OCTA Environmental Cleanup Program

Tier 1 Application

Questions 2 and 3 Example Calculations

The following sample calculations are provided for guidance and reference in preparing the Tier 1 application. For specific questions, please contact Rachyl Occhipinti at rocchipinti@octa.net.

Question 2: Cost/Benefit

2. Based on information provided by the applicant, a cost/benefit calculation will be conducted to compare the total project cost to the area of priority land uses treated by the proposed BMP(s). Please complete the table below **(up to 16 points)**:

	BMP(s)		
	Type 1	Type 2, etc.	
Type(s) of BMP(s) proposed:	Click to enter text.	Click to enter text.	
Number of each BMP type:	Click to enter text.	Click to enter text.	
Total drainage area(s) contributing to each BMP type:	Click to enter text.	Click to enter text.	Total
Drainage area(s) that is/are considered Priority Land Uses*:	Click to enter text.	Click to enter text.	Click to enter text.
Total Project Cost:			Click to enter text.
Cost/Benefit ($/ac of priority land uses):			Click to enter text.
Project Score (to be completed by OCTA):			Click to enter text.
*Refer to City General Plans for general land use distribution/coverage information. Refer to the Statewide Trash Provisions for a complete definition of Priority Land Uses (e.g. high density residential, industrial, commercial, mixed urban, public transportation stations).			

Spatially determined (e.g. GIS, Google Earth).

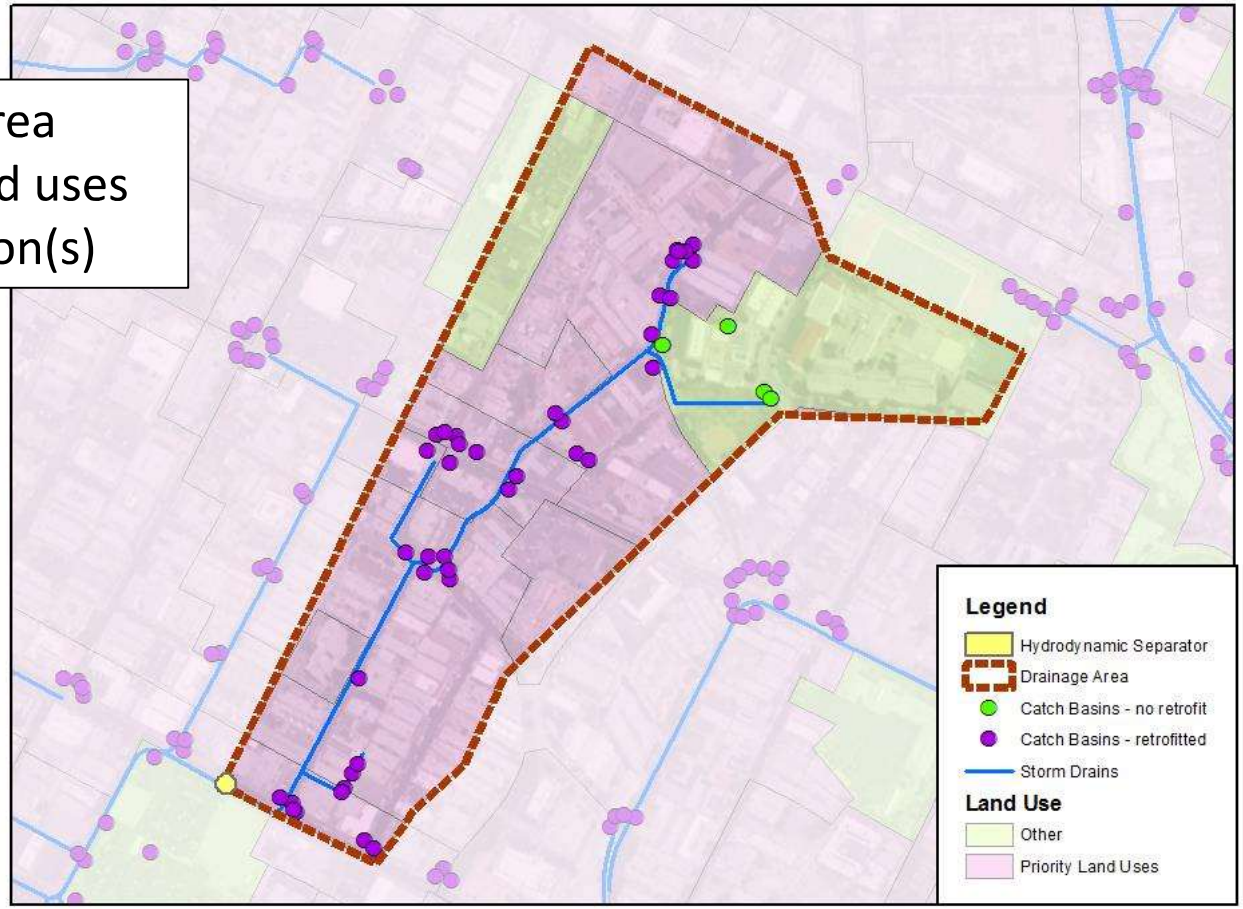
Application Checklist, Item G requires geospatial information to be submitted for Project Drainage Area(s), Priority Land Use(s), and BMP Location(s) (through ArcGIS and/or Google Earth)

Based on Cost/Benefit result

Link to Statewide Trash Provisions:
https://www.waterboards.ca.gov/water_issues/programs/trash_control/docs/trash_sr_040715.pdf

Q2 Example GIS Information

- Drainage area
- Priority land uses
- BMP location(s)



Question 3: Pollutant Reduction Benefit

3. Pollutant Reduction Benefits: Project benefits will be based on treatment capacity and BMP type. Applicant to provide calculations to determine the following scores **(up to 12 points)**:

Line	Factor	Points Available	Multiplier	Line Score
A	Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)	0 to 1	3	Click to
B	Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)	0 to 1.5	3	enter text.
C	BMP Multiplier: •0 points if BMP is not low-impact development (LID) or treatment control •1/3 point for high capacity systems •2/3 point for filters/biofilters •1 point for zero-discharge BMPs	0 to 1	6	
			Project Score:	Click to enter text.
Scoring Equation (Max 12 points): (Ax3) + (Bx3) + (Cx6) *Calculations may be provided on a separate sheet*				

Treatment Capacity

BMP Type

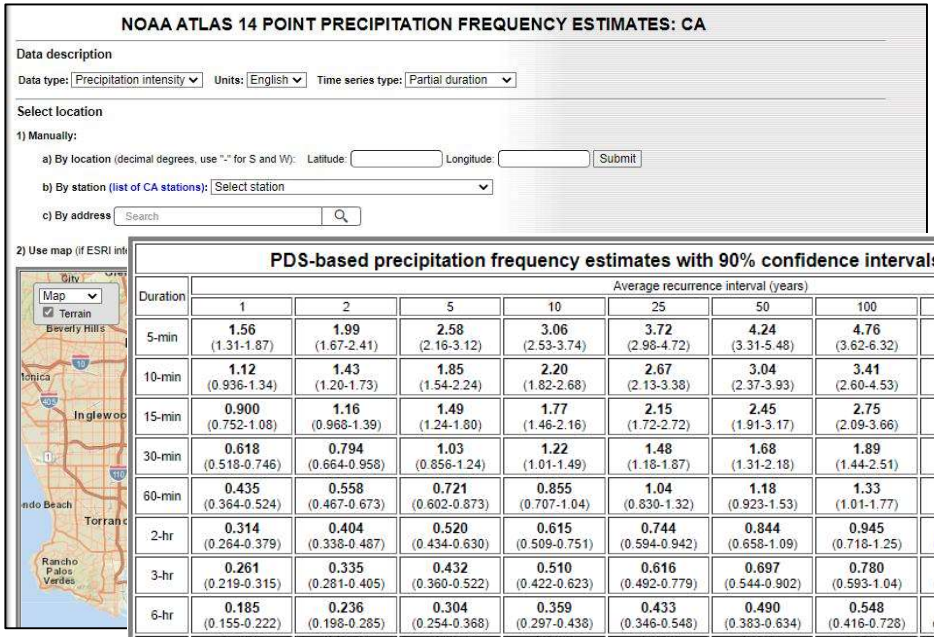
Q3, Line A– Precipitation Intensity

NOAA Precipitation Frequency Estimates: CA

Website QR Code

https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=ca

Used to calculate 1-yr, 1-hr event peak flowrate



PDS-based precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.56 (1.31-1.87)	1.99 (1.67-2.41)	2.58 (2.16-3.12)	3.06 (2.53-3.74)	3.72 (2.98-4.72)	4.24 (3.31-5.48)	4.76 (3.62-6.32)	5.30 (3.91-7.26)	6.06 (4.27-8.66)	6.64 (4.52-9.85)
10-min	1.12 (0.936-1.34)	1.43 (1.20-1.73)	1.85 (1.54-2.24)	2.20 (1.82-2.68)	2.67 (2.13-3.38)	3.04 (2.37-3.93)	3.41 (2.60-4.53)	3.80 (2.81-5.21)	4.34 (3.07-6.20)	4.76 (3.24-7.06)
15-min	0.900 (0.752-1.08)	1.16 (0.968-1.39)	1.49 (1.24-1.80)	1.77 (1.46-2.16)	2.15 (1.72-2.72)	2.45 (1.91-3.17)	2.75 (2.09-3.66)	3.07 (2.26-4.20)	3.50 (2.47-5.00)	3.84 (2.61-5.69)
30-min	0.618 (0.518-0.746)	0.794 (0.664-0.958)	1.03 (0.856-1.24)	1.22 (1.01-1.49)	1.48 (1.18-1.87)	1.68 (1.31-2.18)	1.89 (1.44-2.51)	2.11 (1.56-2.88)	2.40 (1.70-3.44)	2.64 (1.80-3.91)
60-min	0.435 (0.364-0.524)	0.558 (0.467-0.673)	0.721 (0.602-0.873)	0.855 (0.707-1.04)	1.04 (0.830-1.32)	1.18 (0.923-1.53)	1.33 (1.01-1.77)	1.48 (1.09-2.03)	1.69 (1.19-2.42)	1.85 (1.26-2.75)
2-hr	0.314 (0.264-0.379)	0.404 (0.338-0.487)	0.520 (0.434-0.630)	0.615 (0.509-0.751)	0.744 (0.594-0.942)	0.844 (0.658-1.09)	0.945 (0.718-1.25)	1.05 (0.774-1.44)	1.19 (0.840-1.70)	1.30 (0.884-1.93)
3-hr	0.261 (0.219-0.315)	0.335 (0.281-0.405)	0.432 (0.360-0.522)	0.510 (0.422-0.623)	0.616 (0.492-0.779)	0.697 (0.544-0.902)	0.780 (0.593-1.04)	0.864 (0.638-1.18)	0.978 (0.691-1.40)	1.07 (0.726-1.58)
6-hr	0.185 (0.155-0.222)	0.236 (0.198-0.285)	0.304 (0.254-0.368)	0.359 (0.297-0.438)	0.433 (0.346-0.548)	0.490 (0.383-0.634)	0.548 (0.416-0.728)	0.607 (0.448-0.830)	0.686 (0.485-0.982)	0.748 (0.509-1.11)
12-hr	0.119 (0.100-0.143)	0.153 (0.128-0.184)	0.197 (0.165-0.239)	0.234 (0.193-0.285)	0.283 (0.226-0.358)	0.321 (0.251-0.416)	0.360 (0.274-0.478)	0.400 (0.295-0.548)	0.455 (0.321-0.650)	0.497 (0.338-0.738)
24-hr	0.081 (0.071-0.093)	0.104 (0.092-0.120)	0.136 (0.119-0.157)	0.161 (0.141-0.188)	0.197 (0.166-0.237)	0.224 (0.186-0.276)	0.252 (0.204-0.318)	0.281 (0.222-0.364)	0.321 (0.243-0.433)	0.353 (0.258-0.492)

Example Location: Anaheim

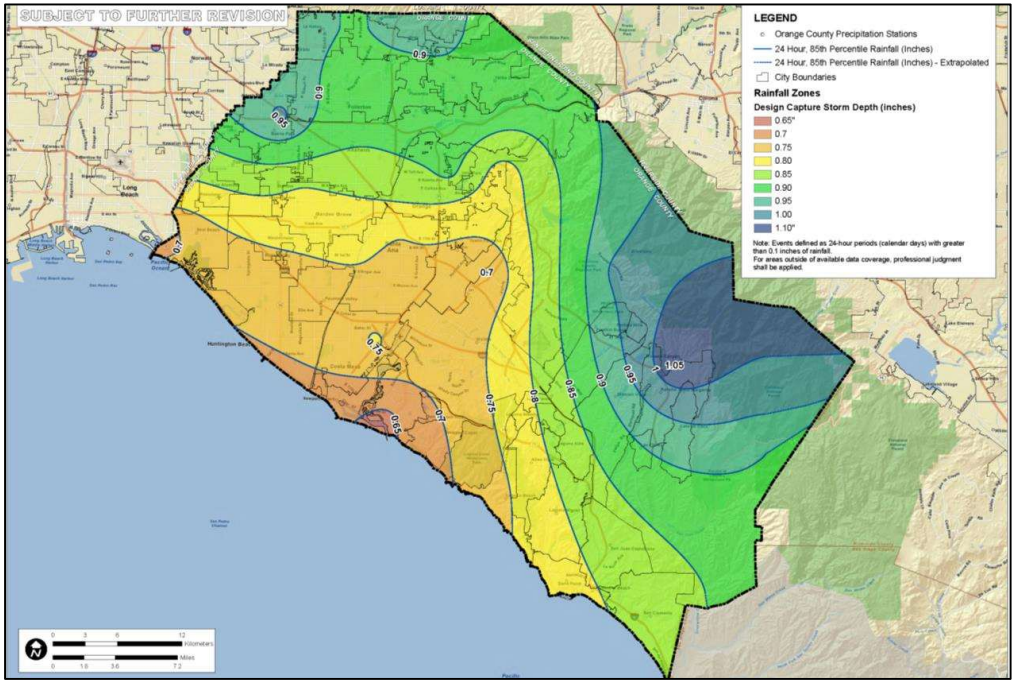
Q3, Line B – Design Storm Depth

Orange County Public Works (2013)
Technical Guidance Document (TGD) for the Preparation of
Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs)

Website QR Code

[See Figure XVI-1:](https://ocerws.ocpublicworks.com/sites/ocpwocerws/files/2021-01/SantaAnaRegion-TechnicalGuidance-December2013.pdf)
https://ocerws.ocpublicworks.com/sites/ocpwocerws/files/2021-01/SantaAnaRegion-TechnicalGuidance-December2013.pdf

Used to calculate 85th percentile, 24-hr design storm runoff



TGD Figure XVI-1

Q3, Line C – Scoring BMP Categories

Tier 1 BMP Category	Definition	Example BMP Type*	
High-Capacity Systems (1/3 point)	Remove trash, coarse sediments, some TSS, and floating hydrocarbons using screening, gravity settling, and centrifugal forces	Hydrodynamic Separators (HDS), Continuous Deflection Systems (CDS), and Linear Radial Gross Solid Removal Devices (GSRD)	
Filters/Biofilters (2/3 point)	Treat-and-release BMPs that promote infiltration and evapotranspiration and are defined as biotreatment or treatment controls BMPs	• Sand filters • Cartridge media filters • Bioretention with underdrains	• Vegetated swales • Vegetated detention basins • Vegetated filter strip • Wet detention basin
Zero-Discharge BMPs (1 point)	Fully capture and retain the design storm and do not release the stormwater back into surface waters or a storm drain system	• Bioretention with no underdrains • Infiltration basins or trenches • Drywells • Permeable pavement with no underdrains	

Projects not considered to be treatment control or LID BMPs will receive zero points for Line C, e.g.:

- Automatic Retractable Screens
- Trash Skimmer
- Trash Boom

Refer to Table 4.1 in the Orange County Technical Guidance Document (2013) for additional BMP types

*Lists are not exhaustive.

Connector Pipe Screen
Example Calculations

Connector Pipe Screen Example

Example Scenario

- Project location: Anaheim, CA
- One (1) connector pipe screen
- Drainage Area = 3 ac
- Priority Land Use Area = 2.5 ac
- Land uses are 75% impervious
- Time of concentration assumed at 20 minutes
- CPS unit is sized to accept the 1-yr, 1-hr event flowrate
- Total project cost = $1,500

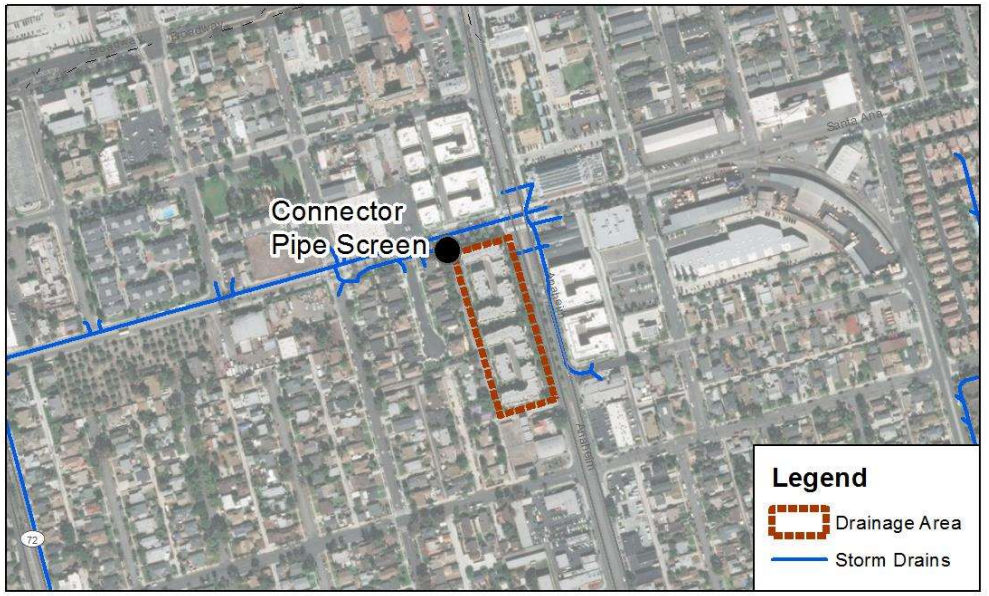
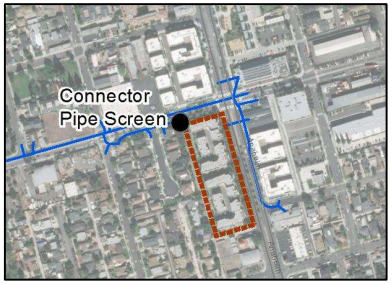


***Image for example purposes only.**

Q2 (Cost/Benefit): Connector Pipe Screen Example

Cost/Benefit (up to 16 points): Based on information provided by the applicant, a cost/benefit calculation will be conducted to compare the total project cost to the area of Priority Land Uses treated by the proposed BMP(s). Required information to be provided by the application includes the following:

	BMP(s)		
	Type 1	Type 2, etc.	
Type(s) of BMP(s) proposed:	CPS	-	
Number of each BMP type:	1	-	
Total drainage area(s) contributing to each BMP type:	3 ac	-	
			Total
Drainage area(s) that is/are considered Priority Land Uses*:	2.5 ac	-	2.5 ac
Total Project Cost:			$1,500
Cost/Benefit ($/ac of priority land uses):			$600/ac
Project Score (to be completed by OCTA):			TBD
*Refer to City General Plans for general land use distribution/coverage information. Refer to the Statewide Trash Provisions for a complete definition of Priority Land Uses (e.g. high density residential, industrial, commercial, mixed urban, public transportation stations).			



Project Cost Benefit
= $1,500/2.5 ac
= $600/ac

Q3.A (1-yr, 1-hr Capacity): Connector Pipe Screen Example

A	**Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)**

Use the Rational Equation to calculate the peak flowrate of the 1-yr, 1-hr event.

Q =CiA

Where,

Q = flowrate of 1-yr, 1-hr event discharging from the drainage area (cfs)

C = runoff coefficient of BMP drainage area (unitless)

i = rainfall intensity of 1-yr, 1-hr event (in/hr)

A = Area draining to the BMP (ac)

C can be assigned based on land use, or calculated:

$$C = (0.75 \times imp + 0.15)$$

imp = impervious fraction of drainage area (ranges from 0 to 1)

Source: North and South Orange County Public Works. 2013/2017. Technical Guidance Document (TGD) for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs).

NOAA Atlas 14 Point Precip Frequency Estimates

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.56 (1.31-1.87)	1.99 (1.67-2.41)	2.58 (2.16-3.12)	3.06 (2.53-3.74)	3.72 (2.98-4.72)	4.24 (3.31-5.48)	4.76 (3.62-6.32)	5.30 (3.91-7.26)	6.06 (4.27-8.66)	6.64 (4.52-9.85)
10-min	1.12 (0.936-1.34)	1.43 (1.20-1.73)	1.85 (1.54-2.24)	2.20 (1.82-2.68)	2.67 (2.13-3.38)	3.04 (2.37-3.93)	3.41 (2.60-4.53)	3.80 (2.81-5.21)	4.34 (3.07-6.20)	4.76 (3.24-7.06)
15-min	0.900 (0.752-1.08)	1.16 (0.968-1.39)	1.49 (1.24-1.80)	1.77 (1.46-2.16)	2.15 (1.72-2.72)	2.45 (1.91-3.17)	2.75 (2.09-3.66)	3.07 (2.26-4.20)	3.50 (2.47-5.00)	3.84 (2.61-5.69)
30-min	0.618 (0.518-0.746)	0.794 (0.664-0.958)	1.03 (0.856-1.24)	1.22 (1.01-1.49)	1.48 (1.18-1.87)	1.68 (1.31-2.18)	1.89 (1.44-2.51)	2.11 (1.56-2.88)	2.40 (1.70-3.44)	2.64 (1.80-3.91)
60-min	0.435 (0.364-0.524)	0.558 (0.467-0.673)	0.721 (0.602-0.873)	0.855 (0.707-1.04)	1.04 (0.830-1.32)	1.18 (0.923-1.53)	1.33 (1.01-1.77)	1.48 (1.09-2.03)	1.69 (1.19-2.42)	1.85 (1.26-2.75)
2-hr	0.314 (0.264-0.379)	0.404 (0.338-0.487)	0.520 (0.434-0.630)	0.615 (0.509-0.751)	0.744 (0.594-0.942)	0.844 (0.658-1.09)	0.945 (0.718-1.25)	1.05 (0.774-1.44)	1.19 (0.840-1.70)	1.30 (0.884-1.93)
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6-hr	0.185 (0.155-0.222)	0.236 (0.198-0.285)	0.304 (0.254-0.368)	0.359 (0.297-0.438)	0.433 (0.346-0.548)	0.490 (0.383-0.634)	0.548 (0.416-0.728)	0.607 (0.448-0.830)	0.686 (0.485-0.982)	0.748 (0.509-1.11)
12-hr	0.119 (0.100-0.143)	0.153 (0.128-0.184)	0.197 (0.165-0.239)	0.234 (0.193-0.285)	0.283 (0.226-0.358)	0.321 (0.251-0.416)	0.360 (0.274-0.478)	0.400 (0.295-0.548)	0.455 (0.321-0.650)	0.497 (0.338-0.738)
24-hr	0.081 (0.071-0.093)	0.104 (0.092-0.120)	0.136 (0.119-0.157)	0.161 (0.141-0.188)	0.197 (0.166-0.237)	0.224 (0.186-0.276)	0.252 (0.204-0.318)	0.281 (0.222-0.364)	0.321 (0.243-0.433)	0.353 (0.258-0.492)

Example Location: Anaheim

Q3.A (1-yr, 1-hr Capacity): Connector Pipe Screen Example

A	Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)

75% impervious drainage area

Criteria	Value	Unit
C= (0.75 × imp) + 0.15 = (0.75 x 75%) + 0.15	0.71	
i = 1-yr, 1-hr intensity*	0.44	in/hr
A	3	ac
1-yr, 1-hr peak flowrate (Q) = (0.71) (0.44 in/hr) (3 ac)	**0.94**	**cfs**
CPS design flowrate (from manufacturer)	1.5	cfs
Fractional percent of 1-yr, 1-hr event traveling to BMP = 1.5/0.94 = 1.6 (max available points = 1)	**1**	

NOAA Atlas 14 Point Precip Frequency Estimates

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.56 (1.31-1.87)	1.99 (1.67-2.41)	2.58 (2.16-3.12)	3.06 (2.53-3.74)	3.72 (2.98-4.72)	4.24 (3.31-5.48)	4.76 (3.62-6.32)	5.30 (3.91-7.26)	6.06 (4.27-8.66)	6.64 (4.52-9.85)
10-min	1.12 (0.936-1.34)	1.43 (1.20-1.73)	1.85 (1.54-2.24)	2.20 (1.82-2.68)	2.67 (2.13-3.38)	3.04 (2.37-3.93)	3.41 (2.60-4.53)	3.80 (2.81-5.21)	4.34 (3.07-6.20)	4.76 (3.24-7.06)
15-min	0.900 (0.752-1.08)	1.16 (0.968-1.39)	1.49	1.77	2.15	2.45 (1.91-3.17)	2.75 (2.09-3.66)	3.07 (2.26-4.20)	3.50 (2.47-5.00)	3.84 (2.61-5.69)
30-min	0.618 (0.518-0.746)	0.7				1.68	1.89 (1.44-2.51)	2.11 (1.56-2.88)	2.40 (1.70-3.44)	2.64 (1.80-3.91)
60-min	0.435 (0.364-0.524)	0.558 (0.467-0.6				1.18	1.33 (1.01-1.77)	1.48 (1.09-2.03)	1.69 (1.19-2.42)	1.85 (1.26-2.75)
2-hr	0.314 (0.264-0.379)	0.404 (0.338-				0.844	0.945 (0.718-1.25)	1.05 (0.774-1.44)	1.19 (0.840-1.70)	1.30 (0.884-1.93)
3-hr	0.261 (0.219-0.315)	0.335 (0.281-0.405)				0.697 (0.544-0.902)	0.780 (0.593-1.04)	0.864 (0.638-1.18)	0.978 (0.691-1.40)	1.07 (0.726-1.58)
6-hr	0.185 (0.155-0.222)	0.236 (0.196-0.285)	0.304 (0.254-0.368)	0.359 (0.297-0.438)	0.433 (0.346-0.548)	0.490 (0.383-0.634)	0.548 (0.416-0.728)	0.607 (0.448-0.830)	0.686 (0.485-0.982)	0.748 (0.509-1.11)
12-hr	0.119 (0.100-0.143)	0.153 (0.128-0.184)	0.197 (0.165-0.239)	0.234 (0.193-0.285)	0.283 (0.226-0.358)	0.321 (0.251-0.416)	0.360 (0.274-0.478)	0.400 (0.295-0.548)	0.455 (0.321-0.650)	0.497 (0.338-0.738)
24-hr	0.081 (0.071-0.093)	0.104 (0.092-0.120)	0.136 (0.119-0.157)	0.161 (0.141-0.188)	0.197 (0.166-0.237)	0.224 (0.186-0.276)	0.252 (0.204-0.318)	0.281 (0.222-0.364)	0.321 (0.243-0.433)	0.353 (0.258-0.492)

0.435
(0.364-0.524)

*Example Location: Anaheim

Q3.B (WQ Storm Hydrology): Connector Pipe Screen Example

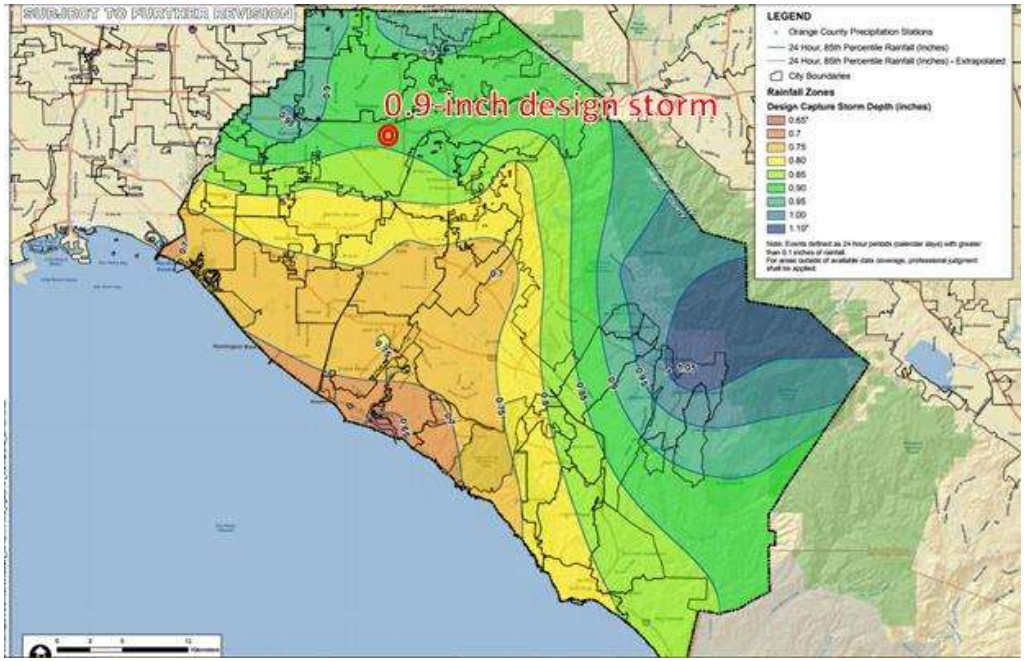
B	**Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)**

Estimate the design storm depth associated with the 85th percentile, 24-hr event.

Criteria	Value	Unit
i = storm depth*	0.90	in

*Example Location: Anaheim

Orange County Public Works, 2013 Technical Guidance Document



Q3.B (WQ Storm Hydrology): Connector Pipe Screen Example

B	**Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)**

Use multiplier to calculate the design storm intensity equivalent to the design storm depth:

Function of topography, geology, land use

Time of Concentration (Tc) (assumed for this example)	20	min
Tc Multiplier	0.19	in/hr
Fraction of design storm entering the BMP	100%	
Equivalent BMP design intensity = (0.19 in/hr)(100%)	0.19	in/hr

Table VI.1: Table of Multipliers for Computing Remaining Design Storm Intensity

Time of Concentration, minutes	Multiplier to Convert Remaining Fraction of Design Capture Storm Depth to Design Intensity, in/hr
60	0.15
30	0.18
20	0.19
15	0.21
10	0.23
5	0.26

Step-by-step instruction provided in Orange County Public Works, 2013 Technical Guidance Document, Section VI.3.1.2.

Q3.B (WQ Storm Hydrology): Connector Pipe Screen Example

B	**Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)**

Calculate the design flowrate equivalent to design volume:

Criteria	Value	Unit
C = (0.75 x 75%) + 0.15	0.71	
I = equivalent BMP design intensity	0.19	in/hr
A	3	ac
Design Storm Flowrate (Q) = (0. 71)(0.19 in/hr)(3 ac)	**0.4**	**cfs**
CPS design flowrate (from manufacturer)	1.5	cfs
Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP= 1.5/0.4 = 3.75 (max available points = 1.5)	**1.5 Points**	

Q3.C (BMP Type): Connector Pipe Screen Example

C	**BMP Multiplier:** • **0 points if BMP is not LID or treatment control** • **1/3 point for high capacity systems** • **2/3 point for filters/biofilters** • **1 point for zero-discharge BMPs**
Connector pipe screens are not considered to be LID or treatment control BMPs per the Orange County Technical Guidance Documents (2013).	
BMP Multiplier (max available points = 1)	**0 Points**

Q3 (Pollutant Reduction Benefit): CPS Example Score

3) Pollutant Reduction Benefits (Up to 12 points): Project benefits will be based on treatment capacity and BMP type.

Scoring Equation (Max 12 points): (A x 3) + (B x 3) + (C x 6)

Line	Factor	Points Available	Points Earned	Calculated Score
A	Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)	(0 to 1) x 3	1	3
B	Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)	(0 to 1.5) x 3	1.5	4.5
C	BMP Multiplier: • 0 points if BMP is not LID or treatment control • 1/3 point for high capacity systems • 2/3 point for filters/biofilters • 1 point for zero-discharge BMPs	(0 to 1) x 6	0	0
			Example Project Score	**7.5**

Hydrodynamic Separator
Example Calculations

Hydrodynamic Separator Example

Example Scenario

- Project location: Anaheim, CA
- One (1) hydrodynamic separator
- Drainage Area = 100 ac
- Priority Land Use Area = 75 ac
- Land uses are 80% impervious
- Time of concentration assumed at 30 minutes
- BMP sized to accept 1-yr, 1-hr event flowrate
- Total project cost = $105,000

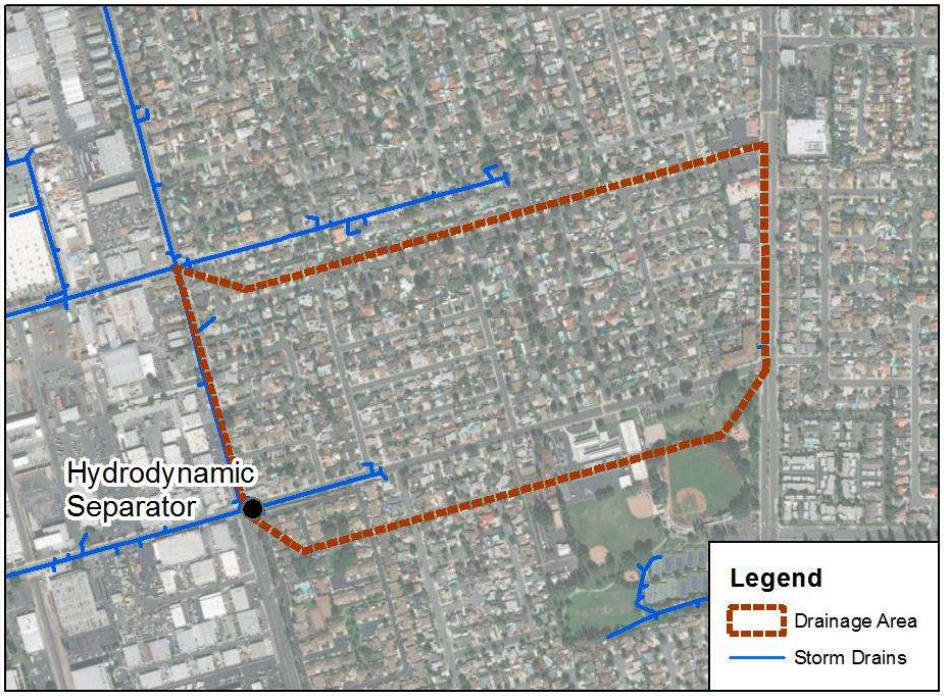


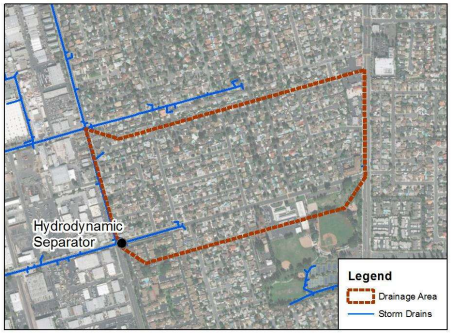
***Image for example purposes only.**

Q2 (Cost/Benefit): Hydrodynamic Separator Example

Cost/Benefit (up to 16 points): Based on information provided by the applicant, a cost/benefit calculation will be conducted to compare the total project cost to the area of Priority Land Uses treated by the proposed BMP(s). Required information to be provided by the application includes the following:

	BMP(s)		
	Type 1	Type 2, etc.	
Type(s) of BMP(s) proposed:	HDS	-	
Number of each BMP type:	1	-	
Total drainage area(s) contributing to each BMP type:	100 ac	-	
			Total
Drainage area(s) that is/are considered Priority Land Uses*:	75 ac	-	75 ac
Total Project Cost:			$105,000
Cost/Benefit ($/ac of priority land uses):			$1,400/ac
Project Score (to be completed by OCTA):			TBD

*Refer to City General Plans for general land use distribution/coverage information. Refer to the Statewide Trash Provisions for a complete definition of Priority Land Uses (e.g. high density residential, industrial, commercial, mixed urban, public transportation stations).



Project Cost Benefit
= $105,000/75 ac
= $1,400/ac

Q3.A (1-yr, 1-hr Capacity): Hydrodynamic Separator Example

A	**Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)**

Use the Rational Equation to calculate the peak flowrate of the 1-yr, 1-hr event.
Q =CiA

80% impervious drainage area

Criteria	Value	Unit
C = (0.75 × imp) + 0.15 = (0.75 x 80%) + 0.15	0.75	
i = 1-yr, 1-hr intensity*	0.44	in/hr
A	100	ac
Q = (0.75) (0.44 in/hr) (100 ac)	33	cfs
HDS design flowrate (from manufacturer)	35	cfs
Fractional percent of 1-yr, 1-hr event traveling to BMP = 35/33 = 1.1 (max available points = 1)	**1 Point**	

*Example Location: Anaheim

NOAA Atlas 14 Point Precip Frequency Estimates

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.56 (1.31-1.87)	1.99 (1.67-2.41)	2.58 (2.16-3.12)	3.06 (2.53-3.74)	3.72 (2.98-4.72)	4.24 (3.31-5.48)	4.76 (3.62-6.32)	5.30 (3.91-7.26)	6.06 (4.27-8.66)	6.64 (4.52-9.85)
10-min	1.12 (0.936-1.34)	1.43 (1.20-1.73)	1.85 (1.54-2.24)	2.20 (1.82-2.68)	2.67 (2.13-3.38)	3.04 (2.37-3.93)	3.41 (2.60-4.53)	3.80 (2.81-5.21)	4.34 (3.07-6.20)	4.76 (3.24-7.06)
15-min	0.900 (0.752-1.08)	1.16 (0.968-1.39)	1.49	1.77	2.15	2.45 (1.91-3.17)	2.75 (2.09-3.66)	3.07 (2.26-4.20)	3.50 (2.47-5.00)	3.84 (2.61-5.69)
30-min	0.618 (0.518-0.746)	0.794				1.68 (1.31-2.18)	1.89 (1.44-2.51)	2.11 (1.56-2.88)	2.40 (1.70-3.44)	2.64 (1.80-3.91)
60-min	0.435 (0.364-0.524)	0.558				1.18 (0.923-1.53)	1.33 (1.01-1.77)	1.48 (1.09-2.03)	1.69 (1.19-2.42)	1.85 (1.26-2.75)
2-hr	0.314 (0.264-0.379)	0.404				0.844 (0.658-1.09)	0.945 (0.718-1.25)	1.05 (0.774-1.44)	1.19 (0.840-1.70)	1.30 (0.884-1.93)
3-hr	0.261 (0.219-0.315)	0.335 (0.281-0.405)				0.697 (0.544-0.902)	0.780 (0.593-1.04)	0.864 (0.638-1.18)	0.978 (0.691-1.40)	1.07 (0.726-1.58)
6-hr	0.185 (0.155-0.222)	0.236 (0.198-0.285)	0.304 (0.254-0.368)	0.359 (0.297-0.438)	0.433 (0.346-0.548)	0.490 (0.383-0.634)	0.548 (0.416-0.728)	0.607 (0.448-0.830)	0.686 (0.485-0.982)	0.748 (0.509-1.11)
12-hr	0.119 (0.100-0.143)	0.153 (0.128-0.184)	0.197 (0.165-0.239)	0.234 (0.193-0.285)	0.283 (0.226-0.358)	0.321 (0.251-0.416)	0.360 (0.274-0.478)	0.400 (0.295-0.548)	0.455 (0.321-0.650)	0.497 (0.336-0.738)
24-hr	0.081 (0.071-0.093)	0.104 (0.092-0.120)	0.136 (0.119-0.157)	0.161 (0.141-0.188)	0.197 (0.166-0.237)	0.224 (0.186-0.276)	0.252 (0.204-0.318)	0.281 (0.222-0.364)	0.321 (0.243-0.433)	0.353 (0.258-0.492)

0.435
(0.364-0.524)

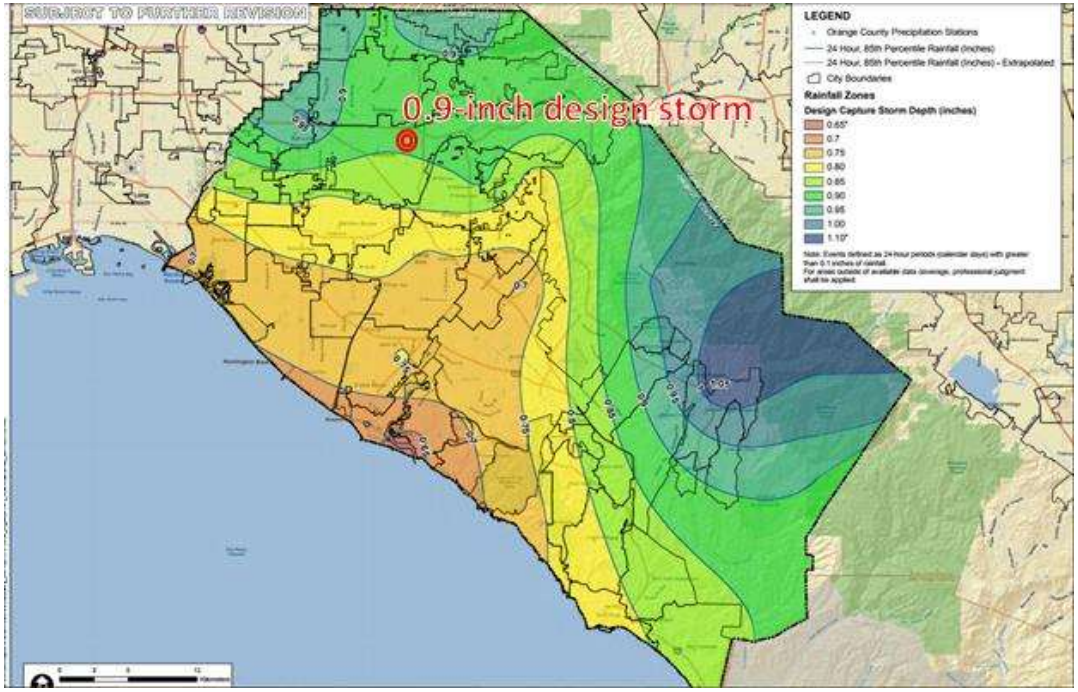
Q3.B (WQ Storm Hydrology): Hydrodynamic Separator Example

B	**Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)**

Criteria	Value	Unit
i= storm depth*	0.90	in

*Example: Anaheim

Orange County Public Works, 2013 Technical Guidance Document



Q3.B (WQ Storm Hydrology): Hydrodynamic Separator Example

B	**Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)**

Use multiplier to calculate the design storm intensity equivalent to the design storm depth:

Time of Concentration of Priority Land Uses (Tc) (assumed for this example)	30	min
Tc Multiplier[1]	0.18	in/hr
Fraction of design storm entering the BMP	100%	
Equivalent BMP design intensity=(0.18 in/hr)(1)	0.18	in/hr

Calculate the design flowrate equivalent to design volume:

Criteria	Value	Unit
C= (0.75 x 80%) + 0.15	0.75	
A	100	ac
Q = (0.75)(0.18 in/hr)(100 ac)	**13.5**	**cfs**
HDS design flowrate (trash treatment capacity of pre-cast HDS unit)	35	cfs
Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP= 35/13.5 = 2.6 (max points available = 1.5)	**1.5 Points**	

[1]Orange County Public Works. 2013. Technical Guidance Document (TGD) for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs). https://ocerws.ocpublicworks.com/sites/ocpwocerws/files/2021-01/SantaAnaRegion-TechnicalGuidance-December2013.pdf, Table VI.1)

Q3.C (BMP Type): Hydrodynamic Separator Example

C	**BMP Multiplier:** • **0 points if BMP is not LID or treatment control** • **1/3 point for high capacity systems** • **2/3 point for filters/biofilters** • **1 point for zero-discharge BMPs**
HDS units are considered high-capacity systems.	
BMP Multiplier (max available points = 1)	**0.33 Points**

Q3 (Pollutant Reduction Benefit): Hydrodynamic Separator Score

3) Pollutant Reduction Benefits (Up to 12 points): Project benefits will be based on treatment capacity and BMP type.

Scoring Equation (Max 12 points): (A x 3) + (B x 3) + (C x 6)

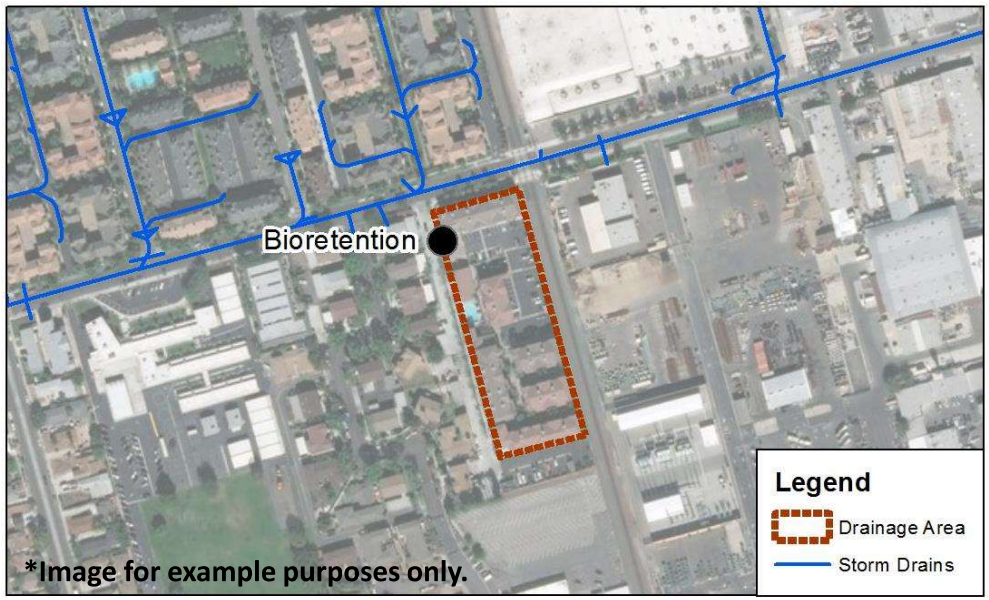
Line	Factor	Points Available	Points Earned	Calculated Score
A	Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)	(0 to 1) x 3	1	3
B	Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)	(0 to 1.5) x 3	1.5	4.5
C	BMP Multiplier: • 0 points if BMP is not LID or treatment control • 1/3 point for high capacity systems • 2/3 point for filters/biofilters • 1 point for zero-discharge BMPs	(0 to 1) x 6	0.33	2
			Example Project Score:	**9.5**

Bioretention without Underdrain
Example Calculations

Bioretention, No Underdrain Example

Example Scenario

- Project location: Anaheim, CA
- Drainage Area = 3 ac
- Priority Land Use Area = 2.5 ac
- Land uses are 75% impervious
- Total project cost = $200,000

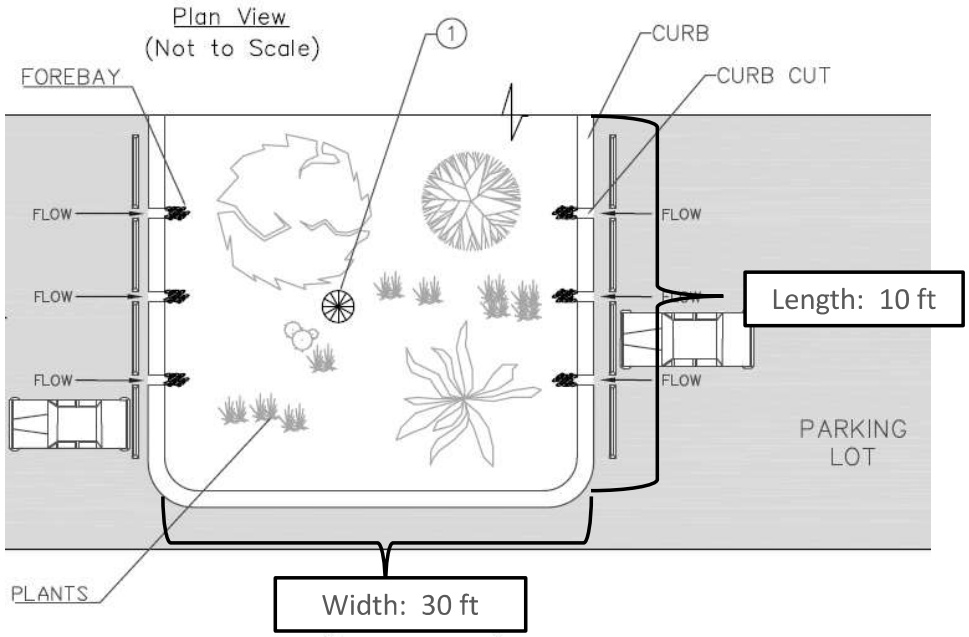


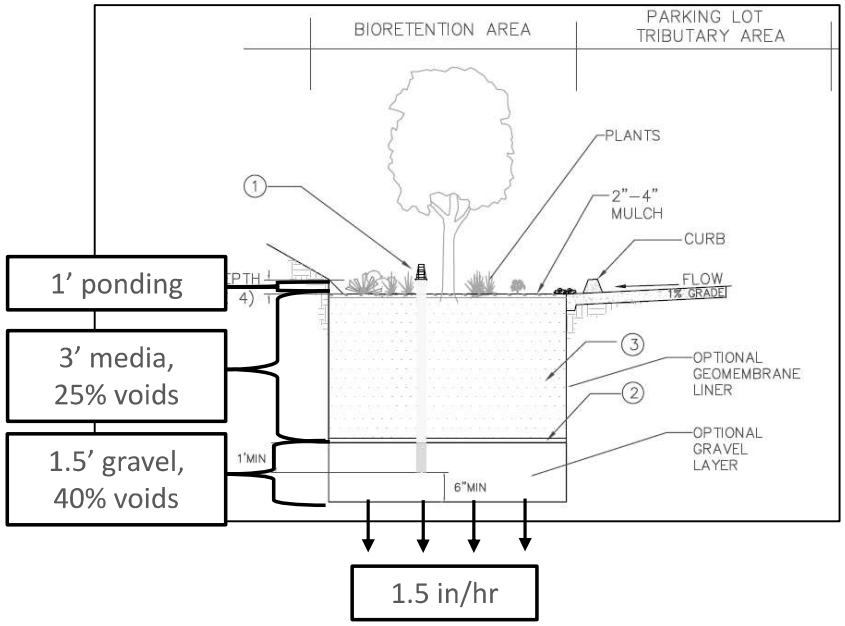
Bioretention, No Underdrain Example

Example Scenario:

- Total effective storage capacity (surface + media + gravel): 705 cf
- Infiltration rate = 3 in/hr; Factor of Safety* = 2 → Design infiltration rate = 1.5 in/hr

*OC TGD 2013, Appendix VII, Section VII.4.3 – Assuming "medium concern"





Q2 (Cost/Benefit): Bioretention, No Underdrain Example

Cost/Benefit (up to 16 points): Based on information provided by the applicant, a cost/benefit calculation will be conducted to compare the total project cost to the area of Priority Land Uses treated by the proposed BMP(s). Required information to be provided by the application includes the following:

	BMP(s)		
	Type 1	Type 2, etc.	Total
Type(s) of BMP(s) proposed:	Bioretention	-	
Number of each BMP type:	1	-	
Total drainage area(s) contributing to each BMP type:	3 ac	-	
Drainage area(s) that is/are considered Priority Land Uses*:	2.5ac	-	2.5 ac
Total Project Cost:			$200,000
Cost/Benefit ($/ac of priority land uses):			$80,000/ac
Project Score (to be completed by OCTA):			TBD

*Refer to City General Plans for general land use distribution/coverage information. Refer to the Statewide Trash Provisions for a complete definition of Priority Land Uses (e.g. high density residential, industrial, commercial, mixed urban, public transportation stations).

Project Cost Benefit
= $200,000/2.5 ac
= $80,000/ac

Q3.A (1-yr, 1-hr Capacity): Bioretention, No Underdrain Example

A	**Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)**

Use the Rational Equation to estimate the 1-yr, 1-hr equivalent runoff volume for the volume-based BMP.

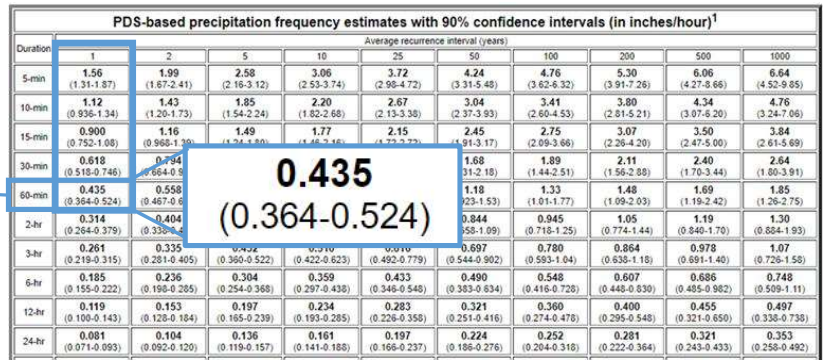
$V_{runoff\text{-}1} = CiA$

75% impervious drainage area

Criteria	Value	Unit
C= (0.75 × imp) + 0.15 = (0.75 x 75%) + 0.15	0.71	
i = 1-yr, 1-hr depth*	0.44	in/hr for 1 hr
A	3	Ac
$V_{runoff\text{-}1}$ =1-yr, 1-hr runoff volume = (0.71)[(0.44 in)/12][(3 ac)(43,560)]	3,402	cf

*Example Location: Anaheim

NOAA Atlas 14 Point Precip Frequency Estimates



PDS-based precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.56 (1.31-1.87)	1.99 (1.67-2.41)	2.58 (2.16-3.12)	3.06 (2.53-3.74)	3.72 (2.98-4.72)	4.24 (3.31-5.48)	4.76 (3.62-6.32)	5.30 (3.91-7.26)	6.06 (4.27-8.66)	6.64 (4.52-9.85)
10-min	1.12 (0.936-1.34)	1.43 (1.20-1.73)	1.85 (1.54-2.24)	2.20 (1.82-2.68)	2.67 (2.13-3.38)	3.04 (2.37-3.93)	3.41 (2.60-4.53)	3.80 (2.81-5.21)	4.34 (3.07-6.20)	4.76 (3.24-7.06)
15-min	0.900 (0.752-1.08)	1.16 (0.968-1.39)	1.49	1.77	2.15	2.45	2.75 (2.09-3.66)	3.07 (2.26-4.20)	3.50 (2.47-5.00)	3.84 (2.61-5.69)
30-min	0.618 (0.518-0.746)					1.68	1.89 (1.44-2.51)	2.11 (1.56-2.88)	2.40 (1.70-3.44)	2.64 (1.80-3.91)
60-min	0.435 (0.364-0.524)	0.558				1.18	1.33 (1.01-1.77)	1.48 (1.09-2.03)	1.69 (1.19-2.42)	1.85 (1.26-2.75)
2-hr	0.314 (0.264-0.379)					0.844	0.945 (0.718-1.25)	1.05 (0.774-1.44)	1.19 (0.840-1.70)	1.30 (0.884-1.93)
3-hr	0.261 (0.219-0.315)	0.335 (0.281-0.405)				0.697 (0.544-0.902)	0.780 (0.593-1.04)	0.864 (0.638-1.18)	0.978 (0.691-1.40)	1.07 (0.726-1.58)
6-hr	0.185 (0.155-0.222)	0.236 (0.198-0.285)	0.304 (0.254-0.368)	0.359 (0.297-0.438)	0.433 (0.346-0.548)	0.490 (0.383-0.634)	0.548 (0.416-0.726)	0.607 (0.448-0.830)	0.686 (0.485-0.982)	0.748 (0.509-1.11)
12-hr	0.119 (0.100-0.143)	0.153 (0.128-0.184)	0.197 (0.165-0.239)	0.234 (0.193-0.285)	0.283 (0.226-0.358)	0.321 (0.251-0.416)	0.360 (0.274-0.478)	0.400 (0.295-0.548)	0.455 (0.321-0.650)	0.497 (0.338-0.738)
24-hr	0.081 (0.071-0.093)	0.104 (0.092-0.120)	0.136 (0.119-0.157)	0.161 (0.141-0.188)	0.197 (0.166-0.237)	0.224 (0.186-0.276)	0.252 (0.204-0.318)	0.281 (0.222-0.364)	0.321 (0.243-0.433)	0.353 (0.258-0.492)

0.435
(0.364-0.524)

Q3.A (1-yr, 1-hr Capacity): Bioretention, No Underdrain Example

A	**Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)**

Estimate the storage volume available within the bioretention cell:

Criteria	Value	Unit
Example bioretention effective design volume	705	cf
Fractional percent of 1-yr, 1-hr event that is treated by the BMP= 705 cf/3,402 cf = 0.21 (max points available = 1)	**0.21 Points**	

$V_{runoff-1}$

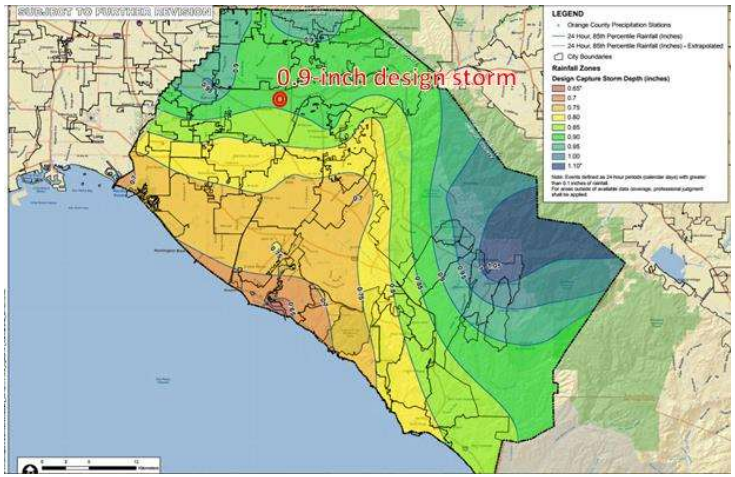
Q3.B (WQ Storm Hydrology): Bioretention, No Underdrain Ex.

B **Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)**

Use the Rational Method to calculate the runoff volume from the 85th percentile, 24-hr event

$V_{runoff\text{-}24} = CiA$

Orange County Public Works, 2013 Technical Guidance Document



Criteria	Value	Unit
C= (0.75 x 75%) + 0.15	0.71	
i= storm depth*	0.9	in
A	3	ac
$V_{runoff\text{-}24}$ = Runoff volume of 85th percentile, 24-hr event = (0.71)[(0.9 in/12)][(3 ac)(43560)]	**6,959**	**cf**

*Example Location: Anaheim

Q3.B (WQ Storm Hydrology): Bioretention, No Underdrain Ex.

B Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)

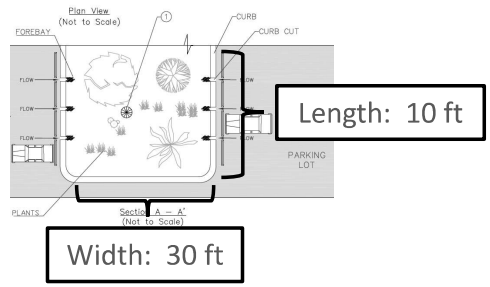
Next, estimate the anticipated volume infiltrated beneath bioretention in 24-hr period:

$$V_{infilt} = A_{bio}(i_{in\ situ}/12)(24\ hr)$$

Where,

A_{bio} = Bottom surface area of BMP (ft^2)

$i_{in\ situ}$ = Effective infiltration rate of in situ soils beneath BMP; FS applied (in/hr)



Criteria	Value	Unit
$i_{in\ situ}$ = infiltration rate / FS = (3 in/hr)/2	1.5	in/hr
V_{infilt}= (10 ft x 30 ft)(1.5 in/hr)(24hr) /12	900	cf

Finally, estimate the storage volume available within the bioretention cell and in situ soils:

Criteria	Value	Unit
Example bioretention effective design volume + in situ storage = 705 + 900 cf	1,605	cf
Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP= 1,605 cf/6,959 cf = 0.23 (max points available = 1.5)	**0.23 Points**	

$V_{runoff\text{-}24}$

Q3.C (BMP Type): Bioretention, No Underdrain Example

C	**BMP Multiplier:** • **0 points if BMP is not LID or treatment control** • **1/3 point for high capacity systems** • **2/3 point for filters/biofilters** • **1 point for zero-discharge BMPs**
Bioretention without underdrain is considered a zero-discharge BMP.	
BMP Multiplier (max available points = 1)	1 Point

Q3 (Pollutant Reduction Benefit): Bioretention, No Underdrain Score

3) Pollutant Reduction Benefits (Up to 12 points): Project benefits will be based on treatment capacity and BMP type.

Scoring Equation (Max 12 points): (A x 3) + (B x 3) + (C x 6)

Line	Factor	Points Available	Points Earned	Calculated Score
A	Fractional percent of 1-yr, 1-hr event peak flowrate discharging from priority land uses to the BMP(s)	(0 to 1) x 3	0.21	0.63
B	Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)	(0 to 1.5) x 3	0.23	0.69
C	BMP Multiplier: • 0 points if BMP is not LID or treatment control • 1/3 point for high capacity systems • 2/3 point for filters/biofilters • 1 point for zero-discharge BMPs	(0 to 1) x 6	1	6
			Example Project Score:	**7.3**

Mixed Flow- and Volume-Based BMP Example Calculations

Mixed Flow/Volume-Based BMP Example

Example Scenario

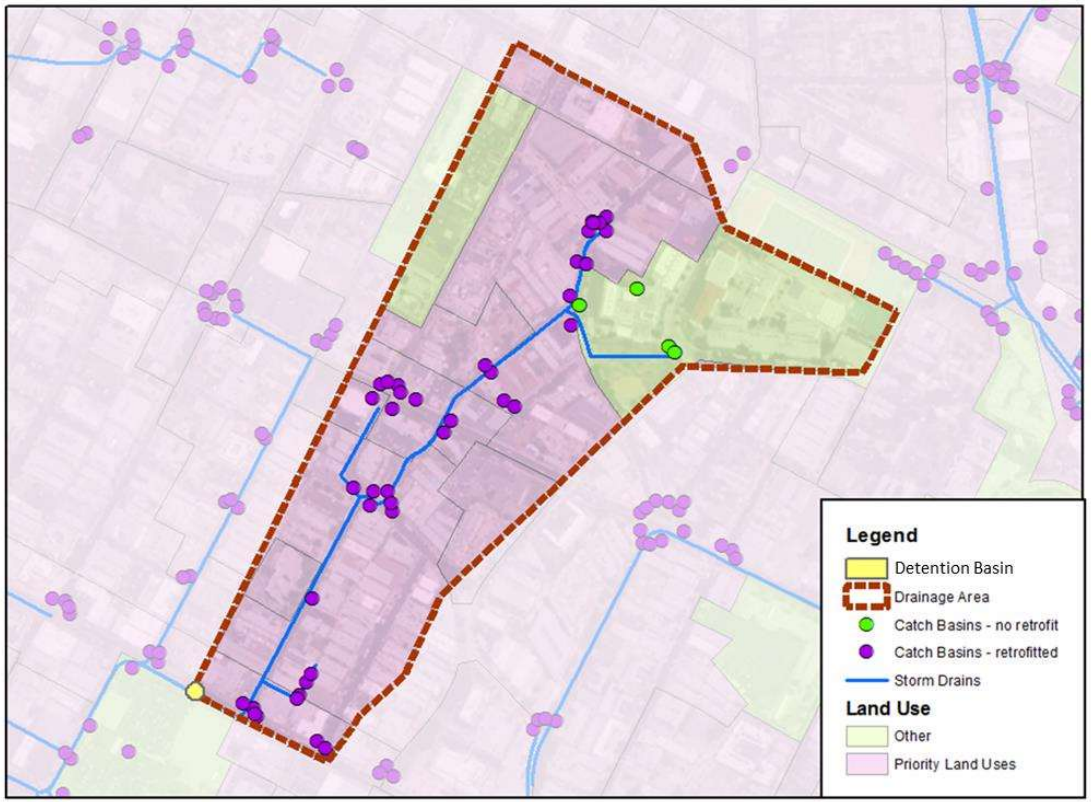
- Total land uses are 75% impervious
- 38 CPS units
  - CPS design flowrates: 1.5 cfs
- 1 detention basin at DA outlet
  - Basin design volume = 206,000 cf
- Total project cost = $257,000

CPS Drainage Area

- Total Drainage Area: 85 ac
- Total Priority LU: 80 ac

Detention Basin Drainage Area

- Total Drainage Area: 100 ac
- Total Priority LU: 80 ac



Q2 (Cost/Benefit): Mixed Flow/Volume BMPs

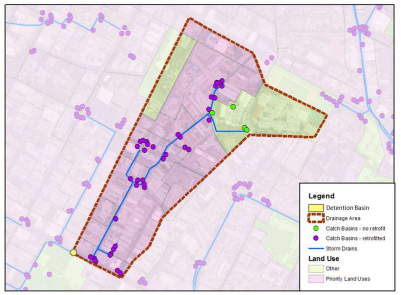
2) Cost/Benefit (up to 16 points): Based on information provided by the applicant, a cost/benefit calculation will be conducted to compare the total project cost to the area of Priority Land Uses treated by the proposed BMP(s). Required information to be provided by the application includes the following:

	BMP(s)		
	Type 1	Type 2, etc.	
Type(s) of BMP(s) proposed:	CPS	Detention Basin	
Number of each BMP type:	38	1	
Total drainage area(s) contributing to each BMP type:	85 ac	100 ac	
Drainage area(s) that is/are considered Priority Land Uses*:	80 ac	80 ac	80 ac
Total Project Cost:			$257,000
Cost/Benefit ($/ac of priority land uses):			$3,213/ac
Project Score (to be completed by OCTA):			TBD
*Refer to City General Plans for general land use distribution/coverage information. Refer to the Statewide Trash Provisions for a complete definition of Priority Land Uses (e.g., high density residential, industrial, commercial, mixed urban, public transportation stations).			

Spatially determined (e.g. GIS, Google Earth). **Not additive here**

Total

Project Cost Benefit
= $257,000/80 ac
= $3,213/ac



Q3.A (1-yr, 1-hr Capacity): Mixed Flow/Volume BMPs

A	**Fractional percent of 1-yr, 1-hr event peak flowrate treated by the BMP(s)**

BMP 1: Connector Pipe Screen

Criteria	Value	Unit
C= (0.75 x 75%) + 0.15	0.71	
I	0.44	in/hr
A = Avg. contrib. DA per CPS = 85 ac/38 units	2.2	ac
Avg. 1-yr, 1-hr peak flowrate (Q)	**0.69**	**cfs**
CPS design flowrates	1.5	cfs
Fractional percent of 1-yr, 1-hr event traveling to BMPs = 1.5/0.69 = 2.17	**1 Point**	

BMP 2: Detention Basin

Criteria	Value	Unit
C= (0.75 x 75%) + 0.15	0.71	
i	0.44	in/hr
A = Contributing DA to Basin	100	ac
$V_{runoff\text{-}1}$ =1-yr, 1-hr runoff volume	**113,400**	**cf**
Example basin design volume	206,000	cf
Fractional percent of 1-yr, 1-hr event captured by BMP = 206,000 /113,400 = 1.8	**1 Point**	

Q3.A Weighted Points:

$$\frac{(\text{BMP1 Points})(\text{BMP1 DA})+(\text{BMP2 Points})(\text{BMP2 DA})}{\text{BMP1 DA}+\text{BMP2 DA}} = \frac{(1)(85\text{ ac})+(1)(100\text{ ac})}{185\text{ ac}} = \mathbf{1}$$

Q3.B (WQ Storm Hydrology): Mixed Flow/Volume BMPs

B Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)

BMP 1: Connector Pipe Screen

Criteria	Value	Unit
Design flowrate equivalent to design volume	0.30	cfs
CPS design flowrate	1.50	cfs
Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP = 1.5/0.3 = 5	**1.5 Points**	

BMP 2: Detention Basin

Criteria	Value	Unit
Runoff volume of 85th percentile, 24-hr event	232,774	cf
Detention basin effective design volume	230,000	cf
Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP = 230,000/232,774 = 0.99	**0.99 Points**	

Q3.B Weighted Points:

$$\frac{(\text{BMP1 Points})(\text{BMP1 DA})+(\text{BMP2 Points})(\text{BMP2 DA})}{\text{BMP1 DA}+\text{BMP2 DA}} = \frac{(1.5)(85\text{ ac})+(0.99)(100\text{ ac})}{185\text{ ac}} = \mathbf{1.22}$$

Q3.C (BMP Type): Mixed Flow/Volume BMPs

BMP 1: Connector Pipe Screen

C	**BMP Multiplier:** • **0 points if BMP is not LID or treatment control** • **1/3 point for high capacity systems** • **2/3 point for filters/biofilters** • **1 point for zero-discharge BMPs**
CPS are not considered to be LID or treatment control BMPs, per the Orange County Technical Guidance Documents (2013, 2017).	
BMP Multiplier	**0 Points**

BMP 2: Detention Basin

C	**BMP Multiplier:** • **0 points if BMP is not LID or treatment control** • **1/3 point for high capacity systems** • **2/3 point for filters/biofilters** • **1 point for zero-discharge BMPs**
Detention Basin is considered a zero-discharge BMP.	
BMP Multiplier	**1 Point**

Q3.C Weighted Points:

$$\frac{(\text{BMP1 Points})(\text{BMP1 DA})+(\text{BMP2 Points})(\text{BMP2 DA})}{\text{BMP1 DA}+\text{BMP2 DA}} = \frac{(0)(85\text{ ac})+(1)(100\text{ ac})}{185\text{ ac}} = \mathbf{0.54}$$

Q3 (Pollutant Reduction Benefit): Mixed Flow/Volume BMPs

3) Pollutant Reduction Benefits (Up to 12 points): Project benefits will be based on treatment capacity and BMP type.

Scoring Equation (Max 12 points): (A x 3) + (B x 3) + (C x 6)

Line	Factor	Points Available	Points Earned	Calculated Score
A	Fractional percent of 1-yr, 1-hr event peak flowrate discharging from priority land uses to the BMP(s)	(0 to 1) x 3	1	3
B	Fractional percent of 85th percentile, 24-hr design event that is treated by the BMP(s)	(0 to 1.5) x 3	1.22	3.66
C	BMP Multiplier: • 0 points if BMP is not LID or treatment control • 1/3 point for high capacity systems • 2/3 point for filters/biofilters • 1 point for zero-discharge BMPs	(0 to 1) x 6	0.54	3.24
			Example Project Score:	**9.9**