Why and How to Evaluate the Feasibility of Infiltrating or Harvesting and Using Stormwater

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SAN MATEO COUNTYWIDE
Water Pollution Prevention Program

Outline of Presentation

- Why prioritize infiltration and harvest/use of stormwater?
- Overview of feasibility evaluation process
  - Reduce project's impervious surfaces
  - Evaluate infiltration
  - Evaluate rainwater harvesting and use
  - When is biotreatment allowed?
  - Very limited use of vault systems
- For more information...

Why Prioritize Infiltration and Harvest/Use?

- As of December 1, 2011, it's the law!
- Beginning 12/1/11 "stormwater treatment" is
  - Rainwater harvesting/reuse,
  - Infiltration,
  - Evapotranspiration,
  - Or, **if these are infeasible**, biotreatment.

December 2011						
Mon	Tue	Wed	Thu	Fri	Sat	Sun
28	29	30	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1
2	3	4	5	6	7	8

Why Prioritize Infiltration and Harvest/Use?

- The Natural Resources Defense Council, U.S. EPA and others are advocating for prioritizing:
  - Infiltration
  - Rainwater harvesting and use
  - Evapotranspiration
- This is because “treat and release” methods are viewed as less effective.

Harvesting for rainwater for indoor toilet flushing

Why Prioritize Infiltration and Harvest/Use?

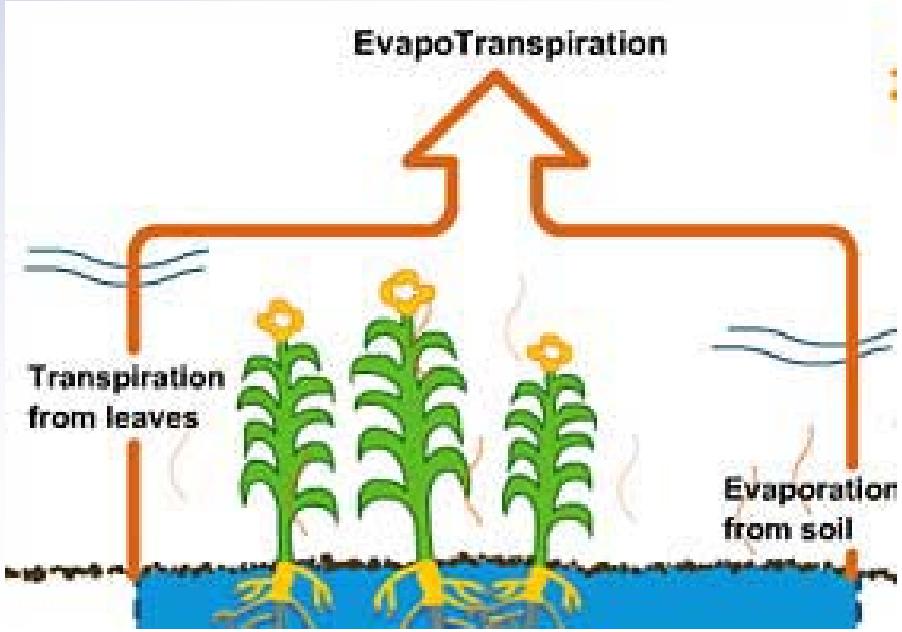
- Bioretention areas that do not infiltrate the full amount of stormwater that requires treatment may remove 50% or more of pollutants of concern.

- Advocates argue that infiltration, harvest/use and evapotranspiration will remove 100% of pollutants.

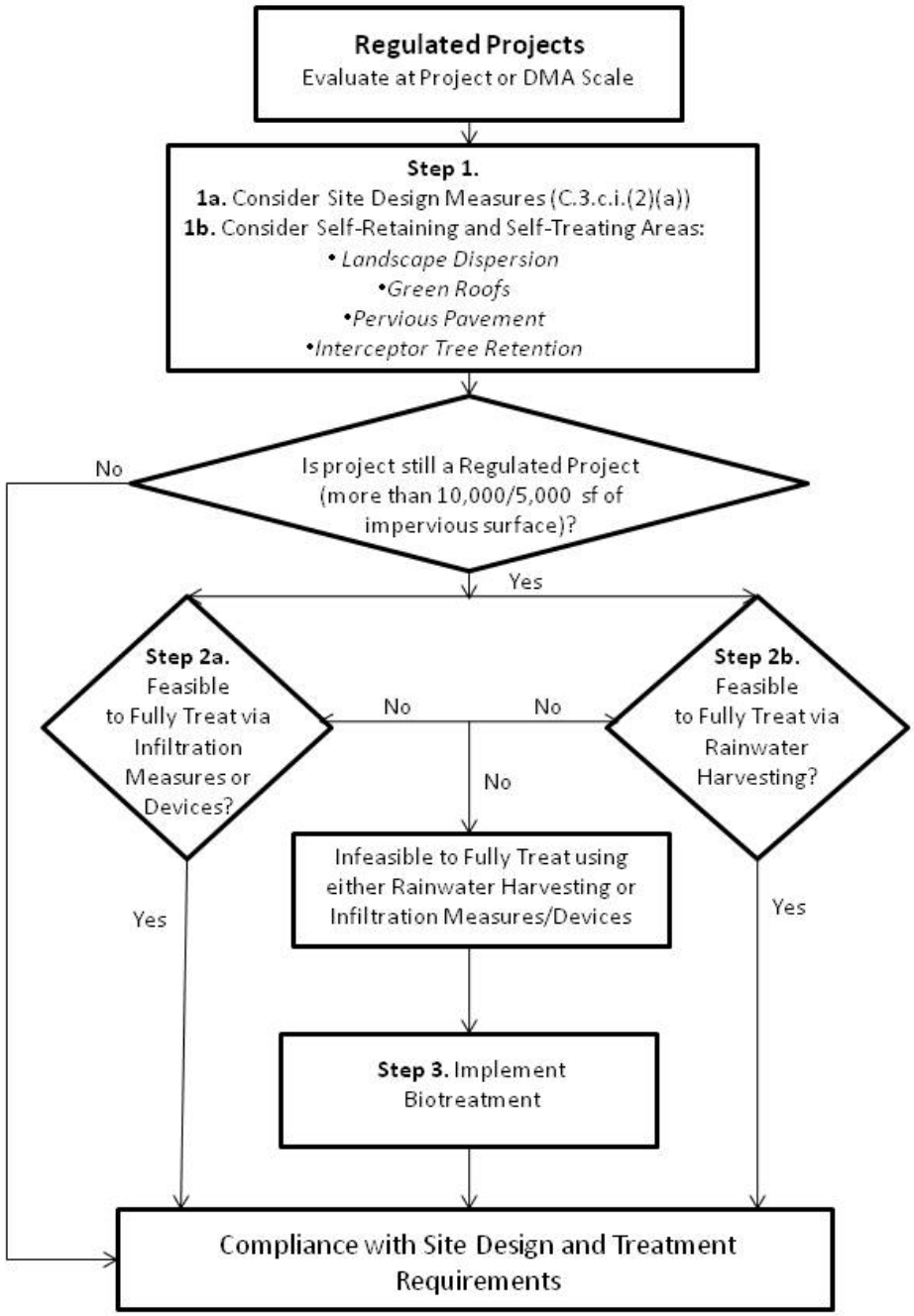
Bioretention/Rain Garden

What about Evapotranspiration?

- Evapotranspiration:
  - Is the combined effect of evaporation and the transpiration of water from plant leaves.
  - Occurs in all landscape-based stormwater treatment systems.
  - Was incorporated in modeling to develop feasibility criteria for infiltration and harvesting/use.



Overview of Feasibility Evaluation



Feasibility Evaluation: Start with a C.3 Regulated Project

Regulated Projects

Evaluate at Project or DMA Scale

- A C.3 Regulated Project
  - Creates or replaces 10,000 sq. ft. or more of impervious surface; or
  - Consists of a restaurant, retail gasoline outlet, auto repair facility, or surface parking (stand alone or part of another use) that creates and/or replaces 5,000 sq. ft. of impervious surface.

Feasibility Evaluation: Start with a C.3 Regulated Project

Regulated Projects

Evaluate at Project or DMA Scale

- A Drainage Management Area (DMA) is a portion of a project that drains to one stormwater treatment measure.
- An individual roof with an area of 10,000 sq.ft., or more, will be evaluated at the DMA scale for rainwater harvesting feasibility.

Feasibility Evaluation:
Step 1: Reduce Area that Needs Treatment

Step 1.

1a. Consider Site Design Measures (C.3.c.i.(2)(a))

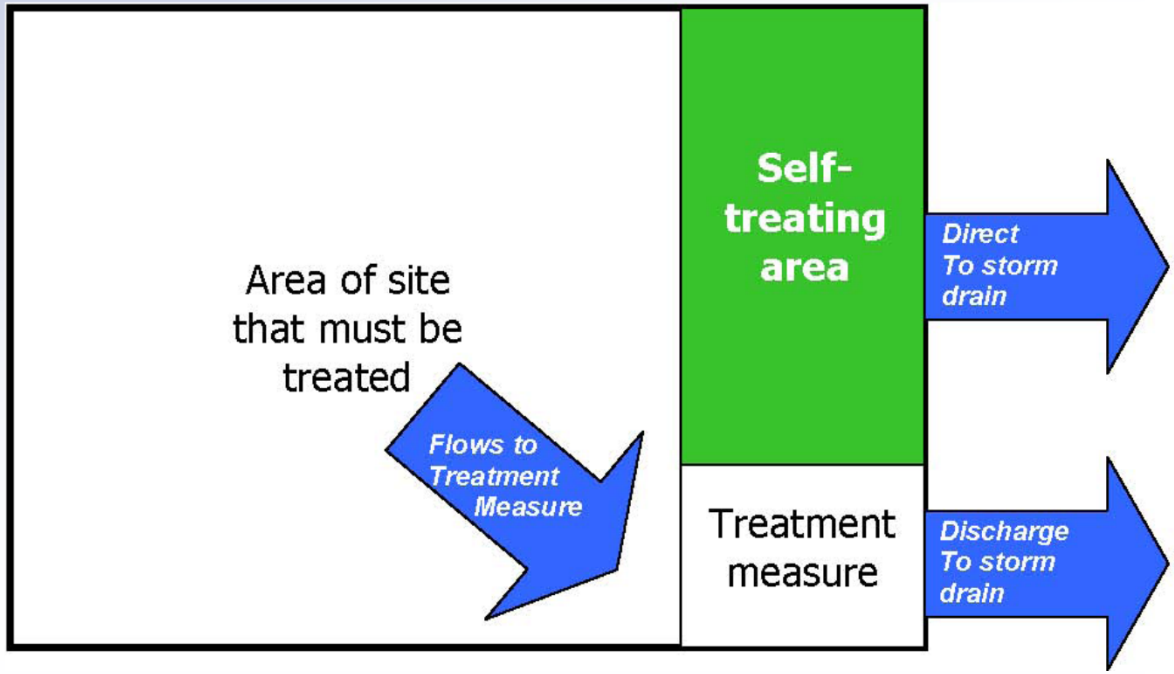
1b. Consider Self-Retaining and Self-Treating Areas:

- *Landscape Dispersion*
- *Green Roofs*
- *Pervious Pavement*
- *Interceptor Tree Retention*

- Use Site Design Measures to reduce the "Potential Rainwater Capture Area"

Self-Treating Areas Reduce the Area that Requires Treatment

- Stormwater from **pervious** portions of the project can flow directly to the storm drain (no mixing with runoff from impervious areas):
  - Landscaping
  - Green roof
  - Properly-designed pervious paving



Self-Treating Areas Reduce the Area that Requires Treatment

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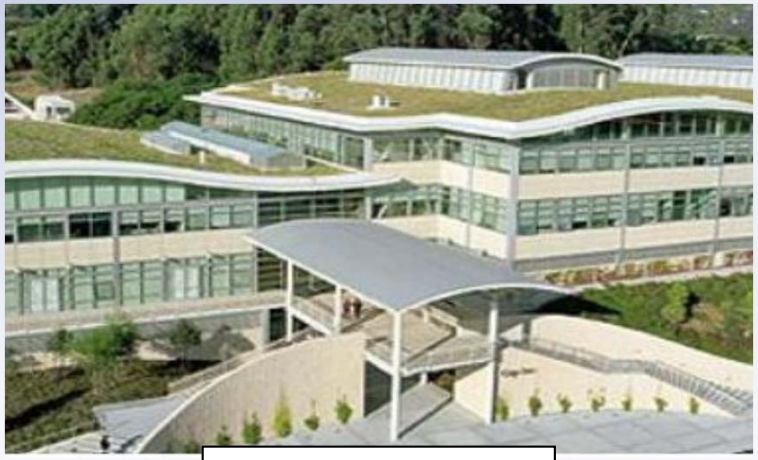
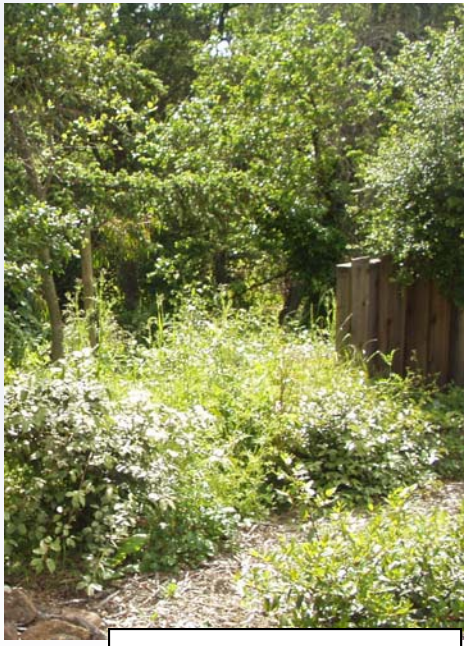
Pervious walkway



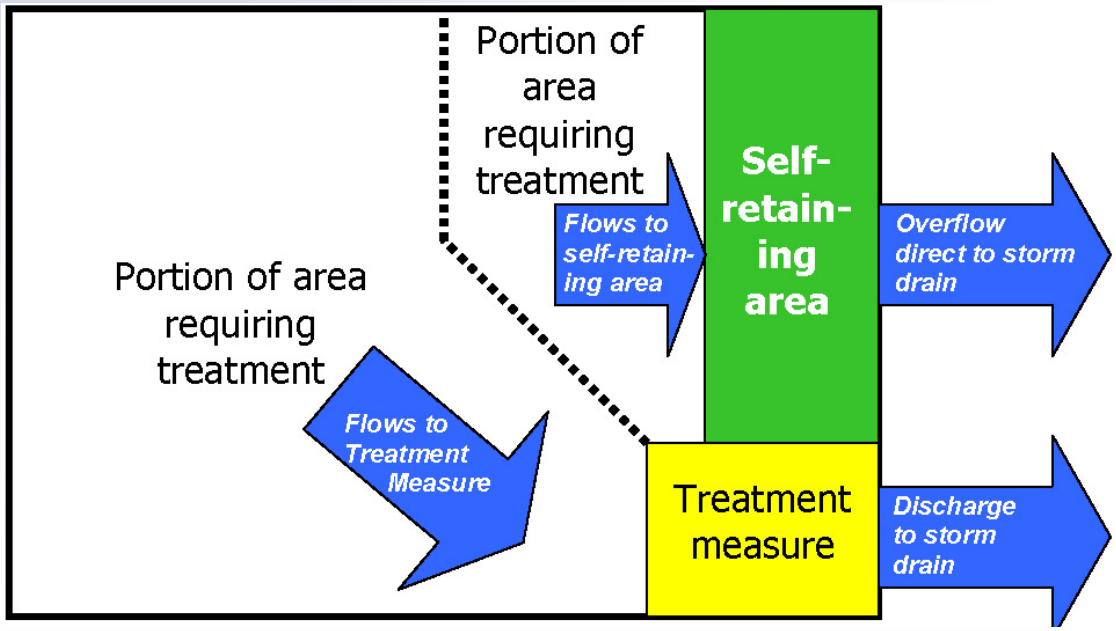
Green Roof



Landscaping

Self-Retaining Areas Reduce the Area that Requires Treatment

- Concave area of landscaping that retains runoff from adjacent impervious surface (e.g, roof)
  - Sized at 2:1 ratio (area of tributary impervious surface: area of landscaping)
  - 3-inch ponding depth
  - No special soils required



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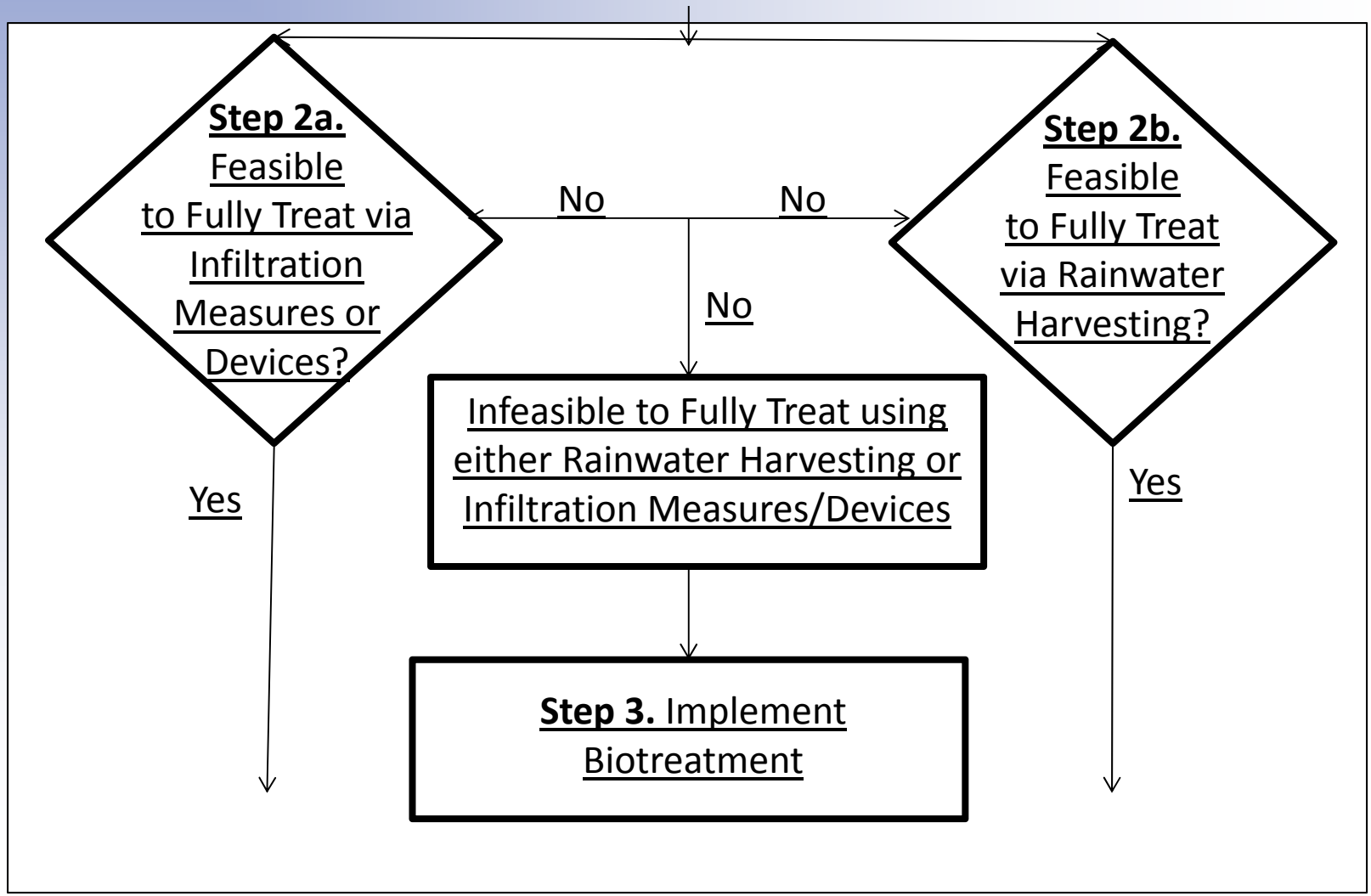
Roof runoff may be dispersed to properly-designed landscaping

“Interceptor” Tree Credits

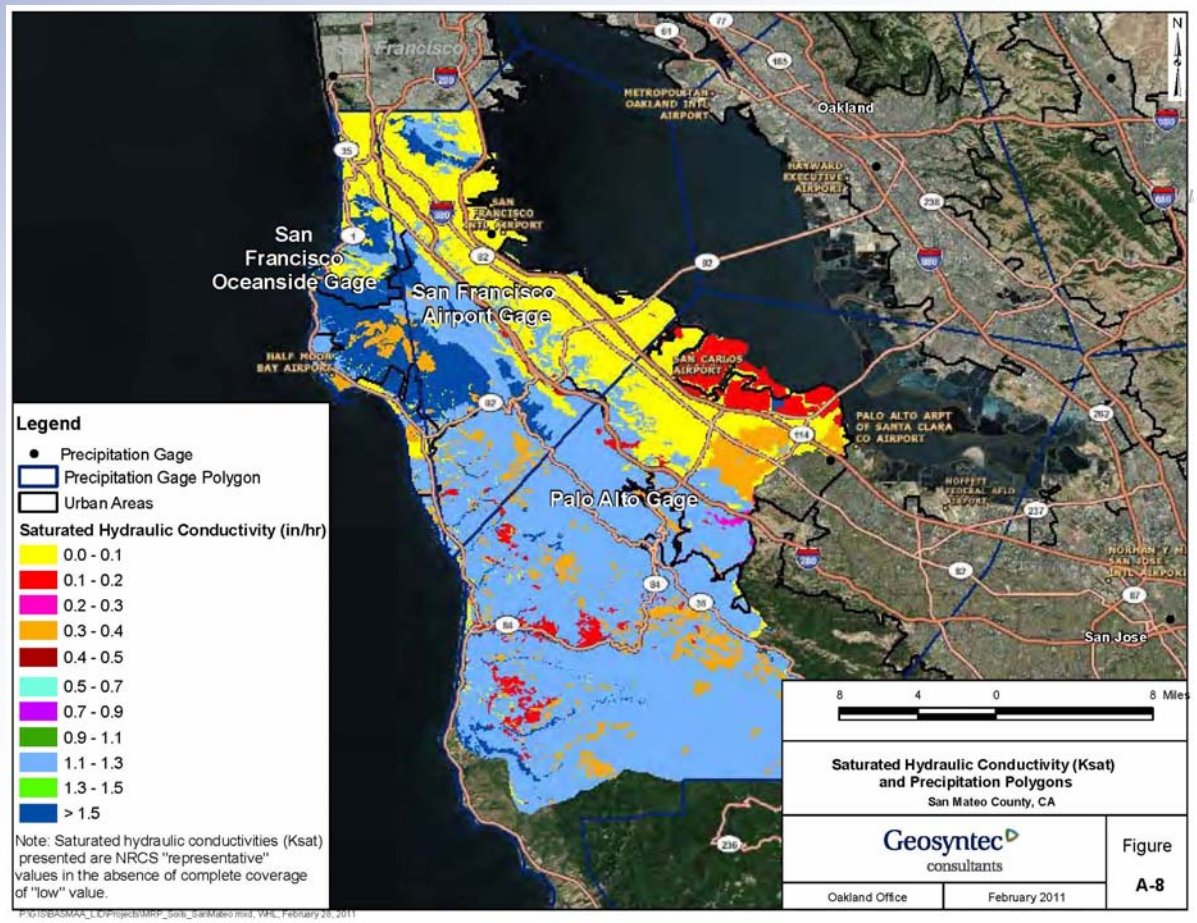
- Credit is allowed based on interception of rainwater by tree canopy.
- Not included in feasibility worksheets (the final number of trees and their locations is usually unknown till later in project design).
- Addressed in the Program’s updated C.3 Technical Guidance.

Feasibility Evaluation: Step 2: Evaluate Feasibility of Either Infiltration or Harvesting/Use



2a: Evaluate Feasibility of Infiltrating the Required Amount of Runoff

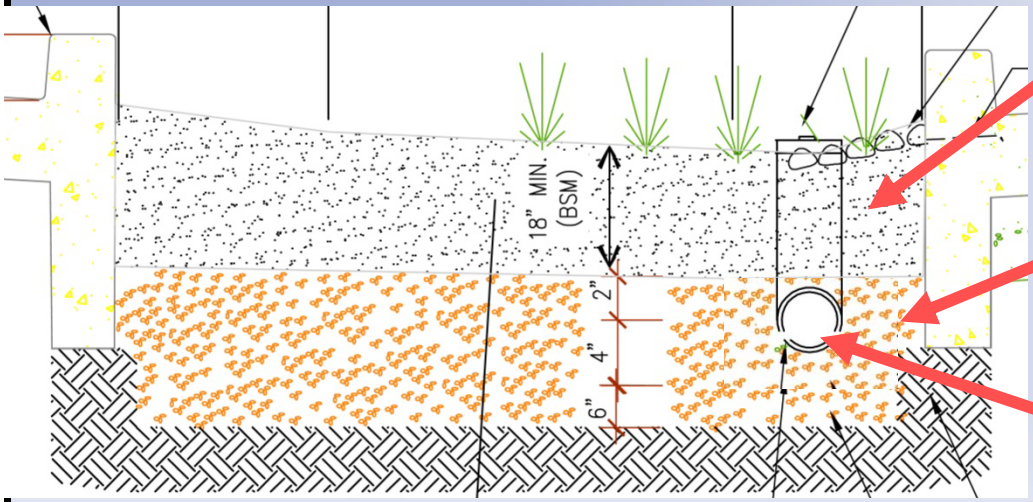
- Infiltration is not expected to be feasible for most development projects, due to clayey soils.
- Infiltrating the amount of runoff specified in Provision C.3.d is feasible only if saturated hydraulic conductivity ≥ 1.6.



How Much Runoff Must Be Treated per Provision C.3.d?

- Projects must treat runoff from 100% of project as follows:
  - ✓ 80% of the average annual runoff (for volume-based treatment measures – the basis for determining infiltration and harvesting/use feasibility), OR
  - Flow of runoff from a rain event of 0.2 inches per hour intensity (flow-based treatment measures)
- These are frequent small storms (1 to 2 year storms)

Basis for Determining Feasibility of Infiltrating the C.3.d Amount of Runoff



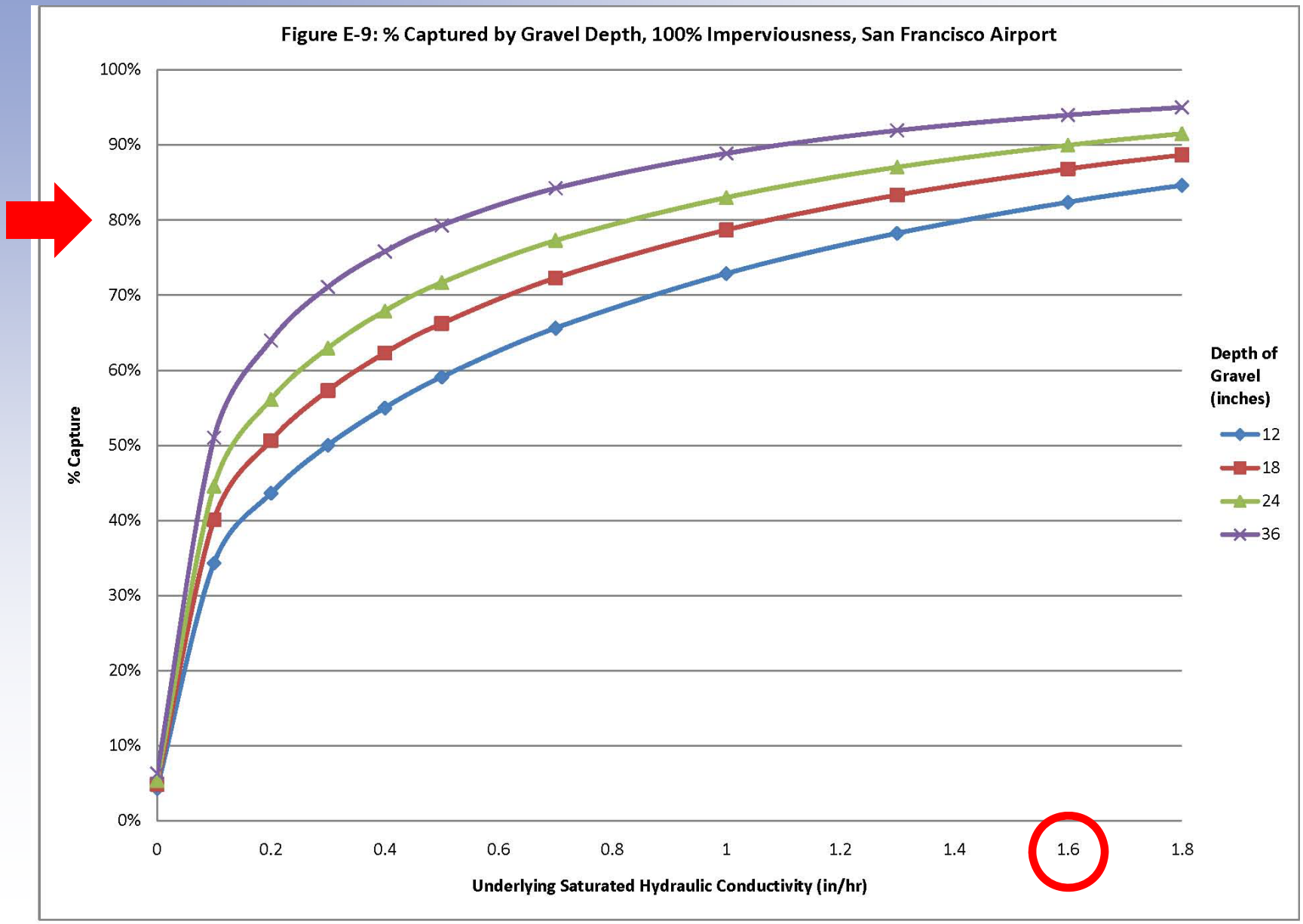
18 inches of biotreatment soil

12-inch layer of Class 2 permeable rock

Underdrain positioned near top of rock layer

- Modeling was based on bioretention area (a.k.a. “bioinfiltration”)
  - 18” of fast-draining soil,
  - 12” underlying rock layer,
  - Infiltration to native soils at bottom of bioretention area
  - Underdrain is near top of rock layer

Example of Infiltration Modeling Results, LID Feasibility Report



Evaluate Feasibility of Infiltration

- Even if the saturated hydraulic conductivity of onsite soils ≥ 1.6, infiltration may be infeasible due to conditions such as:
  - Steep slopes
  - High groundwater table
  - Subsurface contamination
  - Proximity to building foundation

Step 2b: Evaluate the Feasibility of Rainwater Harvesting and Use

- In most cases, it will be infeasible to harvest and use the full amount of runoff required by Provision C.3.d of the MRP.

Rainwater harvesting

- This is due to insufficient demand for nonpotable uses, such as:
  - Irrigation
  - Toilet flushing
  - Industrial process water

Evaluate the Feasibility of Rainwater Harvesting and Use

Rainwater harvesting

- How much water must be used in order to use the full C.3.d amount of stormwater?
  - Applicable sizing criteria in C.3.d is 80% capture of the annual runoff volume
  - Key concept is drawdown time (how quickly the cistern empties to make room for more water)

Evaluate the Feasibility of Rainwater Harvesting and Use

Rainwater harvesting

- To meet 80% capture for toilet flushing for the Palo Alto Rain Gauge area (per acre of impervious area):
  - 16,500 gal. tank, 8,250 gpd (48 hr drawdown)
  - 44,000 gal. tank, 2,900 gpd (15 day drawdown)
  - 2,900 gpd = 340 toilet users @ 8.6 gpd (under Green Building Code)

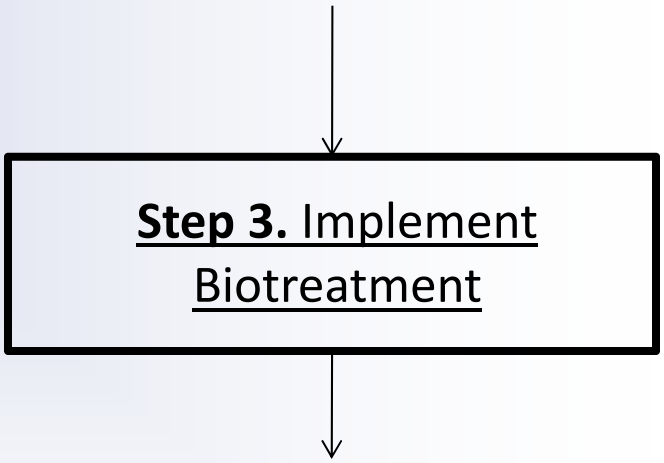
Evaluate the Feasibility of Rainwater Harvesting and Use

Rainwater harvesting

- To meet 80% capture for irrigation for the Palo Alto Rain Gauge Area (per acre of impervious surface):
  - 2,900 gpd = 3.2 acres of turf landscaping (or 6.4 acres of conservation landscaping) per acre of impervious area

Feasibility Evaluation: Step 3 – Biotreatment

- If both infiltration and rainwater harvesting/use are infeasible:
  - Implement biotreatment.



What Are Biotreatment Measures?

- Must filter stormwater through “biotreatment soil”
  - Long-term infiltration rate of 5 to 10 inches per hour
  - Soil must be suitable to support plant health
- Must be large enough in surface area to
  - Have a surface loading rate of at least 5 inches per hour.

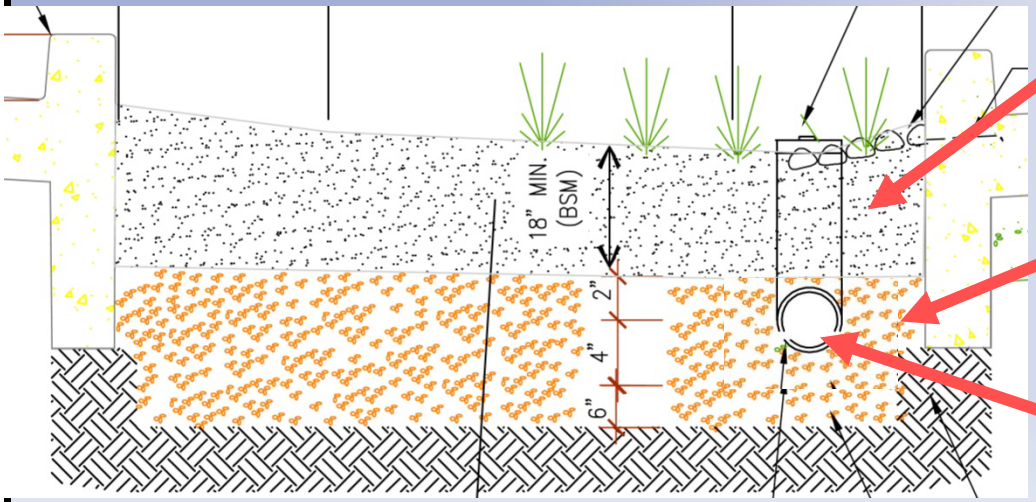
Bioretention/Rain Garden

When Is a Bioretention Area Considered “Biotreatment”?

- It is BIOTREATMENT when
  - Soil is too clayey to infiltrate C.3.d amount of runoff, and
  - An underdrain is provided.
- Unless hazards exist, biotreatment should maximize infiltration,
- Use the SAME DESIGN that is used in locations where it is feasible to infiltrate the C.3.d amount of runoff

Bioretention/Rain Garden

When is a Bioretention Area Infiltration, and When Is It Biotreatment?



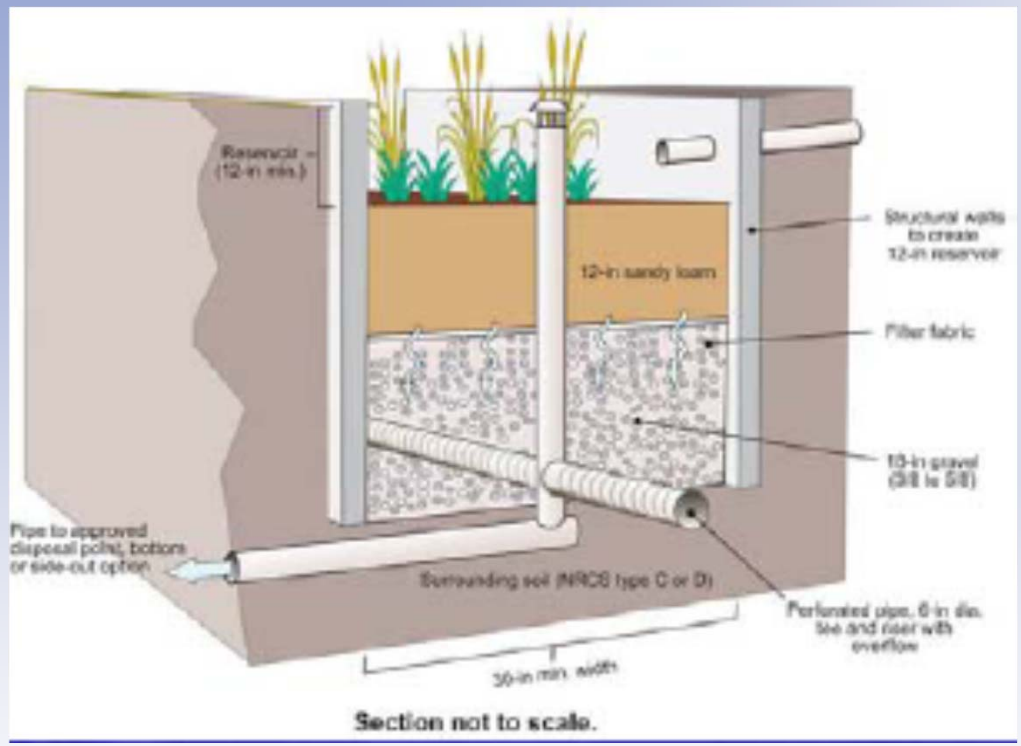
18 inches of biotreatment soil

12-inch layer of Class 2 permeable rock

Underdrain positioned near top of rock layer

- Use this design where there are no hazards to infiltration.
  - If the onsite Soil Saturated Hydraulic Conductivity $\geq$ 1.6, this is infiltration.
  - If the Saturated Hydraulic Conductivity < 1.6, this is biotreatment (that maximizes infiltration).

Avoid infiltration if hazards to infiltration exist

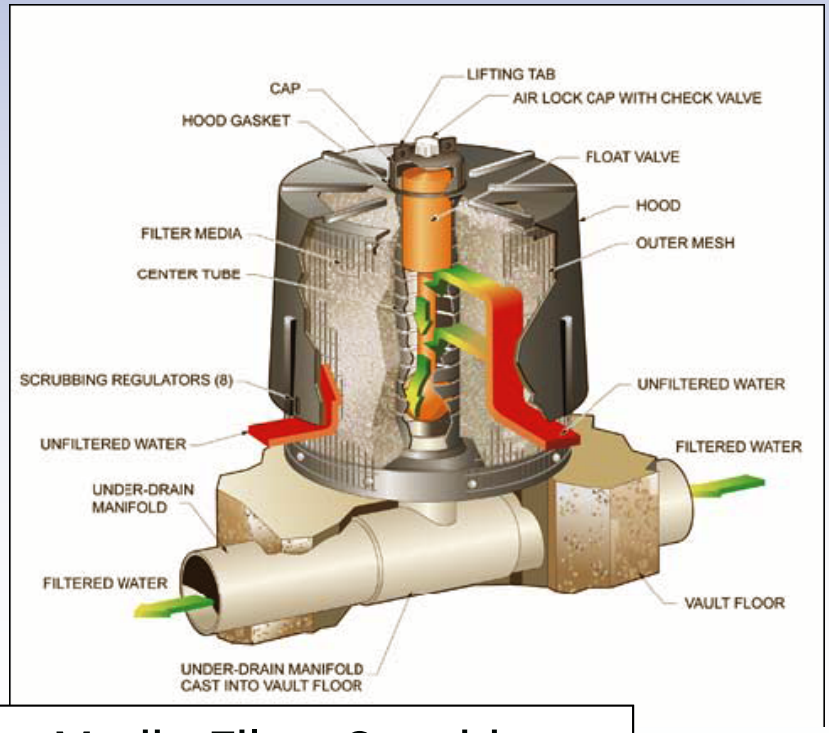


- Hazards to infiltration include:
  - Steep slopes
  - High groundwater table
  - < 10 feet from building foundation
  - Subsurface contamination

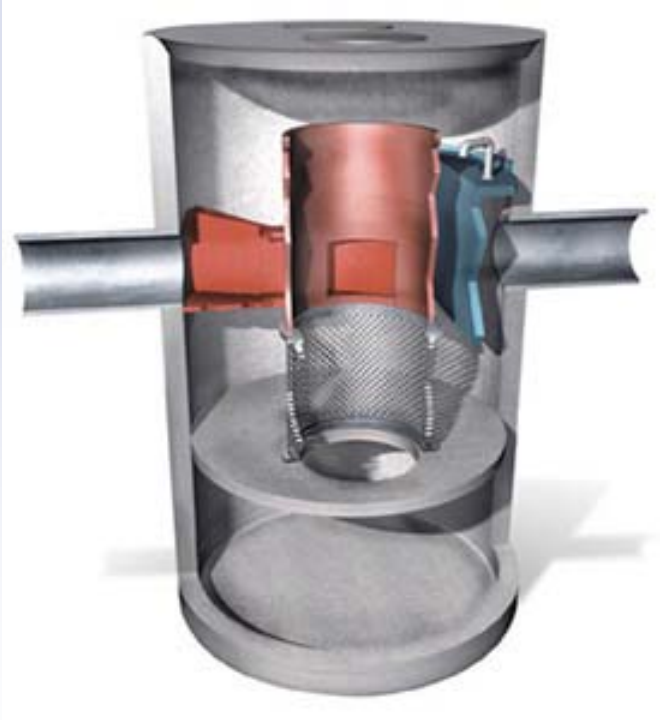
Flow through planter has concrete-lined sides and bottom.

Vault Systems Are Restricted

- Beginning December 1, 2011, mechanical, vault-based stormwater treatment systems will not meet LID treatment requirements.

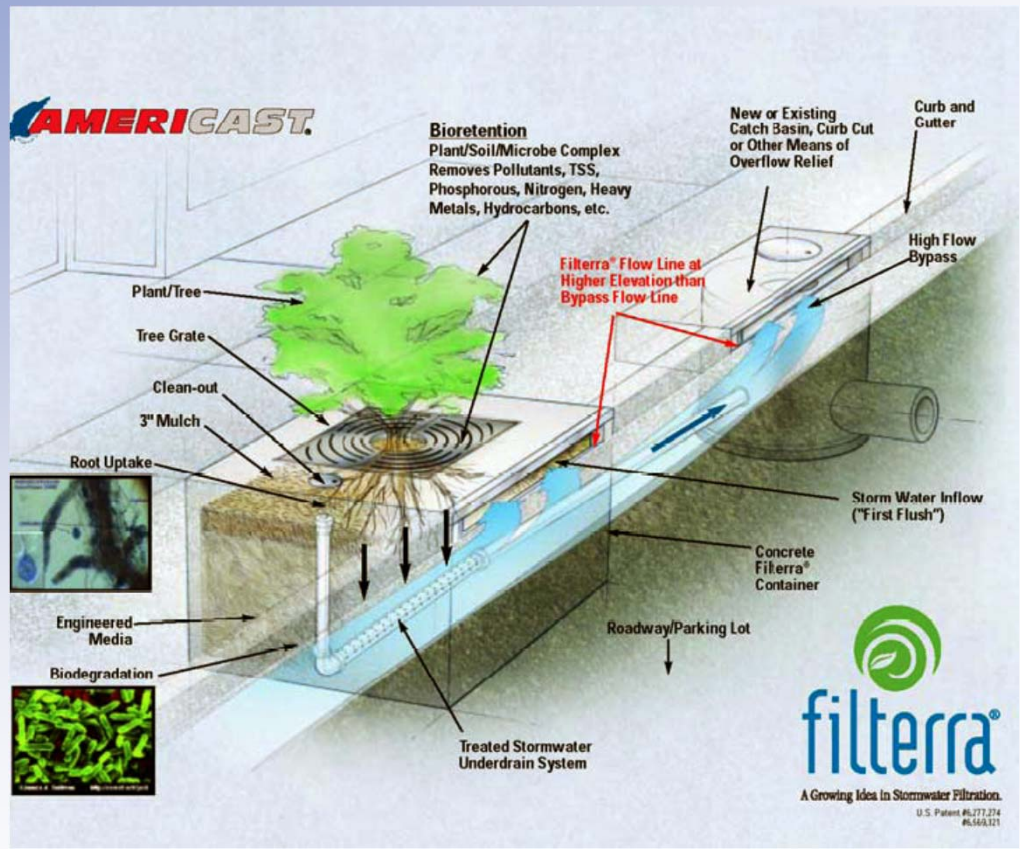


Media Filter Cartridge



Hydrodynamic separator

High-Flow Rate Tree Well Filters Are Restricted



- Example of Manufactured Tree Well filter
- Infiltration rate exceeds biotreatement requirement

Limited Use of Media Filters and Tree Well Filters in “Special Projects”

- Special Projects are smart growth, high density and transit oriented development projects that will receive LID treatment reduction credit
- Water Board December is scheduled to adopt Special Projects criteria on November 28, 2011.

Transit Oriented Development, Redwood City

“Special Projects” Category A
Infill Projects

- Located in central business district or comparable pedestrian oriented district.
- Built as part of objective to preserve or enhance pedestrian-oriented environment.
- Creates or replaces ½ acre or less of impervious surface.
- No surface parking except for emergency access, ADA or loading requirements.
- 85% of lot is covered by buildings; remaining 15% is for safety access, trash/recycling, public uses, etc.

If above criteria are met, project receives 100% LID treatment reduction.

“Special Projects” Category B
High Density Projects

- Located in central business district or comparable pedestrian oriented district.
- Built as part of objective to preserve or enhance pedestrian-oriented environment.
- Creates or replaces > ½ acre, but no more than 2 acres, of impervious surface.
- No surface parking except for emergency access, ADA or loading requirements.
- 85% of lot is covered by buildings; remaining 15% is for safety access, trash/recycling, public uses, etc.

If above criteria are met, a graduated system of LID treatment reduction credit applies.

“Special Projects” Category B Graduated credit system

LID Treatment Reduction	Land Use	Density
50%	Commercial or Mixed Use	Floor Area Ratio 2:1
50%	Residential	50 dwelling units/acre
75%	Commercial or Mixed Use	Floor Area Ratio 3:1
75%	Residential	75 dwelling units/acre
100%	Commercial or Mixed Use	Floor Area Ratio 4:1
100%	Residential	100 dwelling units/acre

“Special Projects” Category C
Transit Oriented Development

- Non-auto oriented project. (No stand-alone surface parking lots, car dealerships, auto and truck rental facilities with onsite surface storage, etc.)
- Within ½ mile radius of existing or planned transit hub, or within a Priority Development Area.
- For commercial or mixed use projects, a minimum floor area ratio of 2:1 is required.
- For residential projects, min. density of 25 dwelling units/acre.

If above criteria are met, a graduated system of LID treatment reduction credit applies.

- Location credit
- Density credit
- Minimize surface parking credit

“Special Projects” Category c Location Credit System

LID Treatment Reduction	Location
50%	Within ¼ mile radius of existing or planned transit hub
25%	Within ½ mile of radius of existing or planned transit hub
25%	Within a planned Priority Development Area (designated by ABAG/MTCA)

“Special Projects” Category C Density credit system

LID Treatment Reduction	Land Use	Density
10%	Commercial or Mixed Use	Floor Area Ratio 2:1
10%	Residential	30 dwelling units/acre
20%	Commercial or Mixed Use	Floor Area Ratio 4:1
20%	Residential	60 dwelling units/acre
30%	Commercial or Mixed Use	Floor Area Ratio 6:1
30%	Residential	100 dwelling units/acre

“Special Projects” Category C
Minimize surface parking credit system

LID Treatment Reduction	Location
10%	10% or less of the total post-project impervious surface is dedicated to at-grade surface parking
20%	No surface parking except for emergency vehicle access, ADA accessibility, and loading zones

For More Information…

- Municipal Regional Stormwater Permit
  www.flowstobay.org/ms_municipalities.php
- San Mateo Countywide New Development Page
  www.flowstobay.org/bs_new_development.php
  - LID Feasibility Report
  - LID Feasibility Worksheets and Attachments
  - C.3 Stormwater Technical Guidance
- Draft Tentative Order Amending the MRP
  - http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/stormwater/MRP/Prov_C3.shtml

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