





## Basic Training: Stormwater Controls for Development Projects

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## Outline of Presentation

- Introduction: why include stormwater controls in development projects?
- Regulatory background
- Difference between construction and post-construction controls
- Types of post-construction controls: LID vs non-LID
- Hydromodification management

## 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?

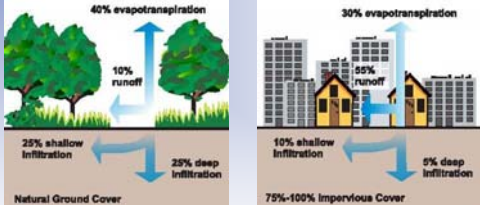
- Natural land forms changed
- Soil moved and compacted
- Vegetation removed
- Impervious surface created
- Structures create barriers in floodplain
- Land uses generate pollutants



## The Biggest Culprit – Impervious Surface

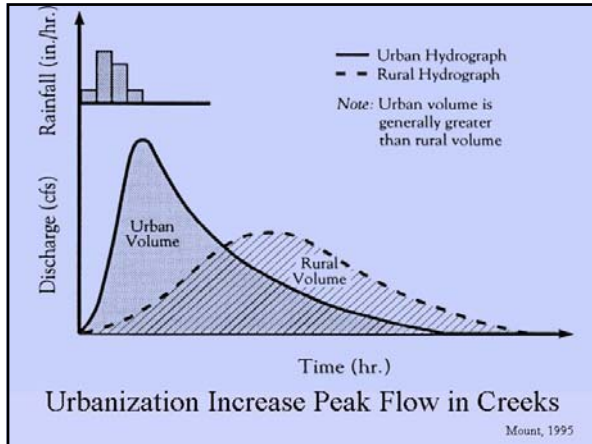


## How does land development affect the hydrologic cycle?



Little runoff before development

Lots of runoff after development



### 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)

### 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)


- Consolidates six Phase 1 municipal permits into one regional permit (76 permittees):
  - San Mateo, Santa Clara, Alameda, and Contra Costa Counties, Fairfield-Suisun, and Vallejo
- Effective Dec. 1, 2009
- Key new requirements:
  - Low Impact Development (LID) measures
  - Monitoring and control measures for pollutants of concern: Trash, Mercury, PCBs, Pesticides



### What's the difference between construction and post-construction controls?



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

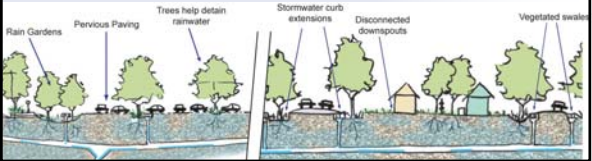
### Post-Construction Controls






- 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)

### Low Impact Development (LID)

- Reduce runoff and mimic a site's predevelopment hydrology:
  - Minimize disturbed areas and impervious surfaces
  - Use infiltration, evapotranspiration, or rainwater harvesting to retain and treat stormwater runoff
  - Use biotreatment where these methods are infeasible



### 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
- Encourage in all projects.
- Require in projects that must implement stormwater treatment.

### Source Control Measures







- **Operational Source Controls** are practices to be conducted on an ongoing basis after construction is completed.
- Examples:
  - Integrated pest management
  - 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.

### Site Design Measures



- 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




- 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

### Stormwater Treatment Measures

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

### New LID Treatment Requirements



- LID treatment methods required since 12/1/11
- LID treatment defined as:
  - Rainwater harvesting/reuse,
  - Infiltration,
  - Evapotranspiration,
  - Or, if these are **infeasible**, 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:

- 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.



### New Requirements for Small and Single Family Home Projects

- 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, and harvesting and use
  - Where this is infeasible, biotreatment is allowed
- **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
- Regional Water Board adopted Special Projects criteria in November 2011 (now part of MRP)
- Some projects will qualify for limited use of “non-LID” measures, e.g., media filters and tree box filters



### LID Treatment Options

LID Technique	Category
Rainwater cisterns	Harvest and use
Landscaped detention, street trees	Evapotranspiration, infiltration
Pervious paving	Infiltration
Infiltration basin	Infiltration
Infiltration trenches	Infiltration
Bioretention areas (unlined, no underdrain)	Evapotranspiration, infiltration
Bioretention areas (lined, with underdrain)	Biotreatment
Flow-through planters	Biotreatment

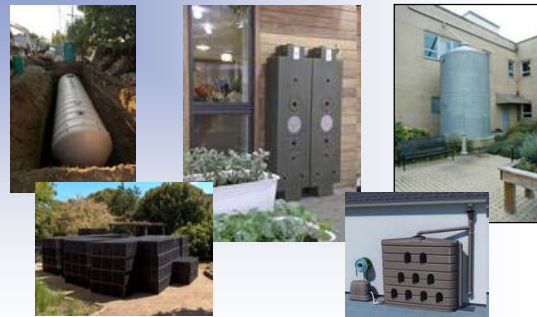
### Rainwater Harvesting and Use

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



Cisterns installed underground

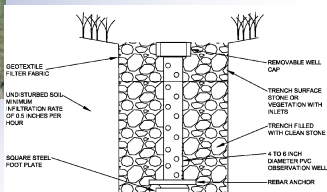
### Rainwater Harvesting



### Infiltration Facilities



Infiltration Trench



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

### Infiltration Trenches




### 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





### 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 with specified infiltration rate (5 to 10 inches/hour).
- Underdrain required if clayey underlying soils.
- Raise underdrain to maximize infiltration, if conditions allow.

### Bioretention Areas



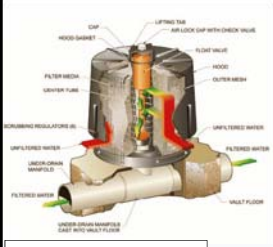
### Flow-through Planter



- No infiltration to underlying soils.
- Planter box with engineered soils and underdrain.
- Stormwater filters through biotreatment soil with specified infiltration rate (5 to 10 inches/hour).
- OK along face of building, if waterproofing is used.

### Media Filters

(Limited use ONLY in “Special Projects”)




- 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.

Example of a Media Filter Cartridge

### Manufactured Tree Well Filters

(Limited use ONLY in “Special Projects”)

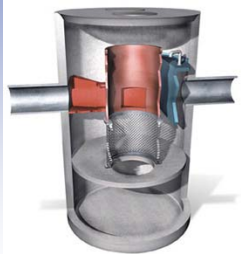


- Tree well filter with proprietary planting media and underdrain
- Planting media has extremely high infiltration rate.
- Now available with biotreatment soil to meet LID requirements (but treats smaller area).

Example of a Manufactured Tree Well Filter

### 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 biotreatment soil

### Extended Detention Basin

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

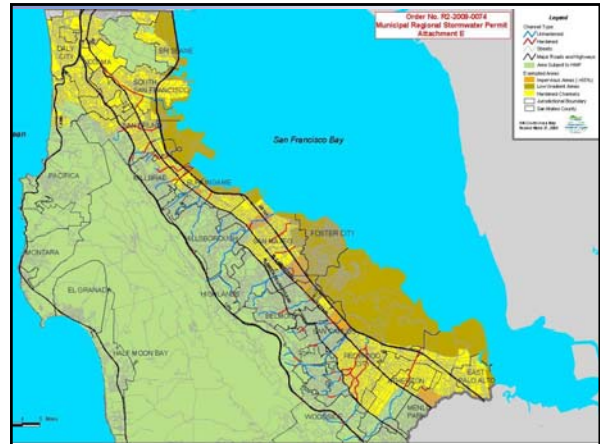


- Basin with specially designed outlet to detain stormwater for at least 48 hours.
- Used to be allowed to treat stormwater by settling.
- OK if used for storage upstream of LID measure or hydromodification control.



### 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.



### 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



### For More Information:

- SMCWPPP C.3 Stormwater Technical Guidance  
[www.flowstobay.org](http://www.flowstobay.org)  
(Click on "Business", then "New Development")
- Municipal Regional Permit and associated documents  
[http://www.waterboards.ca.gov/sanfranciscobay/water\\_issues/programs/stormwater/Municipal/index.shtml](http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/Municipal/index.shtml)  
(Google "SF Bay Municipal Regional Permit")



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