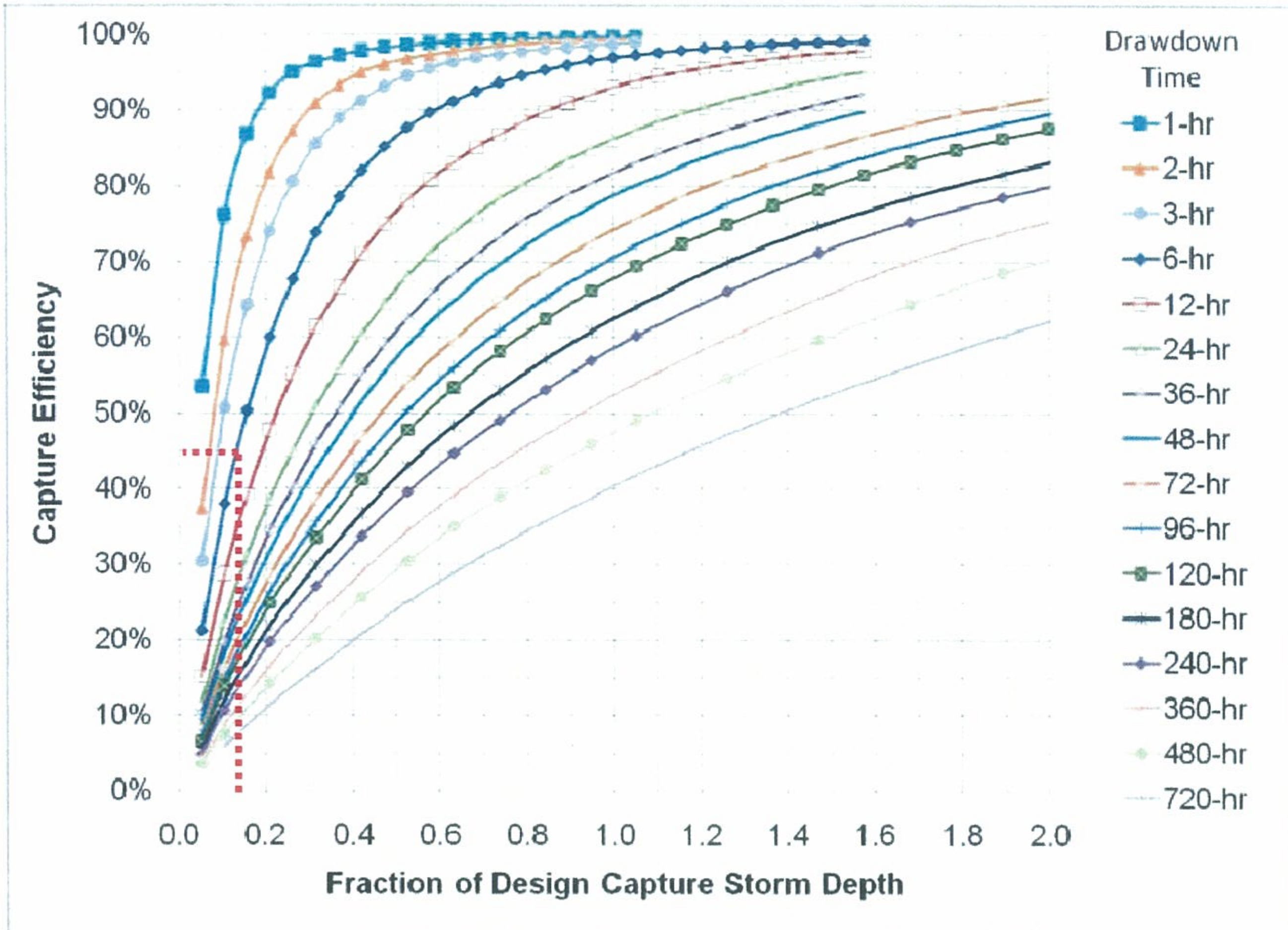
Worksheet E: Determining Capture Efficiency of Volume Based, Constant Drawdown BMP based on Design Volume

Storm Water Planters

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.80	inches
2	Enter the storage volume provided in the BMP, *V* (cu-ft)	V=	300	cu-ft
3	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.99	acres
4	Enter Project Imperviousness, *imp* (unitless)	imp=	90%	
5	Calculate runoff coefficient, $C= (0.75 \times imp) + 0.15$	C=	0.825	
6	Calculate the effective design storm depth provided (inches), $d_{provided}=(V \times 12)/(C \times A \times 43560)$	$d_{provided}$=	0.101	inches
7	Calculate the design storm depth as a fraction of the design capture depth, $X_{fraction} = d_{provided}/d$	$X_{fraction}$=	0.126	
Step 2: Calculate the capture efficiency of the BMP system				
1	Determine the drawdown time of the proposed BMP based on equations provided in the applicable BMP Fact Sheet, *T* (hours)	T=	5	hours
2	Enter the effect of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	--	inches
3	Enter capture efficiency corresponding to d_{HSC} from Table 6.7 (regionally based), Y_1 (Worksheet A)	Y_1=	--	%
4	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the upstream capture efficiency(Y_1), X_1	X_1=	--	
5	Determine the fraction of design capture storm depth corresponding to the cumulative capture efficiency, $X_2=X_1+X_{fraction}$	X_2=	0.126	
6	Using Figure III.2, determine the capture efficiency corresponding to total fraction of design storm depth (X_2) for drawdown time (T), Y_2	Y_2=	45	%
Supporting Calculations				

Describe system:
Storm Water Planters, 12" ponding depths, combined area of 300 ft² *Treats 300 ft² in accordance with Fact Sheet BIO-1 for Capture Efficiency Method* $dprovided = \frac{V\ (ft3) \times 12\ in/ft}{C \times A\ (ac) \times 43{,}560\ ft2/ac} = \frac{300 \times 12}{0.825 \times 0.99 \times 43{,}560} = 0.101$
Provide drawdown calculations per equations in applicable BMP Fact Sheet: *12" ponding depth, per Fact Sheet BIO-1* $Drawdown\ Time\ (hr) = \frac{1\ ft}{2.5\ in/hr} \times 12 \frac{in}{ft} = 4.8\ hours\ (rounded\ up\ to\ 5)$
Graphical Operations

Figure III.2. Capture Efficiency Nomograph for Constant Drawdown Systems in Orange County



Use this graph to provide the supporting graphical operations. See Example III.8.

Area A-6 (SOUTHERLY PARKING DECK)

BIO-7: Proprietary Biotreatment; Filterra System in treatment train with Storm Water Planter (provides 45% capture efficiency)

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

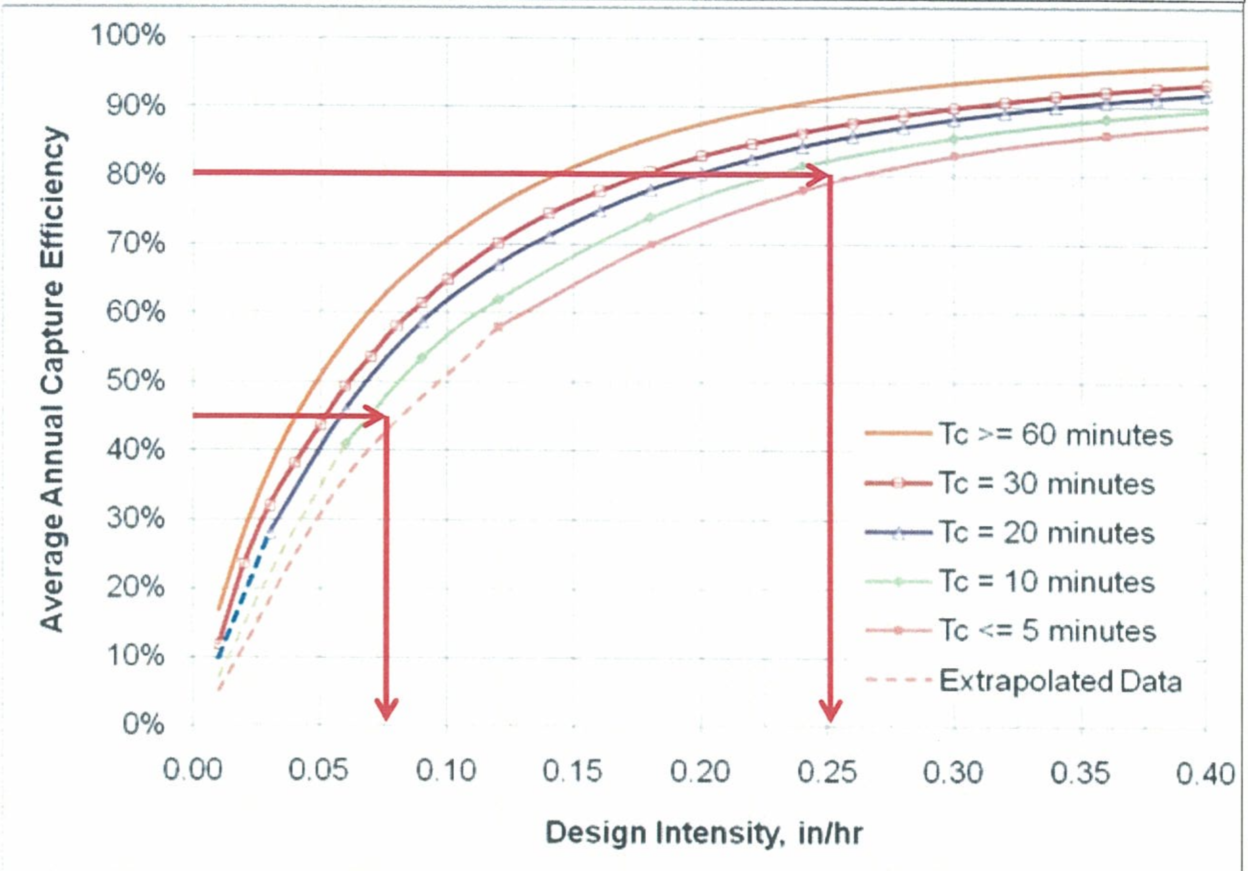
Step 1: Determine the design capture storm depth used for calculating volume				
1	*Enter the time of concentration, T_c (min) (See Appendix IV.2)*	T_c=	6.3	
2	*Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1*	I_1=	0.25	in/hr
3	*Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)*	d_{HSC}=	0.101	inches
4	*Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)*	Y_2=	45	%
5	*Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2*	I_2=	0.075	
6	*Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$*	I_{design}=	0.175	
Step 2: Calculate the design flowrate				
1	*Enter Project area tributary to BMP (s), A (acres)*	A=	0.99	acres
2	*Enter Project Imperviousness, imp (unitless)*	imp=	0.90	
3	*Calculate runoff coefficient, C= (0.75 x imp) + 0.15*	C=	.825	
4	*Calculate design flowrate, Q_{design}= (C x i_{design} x A)*	Q_{design}=	0.14	cfs
Supporting Calculations				
Describe system: *Filterra Bioretention Unit 6' x 10' (Treats up to 0.14 cfs)*				
Provide time of concentration assumptions: *Tc = 6.3 minutes per Preliminary Hydrology Report calculations.*				

Area A-6 (SOUTHERLY PARKING DECK)

BIO-7: Proprietary Biotreatment; Filterra System in treatment train with Storm Water Planter (provides 45% capture efficiency)

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Area A-7

BIO-7: Proprietary Biotreatment; Filterra System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

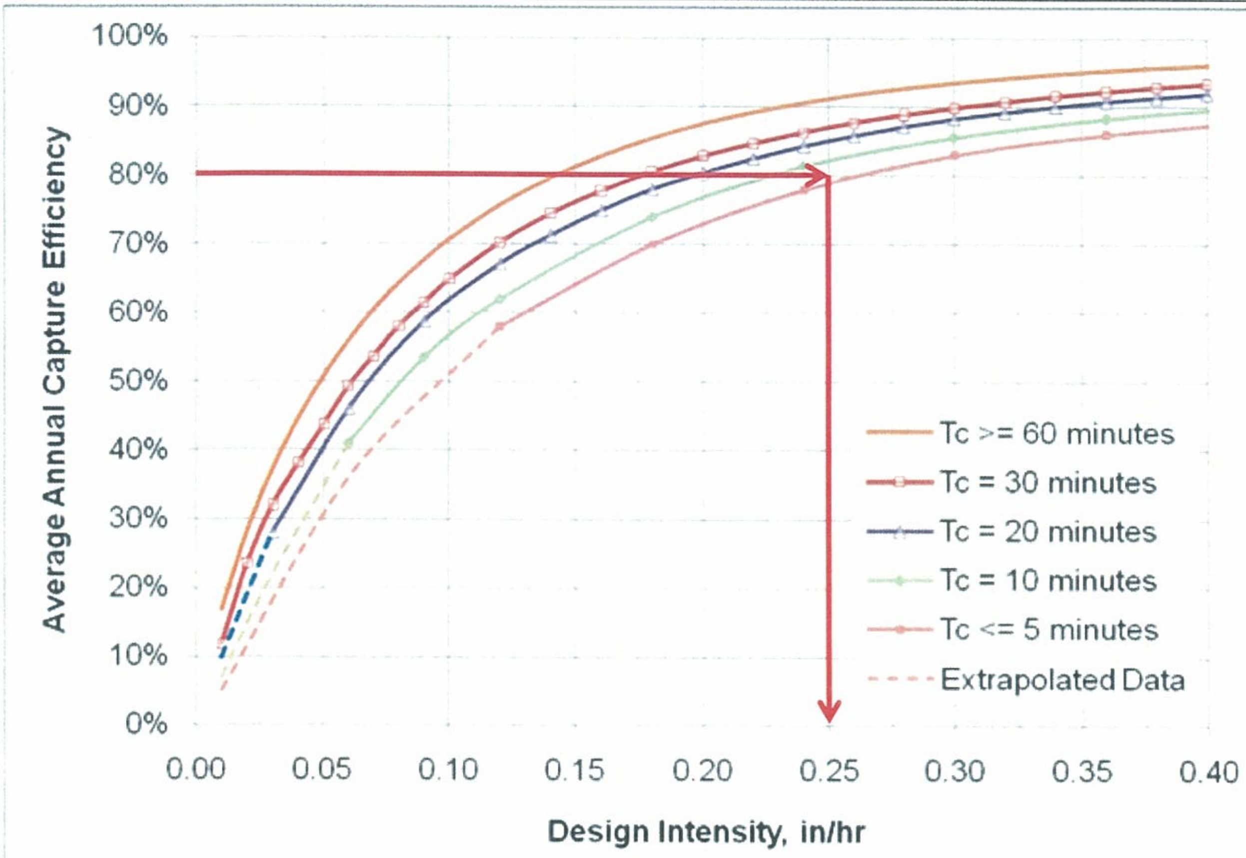
Step 1: Determine the design capture storm depth used for calculating volume				
1	*Enter the time of concentration, T_c (min) (See Appendix IV.2)*	T_c=	7	
2	*Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1*	I_1=	0.25	in/hr
3	*Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)*	d_{HSC}=	-	inches
4	*Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)*	Y_2=	-	%
5	*Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2*	I_2=	-	
6	*Determine the design intensity that must be provided by BMP, $I_{design}= I_1-I_2$*	I_{design}=	0.25	
Step 2: Calculate the design flowrate				
1	*Enter Project area tributary to BMP (s), A (acres)*	A=	0.56	acres
2	*Enter Project Imperviousness, imp (unitless)*	imp=	90%	
3	*Calculate runoff coefficient, C= (0.75 x imp) + 0.15*	C=	0.825	
4	*Calculate design flowrate, Q_{design}= (C x i_{design} x A)*	Q_{design}=	0.116	cfs
Supporting Calculations				
Describe system: *Two (2) Filterra Bioretention Unit in Sump Condition each 4' x 6' (Each Unit Treats up to 0.061 cfs)*				
Provide time of concentration assumptions: *Tc = 7 minutes per Preliminary Hydrology Report calculations.*				

Area A-7

BIO-7: Proprietary Biotreatment; Filterra System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Area A-8 (PRESCHOOL / ADMINISTRATION BUILDING)

BIO-7: Proprietary Biotreatment; Filterra Roofdrain System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

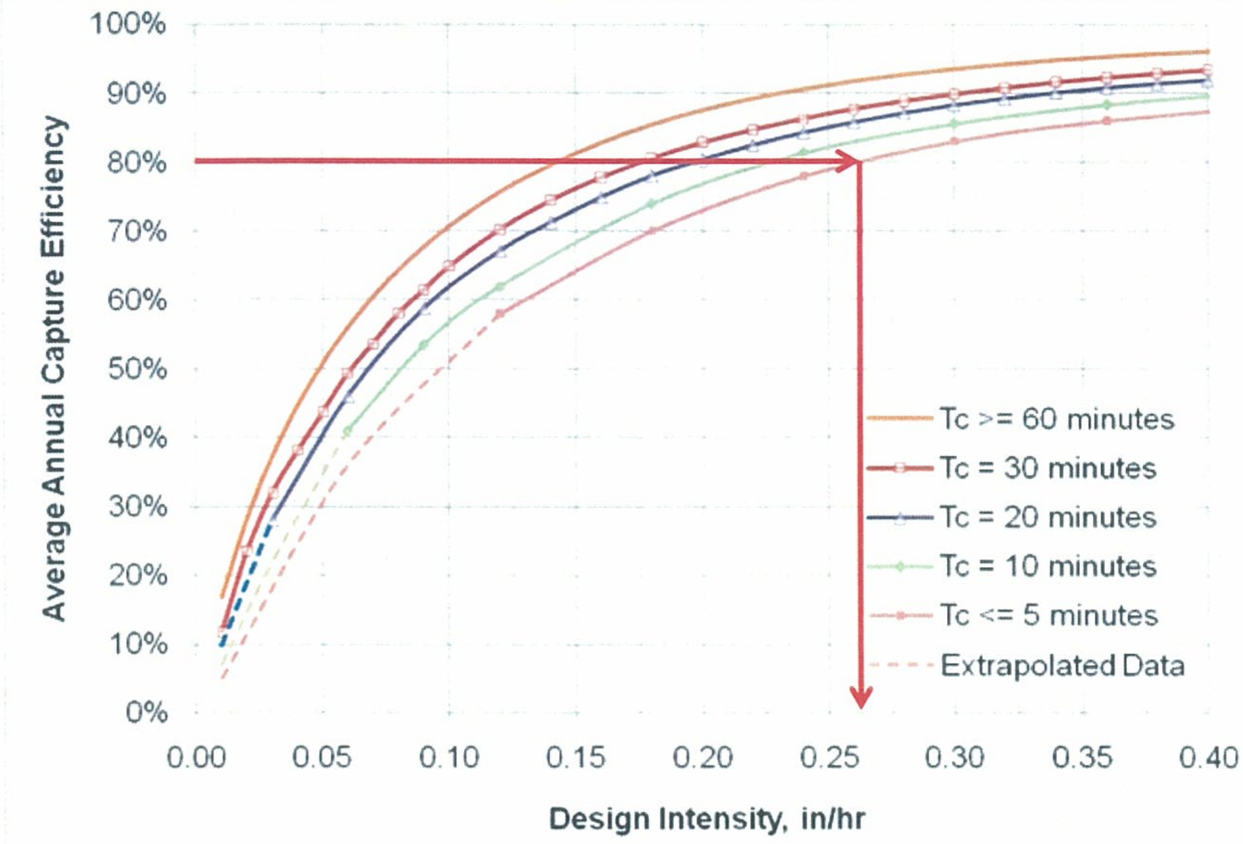
Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter the time of concentration, T_c (min) (See Appendix IV.2)	T_c=	5	
2	Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1	I_1=	0.26	in/hr
3	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	-	inches
4	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	-	%
5	Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2	I_2=	-	
6	Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$	I_{design}=	0.26	
Step 2: Calculate the design flowrate				
1	Enter Project area tributary to BMP (s), A (acres)	A=	0.23	acres
2	Enter Project Imperviousness, imp (unitless)	imp=	90%	
3	Calculate runoff coefficient, C= (0.75 x imp) + 0.15	C=	0.825	
4	Calculate design flowrate, Q_{design}= (C x i_{design} x A)	Q_{design}=	0.049	cfs
Supporting Calculations				
Describe system: Filterra Bioretention Unit 4' x 6' (Treats up to 0.061 cfs)				
Provide time of concentration assumptions: Tc = 5 minutes per Preliminary Hydrology Report calculations.				

Area A-8 (PRESCHOOL / ADMINISTRATION BUILDING)

BIO-7: Proprietary Biotreatment; Filterra Roofdrain System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Area B-1 (LANDSCAPED AREA EAST OF CHRISTIAN EDUCATION BUILDINGS 1 AND 2)

Worksheet A: Hydrologic Source Control Calculation Form

Drainage area ID	***B-1***
Total drainage area	0.30 acres
Total drainage area Impervious Area (IA_{total})	0.08 acres

HSC ID	HSC Type/ Description/ Reference BMP Fact Sheet	Effect of individual HSC_i per criteria in BMP Fact Sheets (XIV.1) (d_{HSCi})[1]	Impervious Area Tributary to HSC_i (IA_i)	$d_i \times IA_i$
B-1	HCS-2: Impervious Area Dispersion; Ratio = 3.67 Self-Retaining	1.0”	0.08	0.08
Box 1:			$\sum d_i \times IA_i =$	.08
Box 2:			$IA_{total} =$	.08
[Box 1]/[Box 2]:			$d_{HSC\ total} =$	1.0
			Percent Capture Provided by HSCs (Table III.1)	80%

1 - For HSCs meeting criteria to be considered self-retaining, enter the DCV for the project.

DCV = 0.30 ac x (0.21*0.75 + 0.15) x (0.80 inches) x 43,560 sf/ac x 1/12 in/ft = 267 cu-ft

- Self-treating area; No additional BMPs needed

Area B-2 (EXISTING SANCTUARY)

BIO-1: Bioretention w/ Underdrain; Downspout Planter Boxes

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.8	inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, *T* (hours)	T=	5	hours
3	Using Figure III.2, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=	0.35	
4	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	-	inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	-	%
6	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency(Y_2), X_2	X_2=	-	
7	Calculate the fraction of design volume that must be provided by BMP, *fraction* = $X_1 - X_2$	fraction=	0.35	
8	Calculate the resultant design capture storm depth (inches), $d_{fraction}$= *fraction* × *d*	$d_{fraction}$=	0.28	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.17	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.9	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.825	
4	Calculate runoff volume, V_{design}= *(C x $d_{rfraction}$ x A x 43560 x (1/12))*	V_{design}=	142	cu-ft
Supporting Calculations				

Provide drawdown time calculations per applicable BMP Fact Sheet:

$DD = (d_p / K_{design}) \times 12$ in/ft
DD = Time to completely drain infiltration basin ponding depth, hours
D_p = Ponding Depth = 1 ft
K_{design} = Infiltration Rate = Assume 2.5 in/hr

DD = (1 ft / 2.5 in/hr) x 12 in/ft = 4.8 hr   Round Up to 5 hr

DD = 5.0 hr
From Step 4, Design Volume = fraction of DCV, adjusted for drawdown = 142 cu-ft

To Determine the Basin Infiltration Area Needed, A = Design Volume / dp

A = 142 cu-ft / 1 ft

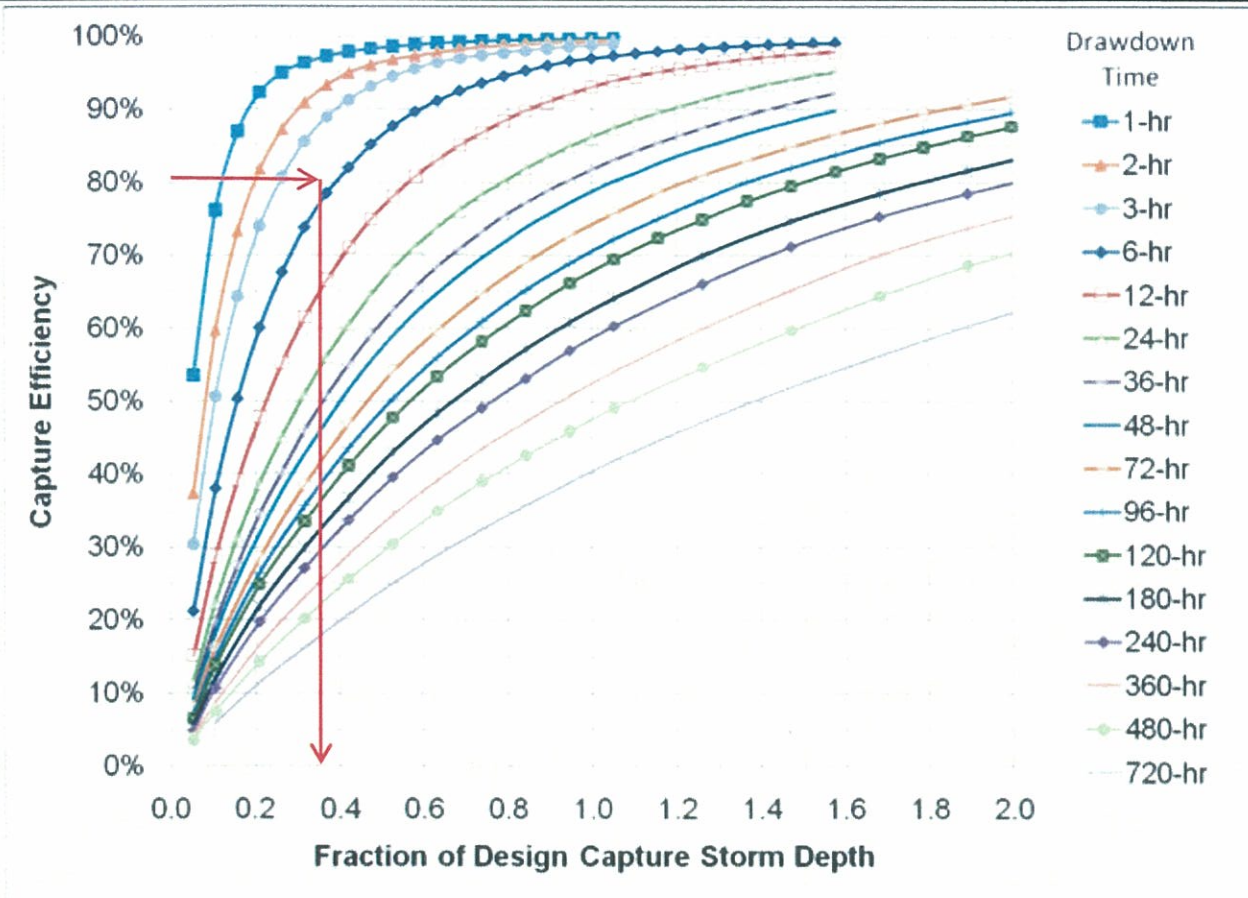
Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Area Needed = 142 square feet

A downspout planter box with underdrain will be constructed at the north-easterly corner of the existing sanctuary where the existing roof drains will be modified to drain through the planter box.
Footprint area of the BMP is approximately: **340 sf = Area Provided**

340 sf > 142 sf
$A_{provided} > A_{required}$

Graphical Operations



Provide supporting graphical operations. See Example III.6.

Area B-3 (EXISTING SANCTUARY)

BIO-1: Bioretention w/ Underdrain; Downspout Planter Boxes

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.8	inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, *T* (hours)	T=	5	hours
3	Using Figure III.2, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=	0.35	
4	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	-	inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	-	%
6	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency(Y_2), X_2	X_2=	-	
7	Calculate the fraction of design volume that must be provided by BMP, *fraction* = $X_1 - X_2$	fraction=	0.35	
8	Calculate the resultant design capture storm depth (inches), $d_{fraction}$= *fraction* × *d*	$d_{fraction}$=	0.28	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.17	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.9	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.825	
4	Calculate runoff volume, V_{design}= (C x $d_{rfraction}$ x A x 43560 x (1/12))	V_{design}=	142	cu-ft

Supporting Calculations

Provide drawdown time calculations per applicable BMP Fact Sheet:

DD = (d_p / K_{design}) x 12 in/ft
DD = Time to completely drain infiltration basin ponding depth, hours
D_p = Ponding Depth = 1 ft
K_{design} = Infiltration Rate = Assume 2.5 in/hr

DD = (1 ft / 2.5 in/hr) x 12 in/ft = 4.8 hr Round Up to 5 hr

DD = 5.0 hr
From Step 4, Design Volume = fraction of DCV, adjusted for drawdown = 142 cu-ft

To Determine the Basin Infiltration Area Needed, A = Design Volume / dp

A = 142 cu-ft / 1 ft

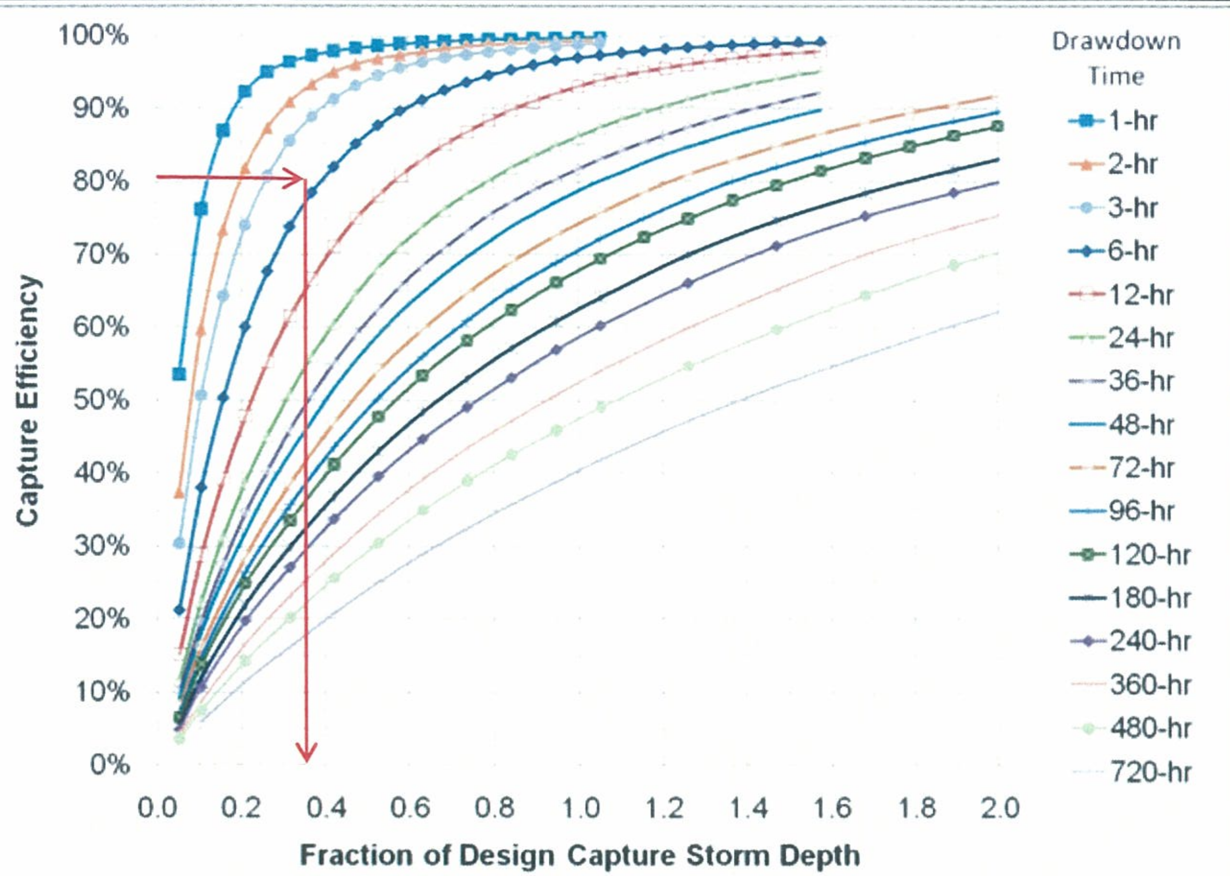
Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Area Needed = 142 square feet

A downspout planter box with underdrain will be constructed at the southerly corner of the existing sanctuary where the existing roof drains will be modified to drain through the planter box. Footprint area of the BMP is approximately: **288 sf = Area Provided**

288 sf > 142 sf
$A_{provided} > A_{required}$

Graphical Operations



Provide supporting graphical operations. See Example III.6.

Area B-4 (HARDSCAPE / LANDSCAPE AREA SOUTH-EAST OF EXISTING SANCTUARY)

BIO-1: Bioretention w/ Underdrain; Storm Water Planter

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

Step 1: Determine the design capture storm depth used for calculating volume				
1	Enter design capture storm depth from Figure III.1, *d* (inches)	d=	0.8	inches
2	Enter calculated drawdown time of the proposed BMP based on equation provided in applicable BMP Fact Sheet, *T* (hours)	T=	5	hours
3	Using Figure III.2, determine the "fraction of design capture storm depth" at which the BMP drawdown time (T) line achieves 80% capture efficiency, X_1	X_1=	0.35	
4	Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)	d_{HSC}=	-	inches
5	Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)	Y_2=	-	%
6	Using Figure III.2, determine the fraction of "design capture storm depth" at which the drawdown time (T) achieves the equivalent of the upstream capture efficiency(Y_2), X_2	X_2=	-	
7	Calculate the fraction of design volume that must be provided by BMP, *fraction* = $X_1 - X_2$	fraction=	0.35	
8	Calculate the resultant design capture storm depth (inches), $d_{fraction}$= *fraction* × *d*	$d_{fraction}$=	0.28	inches
Step 2: Calculate the DCV				
1	Enter Project area tributary to BMP (s), *A* (acres)	A=	0.10	acres
2	Enter Project Imperviousness, *imp* (unitless)	imp=	0.7	
3	Calculate runoff coefficient, *C= (0.75 x imp) + 0.15*	C=	0.675	
4	Calculate runoff volume, V_{design}= *(C x $d_{rfraction}$ x A x 43560 x (1/12))*	V_{design}=	69	cu-ft
Supporting Calculations				

Provide drawdown time calculations per applicable BMP Fact Sheet:

DD = (d_p / K_{design}) x 12 in/ft
DD = Time to completely drain infiltration basin ponding depth, hours
D_p = Ponding Depth = 1 ft
K_{design} = Infiltration Rate = Assume 2.5 in/hr

DD = (1 ft / 2.5 in/hr) x 12 in/ft = 4.8 hr   Round Up to 5 hr

DD = 5.0 hr
From Step 4, Design Volume = fraction of DCV, adjusted for drawdown = 69 cu-ft

To Determine the Basin Infiltration Area Needed, A = Design Volume / dp

Worksheet C: Capture Efficiency Method for Volume-Based, Constant Drawdown BMPs

A = 69 cu-ft / 1 ft

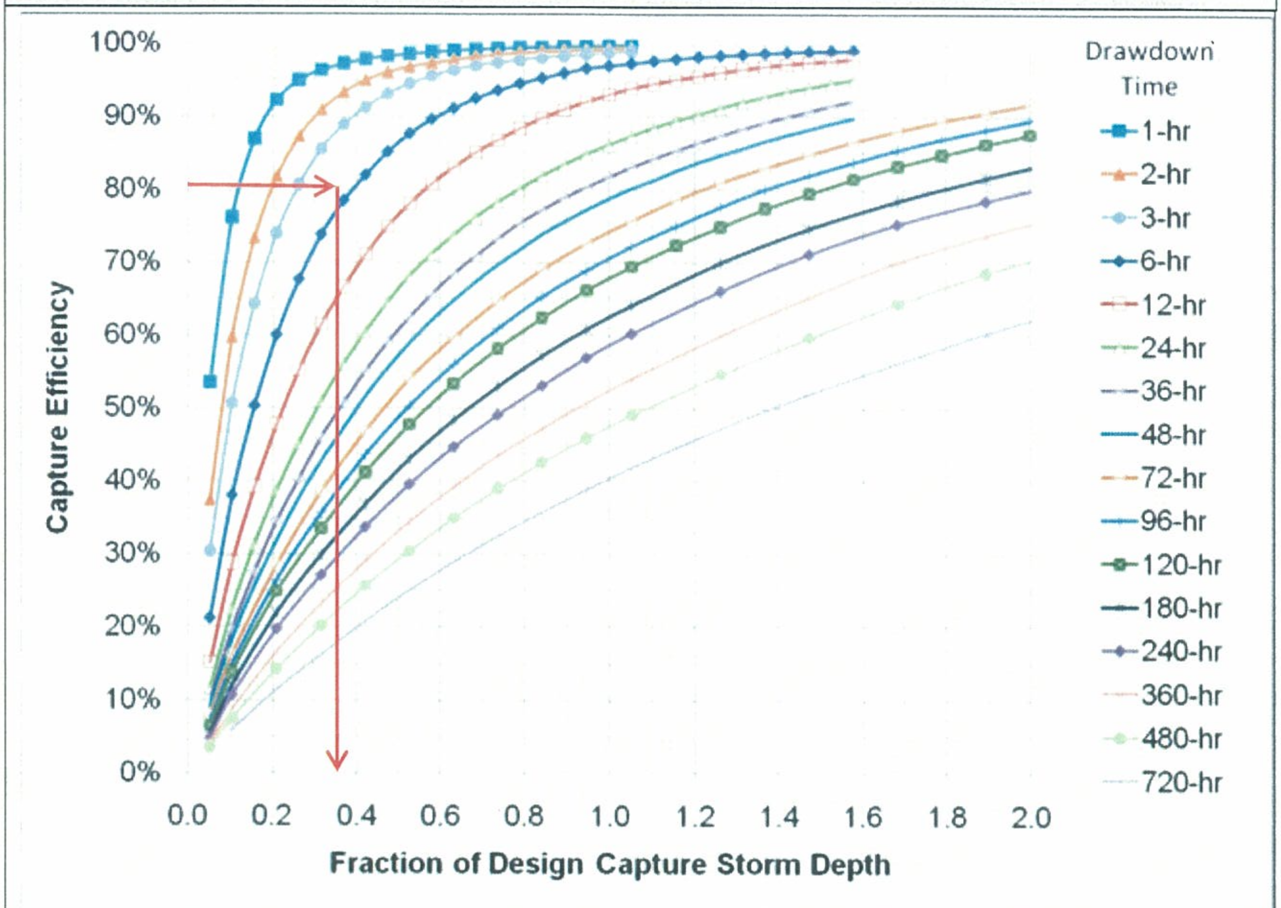
Area Needed = 69 square feet

A storm water planter with underdrain will be constructed at east of the hardscape area between the sanctuary and preschool/administration building

Footprint area of the BMP is approximately: **228 sf = Area Provided**

228 sf > 142 sf
$A_{provided} > A_{required}$

Graphical Operations



Provide supporting graphical operations. See Example III.6.

Area B-5 (MEDITATION GARDEN)

BIO-7: Proprietary Biotreatment; Filterra System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

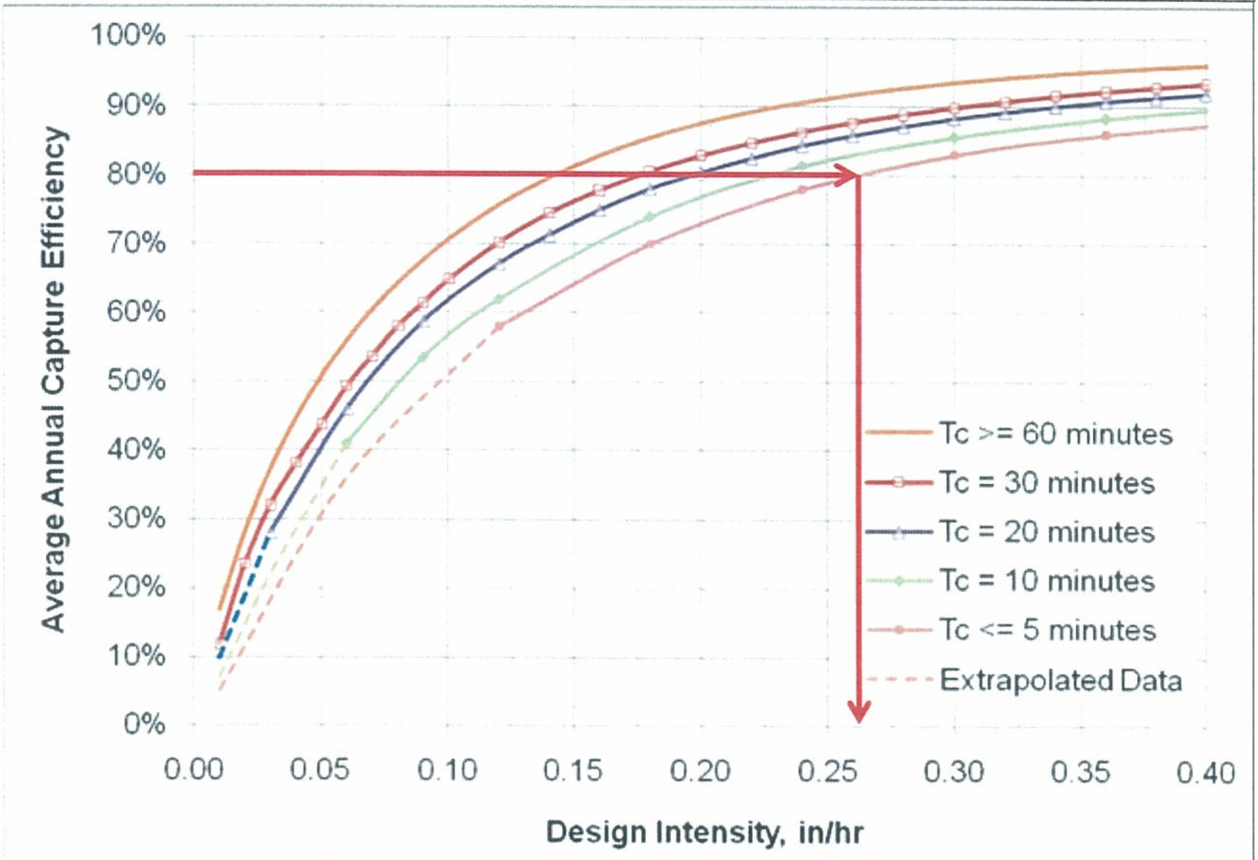
Step 1: Determine the design capture storm depth used for calculating volume				
1	*Enter the time of concentration, T_c (min) (See Appendix IV.2)*	T_c=	5	
2	*Using Figure III.4, determine the design intensity at which the estimated time of concentration (T_c) achieves 80% capture efficiency, I_1*	I_1=	0.26	in/hr
3	*Enter the effect depth of provided HSCs upstream, d_{HSC} (inches) (Worksheet A)*	d_{HSC}=	-	inches
4	*Enter capture efficiency corresponding to d_{HSC}, Y_2 (Worksheet A)*	Y_2=	-	%
5	*Using Figure III.4, determine the design intensity at which the time of concentration (T_c) achieves the upstream capture efficiency(Y_2), I_2*	I_2=	-	
6	*Determine the design intensity that must be provided by BMP, $I_{design}= I_1 - I_2$*	I_{design}=	0.26	
Step 2: Calculate the design flowrate				
1	*Enter Project area tributary to BMP (s), A (acres)*	A=	0.18	acres
2	*Enter Project Imperviousness, imp (unitless)*	imp=	85%	
3	*Calculate runoff coefficient, C= (0.75 x imp) + 0.15*	C=	0.788	
4	*Calculate design flowrate, $Q_{design}= (C \times i_{design} \times A)$*	Q_{design}=	0.037	cfs
Supporting Calculations				
Describe system: *Filterra Bioretention Unit 4' x 4' (Treats up to 0.037 cfs)*				
Provide time of concentration assumptions: *Tc = 5 minutes per Preliminary Hydrology Report calculations.*				

Area B-5 (MEDITATION GARDEN)

BIO-7: Proprietary Biotreatment; Filterra System

Worksheet D: Capture Efficiency Method for Flow-Based BMPs

Graphical Operations



Provide supporting graphical operations. See Example III.7.

Sizing for Hydrodynamic Separation Device (PRE-1) - *CDS Unit - BMP-4*:

Pre-treatment, upstream Treatment-train
Upstream of Underground Detention Basin

The Water Quality Flow Rate Method will be used to determine CDS system sizing. A Flowrate-Based BMP sizing method will be used to determine Qd. The CDS will be designed to treat all flows up to the Qd. At influent rates higher than the Qd, the diversion weir will direct most flow exceeding the treatment flow rate around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and reduces the risk of washout during bypass flows regardless of influent flow rates.

Hydrodynamic Separation Device
CDS Unit
South Shores Church Project - City of Dana Point

Area	Acres	DCV in (cu-ft)	Qd in (cfs)
Drainage Area "A"			
A-1 through A-8	4.0	10,454	0.90

CDS Unit CDS3020 has a rated treated capacity of 2.0 cfs, which exceeds the required design flow of 0.90 cfs.

The CDS Unit CDS3020 has a maximum hydraulic internal bypass capacity of 20.00 cfs. The project's 100-year storm frequency design flow is 18.25 cfs passing through the proposed CDS unit (See Drainage Study in Appendix B).

6.3.3 LOCATION

For on-site Drainage Areas A and B, a combination of Bioretention with Underdrains (BIO-1), Vegetated Swales (BIO-2), Proprietary Biotreatments (BIO-7), and Hydrodynamic Separations Device (PRE-1) will be used as Treatment Control BMPs.

Bioretention with Underdrain BMPs (BIO-1) will include downspout planter boxes serving the roof drains of the proposed Community Life Center (Area A-1) and the existing Sanctuary (Area B-2 and B-3

Proprietary Biotreatment BMPs (BIO-7) will incorporate a combination of Filterra Roofdrain System and Filterra Catch Basin System. Both the Christian Education Buildings (Area A-2 and A-3) and the Preschool/Administration Building's (Area A-8) roofs will drain into Filterra Roofdrain systems before entering into the sites underground storm drain system. The site's main entry street and parking (Area A-4 and A-7) will drain to Filterra Catch Basins before entering the underground storm drain system.

The proposed parking deck is split into two subareas. Area A-5 will drain towards Crown Valley to a Vegetated Swale (BIO-2), such as a bioswale – BMP-2. Area A-6 drains towards Crown Valley to a storm water planter, which treats a portion of the design capture volume. Because of the larger area, a Proprietary Biotreatment Device (BIO-7), such as a Filterra Unit, is included to treat the remaining volume. Larger storm events can bypass these BMPs to proposed catch basins and will flow towards the underground detention basin via RCP Storm Drain.

A Hydrodynamic Separation Device (PRE-1), such as a CDS Unit - BMP-4, will be designed and implemented upstream of the proposed underground detention basin. All flows from Area A will be treated prior to entering the CDS unit. The CDS Unit acts as a pre-treatment device primarily for the underground detention basin.

The landscaped area to the east of the Christian Education Building (Area B-1) is a self-treating area that uses impervious area dispersion into landscaping.

The walkway area to the east of the existing Sanctuary (Area B-4) will drain towards a Bioretention with Underdrain BMP (BIO-1), such as a storm water planter with underdrain.

Lastly, the Meditation Garden (Area B-5) will incorporate a Proprietary Biotreatment BMP (BIO-7), such as a Filterra Box, which all area drains will be directed towards before entering the sites underground storm drain.

See WQMP Exhibit for BMP locations on Section 7.1

6.3.4 RESTRICTIONS ON USE OF INFILTRATION BMPS

The proposed project does not include infiltration BMPs. See Table 2.7: Infiltration BMP Feasibility Worksheet in Appendix D.

Section 7 Project Plans and BMP Location Map

SECTION 7

PROJECT PLANS AND BMP LOCATION MAP ON FILE WITH THE CITY OF DANA POINT

Section 8 Stormwater BMP Maintenance

The City does not accept stormwater structural BMPs as meeting the WQMP requirements standard, unless an Operations and Maintenance (O&M) Plan is prepared and a mechanism is in place that will ensure ongoing long-term maintenance of all structural and non-structural BMPs.

Operation and maintenance details are not required to be included with the Preliminary WQMP, but will be required as part of the Final WQMP.

8.1 Operation and Maintenance (O&M) Plan

This O&M Plan describes the designated responsible party for implementation of this WQMP, including: operation and maintenance of all the structural BMP(s), conducting the training/educational program and duties, and any other necessary activities. The O&M Plan includes detailed inspection and maintenance requirements for all structural BMPs, including copies of any maintenance contract agreements, manufacturer's maintenance requirements, permits, etc.

8.1.1 Responsible Party

The responsible party for implementation of this WQMP is:

Name: G.G. Kohlhagen

Title: Building Committee Chairman / Church Project Manager

Company: South Shores Church

Address: 32712 Crown Valley Parkway, Dana Point, CA 92629

Telephone #: 714-404-4962

Email Address: ggkohlhagen@cox.net

8.1.2 Record Keeping

Parties responsible for the O&M plan shall retain records for at least 5 years.

All training and educational activities and BMP operation and maintenance shall be documented to verify compliance with this O&M Plan. A Training Log and Inspection and Maintenance Log are included in Appendix E of this document.

The **WQMP Verification Form** (Appendix F) shall be completed accurately and submitted, with associated documentation, to the City of Dana Point by September 30 of each year, or as requested by the City. **Failure to complete and submit the verification form will result in a noncompliance and enforcement actions may be taken.**

8.1.3 Vector Control

Standing water which exists for longer than 72 hours may contribute to mosquito breeding areas. Best Management Practices (BMPs) shall be inspected for standing water on a regular basis. Standing water may indicate that the BMP is not functioning properly and proper action to remedy the situation shall be taken in a timely manner.

Elimination of standing water and managing garbage, lawn clippings, and pet droppings, can help decrease the presence of mosquitoes and flies in the area.

The Orange County Vector Control District may be contacted for more information and support at 714-971-2421 or 949-654-2421 or www.ocvcd.org.

8.1.4 Required Permits

No other permits from other agencies besides the City of Dana Point are required.

8.1.5 Inspections

The City may conduct a site inspection to evaluate compliance with the Project WQMP, at any time, in accordance with Dana Point Municipal Code Chapter 15.10, Storm Water/Surface Runoff Water Quality.

8.1.6 Operation and Maintenance Requirements

Operation and maintenance details are not required to be included with the Preliminary WQMP, but will be required as part of the Final WQMP.

The South Shores Church will provide funding for all proposed BMPs and South Shores Church maintenance personnel and hired waste removal company will be maintain the project site.

BMP	Implementation, Inspection and Maintenance Requirements	Frequency
N1. Education for Property Owners, Tenants and Occupants	RP will insure that all owners & tenants will be given a copy of the recorded CC&R's which will contain a section outlining the environmental awareness education materials at the close of escrow. RP shall distribute appropriate materials to owners, tenants and/or occupants via contract language, mailings, website or meeting. Brochures can be requested or downloaded from www.ocwatersheds.com. Brochures and educational articles for RP distribution can also be requested from City Water Quality Engineer.	Information to be initially provided to owners & tenants upon sale or lease agreement. Educational materials will be provided to owners and/or tenants annually, thereafter.
N2. Activity Restriction	Within the CC&R's or lease agreement, the following activity restrictions shall be enforced:	Continuous

BMP	Implementation, Inspection and Maintenance Requirements	Frequency
N3. Common Area Landscape Management & Efficient Landscape Design	Landscape Management Includes: • Mitigation of the potential dangers of fertilizer and pesticide usage through the incorporation of an Integrated Pest Management Program (IPM). • Monitor for runoff and efficiency regularly. • Implementation of a water budget. • Irrigation systems shall be automatically controlled and designed, installed, and maintained so as to minimize overspray and runoff onto streets, sidewalks, driveways, structures, windows, walls, and fences. • Use of native and drought tolerant species when replanting	Inspected once a weeK
N11. Common Area Litter Control	Weekly sweeping and trash pick up as necessary within all project areas and common landscape areas. Daily inspection of trash receptacles to ensure that lids are closed and pick up any excess trash on the ground, noting trash disposal violations by homeowners and reporting the violations to the HOA/RP for investigation.	Daily inspection and weekly sweeping and clean-up or as needed
N12. Contractor/Employee Training	All contractors shall be trained and made aware of this WQMP and operation and maintenance requirements of BMPs.	At first hire and annually thereafter for HOA personnel and employees, to include the educational materials contained in the approved Water Quality Management Plan.
N13. Housekeeping of Loading Docks		
N14. Common Area Catch Basin Inspection	Catch basins will be owned, inspected and maintained by the HOA/RP. Catch basins will be inspected at a minimum on a yearly basis, and prior to the storm season, no later than October 1st of each year.	At a minimum, basins will be inspected and cleaned around October 1ST of each year, prior to "first flush" storm, or as necessary after large storm events to clear inlets of trash, debris and silt.

BMP	Implementation, Inspection and Maintenance Requirements	Frequency
N15. Street Sweeping Private Streets and Parking Lots	Vacuum street sweeping will occur on a weekly basis.	Streets will be vacuum swept on a weekly basis.
SD-13 Provide Storm Drain System Stenciling and Signage	All catch basins where applicable in paved areas, will be marked or stenciled with "No Dumping - Drains to Ocean, No Descargue Basura" language. This will be done in a location that can be clearly seen by all and will be routinely inspected and re-labeled, as necessary. Thereafter, the owner/operator shall routinely inspect and re-label the catch basins, as necessary.	Catch basin labels will be inspected once annually and relabeled as necessary to maintain legibility.
SD-34 Design and Construct Outdoor Material Storage Areas to Reduce Pollutant Introduction		
Sd-32 Design and Construct Trash and Waste Storage Areas to Reduce Pollutant Introduction	Trash will be removed by the local private solid waste management contractor on a weekly basis for proper disposal of the trash to landfill; with recyclable materials and greenwastes to be processed offsite.	Trash dumpster shall be kept in a non-leaking condition.
SD-31 Loading Docks		
SD-31 Maintenance Bays		
SD-33 Vehicle Wash Areas		
SD-36 Outdoor Processing Areas		
SD-33 Equipment Wash Areas		
SD-30 Fueling Areas		
Wash Water Controls for Food Preparation Areas		
Hydromod/LID/Treatment BMP # 1 Downspout Planter Box (BIO)		As recommended.

BMP	Implementation, Inspection and Maintenance Requirements	Frequency
Hydromod/LID/Treatment BMP # 2 Proprietary Bio-filtration, such as Filterra Systems (BIO)	**Included Maintenance** A. Each correctly installed Filterra® unit is to be maintained by the Supplier, or a Supplier approved contractor for a minimum period of 1 year. The cost of this service is to be included in the price of each Filterra® unit. Extended maintenance contracts are available at extra cost upon request. B. Annual included maintenance consists of a maximum of (2) scheduled visits. The visits are scheduled seasonally; the spring visit aims to clean up after winter loads that may include salts and sands. The fall visit helps the system by removing excessive leaf litter. C. Each Included Maintenance visit consists of the following tasks. 1. Filterra® unit inspection 2. Foreign debris, silt, mulch & trash removal 3. Filter media evaluation and recharge as necessary 4. Plant health evaluation and pruning or replacement as necessary 5. Replacement of mulch 6. Disposal of all maintenance refuse items 7. Maintenance records updated and stored (reports available upon request) D. The beginning and ending date of Supplier's obligation to maintain the installed system shall be determined by the Supplier at the time the system is activated. Owners must promptly notify the Supplier of any damage to the plant(s), which constitute(s) an integral part of the bioretention technology.	As recommended.
Hydromod/LID/Treatment BMP # 3 Proposed Bio-filtration swale / depressed landscape (BIO)	**Maintenance Considerations** Properly designed and installed bioretention cells require some regular maintenance, most frequently during the first year or two of establishment. Bioretention cells will require supplemental irrigation during the first 2-3 years after planting. Drought-tolerant species may need little additional water after this period, except during prolonged drought, when supplemental irrigation may become necessary for plant survival. Verify that the maintenance plan includes a watering schedule for the establishment period and in times of extreme drought after plants have been established. While vegetation is being established, remove weeds by hand (weeding frequency should decrease over time, as plants grow). Although plants may need occasional pruning or trimming, bioretention cells should generally not be mowed on a regular basis. Trim vegetation as necessary to maintain healthy plant growth. In some instances, where it is desired to maintain fast-growing, annual herbaceous plant cover, annual mowing may be appropriate. Replace dead plants. If a particular species proves to be prone to mortality, it may need to be replaced with a different species that is more likely to succeed on this particular site. Mulch should be re-applied when erosion is evident. In areas expected to have low metal loads in the runoff, mulch as needed to maintain a 2-3 inch depth. In areas with relatively high metal loads, replace mulch once per year. Bioretention cells should be inspected at least two times per year for sediment buildup, trash removal, erosion, and to evaluate the health of the vegetation. If sediment buildup reaches 25 percent of the ponding depth, it should be removed, taking care to minimize soil disturbance. If erosion is noticed within the bioretention cell, additional soil stabilization measures should be applied. If vegetation appears to be in poor health with no obvious cause, a landscape specialist should be consulted.	As recommended.
Hydromod/LID/Treatment BMP # 4 Proposed Proprietary Filtration, such as CDS Systems	**Maintenance** The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit, e.g., unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.	As recommended.
Hydromod/LID/Treatment BMP # 5 Proposed Underground Detention Basin (HU-2)		As recommended.

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