



Basic Training: Stormwater Controls for Development Projects

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Outline of Presentation

- Introduction: why include stormwater controls in development projects?
- Regulatory background
- Types of post-construction controls: LID vs non-LID
- Hydromodification management
- Green infrastructure requirements

Why include stormwater controls in development projects?



- Uses of San Francisco Bay and many local creeks are impaired for numerous pollutants
- Stormwater runoff is the largest pollutant conveyance
- Stormwater discharge regulations require pollutant and flow controls

What happens during land development?

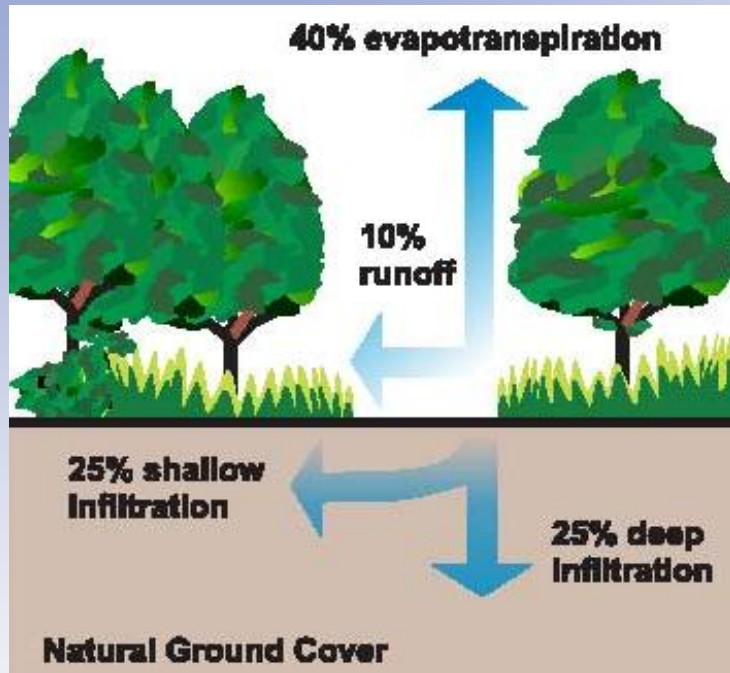
- Natural land forms changed
- Soil moved and compacted
- Vegetation removed
- Impervious surface created
- Structures create barriers in floodplain
- Land uses generate pollutants



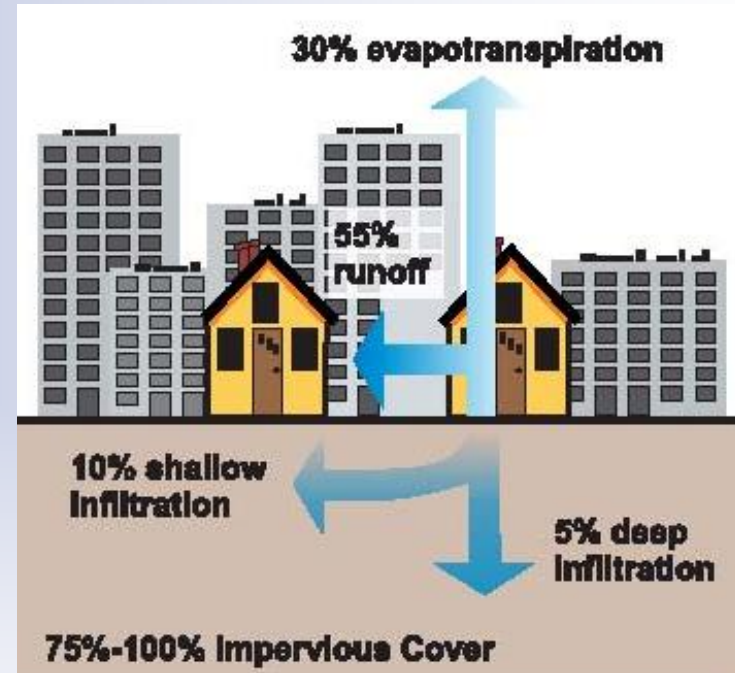
The Biggest Culprit – Impervious Surface



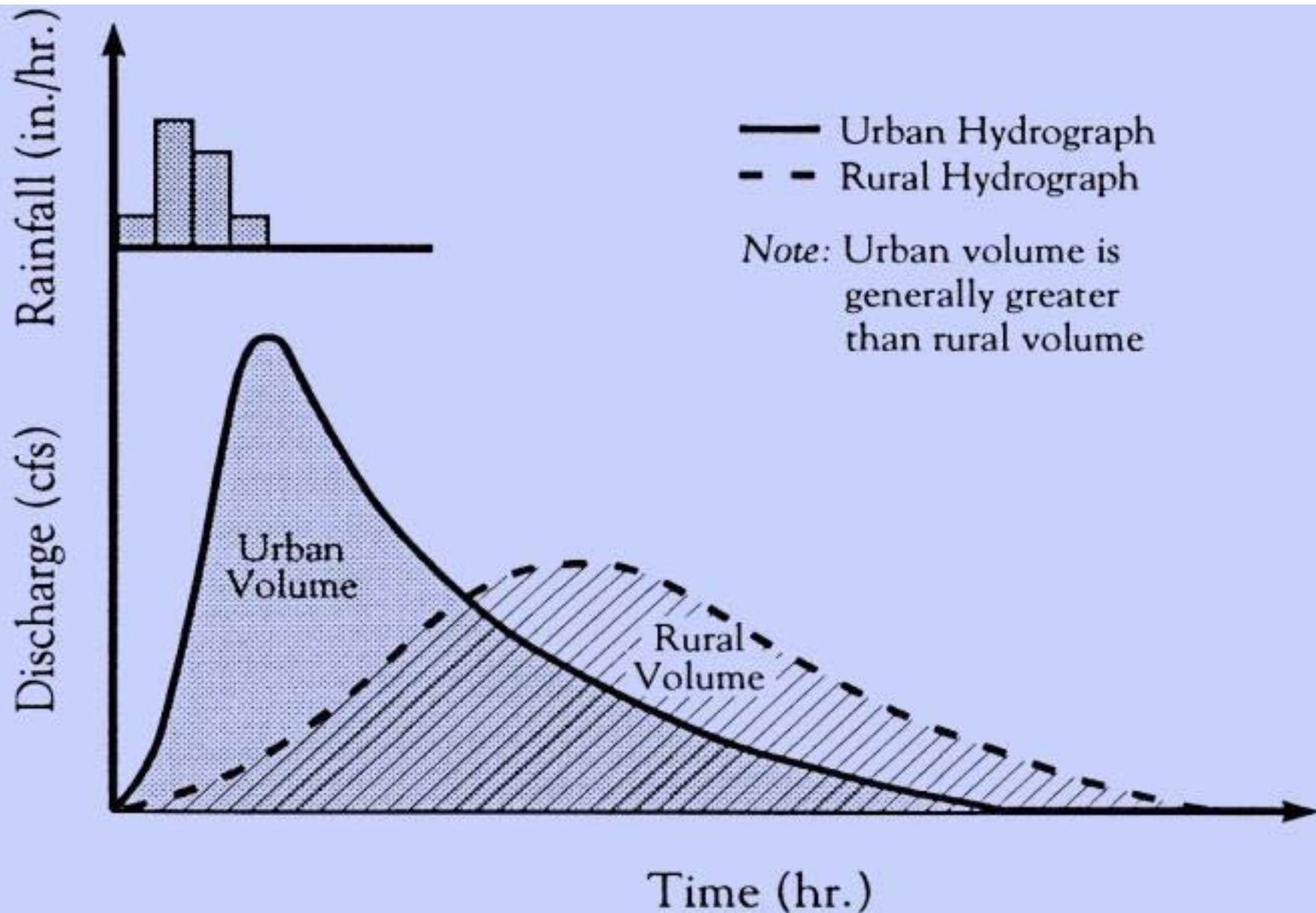
How does land development affect the hydrologic cycle?



Little runoff before
development



Lots of runoff after
development



Urbanization Increase Peak Flow in Creeks

Mount, 1995

How do increases in flow affect creeks?



Yerba Buena Creek – upstream reach



Channel incision
on lower Yerba
Buena Creek
(tributary to
Lower Silver
Creek and
Coyote Creek)



Lower Silver Creek
(Erosion undermining outfall protection
structure on left bank)



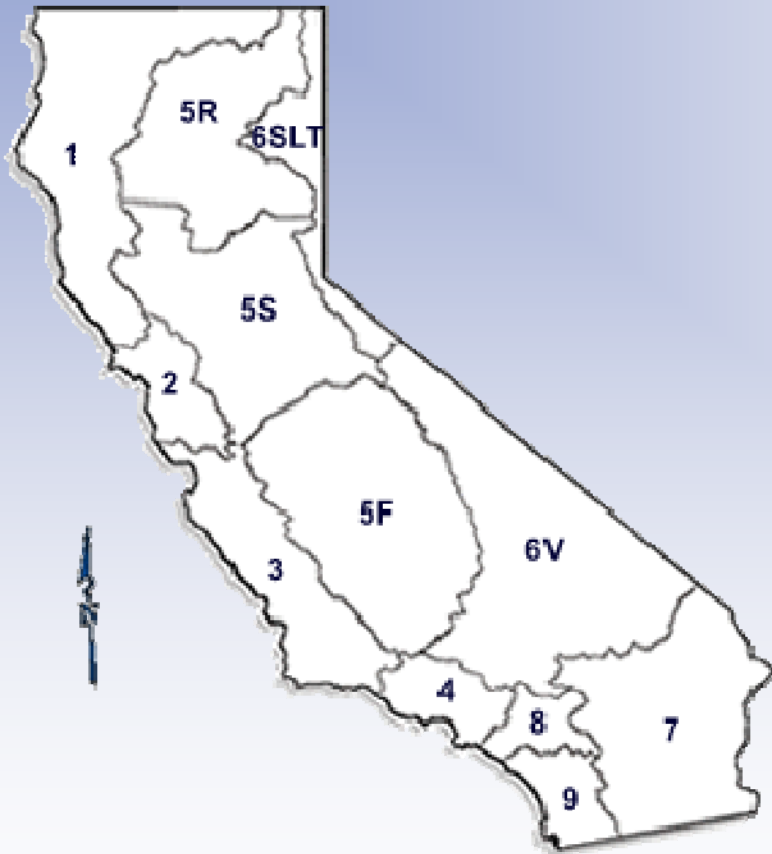
Concrete Lining with Floodwall – Matadero Creek

Regulatory Background: Municipal Stormwater Permits

- Since 1987 the federal Clean Water Act has required municipalities to obtain **permits to discharge stormwater** from municipal storm drain systems
- These are National Pollutant Discharge Elimination System (NPDES) **Municipal Stormwater** Permits
- EPA has also established construction and industrial discharge standards



NPDES Permitting Authority



MS4 = Municipal separate storm sewer system

Regulatory Framework for NPDES Permits in CA

- State Water Resources Control Board
 - Construction General Permit
 - Industrial General Permit
 - Municipal Phase II General Permit (Small MS4s)
- Regional Water Quality Control Boards
 - Municipal Phase I Stormwater Permits
 - Wastewater Treatment Plant Permits
 - Individual Industrial Permits

Bay Area Municipal Regional Permit (MRP)

- One regional permit for urbanized areas (total of 76 permittees):
 - San Mateo, Santa Clara, Alameda, and Contra Costa Counties, Fairfield-Suisun, and Vallejo
- MRP reissued 11/19/15; effective 1/1/16
- Key requirements:
 - Low Impact Development (LID); Green Infrastructure
 - Monitoring and control measures for pollutants of concern: Trash, Mercury, PCBs, Pesticides



MRP Provisions

- Municipal Operations
- New Development and Redevelopment
- Industrial/Commercial Site Controls
- Illicit Discharge Controls
- Construction Site Controls
- Public Education/Outreach
- Water Quality Monitoring
- Pollutant of Concern Controls
 - Pesticides
 - Trash
 - Mercury
 - PCBs
 - Copper
- Exempted/Conditionally Exempted Non-Stormwater Discharges

Stormwater Control Measures: Construction-phase vs. Post-construction



Example of a construction best management practice (BMP)



Example of a post-construction stormwater control measure



Construction controls or “best management practices” (BMPs)

- Implemented during construction only
- Control sediment and erosion (straw wattles, silt fences, hydroseeding, storm drain inlet filters ...)
- Good housekeeping practices to keep pollutants out of stormwater
- A State Construction General Permit is required if one acre or more of land is disturbed
- Municipalities must require construction BMPs in smaller projects, per municipal stormwater permit



Post-Construction Controls

- Permanent features of the project design
- Types of post-construction controls required by Municipal Regional Permit (Provision C.3)
 - Low Impact Development
 - Source control measures
 - Site design measures
 - Stormwater treatment
 - Hydromodification management (HM)

Source Control Measures



- **Structural Source Controls** are permanent design features that reduce pollutant sources.
- Examples include:
 - Covered trash enclosures
 - Non-stormwater discharges drain to landscaping or to sanitary sewer
 - Drought-tolerant native or adapted plants
- Require in projects that must implement stormwater treatment.
- Encourage in all other projects.

Source Control Measures



- **Operational Source Controls** are practices to be conducted on an ongoing basis after construction is completed.
- Examples:
 - Integrated pest management (reduced pesticide use)
 - Street sweeping
- Require in projects that must implement stormwater treatment.
- Encourage in all other projects.

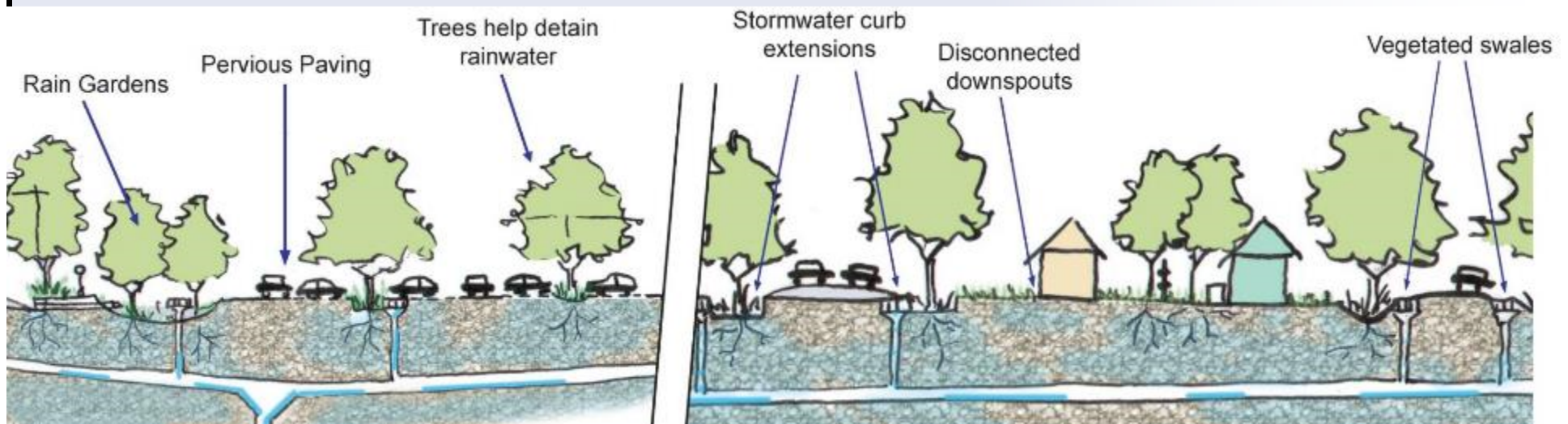


Choose less toxic products for your home and garden. Look for this symbol before you buy.



Low Impact Development (LID)

- Reduce runoff and mimic a site's predevelopment hydrology:
 - Minimize disturbed areas and impervious surfaces
 - Retain and treat stormwater runoff using infiltration, evapotranspiration, rainwater harvesting/use or biotreatment



Site Design Measures



Pervious walkway



"Disconnected" downspout

- Permanent design features that:
 - Reduce impervious surfaces
 - Disconnect impervious surfaces
 - Preserve/protect natural features
- Examples include:
 - Direct runoff to landscaping
 - Pervious paving

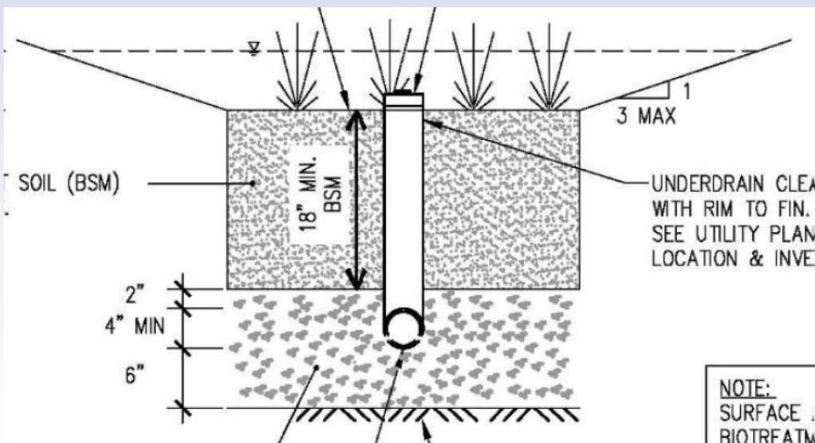
Site Design Measures



Disconnected downspout

- Require in projects that must implement stormwater treatment
- Require in certain small projects not subject to treatment requirements
- Encourage site design measures in all other projects

LID Treatment Measures



- Engineered systems that remove pollutants from stormwater
- Sized to treat stormwater runoff from **frequent, small storm events**
- Provision C.3.d of the MRP specifies numeric sizing criteria for water quality design
- Maintenance agreement required

LID Treatment Requirements

- LID treatment methods required since 12/1/11
- LID treatment defined as:
 - Infiltration
 - Evapotranspiration
 - Rainwater harvesting/use
 - Biotreatment



Harvesting for rainwater for indoor toilet flushing

How Much Runoff Must Be Treated?



- Projects must treat runoff from 100% of project:
 - 80% of average annual runoff (for volume-based treatment measures)
 - Flow of runoff from a rain event of 0.2 inches per hour intensity (flow-based treatment measure)
- This is in Provision C.3.d of the MRP, so it's called the **“C.3.d amount of runoff”**

OR **“water quality design volume or flow”**

Stormwater Treatment Measures

When are they required? (“Regulated Projects”)

- Required for projects that create and/or replace 10,000 sq. ft. or more of impervious surface



- Required for the following types of projects that create and/or replace 5,000 sq. ft. or more of impervious surface:
 - Restaurants
 - Retail gasoline outlets
 - Auto service facilities
 - Parking lots



Other C.3 Regulated Projects

- Road and trail projects that create and/or replace 10,000 sq. ft. of contiguous impervious surface
 - New roads, and sidewalks and bike lanes built as part of new roads
 - Widening of existing roads with traffic lane(s)
 - Trails >10 feet wide or < 50 feet from creek bank



The following are NOT Regulated Projects (do not require treatment):

- Detached single family home;
- Roadway reconstruction within same footprint;
- Road widening that does not add a travel lane;
- Sidewalks and bike lanes along existing roads;
- Impervious trails <10' wide and >50' from creek;
- Sidewalks, bike lanes and trails that drain to vegetated areas or made of permeable paving;
- Interior remodels;
- Routine maintenance and repair;
- Pavement resurfacing within existing footprint.

Small Project and Single Family Home Requirements

- Single family homes (>2,500 sq. ft. of impervious area) and small projects (between 2,500 and 10,000 sq. ft. of impervious area) must implement one of six site design measures:
 - Direct roof runoff into cisterns or rain barrels
 - Direct roof runoff onto vegetated areas
 - Direct sidewalk and patio runoff onto vegetated areas
 - Direct driveway and parking lot runoff onto vegetated areas
 - Construct sidewalks and patios with permeable surfaces
 - Construct bike lanes, driveways, and parking lots with permeable surfaces

Stormwater Treatment Measures

What are the different types?

■ LID Treatment Measures

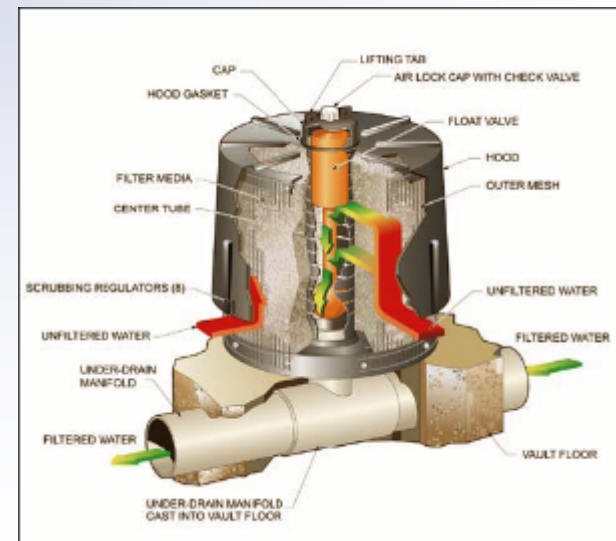
(required since 12/1/11)

- Infiltration
- Evapotranspiration
- Rainwater harvesting/use
- Biotreatment



■ Non-LID Treatment Measures

- High rate media filters and tree well filters
- Allowed only for “Special Projects”



“Special Projects”

- Special Projects are high density and transit oriented development projects that may receive LID treatment reduction credit, i.e., allowed limited use of “non-LID” treatment measures
- Amount of credit based on size of project, lot coverage, location, density, and amount of surface parking
- Non-LID measures are limited to tree box filters and media filters



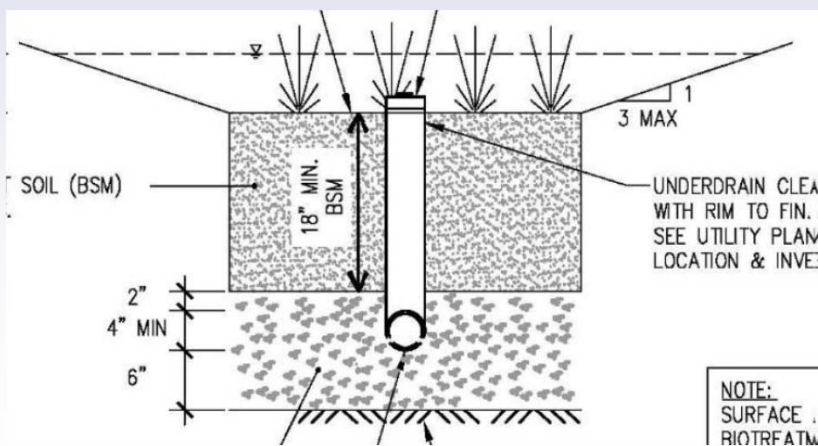
Biotreatment Measures



Flow-through planter

- Most Common
 - Bioretention areas/rain gardens
 - Linear bioretention areas (bioretention swales)
 - Flow-through planters

Bioretention Area/Rain Garden



- Concave landscaped area of any shape
- Engineered biotreatment soil mix with specified long term infiltration rate (5 in/hr)
- Underdrain required if clayey underlying soils
- Raise underdrain to maximize infiltration, if conditions allow

Bioretention Areas

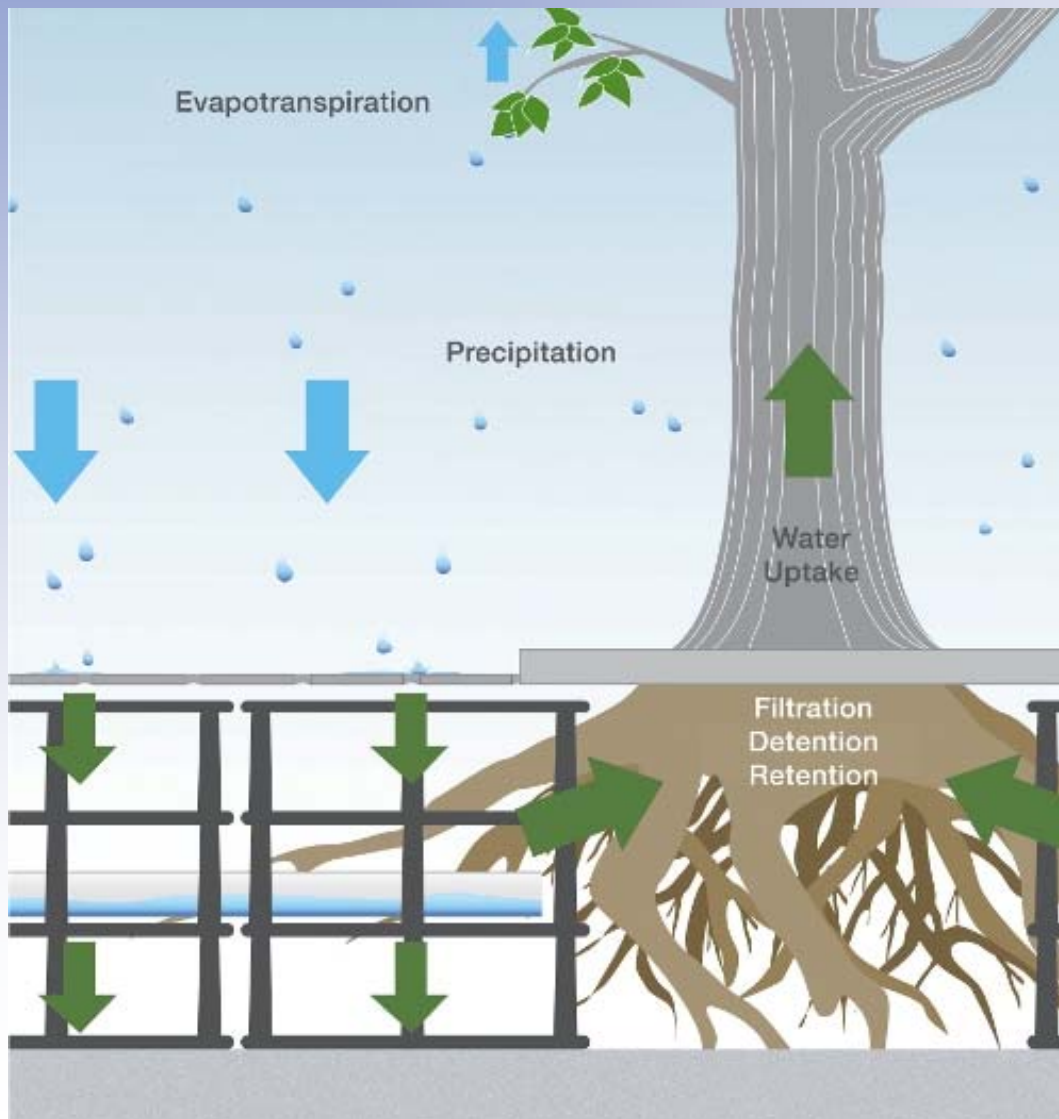


Flow-through Planter



- No infiltration to underlying soils
- Planter box with engineered soils and underdrain
- Stormwater filters through specified biotreatment soil mix
- OK to place along face of building, if waterproofing is used.

Biotreatment in Tree Trench



Rainwater Harvesting and Use

- Captured stormwater used for non-potable uses, such as:
 - Toilet flushing
 - Irrigation



Cisterns installed underground

Rainwater Harvesting



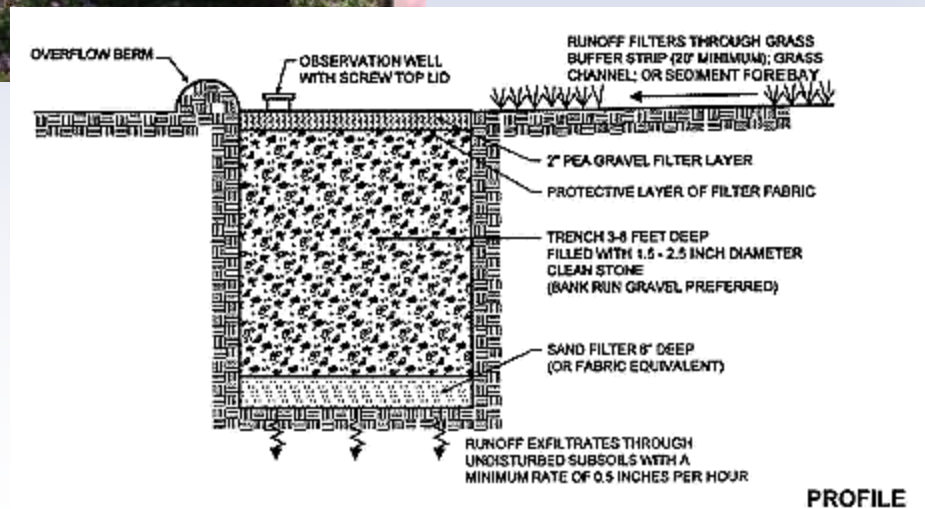
Infiltration Trench



- Store water in void space of rocks, allowing it to infiltrate to surrounding soils
- Requires well-draining soils



Infiltration Trenches



A schematic of an infiltration trench (Source: MDE, 2000)

Permeable Pavement



Green Roofs

- Green roofs are considered site design measures that remove runoff largely through plant evapotranspiration processes
- Planting media needs to be sufficiently deep to:
 - Provide capacity within the pore space of the media for the water quality design volume (typically > 3")
 - Support the long term health of the vegetation selected for the green roof, as specified by a landscape architect or other professional

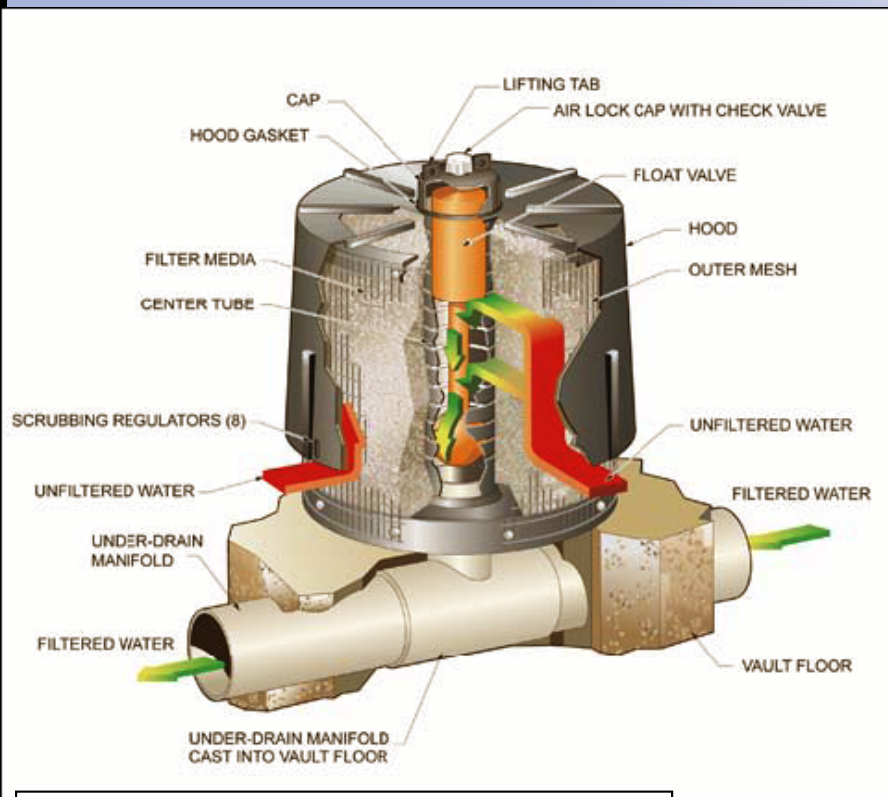


Green Roofs



Media Filters

(Limited use ONLY in “Special Projects”)



Example of a Media Filter Cartridge

- Vault system:
 - Fine particles are filtered by filter media (see example cartridge)
 - The system may be designed to allow settling of large particulates before water is filtered through the media.

Manufactured Tree Well Filters

(Limited use ONLY in “Special Projects”)

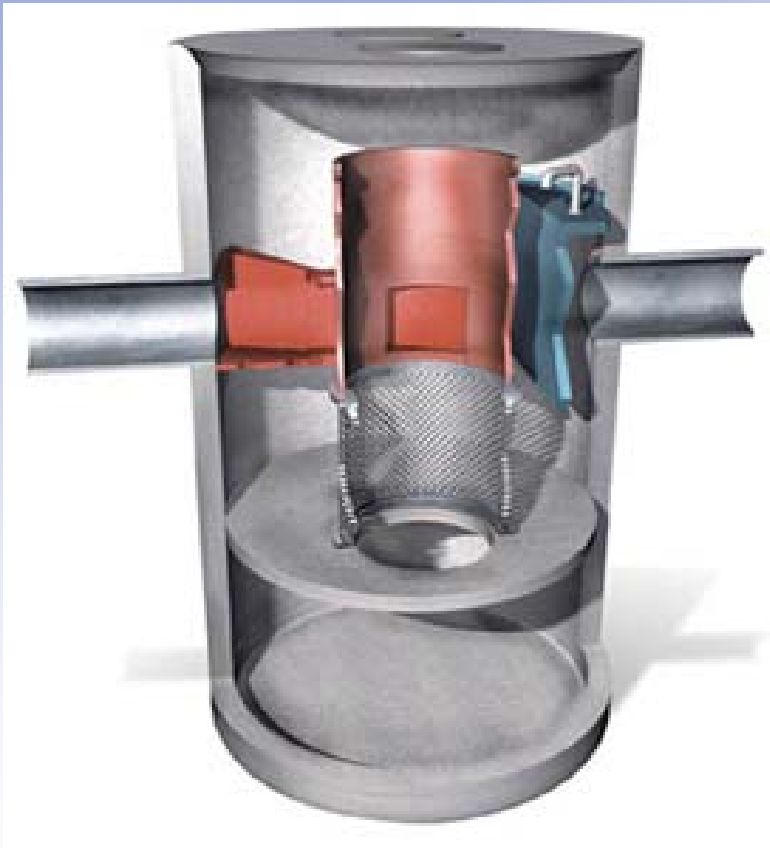


Example of a Manufactured
Tree Well Filter

- Tree well filter with proprietary planting media and underdrain
- Planting media has extremely high infiltration rate.
- Now available with biotreatment soil to meet LID requirements (but treats smaller area).

Hydrodynamic Separators

(NOT a stand-alone treatment measure)



- Vault system
- Settling or separation unit to remove sediments
- Effective for trash and large particles
- Not designed to remove finer particles

Vegetated Swale

(NOT a stand-alone treatment measure unless stormwater filtered through bioretention soils)



- Linear, shallow, vegetated channel
- Used to be allowed to filter stormwater through dense vegetation
- OK if allows stormwater to infiltrate downward through bioretreatment soil

Extended Detention Basin

(NOT a stand-alone treatment measure unless stormwater filtered through bioretention soils)



- Basin with specially designed outlet to detain stormwater for at least 48 hours.
- Used to be allowed to treat stormwater by settling.
- Ok if used for storage upstream of LID measure or hydromodification control.

Hydromodification Management

- **Purpose:** Reduce erosive flows in creeks.
- **Goal:** Match post-project runoff rates, volumes and durations to pre-project condition for a range of storms.
- Required for projects that:
 - Create/replace 1 acre or more of impervious area,
 - Increase impervious area over pre-project condition, AND
 - Drain to creeks susceptible to erosion.

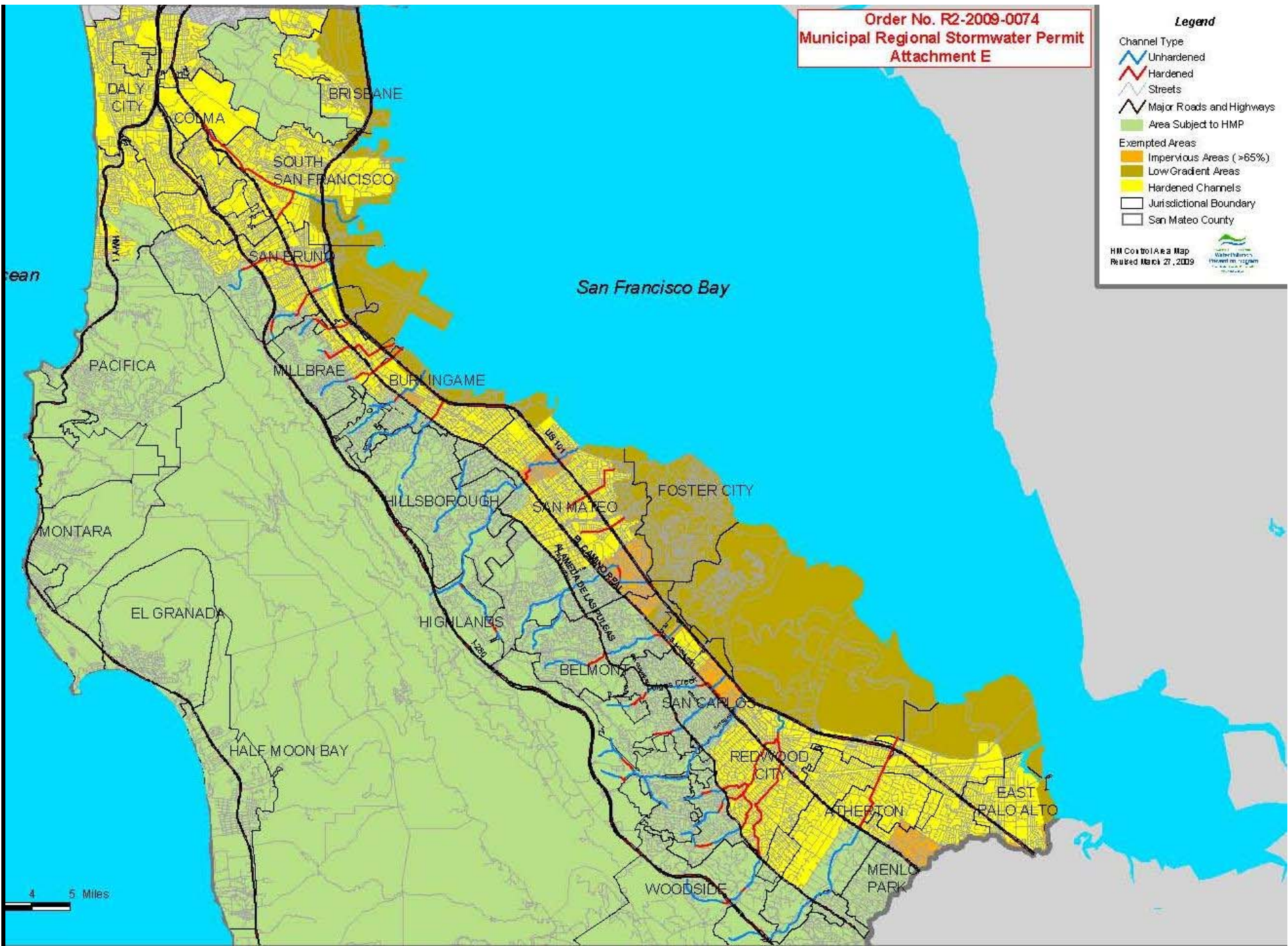


Order No. R2-2009-0074
Municipal Regional Stormwater Permit
Attachment E

Legend

- Channel Type
- Unhardened
 - Hardened
 - Streets
 - Major Roads and Highways
 - Area Subject to HMP
- Exempted Areas
- Impervious Areas (>65%)
 - Low Gradient Areas
 - Hardened Channels
 - Jurisdictional Boundary
 - San Mateo County

HMP Control Area Map
Revised March 27, 2009



Hydromodification Management Control Measures

- Hydrologic source controls
 - Site design measures to reduce imperviousness
 - LID treatment measures
- Flow duration controls
 - Pond, detention basin, tank or vault
 - Specialized outlet to control rate and duration of flow



What is Green Infrastructure? (or Green Stormwater Infrastructure)

- Systems that use vegetation, soils, and natural processes to manage stormwater, integrated into urban streetscapes, parking lots and other developments



Green Infrastructure

- Over the long term, municipalities will need to retrofit existing public streets, roofs, and parking lots to divert runoff to:
 - Vegetated areas
 - Pervious pavements
 - Biotreatment and infiltration facilities
- These measures supplement current requirements for LID on regulated projects

Green Infrastructure Benefits

- GI projects can achieve multiple benefits:
 - Flow reduction
 - Pollutant reduction
 - Urban greening
 - Traffic calming
 - Improved bike and pedestrian safety
 - Climate benefits
 - Increased property values
- Promoting benefits helps get public support



Overview of GI Requirements

- Develop a Green Infrastructure (GI) Plan
 - Prioritize and map planned and potential projects
 - Update related municipal plans
 - Evaluate funding options
 - Track progress
- Conduct education and outreach
- Conduct “early implementation”
 - Construct planned and funded projects
 - Review public project lists and assess opportunity for incorporating GI elements

For More Information:

- SMCWPPP C.3 Stormwater Technical Guidance (rev. 2015)

www.flowstobay.org

(Click on “At Work”, then “C.3 Technical Guidance”
under Business Resources)

- Municipal Regional Stormwater Permit

[http://www.waterboards.ca.gov/sanfranciscobay/water_issues/
programs/stormwater/Municipal/R2-2015-0049.pdf](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/Municipal/R2-2015-0049.pdf)

(Google “SF Bay Municipal Regional Permit”)



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