October 2009

Supplement to the 4th Edition

CONTRA COSTA
CLEAN WATER
PROGRAM

Stormwater C.3 Guidebook

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Contra Costa Clean Water Program

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Contents

IMP Sizing Using the Contra Costa Clean Water Program *Stormwater C.3 Guidebook*

Facility Design	Soil Group	Bioretention Area (ft^2/ft^2)	Upstream Volume, V or V_1 (ft^3/ft^2)	Downstream Volume V or V_2 (ft^3/ft^2)	Rainfall Adjustment for Surface Area	Rainfall Adjustment for Storage Volume	Maximum Release Rate
Bioretention Facility	A	0.07	0.058	No minimum	Equation 4-3	Equation 4-3	No orifice required
	B	0.11	0.092	No minimum	Equation 4-4	Equation 4-4	No orifice required
	C	0.06	0.050	0.066	Equation 4-5	Equation 4-5	Equation 4-9
	D	0.05	0.042	0.055	Equation 4-6	Equation 4-6	Equation 4-10
Flow-through Planter	A	Not permitted in "A" soils					
	B	Not permitted in "B" soils					
	C	0.06	0.050	0.066	Equation 4-5	Equation 4-5	Equation 4-9
	D	0.05	0.042	0.055	Equation 4-6	Equation 4-6	Equation 4-10
Dry Well	A	0.05	0.130	Not applicable	Equation 4-3	Equation 4-3	No release
	B	0.06	0.204	Not applicable	Equation 4-4	Equation 4-4	No release
	C	Not permitted in "C" soils					
	D	Not permitted in "D" soils					
Cistern + Bioretention	A	0.020	0.193	Not applicable	Equation S-1	Equation 4-3	Equation S-5
	B	0.009	0.210	Not applicable	Equation S-2	Equation 4-4	Equation 4-11
	C	0.013	0.105	Not applicable	Equation S-3	Equation 4-5	Equation 4-9
	D	0.017	0.063	Not applicable	Equation S-4	Equation 4-6	Equation 4-10
Bioretention + Vault	A	0.04	Not applicable	0.096	No adjustment	Equation 4-3	No release
	B	0.04	Not applicable	0.220	No adjustment	Equation 4-4	Equation 4-11
	C	0.04	Not applicable	0.152	No adjustment	Equation 4-5	Equation 4-9
	D	0.04	Not applicable	0.064	No adjustment	Equation 4-6	Equation 4-10

Equations:

Equation 4-3	$Rain\ \ Adjustment = \dfrac{0.0009 \times (MAP_{project\ \ site} - 20.2) + 0.07}{0.07}$
Equation 4-4	$Rain\ \ Adjustment = \dfrac{-0.0005 \times (MAP_{project\ \ site} - 20.2) + 0.11}{0.11}$
Equation 4-5	$Rain\ \ Adjustment = \dfrac{-0.0022 \times (MAP_{project\ \ site} - 20.2) + 0.06}{0.06}$
Equation 4-6	$Rain\ \ Adjustment = \dfrac{-0.0022 \times (MAP_{project\ \ site} - 20.2) + 0.05}{0.05}$
Equation 4-9	$Flow\ \ (cfs\ \ per\ \ ft^2) = \dfrac{0.093 \times (MAP_{project\ \ site} - 20.2) + 1.42}{10^6}$
Equation 4-10	$Flow\ \ (cfs\ \ per\ \ ft^2) = \dfrac{0.122 \times (MAP_{project\ \ site} - 20.2) + 1.85}{10^6}$
Equation 4-11	$Flow\ \ (cfs\ \ per\ \ ft^2) = \dfrac{0.071 \times (MAP_{project\ \ site} - 20.2) + 0.91}{10^6}$
Equation S-1	$Area\ Ratio = \dfrac{0.151 \times (MAP_{project\ \ site} - 20.2) + 2.30}{2.30}$
Equation S-2	$Area\ Ratio = \dfrac{0.071 \times (MAP_{project\ \ site} - 20.2) + 0.91}{0.91}$
Equation S-3	$Area\ Ratio = \dfrac{0.093 \times (MAP_{project\ \ site} - 20.2) + 1.42}{1.42}$
Equation S-4	$Area\ Ratio = \dfrac{0.122 \times (MAP_{project\ \ site} - 20.2) + 1.85}{1.85}$
Equation S-5	$Flow\ \ (cfs\ \ per\ \ ft^2) = \dfrac{0.151 \times (MAP_{project\ \ site} - 20.2) + 2.30}{10^6}$

Mean Annual Precipitation (MAP) is determined by finding the project location on the isohyetal map, Contra Costa Public Works Drawing B-166, available at http://www.cccleanwater.org/c3-guidebook.html

Cistern + Bioretention Facility

In this functional sculpture, a cistern captures roof runoff and drains it slowly to a landscaped area. Photo courtesy of the City of Seattle.

A cistern in series with a bioretention facility or flow-through planter can meet treatment and flow-control requirements where space is limited. The cistern includes an orifice for flow control. The downstream bioretention facility or flow-through planter is sized to accommodate the maximum flow from the cistern orifice.

► CRITERIA

Cistern. Size the cistern using Equation 4-8 and the factors and rainfall adjustment equations in the October 2009 Supplement to the 4th Edition. The cistern must also include an orifice or other device to limit outflow to the calculated maximum release rate.

Bioretention facility. Size the bioretention facility or flow-through planter using Equation 4-7 and the factors and rainfall adjustment equations in the October 2009 Supplement to the 4th Edition.

► DETAILS

Preventing mosquito harborage. Cisterns should be designed to drain completely, leaving no standing water. Drains should be located flush with the bottom of the cistern. Alternatively—or in addition—all entry and exit points

Best Uses

- In series with a bioretention facility or flow-through planter to meet flow-control requirements in limited space.
- Management of roof runoff
- Dense urban areas

Advantages

- Storage volume can be in any configuration
- Small footprint

Limitations

- Somewhat complex to design, build, and operate
- Requires head for both cistern and bioretention facility

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Stormwater C.3 Guidebook

www.cccleanwater.org

should be provided with traps or sealed or screened to prevent mosquito entry. Note mosquitoes can enter through openings $\frac{1}{16}$" or larger and will fly for many feet through pipes as small as ¼".

Exclude debris. Provide leaf guards and/or screens to prevent debris from accumulating in the cistern.

Ensure access for maintenance. Design the cistern to allow for cleanout. Avoid creating the need for maintenance workers to enter a confined space. Ensure the outlet orifice can be easily accessed for cleaning and maintenance.

► APPLICATIONS

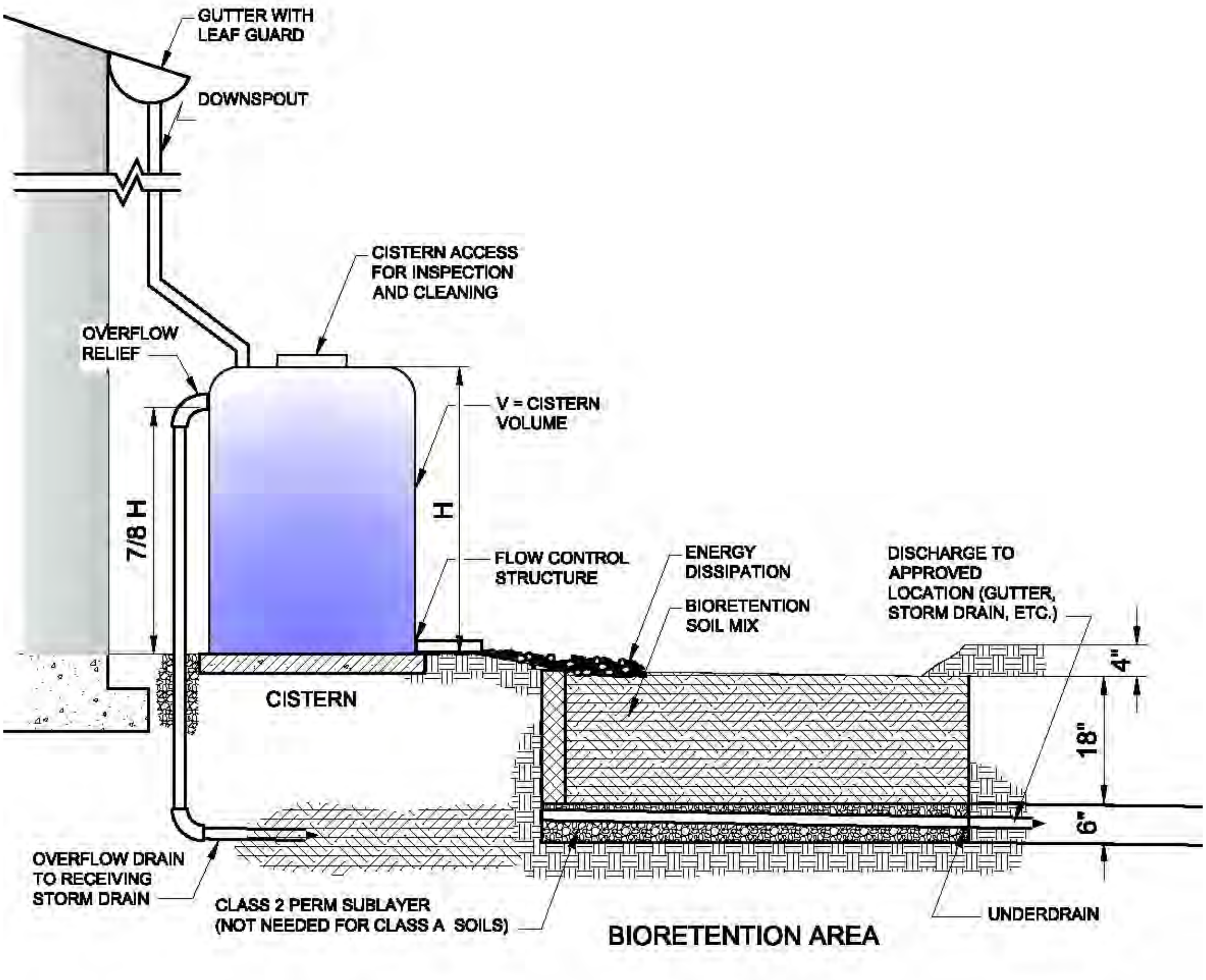
Shallow ponding on a flat roof. The "cistern" storage volume can be designed in any configuration, including simply storing rainfall on the roof where it falls and draining it away slowly. In sites with Group "D" soils, the required average depth amounts to about ¾".

Cistern attached to a building and draining to a planter. This arrangement allows the flow-through planter to be constructed at a height as low as 30".

Use with sand filter. A cistern in series with a sand filter can meet treatment and flow-control requirements. See the CCCWP's policy for selection of treatment facilities (p. 16) and design guidance for sand filters (p. 85).

Design Checklist for Cistern + Bioretention

- ❐ Cistern volume meets or exceeds calculated minimum.
- ❐ Cistern outlet with orifice or other flow-control device restricts flow to calculated maximum.
- ❐ Cistern outlet is piped to bioretention area.
- ❐ Bioretention surface area meets or exceeds the calculated minimum.
- ❐ Except for surface area, bioretention facility is designed to the criteria for "treatment only" in the "Bioretention Facility" design sheet (p. 63) or "Flow-through Planter" design sheet (p. 73).
- ❐ Cistern is designed to drain completely and/or sealed to prevent mosquito harborage.
- ❐ Design provides for exclusion of debris and accessibility for maintenance.
- ❐ Overflow connected to a downstream storm drain or approved discharge point.
- ❐ Emergency spillage will be safely conveyed overland.


GUTTER WITH
LEAF GUARD
DOWNSPOUT
CISTERN ACCESS
FOR INSPECTION
AND CLEANING
OVERFLOW
RELIEF
V = CISTERN
VOLUME
7/8 H
H
FLOW CONTROL
STRUCTURE
ENERGY
DISSIPATION
BIORETENTION
SOIL MIX
DISCHARGE TO
APPROVED
LOCATION (GUTTER,
STORM DRAIN, ETC.)
4"
18"
6"
CISTERN
OVERFLOW DRAIN
TO RECEIVING
STORM DRAIN
CLASS 2 PERM SUBLAYER
(NOT NEEDED FOR CLASS A SOILS)
BIORETENTION AREA
UNDERDRAIN

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Bioretention Facility + Vault

A bioretention facility in series with a vault can meet treatment and flow-control requirements where space is limited. In this configuration, the bioretention facility is sized to a minimum of 4% of the tributary impervious area. The underdrain and overflow from the bioretention facility are routed to a storage vault, which can be located beneath a plaza, sidewalk, or parking area. The vault includes an orifice limiting the rate of discharge from the vault to the storm drain system.

▶ CRITERIA

Bioretention facility. Size and design the bioretention facility to the treatment-only criteria (see Bioretention Facility design sheet, p. 63.)

Vault. Size the vault using Equation 4-8 and the factors and rainfall adjustment equations in the October 2009 supplement to the 4th Edition. The vault must include an orifice or other device to limit outflow.

▶ DETAILS

Preventing mosquito harborage. Vaults should be designed to drain completely, leaving no standing water. Where possible, vaults should have an open bottom to allow infiltration into the native soil. Drains should be located flush with the bottom of the vault. Alternatively—or in addition—all entry and exit points, should be provided with traps or sealed or screened to prevent mosquito entry. Note mosquitoes can enter through openings $\frac{1}{16}$" or larger and will fly for many feet through pipes as small as ¼".

Ensure access for maintenance. Design the vault to allow for cleanout. Avoid creating the need for maintenance workers to enter a confined space. Ensure the outlet orifice can be easily accessed for cleaning and maintenance.

▶ APPLICATIONS

Parking lot. Because the required landscaped bioretention facilities is only 4% of the tributary impervious area, the bioretention component can in many cases be integrated into parking lot medians and islands. The vault component can be located beneath aisles or driveways.

Best Uses

- To meet flow-control requirements in limited space
- Parking lots
- Dense urban areas

Advantages

- Smaller footprint than bioretention facility sized for flow control

Limitations

- Somewhat complex to design, build, and operate
- Requires head for both bioretention facility and vault

CONTRA COSTA CLEAN WATER PROGRAM

Stormwater C.3 Guidebook

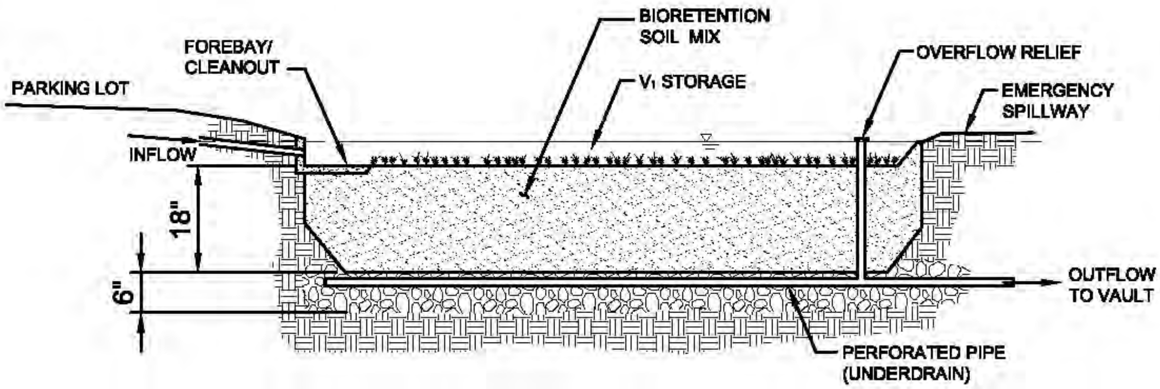
www.cccleanwater.org

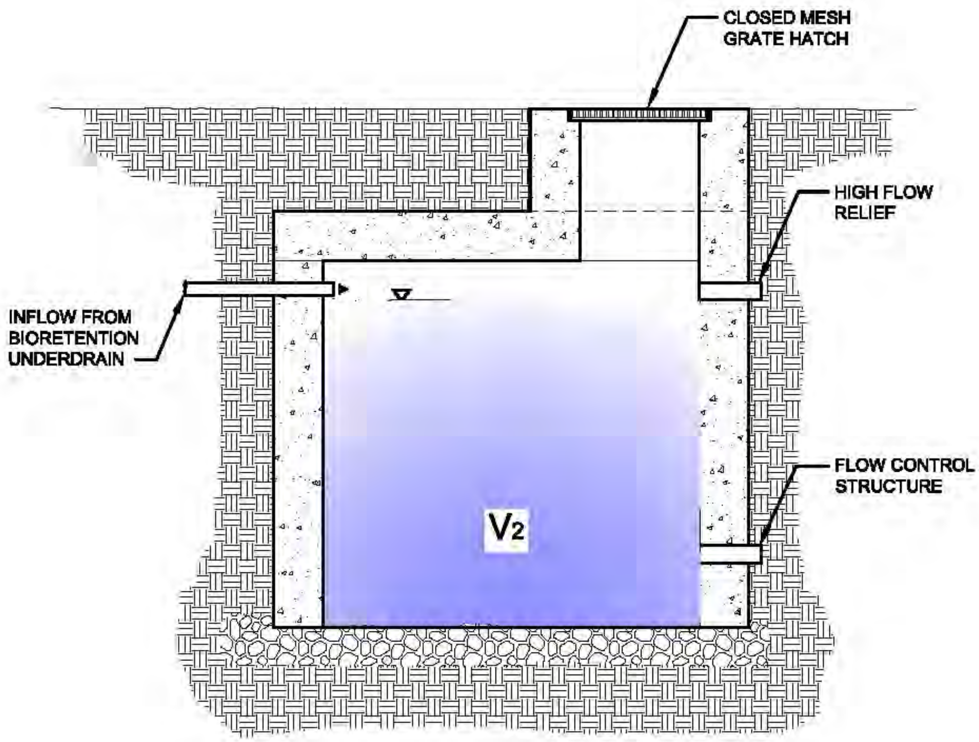
Multiple bioretention facilities draining to a single vault. Two or more bioretention areas can be connected to a single vault. The vault minimum volume and outlet maximum flow rate are the sum of those calculated for each individual bioretention facility.

Vault with pumped discharge. Where insufficient head exists, vaults may be equipped with pumps to discharge (at a rate no greater than the calculated maximum) to a storm drain or approved discharge point.

Design Checklist for Bioretention + Vault

- ❒ Bioretention facility is designed to the treatment-only criteria in the "Bioretention Facility" design sheet (pp. 63-73).
- ❒ Vault volume meets or exceeds calculated minimum.
- ❒ Vault outlet with orifice or other flow-control device restricts flow to calculated maximum.
- ❒ Bioretention facility underdrain is routed to the vault.
- ❒ Bioretention facility overflow is routed to the vault.
- ❒ Sufficient head exists to convey flow from the underdrain to the vault and from the vault to the discharge point.
- ❒ Vault is designed to drain completely and/or sealed to prevent mosquito harborage.
- ❒ Vault design provides for exclusion of debris and accessibility for maintenance.
- ❒ Vault outlet and overflow are connected to a downstream storm drain or approved discharge point.
- ❒ Emergency spillage will be safely conveyed overland.





BIORETENTION WITH VAULT

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