The City of Sunnyvale
Stormwater Quality BMP Guidance Manual
For New and Redevelopment Projects

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Abbreviations and Glossary

Abbreviations

BASMAA – Bay Area Storm Water Management Agencies Association

BMP – Best Management Practices

CASQA – California Stormwater Quality Association

CDD- Community Development Department (City of Sunnyvale)

COA – Conditions of Approval

HM – Hydromodification Management

MEP – Maximum Extent Practicable

NOI – Notice of Intent

PRC – Project Review Committee

RWQCB – Regional Water Quality Control Board

SCVURPPP – Santa Clara Valley Urban Runoff Pollution Prevention Program

SCVWD – Santa Clara Valley Water District

SMC – Sunnyvale Municipal Code

STA – Self-Treating Area

SRA – Self-Retaining Area

SWMP – Storm Water Management Plan

SWPPP – Storm Water Pollution Prevention Plan

SWRCB – State Water Resources Control Board

Glossary

Best Management Practices (BMP) – A structural device, measure, facility or activity that helps to achieve storm water management control objectives at a designated site.

Bioretention - Landscaping features adapted to treat stormwater runoff on a development site. Surface runoff is directed into shallow, landscaped depressions. These depressions are designed with soil mixtures and vegetation that incorporate many of the pollutant removal systems that operate in a natural ecosystem. A bioretention area can be designed to function as a biotreatment system.

Biotreatment – A facility designed to detain stormwater runoff, filter stormwater runoff through soil media and plant roots, and release the treated stormwater runoff to the storm drain system.

Construction BMP – Temporary source control (e.g. cover soil stockpiles) and/or treatment control (e.g. silt fence, temporary detention basin) BMPs intended to minimize pollutants from storm water **during** project construction.

Directly Connected Impervious Area - The area covered by a building, impermeable pavement, and/or other impervious surfaces, which drains directly into the storm drain without first flowing across permeable land area (e.g., turf buffers).

Discharge – When used as a verb, means to allow pollutants to directly or indirectly enter storm water, or to allow storm water or non-storm water to directly or indirectly enter the storm drain system from an activity or operation. When used as a noun, "discharge" means the pollutants, storm water and/or non-storm water that are discharged.

Drainage area – An area, as defined by the highest topography of a site, where all precipitation falling within the area will flow to a single common point.

Drainage sub-area – A smaller portion of the drainage area.

Hydromodification – The change in the runoff hydrograph for a development site, i.e., increases in peak flows, volume and durations of runoff that result when land is developed (e.g., made more impervious). The effects of hydromodification on a receiving stream include, but are not limited to, increased bed and bank erosion, loss of habitat, increased sediment transport and deposition, and increased flooding.

Hydromodification management (HM) – The use of site design and flow control measures to mitigate

the change in a site's runoff hydrograph caused by land development.

Impervious surface –Constructed or modified surface that cannot effectively infiltrate rainfall. Impervious surface includes but is not limited to building rooftops, pavement, sidewalks, and driveways where such surfaces are not constructed with pervious materials. "Impervious surface area" means the ground area covered or sheltered by an impervious surface, measured as if from directly above.

Infiltration - The process of percolating storm water or non-storm water into the subsoil.

Infiltration device –Any structure that is designed to infiltrate storm water into the subsurface and as designed, bypasses the natural groundwater protection afforded by surface or near surface soil. Infiltration devices that do not meet the design criteria in the SCVURPPP guidelines for Infiltration Devices (April 2011, copy included in Appendix D) should be reviewed and approved by the Santa Clara Valley Water District before City building permits are approved.

Low Impact Development (LID) – An approach to new and redevelopment designs to reduce stormwater runoff and mimic a site's predevelopment hydrology by minimizing the amount of disturbed areas and impervious cover and then infiltrating, storing, detaining, evapotranspiring, and/or biotreating stormwater runoff close to its source. LID principles treat stormwater as a resource, rather than a waste product that must be removed from the site.

Low Impact Development (LID) Treatment – The use of LID methods for the purpose of stormwater treatment. The only acceptable method of stormwater treatment under the MRP is through the use of LID.

Non-storm water discharges – Flows that do not consist entirely of storm water. Non-storm water discharges without pollutants can include uncontaminated groundwater and natural springs. Non-storm water discharges that may contain low levels of pollutants include car washing, air conditioner condensate, and hydrant flushing water. (Reference: CASQA Industrial and Commercial BMP Handbook, Fact Sheet SC-10).

Numeric sizing criteria – Hydraulic sizing design criteria for treatment BMPs for storm water runoff. Can be either volume hydraulic design basis or flow hydraulic design basis, depending on the primary mode of action for the treatment BMP. (Reference: Provision C.3.d of Regional Water Quality Control Board, San Francisco Bay Region Order No. R2-2009-0074)

Post-Construction BMP – Permanent source control and/or treatment control BMPs intended to be in place to treat storm water and minimize pollutants discharged to the City's storm drain collection system **after** the project is constructed. If a Storm Water Management Plan is required for a site, then information as to the design, operation, and maintenance of the Post-Construction BMPs must be included in the SWMP.

Redevelopment – Land-disturbing activities that result in the creation, addition, or replacement of impervious surface area on an already developed site. Redevelopment includes, but is not limited to the expansion of a building footprint; addition or replacement of a structure; replacement of impervious surface area that is not part of a routine maintenance activity; and land disturbing activities related to structural or impervious surfaces.

Site Design Measures – Basic methods to reduce the amount and flowrate of stormwater runoff from projects and provide some pollutant removal treatment of the runoff that does leave the projects. These measures include, for example, directing runoff from impervious surfaces into cisterns or landscaped areas, and constructing driveways, patios using permeable materials.

Source Control Best Management Practice – Means any schedule of activities, prohibitions of practices, maintenance procedures, managerial practices or operational practices that aim to prevent storm water pollution by reducing the potential for contamination at the source of pollution.

Special Projects – When considered at a watershed scale, certain land development projects characterized as smart-growth, high-density or

transit-oriented development can either reduce existing impervious surfaces or create less "accessory" impervious areas and automobile-related pollutant impacts. These types of "Special Projects" may be eligible for "LID Treatment Reduction Credits" under Section C.3.e.ii of the Municipal Regional Permit. See Appendix H for more detailed information.

Storm water – Means surface runoff and drainage associated with storm events.

Storm Water Management Plan (**SWMP**) – A plan identifying the measures that will be used for storm water and non-storm water management after construction is complete for any new development or significant redevelopment project subject to the requirements of MRP Provision C.3. The SWMP should include treatment and source control Best Management Practices (BMPs) and site design measures that will treat and control storm water coming from the site to the maximum extent practicable. It must also reflect the information presented in project plan sheets as approved by Plan Check in the Sunnyvale Building Division. SWMPs may be required for projects that add or replace 5,000 square feet or more of impervious area.

Self-Treating Area (STA) – A pervious area designed to treat rain falling directly on its surface via ponding infiltration or evapo-transpiration. An STA must retain approximately 1" of rainfall or be designed to store and infiltrate the C.3.d amount of runoff

Self-Retaining Area (SRA) - A pervious area designed to retain and infiltrate rain falling directly on its surface in addition to runoff from adjacent impervious areas. A maximum 2:1 ratio of impervious area to the receiving pervious area should be used when designing SRAs.

Storm Water Pollution Prevention Plan (**SWPPP**) -A plan identifying the measures that will be used to manage storm water and non-storm water during the construction phase of a project. A SWPPP is required for those facilities that disturb one or more acres of land and must file a Notice of Intent (NOI) with the State Water Resources Control Board. A SWPPP may also be required for projects in the City that are issued a grading permit.

Treatment – See LID Treatment.

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Introduction

Overview

This City Of Sunnyvale Storm Water Quality Best Management Practices (BMP) Guidance Manual 2011 Revision for New and Redevelopment Projects, is being provided by the City of Sunnyvale (City) to guide project applicants and City staff in the preparation, review, and approval of new and redevelopment projects according to the current requirements of the City's NPDES Storm Water Discharge permit. The focus of the BMP Guidance Manual is on Post-Construction BMPs, although BMPs to be implemented during construction are also addressed. More detailed resources to address Construction BMPs are provided on page 32 and in Appendix A – Blueprint for a Clean Bay.

As described in the Glossary above, BMPs include any kind of procedure or device designed to minimize the quantity of pollutants that enter the storm drain system. Procedures can include the use of site design measures early in the planning stages of a project site to incorporate BMPs in the site landscape to minimize water quality impacts. It may also include source control BMPs such as placing signage on storm drain inlets, covering trash enclosures, and implementing practices such as sweeping and spill prevention programs. Treatment BMPs include permanent devices such as permeable paving, infiltration trenches, and bioretention areas. A summary of BMPs and references for more detailed information on BMPs can be found in Appendix C.1.

Referenced Material

The majority of the information for this BMP guidance manual is derived from two sources, the California Storm Water Quality Association (CASQA) Storm Water Quality Best Management Practices Handbook (4 volumes) and the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) C.3 Storm Water Handbook. The CASQA documents can be found at http://www.cabmphandbooks.com/ and the SCVURPPP documents can be found at www.scvurppp.org. The specific information from the sources mentioned above has been customized in this Guidance Manual for the City's processes and practices, and portions of documents from these sources are found in the appendices as applicable.

Municipal Regional Stormwater Permit Applicability

The Municipal Regional Stormwater Permit (MRP) was adopted by the Regional Water Quality Control Board in October 2009 to regulate municipal separate stormwater systems in 76 jurisdictions in the San Francisco Bay Area. Agencies subject to the MRP include: Sunnyvale, 12 other municipalities in the Santa Clara Valley, the Santa Clara Valley Water District, and Santa Clara County, which together form the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). The MRP introduces more prescriptive requirements for new development and redevelopment projects than Sunnyvale's previous municipal stormwater permit. Major requirements for new development and redevelopment projects since the MRP went into effect on December 1, 2009 include:

- Projects ***that create and/or replace 10,000 square feet or more of impervious surface*** are required to implement stormwater treatment measures, site design measures, and source control measures.
- Projects ***that create and/or replace 1 acre or more of impervious surface***, and are located in areas where creeks are susceptible to development-induced erosion, are required to implement hydromodification management (HM) measures, so that the post-project rate and duration of stormwater runoff matches pre-project conditions.
- Local agencies are required to encourage the use of appropriate site design measures and source control measures in all projects subject to City review, regardless of size.

The following new requirements will go into effect December 1, 2011:

- Low impact development (LID) treatment ***must*** be used for all projects that require stormwater treatment measures. LID treatment consists of infiltration, evapotranspiration or rainwater harvesting and use. In cases where these methods are infeasible, biotreatment may be used.
- The size threshold that triggers the stormwater treatment measures for development and redevelopment projects ***will drop from the existing threshold of 10,000 square feet of impervious surface to 5,000 square feet of impervious surface***, for restaurants, retail gasoline outlets, auto service facilities, and uncovered parking lots (either stand-alone lots or those that are part of another use).
- Certain smart growth, high density, and transit-oriented development ***"Special Projects"*** may be allowed to meet stormwater treatment requirements with manufactured media filters or proprietary tree well filters, subject to the approval by the Regional Water Quality Control Board of regional "Special Projects" criteria and procedures.
- ***Beginning December 1, 2012, all projects which create and/or replace 2,500 square feet to 10,000 square feet***, including detached single-family residences that are not part of a larger plan of development, must implement one or more site design measures.

The requirements listed above are included in Provision C.3 of the MRP, which can be downloaded at: http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2009/R2-2009-0074.pdf.

Authority

City staff from the Departments of Public Works, Community Development, Environmental Services and the Office of the City Attorney have worked together to develop the best approach for implementing requirements in the Storm Water NPDES Permit, especially Provision C.3 requirements. In order to implement the NPDES permit provisions, the City needed adequate legal authority to implement control measures for new development and significant redevelopment, including all requirements of Provision C.3. This authority was put into place through amendments to City's Municipal Code Chapter 12.60.

The Storm Water Chapter includes:

- General provisions and definitions;
- Discharge prohibitions to the storm water conveyance system;
- Requirements for storm water pollution prevention and the development of Storm Water Management Plans;
- Numeric sizing criteria for pollutant removal treatment systems;
- Applicability of Hydromodification Management requirements to certain areas of the City based on drainage area to creeks and watersheds;
- Requirements for agreements to maintain storm water treatment Best Management Practices (BMPs) once constructed;
- Guidance on the selection of BMPs as well as minimum Best Management Practices for all dischargers;
- Authority for City staff to inspect and require the proper operation and maintenance of treatment devices;
- The process by which waivers and alternative compliance with permit requirements may be demonstrated; and
- Penalties for failure to comply with provisions of the chapter.

The most recent version of SMC 12.60 may be viewed at http://qcode.us/codes/sunnyvale/ or at the City's website: http://www.sunnyvale.ca.gov/ by looking under "About the City" and clicking on "Municipal Codes".

Overview of Project Review Process

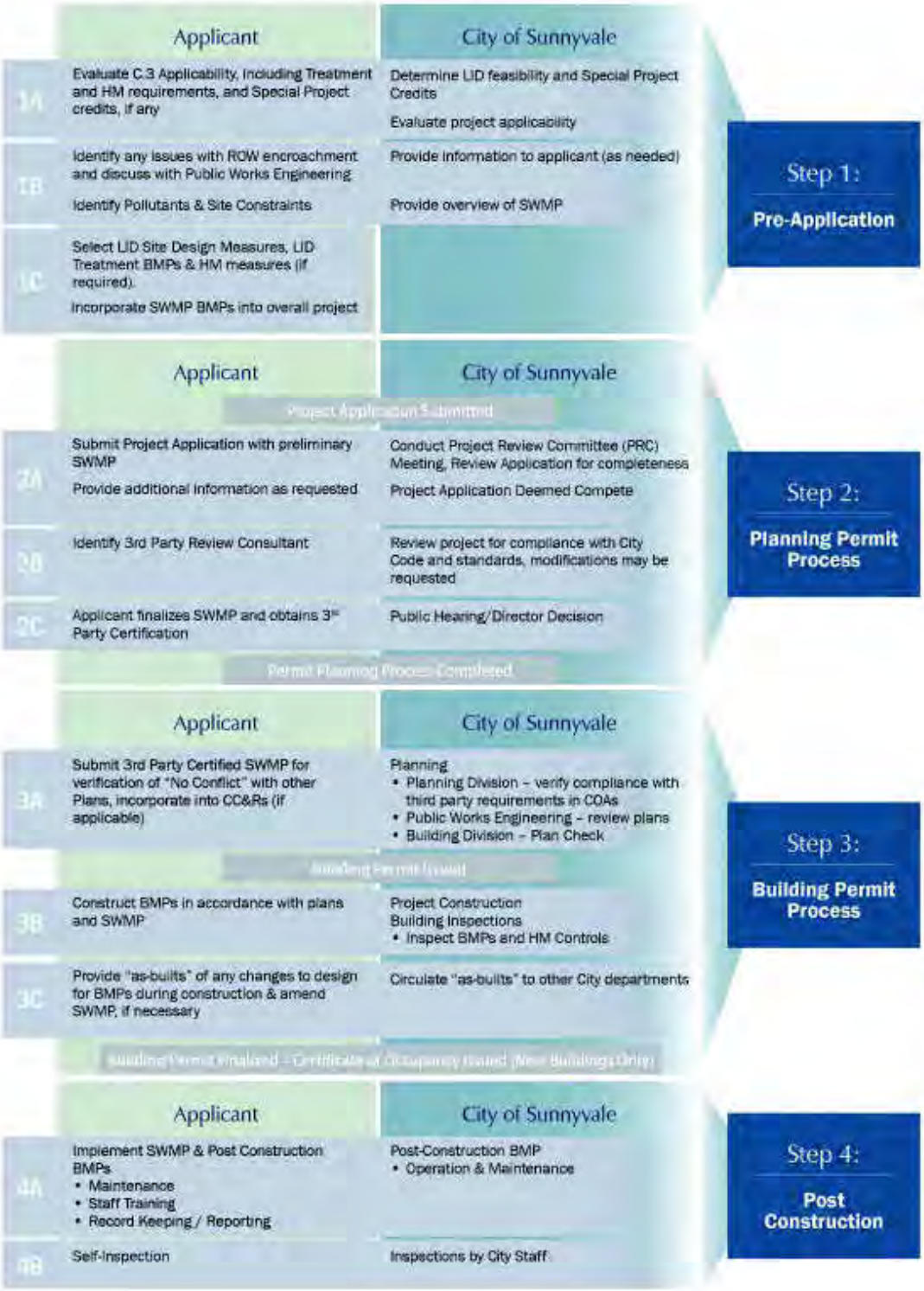
The review and approval process for projects that require Storm Water Management Plans is slightly different from the City's usual project review

process. Figure 1 shows the four major steps for both the applicant and the City, including specific actions that must be completed before moving on to the next step of the project approval process. The figure shows the start of the project from its conception and project application preparation at the top through project plan design/review, and construction of the post-construction BMPs, to the completion of the project and maintenance and inspection of post-construction BMPs at the bottom.

The left side of the figure represents the steps that the applicant must take to prepare and submit appropriate documentation that describes the site design and BMP approaches that will be used in a specific Storm Water Management Plan (SWMP) for the project. A summary of SWMP contents is included in Step 1C and a detailed description of what must be included in the SWMP is found in Appendix A. More detailed guidance to assist in the sizing of storm water treatment BMPs can be found in Appendix F, Flow–Based and Volume-Based Sizing Examples.

The center portion of Figure 1 shows the City's review process and actions needed to reach the project milestones listed at the bottom of each step. This graphic is included to show a project applicant where their project is in the approval process.

Figure 1: Steps in the Project Review Process for New and Redevelopment Projects in Sunnyvale

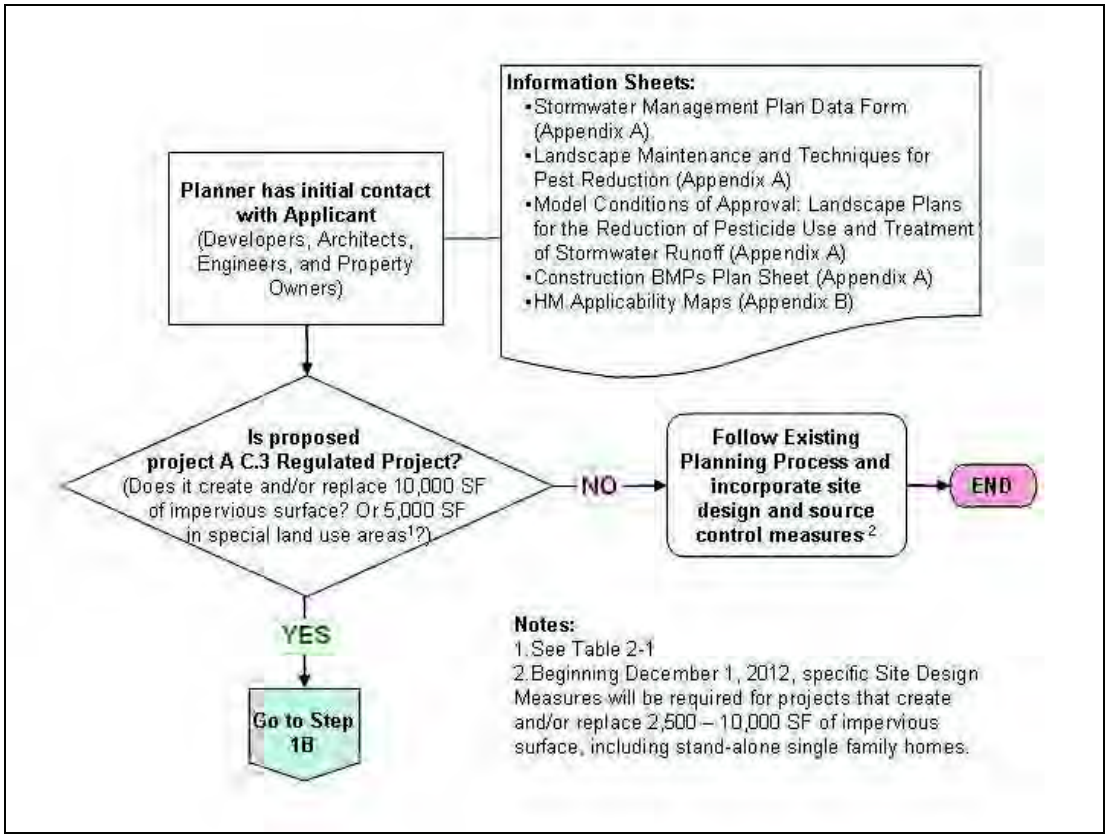


Step 1: Pre Application

Step 1A: Applicability Evaluation

When an applicant is first developing a concept for a project, it is recommended that the applicant meet with City staff for guidance and to evaluate whether the C.3 Provisions apply to the project. Exclusions to the C.3 Provisions are described in the **Step 1a.1:When C.3 Provisions Are Not Applicable** that follows while more specific applicability evaluation is described in **Step 1a.2: When C.3 Provisions are Applicable** and is summarized in Figure 2.

Figure 2: Project Applicability Flow Chart



Step 1A.1: When C.3 Provisions Are Not Applicable

Certain types of projects are excluded from Provision C.3 requirements, even if they meet the impervious surface thresholds described in Step 1a.2.

The list of excluded project types is shown in Table 1.

Table 1
Projects Excluded from Provision C.3 Requirements

	Excluded Project Types
New Development	• Construction of a detached single-family home project that is not part of a larger plan of development, with the incorporation of appropriate pollutant source control and design measures and using landscaping to treat runoff from roof and house associated impervious surfaces.
Redevelopment and Special Land Use Categories	• Interior remodels; • Routine maintenance or repair, such as roof or exterior wall surface replacement; or • Pavement resurfacing within the existing footprint.
Road projects	• Sidewalks built as part of new streets or roads and built to direct stormwater to adjacent vegetated areas, • Bicycle lanes that are built as part of new streets or roads, but are not hydraulically connected to new streets or roads and that direct stormwater to adjacent vegetated areas; • Impervious trails built to direct stormwater runoff to adjacent vegetated areas, or non-erodible permeable areas, preferably away from creeks or toward outboard sides of levees • Sidewalks, bicycle lanes, or trails constructed with permeable surfaces such as pervious concrete, porous asphalt, unit pavers, and granular materials, • Caltrans highway projects and associated facilities.
Source: San Francisco Bay Regional Water Quality Control Board, Municipal Regional Permit Provision C.3.b.ii., October 2009	

If the C.3 Provisions are not applicable, then the applicant will follow the usual City process for permitting. However, the City may apply the following conditions of approval for storm water management:

- Projects shall be designed to minimize and reduce directly connected impervious surfaces as well as to treat storm water runoff by incorporating elements that collect, detain, and infiltrate runoff.
- Landscaped areas in projects should be designed with efficient irrigation to reduce runoff, promote surface infiltration, and minimize the use of fertilizers and pesticides that can contribute to water pollution.

The City may also require source control measures appropriate for the types of land use and potential pollutant sources expected on the site. (See Appendix C.1.)

Step 1A.2: When C.3 Provisions Are Applicable

Provision C.3.b of the City's Stormwater NPDES Permit and Sunnyvale Municipal Code SMC 12.60.121 through 12.60.123 require that the following projects must provide site design measures, source control measures, and stormwater treatment measures to control pollutants in stormwater, as well as hydromodification management measures if applicable:

- Projects that create and/or replace 10,000 ft^2 or more of impervious surface;
- Projects that fall into special land use categories (listed in Table 2) and create and/or replace 5,000 ft^2 or more of impervious surface (as of December 1, 2011);

The types of projects for which C.3 Provisions are applicable are listed in Table 2.

Table 2
Projects Types for which C.3 Provisions Apply

Development Category	Included Project Types
New Development	Commercial, industrial, residential housing subdivisions (e.g., detached single-family home subdivisions, multifamily attached subdivisions such as townhomes, condominiums and apartments), mixed-use, and public projects.
Redevelopment	Commercial, industrial, residential housing subdivisions (e.g., detached single-family home subdivisions, multifamily attached subdivisions such as townhomes, condominiums and apartments), mixed-use, and public projects. Figure 3 shows how the requirements apply to redevelopment projects.
Special Land Use Categories	▪ Auto service facilities described by the following Standard Industrial Classification (SIC) Codes: 5013, 5014, 5541, 7532-7534 and 7536-7539[1]; ▪ Retail gasoline outlets; ▪ Restaurants (SIC Code 5812 Eating Places); ▪ Uncovered parking lots (stand alone or part of any other development project, including the top, uncovered portion of parking structures, unless the uncovered portion drains to the sanitary sewer (as well as the covered portion).
Road Projects	▪ New streets or roads, including sidewalks and bicycle lanes built as part of the new streets or roads; ▪ Widening of existing streets or roads with additional traffic lanes. ▪ Impervious trails with a width of 10 feet or greater and within 50 feet from top of creek banks.

Source: San Francisco Bay Regional Water Quality Control Board, Municipal Regional Permit Provision C.3.b.ii., October 2009.

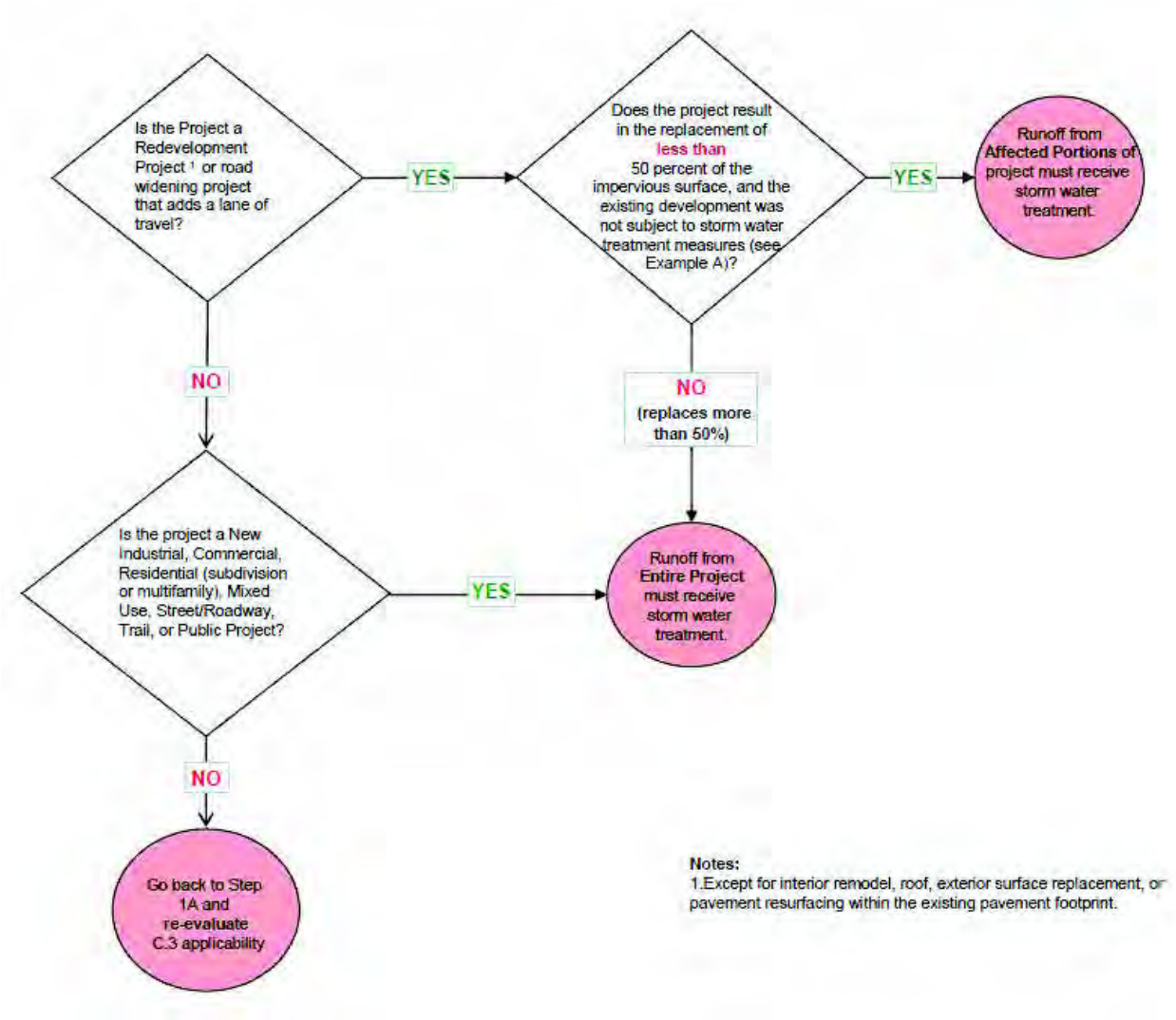
Note: 1) Standard Industrial Classifications referenced above:

- 5013 Motor Vehicle Supplies and New Parts
- 5014 Tires and Tubes
- 5541 Gasoline Service Stations
- 7532 Top, Body, and Upholstery Repair Shops and Paint Shops
- 7533 Automotive Exhaust System Repair Shops
- 7534 Tire Retreading and Repair Shops
- 7536 Automotive Glass Replacement Shops
- 7537 Automotive Transmission Repair Shops
- 7538 General Automotive Repair Shops
- 7539 Automotive Repair Shops, Not Elsewhere Classified

Step 1A.3: Significant Redevelopment Projects

The proportion of impervious surface replaced on the site determines whether the entire site or only a portion of the site must be included in treatment system design. Figure 3 is a flow chart that describes what is or is not a significant redevelopment project. Examples of how the requirements apply to sample redevelopment projects are found in Appendix A.

Figure 3: Significant Redevelopment Determination



Step 1A.4: Applicability of Hydromodification Management Requirements

In addition to complying with stormwater treatment requirements, projects located in areas near sensitive streams that create and/or replace 1-acre or more of impervious surface will also need to comply with hydromodification management (HM) requirements. "Hydromodification" refers to changes in the timing, runoff rates, and volumes of stormwater runoff from a site. When a site is developed with impervious surfaces, much of the rainwater can no longer infiltrate into site soils, so it flows offsite at faster rates and greater volumes, which can result in creek erosion. Maps contained in Appendix B will assist an applicant in identifying whether their project location is in an area where HM is required.

Projects subject to the HM requirements must incorporate HM measures, which are designed to maintain the pre-project flow characteristics such that any increase in runoff from the project site does not cause erosion or other impacts in the receiving stream. HM measures include constructed facilities (such as basins, ponds, or underground vaults) that manage the flow rates and volumes of stormwater leaving a site. Site design and LID treatment measures can help to reduce or eliminate the hydromodification effects of development projects. In some cases, a single stormwater control measure may be used to meet both the treatment and HM requirements for a project.

Unless it is a single-family home that is not part of a larger plan of development, your project will be required to comply with the HM requirements if it meets all of the following applicability criteria:

- The project creates and/or replaces one acre or more of impervious surface,
- The project will increase impervious surface over pre-project conditions, AND
- The project is located in a susceptible area, as shown on the HM applicability maps in Appendix B.

If your project does meet all of the above criteria, HM controls will be required, and further guidance on design criteria can be found in MRP Provision C.3.g, MRP Attachment F, and the SCVURPPP C.3 Handbook, Chapter 7. MRP Attachment F includes an "Impracticability Provision" which would allow an applicant to use alternative methods of compliance where HM controls would be impracticable.

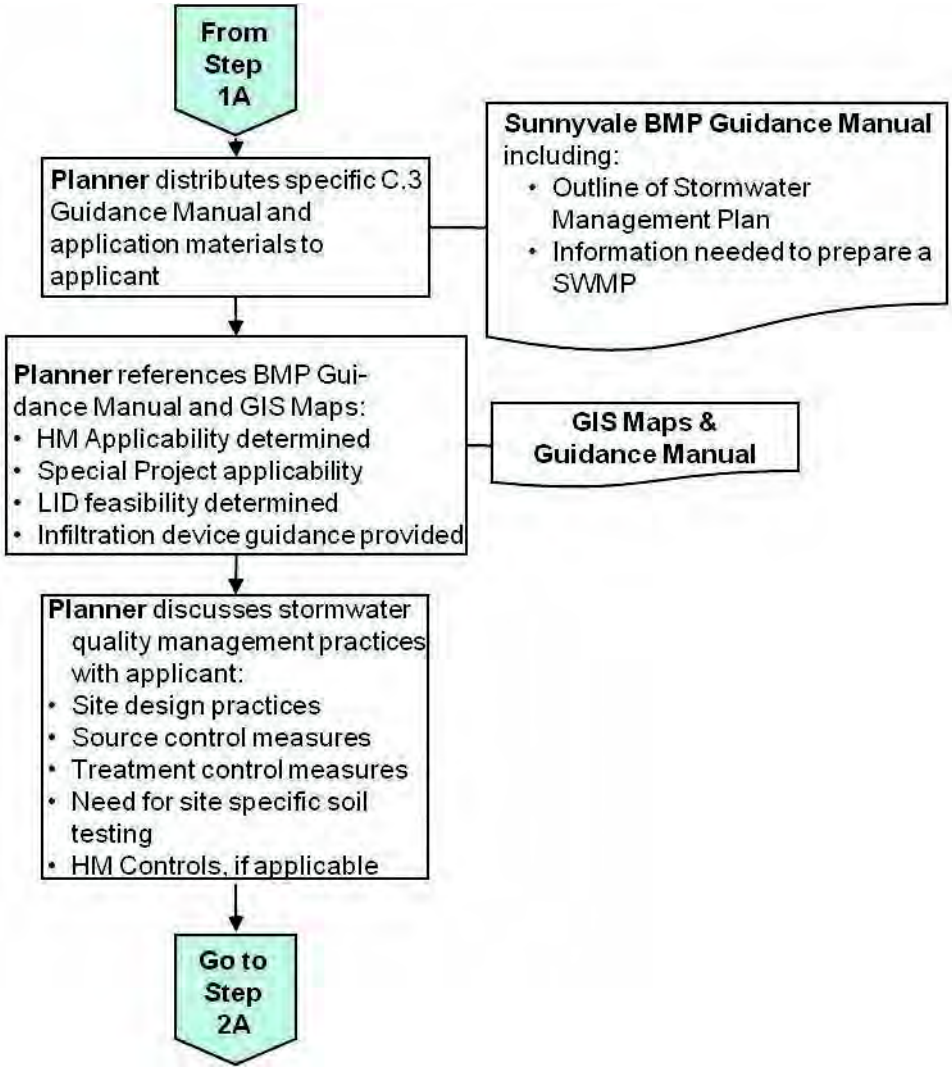
Step 1A.5: Infeasibility/ Impracticability of BMP Implementation

If it is found that BMP implementation is infeasible or impractical after an initial review and assessment of BMPs, then an alternative compliance demonstration for the C.3 Provisions can be made as described in Step 1C (Eligibility for Alternative Compliance if onsite storm water control measures are impracticable).

Step 1B: Applicant Education

If a project is required to comply with the C.3 Provisions, the following Figure 4 shows the applicant education process steps that will be taken:

Figure 4: Applicant Education and Information



The City maps found in Appendix B should be consulted to identify the project location and determine:

1. Which creeks or channels will receive storm water from the project.
2. Whether the HM requirements are applicable.
3. Whether the use of infiltration BMPs (as defined in the City Ordinance 12.60.190) is potentially feasible based on soil types present, depth to groundwater at a project location, and project proximity to an identified groundwater protection area. Additional soil testing may be required to determine infiltration rates and other characteristics.

4. Other general constraints for the use of BMPs at the specific project location.

These items will be documented on the Stormwater Management Plan Data Form found in Appendix A and on the Site Plan prepared for the SWMP, if one is required. The use of site design techniques to minimize impervious surface are highly recommended as described in greater detail below.

Step 1B.1: Site Design Techniques to Minimize Impervious Surfaces

Using site design measures to manage storm water quality requires both planning and design early in the project development process. As described in Appendix C.1, planning and design elements should address the following:

1. **Planning** – Identify sensitive areas on a project site such as existing trees, erosive soils, riparian areas, wetlands, or other sensitive areas that need to be protected and preserved.

2. **Design** – Utilize drainage as a design element in site plan development. When possible, natural drainage should guide the pattern of development and influence layout of pathways, parks, open spaces/areas, and building structures. Suggested methods include:
   a. **Limit disturbance of natural water bodies and drainage systems:**
      1) Minimize compaction of highly permeable soils.
      2) Protect slopes and channels from erosion.
      3) Conserve natural areas, including existing trees, other vegetation and soils.
   b. **Minimize impervious surface area:**
      1) Design compact, multi-story and/or clustered buildings
      2) Minimize surface parking
      3) Reduce street width where allowed.
      4) Use alternative surfaces such as permeable paving (e.g., pervious asphalt, pavers, concrete, turf block, etc.) and green roofs where feasible.
   c. **Use Self-Treating Areas to reduce the amount of area requiring LID treatment BMPs:**
      1) Self-Treating Areas (STA) are defined as pervious areas designed to treat rain falling directly on the surface via ponding infiltration or evapo-transpiration.
      2) Pervious surfaces acceptable for use as STAs include: landscaping, green roofs, pervious paving, and artificial turf.
      3) STAs must retain approximately 1" of rainfall or be designed to store and infiltrate the C.3.d amount of runoff.
      4) Runoff from an STA can flow directly to the storm drain system and does not require treatment through another LID treatment measure.
      5) STA Credit can be achieved based on the interception of rainwater by tree canopy. See Appendix C.1 for more information.
      6) STA should be shown on plans and documented in the Table A-2: Stormwater Management Plan BMP Summary Table.
   d. **Maximize storm water retention through the use of Self-Retaining Areas:**
      1) Direct runoff from impervious surfaces onto vegetated areas. If the vegetated area can retain and infiltrate the runoff from the contributing impervious surface, it is called a Self-Retaining Area (SRA) or zero discharge area.
      2) Similar to STAs, SRAs must retain and infiltrate at least 1" of rainfall on the area itself. In addition, SRAs can accept drainage from some adjacent impervious area, producing no treatment-required runoff.
      3) A maximum 2:1 ratio of impervious area to the receiving pervious area should be used when designing SRAs.
      4) SRAs minimize the amount of impervious area directly connected to storm water collection systems.
      5) Use small landscaped areas in parkway plantings, along street

shoulders, under decks, in parking lot planters, and at roof downspouts to break up continuous impervious areas.

6) Increase treatment and infiltration / evapotranspiration potential of the landscape through maintaining soil drainage capacity and plant selection using deeply rooted plants, as appropriate.
7) SRA should be shown on plans and documented in the Table A-2: Stormwater Management Plan BMP Summary Table.

3. In addition to the information found in Appendix C.1, more detailed information on the use of site designs to manage storm water can be found in:

a. BASMAA's Start at the Source: Residential Site Planning and Design Guidance Manual for Storm Water Quality Protection.
b. BASMAA's Using Site Design Techniques to Meet Development Standards for Storm Water Quality – A Companion to Start at the Source.
c. SCVURPPP's C.3 Storm Water Handbook: Guidance for Implementing Storm Water Requirements for New and Redevelopment.

These documents can be downloaded at http://www.scvurppp-w2k.com/nd_wp.shtml.

Step 1B.2: MRP-Defined LID Treatment BMPs

In addition to Site Design Principles as described above, BMPs can be described as either Source Control Measures or LID Treatment Measures. The MRP requires that both source controls and LID Treatment Measures be applied to all regulated projects. Appendix C.1 includes descriptions of Source Control Measures in Tables C-1 and C-2. Table C-3 provides a list of Treatment Measures, organized by LID treatment type. Further information is also provided below in Step 1C, Stormwater Management Plan Preparation Guidelines.

BMP selection should be based upon the pollutants of concern identified on the site, and the site constraints. Specific discussion regarding BMP selection under the MRP in the areas of LID Treatment and feasibility, and BMP selection for "Special Projects" follows.

LID Treatment. As of December 1, 2011, stormwater treatment requirements must be met using LID treatment. This consists of infiltration, evapotranspiration, and/or rainwater harvesting and reuse, or, where this is infeasible, biotreatment measures may be used. Table C-3 lists approved LID treatment measures. Manufactured, vault-based stormwater treatment systems will not be allowed as stand-alone treatment measures, except in certain "Special Projects," described below. Other Non-LID treatment measures found in Table C-3 such as extended detention, some types of vegetated swales, media filters, and tree well filters can only be considered as part of a treatment train with LID treatment.

LID Feasibility. When selecting LID treatment measures for the project, the applicant must determine the feasibility of treating the entire water quality design volume or flow rate (i.e., the amount of stormwater that requires treatment per Provision C.3.d of the MRP) with infiltration or rainwater harvesting and use.[1] The LID feasibility worksheets to be used for this purpose are included in Appendix C.2 and should be submitted with the Stormwater Management Plan described in Step 1C.

Where infiltration is feasible, stormwater infiltration measures such as unlined landscaped detention areas and infiltration trenches may be used. Bioretention areas that infiltrate into native soil are another type of stormwater infiltration measure. If infiltration is infeasible, the project should evaluate whether there is sufficient non-potable water demand on-site to make rainwater harvesting and use feasible. If rainwater harvesting and use is also determined to be infeasible, then biotreatment measures may be used.

[1] The feasibility of evapotranspiration does not need to be evaluated because it is assumed to be a component of rainwater harvesting, infiltration, and the use of landscape-based site design measures.

Biotreatment. Biotreatment measures are landscape-based stormwater treatment measures, such as a bioretention areas or flow-through planters that filter stormwater through a special engineered soil layer and collect treated water in subdrains that are directly connected to the storm drain collection system. The MRP requires that biotreatment measures be designed with a surface area that accommodates a 5-inch/hour stormwater runoff surface loading rate, and to use biotreatment soil as specified in regional biotreatment soil specifications approved by the Regional Water Quality Control Board (or equivalent). A sample specification for biotreatment soil is found in Appendix C.3.

The Urban Runoff Program's updated C.3 Handbook provides design guidance for biotreatment measures, including **bioretention** areas and flow-through planters. In addition to providing stormwater treatment, biotreatment measures can provide attractive landscaped areas that serve as amenities to the project. The Urban Runoff Program's C.3 Handbook includes a list of appropriate plant species for biotreatment measures, with an emphasis on climate-adapted and native species. A professional landscape architect can select from this list a palette of plants that will help enhance site aesthetics while meeting stormwater requirements, as found in Appendix C.3.

Step 1B.3: Special Projects

The MRP includes a provision that will allow some high density and transit-oriented development projects – referred to as "Special Projects" – to receive LID treatment reduction credits. Special Projects will be allowed to use certain stand-alone, non-LID treatment measures to treat some, or all, of the MRP – Provision C.3.d amount of stormwater runoff. The Water Board amended Provision C.3.e.ii of the MRP on November 28, 2011 to include a list of criteria for identifying specific categories of Special Projects and corresponding percentages of LID treatment reduction, along with requirements for the types of non-LID treatment measures that are allowed. The Special Projects worksheet and LID treatment reduction credits are provided in Appendix H. If these credits apply to the project, complete the special project worksheet and submit as part of the Stormwater Management Plan.

Step 1C: Storm Water Management Plan (SWMP) Preparation Guidelines

Once it is determined that a project must implement the numeric sizing criteria for storm water BMPS as required in SMC Chapter 12.60.150, the applicant is required to submit a Storm Water Management Plan (SWMP).The SWMP documents the decisions made regarding the selection, sizing, design, and location of BMPs. In general, a SWMP consists of a written report and a number of maps/plans. A preliminary SWMP Pre-Application, a preliminary SWMP with site layout and BMP selection and sizing should be submitted as part of the permit application process in Step 2.

Step 1C.1: SWMP Content Summary

The written report should contain the following information:

1. Table of Contents
2. Project Description including identification of receiving waters and potential pollutants of concern. Prepare Stormwater Management Plan Data Form found in Appendix A.
3. Site Constraints
4. Determination of Hydromodification Management applicability.
5. Determine if the project meets the definition of a Special Project or if infeasibility criteria apply.
6. Description of BMP(s) to be implemented at the site, complete with design calculations to show that they are appropriately sized. Prepare Infiltration/Harvesting and Use Feasibility Screening Worksheet found in Appendix C.2
7. Description of infiltration BMPs and groundwater / soil infiltration characteristics.

8. Description of Source Control BMPs and Post-Construction BMP maintenance.

The second part of the SWMP should include a series of maps/plans:

1. Vicinity Map
2. Existing and Proposed site maps showing contours, stormwater drainage areas, storm drains, water bodies, proposed BMPs, and other related information.
3. Grading Plans
4. Utility Plans
5. Landscaping plans

The SWMP preparation guidelines are described in greater detail in Appendix A "***How to Prepare a Storm Water Management Plan***". Information to assist with BMP selection is found in Appendix C.1.

A SWMP describes the site design measures and LID treatment and source control BMPs that will be incorporated in the project to reduce the impacts to urban runoff from the development. The major steps in the development of a SWMP are:

1. Identify the expected pollutants of concern based on the proposed land use and activities. Implement source control measures to address the pollutants of concern.
2. Identify the site constraints (e.g. high groundwater, space available, topography, proximity to groundwater protection areas, low-permeability soils, or location within HM[2] applicability area) that could affect the types of BMPs that can be implemented. Look for opportunities to incorporate Site Design measures for the project.
3. Use Site Design measures to minimize imperviousness by using STA and redirect runoff from impervious surfaces to more pervious areas by using SRA. Types of designs that minimize imperviousness may include, but are not limited to: inclusion of self-treating areas, clustering buildings/structures, reducing building footprints, and using permeable paving materials. Designers should also look for opportunities to direct runoff from impervious surfaces (e.g., roof tops, plazas, walkways, and access roads) to more pervious landscape or other storm water treatment areas.
4. Once Site Design measures are incorporated, select Best Management Practices for those impervious areas that cannot be served by site design measures. Best Management Practices include:
   - Source Control Measures
   - LID Treatment Control Measures

   Per MRP Provision C.3.c, only Low Impact Development (LID) treatment controls may be used. Preferred LID methods include rainwater harvesting and reuse, infiltration, and evapotranspiration. Biotreatment may only be used if the implementation of preferred LID methods is infeasible. Table C-3 includes a listing of LID treatment controls and selection guidance. The application of harvesting and reuse, infiltration, or evapotranspiration may be determined to be infeasible based on factors such as soil type and depth to groundwater. The LID feasibility worksheets are found in Appendix C.2. The Infiltration/Harvesting and Use Feasibility Screening Worksheet should be prepared and submitted with the SWMP. If appropriate , the Infiltration and/or Rainwater Harvesting and Use Feasibility Worksheets should be submitted.
5. If the site is located within the HM[1] applicability areas and meets the criteria for HM implementation, select Treatment Control Measures that have flow control benefits to the maximum extent practicable. These Best Management Practices are summarized in Appendix C.1. They are accompanied with reference information that describes each BMP and ways to evaluate their effectiveness. If the project needs additional HM control

[2]The HM requirements applies to only certain areas of the City that have storm water flows to natural creek drainages and are identified on GIS maps showing HM applicability zones included in Appendix B.

measures, refer to Chapter 7 of the SCVURPPP C.3 Handbook for more details.

6. Install, operate, and maintain selected BMPs including LID treatment controls and source controls. Describe the maintenance procedures to be conducted. Establish an inspection schedule in accordance with CASQA Storm Water BMP Handbook guidance or the manufacturer's recommendations.

Step 1C.2: Eligibility for Alternative Compliance if LID Measures are Impracticable

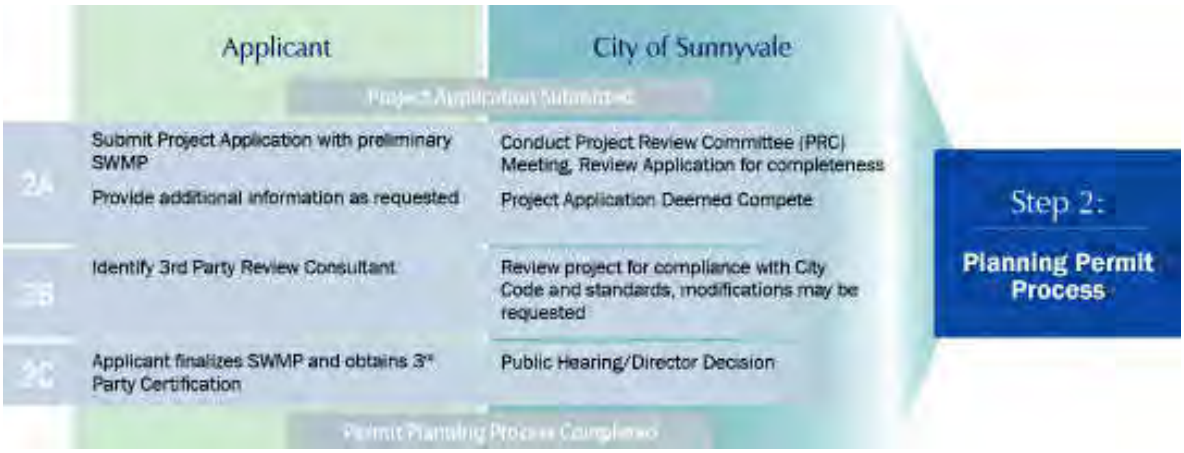
If a regulated project would encounter significant obstacles in implementing LID measures, compliance with the permit can be achieved through alternative means. In both of the following options, the applicant is directed to treat some portion of the runoff on-site.

1. LID Treatment at an offsite location: For any stormwater runoff that cannot be treated on-site, an equivalent amount of runoff can be treated with LID treatment measures at an offsite project in the same watershed. The offsite project must have hydraulically sized treatment control measures sufficient to handle an equivalent quantity and quality of runoff, resulting in a net environmental benefit.

2. Payment of In-Lieu Fees: For any stormwater runoff that cannot be treated on-site, fees may be paid to support a regional municipal stormwater treatment project. As of the writing of this manual, no regional projects have been developed within the City of Sunnyvale. Check with City staff to see if this is an option for your project.

The SWMP should contain discussion regarding the infeasibility of LID and how alternative compliance will be achieved.If the project fails to provide any alternative compliance according to the approved schedule, it will be considered a violation of the Sunnyvale Municipal Code Chapter 12.60. Enforcement actions and penalties as outlined in SMC 12.60.310-360 may be imposed. The full text of the Chapter 12.60 of the Sunnyvale Municipal Code can be found at http://qcode.us/codes/sunnyvale/ or at http://www.sunnyvale.ca.gov/ in the Municipal Codes Section of the website.

Step 2: Planning Permit Process



The City's planning permit process includes preparation of the project application by the applicant and review by the City as follows:

Step 2A: Project Review Committee
Step 2B: Initiate Third Party Review
Step 2C: Project Approval

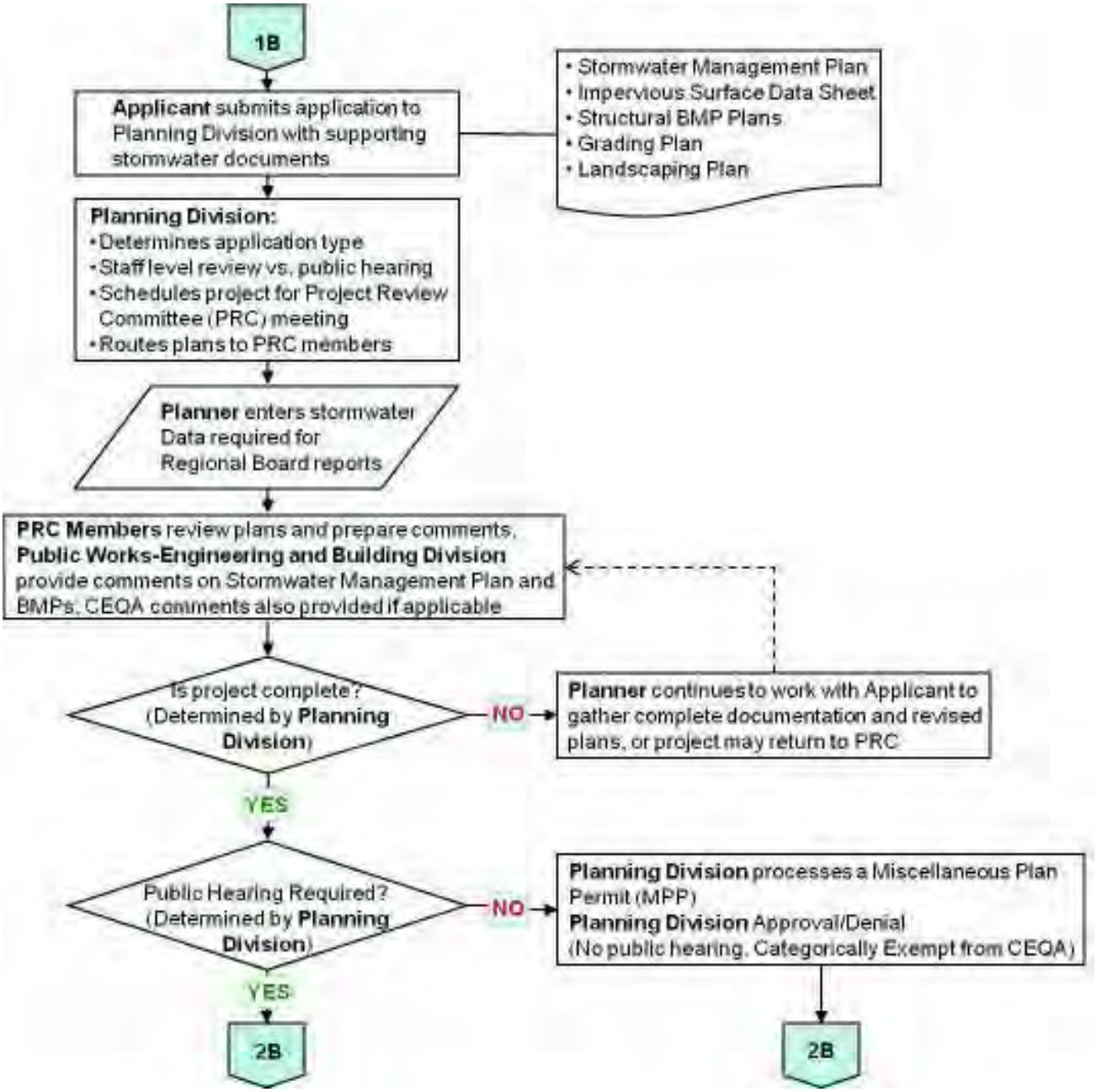
Steps 2A through 2C are described in greater detail below.

Once a project has received project approval, the project can proceed to preparation of a building permit application in Step 3.

Step 2A: City Review Process – Project Review Committee

Once a preliminary SWMP has been prepared and submitted as part of the Project Application, the flow chart below describes the City's review process for the preliminary storm water management plan.

Figure 5: Plan Approvals



Step 2B: Initiate Third Party Certification of Design Criteria

As stated in the Sunnyvale Municipal Code (SMC 12.60.180), the Director of Public Works, Director of Community Development or their authorized staff may require a developer to provide a signed certification from a "qualified" professional that any plan for proposed storm water treatment facilities and Best Management Practices meet the requirements of SMC 12.60.150 and the established criteria expressed in that Chapter. Before a Building Permit can be issued as described in Step 3A, this "third party" certification must be completed. The "third-party" reviewer can not be the same individual/firm that prepared the design of the stormwater management facilities.

To facilitate "third-party" reviews and certifications, the City prepared a Request for Qualifications (RFQ) from a number of engineering and consulting firms in January 2008. The requirements for being considered a "qualified" consultant are listed in SMC 12.60.180. After reviewing the responses from firms responding to the RFQ, the City prepared a list of qualified consultants to certify storm water management plans. The City does not endorse or recommend any particular consultant on the list, but provides the list to assist project applicants in finding firms that have qualified staff, that meet the requirements of the City's ordinance. The current list of qualified consultants is available on the City's website, Storm Water Requirements page (http://sunnyvale.ca.gov/Departments/CommunityDevelopment/PermitsPlanChecksandFees/StormWaterRequirements.aspx) or may be obtained from Planning Division Staff.

Other firms may be added to the list of qualified firms at the request of the applicant, but the proposed firm must first submit the same "Statement of Qualifications" to the City as was required in the RFQ, and then the submission must undergo a review by City staff before the firm can be added to the list. The qualified consultant list will be updated approximately every two years and an update is planned for 2012.

When third-party certification of a Storm Water Management Plan is required by the City from a project applicant, the firm providing that certification should be prepared to do the following:

1. Review the requirements in the Sunnyvale Storm Water Quality BMP Applicant Guidance Manual for New and Redevelopment Projects (Sunnyvale BMP Guidance Manual).
2. Review the Sunnyvale Municipal Code Minimum Requirements portion of the Storm Water Management Plan Checklist in Appendix A. Proposed storm water BMPs shall be selected and sized to treat the quantity of runoff expected to meet the standards described in SMC 12.60.150
3. Review the Maps, Plan Summary, and Plan Sheets submitted as a part of the Building Permit Application. Ensure that there are no conflicts between Storm Water Management Plan sheet designs and any other Plan Sheets (e.g., Grading plan, Utility plan, and Landscaping Plan) that may be required by the City.
4. Provide a compliance review stamp on the Items No. 2 and 3, above.
5. The Storm Water Management Plan shall be signed and stamped by a Professional Engineer by stating as follows: "The sizing, selection, and preliminary design of the treatment Best Management Practices and control measures in the Storm Water Management Plan meet the requirements of Sunnyvale Municipal Code,

Chapter 12.60.150 (Numeric Sizing Criteria for Treatment Systems)."

6. Before the building permit is finalized or the Certificate of Occupancy is issued for new buildings, the project applicant and third-party reviewer must provide recertification of the design if there are any as-built modifications to the original approved plan sheets. Also, current contact information for the parties responsible for implementing the Storm Water Management Plan must be provided.

An example of a Third – Party Certification Checklist is provided in Appendix A.

Additions to the Qualified Consultants List

To be added to the list described above, the firm/person wanting to be included on the Qualified Consultants List must submit information to CDD staff to demonstrate their qualifications, as the other firms on the List have already done. City staff will review those qualifications submitted and determine if they meet the criteria established in SMC 12.60.180. To be qualified for inclusion on the List, a Statement of Qualifications must submitted to CDD staff and include the following:

- The firm's name, business address, telephone number and year established.
- Name and phone number of a primary contact person for the firm.
- Names of the principles and key personnel who will be assigned to conduct the review.

Describe their qualifications and experience by providing answers to the items below:

1. The background of these individuals: i.e., civil engineer, licensed architect, or landscape architect registered in the State of California.

2. Listing of the training completed by these individuals on Best Management Practices design for managing storm water quality within the three years prior to the date their statement of qualifications is submitted.

3. Proof of training completed by these individuals that was conducted by an organization with storm water treatment and Best Management Practices design expertise. Training conducted by an organization with storm water treatment best management practice design expertise may be considered as qualifying. Such organizations include, but are not limited to:

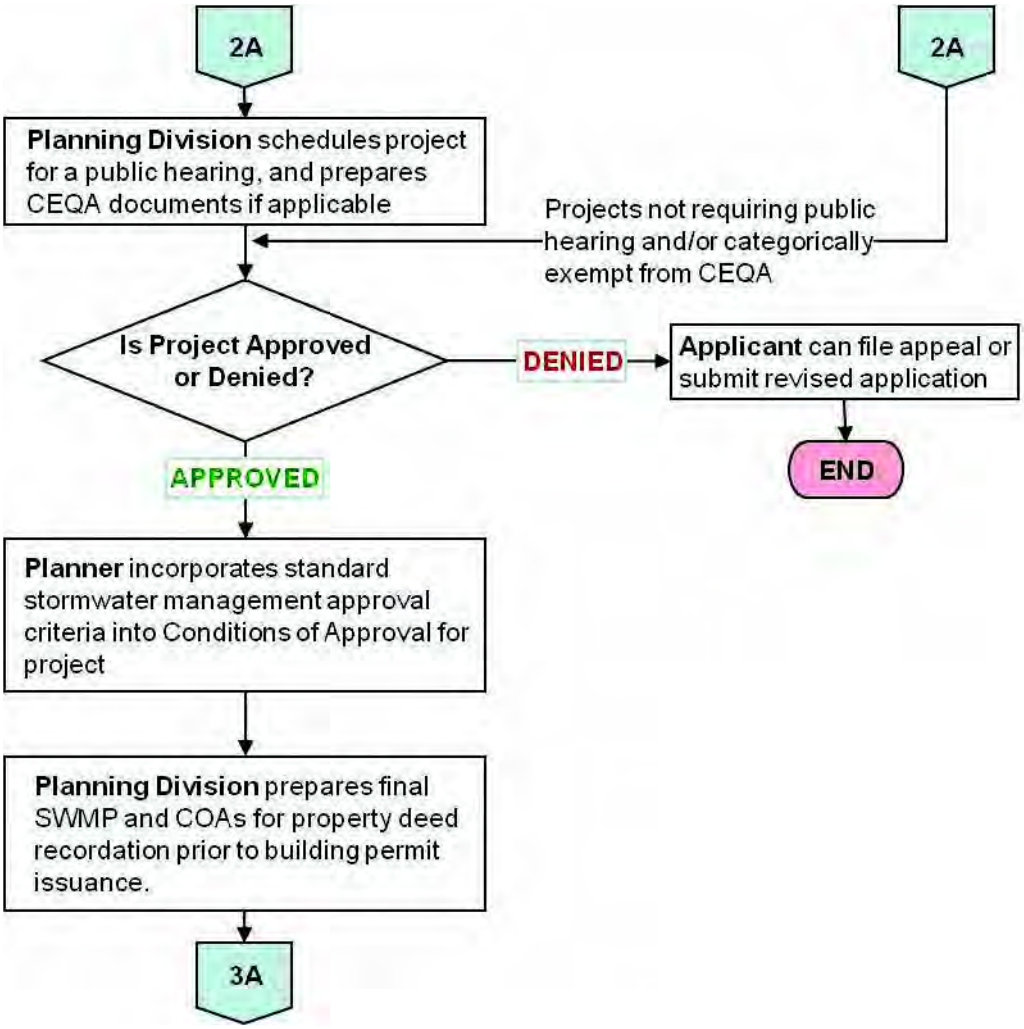
- Universities
- American Society of Civil Engineers
- American Society of Landscape Architects
- American Public Works Association
- California Water Environment Association
- California Storm Water Quality Association
- Santa Clara Valley Urban Runoff Pollution Prevention Program

Examples of proof may include, but are not limited to class transcripts, CEU/credit certificates, and course outlines with proof of attendance.

Step 2C: City Approval Process – Project Decision

Following City Planning staff review of the preliminary storm water management plan submitted with the project application, the following flow chart shows the City's approval process.

Figure 6: Project Decision



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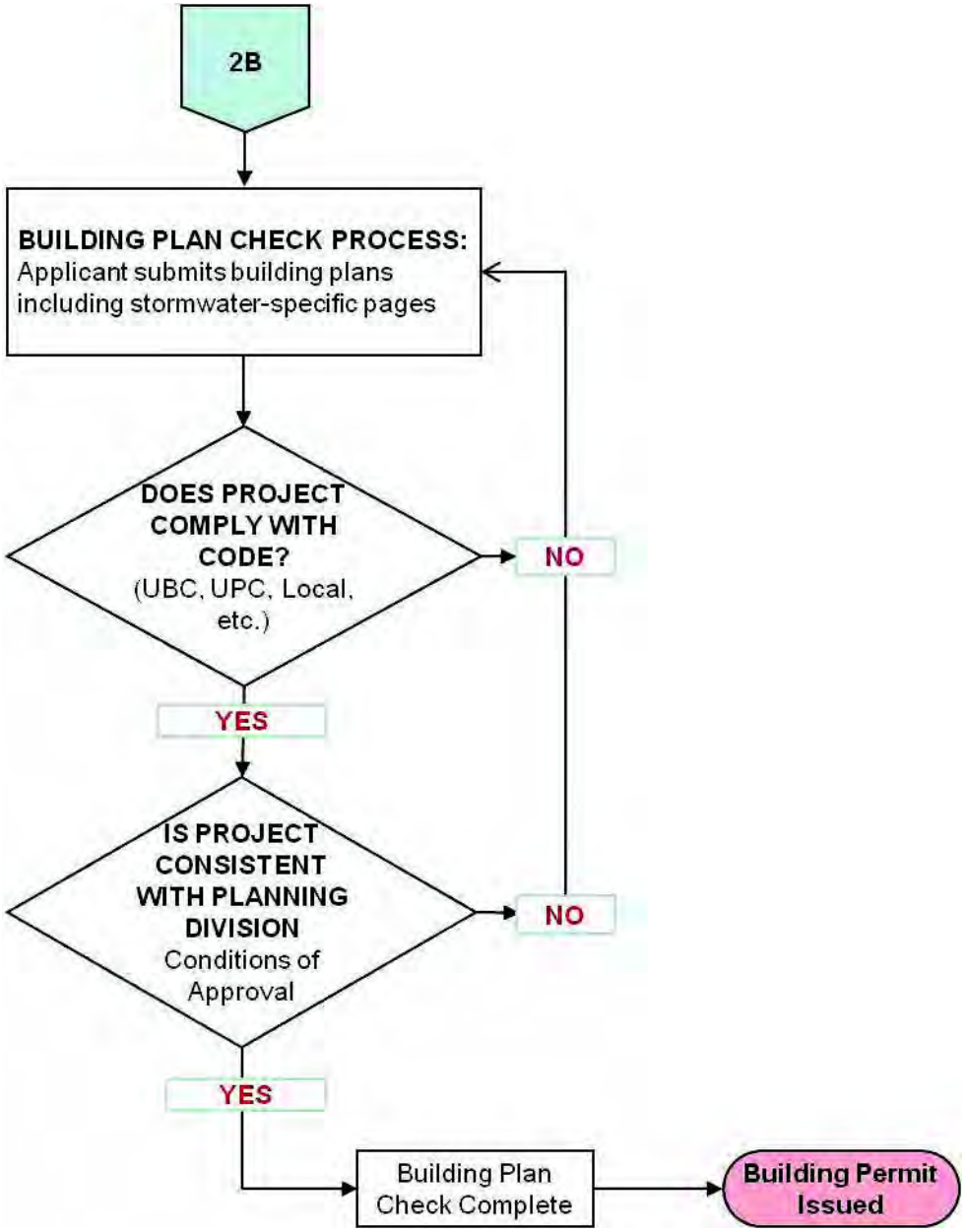
Step 3: Building Permit Process

Step 3A: City Building Permit Review and Issuance

Once a project application has been approved, the applicant then works with the City's Building Division staff to obtain a building permit which includes the Conditions of Approval for storm water quality approved by the City's Planning Division. SWMPs must have their third-party certification of the SWMP complete as described in Step 2B before Building Permits are issued and it is preferable for the third-party certification of the SWMP to be complete at the time of the submittal for Plan Check. This includes the Storm Water Plan Sheet review and certification for no conflicts with other plan sheets such as those for landscaping and other utilities.

Figure 7: Plan Check and Building Permits



Step 3B: Project Construction

Usually, post-Construction BMPs are not installed in the early stages of construction as they may be adversely affected by ongoing construction activities. In most cases, the post-construction BMPs are not completed and made operational until the exterior construction is near completion and the disturbed soil areas have been stabilized. During construction, a storm water pollution prevention plan is prepared, which includes specific BMPs that are installed for only the duration of the construction project to protect existing storm drains near to the construction activities, control soil erosion, and prevent discharge of materials to storm water collection systems that can impact aquatic life.

Construction BMP requirements described in the City's Blueprint for a Clean Bay can be found in Appendix A. Projects that create 1-acre or more of disturbance must submit a Notice of Intent (NOI) to the State Water Resources Control Board (SWRCB) to be covered under the SWRCB's Construction General Permit (CGP) for Storm Water Discharges. The CGP and other relevant information about the SWRCB's Construction Stormwater program can be found at http://www.swrcb.ca.gov/water_issues/programs/stormwater/construction.shtml.

The CGP requires the preparation of a storm water pollution prevention plan (SWPPP) by a Qualified SWPPP Developer (QSD). The SWPPP must be implemented on the construction site by a Qualified SWPPP Practitioner (QSP). Additional information on SWPPP development and Construction BMPs is available from the California Stormwater Quality Association: http://www.casqa.org/LinkClick.aspx?fileticket=OZdL94Tcjig%3d&tabid=200.

The SWPPP should be designed to address the following objectives:

- All pollutants and their sources, including sources of sediment associated with construction, construction site erosion and all other activities associated with construction activity are controlled;
- Where not otherwise required to be under a Regional Water Board permit, all non-storm water discharges are identified and either eliminated, controlled, or treated;
- Site BMPs are effective and result in the reduction or elimination of pollutants in storm water discharges and authorized non-storm water discharges from construction activity to the BAT/BCT standard;
- Calculations and design details as well as BMP controls for site run-on are complete and correct, and
- Stabilization BMPs installed to reduce or eliminate pollutants after construction are completed.

It should be emphasized that the SWRCB administers the CGP and SWPPP programs and this information is provided here solely for the applicant's benefit. In accordance with Regional Board Order No. 01-119, the applicant should be prepared to demonstrate to City staff, upon request, compliance with the NOI and SWPPP program.

Step 3C: City Building Inspections

Inspections of construction sites by the City's Building Division will occur periodically through the construction phases. This includes inspection of Storm Water Pollution Prevention Plan BMPs in place during the construction phase of the project and Post-construction BMPs and HM facilities, if required, that are being built according to the approved plans for treatment of storm water when the facility is completed. The MRP requires an inspection within 45 days of the installation of Post-construction BMPs. An example of the inspection content is found in Appendix G. Enforcement actions will be taken and/or notices will be issued if the project does not comply with the Storm Water Pollution Prevention Plan.

Once the project is constructed, the City's Building Division will conduct a final building inspection of the post-construction storm water BMPs included in the project plan sheets as well as for the other structures that are a part of the project before a Building Permit is finalized or Certificate of Occupancy is issued for new buildings.

If there have been any changes to the design plans for the storm water treatment BMPs from those originally submitted and approved in the Storm Water Management Plan, then the revised "as- built" information needs to be included in an amendment to the SWMP for the facility before the Building Permit is finalized or Certificate of Occupancy is granted.

Step 4: Post Construction

Step 4A: Post Construction BMP Operations and Maintenance

Once a project is completed, the post-construction BMPs must be maintained and inspected as described in the project's SWMP, so that the BMPs can provide the water quality protection required for the site. Installation, operation, maintenance, inspection and recordkeeping of the post-construction BMPs are the responsibility of the applicant and/or property owner identified in the SWMP. Records supporting post-construction operations and maintenance activities need to be kept by the party identified in the SWMP.

Step 4B: Post-Construction Compliance Inspections

The City's Pre-treatment Division staff is responsible for inspecting the facility post-construction, and assuring that the applicant/owner is operating and maintaining the post-construction BMPs in accordance with their approved SWMP. Staff will visit the sites and perform inspections at a frequency determined by MRP C3.h.iii, or approximately once every five years. Records supporting operations and maintenance activities associated with storm water treatment BMPs will be reviewed as well.

An example of the inspection checklist that the City will be using is included in Appendix G.

Additional resources for Post-Construction BMP maintenance can be found in the CASQA Municipal Handbook Sections 3 and 4 for Maintenance of Municipal Facilities, in the CASQA Industrial Handbook Sections 3 and 4 for Maintenance of Industrial Facilities and in the CASQA New and Redevelopment Handbook, Section 5. (http://www.cabmphandbooks.com/).

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References and Web Links

Bay Area Storm Water Management Agencies Association (BASMAA)

Start at the Source Manual and Using Site Design Techniques to Meet Development Standards for Storm Water Quality: A Companion Document to Start at the Source

California Storm Water Quality Association (CASQA)

Storm Water Best Management Practice Handbook: (3 Volumes):

- New and Redevelopment
- Industrial and Commercial
- Municipal

www.cabmphandbooks.com

Construction Handbook / Web Portal:

https://www.casqa.org/store/products/tabid/154/p-167-construction-handbookportal-initial-subscription.aspx

City of Sunnyvale

Sunnyvale Municipal Code Chapter 12.60: http://qcode.us/codes/sunnyvale/ or

http://www.sunnyvale.ca.gov/ in the Municipal Codes Section of the website

Friends of the San Francisco Estuary

Erosion and Sediment Control Field Manual, Third Edition, 1999.This document can be obtained by contacting: Friends of the San Francisco Estuary, P.O. Box 791, Oakland, CA 94604-0791, Telephone: 510-622-2419.

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)

New Development/Redevelopment Resources: http://www.scvurppp-w2k.com/nd_wp.shtml

C.3 Storm Water Handbook, December 2011: http://www.scvurppp-w2k.com/nd_wp.shtml#c3handbook Model List of Source Control Measures and other C.3 implementation related documents http://www.scvurppp-w2k.com/permit_c3.htm

State Water Resources Control Board (SWRCB)/Regional Water Quality Control Board

Construction General Storm Water Permit (NOI/SWPPP) http://www.swrcb.ca.gov/stormwtr/construction.html

Municipal Regional NPDES Permit No. R2-2009-0074 can be downloaded from http://www.swrcb.ca.gov/sanfranciscobay/water_issues/programs/stormwater/mrp.shtml

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Appendix A: Supplementary Information and How to Prepare a SWMP

Redevelopment Examples A-3

Stormwater Management Plan Data Form A-7

How to Prepare a Storm Water Management Plan: A-11

Part 1: Written Report: Storm Water Management Plan Checklist

1) Table of Contents
2) Project Description

   Table A-1, Pollutants of Concern Based on Facility Activities.

3) Site Constraints
4) HM Applicability Determination
5) BMP Description
6) Infiltration Devices

   Table A-2, BMP Summary Table Example

7) Post construction BMP maintenance and/or Source Control

Part 2: Maps and Plan Summary

8) Vicinity Map, (scale 1-inch = 250 feet)
9) Existing and Proposed site plans (to scale)
10) Storm Water Management Plan sheet list
11) to 13) Other Plans, as applicable

Third-Party Certification Checklist A-19

Construction BMPS Plan Sheet (Sample) A-21

Model Conditions of Approval: Landscape Plans for the Reduction of Pesticide Use and Treatment of Storm Water Runoff A-23

Property Maintenance Fact Sheet: Landscape Maintenance Techniques for Pest Reduction A-25

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Redevelopment Examples

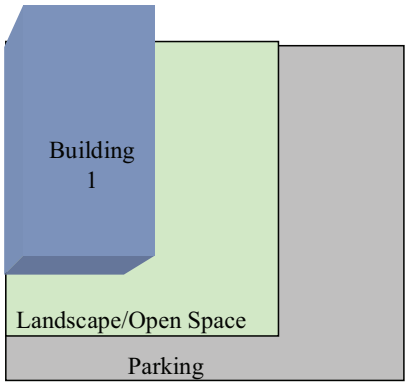
An example of a redevelopment project and the portions of the project that would be subject to specific numeric sizing criteria for storm water BMPs depending on the proportion of the project site that is being redeveloped is provided below.

Redevelopment projects that could increase the impervious surface could include remodel, tenant improvement, or new building to replace an existing building.

EXAMPLE: REDEVELOPMENT PROJECTS (Not Special Land Use)
(Not To Scale)

ORIGINAL SITE DESCRIPTION

Site Reference	**Existing** *Square Feet*
Building 1 (Impervious)	12,000
Parking (Impervious)	15,000
Landscaping	7,500
Open Space	20,000
Total Site	**54,500**
Total Impervious Surface	*27,000*
50% of Impervious surface	*13,500*

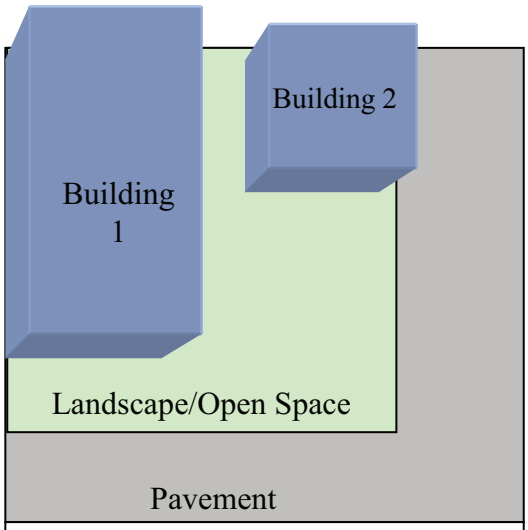


EXAMPLE A – Not subject to C.3.

New building and parking area to replace existing landscaping / open space.

Site Reference	**Existing** *Square Feet*	**Proposed Additions/Changes** *Square Feet*	**Total** *Square Feet*
Building 1 (Impervious)	12,000		12,000
New Building 2 (Impervious)	0	+7,000	7,000
Parking (Impervious)	15,000	+2,000	17,000
Landscaping/Open Space	27,500	-9,000	18,500
Total Site	**54,500**	**<0>**	**54,500**
Total Impervious Surface	*27,000*		*36,000*
Total of Existing Impervious Surface Altered			*0*
Total Impervious Surface Created and/or Replaced			*9,000*

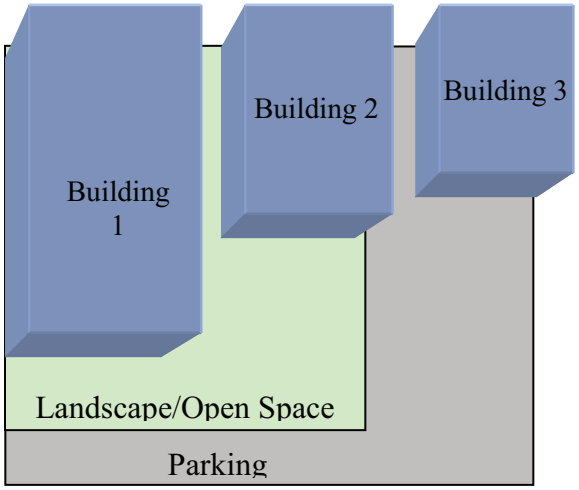
Since the total impervious surface created and/or replaced is less than 10,000 square feet, the site is not subject to Provision C.3 numeric sizing criteria for storm water BMPs. However, it *is* subject to other City requirements such as source control BMPs. The use of LID site design measures is encouraged (e.g. minimize impervious areas and to drain storm water to vegetated areas, etc) as much as possible.



Note: redevelopment projects in the special land use category that create and/or replace 5,000 square feet or more impervious area will be regulated as of 12/1/2011.

EXAMPLE B – Partial Site Treatment

New building and parking area to replace existing landscaping / open space, AND new building to replace existing parking area.



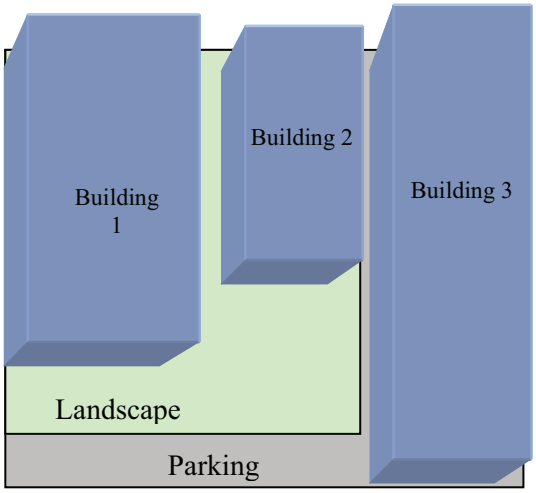
Site Reference	Existing *Square Feet*	Proposed Additions/Changes *Square Feet*	Total *Square Feet*
Building 1 (Impervious)	12,000	-	12,000
New Building 2 (Impervious)	0	7,000	7,000
New Building 3 (Impervious)	0	5,000	5,000
Parking (Impervious)	15,000	+2,000 -5,000	12,000
Landscaping / Open Space	27,500	-9,000	18,500
Total Site	**54,500**	**<0>**	**54,500**
Total Impervious Surface	*27,000*	*+9,000*	*36,000*
Total of Existing Impervious Surface Altered			*5,000*
Total Impervious Surface Created and/or Replaced			*14,000*

The total impervious surface created and/or replaced is greater than 10,000 ft^2, so the site is subject to Provision C.3 stormwater requirements. Since less than 50% of the existing impervious area (i.e. less than 13,500 ft^2) is altered by the construction of Building 3, only the runoff from the NEW buildings and new parking area is subject to C.3 numeric sizing criteria. However, the use of LID site design measures is encouraged (e.g. minimize impervious areas and to drain storm water to vegetated areas, etc)

C.3.b.ii.(3) (b) Where a redevelopment results in an alteration **of less than 50 percent** of the impervious surface of a previously existing development that was not subject to Provision C.3, only the new and/or replaced impervious surface of the project must be included in the treatment system design (i.e., stormwater treatment systems must be designed and sized to treat stormwater runoff from the new and/or replaced impervious surface of the project).

EXAMPLE C – Total Site Treatment

New building and parking area to replace existing landscaping / open space, AND new building to replace existing parking area.



Site Reference	**Existing** *Square Feet*	**Proposed Additions/Changes** *Square Feet*	**Total** *Square Feet*
Building 1 (Impervious)	12,000	-	12,000
New Building 2 (Impervious)	0	7,000	7,000
New Building 3 (Impervious)	0	14,000	14,000
Parking (Impervious)	15,000	+2,000 -14,000	3,000
Landscaping / Open Space	27,500	-9,000	18,500
Total Site	**54,500**	**<0>**	**54,500**
Total Impervious Surface	*27,000*		*36,000*
Total of Existing Impervious Surface Altered			*14,000*
Total Impervious Surface Created and/or Replaced			*23,000*

The total impervious surface created and/or replaced is greater than 10,000 ft^2, so the site is subject to Provision C.3 stormwater requirements. And, since greater than 50% of the existing impervious area (i.e. more than 13,500 ft^2) is altered by the construction of Building 3, the runoff from the entire 57,500 ft^2 site is subject to C.3 numeric sizing criteria.

C.3.b.ii.(3)(a) Where a redevelopment project results in an alteration of **more than 50 percent** of the impervious surface of a previously existing development that was not subject to Provision C.3, the entire project, consisting of all existing, new, and/or replaced impervious surfaces, must be included in the treatment system design (i.e., stormwater treatment systems must be designed and sized to treat stormwater runoff from the entire redevelopment project).

STORMWATER MANAGEMENT PLAN DATA FORM

(NPDES PERMIT PROVISION C.3)

Planning Permit Number_____
Date Deemed Complete_____
Approval / Public Hearing Date_____

PROJECTS THAT REQUIRE STORMWATER MANAGEMENT PLANS

New or redeveloped commercial, industrial or residential projects require a SWMP when they create or replace 10,000 square feet or more of new or replaced impervious surface. If the increase or replacement is for 50% or more of existing impervious surface, the entire development is subject to stormwater treatment measures. If the increase or replacement is for less than 50% of existing impervious surface, only the added impervious surface area is subject to stormwater treatment measures.

All restaurants, auto service facilities, retail gasoline outlets, and uncovered parking lot projects (stand-alone or part of another development project, including the top uncovered portion of parking structures) that create and/or replace 5,000 sq. ft. or more of impervious surface on the project site must also fill out this worksheet.
Interior remodeling projects, routine maintenance or repair projects such as re-roofing and re-paving, and single family homes that are not part of a larger plan of development are NOT required to complete this worksheet.

DEFINITION OF IMPERVIOUS SURFACES

An impervious surface prevents the infiltration or passage of water into the soil. Impervious surfaces can include building rooftops, covered patios, driveways, parking lots, paved areas, sidewalks and streets, unless they are constructed with pervious materials that allow passage of water into subsurface soils.

1. Project Information:

Project Address	
Cross-Streets	
APN	
Site Area (square feet)	
Applicant Name	
Receiving Watershed (creek, river or bay)	
Project Description	

2. Project Type (*Check all that apply*):

☐ New Development ☐ Commercial ☐ Pavement Replacement ☐ Multi-Family - No. Units _____

☐ Redevelopment ☐ Public ☐ Industrial ☐ Auto Service – SIC code _____

☐ Single-Family ☐ Gas Station ☐ Restaurant ☐ Uncovered Parking Lot

☐ Other: _____

3. Project Impervious Surface Data:

	Description	Existing sq. ft.	Proposed sq. ft.
a	Impervious surface area (includes land covered by buildings, sheds, patios/covers, parking lots, streets, sidewalks, paved walkways and driveways)	sq. ft.	sq. ft.
b	Pervious Area (includes landscaping, pervious pavement, and natural buffer areas)	sq. ft.	sq. ft.
c	Total Project Area (a + b)	sq. ft.	sq. ft.
d	Percent Impervious (a ÷ c)x100	%	%
e	Percent Pervious (b÷ c) x 100	%	%
f	Impervious created or added		sq. ft.
g	Impervious area replaced		sq. ft.
h	Percent Replacement of existing impervious surface area (g ÷ $a_{[existing]}$) x 100 Note: if this value exceeds 50%, C.3 requirements apply to the entire site.		%
i	Estimated area of land disturbed during construction (includes clearing, grading or excavating)		sq. ft.

4. Does the total area of land disturbed equal 1 acre or more?

☐ Yes ☐ No. If yes, the project must obtain coverage under the State Construction General Permit.

5. Does runoff from offsite flow through the project site?

☐ Yes ☐ No. If yes show where offsite runoff flows onto project site on the Site map prepared for the SWMP.

6. GIS Map Review:

a. Is project site within the HM Inclusion Area?
☐ Yes ☐ No. If yes, then HM requirements of SMC 12.60.160 apply.

b. Is project site within the Infiltration Device Exclusion Area?
☐ Yes ☐ No. If yes, the use of infiltration devices for stormwater treatment is not allowed.

7. Type of Pesticide Reduction Measures Used (*Check all that apply*):

☐ Education (PEDU)
☐ Condition of Approval (PCOA)
☐ Doesn't Apply (DNA)

8. Types of Stormwater Control Measures Used (*Check all that apply*):

☐ Stormwater Treatment Measures (STM)
☐ Source Control Measures (SCM)
☐ Site Design Measures (SDM)
☐ Doesn't Apply (DNA)

For more information regarding selection of Best Management Practices (BMPs) for stormwater pollution prevention or stormwater treatment, contact the Planning Division at (408) 730-7440 or planning@ci.sunnyvale.ca.us.

10. Identify Specific Stormwater Control Measures Used

Site Design	Source Controls	LID Treatment
☐ Alternative driveway design ☐ Cluster structures / pavement ☐ Disconnect downspouts ☐ Green Roof ☐ Micro-detention in landscape ☐ Minimize change in runoff hydrograph ☐ Minimize land disturbance ☐ Minimum-impact street or parking lot design ☐ Minimize impervious surfaces ☐ Preserve open space ☐ Protect riparian & wetland areas, riparian buffers ☐ Self-retaining area ☐ Self-treating area ☐ Other _____	☐ Alternative building materials ☐ Storm drain labeling ☐ Beneficial landscaping (minimizes irrigation, runoff, pesticides and fertilizers; promotes treatment) ☐ Covers, drains for loading docks, maintenance bays, fueling areas ☐ Covered dumpster area, drain to sanitary sewer ☐ Maintenance (street sweeping, catch basin cleaning) ☐ Outdoor material storage protection ☐ Swimming pool drain to sanitary sewer ☐ Wash area/racks, drain to sanitary sewer Other_____	☐ Dry Well ☐ Exfiltration Trench ☐ Infiltration basin / trench ☐ Permeable Pavement ☐ Rainwater Harvesting/Reuse ☐ Unlined Retention basin ☐ Other _____ **Biotreatment** ☐ Bioretention ☐ Planter box ☐ Flow-through planter **Other Treatment** ☐ None (only if all impervious surface drains to self-retaining areas) ☐ **Numeric Sizing Criteria Used:** ☐ Flow Hydraulic Design Basis, or ☐ Volume Hydraulic Design Basis

PLANNING REVIEW BY:_____ DATE:___/___/___ DATA ENTRY BY:_____ DATE:___/___/___

11. Alternative Certification: Was the treatment system sizing and design reviewed by a qualified third-party professional that is not a member of the project team or agency staff?

☐ Yes ☐ No Name of Reviewer_____

12. Operation & Maintenance Information

Property Owner's Name _____

Responsible Party for Stormwater Treatment/Hydromodification Control O&M:

Name: _____

Address: _____

Phone/E-mail: _____

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How to Prepare a Storm Water Management Plan (SWMP)

The following section includes a checklist and descriptions of the information needed to complete a Storm Water Management Plan (SWMP). The minimum requirements for a SWMP are described in SMC 12.60.140, and listed in the top portion of the Storm Water Management Plan Checklist, below. The following discussion provides recommended guidelines for how to prepare a thorough and complete SWMP. Applicants are encouraged to follow these guidelines in order to receive a favorable and timely review.

The SWMP should consist of two parts: first, a written narrative that outlines all aspects of the plan, and second, appropriate maps and site plans that show the location of treatment BMPs and the areas from which they will be treating storm water flows. Design plan sheets, drawn to scale and including cross-sectional drawing of the treatment BMPs selected for construction at the site need to be included, where appropriate.

Storm Water Management Plan Preparation Instructions

Part 1 - Written Report – Use the Check List provided below to ensure that each of the following items are addressed in the SWMP provided with the project application. The SWMP should include all of the following information before it can be considered complete.

1. Provide a table of contents for the SWMP.

2. Project Description (Page 1 of the SWMP Data Sheet, Appendix A)

a. Provide General Information:

1) Project Name and Applicant Name
2) Project Location (address) and APN #
3) Project type (new development or redevelopment of an already developed property) and Project Classification (residential, commercial, industrial, and roadway).
4) Description of proposed activities that will occur at the facility.

b. Provide a Vicinity Map (1-inch = 250 feet) and identify water bodies that will receive runoff from the site. All watercourses, impoundments, and wetlands within 500 feet of the facility should be shown on either the vicinity or project map. (Projects will drain to Calabazas Creek, Sunnyvale East Channel, Sunnyvale West Channel, Moffett Channel, El Camino Channel, or Stevens Creek. See GIS maps in Appendix B of this manual to identify the water body that will receive the project's storm water drainage.)

c. Pollutants of Concern in Receiving Waters: Identify pollutants of concern based on potential activities and land uses of the project site (See Table A-1). At a minimum, stormwater management measures selected for the project should be able to protect receiving waters from pollutants of concern. Pollutants of concern are listed in the CWA Section 303(d) List of Water Quality Limited Segments adopted by the SWRCB in 2010 (To see creek specific information, click on the "Map" tab at http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml). Typical pollutants listed for receiving waters in Santa Clara County include pesticides-, trash, mercury and sediment. Creeks within Sunnyvale are listed for diazinon (pesticides) and trash. Trash is now considered a key pollutant of concern within the MRP jurisdictions, and according to SMC 12.60.130, "All regulated projects will install full trash capture devices to collect litter and debris from their project site, prior to connecting to the city's storm drain collection system."

Storm Water Management Plan Checklist

Sunnyvale Municipal Code Minimum Requirements:	**Check Items**
1. Name and Address of Regulated Project	
2. Responsible operator(s) of each treatment system and hydromodification (HM) control, if any.	
3. A description of activities and pollutant sources.	
4. Specific descriptions of the locations of installed stormwater treatment systems and HM controls, if any.	
5. Description of the type and size of the installed stormwater treatment systems and HM controls, if any	
6. Description of applicable operation and maintenance procedures, including recommended inspections, for all structural BMPs, stormwater treatment systems. a. Manufacturer recommendations if applicable b. CASQA Handbook recommendations	
7. Description of record keeping and internal procedures to ensure documentation and verification of applicable operational maintenance procedures. Records must be maintained for a period of at least three years.	
8. A completed Stormwater Management Plan Data Form	
9. A copy of the required third party certification for the regulated projects adherence to numeric sizing criteria.	
10. A signed statement by the property owner ensuring that onsite, joint, or offsite stormwater treatment systems and HM controls installed to meet the requirements for regulated projects are properly operated and maintained for the life of the project pursuant to SMC Section 12.60.200 agreement to maintain best management practices.	
11. A Completed Infiltration/Harvesting and Use Feasibility Screening Worksheet (Appendix C.2) and Infiltration and/or Rainwater Harvesting and Use Feasibility Worksheets, as appropriate.	
Recommended Additional Information	
1. Site Constraints: Describe and provide supporting geotechnical investigations (soil maps, depth to groundwater, soil permeability)	
2. BMP Description - Complete BMP Summary Table A-2 (below) with descriptions of each BMP selected. Provide sizing criteria, calculations and specifications for selected BMPs. Also provide for each BMP used:	
3. Post-Construction BMP maintenance and/or Source Control: a. Describe preventive maintenance actions needed for the operation of all treatment BMPs in Table A-2. b. Describe the elements of a self-inspection program in Table A-3. c. Describe handling and storage of process materials and wastes (e.g., stockpiles, dumpsters, tallow bins, recyclables or vehicle storage) to prevent storm water runoff contamination or spills. List spill response procedures (if applicable). d. Describe record keeping and internal reporting procedures. e. Provide facility owner/operator contact information for post-construction inspections of BMPs.	
Recommended Maps and Drawings	
1. Provide Existing and Proposed Site Maps/Plans (scale 1" = 40') that identifies, the following: a. Entire property included on one plan page with any easements and rights-of-way b. Existing and proposed topographic contours with drainage areas and sub-areas (if applicable) delineated and arrow showing flow direction of storm water. c. Identify areas for outdoor storage of process materials and wastes on the site plan. d. Show existing/proposed buildings, covered activity areas, and treatment BMP measure locations and type. Details and specifications for selected BMPs e. Identify private storm drain systems and/or public storm conveyance systems including storm drain inlets with existing and proposed flows labeled f. Identify nearby water bodies (e.g. streams, creeks, channels, ponds), impoundments, and wetlands g. Identify potential areas where soil erosion could occur h. If applicable, show the following: 1) 100-year Flood elevations 2) Soil boring locations, depth(s) to groundwater and date(s) of measurement 3) Monitoring well locations, depth(s) to groundwater and date(s) of measurement 4) Water supply well locations within property and on adjacent properties	
2. Grading Plan	
3. Utility Plan	
4. Landscaping Plans	

Table A-1: Pollutants of Concern Based on Facility Activities

Facility Activity	Pollutants of Concern
Commercial/Residential – General	Oil and grease, sediments, pesticides, trash
Commercial – food related	Pathogens, oil, and grease, pesticides, trash
Commercial – animal related	Pathogens, nutrients, pesticides
Commercial – auto related	Total petroleum hydrocarbons, metals, Poly Aromatic Hydrocarbons (PAH), and surfactants
Industrial	Total petroleum hydrocarbons, sediment, metals, PAHs, PCB, pH, surfactants
Agricultural	Sediment, nutrients, pesticides

The pollutants of concern for a facility should be summarized in the Stormwater Management Plan Data Sheet and described further, as necessary, in the text of the Storm Water Management Plan. Treatment BMPs selected for the project must provide suitable treatment for the pollutants of concern identified for the project.

3. **Identify Site Constraints:** Identify site constraints using maps provided in Appendix B and any site specific studies performed on the parcel. This information is required on the second page of the SWMP Data Sheet. Provide supporting geotechnical investigations (soil maps, borings, depth to groundwater, soil permeability) as needed for BMPs selected. Include as an attachment to the plan, if appropriate and available.

4. **Determine if Project Is Subject to Hydromodification Management Requirements:** Some projects, depending on project size and location within the City, are required to manage increases in storm water peak flow and increased runoff volume. Projects that create and/or replace 1-acre or more of impervious surface within certain storm drain catchment areas of Stevens Creek and Calabazas Creek are subject to HM requirements. Specific lot locations that have storm drainage discharges to portions of Calabazas and Stevens Creek where the HM requirements will apply can be found on HM maps in Appendix B. Control of storm water peak flow and increased runoff volume from smaller-sized projects is encouraged, but not required.

   Projects subject to HM provisions are required to limit storm water peak flow and volume discharges from a site to pre-project levels. Further guidance on design criteria can be found in MRP Provision C.3.g, MRP Attachment F, and the SCVURPPP C.3 Handbook, Chapter 7. MRP Attachment F includes an "Impracticability Provision" which would allow an applicant to use alternative methods of compliance where HM controls would be impracticable.

5. **BMP Selection and Description, as reported in the SWMP text and BMP Summary Table:**

   a. Once the site-specific factors have been identified, select the appropriate BMPs for the site as discussed in Step 1B of the planning process. Summarize all BMPs, including SRA, STA and LID Treatment selected in a table, using headings similar to those provided as an example in Table A-2, below. Complete the Infiltration/Harvesting and Use Feasibility Screening Worksheet found in Appendix C.2.

      Appendix C.1 contains detailed descriptions of the three categories of BMPs applicable to Sunnyvale projects. Table C-3 identifies the post-construction LID treatment measures that meet the "maximum extent practicable" (MEP) standard as defined by the MRP. Note that several BMPs which had been commonly applied are <u>no longer</u> considered "MEP" when used as "stand-alone" storm water treatment devices. These include:

- Storm Drain Inlet Filters (also known as drain inserts)
- Oil/Water Separators (water quality inlets)
- Hydrodynamic Separators (vortex separators)
- Vegetated Swales (unless designed to infiltrate the water quality volume into the subsurface)
- Proprietary media filters.

In the written text of the SWMP, provide additional information regarding the BMPs selected.

- Provide a description of the entire site drainage area, including all the project property and, if applicable, any areas that may be off the project property, but drain onto it.
- Show all treatment BMP locations, the sub- drainage areas flowing into them, and identify the direction of storm water flows into the BMP on a Site Plan Sheet for the project area.
- Identify the potential pollutants present for each sub-drainage area, which would be a subset of all pollutants of concern for the site.
- Provide the percent impervious surface present and/or the runoff coefficient to be used for the BMPs.
- Provide the hydrologic and hydraulic computations for flow and/or volume for each of the sub-drainage areas using the appropriate numeric sizing criteria (See SMC 12.60.150).

To complete Table A-2 BMP Summary Table:

- Provide the description of each BMP selected.
- Classify the BMP selected as either Site Design, Source Control, or Treatment Control.
- Identify the type of sizing criteria used:
- Volume Hydraulic Design,
- Flow Hydraulic Design, or.
- Combination Flow and Volume Design.
- Identify the sizing method used:
  - For Volume it is either the Urban Runoff Quality Management method (85th percentile of the 24-hour storm runoff event) or the CA BMP Handbooks Appendix D method to achieve 80% or more capture, using local rainfall data.
  - For Flow Hydraulic Design, BMPs will be sized using one of these three options: Factored Flood Flow Method (10% of the 50–year peak flow rate); the CA BMP Handbook method (the flow produced by a rain event equal to at least two times the 85th percentile hourly rainfall intensity); or the Uniform Intensity Method (the flow produced by a rain event equal to at least 0.2 inches/hour intensity). (See SMC 12.60.150 for design criteria and Appendix F.)
  - Treatment systems that use a combination of flow and volume capacity shall be sized to treat at least eighty percent of the total runoff over the life of the project, using local rainfall data.
- Identify the Runoff Coefficient selected and the BMP size in either cubic feet or cubic feet/second

b. Describe the proposed site activities that may affect storm water quality in each of the drainage or sub-drainage areas.

c. Identify each of the pollutants of concern for each drainage or sub-drainage area (this may be a subset of the pollutants of concern for the entire project). Describe source control measures to be used to address pollutants.

d. The Percent Impervious and/or runoff coefficient (see example computations described in Appendix F).

e. Flow and/or volume of storm water generated to be treated by an area, using computations described in Appendix F:
   - Hydrologic computations
   - Hydraulic computations for runoff conveyance systems (e.g., swales, channels, culverts, pipes, etc.)

Table A-2: Stormwater Management Plan BMP Summary Table

Area/Sub-drainage ID	Existing Area (Ac or Ft^2)	Proposed Area (Ac or Ft^2)	BMP ID	BMP Classification: Site Design[2]	BMP Classification: Source Control	BMP Classification: LID Treat-ment Type (see Table C-3)	Sizing Criteria (Volume or Flow)	Runoff Coefficient	BMP size (ft^3 or cfs)	Pollutant(s) addressed by BMP	SCVWD Infiltration Device Type (A,B, or C) and depth to gw (See Appendix D)	SWMP Calculation Sheet Page No.
Building____												
Building____												
Building____												
Building____												
Parking - Impervious												
Other Hardscape												
Subtotal - Total Impervious Area												
Landscape												
Turf												
Parking – Pervious												
Open Space												
Other												
Subtotal - Total Pervious Area												
Total Project Area												
% of Total Project Area Impervious												
% of Total Project Area Pervious												

Notes:
1.Add Rows as Necessary to Describe Project
2. List site design techniques used: Self Treating Area (STA), Self Retaining Area (SRA).

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6. **Infiltration Devices**

Infiltration Inclusion Zones in the City of Sunnyvale have been identified on the GIS layer maps in Appendix B. The Infiltration Inclusion Zone is an area where the depth to groundwater, more permeable soil conditions, and other factors are such that infiltration devices (e.g., shallow dry wells, infiltration basins, infiltration and exfiltration trenches, unlined retention basins and unlined or open bottom vaults) can be used if the special guidelines discussed below are followed.

The Infiltration Inclusion Zone shown on the maps was developed based on generalized information on the depth of groundwater greater than 30 feet from ground surface and soil permeabilities categorized as "moderate" using data provided by the Santa Clara Valley Water District (SCVWD). Soil permeabilities in this area range from 0.06 in/hr to 2.0 in/hr. The soil permeability rate is applicable for soils up to 60 inches deep. These include Arbuckle Pleasanton and Yolo soil associations. The use of infiltration devices in the infiltration inclusion zone is generally acceptable, although site specific information regarding the depth to groundwater and soil infiltration rates may be required to obtain other permits that may be needed from the SCVWD and to demonstrate that infiltration devices are feasible at the project site.

If an infiltration device will be used, identify the vertical distance between the base of an infiltration device and seasonal high groundwater depth. Refer to SMC 12.60.040 (x) for the definition of a storm water infiltration device and to SMC 12.60.190 for minimum criteria for the use of storm water infiltration devices. Also, review the Infiltration Device Guidelines which can be found in Appendix D. SCVWD review and approval of the proposed infiltration devices is required if Table D-1 guidelines are not met.

7. **Plans for Post-Construction BMP Maintenance and/or Source Control**

Note that the City has the authority to make inspections to enforce compliance with the Stormwater Management Chapter (12.60) of the Sunnyvale Municipal Code, and that civil penalties can be imposed (see SMC 12.60.240-360). Therefore, it is in the best interest of the applicant to properly operate and maintain installed BMPs on the site. Self-inspection and employee training programs are also recommended to help ensure that the site remains in compliance.

a. Describe pesticide reduction measures, if a landscaping plan required. Examples can be found in Appendix A, Landscape Maintenance Techniques for Pest Reduction.

b. Describe preventive maintenance actions needed for the operation of treatment BMPs once the facility is constructed. Identify other facility equipment, and systems needed to ensure source control BMP measures are followed after the facility is constructed. Provide the following information:

1) Name and contact information for party or agency responsible for BMP maintenance and source control activities
2) Description of each LID treatment BMP and/or source control activity and required maintenance.
3) Frequency of maintenance activities and dates when BMP became active.

c. Identify the elements of a self-inspection program to investigate non-storm water discharges, BMP maintenance activities, effectiveness of BMPs, and prevention of soil erosion. Provide the following information:

1) Name and contact information for party or agency responsible for self inspection activities
2) Description of items for self inspection (e.g. BMPs, non-stormwater discharges, soil erosion, required maintenance, etc.)
3) Schedule for inspections.

d. Describe employee training program to implement the post-construction operations and maintenance of all storm water BMPs at the project site. Provide the following information:

1) Name and contact information for party or agency responsible for employee training program.
2) Description of items for self inspection (e.g. maintenance, inspections, pesticide use, etc.)
3) Schedule for training.
4) List of employees to be trained.

e. Describe spill response procedures (if applicable) based on the types of materials being handled outdoors at the facility.

f. Identify any areas to be used for outdoor storage and handling of process materials and wastes (e.g., stockpiles, dumpsters, tallow bins, recyclables or vehicle storage) on the site map described in #8 below. Describe how materials will be handled or stored on site to prevent storm water runoff contamination or spills.

g. Describe record keeping and internal reporting procedures for self-inspections and maintenance of BMPs. Provide information as to who will keep the records and where they will be located.

h. Provide current contact information for the facility owner or operator so that post-construction inspections of the storm water treatment BMPs can be scheduled.

Part 2 – Maps and Plan Summary

8. Provide a Vicinity Map (scale 1-inch = 250' feet (It can be the same scale map used for Part 1, Item 2.b of the checklist).

9. Provide Existing and Proposed Site Plan (scale 1-inch = 40 feet).

The Site Plan Sheets must match all information presented in the Storm Water Management Plan narrative submitted as a part of the Project Application. Identify the following:

a. Entire property included on one plan sheet/map with any easements and rights-of-way

b. Existing and proposed topographic contours with drainage areas and sub-areas delineated with arrows showing surface water flow direction.

c. Show any existing structures that will remain and all new/proposed: buildings, sidewalks, driveways, parking areas, and covered activity areas as described in Table 1 – BMP Summary Table. Provide information on acreage/square feet of entire project property, acreage/square feet of new or replaced impervious surface on the project property, and estimated surface drainage area being treated by an individual BMP. The Table A-2 – BMP Summary Table from above can be copied to the site map to provide this information.

d. Identify private storm drain systems and/or public storm conveyance systems including storm drain inlets and provide information on existing and proposed flows to each inlet. Note that all runoff from the regulated project area must be treated using LID methods before it reaches a storm drain inlet. Traditional storm drainage infrastructure should be designed to capture large storm events which would bypass or overflow LID systems.

e. Identify any water bodies (e.g. streams, creeks, channels, and ponds), impoundments, and wetlands that occur within 500 feet of the project boundary.

f. Identify locations of treatment control Best Management Practice measures and show proposed areas that will drain into them.

g. Identify potential areas where soil erosion could occur.

h. If applicable, show the following:

1) 100-year flood elevations

2) Soil boring locations, depth(s) to groundwater and date(s) of measurement.

3) Monitoring well locations, depth(s) to groundwater and date(s) of measurement.

4) Water supply well locations within property and on adjacent properties (within 500 feet).

5) Landscaping Plan (if landscape is to be used as part of a storm water treatment BMP).

10. Plan Sheets

In addition to the site map, the applicant should submit a list of plan sheets related to the storm water facilities that will be prepared and submitted to the City for the building permit. These design plan sheets need to include profiles or cross-sections and details of any structures that will be constructed to manage storm water from the project site. The Storm Water Management Plan narrative and the Storm Water Management Plan Sheets must match; all BMP designs and treatment devices included on the plan sheets must also be discussed in the SWMP narrative.

The plans listed below may be required as part of the building permit application, depending on the project. If they are submitted, there must be no conflicts between these plans and the Storm Water Management Plan Sheets.

11. Grading Plan

12. Utility Plan

13. Landscaping Plans

14. Construction BMP Plan Sheet (sample follows)

Third - Party Certification Checklist

This checklist is to be used to assist third-party reviewers of Storm Water Management Plans (SWMPs) for a project.

Information/Plans Required	Provided? Yes/No
1. All of the SMC Minimum Requirements on the Storm Water Management Plan Checklist (Appendix A) have been addressed in the SWMP being reviewed.	
2. BMPs selected will treat storm water to remove the types of pollutants expected from this site and conform with the LID treatment requirements.	
3. BMPs are appropriately sized to treat the quantity of storm water expected from this site to meet the requirements of SMC 12.60.150.	
4. There are no conflicts between the SWMP Plan sheet and any other plan sheets included with the project (e.g., Grading, Utility, or Landscaping Plan Sheets) that may be required by the City.	
5. A compliance review stamp is provided on the SWMP and any plan sheets as reviewed in #3 and #4 above.	
6. The SWMP is signed and stamped by a Professional Engineer and states as follows: The sizing, selection, and preliminary design of the Best Management Practices and control measures in the Storm Water Management Plan meet the requirements of SMC 12.60.150	
7. If there are any modifications to the SWMP as the project is being developed, the as-built designs must be reviewed and recertified by the third-party reviewer before the building permit is finalized or the Certificate of Occupancy is issued.	

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SAMPLE ONLY PENDING
SCVURPPP PREPARATION

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.

Construction Best Management Practices (BMPs)

Construction projects are required to implement the stormwater best management practices (BMP) on this page, as they apply to your project. Please note: the wet season begins on October 1 and continues through April 30.

Materials & Waste Management

Non-Hazardous Materials

- ❑ Berm and cover stockpiles of sand, dirt or other construction material with tarps when rain is forecast or if not actively being used within 14 days.
- ❑ Use (but don't overuse) reclaimed water for dust control.

Hazardous Materials

- ❑ Label all hazardous materials and hazardous wastes (such as pesticides, paints, thinners, solvents, fuel, oil, and antifreeze) in accordance with city, county, state and federal regulations.
- ❑ Store hazardous materials and wastes in water tight containers, store in appropriate secondary containment, and cover them at the end of every work day or during wet weather or when rain is forecast.
- ❑ Follow manufacturer's application instructions for hazardous materials and be careful not to use more than necessary. Do not apply chemicals outdoors when rain is forecast within 24 hours.
- ❑ Arrange for appropriate disposal of all hazardous wastes.

Waste Management

- ❑ Cover waste disposal containers securely with tarps at the end of every work day and during wet weather.
- ❑ Check waste disposal containers frequently for leaks and to make sure they are not overfilled. Never hose down a dumpster on the construction site.
- ❑ Clean or replace portable toilets, and inspect them frequently for leaks and spills.
- ❑ Dispose of all wastes and debris properly. Recycle materials and wastes that can be recycled (such as asphalt, concrete, aggregate base materials, wood, gyp board, pipe, etc.)
- ❑ Dispose of liquid residues from paints, thinners, solvents, glues, and cleaning fluids as hazardous waste.

Construction Entrances and Perimeter

- ❑ Establish and maintain effective perimeter controls and stabilize all construction entrances and exits to sufficiently control erosion and sediment discharges from site and tracking off site.
- ❑ Sweep or vacuum any street tracking immediately and secure sediment source to prevent further tracking. Never hose down streets to clean up tracking.

Equipment Management & Spill Control

Maintenance and Parking

- ❑ Designate an area, fitted with appropriate BMPs, for vehicle and equipment parking and storage.
- ❑ Perform major maintenance, repair jobs, and vehicle and equipment washing off site.
- ❑ If refueling or vehicle maintenance must be done onsite, work in a bermed area away from storm drains and over a drip pan big enough to collect fluids. Recycle or dispose of fluids as hazardous waste.
- ❑ If vehicle or equipment cleaning must be done onsite, clean with water only in a bermed area that will not allow rinse water to run into gutters, streets, storm drains, or surface waters.
- ❑ Do not clean vehicle or equipment onsite using soaps, solvents, degreasers, steam cleaning equipment, etc.

Spill Prevention and Control

- ❑ Keep spill cleanup materials (rags, absorbents, etc.) available at the construction site at all times.
- ❑ Inspect vehicles and equipment frequently for and repair leaks promptly. Use drip pans to catch leaks until repairs are made.
- ❑ Clean up spills or leaks immediately and dispose of cleanup materials properly.
- ❑ Do not hose down surfaces where fluids have spilled. Use dry cleanup methods (absorbent materials, cat litter, and/or rags).
- ❑ Sweep up spilled dry materials immediately. Do not try to wash them away with water, or bury them.
- ❑ Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
- ❑ Report significant spills immediately. You are required by law to report all significant releases of hazardous materials, including oil. To report a spill: 1) Dial 911 or your local emergency response number, 2) Call the Governor's Office of Emergency Services Warning Center, (800) 852-7550 (24 hours).

Earthwork & Contaminated Soils

Erosion Control

- ❑ Schedule grading and excavation work for dry weather only.
- ❑ Stabilize all denuded areas, install and maintain temporary erosion controls (such as erosion control fabric or bonded fiber matrix) until vegetation is established.
- ❑ Seed or plant vegetation for erosion control on slopes or where construction is not immediately planned.

Sediment Control

- ❑ Protect storm drain inlets, gutters, ditches, and drainage courses with appropriate BMPs, such as gravel bags, fiber rolls, berms, etc.
- ❑ Prevent sediment from migrating offsite by installing and maintaining sediment controls, such as fiber rolls, silt fences, or sediment basins.
- ❑ Keep excavated soil on the site where it will not collect into the street.
- ❑ Transfer excavated materials to dump trucks on the site, not in the street.
- ❑ Contaminated Soils
- ❑ If any of the following conditions are observed, test for contamination and contact the Regional Water Quality Control Board:
  - ■ Unusual soil conditions, discoloration, or odor.
  - ■ Abandoned underground tanks.
  - ■ Abandoned wells
  - ■ Buried barrels, debris, or trash.

Paving/Asphalt Work

- ❑ Avoid paving and seal coating in wet weather, or when rain is forecast before fresh pavement will have time to cure.
- ❑ Cover storm drain inlets and manholes when applying seal coat, tack coat, slurry seal, fog seal, etc.
- ❑ Collect and recycle or appropriately dispose of excess abrasive gravel or sand. Do NOT sweep or wash it into gutters.
- ❑ Do not use water to wash down fresh asphalt concrete pavement.

Sawcutting & Asphalt/Concrete Removal

- ❑ Completely cover or barricade storm drain inlets when saw cutting. Use filter fabric, catch basin inlet filters, or gravel bags to keep slurry out of the storm drain system.
- ❑ Shovel, abosorb, or vacuum saw-cut slurry and dispose of all waste as soon as you are finished in one location or at the end of each work day (whichever is sooner!).
- ❑ If sawcut slurry enters a catch basin, clean it up immediately.

Concrete, Grout & Mortar Application

- ❑ Store concrete, grout and mortar under cover, on pallets and away from drainage areas. These materials must never reach a storm drain.
- ❑ Wash out concrete equipment/trucks offsite or in a contained area, so there is no discharge into the underlying soil or onto surrounding areas. Let concrete harden and dispose of as garbage.
- ❑ Collect the wash water from washing exposed aggregate concrete and remove it for appropriate disposal offsite.

Dewatering

- ❑ Effectively manage all run-on, all runoff within the site, and all runoff that discharges from the site. Divert run-on water from offsite away from all disturbed areas or otherwise ensure compliance.
- ❑ When dewatering, notify and obtain approval from the local municipality before discharging water to a street gutter or storm drain. Filtration or diversion through a basin, tank, or sediment trap may be required.
- ❑ In areas of known contamination, testing is required prior to reuse or discharge of groundwater. Consult with the Engineer to determine whether testing is required and how to interpret results. Contaminated groundwater must be treated or hauled off-site for proper disposal.

Painting & Paint Removal

Painting cleanup

- ❑ Never clean brushes or rinse paint containers into a street, gutter, storm drain, or surface waters.
- ❑ For water-based paints, paint out brushes to the extent possible. Rinse to the sanitary sewer once you have gained permission from the local wastewater treatment authority. Never pour paint down a drain.
- ❑ For oil-based paints, paint out brushes to the extent possible and clean with thinner or solvent in a proper container. Filter and reuse thinners and solvents. Dispose of residue and unusable thinner/solvents as hazardous waste.

Paint removal

- ❑ Chemical paint stripping residue and chips and dust from marine paints or paints containing lead or tributyltin must be disposed of as hazardous waste.
- ❑ Paint chips and dust from non-hazardous dry stripping and sand blasting may be swept up or collected in plastic drop cloths and disposed of as trash.

Landscape Materials

- ❑ Contain stockpiled landscaping materials by storing them under tarps when they are not actively being used.
- ❑ Stack erodible landscape material on pallets. Cover or store these materials when they are not actively being used or applied.
- ❑ Discontinue application of any erodible landscape material within 2 days before a forecast rain event or during wet weather.

Storm drain polluters may be liable for fines of up to $10,000 per day!

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Model Conditions of Approval: Landscape Plans for the Reduction of Pesticide Use and Treatment of Storm Water Runoff

If a landscaping plan is required as part of a development project application, the plan shall meet the following conditions related to reduction of pesticide use on the project site:

1. Landscaping shall be designed with efficient irrigation to reduce runoff, promote surface infiltration, and minimize the use of fertilizers and pesticides that can contribute to water pollution.
2. Where feasible, landscaping shall be designed and operated to treat storm water runoff by incorporating elements that collect, detain, and infiltrate runoff. In areas that provide detention of water, plants that are tolerant of saturated soil conditions and prolonged exposure to water shall be specified.
3. Plant materials selected shall be appropriate to site specific characteristics such as soil type, topography, climate, amount and timing of sunlight, prevailing winds, rainfall, air movement, patterns of land use, ecological consistency, and plant interactions to ensure successful establishment.
4. Existing native trees, shrubs, and groundcover shall be retained and incorporated into the landscape plan to the maximum extent possible.
5. Proper maintenance of landscaping, with minimal pesticide use, shall be the responsibility of the property owner. See "Fact Sheet on Landscape Maintenance Techniques for Pest Reduction" as a good example of an education piece for property owners.

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PROPERTY MAINTENANCE FACT SHEET

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Landscape Maintenance Techniques for Pest Reduction

Who should use this Fact Sheet?

- Development Project Applicants
- City/County Planners
- Landscape Maintenance Personnel
- Landscape Architects
- Homeowners

Why is it Important to Reduce Pesticide Usage?

When it rains, pesticides used in maintaining landscapes and gardens are washed off the plants and soils they are used to protect. This stormwater runs off the landscape and flows to the nearest storm drain, which ultimately carries the water to a local creek or the San Francisco Bay without treatment. Pesticides carried with stormwater into creeks and the Bay are harmful to the fish and other organisms that live there. Minimizing our use of pesticides in landscape maintenance helps protect water quality, aquatic life, and our own health.

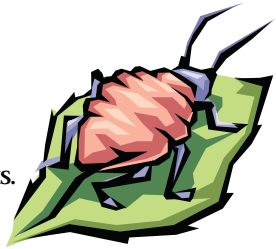
What is Integrated Pest Management?

IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed, according to established guidelines, and treatments are made with the goal of managing only the target organism to an acceptable level. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment.

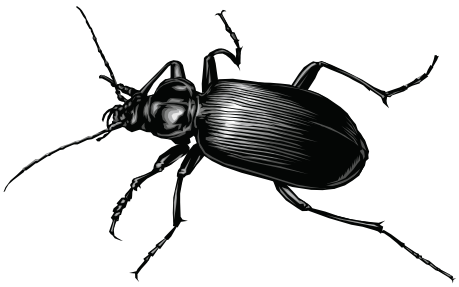
How Can Landscape Design and Maintenance Techniques Reduce Pesticide Usage

Pesticides are often used in maintaining landscapes. The amount of pesticides entering our waters can be decreased by using alternative design and maintenance techniques that:

- Reduce the potential for the pesticides to run off the landscape;
- Reduce the amount of chemicals necessary to ensure healthy plants or eliminate the need for pesticide usage at all; or,
- Decrease the need for landscape maintenance by designing landscapes that minimize pest infestation and create low maintenance environments.



Refer to the back of this fact sheet for more design and maintenance tips.



Pest Reducing Landscape Design Techniques

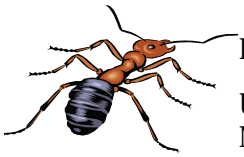
- Design the landscape for efficient irrigation and drainage.
- Design the landscape to conform to natural drainage patterns.
- Retain existing native, pest-resistant trees, shrubs and plants.
- Select pest-resistant plants adapted to your specific area. Consider site-specific characteristics such as the soil, topography, climate, amount and timing of sunlight, prevailing winds, rainfall, air movement, patterns of land use, ecological consistency and plant interactions.
- Prevent the need for routine pruning by selecting plants based on their size and shape when mature.
- Situate plants to facilitate maintenance. Install mowing strips, tree wells and pathway edging to reduce problems associated with maintaining the interface between different elements of the design.
- Plant at the right time of year.

Pest Reducing Landscape Maintenance Techniques

- Employ Integrated Pest Management methods before using chemical pesticides to treat a pest problem (i.e., biological, physical and cultural controls).
- If pesticides are necessary, use the least toxic pesticide available. Avoid use of copper-based pesticides.
- Do not over apply pesticide. Spray only where the infestation exists. Follow the manufacturer's instructions for mixing and applying materials.
- Properly sweep up spilled fertilizers or pesticides. Do not wash away or bury such spills.
- Properly dispose of chemical wastes by recycling, reusing, or disposing of as hazardous waste. Do not dispose of debris into or near channels or other waterways or leave it on the street where it may contact runoff.
- Apply pesticides at the appropriate time to maximize their effectiveness and minimize the likelihood of discharging undegraded pesticides into runoff. Avoid application if rain is expected.
- Maintain healthy soils by incorporating organic matter, making regular pH adjustments, and appropriately fertilizing.
- Do not overwater. Do not allow overspray.
- Prune to increase air circulation but do not overprune.
- Apply 2-4 inches of mulch or geotextiles to exposed soils to prevent weed growth.
- Mow lawns and turf high and leave clippings.
- Replace problem plants with locally-adapted, pest resistant plants.
- Place trash and recycling canisters away from buildings and properly cover.
- Remove, rake up and dispose of diseased plant parts.

ADDITIONAL RESOURCES

IPM Access, www.efn.org/~ipmpa, *IPM Based Landscape Design.*



Bio-Integral Resource Center (BIRC) (510) 524-2567

Central Contra Costa County Sanitary District *Our Water Our World* IPM Fact Sheets www.centralsan.org

San Francisco Department of the Environment www.sfenvironment.com

www.watershedwatch.net

Pest Resistant Plant List www.scvurppp.org

University of California Cooperative Extension Master Gardeners (in the phone book)

University of California IPM (800) 994-8849 www.ipm.ucdavis.edu

- Natural Enemies Handbook: The Illustrated Guide to Biological Pest Control
- The UC Guide to Solving Garden and Landscape Problems: An Interactive CD-ROM
- Pests of Landscape Trees and Shrubs

Appendix C: BMP Information

Appendix C.1: BMP Summary and References..... C-3

Appendix C.2: LID Feasibility Worksheets..... C-15

Appendix C.3: Biotreatment Soil Specification and Green Roof Specification C-29

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Appendix C.1: BMP Summary and References

Types of BMPs C-5

Site Design Principles C-5

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Source Control Measures To Be Implemented Post-Construction C-7

Table C-1: Sunnyvale Source Control Applicability C-7

Sunnyvale Source Control Measures with Detailed Descriptions C-8

Table C-2: CASQA Source Control Summary C-12

Treatment Control Measures C-13

Table C-3: Summary of LID and Non-LID Stormwater Treatment Measures C-15

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Types of BMPs

BMPs can be generally divided into three categories:

1. Site Design Principles – Principles that use architectural, landscape, and engineering planning to reduce runoff and the pollutants that may be discharged
2. Source Control Measures – Practices that reduce the pollutants at their source, before they could enter storm water
3. Treatment Control Measures – Practices that retain stormwater onsite or treat and remove pollutants from storm water prior to discharge to the City's storm drain system. As defined by the MRP, only LID treatment control BMPs may be used to satisfy permit requirements. The allowable BMPs are restricted to those which are contained in Table C-3.

It is recommended that applicants first consider minimizing the amount of storm water that needs to be treated by first using Site Design Principles, implementing Source Control Measures, and finally using Treatment Control Measures for that quantity of runoff that cannot be managed through the first two categories. Each of the three categories of BMPs is summarized below and references are provided for more detailed information.

Site Design Principles

Site Design Principles are documented in the manuals: *Start at the Source* (1999), and *Using Site Design Techniques to Meet Development Standards for Storm Water Quality: A Companion Document to Start at the Source* (May 2003) both prepared by the Bay Area Storm Water Management Agencies Association (BASMAA) and found at (http://www.scvurppp-w2k.com/nd_wp.shtml). See also SCVURPPP's *C.3 Stormwater Handbook*: http://www.scvurppp-w2k.com/nd_wp.shtml#c3handbook

Site Design Principles include the following design philosophies:

1. **Self-Treating Areas (STAs)** – pervious areas designed to treat rain falling directly on the surface via ponding, infiltration, and/or evapotranspiration.
   a. Pervious surfaces acceptable for use as STAs include: landscaping, green roofs, pervious paving, and artificial turf.
   b. STAs must retain approximately 1" of rainfall or be designed to store and infiltrate the C.3.d amount of runoff.
   c. Runoff from an STA can flow directly to the storm drain system and does not require treatment through another LID treatment measure.
   e. STA Credit can be achieved based on the interception of rainwater by tree canopy:
      i. Preservation of an existing tree results in STA credit equal to the square footage of site area beneath the tree canopy.
      ii. A new evergreen tree planted on the site results in STA credit of 200 square feet per tree.
      iii. A new deciduous tree planted on the site results in STA credit of 100 square feet per tree.
2. **Self-Retaining Areas (SRAs)** - pervious area that use infiltration or retention concepts to retain at least 1" of rainfall on the area itself, in addition to runoff from some adjacent impervious area, producing no treatment-required runoff. Also known as Zero Discharge Areas
   a. A maximum 2:1 ratio of impervious area to the receiving pervious area should be used when designing SRAs.
   b. SRAs must retain approximately 3" of rainfall (if using the 2:1 ratio) or be designed to store and infiltrate the C.3.d amount of runoff for the SRA and contributing impervious area.
   c. Examples of SRAs include:
      i. Partial green roof, receiving drainage from other impervious roof areas

ii. Roof runoff dispersion to landscaping

iii. Pervious paving with additional storage to retain and infiltrate the C.3.d volume of runoff from adjacent impervious parking area.

Self-Treating Areas are considered to be pervious and can be subtracted from the total impervious area created and/or replaced. This may result in a project falling below the C.3 treatment threshold for a regulated project. Impervious area contributing runoff to a pervious (Self-Retaining) area cannot be subtracted from the impervious area created and/or replaced. However, the contributing area is receiving treatment from the Self- Retaining area and may be subtracted from the total impervious area being evaluated for LID feasibility.

Site Design: Conditions of Approval

The City has developed general Conditions of Approval (COA) to include measures that support site design principles with the intent of keeping pollutants our of storm water, ground water, creeks, and the South San Francisco Bay. Examples of these COAs are described below:

A. General:
   1. The project will incorporate site design measures for reducing water quality impacts of the project, in compliance with the City of Sunnyvale's NPDES Storm Water Permit Provision C.3 requirements and the Sunnyvale Municipal Code Chapter 12.60.

B. Minimize Land Disturbance:
   1. Significant natural features and resources on site such as undisturbed forest area, setbacks, trees, erosive soils, wetlands, or riparian areas shall be identified within the area to be developed and protected during construction and in the future use of the site.
   2. Site layout shall conform to natural land forms. Buildings shall be located to utilize natural drainage systems as much as possible and avoid unnecessary disturbance of vegetation and soils. Development on unstable or easily erodable soils shall be avoided, due to their greater erosion potential.

C. Minimize Impervious Surfaces:
   1. Directly connected impervious surface shall be minimized. Runoff from impervious areas shall be channeled to pervious areas (e.g., park strips, vegetated planters) where possible, prior to discharge to the storm drain.
   2. Site permeability shall be maximized by clustering buildings, reducing building footprints, minimizing impervious surfaces, and use of permeable paving materials, where feasible.
   3. The project shall cluster structures and incorporate smaller lot sizes, where feasible, to reduce overall impervious surface coverage and provide more undisturbed open space for the protection of water resources.

D. Preserve Open Space:
   1. The amount of open space on the site shall be maximized and open space area maintained in a natural manner.
   2. Undisturbed areas such as forested conservation areas and stream buffers shall be utilized to treat and control storm water runoff from other areas of the site with proper design.

E. Reduce Effects of Hydromodification:
   1. The project shall utilize infiltration measures to reduce storm water discharge to the greatest extent feasible.
   2. The project shall minimize increases in storm water flow and volume resulting from the development project to protect creeks and waterways from flooding and erosion impacts.

F. Street Designs:
   1. Where density, topography, soils, slope, and safety issues permit, vegetated open channels or other landscape features shall be used in the street right-of-way to convey and treat storm water runoff from roadways.

2. Sidewalks shall be sloped to drain to vegetated park strips, if park strips are included in the design.

G. Parking Lots:
   1. Minimize the amount of impervious areas associated with parking lots by providing compact car spaces, reducing stall dimensions, incorporating efficient parking lanes and using permeable pavement in overflow parking areas, where feasible.
   2. Place curb cuts (one every 10 feet), tire stops, or other means to protect landscaped treatment areas and allow maximum flow of storm water into landscaped areas.
   3. The use of permeable paving for parking and driveway surface areas is encouraged to reduce runoff from the site. Paving should meet fire department requirements and be structurally appropriate for the location.

H. Landscaping as a Storm Water Drainage/Treatment Feature:
   1. Projects shall be designed to direct storm water runoff into landscaping or natural vegetation, where feasible.
   2. Large landscaped areas shall be designed to collect and infiltrate storm water where feasible. Overflow drains shall be placed so that landscaped areas can store runoff and drain at capacity. Such collection areas shall be designed and maintained to prevent vector (e.g., mosquito) control problems (see Self-Treating Areas, above).
   3. Where possible, runoff from impervious areas, such as rooftops, roadways and sidewalks shall be directed to pervious areas or vegetated areas prior to discharge to the storm drain system (see Self-Retaining Area above.)

I. Riparian Areas:
   1. Naturally vegetated buffers shall be delineated and preserved along perennial streams, rivers, lakes, and wetlands.

Source Control Measures To Be Implemented Post-Construction

Source control measures are often used to minimize the sources of water quality problems before they are discharged into the storm drain system. Source control measures have been developed and documented by the City of Sunnyvale, by CASQA in their BMP Handbooks, and by SCVURPPP. City of Sunnyvale source control measures can be found in Table C-1, and must be applied to regulated projects within Sunnyvale City limits, if appropriate to site activities. CASQA Source Control fact sheets, some of which are referenced in the City's source control measures, may also be applicable and are summarized in Table C-2. The complete fact sheets can be found at (http://www.cabmphandbooks.com/). Source control measure selection is determined by the types of activities that will occur at the project site. Table C-1 identifies Sunnyvale source control BMPs that are applicable to some example developments. A detailed description of each source control listed in Table C-1 is included in the text that follows.

Table C-1: Sunnyvale Source Control Applicability Summary

	Example Developments			
Source Control BMPs	Multi-Family Residential	Commercial	Gas Station	Restaurant
1. Illegal Dumping	●	●	●	●
2. Replumb of Interior floor drains		●	●	●
3. Parking Structure	●	●		
4. Pesticide/Fertilizer Application	●	●	●	●

5. Pool/Spa/Fountain Discharge	●	●		
6. Food Service Equipment Cleaning		●		●
7. Refuse Areas	●	●	●	●
8. Outdoor Process Activities/Equipment		●	●	
9. Outdoor Equipment/Materials Storage	●	●	●	
10. Vehicle/Equipment Cleaning, Repair and Maintenance		●	●	
11. Fuel Dispensing Areas			●	
12. Loading Docks		●		●
13. Fire Sprinkler Test Water		●		●
14. Miscellaneous Drain/Wash Water	●	●	●	●
15. Sidewalks/Parking Lots/Private Roads	●	●	●	●

Sunnyvale Source Control Measure Description

The City has developed source control measures as summarized in the list that follows. Where applicable cross-references to the CASQA BMP Handbooks exist, the CASQA volume number and location of the fact sheet are included. The CASQA Industrial and Commercial and New Development and Redevelopment are abbreviated as CASQA I&C and CASQA ND&R respectively. CASQA Source Control Measures are also summarized in Table C-2, below. The following descriptions of BMPs provided by the City can be used to control sources of storm water pollutants associated with the post-construction phase of new or redevelopment projects. One or more of listed control methods may be applicable to an identified pollution source.

1. Control of Illegal Dumping to Storm Drain Inlets and Waterways:

a. On-site storm drain inlets shall be clearly marked with the words "NO DUMPING! FLOWS TO BAY" or equivalent.

b. Any discharge to the storm drain system not composed entirely of stormwater is prohibited. Prohibited discharges include but are not limited to discharges from toilets, sinks, industrial processes, cooling systems, boilers, fabric cleaning, equipment cleaning, or vehicle cleaning.

c. It is unlawful to throw, deposit, leave, abandon, maintain or keep materials or wastes on public or private lands in a manner and place where they may result in an illicit discharge

2. Replumb of Interior Floor Drains:

a. Interior floor drains shall be plumbed to the sanitary sewer. Installing new connections and new piping can be costly and requires approval from the Water Pollution Control Plant. An Industrial Wastewater Discharge Permit may be required for discharges from commercial or industrial processes.

3. Parking Structures:

a. Interior level parking garage floor drains shall be connected to a water treatment device approved by the City of Sunnyvale prior to discharging to the sanitary sewer system.

4. Pesticide Use Reduction (CASQA I&C):

a. Landscaping shall be designed to minimize irrigation, runoff, and use of fertilizers and pesticides. Landscaping shall also promote surface infiltration where appropriate.

b. Structures shall be designed to discourage the occurrence and entry of pests into buildings (i.e. locating dumpster areas away from occupied buildings, covering foundation vents with screens).

c. In areas that provide detention water, plants that are tolerant of saturated soil conditions and prolonged exposure to water shall be specified. Refer to SCVURPPP's Plant List and Planting Guidance for Landscape-Based Stormwater Measures – Appendix D of the SCVURPPP C.3 Stormwater Handbook.

d. Plant material selected shall be appropriate to site specific characteristics such as soil type, topography, climate, amount and timing of sunlight, prevailing winds, rainfall, air movement, patterns of land use, ecological consistency and plant interactions to ensure successful establishment.

e. Existing native trees, shrubs, and ground cover shall be retained and incorporated in the landscape plan to the maximum extent possible.

f. Proper maintenance of landscaping, with minimal pesticide use, shall be the responsibility of the property owner.

5. Pool/Spa/Fountain Discharge:

a. New or rebuilt pools (including swimming pools, hot tubs, spas and fountains) shall have a connection to the sanitary sewer system to facilitate draining. This connection could be a drain in the pool to the sanitary sewer, or a sanitary sewer cleanout located close enough to the pool so that a hose can readily direct the pool discharge into the sanitary sewer cleanout.

b. Discharges from swimming pools, hot tubs, spas and fountains shall be directed to the sanitary sewer, subject to the local sanitary sewer agency's authority and standards, or to a landscaped area that can accommodate the volume.

c. When draining is necessary, a hose or other temporary system shall be directed into a sanitary sewer cleanout. The clean-out shall be located in a readily accessible area from the pool (e.g., within 10 feet of the pool).Discharge flows should be kept to the low levels typically possible through a garden hose.

6. Food Service Equipment Cleaning (CASQA I&C – Appendix D):

a. Food service facilities, including restaurants and grocery stores shall have a sink or other area for cleaning floor mats, containers, hood filters, and equipment. The cleaning area must be located indoors or in a covered area outdoors. It must also be large enough to clean the largest mat or piece of equipment that needs cleaning. The sink or cleaning area shall be connected to a grease interceptor prior to discharge to the sanitary sewer system.

7. Refuse Areas (CASQA ND&R - SD-32, CASQA I&C - SC-34):

a. New facilities such as food service, commercial, and/or multi-family residential complexes or subdivisions shall provide a covered, enclosed area for compactors and trash, food waste, and recycling containers that prevents water run-on and run-off from the enclosed area.

b. For new facilities, refuse/recyclable storage areas shall not have a connection to the storm drain system and shall have a connection to the sanitary sewer system that is equipped with a water quality inlet to trap solids and surface-floating oil.

c. Use dry clean-up methods for spills within the storage areas. Do not hose down and wash spill materials into storm sewers. If the area must be cleaned with water or pressure-washed, trap and collect wash water to prevent entry into the storm drain system. Wash water containing any cleaning agent or degreaser shall be collected and discharged to the sanitary sewer and shall not be discharged to a storm (follow the "Mobile Cleaner Best Management

Practices" available from the Water Pollution Control Plant, Pretreatment Program).

8. Process Activities:

a. Process activities shall be performed indoors if possible. If performed outdoors, the area shall be covered and designed to prevent run-on and run-off from the process activity site.

b. Process equipment area shall drain to the sanitary sewer system. The discharge of wastewater from commercial and industrial processes requires approval from the Water Pollution Control Plant, and an Industrial Wastewater Discharge Permit may be required.

9. Outdoor Equipment/Materials Storage (CASQA ND&R - SD-34; CASQA I&C-SC-31, SC-33):

a. All outdoor equipment and materials storage areas shall be covered and shall be designed to prevent the runoff and run-on of storm water using berms or curbing along the perimeter.

b. Storage areas containing non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system and be contained by berms, dikes, liners, or vaults. Connections require approval from the Water Pollution Control Plant, and an Industrial Wastewater Discharge Permit may be required.

c. All hazardous materials and wastes as defined or regulated by Title 20 of the Sunnyvale Municipal code must be used and stored in compliance with the City of Sunnyvale's Hazardous Materials Ordinance and the Hazardous Materials management Plan for the site approved by the City of Sunnyvale Public Safety Department, Fire, and Environmental Services/Haz-Mat Division.

10. Vehicle/Equipment Cleaning, Repair and Maintenance (CASQA ND&R-SD-31, SD-33; CASQA I&C SC-21, SC-22, Appendix D):

a. Wastewater from vehicle and equipment washing operations shall not be discharged to the storm drain system.

b. Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such use. Vehicle/equipment washing areas shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.

c. Commercial car wash facilities shall be designed and operated such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer or a wastewater reclamation system.

d. Vehicle/equipment repair and maintenance shall be performed in a designated area indoors, or if such services must be performed outdoors, in an area designed to prevent run-on and runoff of storm water.

e. Secondary containment shall be provided for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.

f. Vehicle service facilities shall not contain floor drains unless the floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer. Connections require approval from the Water Pollution Control Plant, and an Industrial Wastewater Discharge Permit may be required.

g. Vehicle fluids, hazardous materials, or rinse water from parts cleaning operations shall not be discharged into storm drains.

h. Vehicle fluid removal shall be performed in an area with secondary containment.

Leaking vehicle fluids shall be contained or drained from the vehicle immediately.

i. Open containers containing vehicle fluid and drip parts shall not be left unattended unless within a secondary containment area.

11. Fuel Dispensing Areas (CASQA ND&R - SD-30; CASQA I&C SC-20):

a. Fueling areas[3] shall have impermeable floors (i.e. Portland Cement concrete or equivalent smooth impervious surface) that are graded at the minimum slope to prevent ponding. Fueling areas shall also be separated from the rest of the site by a grade break that prevents run-on of storm water to the maximum extent possible.

b. Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. The canopy shall not drain into the fueling area. The property owner shall routinely dry sweep the fueling area.

12. Loading Docks:

a. Loading docks shall be covered and/or graded to minimize run-on and runoff from the loading area. Roof downspouts shall be positioned to direct storm water away from the loading area.

b. Loading docks for loading and unloading liquids in containers shall be provided with an inlet with a shutoff valve and have enough capacity to hold a spill while the valve is closed.

c. Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.

d. Door skirts between the trailers and the building shall be installed to prevent exposure of loading activities to rain.

13. Fire Sprinkler Test Water:

a. Sanitary sewer connections shall be provided to drain fire sprinkler test water.

14. Miscellaneous Drain/Wash Water:

a. Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.

b. Air compressor or air conditioner condensate drain lines may not discharge to the storm drain system. Condensate from air conditioning units shall be directed to vegetated areas or the sanitary sewer.

c. Building roof drains shall discharge and drain away from the building foundation to an unpaved or vegetated area, wherever possible.

d. Roof top equipment shall drain to the sanitary sewer.

15. Sidewalks, Parking Lots, and Private Roads (CASQA I&C – SC-43):

a. Sidewalks, parking lots and private roads shall be swept regularly to prevent the accumulation of litter and debris. Debris resulting from pressure washing shall be trapped and collected to prevent entry into the storm drain system. Wash water containing any cleaning agent or degreaser shall be collected and may be discharged to the sanitary sewer with approval of the Water Pollution Control Plant. Wash water containing any cleaning agent or degreaser shall not be discharged to a storm drain. BMPs and certification in surface cleaning techniques can be obtained from the Water Pollution Control Plant.

b. Owners of private streets and storm drains shall prepare and implement a plan for street sweeping of paved private roads and cleaning of all storm drain inlets.

[3] The fueling area is defined as the area extending minimum of 6.5 feet from the corner of each dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

Table C-2: CASQA Source Control Summary

		Example Developments				
BMP Source	**BMP Name**	**Multi-Family Residential**	**Commercial**	**Gas Station**	**Restaurant**	**Industrial**
CASQA-Design	SD-10: Site Design and Landscape Planning	X	X	X	X	X
CASQA-Design	SD-11: Roof Runoff Controls	X	X	X	X	X
CASQA-Design	SD-12: Efficient Irrigation	X	X	X	X	X
CASQA-Design	SD-13: Storm Drain System Signs	X	X	X	X	X
CASQA-Design	SD-20: Pervious Pavements	X	X	X	X	X
CASQA-Design	SD-21: Alternative Building Materials	X	X	X	X	X
CASQA-Design	SD-30: Fueling Areas			X		X
CASQA-Design	SD-31: Maintenance Bays and Docks		X	X		X
CASQA-Design	SD-32: Trash Enclosures	X	X	X	X	X
CASQA-Design	SD-33: Vehicle Washing Areas		X	X		X
CASQA-Design	SD-34: Outdoor Material Storage Areas		X	X		X
CASQA-Design	SD-35: Outdoor Work Areas	X	X	X		X
CASQA-Design	SD-36: Outdoor Processing Areas	X	X	X		X
CASQA Maintenance	SC-10: Non-Storm water Discharges	X	X	X	X	X
CASQA Maintenance	SC-11: Spill Prevention		X	X		X
CASQA Maintenance	SC-20: Vehicle and Equipment Fueling		X	X		X
CASQA Maintenance	SC-21: Vehicle and Equipment Cleaning		X	X		X
CASQA Maintenance	SC-22: Vehicle and Equipment Repair		X	X		X
CASQA Maintenance	SC-30: Outdoor Loading/Unloading		X	X		X
CASQA Maintenance	SC-31: Outdoor Liquid Container Storage		X	X		X
CASQA Maintenance	SC-32: Outdoor Equipment Operations		X	X		X
CASQA Maintenance	SC-33: Outdoor Storage of Raw Materials	X	X	X		X
CASQA Maintenance	SC-34: Waste Handling and Disposal	X	X	X	X	X

BMP Source	BMP Name	Example Developments				
		Multi-Family Residential	Commercial	Gas Station	Restaurant	Industrial
CASQA Maintenance	SC-35: Safer Alternatives		X	X		X
CASQA Maintenance	SC-40: Contaminated or Erodible Areas	X	X	X	X	X
CASQA Maintenance	SC-41: Building and Grounds Maintenance	X	X	X	X	X
CASQA Maintenance	SC-42: Building Repair and Construction	X	X	X	X	X
CASQA Maintenance	SC-43: Parking/Storage Area Maintenance	X	X	X	X	X
CASQA Maintenance	SC-44: Drainage System Maintenance	X	X	X	X	X

Treatment Control Measures

As of December 1, 2011, stormwater treatment requirements must be met using low impact development (LID) treatment. This consists of infiltration, evapotranspiration, and/or rainwater harvesting and reuse, or, where this is infeasible, biotreatment measures may be used. The application of harvesting and reuse, infiltration, or evapotranspiration may be determined to be infeasible based on the following criteria:

- Locations with tight clay soils that significantly limit the infiltration of stormwater. (This is likely to be the primary limiting factor for projects in the City of Sunnyvale.)
- Locations where seasonal high groundwater would be within 10 feet of the base of the LID treatment measure. (This may impact developments occurring in Sunnyvale, north of Highway 101.)
- Locations within 100 feet of a groundwater well used for drinking water.
- Development sites where pollutant mobilization in the soil or groundwater is a documented concern. (e.g. sites with documented soil or groundwater contamination issues.)
- Locations with potential geotechnical hazards (e.g. near retaining walls, slopes, footings, or foundations which are not designed for hydraulic loads).
- Smart growth and infill or redevelopment sites where the density and/or nature of the project would create significant difficulty for compliance with the onsite volume retention requirement.

If any of the above criteria may be impacting the project, the applicant may review and complete the LID Feasibility materials included in Appendix C.2. Manufactured, vault-based systems will not be allowed as stand-alone treatment measures, except in certain "Special Projects," described in Step 1B of this manual. Treatment Control measures have been defined and described by CASQA, BASMAA, and SCVURPPP. In addition, certain types of treatment control measures that may be infiltration devices are further regulated by the Santa Clara Valley Water District (SCVWD). Table C-3, below, includes all of the treatment control BMPs that will meet the LID standard, in addition to several BMPs that may only be used in combination with LID measures as part of a treatment train.

For further information and design guidance on the BMPs listed in Table C-3, refer to:

- CASQA BMP Handbooks (http://www.cabmphandbooks.com/):
  - CASQA Industrial and Commercial BMP Handbook
  - CASQA – New Development and Redevelopment BMP Handbook
- SCVURPPP fact sheets and other useful guidance can be found at the SCVURPPP website (http://www.scvurppp-w2k.com/nd_wp.shtml)
- SCVURPPP maintenance fact sheets included in Appendix E
- Bay Area Stormwater Management Agencies Association, Start at the Source, 1999

Table C-3: Summary of Stormwater Treatment Measures and Sizing Methods

BMP Name	LID Treatment (Type)	Non-LID Treatment	Infiltration Device? (1)	Sizing Method		BMP Source	Comments
				Volume Based	Flow Based		
PERMEABLE PAVING							
Un-Grouted Unit Pavers	Infiltration, if designed with an underlying gravel layer sufficient to store the C.3.d amount of runoff.		No	X		BASMAA	
Unit Pavers on Sand			No	X		BASMAA	
Crushed Aggregate			No	X		BASMAA	
Pervious Pavements (pervious concrete/asphalt)			Maybe	X		CASQA SD-20	Not an infiltration device If used as self-treating area; may need SCVWD review if includes additional gravel depth to treat runoff from a tributary area
INFILTRATION MEASURES							
Bioretention	Infiltration		No	X	X	CASQA TC-32	Bioretention areas that are unlined, and with either no underdrain or an underdrain raised above a gravel layer sufficient to store the C.3.d amount of runoff
Landscape Detention	Infiltration		No	X			
Dry-Well	Infiltration		Yes	X			
Infiltration Trench	Infiltration		Yes	X		CASQA TC-10	
Infiltration Basin	Infiltration		Yes	X		CASQA TC-11	
Unlined or Open-Bottomed Vault or Box Below Grade	Infiltration		Yes	X		SCVWD	
Unlined Retention Basin	Infiltration		Yes	X		SCVWD	
Exfiltration Trench	Infiltration		Yes	X		SCVURPPP Maint. Fact Sheet	
RAINWATER HARVESTING/USE							
Cistern	Rainwater harvest/use		No	X		BASMAA	If it is infeasible to harvest and use the C.3.d amount of runoff, other LID treatment is required, but applicant may voluntarily opt to do some harvesting and use.
Retention/Irrigation	Rainwater harvest/use		No	X		CASQA TC-12	

BMP Name	LID Treatment (Type)	Non-LID Treatment	Infiltration Device? (1)	Sizing Method		BMP Source	Comments
				Volume Based	Flow Based		
BIOTREATMENT (See Note 2)							
Bioretention	Biotreatment		No	X	X	CASQA TC-32	Must be constructed with biotreatment soils, per BASMAA soil specifications, and with a design surface loading rate of 5 in/hr. Typically have underdrains.
Planter Boxes	Biotreatment		No	X	X	SCVURPPP Maint. Fact Sheet	
GREEN ROOFS							
Extensive green roof	Evapotranspiration		No	X		BASMAA	Can be considered self-treating if BASMAA's green roof specifications are implemented.
Intensive green roof or roof gardens	Evapotranspiration		No	X		BASMAA	
NON-LID TREATMENT MEASURES (See Note 3)							
Extended Detention Basin	Non-LID	X	No	X		CASQA TC-22	Applicant may opt to use non-LID treatment measures only as part of a treatment "train" with LID treatment.
Vegetated Swale	Non-LID	X	No		X	CASQA TC-30	
Vegetated Buffer Strip	Non-LID	X	No		X	CASQA TC-31	
Media Filter	Non-LID	X	No		X	CASQA TC-40 or MP-40	Media filter and/or tree well filter may be used as stand-alone treatment in Special Projects, subject to City approval.
Tree Well Filter	Non-LID	X	No		X	Proprietary (see manufacturer) or generic	

Notes

1. Infiltration devices may require SCVWD review. See Appendix D for stormwater infiltration device guidelines.
2. Biotreatment measures are landscape-based stormwater treatment measures that filter stormwater through special, fast-draining soils and collect treated water in subdrains connected to the storm drain system. The MRP will only allow biotreatment measures if infiltration, evapotranspiration, and/or harvesting and reuse are infeasible at the project site.
3. Non-LID Treatment measures do not meet the MEP standard as defined by the MRP, and may only be used in combination with other approved BMPs or in Special Projects.

List of Acronyms and Source Documents

BASMAA - Bay Area Stormwater Management Agencies Association, Start at the Source, 1999
CASQA - California Storm Water Quality Association
CASQA I & C - Industrial and Commercial BMP Handbook
CASQA ND & R - New Development and Redevelopment BMP Handbook
SCVWD - Santa Clara Valley Water District
SCVURPPP - Santa Clara Valley Urban Runoff Pollution Prevention Program, Maintenance Fact Sheet
SSCM - Sunnyvale Source Control Measures found in Appendix C.1.

Appendix C.2: LID Feasibility Worksheets

Infiltration/Harvesting and Use Feasibility Screening Worksheet..... C-19

LID Feasibility Worksheet Attachments..... C-22

Infiltration Feasibility Worksheet C-27

Rainwater Harvesting and Use Feasibility Worksheet..... C-29

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Infiltration/Harvesting and Use Feasibility Screening Worksheet

*Apply these screening criteria for **C.3 Regulated Projects*** required to implement Provision C.3 stormwater treatment requirements. See the Glossary (Attachment 1) for definitions of terms marked with an asterisk (*). Contact municipal staff to determine whether the project meets **Special Project*** criteria. If the project meets Special Project criteria, it may receive LID treatment reduction credits.*

1. Applicant Info

Site Address: _____, CA APN: _____

Applicant Name: _____ Phone No.: _____

Mailing Address: _____

2. Feasibility Screening for Infiltration

Do site soils either (a) have a **saturated hydraulic conductivity*** (Ksat) that will NOT allow infiltration of 80% of the annual runoff (that is, the Ksat is LESS than 1.6 inches/hour), or, if the Ksat rate is not available, (b) consist of Type C or D soils?[1]

☐ Yes (continue) ☐ No – complete the Infiltration Feasibility Worksheet. If infiltration of the C.3.d amount of runoff is found to be feasible, there is no need to complete the rest of this screening worksheet.

3. Recycled Water Use

Check the box if the project is installing and using a recycled water plumbing system for non-potable water use.

☐ The project is installing a recycled water plumbing system, and installation of a second non-potable water system for harvested rainwater is impractical, and considered infeasible due to cost considerations. Skip to Section 6.

4. Calculate the Potential Rainwater Capture Area* for Screening of Harvesting and Use

Complete this section for the entire project area. If rainwater harvesting and use is infeasible for the entire site, and the project includes one or more buildings that each have an individual roof area of 10,000 sq. ft. or more, then complete Sections 4 and 5 of this form for each of these buildings.

4.1 Table 1 for (check one): ☐ The whole project ☐ Area of 1 building roof (10,000 sq.ft. min.)

Table 1: Calculation of the **Potential Rainwater Capture Area***

The Potential Rainwater Capture Area may consist of either the entire project area or one building with a roof area of 10,000 sq. ft. or more.

	1	2	3	4
	Pre-Project Impervious surface[2] (sq.ft.), if applicable	Proposed Impervious Surface[2] (IS), in sq. ft.		Post-project landscaping (sq.ft.), if applicable
		Replaced[3] IS	Created[4] IS	
a. Enter the totals for the area to be evaluated:				
b. Sum of replaced and created impervious surface:	N/A			N/A
c. Area of existing impervious surface that will NOT be replaced by the project.		N/A		N/A

[1] Base this response on the site-specific soil report, if available. If this is not available, consult soil hydraulic conductivity maps in Attachment 3.
[2], Enter the total of all impervious surfaces, including the building footprint, driveway(s), patio(s), impervious deck(s), unroofed porch(es), uncovered parking lot (including top deck of parking structure), impervious trails, miscellaneous paving or structures, and off-lot impervious surface (new, contiguous impervious surface created from road projects, including sidewalks and/or bike lanes built as part of new street). Impervious surfaces do NOT include vegetated roofs or pervious pavement that stores and infiltrates rainfall at a rate equal to immediately surrounding, unpaved landscaped areas, or that stores and infiltrates the **C.3.d amount of runoff***.
[3] "Replaced" means that the project will install impervious surface where existing impervious surface is removed.
[4] "Created" means the project will install new impervious surface where there is currently no impervious surface.
* For definitions, see Glossary (Attachment 1).

4.2 Answer this question ONLY if you are completing this section for the entire project area. If existing impervious surface will be replaced by the project, does the area to be replaced equal 50% or more of the existing area of impervious surface? *(Refer to Table 1, Row "a". Is the area in Column 2 > 50% of Column 1?)*

☐ Yes, C.3. stormwater treatment requirements apply to areas of impervious surface that will remain in place as well as the area created and/or replaced. This is known as the 50% rule.

☐ No, C.3. requirements apply only to the impervious area created and/or replaced.

4.3 Enter the square footage of the **Potential Rainwater Capture Area***. If you are evaluating only the roof area of a building, or you answered "no" to Question 4.2, this amount is from Row "b" in Table 1. If you answered "yes" to Question 4.2, this amount is the sum of Rows "b" and "c" in Table 1.:

_____ square feet.

4.4 Convert the measurement of the **Potential Rainwater Capture Area*** from square feet to acres (divide the amount in Item 4.3 by 43,560):

_____ acres.

5. Feasibility Screening for Rainwater Harvesting and Use

5.1 Use of harvested rainwater for landscape irrigation:

Is the onsite landscaping LESS than 2.5 times the size of the **Potential Rainwater Capture Area*** (Item 4.3)? (Note that the landscape area(s) would have to be contiguous and within the same Drainage Management Area to use harvested rainwater for irrigation via gravity flow.)

☐ Yes (continue) ☐ No – Direct runoff from impervious areas to **self-retaining areas*** OR refer to Table 11 and the curves in Appendix F of the LID Feasibility Report to evaluate feasibility of harvesting and using the C.3.d amount of runoff for irrigation.

5.2 Use of harvested rainwater for toilet flushing or non-potable industrial use:

a. Residential Projects: Proposed number of dwelling units:_____

Calculate the dwelling units per impervious acre by dividing the number of dwelling units by the acres of the **Potential Rainwater Capture Area*** in Item 4.4. Enter the result here:

_____)

Is the number of dwelling units per impervious acre LESS than 100 (assuming 2.7 occupants/unit)?

☐ Yes (continue) ☐ No – complete the Harvest/Use Feasibility Worksheet.

b. Commercial/Industrial Projects: Proposed interior floor area:_____ (sq. ft.)

Calculate the proposed interior floor area (sq.ft.) per acre of impervious surface by *dividing the interior floor area (sq.ft.) by the acres of the* ***Potential Rainwater Capture Area**** *in Item 4.4. Enter the result here:*

_____

Is the square footage of the interior floor space per impervious acre LESS than 70,000 sq. ft.?

☐ Yes (continue) ☐ No – complete the Harvest/Use Feasibility Worksheet

c. School Projects: Proposed interior floor area:_____ (sq. ft.)

Calculate the proposed interior floor area per acre of impervious surface by *dividing the interior floor area (sq.ft.) by the acres of the* ***Potential Rainwater Capture Area**** *in Item 4.4. Enter the result here:*

_____.

Is the square footage of the interior floor space per impervious acre LESS than 21,000 sq. ft.?

☐ Yes (continue) ☐ No – complete the Harvest/Use Feasibility Worksheet

* For definitions, see Glossary (Attachment 1).

d. Mixed Commercial and Residential Use Projects

- Evaluate the residential toilet flushing demand based on the dwelling units per impervious acre for the residential portion of the project, following the instructions in Item 5.2.a, except you will use a prorated acreage of impervious surface, based on the percentage of the project dedicated to residential use.
- Evaluate the commercial toilet flushing demand per impervious acre for the commercial portion of the project, following the instructions in Item 5.2.a, except you will use a prorated acreage of impervious surface, based on the percentage of the project dedicated to commercial use.

e. Industrial Projects: Estimated non-potable water demand (gal/day): _____

Is the non-potable demand LESS than 2,400 gal/day per acre of the Potential Rainwater Capture Area?

☐ Yes (continue) ☐ No – refer to the curves in Appendix F of the LID Feasibility Report to evaluate feasibility of harvesting and using the C.3.d amount of runoff for industrial use.

6. Use of Biotreatment

If only the "Yes" boxes were checked for all questions in Sections 2 and 5, or the project will have a recycled water system for non-potable use (Section 3), then the applicant may use appropriately designed bioretention facilities for compliance with C.3 treatment requirements. The applicant is encouraged to maximize infiltration of stormwater if site conditions allow.

7. Results of Screening Analysis

Based on this screening analysis, the following steps will be taken for the project (check all that apply):

☐ Implement biotreatment measures (such as an appropriately designed bioretention area).

☐ Conduct further analysis of infiltration feasibility by completing the Infiltration Feasibility Worksheet.

☐ Conduct further analysis of rainwater harvesting and use (check one):

- ☐ Complete the Rainwater Harvesting and Use Feasibility Worksheet for:
  - ☐ The entire project
  - ☐ Individual building(s), if applicable, describe:_____
- ☐ Evaluate the feasibility of harvesting and using the C.3.d amount of runoff for irrigation, based on Table 11 and the curves in Appendix F of the LID Feasibility Report
- ☐ Evaluate the feasibility of harvesting and using the C.3.d amount of runoff for non-potable industrial use, based on the curves in Appendix F of the LID Feasibility Report.

* For definitions, see Glossary (Attachment 1).

LID Feasibility Worksheet
Attachment 1: Glossary

Biotreatment

A type of low impact development treatment allowed under Provision C.3.c of the *MRP**, if infiltration, evapotranspiration and rainwater harvesting and use are infeasible. As required by Provision C.3.c.i(2)(vi), biotreatment systems shall be designed to have a surface area no smaller than what is required to accommodate a 5 inches/hour stormwater runoff surface loading rate and shall use biotreatment soil as specified in the biotreatment soil specifications submitted by the MRP co-permittees to the Regional Water Quality Control Board on May 1, 2011, or equivalent.

C.3 Regulated Projects:

Development projects as defined by Provision C.3.b.ii of the *MRP**. This includes public and private projects that create and/or replace 10,000 square feet or more of impervious surface, and restaurants, retail gasoline outlets, auto service facilities, and uncovered parking lots (stand-alone or part of another use) that create and/or replace 5,000 square feet or more of impervious surface. Single family homes that are not part of a larger plan of development are specifically excluded.

C.3.d Amount of Runoff

The amount of stormwater runoff from C.3 Regulated Projects that must receive stormwater treatment, as described by hydraulic sizing criteria in Provision C.3.d of the *MRP**.

Heritage Tree

An individual tree of any size or species given the 'heritage tree' designation as defined by the municipality's tree ordinance or other section of the municipal code.

Infiltration Devices

Infiltration facilities that are deeper that they are wide and designed to infiltrate stormwater runoff into the subsurface and, as designed, bypass the natural groundwater protection afforded by surface soil. These devices include dry wells, injection wells and infiltration trenches (includes French drains).

Infiltration Facilities

A term that refers to both infiltration devices and measures.

Infiltration Measures

Infiltration facilities that are wider than they are deep (e.g., bioinfiltration, infiltration basins and shallow wide infiltration trenches and dry wells).

Low Impact Development (LID) Treatment

Removal of pollutants from stormwater runoff using the following types of stormwater treatment measures: rainwater harvesting and use, infiltration, evapotranspiration, or, where these are infeasible, biotreatment.

Municipal Regional Stormwater Permit (MRP)

The municipal stormwater NPDES permit under which discharges are permitted from municipal separate storm sewer systems throughout the NPDES Phase I jurisdictions within the San Francisco Bay Region.

Potential Rainwater Capture Area

The impervious area from which rainwater may be potentially be captured, if rainwater harvesting and use were implemented for a project. If the entire site is evaluated for rainwater harvesting and use feasibility, this consists of the impervious area of the proposed project; for redevelopment projects that replace 50% or more of the existing impervious surface, it also includes the areas of existing impervious surface that are not modified by the project. If only a roof area or designated impervious area is evaluated for rainwater harvesting and use feasibility, the potential rainwater capture area consists only of the applicable impervious area.

Screening Density

A threshold of density (e.g., number of units or interior floor area) per acre of impervious surface, associated with a certain potential demand for non-potable water, for C.3 regulated projects. The screening density varies by municipality, according to location (see Attachment 2.) If the screening density is met or exceeded, the Rainwater Harvesting and Use Feasibility Worksheet must be completed for the project.

Self-Retaining Area

A portion of a development site designed to retain the first one inch of rainfall (by ponding and infiltration and/or evapotranspiration) without producing stormwater runoff. Self-retaining areas must have at least a 2:1 ratio of contributing area to a self-retaining area and a 3" ponding depth. Self-retaining areas may include graded depressions with landscaping or pervious pavement.

Areas that Contribute Runoff to Self-Retaining Areas are impervious or partially pervious areas that drain to self-retaining areas.

Self-Treating Area

A portion of a development site in which infiltration, evapotranspiration and other natural processes remove pollutants from stormwater. Self-treating areas may include conserved natural open areas, areas of landscaping, green roofs and pervious pavement. Self-treating areas treat only the rain falling on them and do not receive stormwater runoff from other areas.

Special Projects

Certain types of smart growth, high density and transit oriented development projects that are allowed, under Provision C.3.e.ii of the MRP, to receive LID treatment reductions. The specific development project types will be described in an amendment to the MRP, anticipated in Fall 2011.

Total Project Cost

Total project cost includes the construction (labor) and materials cost of the physical improvements proposed; however, it does not include land, transactions, financing, permitting, demolition, or off-site mitigation costs.

LID Feasibility Worksheet
Attachment 2: Toilet-Flushing Demand for Harvested Rainwater[1] Required for Rainwater Harvesting Feasibility per Impervious Acre (IA) [2]

Table 1 - Alameda County:

Rain Gauge[3]	Required Demand (gal/day/IA)[4]	Residential		Office/Retail[5]		Schools[6]	
		No. of residents per IA[7]	Dwelling Units per IA[8]	Employees per IA[9]	Interior Floor Area (sq.ft./IA)[10]	Employees[11] per IA	Interior Floor Area (sq.ft./IA)[12]
Berkeley	5,900	690	255	860	172,000	170	51,000
Dublin	4,100	480	177	590	118,000	120	36,000
Hayward	4,800	560	207	700	140,000	140	42,000
Palo Alto	2,900	340	125	420	84,000	90	27,000
San Jose	2,400	280	103	350	70,000	70	21,000

Table 2 - Santa Clara County:

Rain Gauge[3]	Required Demand (gal/day/IA)[4]	Residential		Office/Retail[5]		Schools[6]	
		No. of residents per IA[7]	Dwelling Units per IA[8]	Employees per IA[9]	Interior Floor Area (sq.ft./IA)[10]	Employees[11] per IA	Interior Floor Area (sq.ft./IA)[12]
Morgan Hill	6,500	760	260	940	188,000	190	57,000
Palo Alto	2,900	340	116	420	84,000	90	27,000
San Jose	2,400	280	96	350	70,000	70	21,000

Table 3 – San Mateo County:

Rain Gauge[3]	Required Demand (gal/day/IA)[4]	Residential		Office/Retail[5]		Schools[6]	
		No. of residents per IA[7]	Dwelling Units per IA[8]	Employees per IA[9]	Interior Floor Area (sq.ft./IA)[10]	Employees[11] per IA	Interior Floor Area (sq.ft./IA)[12]
Palo Alto	2,900	340	124	420	84,000	90	27,000
San Francisco	4,600	530	193	670	134,000	140	42,000
SF Oceanside	4,300	500	182	620	124,000	130	39,000

Table 4 – Contra Costa County:

Rain Gauge[3]	Required Demand (gal/day/IA)[4]	Residential		Office/Retail[5]		Schools[6]	
		No. of residents per IA[7]	Dwelling Units per IA[8]	Employees per IA[9]	Interior Floor Area (sq.ft./IA)[10]	Employees[11] per IA	Interior Floor Area (sq.ft./IA)[12]
Berkeley	5,900	690	254	860	172,000	170	51,000
Brentwood	4,200	490	180	610	122,000	120	36,000
Dublin	4,100	480	176	590	118,000	120	36,000
Martinez	5,900	690	254	860	172,000	170	51,000

Table 5 – Solano County:

Rain Gauge[3]	Required Demand (gal/day/IA)[4]	Residential		Office/Retail[5]		Schools[6]	
		No. of residents per IA[7]	Dwelling Units per IA[8]	Employees per IA[9]	Interior Floor Area (sq.ft./IA)[10]	Employees[11] per IA	Interior Floor Area (sq.ft./IA)[12]
Lake Solano	9,000	1,050	362	1,300	260,000	270	81,000
Martinez	5,900	690	238	860	172,000	170	51,000

Notes:

1. Demand thresholds obtained from the "Harvest and Use, Infiltration and Evapotranspiration Feasibility/Infeasibility Criteria Report" (LID Feasibility Report) submitted to the Regional Water Board on May 1, 2011.
2. Toilet flushing demands assume use of low flow toilets per the California Green Building Code.
3. See Attachment 3 to identify the rain gauge that corresponds to the project site.
4. Required demand per acre of impervious area to achieve 80% capture of the C.3.d runoff volume with the maximum allowable drawdown time for cistern of 50,000 gallons or less, from Table 9 of the LID Feasibility Report.
5. "Office/Retail" includes the following land uses: office or public buildings, hospitals, health care facilities, retail or wholesale stores, and congregate residences.
6. "Schools" includes day care, elementary and secondary schools, colleges, universities, and adult centers.
7. Residential toilet flushing demand identified in Table 10 of the LID Feasibility Report.
8. Residential toilet flushing demand divided by the countywide average number of persons per household (US Census data reported on www.abag.org), as follows: Alameda County: 2.71 persons per household; Santa Clara County: 2.92; San Mateo County: 2.74; Contra Costa County: 2.72; Solano County: 2.90.
9. Office/retail employee toilet flushing demand identified in Table 10 of the LID Feasibility Report.
10. Interior floor area required for rainwater harvest and use feasibility per acre of impervious area is based on the number of employees in Column 5 multiplied by an occupant load factor of 200 square feet per employee (reference: 2010 California Plumbing Code, Chapter 4, Plumbing Fixtures and Fitting Fixtures, Table A, page 62.)
11. School employee toilet flushing demand identified in Table 10 of the LID Feasibility Report. Each school employee represents 1 employee and 5 "visitors" (students and others).
12. Interior floor area required for rainwater harvest and use feasibility per acre of impervious area is based on the number of employees in Column 7 multiplied by 6 to account for visitors, then multiplied by an occupant load factor of 50 square feet per employee (reference: 2010 California Plumbing Code).

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Infiltration Feasibility Worksheet

Municipal Regional Stormwater Permit (MRP)
Stormwater Controls for Development Projects

Complete this worksheet for C.3 Regulated Projects* *for which the soil hydraulic conductivity (Ksat) exceeds 1.6. Use this checklist to determine the feasibility of treating the* C.3.d *amount of runoff** *with infiltration. Where it is infeasible to treat the C.3.d amount of runoff* with infiltration or rainwater harvesting and use, stormwater may be treated with* biotreatment* *measures. See Glossary (Attachment 1) for definitions of terms marked with an asterisk (*).*

1. Enter Project Data.

1.1 Project Name: _____

1.2 Project Address: _____

1.3 Applicant/Agent Name: _____

1.4 Applicant/Agent Address: _____

1.5 Applicant/Agent Email: _____ Applicant / Agent Phone: _____

2. Evaluate infiltration feasibility.

Check "Yes" or "No" to indicate whether the following conditions apply to the project. If "Yes" is checked for any question, then infiltration is infeasible, and you can continue to Item 3.1 without answering any further questions in Section 2. If all of the answers in Section 2 are "No," then infiltration is feasible, and you may design infiltration facilities* *for the area from which runoff must be treated. Items 2.1 through 2.3 address the feasibility of using* infiltration facilities*, *as well as the potential need to line bioretention areas.*

		Yes	No
2.1	Would infiltration facilities at this site conflict with the location of existing or proposed underground utilities or easements, or would the siting of infiltration facilities at this site result in their placement on top of underground utilities, or otherwise oriented to underground utilities, such that they would discharge to the utility trench, restrict access, or cause stability concerns? (If yes, attach evidence documenting this condition.)	☐	☐
2.2	Is there a documented concern that there is a potential on the site for soil or groundwater pollutants to be mobilized? (If yes, attach documentation of mobilization concerns.)	☐	☐
2.3	Are geotechnical hazards present, such as steep slopes, areas with landslide potential, soils subject to liquefaction, or would an infiltration facility need to be built less than 10 feet from a building foundation or other improvements subject to undermining by saturated soils? (If yes, attach documentation of geotechnical hazard.)	☐	☐

Respond to Questions 2.4 through 2.8 only if the project proposes to use an infiltration device*.

2.4	Do local water district or other agency's policies or guidelines regarding the locations where infiltration may occur, the separation from seasonal high groundwater, or setbacks from potential sources of pollution prevent infiltration devices from being implemented at this site? (If yes, attach evidence documenting this condition.)	☐	☐
2.5	Would construction of an infiltration device require that it be located less than 100 feet away from a septic tank, underground storage tank with hazardous materials, or other potential underground source of pollution? (If yes, attach evidence documenting this claim.)	☐	☐

Infiltration Feasibility Worksheet

		Yes	No
2.6	Is there a seasonal high groundwater table or mounded groundwater that would be within 10 feet of the base of an infiltration device* constructed on the site? (If yes, attach documentation of high groundwater.)	☐	☐
2.7	Are there land uses that pose a high threat to water quality – including but not limited to industrial and light industrial activities, high vehicular traffic (i.e., 25,000 or greater average daily traffic on a main roadway or 15,000 or more average daily traffic on any intersecting roadway), automotive repair shops, car washes, fleet storage areas, or nurseries? (If yes, attach evidence documenting this claim.)	☐	☐
2.8	Is there a groundwater production well within 100 feet of the location where an infiltration device would be constructed? (If yes, attach map showing the well.)	☐	☐

3. Results of Feasibility Determination

		Infeasible	Feasible
3.1	Based on the results of the Section 2 feasibility analysis, infiltration is (check one):	☐	☐

→ If "FEASIBLE" is indicated for Item 3.1, then the amount of stormwater requiring treatment must be treated with infiltration (or rainwater harvest and use, if feasible). Infiltration facilities may be designed for the area from which runoff must be treated.*

→ If "INFEASIBLE" is checked for item 3.1, then the applicant may use appropriately designed biotreatment facilities for compliance with C.3 treatment requirements. The applicant is encouraged to maximize infiltration of stormwater if site conditions allow.*

Name of Applicant (Print)

Name of Applicant (Sign) Date

Rainwater Harvesting and Use Feasibility Worksheet

Municipal Regional Stormwater Permit (MRP)

Stormwater Controls for Development Projects

Complete this worksheet for all **C.3 Regulated Projects*** for which the project density exceeds the **screening density*** provided by municipal staff. Use this worksheet to determine the feasibility of treating the **C.3.d amount of runoff*** with rainwater harvesting and use for indoor, non-potable water uses. Where it is infeasible to treat the C.3d amount of runoff with either harvesting and use or infiltration, stormwater may be treated with **biotreatment*** measures. See Glossary (Attachment 1) for definitions of terms marked with an asterisk (*).

Complete this worksheet for the entire project area. If the project includes one or more buildings that each individually has a roof area of 10,000 square feet or more, complete a separate copy of this form for each of these buildings.

1. Enter Project Data.

1.1 Project Name: _____

1.2 Project Address: _____

1.3 Applicant/Agent Name: _____

1.4 Applicant/Agent Address: _____

(For projects with a potential non-potable water use other than toilet flushing, skip to Question 5.1)

1.5 Project Type: _____ If residential or mixed use, enter # of dwelling units: _____

1.6 Enter square footage of non-residential interior floor area.: _____

1.7 Potential rainwater capture area*: _____ sq.ft.

1.8 If it is a **Special Project***, indicate the percentage of **LID treatment*** reduction: _____ percent

(Item 1.8 applies only to entire project evaluations, not individual roof area evaluations.)

1.9 Total potential rainwater capture area that will require LID treatment: 0 sq.ft.

(This is the total rain capture area remaining after any Special Project LID treatment reduction is applied.)

2. Calculate Area of Self-Treating Areas, Self-Retaining Areas, and Areas Contributing to Self-Retaining Areas.

(For areas within the Potential Rain Capture Area only)

2.1 Enter square footage of any **self-treating areas*** in the area that is being evaluated: _____ sq.ft.

2.2 Enter square footage of any **self-retaining areas*** in the area that is being evaluated: _____ sq.ft.

2.3 Enter the square footage of areas contributing runoff to **self-retaining area***: _____ sq.ft.

2.4 TOTAL of Items 2.1, 2.2, and 2.3: - sq.ft.

3. Subtract credit for self-treating/self-retaining areas from area requiring treatment.

3.1 Subtract the TOTAL in Item 2.4 from the potential rainwater capture area in Item 1.9: - sq.ft.

3.2 Convert the remaining area required for treatment in Item 3.1 from square feet to acres: 0.00 acres

4. Determine feasibility of use for toilet flushing based on demand

4.1 Project's dwelling units per acre of adjusted potential rain capture area (Divide the number in 1.5 by the number in 3.2) _____ dwelling units/acre

4.2 Non-residential interior floor area per acre of adjusted potential rain capture area (Divide the number in 1.6 by the number in 3.2) _____ Int. non-res. floor area/acre

Note: formulas in Items 4.1 and 4.2 are set up, respectively, for a residential or a non-residential project. Do not use these pre-set formulas for mixed use projects. For mixed use projects, evaluate the residential toilet flushing demand based on the dwelling units per acre for the residential portion of the project (use a prorated acreage, based on the percentage of the project dedicated to residential use). Then evaluate the commercial toilet flushing demand per acre for the commercial portion of the project (use a prorated acreage, based on the percentage of the project dedicated to commercial use).

4.3 Refer to the applicable countywide table in Attachment 2. Identify the number of dwelling units per impervious acre needed in your Rain Gauge Area to provide the toilet flushing demand required for rainwater harvest feasibility. _____ dwelling units/acre

4.4 Refer to the applicable countywide table in Attachment 2. Identify the square feet of non-residential interior floor area per impervious acre needed in your Rain Gauge Area to provide the toilet flushing demand required for rainwater harvest feasibility. _____ int. non-res. floor area/acre

Check "Yes" or "No" to indicate whether the following conditions apply. If "Yes" is checked for any question, then rainwater harvesting and use is infeasible. As soon as you answer "Yes", you can skip to Item 6.1. If "No" is checked for all items, then rainwater harvesting and use is feasible and you must harvest and use the C.3.d amount of stormwater, unless you infiltrate the C.3.d amount of stormwater.*

4.5 Is the project's number of dwelling units per acre of adjusted area requiring treatment (listed in Item 4.1) LESS than the number identified in Item 4.3? ☐ Yes ☐ No

4.6 Is the project's square footage of non-residential interior floor area per acre of adjusted area requiring treatment (listed in Item 4.2) LESS than the number identified in Item 4.4? ☐ Yes ☐ No

5. Determine feasibility of rainwater harvesting and use based on factors other than demand.

5.1 Does the requirement for rainwater harvesting and use at the project conflict with local, state, or federal ordinances or building codes? ☐ Yes ☐ No

5.2 Would the technical requirements cause the harvesting system to exceed 2% of the Total Project Cost, or has the applicant documented economic hardship in relation to maintenance costs? (If so, attach an explanation.) ☐ Yes ☐ No

5.3 Do constraints, such as a slope above 10% or lack of available space at the site, make it infeasible to locate on the site a cistern of adequate size to harvest and use the C.3.d amount of water? (If so, attach an explanation.) ☐ Yes ☐ No

5.4 Are there geotechnical/stability concerns related to the surface (roof or ground) where a cistern would be located that make the use of rainwater harvesting infeasible? (If so, attach an explanation.) ☐ Yes ☐ No

5.5 Does the location of utilities, a septic system and/or heritage trees* limit the placement of a cistern on the site to the extent that rainwater harvesting is infeasible? (If so, attach an explanation.) ☐ Yes ☐ No

Note 1: It is assumed that projects with significant amounts of landscaping will either treat runoff with landscape dispersal (self-treating and self-retaining areas) or will evaluate the feasibility of havesting and using rainwater for irrigation using the curves in Appendix F of the LID Feasibility Report.

6. Results of Feasibility Determination

6.1 Based on the results of the feasibility analysis in Item 4.4 and Section 5, rainwater harvesting/use is (check one): Infeasible ☐ Feasible ☐

➔ If "FEASIBLE" is indicated for Item 6.1 the amount of stormwater requiring treatment must be treated with harvesting/use, unless it is infiltrated into the soil.

➔ If "INFEASIBLE" is checked for Item 6.1, then the applicant may use appropriately designed bioretention[1] facilities for compliance with C.3 treatment requirements. If Ksat > 1.6 in./hr., and infiltration is unimpeded by subsurface conditions, then the bioretention facilities are predicted to infiltrate 80% or more average annual runoff. If Ksat < 1.6, maximize infiltration of stormwater by using bioretention if site conditions allow, and remaining runoff will be discharged to storm drains via facility underdrains. If site conditions preclude infiltration, a lined bioretention area or flow-through planter may be used.*

_____
Applicant (Print)

_____ _____
Applicant (Sign) Date

Appendix C.3: Specifications

Biotreatment Soil Specification C-31

Green Roof Specifications C-39

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Soil Specifications

The regional biotreatment soil specifications, approved by the Regional Water Board on November 28, 2011, are provided on the following pages. The soil specifications are included in Attachment L of the Municipal Regional Stormwater Permit (MRP), as amended. Effective December 1, 2011, stormwater biotreatment measures are required to use the Water Board-approved specifications. Alternative biotreatment mixes that achieve a long-term infiltration rate of 5 to 10 inches per hour, and are suitable for plant health, may be used in accordance with the requirements described in the specifications, under the heading "Verification of Alternative Bioretention Soil Mixes".

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ATTACHMENT L

Provision C.3.c.i.(1)(b)(vi)

Specification of soils for Biotreatment or Bioretention Facilities

Soils for biotreatment or bioretention areas shall meet two objectives:

- Be sufficiently permeable to infiltrate runoff at a minimum rate of 5" per hour during the life of the facility, and
- Have sufficient moisture retention to support healthy vegetation.

Achieving both objectives with an engineered soil mix requires careful specification of soil gradations and a substantial component of organic material (typically compost).

Local soil products suppliers have expressed interest in developing 'brand-name' mixes that meet these specifications. At their sole discretion, municipal construction inspectors may choose to accept test results and certification for a 'brand-name' mix from a soil supplier.

Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site.

Batch-specific test results and certification shall be required for projects installing more than 100 cubic yards of bioretention soil.

SOIL SPECIFICATIONS

Bioretention soils shall meet the following criteria. "Applicant" refers to the entity proposing the soil mixture for approval by a Permittee.

1. General Requirements – Bioretention soil shall:
   a. Achieve a long-term, in-place infiltration rate of at least 5 inches per hour.
   b. Support vigorous plant growth.
   c. Consist of the following mixture of fine sand and compost, measured on a volume basis:

      60%-70% Sand

      30%-40% Compost

2. Submittal Requirements – The applicant shall submit to the Permittee for approval:
   a. A sample of mixed bioretention soil.
   b. Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.
   c. Grain size analysis results of the fine sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
   d. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in 4.

e. Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".

f. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.

g. A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.

h. Provide the name of the testing laboratory(s) and the following information:

(1) Contact person(s)

(2) Address(s)

(3) Phone contact(s)

(4) E-mail address(s)

(5) Qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal

3. Sand for Bioretention Soil

a. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be nonplastic.

b. Sand for Bioretention Soils shall be analyzed by an accredited lab using #200, #100, #40, #30, #16. #8, #4, and 3/8 inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
3/8 inch	100	100
No. 4	90	100
No. 8	70	100
No. 16	40	95
No. 30	15	70
No. 40	5	55
No. 100	0	15
No. 200	0	5

Note: all sands complying with ASTM C33 for fine aggregate comply with the above gradation requirements.

4. Composted Material

Compost shall be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials not including manure or biosolids meeting the standards developed by the US Composting Council (USCC). The product shall be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).

a. Compost Quality Analysis – Before delivery of the soil, the supplier shall submit a copy of lab analysis performed by a laboratory that is enrolled in the US Composting Council's Compost Analysis Proficiency (CAP) program and using approved Test Methods for the Evaluation of Composting and Compost (TMECC). The lab report shall verify:

(1) Feedstock Materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues.

(2) Organic Matter Content: 35% - 75% by dry wt.

(3) Carbon and Nitrogen Ratio: C:N < 25:1 and C:N >15:1

(4) Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable. In addition any one of the following is required to indicate stability:

(i) Oxygen Test < 1.3 O2 /unit TS /hr

(ii) Specific oxy. Test < 1.5 O2 / unit BVS /

(iii) Respiration test < 8 C / unit VS / day

(iv) Dewar test < 20 Temp. rise (°C) e.

(v) Solvita® > 5 Index value

(5) Toxicity: any one of the following measures is sufficient to indicate non-toxicity.

(i) NH4- : NO3-N < 3

(ii) Ammonium < 500 ppm, dry basis

(iii) Seed Germination > 80 % of control

(iv) Plant Trials > 80% of control

(v) Solvita® > 5 Index value

(6) Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.

(i) Total Nitrogen content 0.9% or above preferred.

(ii) Boron: Total shall be <80 ppm; Soluble shall be <2.5 ppm

(7) Salinity: Must be reported; < 6.0 mmhos/cm

(8) pH shall be between 6.5 and 8. May vary with plant species.

b. Compost for Bioretention Soil Texture – Compost for bioretention soils shall be analyzed by an accredited lab using #200, 1/4 inch, 1/2 inch, and 1 inch sieves ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
1 inch	99	100
1/2 inch	90	100
1/4 inch	40	90
No. 200	2	10

c. Bulk density shall be between 500 and 1100 dry lbs/cubic yard

d. Moisture content shall be between 30% - 55% of dry solids.

e. Inerts – compost shall be relatively free of inert ingredients, including glass, plastic and paper, < 1 % by weight or volume.

f. Weed seed/pathogen destruction – provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach min. 55C for 15 days with at least 5 turnings during that period.

g. Select Pathogens – Salmonella <3 MPN/4grams of TS, or Coliform Bacteria <10000 MPN/gram.

h. Trace Contaminants Metals (Lead, Mercury, Etc.) – Product must meet US EPA, 40 CFR 503 regulations.

i. Compost Testing – The compost supplier will test all compost products within 120 calendar days prior to application. Samples will be taken using the STA sample collection protocol. (The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741 Phone: 631-737-4931, www.compostingcouncil.org). The sample shall be sent to an independent STA Program approved lab. The compost supplier will pay for the test.

VERIFICATION OF ALTERNATIVE BIORETENTION SOIL MIXES

Bioretention soils not meeting the above criteria shall be evaluated on a case by case basis. Alternative bioretention soil shall meet the following specification: "Soils for bioretention facilities shall be sufficiently permeable to infiltrate runoff at a minimum rate of 5 inches per hour during the life of the facility, and provide sufficient retention of moisture and nutrients to support healthy vegetation."

The following steps shall be followed by municipalities to verify that alternative soil mixes meet the specification:

1. General Requirements – Bioretention soil shall achieve a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth. The applicant refers to the entity proposing the soil mixture for approval.

   a. Submittals – The applicant must submit to the municipality for approval:

      (1) A sample of mixed bioretention soil.

      (2) Certification from the soil supplier or an accredited laboratory that the Bioretention Soil meets the requirements of this guideline specification.

      (3) Certification from an accredited geotechnical testing laboratory that the Bioretention Soil has an infiltration rate between 5 and 12 inches per hour as tested according to Section 1.b.(2)(ii).

      (4) Organic content test results of mixed Bioretention Soil. Organic content test shall be performed in accordance with by Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method".

      (5) Grain size analysis results of mixed bioretention soil performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.

      (6) A description of the equipment and methods used to mix the sand and compost to produce Bioretention Soil.

      (7) The name of the testing laboratory(s) and the following information:

         (i) contact person(s)

         (ii) address(s)

         (iii) phone contact(s)

         (iv) e-mail address(s)

         (v) qualifications of laboratory(s), and personnel including date of current certification by STA, ASTM, or approved equal

   b. Bioretention Soil

      (1) Bioretention Soil Texture

      Bioretention Soils shall be analyzed by an accredited lab using #200, and 1/2" inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	**Percent Passing (by weight)**	
	Min	***Max***
1/2 inch	97	100
No. 200	2	5

      (2) Bioretention Soil Permeability testing

      Bioretention Soils shall be analyzed by an accredited geotechnical lab for the following tests:

(i) Moisture – density relationships (compaction tests) shall be conducted on bioretention soil. Bioretention soil for the permeability test shall be compacted to 85 to 90 percent of the maximum dry density (ASTM D1557).

(ii) Constant head permeability testing in accordance with ASTM D2434 shall be conducted on a minimum of two samples with a 6-inch mold and vacuum saturation.

MULCH FOR BIORETENTION FACILITIES

Mulch is recommended for the purpose of retaining moisture, preventing erosion and minimizing weed growth. Projects subject to the State's Model Water Efficiency Landscaping Ordinance (or comparable local ordinance) will be required to provide at least two inches of mulch. Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. Aged mulch can be obtained through soil suppliers or directly from commercial recycling yards. It is recommended to apply 1" to 2" of composted mulch, once a YUear, preferably in June following weeding.

Green Roof Specifications

The regional green roof specifications, approved by the Regional Water Board on November 28, 2011, are provided on the following pages.

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Alameda Countywide
Clean Water Program

Contra Costa
Clean Water Program

Fairfield-Suisun
Urban Runoff
Management Program

Marin County
Stormwater Pollution
Prevention Program

Napa County
Stormwater Pollution
Prevention Program

San Mateo Countywide
Water Pollution
Prevention Program

Santa Clara Valley
Urban Runoff Pollution
Prevention Program

Sonoma County
Water Agency

Vallejo Sanitation
and Flood
Control District

B A S M A A

April 29, 2011

Bruce Wolfe, Executive Officer
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

Subject: Green Roof Minimum Specifications - MRP Provision C.3.c.iii.(4)

Dear Mr. Wolfe:

This letter and attachment are submitted on behalf of all 76 permittees subject to the requirements of the Municipal Regional Stormwater NPDES Permit (MRP).

MRP Provision C.3.c.i.(2)(vii.) states:

> Green roofs may be considered biotreatment systems that treat roof runoff only if they meet certain minimum specifications. By May 1, 2011, the Permittees shall submit for Water Board approval proposed minimum specifications for green roofs. This submittal to the Water Board shall, at a minimum, contain the information required in Provision C.3.c.iii.(4). Once the Water Board approves green roof minimum specifications, the Permittees shall ensure that green roofs installed to meet the requirements of Provision C.3.c. and C.3.d. comply with the Water Board-approved minimum specifications.

MRP Provision C.3.c.iii.(4) requires the Permittees, collaboratively or individually, to submit a report to the Water Board containing the following information:

- Proposed minimum design specifications for green roofs;
- Relevant literature and field data showing the feasibility of the minimum design specifications;
- Relevant literature, field, and analytical data showing adequate pollutant removal and compliance with the Provision C.3.d. hydraulic sizing criteria;
- Discussion of data and lessons learned from already installed green roofs;
- Discussion of barriers, including institutional and technical site specific constraints, to installation of green roofs and proposed strategies for removing these identified barriers; and
- Guidance for the Permittees to apply the minimum specifications in a consistent and appropriate manner.

Bay Area

Stormwater Management

Agencies Association

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Through the Bay Area Stormwater Management Agencies Association (BASMAA), the Permittees have worked together to develop the attached report, which addresses each of these requirements. The Permittees reviewed available literature, including USEPA's 2009 report, "Green Roofs for Stormwater Runoff Control," considered their experience with green roof projects in their jurisdictions, and queried some Bay Area developers who have experience with green roof projects or have evaluated using green roofs in their projects.

Our report concludes that typical green roof designs meet the C.3.d. hydraulic sizing criteria for treatment systems.

A recent media release by Green Roofs for Healthy Cities states the green roof industry grew by more than 16% in 2009. This acceleration in green roof installations appears to be separate from the influence of standards, requirements, or other regulatory drivers related to stormwater pollution prevention. The primary drivers include energy efficiency, reduction of greenhouse gases, credits toward LEED certification, and environmental cachet. Barriers to green roof construction appear to be cost and the regional development community's lack of familiarity with green roof construction; these barriers are already being overcome through the active promotion of green roof technology by groups such as Green Roofs for Healthy Cities.

As required, our report proposes strategies for furthering green roofs and overcoming barriers to green roofs and includes language the Permittees intend to incorporate in their C.3 compliance guidance for applicants for development approvals.

Please contact Jill Bicknell, BASMAA Development Committee Chair, at 408-720-8811 if you have any questions about the submittal or need additional information.

We certify under penalty of law that this document was prepared under our direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on our inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of our knowledge and belief, true, accurate, and complete. We are aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

James Scanlin, Alameda Countywide Clean Water Program

Tom Dalziel, Contra Costa Clean Water Program

Kevin Cullen, Fairfield-Suisun Urban Runoff Management Program

Matt Fabry, San Mateo Countywide Water Pollution Prevention Program

Adam Olivieri, Santa Clara Valley Urban Runoff Pollution Prevention Program

Lance Barnett, Vallejo Sanitation and Flood Control District

Attachment: Green Roof Minimum Specifications

cc: Tom Mumley, Regional Water Board
Shin-Roei Lee, Regional Water Board
Dale Bowyer, Regional Water Board
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BASMAA Board of Directors

Bay Area
Stormwater Management
Agencies Association

Green Roof Minimum Specifications

Provision C.3.c.iii.(4)

Submitted to the

California Regional Water Quality Control Board

San Francisco Bay Region

29 April 2011

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APPENDIX A: BAY AREA GREEN ROOF PROJECT EXAMPLES

APPENDIX B: RESULTS OF DEVELOPER SURVEY

Disclaimer: This document is not intended to provide general specifications or guidance for design or construction of green roofs. Discussion of and recommendations for minimum requirements are limited to elements of green roof design related to compliance with stormwater treatment requirements.

1 · Introduction

Green roofs are vegetated roof systems that filter, absorb, and retain or detain the rain that falls upon them. Green roof systems are comprised of a layer of planting media planted with vegetation, underlain by other structural components including waterproof membranes, synthetic insulation and geofabrics.

A green roof can be either *extensive*, covering most of the roof's surface with typically up to 7 inches of lightweight planting media and a few types of low-profile, low-maintenance plants, or *intensive,* with a thicker planting media (8 to 48 inches), more varied plantings including shrubs and trees, and a more garden-like appearance.

Rain that falls onto green roofs is returned to the atmosphere either by evaporation or transpiration by plants, which remove the water from the planting media. When the media becomes saturated, the excess water percolates through to the drainage layer and is discharged through the roof downspouts. Green roofs can provide high rates of rainfall retention and decrease the peak flow rate because of the temporary storage that occurs in the media during discharge events.

The San Francisco Bay Area Municipal Regional Stormwater Permit (MRP) Provision C.3.c.i.(2)(b)(vii) states:

Green roofs may be considered biotreatment systems that treat roof runoff only if they meet certain minimum specifications. By May 1, 2011, the Permittees shall submit for Water Board approval, proposed minimum specifications for green roofs. This submittal to the Water Board shall, at a minimum, contain the information required in Provision C.3.c.iii.(4). Once the Water Board approves green roof minimum specifications, the Permittees shall ensure that green roofs installed to meet the requirements of Provision C.3.c. and d. comply with the Water Board-approved minimum specifications.

MRP Provision C.3.c.iii.(4) requires the permittees to submit to the Water Board, by May 1, 2011, a report including:

- Proposed minimum design specifications for green roofs;
- Relevant literature and field data showing the feasibility of the minimum design specifications
- Relevant literature and field data showing adequate pollutant removal and compliance with the Provision C.3.d. hydraulic sizing criteria;

- Discussion of data and lessons learned from already installed green roofs;
- Discussion of barriers, including institutional and technical site-specific constraints, to installation of green roofs and proposed strategies for removing these barriers;
- Guidance for the Permittees to apply the minimum specifications in a consistent and appropriate manner.

This report addresses each of these requirements, in order.

2 · Minimum Design Specifications for Green Roofs

A green roof system consists of a number of components, which may include vegetation, planting media, geotextile fabric, a supporting structure and drainage system, insulation, root barrier, and waterproof membrane. It is not the intention of this document to provide specifications for all elements of a green roof but rather to specify the minimum requirements to comply with the stormwater low impact development (LID) treatment requirements. These minimum requirements are limited to the elements necessary for stormwater treatment, i.e. the depth of planting media, selection of appropriate plants, and the ability of the media and other components to support healthy plants.

Having conducted a literature review and considered the relevant questions, the permittees recommend the following regarding the use of green roofs for stormwater runoff control.

Minimum specifications for green roofs should be consistent with Provision C.3.c.i.(2)(b), which states: “Require each Regulated Project to treat 100% of the amount of runoff identified in Provision C.3.d. for the Regulated Project’s drainage area with LID treatment measures…” Provision C.3.d. states that Permittees shall require that stormwater treatment systems constructed for Regulated Projects meet either the Volume Hydraulic Design Basis criteria or the Flow Hydraulic Design Basis criteria.

Provision C.3.d.i.(1) provides a Volume Hydraulic Design Basis which may be calculated by either of two methods. These methods yield, for the Bay Area, required unit basin storage volumes ranging from approximately 0.6 to 1.3 inches over the drainage area to the treatment measure, depending on location and rainfall patterns. This equates to about 0.1 cubic feet or less for each square foot of roof area (assuming 100%

imperviousness). Granular soils or engineered media typically used in green roof construction have a porosity of 0.4 or more. Therefore, a green roof with a planting medium that is 0.1 feet/0.4, or 0.25 feet (3 inches) deep provides the required volume specified by Provision C.3.d.i.(1) within the pores of the media. The minimum media depth to achieve the required C.3.d volume could be less in some areas, again depending on rainfall patterns and the porosity of the planting media used.

Provision C.3.d.i.(2) provides a Flow Hydraulic Design Basis which may be calculated by any of three roughly equivalent methods. One of these methods is "the flow of runoff resulting from a rain event equal to at least 0.2 inches per hour intensity." Granular soils typically used in green roof construction have an infiltration rate of considerably more than 0.2 inches per hour. Therefore a green roof (regardless of media depth) meets the requirements of Provision C.3.d.i.(2) at least as effectively as a conventional roof routed through an LID facility (such as biotreatment) built to the hydraulic sizing design criteria specified in Provision C.3.d.i.(2).

The permittees conclude the minimum specifications in Provision C.3.d., as referenced in Provision C.3.c.(2)(b), should apply to green roofs and can be met by typical green roof designs.

The key factor for designing a green roof that provides effective stormwater retention and treatment is the ability of the planting media to support healthy plants. Development project applicants should work with a landscape architect or similar professional to select appropriate plants for the roof location and determine the appropriate media depth to support those plants. To maximize the effectiveness of green roofs with regard to on-site retention and treatment, permittees will also encourage designs that use soil media deeper than the minimum required to support plants. Designs with deeper soil media are increasingly used to support a wider variety of plantings, including native plant palettes that can mimic pre-development ecology.

In summary, the following minimum design specifications for green roofs are recommended:

- The planting media used in a green roof system shall be sufficiently deep to provide capacity within the pore space of the media for the required runoff volume specified by Provision C.3.d.i.(1).

- The planting media used in a green roof system shall also be sufficiently deep to support the long term

health of the vegetation selected for the green roof, as specified by a landscape architect or other knowledgeable professional.

3 · Relevant Literature and Field Data

3.1 Feasibility of the Minimum Design Specifications

The technical feasibility of constructing green roofs to meet the C.3.d. requirements is established by existing green roofs in the region, including the GAP Headquarters Building in San Bruno, the retail building occupied by West Elm in Emeryville, and the Academy of Sciences building in San Francisco, as well as much more extensive implementation of green roofs in other US cities (notably Chicago) and in Europe.

Appendix A summarizes information about example Bay Area green roof projects.

3.2 Adequate Pollutant Removal and Compliance with Sizing Criteria

Compliance with the Provision C.3.d. hydraulic sizing criteria is discussed above.

There is no standard or definition, in the MRP or elsewhere, for "adequate pollutant removal." Like preceding municipal stormwater NPDES permits, the MRP does not specify requirements for treatment effectiveness or for effluent quality. The International Stormwater BMP Database (2008) illustrates that stormwater BMPs exhibit wide ranges of effluent quality and pollutant removal.

In a review of water quality data for green roofs, Johnson (2008) states: "While… data suggest that green roofs can be designed to filter some pollutants from rainwater, none are comprehensive enough to validate long-term performance of green roof designs." USEPA (2009) notes studies of green roof performance in North America are of pilot-scale or sometimes commercial-scale green roofs without replication. The Pennsylvania studies reported in USEPA (2009) found green roof runoff appears similar to what might be expected as leaching from any other planted system in the landscape. Total phosphorous was comparable to that in residential stormwater runoff. Nitrate concentrations, on the other hand, were similar for green roof and asphalt roof runoff.

As stated in USEPA (2009): "The greatest benefit green roofs can provide is the reduction in runoff…." USEPA (2009) concludes green roofs can retain over 50% of total precipitation. The data

cited is from Pennsylvania, and it was found retention was nearly 95% during summer months and much smaller (less than 20%) during winter months. Vegetation plays an important role in making soil moisture available for evapotranspiration.

In a final report on the Seattle Green Roof Evaluation Project, Magnusson Klemencic Associates (2007) report volume reductions of 65% to 94% over an 18-month period. The authors note green roofs are "amazingly capable of rebounding between events."

All studies reviewed indicate reduced peak flows and increased times of concentration for all storms. The most common practice for extensive green roofs incorporates 3 to 4 inches of growing medium vegetated with a mixture of sedum plants. These systems have shown to achieve 50% to 75% water retention in a typical year, while significantly increasing the time of concentration for larger storms.

We found no available data on green roof performance for the Bay Area or similar semi-arid climates. Interpretive information for the California Academy of Sciences states 98% of runoff is retained.

We conclude pollutant removal by green roofs is as good as that of accepted treatment BMPs and considerably better than many BMPs when reductions in runoff volume are taken into account.

4 · Discussion of Data and Lessons Learned

Innovation in green roof design continues. Some recent examples of innovation include the use of waste polystyrene as one component of the soil media mix; use of increased depths (to 6 inches) to increase rainfall retention and reduce irrigation requirements, and an emphasis on native plants and creation of native-like habitats (Compton, 2006). Magnuson Klemencic Associates (2007) suggest there is an optimal depth for green roof soil media for stormwater control, and that the depth is dependent on climate. In Seattle, a 6-inch depth of the media used allowed the entire depth to become unsaturated at least some of the time, while maximizing the unsaturated depth available to absorb rainfall from subsequent storms.

USEPA (2009) suggests, based on monitoring of five precipitation events at a limited number of test sites, that green roof runoff appears similar, in the concentration of nutrients and ions, to leaching from other planted systems in the landscape. However,

nitrate concentrations were similar to runoff from conventional roofs. The authors suggest avoiding direct discharge of green roof drainage to receiving waters.

5 · Discussion of Barriers and Proposed Strategies

Use of green roofs is still in its infancy in the US, in comparison to Germany where many cities offer substantial financial incentives and an estimated 12% of flat roofs are green roofs (Live Science, 2009). However, green roofs are growing in the US, as evidenced by the amount of activity and example projects at www.greenroofs.org. A recent media release by Green Roofs for Healthy Cities states the green roof industry grew 16.1% in 2009, reaching an estimated 10 million square feet annually.

The acceleration of green roof installations is occurring separate from the influence of standards, requirements, or other regulatory drivers related to stormwater pollution prevention. Rather, primary drivers include energy efficiency, reduction of greenhouse gases, credits toward Leadership in Energy and Environmental Design (LEED) certification (Federal Energy Management Program, 2004), and environmental cachet (Velasquez and Kiers, 2007).

The primary barriers to green roof construction appear to be cost and the regional development community's lack of familiarity with green roof construction. Costs in the US have been high in comparison to costs in Europe, perhaps due to lack of familiarity with the technology, use of imported materials, and lack of industry standards (Federal Energy Management Agency, 2004). These factors seem more significant than remaining institutional and technical constraints, as evidenced by the rapid expansion in the use of green roofs throughout various states and regions.

In preparation for this report, 12 Bay Area developers participated in a survey regarding perceived obstacles to implementing green roofs. Three had actual experience with green roof projects, and an additional three had evaluated the option of a green roof for one or more specific projects but decided to use a conventional roof instead. Significant perceived barriers include:

- Cost of initial construction
- Cost of maintenance
- Additional structural requirements for buildings
- Lack of incentives offered by local governments

- Uncertainty in the local development review process
- Liability concerns

Among perceived effective incentives, tax incentives, green building credits (such as LEED) and grant funding were noted.

Complete survey results are shown in Appendix B.

Barriers to green roof installation are already being overcome through the active promotion of green roof technology by groups such as Green Roofs for Healthy Cities.

Increasingly widespread interest in LEED accreditation is also furthering green roofs. The following LEED credits may potentially be earned by incorporating a green roof in a development project, subject to meeting the specific LEED criteria for each credit:

- SS 5.1 Protect or Restore Habitat
- SS 5.2 Maximize Open Space
- SS 6.1 Stormwater Quantity Control
- SS 6.2 Stormwater Quality Control
- SS 7.2 Heat Island Effect, Roof
- WE 1.1 Water Efficient Landscaping, Reduce irrigation by 50%
- WE 1.2 Water Efficient Landscaping, No potable water use or no irrigation

Green roofs could potentially contribute to additional LEED credits in specific cases. It should be noted that requirements for LEED credits for stormwater quantity and quality control are somewhat different than requirements for MRP compliance.

The more rapid and widespread adoption of green roofs in Chicago, Washington, DC, and in German cities seems due to specific financial and zoning incentives created by municipal government. Incentives offered by US cities and states include direct incentives (property tax abatements, grants, and loans) and indirect incentives (reduced permit fees, credits against stormwater utility fees, “fast track” permitting, density and zoning bonuses, and recognition and awards programs) (DC Greenworks, 2010). Another incentive is the avoidance of the cost to upgrade storm drain capacity to accommodate increased runoff from the development project, since the green roof will mitigate the increase in runoff.

BASMAA proposes the following strategies for furthering green roofs and overcoming barriers to green roofs:

- When reviewing applications for development approvals, permittees will credit green roofs as LID treatment in accordance with Provision C.3.i.(2)(b). This may include categorizing green roofs as "self retaining ares: or as "self-treating areas."
- Permittees will seek to integrate their review of proposals to use green roofs for NPDES compliance for new developments with consideration of such proposals in connection with municipal climate change, urban greening, green infrastructure, sustainable development, energy efficiency, and other related environmental programs the municipalities are implementing.
- BASMAA will prepare and publish guidance detailing the similarities and differences between MRP requirements for green roofs and LEED points obtainable from green roofs and suggesting ways planners and designers can design roofs to achieve both benefits.
- BASMAA and the permittees will communicate with green roof industry proponents to ensure they have accurate information about the benefits of green roofs with regard to water quality and also with regard to MRP compliance.
- BASMAA and the permittees will continue to evaluate trends in green roof design, and encourage the use of design features that maximize runoff retention, evapotranspiration and treatment, as appropriate.
- Permittees will refer applicants for development approvals to information and design resources created by the green roof industry.
- The permittees will consider conducting an investigation of retention and evapotranspiration on one or more green roofs as a potential "BMP Effectiveness Investigation" per MRP Provision C.8.d.ii. In particular, it may be useful to set up long-term monitoring of rainfall, pan evaporation, soil moisture, and drainage flows at a green roof to evaluate characteristics specific to the Bay Area's semi-arid climate and to facilitate calibration of rainfall/runoff models applicable to green roofs.

6 · Guidance for Permittees

The permittees will include the following in their C.3 compliance guidance to applicants for development approvals.

- Inclusion of green roofs in LID designs is encouraged.
- Green roofs may be credited as "self-retaining areas" or as "self-treating areas" for treatment and hydrograph modification management.
- The planting media used in a green roof system must be sufficiently deep to provide capacity within the pore space of the media for the required runoff volume specified by Provision C.3.d.i.(1). If the green roof system receives runoff from non-green areas of the roof, such as mechanical/HVAC equipment areas or impervious walkways, the depth of the media must be increased to account for the additional runoff.
- The planting media used in a green roof system must be sufficiently deep to support the long term health of the vegetation selected for the green roof, as specified by a landscape architect or other knowledgeable professional.
- Plants should be selected which will create a healthy, drought-tolerant roof cover. In general, selected plants should be:
    - Native or adapted species tolerant of extreme climate conditions (e.g., heat, drought, wind);
    - Low-growing, with a range of growth forms (e.g., spreading evergreen shrubs or subshrubs, succulents, perennials, self-seeding annuals);
    - Possessive of a shallow root system without the chance of developing a deep taproot; and
    - Long lived or self-propagating, with low maintenance and fertilizer needs.
- Vegetation must be maintained in a healthy state for the life of the project.
- Irrigation systems may be required to establish and/or maintain selected plants. In addition, local fire codes may require irrigation systems to prevent a fire hazard or for emergency fire suppression.
- Applicants should be encouraged to drain green roofs to landscape or to bioretention facilities where

feasible to do so. Drainage directly to receiving waters should be avoided.

- Buildings with green roofs should provide the required facilities (e.g., ladders, guard rails, tie offs) to ensure safe access by maintenance workers in compliance with OSHA regulations.

7 · References

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Appendix A: Bay Area Green Roof Project Examples

West Elm Furniture Store, Emeryville. A 5,879-square-foot monolithic green roof was constructed on a commercial building, comprising about 1/3 of the total roof area. The roof met the current City requirement to treat stormwater with a vegetated BMP and also contributes to store branding and association with sustainability goals. Skylights were incorporated into the design to allow for roof access and meet Fire Marshal requirements. *Contact:* Peter Schultze-Allen, City of Emeryville, 510-596-3728, pschultze-allen@ci.emeryville.ca.us.

Casa Feliz Studio Apartments, San Jose. A 5,375-square-foot green roof was constructed on a 60-unit affordable multi-family residential building. The building is part of redevelopment of a 0.34-acre site; the roof helped the project qualify for LEED gold certification and avoid a costly capacity upgrade to a local storm drain. The roof is designed to retain up to 80% of stormwater. *Contact:* Juan Borrelli, City of San Jose, 408-793-4384, juan.borrelli@sanjoseca.gov.

4th Street Apartments, San Jose. A 15,200-square-foot green roof was provided for a multi-family apartment building with 100 apartments and two floors of covered parking. A drip irrigation system was installed to facilitate plant establishment. *Contact:* Juan Borrelli, City of San Jose, 408-793-4384, juan.borrelli@sanjoseca.gov.

AgeSong Assisted Living Facility, Emeryville. A 4,640-square-foot modular green roof includes 4-inch-deep cells with pre-grown drought-tolerant plants and covers about a third of a parking structure rooftop. The roof met a current City requirement to treat stormwater with a vegetated BMP and provides an opportunity for residents and the public to visit the roof. *Contact:* Green Grids, 818-350-7330.

San Jose Police Southside Substation, San Jose. A 3-story, 107,000-square-foot building on a 10.5-acre site includes a green roof, which helped the project obtain LEED certification. *Contact:* Juan Borrelli, City of San Jose, 408-793-4384, juan.borrelli@sanjoseca.gov.

Appendix B: Results of Developer Survey

lprickett Sign Out

+ Create Surv

My Surveys Address Book My Account

You have a **BASIC account** | To remove the limits of a BASIC account and get unlimited questions, **upgrade now!**

Building Industry Green Roof Survey Edit

Default Report + Add Report

Response Summary

Total Started Survey: 12
Total Completed Survey: 12 (100%)

PAGE: IDENTIFYING OBSTACLES TO BUILDING GREEN ROOFS IN THE SAN FRANCISCO BAY AREA

1. Please indicate the number of projects that you have worked on that either (a) INCLUDED a green roof, or (b) did not include but EVALUATED use of a green roof. Download

Number of applicable projects:

	0 projects	1 project	2 projects	3 projects	4 projects	5 or more projects	Response Count
a. Projects that INCLUDED a green roof:	**75.0% (9)**	0.0% (0)	0.0% (0)	0.0% (0)	8.3% (1)	16.7% (2)	12
b. Projects that EVALUATED but did not include a green roof:	**50.0% (6)**	16.7% (2)	0.0% (0)	8.3% (1)	0.0% (0)	25.0% (3)	12
						answered question	12
						skipped question	0

2. From the following list, please rate the "Top-Ten" issues that you perceive as barriers to developing green roofs. Create Chart Dow

	Most significant barrier									Least significant barrier	N/A	Rating Average	Resp Co
Lack of green roof professionals	0.0% (0)	0.0% (0)	0.0% (0)	18.2% (2)	0.0% (0)	0.0% (0)	9.1% (1)	18.2% (2)	18.2% (2)	**36.4% (4)**	0.0% (0)	8.09	1
Lack of standard green roof specifications	0.0% (0)	9.1% (1)	9.1% (1)	9.1% (1)	0.0% (0)	0.0% (0)	9.1% (1)	**27.3% (3)**	18.2% (2)	18.2% (2)	0.0% (0)	7.09	1
Lack of incentives offered by local governments	**36.4% (4)**	9.1% (1)	0.0% (0)	18.2% (2)	0.0% (0)	0.0% (0)	0.0% (0)	18.2% (2)	9.1% (1)	0.0% (0)	9.1% (1)	3.90	1
Uncertainty in the local development review process	9.1% (1)	0.0% (0)	**36.4% (4)**	0.0% (0)	9.1% (1)	27.3% (3)	9.1% (1)	9.1% (1)	0.0% (0)	0.0% (0)	0.0% (0)	4.64	1
Barriers to financing and insurance	0.0% (0)	9.1% (1)	9.1% (1)	18.2% (2)	**36.4% (4)**	0.0% (0)	18.2% (2)	0.0% (0)	9.1% (1)	0.0% (0)	0.0% (0)	5.09	1
Cost of construction	**33.3% (4)**	16.7% (2)	25.0% (3)	0.0% (0)	8.3% (1)	8.3% (1)	8.3% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	2.92	1
												answered question	1
												skipped question	0

2. From the following list, please rate the "Top-Ten" issues that you perceive as barriers to developing green roofs. Create Chart Dow

Cost of ongoing maintenance	0.0% (0)	**36.4% (4)**	0.0% (0)	18.2% (2)	18.2% (2)	18.2% (2)	9.1% (1)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	4.09	1
Liability concerns	**27.3% (3)**	0.0% (0)	9.1% (1)	9.1% (1)	18.2% (2)	18.2% (2)	0.0% (0)	9.1% (1)	9.1% (1)	0.0% (0)	0.0% (0)	4.45	1
Lack of knowledge within my firm	0.0% (0)	8.3% (1)	0.0% (0)	0.0% (0)	8.3% (1)	0.0% (0)	**25.0% (3)**	8.3% (1)	**25.0% (3)**	8.3% (1)	16.7% (2)	7.30	1
Aesthetic appearance of green roofs	0.0% (0)	0.0% (0)	9.1% (1)	0.0% (0)	0.0% (0)	18.2% (2)	9.1% (1)	9.1% (1)	9.1% (1)	**45.5% (5)**	0.0% (0)	8.09	1
											Other (please specify) Show Responses		2
											answered question		**1**
											skipped question		**(**

3. What are some specific financing barriers to green roof construction (check all that apply)? Create Chart Download

	Response Percent	Response Count
Existing policies of financial institutions/lenders	16.7%	2
Existing policies of insurance companies	33.3%	4
Lack of knowledge on the part of financial institutions	25.0%	3
Lack of knowledge on the part of insurance companies	33.3%	4
Don't know	**58.3%**	**7**
Other (please specify)	0.0%	0
	answered question	**12**
	skipped question	**0**

4. What are some specific green roof construction cost concerns that may be barriers to green roof development (check all that apply)? Create Chart Download

	Response Percent	Response Count
Specialized consultants	58.3%	7
Additional infrastructure costs are considered a barrier for any size project	41.7%	5
Additional infrastructure costs MAY be a barrier depending on the overall size or cost of a project	33.3%	4
	answered question	**12**
	skipped question	**0**

4. What are some specific green roof construction cost concerns that may be barriers to green roof development (check all that apply)? Create Chart Download

Lack of standard specifications	33.3%	4
Maintenance costs	**75.0%**	**9**
Don't know	8.3%	1
Other (please specify) Hide Responses	16.7%	2

1.	liability	Wed, Nov 3, 2010 4:00 PM	Find...
2.	Additional structural impacts	Mon, Oct 25, 2010 3:05 PM	Find...

answered question	**12**
skipped question	**0**

5. Please identify specific technical or institutional challenges/barriers with constructing green roofs (check all that apply). Create Chart Download

	Response Percent	Response Count
Building code requirements	41.7%	5
Fire code and life safety requirements	25.0%	3
Conflicts with green building codes, green-house gas reduction requirements and/or water and energy conservation and efficiency requirements	33.3%	4
Lack of or insufficient warranties for materials such as waterproofing membrane	**75.0%**	**9**
Structural requirements for buildings	58.3%	7
Other (please specify)	0.0%	0

answered question	**12**
skipped question	**0**

6. Please indicate which of the following would be likely to motivate you to build a green roof project (check all that apply). Create Chart Download

	Response Percent	Response Count
Seeing local examples of how green roofs provided benefits to development projects, such as reduced energy costs, extended roof life, habitat value, improved aesthetics and/or market value, etc.	25.0%	3

answered question	**12**
skipped question	**0**

6. Please indicate which of the following would be likely to motivate you to build a green roof project (check all that apply). Create Chart Download

Grant funding	41.7%	5
Tax incentives	**66.7%**	**8**
Requirement to provide non-mechanical stormwater treatment	25.0%	3
Clear information regarding requirements is provided by local jurisdictions	33.3%	4
Earning green building credits under a green building rating system (such as LEED or GreenPoint Rated)	50.0%	6
Other (please specify) Hide Responses	8.3%	1

1. none	Wed, Nov 3, 2010 4:00 PM	Find...

answered question	**12**
skipped question	**0**

7. Please identify green roof liability issues/concerns with regard to, primarily, for-sale projects (check all that apply). Create Chart Download

	Response Percent	Response Count
Potential for leaks	83.3%	10
Maintenance requirements	**91.7%**	**11**
Other (please specify) Hide Responses	25.0%	3

1. ambulance chasing lawyers	Wed, Nov 3, 2010 4:00 PM	Find...
2. There are potentially NO increases liabilities; membrane lasts longer and is better protected, studies have shown actual fire protection. If accessible, may trigger insurance liabilities associated with access and not necessarily the green roof. Maintenance CAN be increased, but not necessarily so.	Wed, Nov 3, 2010 12:16 PM	Find...
3. Some warranties can be voided by change in ownership.	Wed, Nov 3, 2010 10:40 AM	Find...

answered question	**12**
skipped question	**0**

8. Please describe any other specific factors not already included above that would make a green roof NOT economically or technically viable. Download

answered question	**1**
skipped question	**11**

8. Please describe any other specific factors not already included above that would make a green roof NOT economically or technically viable. Download

	Response Count
Hide Responses	1

1. Primarily cost barrier and in some cases structural loading (certain types of existing buildings).	Wed, Nov 3, 2010 12:16 PM	Find...

answered question	**1**
skipped question	**11**

9. Which of the following describes your profession (check all that apply)? Create Chart Download

	Response Percent	Response Count
Developer of commercially funded projects	**41.7%**	**5**
Affordable housing or other non-profit developer	8.3%	1
Engineering consultant	8.3%	1
Architect	16.7%	2
Other (please specify) Hide Responses	33.3%	4

1. Landscape Architect	Wed, Nov 3, 2010 12:41 PM	Find...
2. Landscape Architect	Wed, Nov 3, 2010 12:16 PM	Find...
3. Landscape Architect	Wed, Nov 3, 2010 10:40 AM	Find...
4. Retail	Mon, Nov 1, 2010 9:10 AM	Find...

answered question	**12**
skipped question	**0**

10. If you would like to receive email updates regarding stormwater requirements for development projects, please provide your contact information below. Download

	Response Percent	Response Count
Name: Show Responses	**100.0%**	**9**
Company: Hide Responses	**100.0%**	**9**

answered question	**9**
skipped question	**3**

10. If you would like to receive email updates regarding stormwater requirements for development projects, please provide your contact information below. Download

1.	Americap Development Partners	Wed, Nov 3, 2010 2:30 PM	Find...
2.	Design Ecology / UCB	Wed, Nov 3, 2010 12:16 PM	Find...
3.	WRA, Inc	Wed, Nov 3, 2010 10:40 AM	Find...
4.	Lewis Planned Communities	Wed, Nov 3, 2010 9:35 AM	Find...
5.	DRG Builders	Wed, Nov 3, 2010 7:48 AM	Find...
6.	dk Consulting	Fri, Oct 29, 2010 3:58 PM	Find...
7.	Agemark	Tue, Oct 26, 2010 1:30 PM	Find...
8.	Peter G. Shutts	Mon, Oct 25, 2010 3:05 PM	Find...
9.	Eden Housing	Mon, Oct 25, 2010 2:21 PM	Find...

Street Address: Show Responses	88.9%	8
City, State, Zip: Show Responses	88.9%	8
Phone Number: Show Responses	**100.0%**	**9**
Email Address: Show Responses	**100.0%**	**9**
	answered question	**9**
	skipped question	**3**

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Appendix C.4: Santa Clara Valley Planting Guidance

Introduction

General Recommendations

Plants for Stormwater Measures (includes comprehensive plant list)

Stormwater Measures

Planting Specifications

Monitoring and Maintenance

Bay-Friendly Landscaping and Integrated Pest Management (IPM)

Nursery Sources for Native Plants

References

Credits

1 Introduction

The purpose of the Plant List for Stormwater Measures is to provide guidance on the planting techniques and selection of appropriate plant materials for implementing stormwater measures. In selecting plant materials, it is important to consider factors that influence plant establishment and success, such as microclimate, type of soil, water availability, proximity to saltwater, and exposure to sun. The list has integrated specifications for each plant to improve the use and function of the list. Categories such as Sunset Zoning and Santa Clara Regions are listed to aid in proper plant selection for environmental conditions. The list has also been cross-referenced with the Santa Clara Valley Water District's *Approved Plant List* which identifies low water use plants that qualify for their Landscape Rebate Program (for more information: www.valleywater.org/Programs/LandscapeRebateProgram.aspx). In addition, the list identifies water needs for plants using the Water Use Classifications of Landscape Species (WUCOLS) in region # 1 for the north central coastal of California.

In addition, the function of the individual stormwater measure should be carefully considered when selecting plant materials. Factors to be considered include inundation period, expected flow of water, and access and maintenance requirements.

Numerous resources are available to assist in selecting appropriate plant species in Santa Clara County, including Sunset's *Western Garden Book*, the Santa Clara Valley Water District's *Approved Plant List*, and East Bay M.U.D.'s *Landscapes for Summer-Dry Climates of the San Francisco Bay Region*. There is also a list near the end of this document from the California Native Plant Society of local nurseries that offer native plants.

2 General Recommendations

Avoid the use of invasive species. In selecting plants for stormwater measures, the use of invasive species should be avoided. A complete list of invasive plants can be found at www.cal-ipc.org, the California Invasive Plant Council's Invasive Plant Inventory.

Minimize or eliminate the use of irrigated turf. Effort should be made to minimize the use of irrigated turf, which has higher maintenance requirements and greater potential for polluted runoff.

Select California natives and/or drought tolerant plants. Planting appropriate, drought tolerant California natives or Mediterranean plants reduces water consumption for irrigations, and reduces mowing, fertilizing, and spraying. For the purposes of the plant list on the following pages, "drought tolerant" refers to plants that meet the following criteria:

- Are identified as drought tolerant as follows: *California Native Plants for the Garden* (Borstein, et al.).
- Are identified as requiring occasional or infrequent irrigation in Borstein, et al., *or Plants and Landscapes for Summer Dry Climates* (EBMUD).
- Are identified as requiring no summer water in EBMUD.
- Are identified as requiring little or no water in the Sunset *Western Garden Book*.
- Are identified as requiring low or very low irrigation in the *Guide to Estimating Irrigation Water Needs of Landscape Plantings in California* (University of California Cooperative Extension).

Plants not listed in any of the above references will require that the design professional base selection upon successful experience with species on previous projects under similar horticultural conditions.

Site-specific Factors

Given Santa Clara County spans several Sunset climate zones, with variable humidity, heat, frost, and wind factors, as well as varying soil characteristics, plants need to be selected with an understanding of specific climate and microclimate conditions, and grouped in appropriate hydrozones.

Supplemental watering needs

Many plants listed as drought tolerant per the above references may require more supplemental watering in fast-draining, engineered soils.

3 Plants for Stormwater Measures

Plants play an important role in the function of landscape-based stormwater treatment measures:

- Infiltration and evapotranspiration. Plants aid in the reduction of stormwater runoff by both increasing infiltration, and by returning water to the atmosphere through evapotranspiration.
- Sedimentation. Some stormwater treatment measures, such as vegetated swales and vegetated buffer strips, are designed to remove coarse solids through sedimentation that is aided by dense, low-growing vegetation.
- Pollutant trapping. Vegetation helps to prevent the resuspension of pollutants associated with sediment particles. It is essential that pollutants removed during small storms are not remobilized during large storms.
- Phytoremediation. Plants for stormwater treatment measures are important for their role in phytoremediation, the uptake of nutrients and the ability to neutralize pollutants.
- Soil stabilization. As in any landscaped area, established plantings help control soil erosion. This is important both to keep sediment out of stormwater and to retain the surface soils, which help to remove pollutants from infiltrated runoff.
- Aesthetic benefits. Plants within or adjacent to stormwater facilities provide an aesthetic benefit.

Plants suitable for use in stormwater treatment measures are organized according to the

following categories:

- Emergent refers to those species which occur on saturated soils or on soils covered with water for most of the growing season. The foliage of emergent aquatics is partly or entirely borne above the water surface.
- Grasses refer to those species that are monocotyledonous plants with slender-leaved herbage found in the in the Family Poaceae.
- Herbaceous refers to those species with soft upper growth rather than woody growth. Some species will die back to the roots at the end of the growing season and grow again at the start of the next season. Annuals, biennials and perennials may be herbaceous.
- Shrub is a horticultural distinction that refers to those species of woody plants which are distinguished from trees by their multiple stems and lower height. A large number of plants can be either shrubs or trees, depending on the growing conditions they experience.

- Tree refers to those species of woody plants with one main trunk and a rather distinct and elevated head.

Plants suitable for use in stormwater treatment measures in the Santa Clara Valley are listed in Table D-1, below, which lists the plants in alphabetical order by Latin name, in the categories described above. The columns in the table indicate stormwater treatment measures for which each plant species may be suitable.

Invasive species

Under no circumstances shall any plants listed as invasive by the California Invasive Plant Council's Invasive Plant Inventory be specified (www.cal-ipc.org/ip/inventory/weedlist.php).

Plant List for Stormwater Measures

		Green Roof - extensive	Green Roof - intensive	Turf Block Pavers	Vegetated Swale	Vegetated Buffer Strip	Tree Well Filter[2]	Flow-Through Planter	Bioretention Area	Infiltration Trench	Extended Detention Basin (3 Days non- biotreatment soil)	Extended Detention Basin (5 Days biotreatment soil)	California Native	Drought Tolerant	Sunset Zone OR Santa Clara Region: Numbers denote the Sunset Zone [3]. When Sunset Zone not available, general environment preferred is listed using letters (W=wetland, R=riparian, I=inland, M=Moderate). When only genus is listed, preferred zone can vary for different species.	Santa Clara Valley Water District Approved Plant List[4]	Water Needs for WUCOLS[5] Region #1: H-High, M-Moderate, L-Low, VL-Very Low
Emergent Species																	
Artemisia douglasiana	mugwort										✓	✓	✓		W	✓	L
Carex barbarae	Santa Barbara sedge	✓	✓			✓					✓	✓	✓	✓	4-8, 14-24		M
Carex densa	dense sedge										✓	✓	✓		W		M
Carex obnupta	slough sedge										✓	✓	✓		W		M
Eleocharis macrostachya	creeping spikerush									✓	✓	✓	✓		W		
Iris douglasiana	Pacific coast iris		✓		✓	✓		✓	✓	✓			✓	✓	4-9, 14-24	✓	L
Juncus balitcus [1]	baltic rush										✓	✓	✓		W		H
Juncus bufonius	toad rush										✓	✓	✓		W		H
Juncus effusus [1]	Pacific rush										✓	✓	✓		1-24,		H
Juncus leseurii	common rush										✓	✓	✓		W		H
Juncus mexicanus	Mexican rush										✓	✓	✓		W		H
Juncus patens	blue rush		✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	4-9, 14-24		H
Juncus xiphioides	iris-leaved rush										✓	✓	✓		W		H
Limonium californicum	marsh rosemary										✓	✓	✓	✓	W		L
Phragmites spp.	common reeds										✓	✓			W		
Scirpus actutus	tule										✓	✓	✓		W		
Scirpus americanus [1]	three square										✓	✓	✓		W		
Scirpus californicus [1]	California bulrush										✓	✓	✓		W		
Spartina foliosa	California cordgrass										✓	✓	✓		W		
Typha angustifolia	narrowleaf cattail										✓	✓	✓		W		
Typha latifolia	cattail										✓	✓	✓		W		
Grass Species																	
Agrostis exarata	spike bentgrass			✓							✓	✓	✓		W		
Alopecurus aequalis	shortawn foxtail										✓	✓	✓		W		
Alopecurus saccatus	Pacific foxtail										✓	✓	✓		W		
Aristida purpurea	purple three-awn		✓		✓	✓		✓	✓				✓	✓	I	✓	
Bouteloua gracilis	blue grama	✓	✓	✓	✓	✓	✓		✓				✓	✓	1-3, 7-11, 14, 18-21	✓	L
Calamagrostis X acutiflora	reed grass		✓			✓		✓			✓			✓	2B-24	✓	L
Carex pansa	California meadow sedge	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	M		M
Carex praegracilus	clustered field sedge										✓	✓	✓		W		M
Carex (divulsa) tumulicola	Berkeley sedge										✓		✓		M		M
Chondropetalum tectorum	cape rush		✓		✓	✓		✓	✓	✓	✓	✓		✓	8, 9, 14-24		H
Danthonia californica	California oatgrass										✓	✓	✓		W		
Deschampsia cespitosa [1]	tufted hairgrass		✓		✓	✓			✓	✓	✓	✓	✓	✓	2-24,		L

[*] Denotes riparian species with limited drought tolerance
[1] Denotes species with phytoremediation capabilities
[2] Non-tree species to be used only with adequate planting surface and when infiltration rates are 5-10 inches/hour
[3] Sunset Zones are courtesy of Sunset Magazine, www.sunset.com/garden/climate-zones
[4] SCVWD Approved Plant List identifies low water use plants that qualify for their Landscape Rebate Program
[5] Water Use Classification of Landscape Species (WUCOLS) from A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III, University of California Cooperative Extension and the California Department of Water Resources, 2000, http://www.water.ca.gov/pubs/planning/guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_ca/wucols.pdf.

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Plant List for Stormwater Measures

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Grass Species cont'd																	
Deschampsia cespitosa ssp. holciformis	Pacific hairgrass		✓		✓	✓			✓	✓	✓	✓	✓	✓	4-9, 14-24		
Deschampsia danthonioides	annual hairgrass										✓	✓	✓		M		
Distichlis spicata	salt grass										✓	✓	✓		W		
Eleocharis palustris	creeping spikerush										✓	✓	✓		W		
Elymus glaucus	blue wild rye	✓	✓		✓	✓			✓	✓	✓		✓	✓	M		L
Festuca californica	California fescue		✓			✓	✓	✓	✓				✓	✓	4-9, 14-24	✓	L
Festuca idahoensis	Idaho fescue		✓	✓	✓	✓	✓	✓					✓	✓	1-10, 14-24	✓	VL
Festuca rubra[1]	red fescue		✓	✓	✓	✓	✓	✓					✓	✓	A2, A3; 1-10, 14-24	✓	L
Festuca rubra 'molate'	Molate fescue		✓	✓	✓	✓	✓	✓					✓	✓	M		
Leymus triticoides	creeping wildrye		✓		✓	✓			✓	✓	✓		✓	✓	M		VL
Linum usitatissimum [1]	flax							✓	✓					✓	M	✓	VL
Melica californica	California melic				✓	✓							✓	✓	M		
Melica imperfecta	coast range melic				✓	✓		✓	✓				✓	✓	I	✓	
Muhlenbergia rigens	deergrass		✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	4-24,	✓	L
Nassella pulchra	purple needlegrass		✓		✓	✓	✓		✓	✓			✓	✓	4-9, 11, 14-24		VL
Nassella lepida	foothill needlegrass		✓		✓	✓	✓			✓			✓	✓	7-9, 11, 14-24		VL
Sisyrinchium bellum	blue-eyed grass	✓			✓	✓		✓		✓			✓	✓	M	✓	VL
Herbaceous Species																	
Achillea millefolium [1]	common yarrow	✓	✓			✓	✓	✓					✓	✓	A1-A3; 1-24	✓	L
Allium spp.	wild onion	✓	✓		✓	✓		✓	✓				✓	✓	VARIES	✓	M
Anthemis nobilis (Chamaemelum nobile)	chamomile			✓	✓		✓							✓	2-24,		L
Armeria maritima	sea pink	✓	✓			✓	✓	✓					✓	✓	A2, A3; 1-9, 14-24	✓	M
Clarkia spp.	Clarkia	✓	✓		✓	✓			✓				✓	✓	A2, A3; 1-24	✓	
Epilobium densiflorum	dense spike-primrose				✓	✓		✓	✓	✓			✓	✓	M		L
Eriogonum latifolium	coast buckwheat					✓	✓						✓	✓	M	✓	L
Eriogonum fasciculatum	flattop buckwheat					✓	✓						✓	✓	7-9, 12-24	✓	L
Eschscholzia californica	California poppy	✓	✓	✓		✓		✓	✓				✓	✓	1-24; H1	✓	VL
Layia platyglossa	tidy tips	✓	✓			✓							✓	✓	1-10, 14-24	✓	
Limonium californicum	marsh rosemary				✓	✓		✓	✓	✓	✓	✓	✓	✓	W		L
Linanthus spp.	linanthus	✓	✓		✓	✓			✓				✓	✓	1-9, 14-24	✓	
Lotus scoparius	deerweed	✓	✓			✓			✓				✓	✓	M (I)		VL
Mimulus aurantiacus	common monkeyflower		✓		✓	✓		✓	✓				✓	✓	7-9, 14-24	✓	L
*Mimulus cardinalis**	scarlet monkeyflower		✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	2-24,		L
Monardella spp.	coyote mint					✓			✓				✓	✓	VARIES	✓	L

* Denotes riparian species with limited drought tolerance
[1] Denotes species with phytoremediation capabilities
[2] Non-tree species to be used only with adequate planting surface and when infiltration rates are 5-10 inches/hour
[3] Sunset Zones are courtesy of Sunset Magazine, www.sunset.com/garden/climate-zones
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Herbaceous Species cont'd																	
Nepeta spp.	catmint		✓		✓	✓	✓		✓					✓	VARIES	✓	L
Penstemon spp.	bearded tongue		✓		✓	✓	✓	✓	✓				✓	✓	VARIES	✓	L-M
Sedum spp.	stonecrop	✓	✓			✓								✓	VARIES	✓	L
Sempervivum spp.	hen and chicks	✓	✓			✓								✓	2-24,	✓	L
Thymus pseudolanuginosus	woolly thyme	✓	✓	✓	✓	✓	✓	✓	✓					✓	A1-A3; 1-24	✓	M
Shrub Species																	
Adenostoma fasciculatum	chamise		✓			✓							✓	✓	6-9, 14-24		VL
Agave filifera	thread-leaf agave		✓		✓	✓		✓		✓				✓	12-24,	✓	L
Agave parryi	Parry's agave		✓		✓	✓		✓		✓				✓	I	✓	L
Agave victoriae-reginae	Queen Victoria Agave		✓		✓	✓		✓		✓				✓	10, 12, 13, 15-17, 21-24	✓	L
Arctostaphylos densiflora 'McMinn'	manzanita 'McMinn'		✓			✓		✓	✓				✓	✓	7-9, 14-21	✓	VL
Arctostaphylos manzanita	common manzanita		✓			✓		✓					✓	✓	4-9, 14-24	✓	VL
Arctostaphylos uva-ursi 'Emerald Carpet'	manzanita 'Emerald Carpet'		✓			✓	✓	✓	✓				✓	✓	6-9, 14-24	✓	VL
Baccharis pilularis 'Twin Peaks'	coyote brush prostrate		✓			✓	✓	✓	✓				✓	✓	5-11, 14-24	✓	L
Baccharis salicifolia	mulefat										✓	✓	✓		W		
Berberis thunbergii	Japanese barberry		✓		✓	✓		✓						✓	A3; 2B-24	✓	L
Buddleia spp.	butterfly bush					✓			✓					✓	VARIES	✓	L
Calycanthus occidentalis	spicebush				✓	✓		✓	✓				✓	✓	4-9, 14-24		L
Carpenteria californica	bush anemone				✓	✓		✓	✓				✓	✓	5-9, 14-24	✓	L
Ceanothus hearstiorum	ceanothus		✓			✓			✓				✓	✓	5-9, 14-24	✓	VL
Ceanothus spp.	ceanothus		✓			✓			✓				✓	✓	5-9, 14-24	✓	VL
Cephalanthus occidentalis	buttonbush				✓	✓	✓	✓	✓		✓	✓	✓		2-10, 14-21	✓	
Cercocarpus betuloides	mountain mahogany					✓							✓	✓	3, 5, 7-10, 14-24		VL
Cistus spp.	rockrose					✓								✓	6-9, 14-24	✓	L
Cornus stolonifera (same as C. sericea)	redtwig dogwood				✓	✓		✓	✓	✓	✓	✓	✓		A1-A3; 1-9, 14-21		H
Dietes spp.	fortnight lily				✓	✓		✓						✓	8, 9, 12-24; H1, H2	✓	L
Echium candicans	pride-of-padeira		✓		✓	✓		✓						✓	14-24	✓	L
Garrya elliptica	coast silk tassle		✓			✓		✓					✓	✓	4-9, 14-24	✓	L
Heteromeles arbutifolia	toyon		✓			✓		✓	✓				✓	✓	5-9, 14-24	✓	VL
Holodiscus sp.	oceanspray					✓			✓				✓	✓	VARIES	✓	L
Lavandula spp.	lavender		✓			✓	✓	✓						✓	VARIES	✓	L
Lavatera assurgentiflora	tree mallow					✓								✓	VARIES	✓	L
Lepechinia calycina	pitcher sage					✓							✓	✓	7-9, 14-24	✓	
Lupinus albifrons	silver lupine					✓							✓	✓	M	✓	VL

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[2] Non-tree species to be used only with adequate planting surface and when infiltration rates are 5-10 inches/hour
[3] Sunset Zones are courtesy of Sunset Magazine, www.sunset.com/garden/climate-zones
[4] SCVWD Approved Plant List identifies low water use plants that qualify for their Landscape Rebate Program
[5] Water Use Classification of Landscape Species (WUCOLS) from A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III, University of California Cooperative Extension and the California Department of Water Resources, 2000, http://www.water.ca.gov/pubs/planning/guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_ca/wucols.pdf.

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Plant List for Stormwater Measures

		Green Roof - extensive	Green Roof - intensive	Turf Block Pavers	Vegetated Swale	Vegetated Buffer Strip	Tree Well Filter[2]	Flow-Through Planter	Bioretention Area	Infiltration Trench	Extended Detention Basin (3 Days non- biotreatment soil)	Extended Detention Basin (5 Days biotreatment soil)	California Native	Drought Tolerant	Sunset Zone OR Santa Clara Region: Numbers denote the Sunset Zone [3]. When Sunset Zone not available, general environment preferred is listed using letters (W=wetland, R=riparian, I=inland, M=Moderate). When only genus is listed, preferred zone can vary for different species.	Santa Clara Valley Water District Approved Plant List[4]	Water Needs for WUCOLS[5] Region #1: H-High, M-Moderate, L-Low, VL-Very Low
Shrub Species cont'd																	
Mahonia aquifolium	Oregon grape		✓			✓		✓	✓				✓	✓	2-12, 14-24	✓	M
Mahonia repens	creeping Oregon grape		✓			✓	✓	✓	✓				✓	✓	2B-9, 14-24		L
Myrica californica	Pacific wax myrtle		✓			✓							✓	✓	4-9, 14-24	✓	L
Physocarpus capitatus	Pacific ninebark						✓				✓	✓	✓		2B, 3-9, 14-19		
Pittosporum tobira	mock orange					✓		✓						✓	8-24; H1, H2	✓	L
Prunus ilicifolia	holleyleaf cherry				✓	✓			✓				✓	✓	VARIES	✓	L
Rhamnus Californica	coffeeberry		✓			✓		✓	✓				✓	✓	3A-10, 14-24; H1, H2	✓	L
Rhus integrifolia	lemonade berry					✓							✓	✓	8, 9, 14-17, 19-24	✓	L
Ribes aureum	golden currant				✓	✓		✓	✓				✓	✓	A2, A3, 1-12, 14-23	✓	L
Ribes malvaceum	chaparral currant					✓							✓	✓	6-9, 14-24	✓	VL
Ribes sanguineum	Red-flowering currant					✓							✓	✓	A3, 4-9, 14-24	✓	L
Ribes speciosum	fuchsia-flowered currant				✓	✓		✓		✓			✓	✓	7-9, 14-24	✓	L
Rosa californica	California wild rose				✓	✓		✓	✓	✓			✓	✓	M	✓	L
Rubus ursinus	California blackberry					✓			✓				✓	✓	M	✓	L
Salvia brandegii	black sage					✓							✓	✓	15-17, 19-24	✓	
Salvia clevelandii	Cleveland sage					✓			✓				✓	✓	8,9,12-24	✓	L
Salvia leucophylla	purple sage					✓			✓				✓	✓	8, 9, 14-17, 19-24	✓	L
Salvia melifera	black sage					✓							✓	✓	7-9, 14-24	✓	L
Salvia sonomensis	creeping sage				✓	✓	✓		✓				✓	✓	7,9,14-24	✓	L
Sambucus mexicana	elderberry					✓		✓	✓				✓	✓	2-24, H1	✓	L
Santolina spp.	santolina				✓	✓		✓	✓					✓	VARIES	✓	L
Symphoricarpos albus	snowberry					✓		✓					✓	✓	A3; 1-11, 14-21	✓	L
Stachys spp.	lambs ear	✓	✓		✓	✓	✓	✓	✓					✓	VARIES	✓	L
Styrax officinalis redivivus	California snowdrop					✓			✓				✓	✓	6-10, 14-24 BEST IN 14-16, 18-24	✓	L
Trichostema spp.	wooly blue curls		✓			✓			✓				✓	✓	14-24	✓	VL
Yucca whipplei	our lord's candle				✓	✓		✓						✓	2-24,	✓	L
Zauschneria californica (Epilobium c.)	California fuchsia		✓			✓	✓						✓	✓	2-11, 14-24	✓	L
Tree Species																	
Acer circinatum	vine maple		✓		✓	✓	✓		✓	✓			✓		A3; 2B-6, 14-17		M
*Acer macrophyllum**	big leaf maple				✓	✓			✓				✓		2-9, 14-24		M
Acer negundo v. Californicum*	box elder				✓	✓	✓		✓	✓	✓	✓	✓		A2, A3; 1-10, 12-24		M
Aesculus californica	buckeye					✓							✓	✓	3-10, 14-24	✓	VL
*Alnus rhombifolia **	white alder				✓	✓	✓		✓		✓	✓	✓		1B-10, 14-21		H
*Alnus rubra**	red alder				✓	✓	✓		✓	✓	✓	✓	✓		3-7, 14-17		

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Plant List for Stormwater Measures

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Tree Species cont'd																	
Arbutus menziesii	madrone					✓							✓	✓	4-7, 14-19	✓	L
Arbutus unedo	strawberry tree		✓			✓								✓	4-24,	✓	L
Betula nigra	river birch				✓	✓	✓		✓	✓					1-24,		H
Calocedrus decurrens	incense cedar					✓							✓		2-12, 14-24	✓	M
Celtis occidentalis	common hackberry					✓								✓	1-24,	✓	L
Cercidium floridum	blue palo verde					✓							✓	✓	8-14, 18-20		VL
Cercis occidentalis	redbud		✓			✓							✓	✓	2-24,	✓	VL
Chilopsis sp.	desert willow		✓		✓	✓			✓				✓	✓	3B, -14, 18-23	✓	VL
Chionanthus retusus	Chinese fringe tree					✓									3-9, 14-24		M
Corylus cornuta v. Californica	California hazelnut				✓	✓	✓		✓				✓	✓	2-9, 14-20		L
Crataegus	hawthorn		✓		✓		✓							✓	VARIES	✓	M
Fraxinus latifolia	Oregon ash				✓	✓	✓		✓	✓	✓	✓	✓		3-9, 14-24		H
Geijera parviflora	Australian willow					✓									8, 9, 12-24		M
Gleditsia triacanthos[1]	honey locust				✓	✓	✓		✓	✓	✓	✓		✓	1-16, 18-20		L
Lagerstroemia spp.	crepe myrtle		✓			✓					✓			✓	VARIES	✓	L
Lyonothamnus floribundus asplendifolius	Catalina ironwood					✓							✓	✓	14-17, 19-24	✓	L
Morus alba (fruitless var.)[1]	white mulberry					✓									2-24; H1, H2		M
Platanus X acerifolia	london plane tree				✓	✓	✓							✓	2-24,	✓	L
*Platanus racemosa**	western sycamore				✓	✓	✓		✓		✓	✓	✓		4-24,	✓	M
*Populus fremontii** [1]	Fremont's cottonwood				✓	✓	✓		✓	✓	✓		✓		1-12, 14-21		M
Prunus, spp.	plum				✓	✓								✓	VARIES		M/L
Quercus agrifolia	coast live oak					✓							✓	✓	7-9, 14-24	✓	VL
Quercus kelloggii	California black oak					✓							✓	✓	6, 7, 9, 14-21		L
Quercus lobata	valley oak					✓			✓				✓	✓	3B-9, 11-24	✓	L
Quercus palustris	pin oak					✓									2-10, 14-24		M
Quercus virginiana	southern live oak						✓								2-24,		M
*Salix laevigata**[1]	red willow				✓	✓			✓	✓	✓	✓	✓		W		H
*Salix lasiolepis**[1]	arroyo willow				✓	✓			✓	✓	✓	✓	✓		W		H
Salix lucida ssp. lasiandra *[1]	shining willow				✓	✓			✓	✓	✓	✓	✓		W		H
*Sequoia sempervirens**	coast redwood				✓	✓					✓	✓	✓		4-9, 14-24		H
Umbellularia californica	California bay				✓	✓							✓		4-9, 14-24		M

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4 Stormwater Measures

For each of the stormwater measures offered in the Plant List for Stormwater Measures there is a brief description of each, including the key factors that should influence planting techniques and plant selection.

Green Roof

A green roof is intended to capture precipitation and roof runoff. Green roofs utilize a lightweight, porous planting substrate as a medium for plant growth. The depth and composition of this substrate is extremely important in determining types of plants that will be successful as part of a green roof system. Intensive green roofs, which can have up to 48" of substrate, can support a wider variety of plant types. Look for plants with check marks in the Green Roof sections of the list. *Extensive* green roofs, which have a depth of 3" to 7" of planting medium, are suitable for a limited number of grass and herbaceous species. These roofs generally require little maintenance and should be designed to succeed with minimal irrigation. In addition to the species listed, pre-vegetated mats can be utilized on extensive green roofs. Information can be found at www.thehenryford.org/rouge/leedlivingroof.aspx.

Turf Block Pavers: Pervious paving

Some pervious paving systems can be planted with grass or herbaceous species in order to assist with erosion prevention as well as promote infiltration and pollutant uptake. Plant species should be tolerant of compaction, have the ability to neutralize contaminants, and should not interfere with maintenance and use of the paved surface. Most plant species cannot tolerate frequent vehicular compaction. Therefore, turf block pavers are best suited for areas requiring infrequent access, such as emergency vehicle access routes. Paver manufacturer should be consulted regarding recommended and acceptable plant species.

Vegetated Swale

Plants in a vegetated swale slow water movement, which assists with the sedimentation of coarse solids and increases infiltration through a layer of topsoil. Therefore, a vegetated swale should be planted with the intent of slowing water flow, retaining pollutants associated with solids that settle out, and stabilizing the topsoil. Plantings can include grass and herbaceous species. All plants should be tolerant of extended periods of dry conditions. However, species tolerant to periodic inundation should be concentrated within the center of the swale where the soil would be saturated for a greater duration.

Vegetated Buffer Strip

Vegetated buffer strips should be designed to function and appear as natural vegetated areas adjacent to development. They treat surface runoff from adjacent impervious areas so a variety of trees, shrubs, grass, and herbaceous species should be included in order to maximize water and nutrient uptake, as well as to retain sediment.

Tree Well Filter

Trees and shrubs planted in tree well filters should be an appropriate size for the space provided. Plant roots are confined to the container, and therefore it is recommended that small trees and shrubs with shallow, fibrous roots be planted in the tree well filter. Provided that site conditions allow, it may be possible to work with the manufacturer to design a container that would allow for the planting of larger trees or shrubs. Plants for tree well filters should be tolerant of frequent, but temporary periods of inundation as well as adapted to extremely well-drained soils. Species with the ability to neutralize contaminants are preferred.

Flow-Through Planter

Plant species for flow-through planters will depend on the size of the planter. Shrubs and trees should be placed in planters only when there is sufficient space. Recommended minimum soil depth for shrubs is 18", and for small trees is 36". Plant species should be adapted to well-drained soils. Irrigation is typically required, but selecting plants adapted to extended dry periods can reduce irrigation requirements.

Bioretention Area

Bioretention areas are intended to act as filters with plants. Plants in bioretention areas help with phytoremediation and infiltration. Therefore, nutrient uptake and the ability to neutralize pollutants are priorities for species selection. Plants for these areas should be able to withstand periods of inundation as well as extended periods of drought. Emergent, grass and herbaceous species can be planted in the bioretention area, while shrub and tree species should be concentrated on the outer edges. Grasses can also be planted along the exterior to slow the velocity of flow and allow the sedimentation of coarse solids, which helps minimize clogging of the bioretention area. Supplemental irrigation will be necessary to maintain emergent species during extremely dry conditions.

Infiltration Trench

An infiltration trench is an aggregate filled trench that receives and stores stormwater runoff in the void spaces between the aggregate and allows it to infiltrate into the surrounding soil. Vegetated filter strips of grass species on either side of the trench can slow and pre-treat the runoff while the trench can physically remove fine sediment and other suspended solids.

Extended Detention Basin

Extended detention basins are intended to capture and detain water for much longer periods (up to 72 hours) than bioretention areas. They are designed to drain completely between storms. Plants in extended detention basins increase pollutant removal and assist with soil stabilization, therefore nutrient uptake and the ability to neutralize pollutants are priorities for species selection. Because extended detention basins are intended to capture and move large quantities of water, trees should not be planted in the basins. Shrubs are typically not specified for extended detention basins, but may be included only on the outer perimeter (top of bank) so that they do not interfere with detention. Species should be adapted to periodic inundation, saturation, and extended periods of dry conditions. Emergent, grass and herbaceous species for extended detention basins should consists of species that are able withstand extended periods of inundation. Supplemental irrigation will be necessary to maintain emergent species during extremely dry conditions.

5 Planting Specifications

Planting plans and specifications must be prepared by a qualified professional and coordinated with other site development details and specifications including earthwork, soil preparation and irrigation (if used). Plans indicating a planting layout, with species composition and density, should be prepared on a site-specific basis. Reference Bay Friendly Landscaping Guidelines prepared by StopWaste.org (available at www.BayFriendly.org), which outline principles and practices to minimize waste, protect air and water quality, conserve energy and water, and protect natural ecosystems, including:

- Evaluate site and assess the soil;
- Consider potential for fire;
- Select plants for appropriate size upon maturity, do not over-plant;
- Irrigation, if required, should be designed as a high efficiency, water conserving system; and

- Utilize compost (see the specification in the Bay-Friendly Landscaping Guidelines) and mulch to build healthy soils and increase the water holding capacity of the soil.

Propagation and Planting Methods

The propagation methods for different species will vary, depending upon type of plant and stormwater adaptation. In general, container stock will be utilized most commonly for green roofs, flow-through planters, tree well filters, vegetated swales and buffer strips and infiltration trenches. Bioretention areas and extended detention basins will generally utilize native plants available as transplants (plugs), pole cuttings and seed mixes.

Container Stock. Planting holes for container stock should be twice as wide and only as deep as the container size. Plant spacing should be determined on a site-specific basis. When planting, the root collar and base of the stem should be 1" above the adjacent soil surface. Soils should be backfilled and tamped down to assure contact with the roots. The planting should be watered-in promptly to promote the settling of soil. If appropriate, container plantings may receive a balanced time-released fertilizer tablet, quantity and placement per manufacturer's recommendation, placed in the planting hole prior to installation of the plant. Planting berms for water retention and mulch shall be used to enhance plant establishment. Trees shall be staked or guyed to provide interim support until established.

Transplants (Plugs). Transplanted plant divisions, referred to here as "plugs", should be planted during the fall dormant period, preferably between October 1 and November 15 after first soaking rain. Plugs should be collected from a suitable collection site in the vicinity of the constructed basins. Plugs are clumps of plant roots, rhizomes or tubers combined with associated soil that can be manually removed, or salvaged with an excavator or backhoe. The maximum recommended size is 1 foot x 1 foot. Whole plants or plant divisions can be utilized. The plugs should be from healthy specimens free of insects, weeds and disease. The plugs should be spaced from 1 foot to 6 feet apart, depending on the size of the plug. Smaller plugs can be planted at the minimum distance to promote faster spreading and cover. Larger plugs from cattail and bulrush species should be planted at 3-foot to 6-foot intervals. To plant a plug, a hole slightly wider than the diameter of the plug should be prepared and the roots system of the plug placed in the hole. Do not over-excavate the hole depth or the plant will settle below grade. A shovel could be used to create the planting hole. Manual planting with a spade is recommended for wet soils. Power augers can be used for creating holes in dry soils. Alternatively, a trench could be created along the narrow axis of the extended detention basin, and planting material manually placed at specified elevations in relation to the proximity of permanently saturated soils. To plant a plug with an established root system, the base of the stem and top of the root collar should be level with the ground surface. Tubers should be secured to prevent floating. Rhizomes should be placed in the soil with a slight upward angle. The hole or trench containing the plug(s) should be backfilled with soil and the soil tamped down to assure good soil contact and secure the plug. The vegetative portion of the plant should be cut back to prevent water loss and wilting, and encourage the growth of roots and new shoots. Plugs of wetland plants should be grown in saturated soil. The soil should not be allowed to dry out after planting. Plugs should be planted immediately, when possible. When necessary, plugs can be stored in a cool, moist, shaded location for a maximum of one day. Plants must be thoroughly watered.

Pole Cuttings. Pole cuttings should be collected from the 1-year old wood of dormant trees and have a minimum of 5 viable nodes. The parent material should be healthy and free of diseases. The basal area of the pole cutting should be a minimum of one to two inches in diameter; however, the diameter at the base should not exceed 2 inches. The optimum diameter width of the base is 1 inch. The length of the cutting should be a minimum of 2 feet and should not exceed a maximum of 4 feet in length. Generally, 75 percent of the length of the cutting should be planted beneath the soil surface.

Pole cuttings should be collected no more than 2 days prior to planting. Cuttings should be placed in cool water to promote swelling of the nodes. Water should be kept fresh by aeration and/or by daily replacement. The pole cuttings should be placed in a hole approximately 3 feet deep (as determined by the length of the cutting) and backfilled with native soil, or a rich organic medium mixed with native soil. Soil should be tamped down to remove air pockets and assure soil contact with the cutting.

Seeding. Seeding should be conducted after plugs, container stock and pole cuttings are installed. Hydroseeding or broadcast method shall be utilized as appropriate for the size and accessibility of the area. The soil surface should be scarified prior to seeding. Do not damage previously planted vegetation. The seeds should be planted in fall, ideally in October. Seeds should be broadcast or hydroseeded over the specified planting area. With broadcast seeding, the seed should be applied with hand-held spreaders to scarified soil. The soil surface should then be raked to cover the seeds with about one-eighth to one-quarter inch of soil to discourage predation, and tamped or rolled to firm soil surface. Seeds should be planted at the ratios and rates specified by the supplier. The seed should be free of weeds and diseases. The certified germination percentage should be provided by the supplier.

Water Level Management and Irrigation for Plant Establishment

All newly planted material will need careful attention to watering requirements to ensure proper establishment. As mentioned in the introduction, it is important to select plants based on specific site conditions, which will affect the availability of water for plant use. In addition, grouping plants with similar water requirements can help reduce irrigation needs. The specific approach will vary for irrigated and non-irrigated conditions, and for each stormwater application. In most cases, stormwater applications will require a permanent irrigation system which shall be designed to maximize water conservation. Irrigation specifications and design plans shall be provided.

Plants such as shrubs and trees grown in naturalized areas that are not saturated to the surface or inundated shall be irrigated with drip irrigation. The irrigation system shall remain in place for a minimum of three years, and should continue until it is demonstrated that the plantings can survive on annual rainfall and/or groundwater. Seeded areas do not need irrigation in years of normal rainfall. If a period of drought occurs after seeding, supplemental watering may be needed for germination in the first year.

The plants on the bottom and edge of the constructed basins should be allowed to become established for one growing season prior to the onset of significant flooding that will inundate the plantings for extended periods. The types of plants recommended for these locations are rushes, sedges, grasses and herbaceous species. Initially, saturated soils are required for the bioretention areas and extended detention basins during the establishment period of the plantings. After the plants have become established, inundation with a surface depth of 1 cm to 2 cm alternating with short dry periods is recommended for the basins during the first year. Periodic shallow flooding of these basins can slow the growth of non-native weedy terrestrial species in the wetland system; however, the water depth should not be greater than the height of the plants. This initial irrigation regime will prevent plant mortality from dry periods or excessive flooding in the first year, and reduce the growth of non-native weedy species. Emergent species should be planted in saturated soil so the plants will become established. For emergent species, the water level in the first year should be maintained to allow for soil saturation or shallow inundation around the base of the plants. Significant flooding and inundation of stems and leaves of the plants should be avoided the first year. Tall plugs and plantings can tolerate greater depths of inundation if a significant portion of the stems and leaves of the plantings remain above the water surface.

6 Monitoring and Maintenance

General Requirements

All planted areas shall be monitored and maintained as required to ensure proper establishment by a Contractor with a valid California C-27 contractor's license. Frequency of site visits and required maintenance practices will vary depending upon the stormwater measure and plant selection. Maintenance shall include watering, cultivation, weeding and pruning as necessary to maintain optimum growth conditions and, as appropriate to the specific stormwater measure, to keep the planted areas neat and attractive in appearance. In all instances, controlling weeds and unwanted growth with chemical applications is prohibited.

The contractor shall be familiar with the design and function of the specific stormwater measure(s) to ensure that the plantings are maintained appropriately and do not interfere with the efficient runoff drainage and filtration.

Ongoing management of invasive weed species will be required in all applications. Monthly hand weeding will allow the naturalized vegetation to take hold, and will ultimately be less costly than less frequent, and more intensive clearing. Regular application of arbor chip mulch, or other mulch material that will knit together and resist floating with surface runoff, will also help control weed growth.

Erosion Control

Particularly with landscapes that are not fully established, contractors will need to monitor and evaluate potential for erosion and sediment accumulation in the runoff, which will influence irrigation scheduling and as well as determine the need for additional erosion control measures. Soil can be protected from erosion by a number of methods including:

Keep the soil covered with vegetation to the extent possible;

Slow water runoff by using compost berms, blanket, socks or tubes along slopes;

Cover bare soil with a minimum of 2" mulch cover;

Minimize the use of blowers in planting beds and on turf;

On slopes use coarse shredded mulch that is not prone to washing into storms drains; and

Store leaf litter as additional much in planting beds as appropriate.

Irrigation Systems

Where irrigation systems have been installed for temporary or permanent irrigation, the contractor shall maintain the irrigation system for optimum performance, as per manufacturer's specifications. Contractor shall inspect the entire system on an ongoing basis, including cleaning and adjusting all sprinkler and bubbler heads, drip emitters and valves for proper coverage. Contractor shall monitor the irrigation system while operating to identify and correct problems with water runoff or standing water.

Monitor soil moisture within plant root zones using a soil probe or shovel and adjust irrigation schedules accordingly if a soil moisture sensor is not being utilized to signal the irrigation controller. If a Weather-Based Irrigation Controller (WBIC), otherwise known as a "Smart" Controller is not utilized on the project, irrigation shall be scheduled using a water budget approach, basing irrigation frequency on evapotranspiration

data (ET) to avoid over-irrigation of plant material. Adjust irrigation frequency within each hydrozone area a minimum of every four weeks to respond to expected adjustments in ET data.

If a standard turf mix is used in lieu of a no-mow variety, implement grasscycling, where appropriate to the stormwater treatment measure. Grass clippings shall not be carried into the drainage structures. Refer to A Landscaper's Guide to Grasscycling available from StopWaste.org at www.BayFriendly.org.

Bioretention and Extended Detention Basins

In bioretention and extended detention basins, in particular, non-native invasive plant species should be carefully monitored and controlled to reduce competition with the native plantings and to assure the success of the revegetation activities. The establishment of weeds and invasive species in the bottom of the basins can be partially controlled during the establishment period by implementing the watering schedule of initial saturation followed by alternating periods of shallow inundation and dry soil. Manual methods of weed removal should be conducted on the bottom, edge and side of the basins when these areas are not inundated. Areas with hydroseeding on the banks of the basins should be weeded carefully to avoid removal of the native species.

Weeding should be conducted regularly the first two years to prevent the growth, flowering, and seed set of non-native weeds and invasive species. After the first two years, weeding frequency will be determined on a site-specific basis as determined by the type of weeds and seasonal growth cycle of the weed species. In general, weeding once a month will be necessary to avoid more extensive and costly eradication in the future.

Long-term maintenance tasks on the banks of the basins will include continued control of nonnative weeds and invasive plants, and control of erosion. Erosion could include gullies, rills and sheet erosion. Actions to control erosion should include redirecting or dissipating the water source. Recontouring and subsequent mulching and/or reseeding with erosion control species may be required in bare areas. In the event of extensive die-off of the native plant species, the bare areas should be replanted. Where the event that caused plant mortality was not a natural catastrophic occurrence, the site condition that resulted in the die-off should be investigated and remedial action to correct the problem should be undertaken prior to replanting.

7 Bay-Friendly Landscaping and Integrated Pest Management (IPM)

This section provides a summary of Bay-Friendly landscaping and integrated pest management techniques, based on landscaping guidelines prepared by StopWaste.org (available at www.BayFriendly.org).

Bay Friendly Landscaping

Bay-Friendly landscaping is a whole systems approach to the design, construction and maintenance of the landscape in order to support the integrity of the San Francisco Bay watershed. Project sponsors are encouraged to use landscape professionals who are familiar with and committed to implementing Bay-Friendly landscaping practices from the initial plant selection through the long-term maintenance of the site. This section summarizes Bay-

Friendly Landscaping practices that may be implemented information that project sponsors need about how these practices canto benefit water quality of the Bay and its tributaries.

Bay-Friendly landscaping is based on 7 principles of sustainable landscaping and features the following practices

- Landscape Locally
- Less to the Landfill
- Nurture the Soil
- Conserve Water
- Conserve Energy
- Protect Water and Air Quality
- Create and Protect Wildlife Habitat

Integrated Pest Management

All creeks in the San Francisco Bay Area exceed water quality toxicity limits, primarily due to the pesticide Diazinon entering urban runoff. Although the residential use of Diazinon is currently being phased out, the use of a group of highly toxic chemicals, called pyrethroids, is increasing. Because all pesticides are toxins, an integrated pest management (IPM) places a priority on avoiding their use. IPM is a holistic approach to mitigating insects, plant diseases, weeds, and other pests. Each agency has a Source Control Measures List that includes provisions for using IPM in the landscaping plans of development projects. Contact the local agency to learn about the IPM requirements that may apply to your projects. Remember that avoiding pesticides and quick release synthetic fertilizers are particularly important in your project's stormwater treatment measures, to protect water quality.

IPM encourages the use of many strategies for first preventing, and then controlling, but not eliminating, pests. It places a priority on fostering a healthy environment in which plants have the strength to resist diseases and insect infestations, and out-compete weeds. Using IPM requires an understanding of the life cycles of pests and beneficial organisms, as well as regular monitoring of their populations. When pest problems are identified, IPM considers all viable solutions and uses a combination of strategies to control pests, rather than relying on pesticides alone. The least toxic pesticides are used only as a last resort. IPM features the following practices:

- Prevent Pest Problems
- Watch for and Monitor Problems
- Education is Key
- Use Physical and Mechanical Controls
- Use Biological Controls
- Least Toxic Pesticides are a Last Resort

For more information about sustainable landscaping and integrated pest management practices or to download a copy of the Bay-Friendly Landscaping Guidelines: Sustainable Practices for the Landscape Professional, visit www.BayFriendly.org.

8 Nursery Sources for Native Plants

It is recommended that the native plants used in treatment controls be grown by a qualified nursery. Seed collection should be conducted by a qualified botanist and/or nursery staff. Seed should be collected locally from selected sites to maintain the genetic integrity of the native plant species. The seeds shall be propagated by the nursery for planting during the fall dormant season. The appropriate container size for each species shall be used by the nursery.

The following are local nurseries that the California Native Plant Society acknowledges as locations to buy native plants:

Acterra Wholesale Native Nursery Foothills Park Palo Alto 650-949-3158 http://www.acterra.org A wholesale nursery growing local native stock. Open to professionals by appointment.	Capitol Wholesale Nursery, Inc. 2938 Everdale Drive San Jose, CA 95148 408-239-0589 cwnsales@sbcglobal.net Wholesale, retail and broker nursery that emphasizes sustainable landscapes.
Baylands Nursery 965 Weeks Street East Palo Alto, CA 94303 www.baylands.com Wholesale & retail plants, about one-third native.	Middlebrook Gardens 76 Race Street San Jose, CA 95126 408-292-9993 www.middlebrook-gardens.com California Native plants nursery organized by plant community, open the first and third weekends of the month throughout the summer.
C. H. Baccus 900 Boynton Avenue San Jose, CA 95117	Yerba Buena Nursery 19500 Skyline Boulevard Woodside, CA 94062

408-244-2923 Mail order bulbs.	650-851-1668 www.yerbabuenanursery.com Retail plants and some seed, large demonstration garden with mature examples of many cultivar and species natives. Except for ferns, all native.

9 References

A Field Guide to Compost Use, The Composting Council, Alexandria, VA. http://www.compostingcouncil.org/index.cfm.

A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California: The Landscape Coefficient Method and WUCOLS III, University of California Cooperative Extension and the California Department of Water Resources, 2000, http://www.water.ca.gov/pubs/planning/guide_to_estimating_irrigation_water_needs_of_landscape_plantings_in_ca/wucols.pdf.

Bornstein, Carol, David Fross and Bart O'Brien, California Native Plants for the Garden.

California Irrigation Management Information System, www.cimis.water.ca.gov, Waste management and recycling, www.ciwmb.ca.gov.

California Stormwater Quality Association (CASQA). Stormwater BMP Handbook: New Development and Redevelopment. January 2003.

City of Santa Rosa. 2005. Appendix A. Landscaping and Vegetation for Storm Water Best Management Practices in New Development and Redevelopment in the Santa Rosa Area.

East Bay Municipal Utility District (EBMUD), Plants and Landscapes for Summer Dry Climates.

Hogan, E.L., Ed. 1994. Sunset Western Garden Book, Sunset Publishing Corporation, Menlo Park, CA.

Irrigation water audits, Irrigation Association, www.irrigation.org, and the Irrigation Technology Research Center, www.itrc.org.

Pests of Landscape Trees and Shrubs: An Integrated Pest Management Guide, 2nd ed., UC Publication 3359, http://www.ipm.ucdavis.edu.

Santa Clara Valley Water District Approved Plant List for Landscape Rebate Program, http://www.valleywater.org/Programs/Landscaping.aspx.

StopWaste.org www.bayfriendly.org

Bay-Friendly Landscape Guidelines

A Landscaper's Guide to Grasscycling

A Landscaper's Guide to Mulch

Sunset Magazine, www.sunset.com/garden/climate-zones

The Weed Worker's Handbook, A Guide to Techniques for Removing Bay Area Invasive Plants, The Watershed Council (510) 231-5655 and the California Invasive Plant Council (510) 843-3902.

University of California Cooperative Extension, Guide to Estimating Irrigation Water Needs of Landscape Plantings in CA.

10 Credits

This guidance is based on planting guidance prepared by Design, Community and Environment for the Alameda Countywide Clean Water Program's C.3 Technical Guidance. The plant list included in Section D.3 was prepared by Design, Community and Environment specifically for the Santa Clara Valley Urban Runoff Pollution Prevention Program to identify species appropriate for local climate conditions.

Appendix D: SCVWD Infiltration Device Guidelines

Purpose of the Guidelines D-3

Categorization of Treatment Control Measures D-3

Category A - Infiltration Device BMPs (require SCVWD review and approval if guidelines not met)

Category B – BMPs using Indirect Infiltration (SCVWD review not required)

Category C - BMPs that Discharge Directly to Storm Drain (SCVWD review not required)

Table D-1: Stormwater Infiltration Device Guidelines D-4

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SCVWD Infiltration Device Guidelines

Purpose of the Guidelines

The Santa Clara Valley Water District (SCVWD) manages drinking water resources and provides stewardship for Santa Clara County's watersheds, reservoirs, streams and groundwater basins. As such, the SCVWD is responsible for groundwater quality protection. Concerns regarding the contamination of groundwater may limit the types and locations of stormwater treatment BMPs that may be used on a project site. The treatment BMPs of most concern are "infiltration devices", defined as structures that are designed to bypass the natural filtration of surface soils and to transmit runoff directly to subsurface soils and groundwater aquifers. Other treatment BMPs that treat stormwater prior to subsurface infiltration, including landscape measures that utilize infiltration through surface or imported soils (indirect infiltration), and treatment BMPs that discharge directly to storm drains without infiltration pose minimal risk to groundwater quality.

Table D-1 provides SCVWD guidelines for use of infiltration devices based on the proposed site use or condition. The guidelines include required horizontal setbacks from drinking water wells, septic systems, underground storage tanks and known contamination sites; required vertical separation from seasonally high groundwater; and whether pretreatment prior to infiltration is required. Pretreatment can be provided by infiltration through surface soils, such as the use of an indirect infiltration BMP. **If the guidelines are not met, i.e., if there are any variances from the required setbacks or separations, SCVWD review and approval of the stormwater treatment plan is required.**

The lists below provide guidance as to the types of treatment BMPs and their limitations, if any. This information should be used in conjunction with the maps found in Appendix B that show where infiltration devices may be used.

Categorization of Treatment Control Measures

1. Category A – Infiltration Device BMPs (require SCVWD review and approval if Table D-1 guidelines are not met):
   a. Infiltration Basin
   b. Infiltration Trench
   c. Exfiltration Trench (including French Drain)
   d. Unlined Retention Basin
   e. Dry Well
   f. Unlined or open bottom vault/box below grade
   g. Permeable paving (if used to treat runoff from a tributary area)
2. Category B – BMPs using Indirect Infiltration (SCVWD review not required):
   a. Bioretention
   b. Wet Pond
   c. Lined Retention Pond/irrigation
   d. Landscape Detention
   e. Planter Boxes
   f. Permeable Pavement (if used only as a self-treating area)
3. Category C – Includes all other BMPs that discharge directly to storm drain and do not infiltrate stormwater (SCVWD review not required).

Table D-1
Stormwater Infiltration Device Guidelines

Site Use/Condition		Required Horizontal Setbacks (feet)				Required Vertical Separation from Seasonally High Groundwater (feet)	Pretreatment Required[i]
		Drinking Water Wells	Septic Systems	Underground Storage Tanks	Known Contamination Site[d]		
Residential	Single Residential Lot (<10,000 sq. feet)	Exempt from setback and separation requirements, however should still comply with construction and maintenance BMPs					
	Single Residential Lot (10,000 sq. feet to 1 acre)	600[e]	100[g]	Dependent upon depth to water[h]	Regulatory Agency Approval Required if within 1,500 feet	10	No
	Residential Subdivision (>1 acre)	600[e]	100[g]	Dependent upon depth to water[h]	Regulatory Agency Approval Required if within 1,500 feet	10	Individual Residences - No Runoff from Subdivision Roads - Yes
Commercial, Industrial, and Transportation	Transportation Corridor - Main Roads[a]	1,500[f]	100[g]	Dependent upon depth to water[h]	Regulatory Agency Approval Required if within 1,500 feet	30	Yes
	Transportation Corridor - Minor Roads[a]	1,500[f]	100[g]	Dependent upon depth to water[h]	Regulatory Agency Approval Required if within 1,500 feet	10	Yes
	Transportation Corridor - Other[a]	Not Allowed					
	High Risk Commercial/Industrial[b]	Not Allowed					
	Other Commercial/Industrial[c]	1,500[f]	100[g]	Dependent upon depth to water[h]	Regulatory Agency Approval Required if within 1,500 feet	30	Yes
Other	Known Contamination Site[d]	Not Allowed					

General Notes:

1. A stormwater infiltration device is any structure that is designed to bypass the natural filtration of surface soils and to transmit runoff directly to subsurface soils and eventually groundwater.

2. District review is required for any variances from the required setbacks or separations.

3. Wells used to inject non-hazardous fluids underground are Class V injection wells as defined by the USEPA. A Box Below Grade (BBG) or any infiltration basin or trench that includes a subsurface distribution system is also classified as a Class V injection well. All stormwater infiltration devices meeting the EPA definition of a Class V injection well must comply with the requirements of the EPA Underground Injection Control (UIC) Program. The USEPA defines a Class V injection well as any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface drainage dimension, or an improved sinkhole, or a subsurface fluid distribution system. For general information on the UIC program and regulation of stormwater wells visit http://www.epa.gov/safewater/uic/class5/pdf/fs_uic-class5_classvstudy_fs_storm.pdf.

Appendix E: SCVURPPP Maintenance Fact Sheets

Exfiltration Trench E-3

Planter Boxes E-5

Porous (Pervious) Pavement E-7

Roof Gardens E-10

The factsheets included in this appendix are supplementary to the maintenance fact sheets developed by CASQA. A complete set of CASQA maintenance fact sheets can be found at the following website:

http://www.scvurppp-w2k.com/Treatment_Control_BMPs.htm

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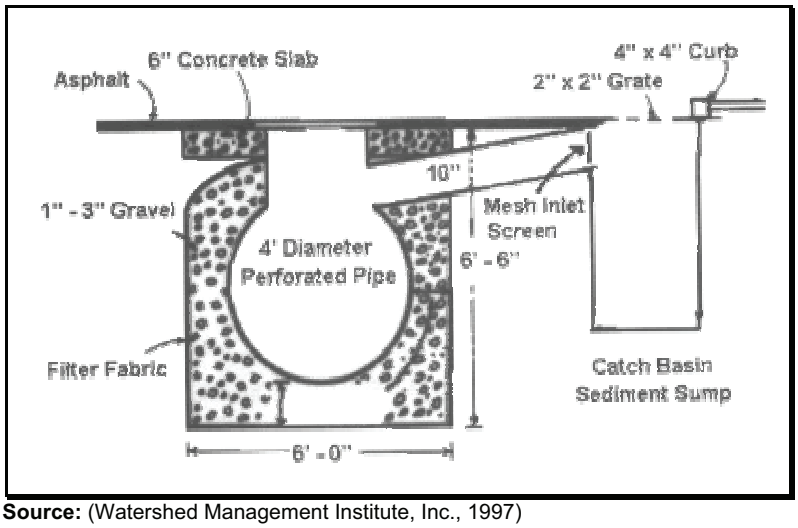
Exfiltration Trench



Source: (Watershed Management Institute, Inc., 1997)

General Description

Exfiltration trench consists of a perforated or slotted pipe laid in a bed of filter media, such as sand. They are similar to infiltration trenches with the exception they can be placed below paved surfaces such as parking lots and streets. The exfiltration trench performs well at removal of fine sediment and pollutants. Pretreatment using buffer strips or swales is important for limiting amount of coarse sediment entering the pipe, which can clog the surrounding filter media and render it ineffective.

Inspection/Maintenance Considerations

Successful operation depends on maintaining the percolation rate of the trench's sides and bottom. The keys to long-term performance are accurate estimation of percolation rate, proper construction, pretreatment, offline design, and maintenance accessibility. Frequency of clogging is dependent on effectiveness of pretreatment, such as vegetative buffer strips and street sweeping, at removing sediments. Accumulated sediments need to be removed from the pipe to allow percolation into filter media. If filter media becomes clogged, it can be expensive to remove pipe and replace media to allow for proper percolation.

Maintenance Concerns, Objectives, and Goals

- Accumulation of metals
- Clogged Soil Outlet Structures
- Vegetation/Landscape Maintenance

Targeted Constituents

✓	Sediment	■
✓	Nutrients	■
✓	Trash	■
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■
✓	Oxygen Demanding	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

Santa Clara Valley Urban Runoff Pollution Prevention Program

Inspection Activities	Suggested Frequency
■ Inspect to assure exfiltration trench was installed and working properly.	Immediately following construction
■ Inspect pretreatment BMP for potential erosion and sediment accumulation. ■ Inspect observation well to determine percolation rate. ■ Inspect pipe for accumulated sediments.	Annually, or as needed
Maintenance Activities	**Suggested Frequency**
■ Remove accumulated solids from pretreatment BMPs to prevent transport into trench. ■ Implement source controls, such as street sweeping and landscape practices, to reduce sediment transport. ■ Vacuum out sediment and debris that accumulated within exfiltration pipe. High pressure cleaning of the holes or slots in the pipes may be needed to reduce clogging. ■ Remove sediments which accumulate within the aggregate envelope, or replace aggregate if needed.	Annually, or as needed

References

Operations, Maintenance, and Management of Stormwater Management Systems (Watershed Management Institute, Inc., 1997)

Planter Boxes

Source: www.americastusa.com, 2003

General Description

There are two types of planter boxes: contained and infiltration/flow-through design. The contained planter boxes are designed to intercept rainfall and slowly drain through filter media and out of the planter. The infiltration and flow-through planter boxes are designed to intercept rainfall or receive runoff (e.g., downspout from rooftop), filter it through the planter, and allow infiltration into native soil (infiltration planter) or allow filtered runoff to be collected in a pipe and discharged off-site (flow-through planter). Pollution reduction is achieved as the water filters through the soil and plant roots. Water should drain through the planter within 3-4 hours after a storm event.

Inspection/Maintenance Considerations

Planter boxes require maintenance of filter media to allow uniform percolation of stormwater through planter. Vegetation needs to be kept healthy and dense enough to provide filtering function while protecting underlying soils from erosion. Obstructions and debris need to be removed from source of runoff (e.g., downspout) to allow unimpeded flow to the planter. All holes, cracks and damage to planter construction need to be repaired to maintain structural integrity of planter.

Maintenance Concerns, Objectives, and Goals

- Clogged Soil
- Vegetation Management
- Aesthetics

Targeted Constituents

✓	Sediment	■
✓	Nutrients	■
✓	Trash	
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■
✓	Oxygen Demanding	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

Santa Clara Valley *Urban Runoff* Pollution Prevention Program

Inspection Activities	Suggested Frequency
■ Inspect for proper construction. ■ Inspect for accumulated sediment/debris.	Immediately following construction As needed
■ Inspect runoff inlet structure to insure flow is unimpeded. Inspect rock splash pads to insure inflow is not creating erosion. ■ Inspect filter media for clogging and check that infiltration rate meets target (drains 3-4 hours after storm event). ■ Inspect planter box for structural deficiencies and needed repairs. ■ Inspect vegetation for health and check if plant growth is interfering with planter operation. Inspect irrigation to see if it is working properly. ■ Inspect overflow pipe for obstructions and debris.	Annually, or as needed
Maintenance Activities	**Suggested Frequency**
■ Excavate, clean and or replace filter media (sand, gravel, topsoil) to insure adequate infiltration rate. ■ Plug holes in planter that are not consistent with the original design. ■ Allow water to flow directly through the planter to the ground. ■ Remove litter and debris, including fallen leaves from deciduous plants and accumulated sediments from the planter. ■ Repair all cracks and structural deficiencies in planter. ■ Add mulch to planter soil. ■ Replant, and prune or remove plants that interfere with planter operation.	Annually, or as needed

References

Stormwater Management Manual, Chapter 6, O & M Requirements, City of Portland, 2002.

Porous Pavement

Source: (Ohio Dept of Natural Resources, 2003)

General Description

Porous pavement is a permeable pavement surface that allows surface runoff to infiltrate into the subsoil. Stone reservoirs are often constructed below pavement to temporarily store surface runoff prior to infiltration; or are used to collect stormwater in underlying drain pipes prior to discharge off-site. Pollutants are removed by absorption onto soil particles and by bacterial decomposition in the reservoir or in surface soils. There are many types of porous pavement including: turf blocks (grass planted through load-bearing plastic or concrete frame), modular blocks (stone or concrete blocks interspersed with pervious material such as gravel or sand), granular pavement (crushed aggregrate with wood mulch and cobbles), porous asphalt, and pervious concrete.

Inspection/Maintenance Considerations

Successful operation of porous pavement depends on maintaining the percolation rate of the porous spaces in the pavement surface and in the underlying base and soils. Keys to assuring long-term performance are accurate estimation of the soil's percolation rate, proper construction, and regular maintenance. Porous pavements have a tendency to clog with fine particulate matter. Once clogged, it is very difficult and expensive to rehabilitate, often requiring complete replacement. The production and transport of fine particulate matter and debris from adjacent areas should be managed using pretreatment BMPs.

Porous asphalt and concrete should be regularly swept and/or vacuumed to maintain porosity. High pressure jet hosing should be used less frequently to "deep clean" voids and help restore permeability. If porous pavement continues to clog, rehabilitation (e.g., drilling holes through pavement) or replacement may be need. Spills of gasoline or other potentially hazardous materials can lead to soil or groundwater contamination. Spills must be immediately vacuumed, followed by jet washing.

Maintenance Concerns, Objectives, and Goals

- Reduced porosity from clogging
- Limit erosion / sedimentation from adjacent area
- Keep pavement surface clean from debris and sediment

Targeted Constituents

✓	Sediment	■
✓	Nutrients	■
✓	Trash	
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	
✓	Organics	■
✓	Oxygen Demanding	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

Santa Clara Valley Urban Runoff Pollution Prevention Program

Inspection Activities	Suggested Frequency
■ Inspect to assure pavement was installed and working properly. ■ Inspect adjacent areas for potential erosion or damage to vegetation.	Post-construction
■ Visibly inspect surface after major storm event for evidence of debris, ponding of water, oil-dripping accumulations, clogging of pores, and other damage. ■ Inspect overflow devices (pipes) for obstructions or debris that would prevent proper drainage when filtration capacity is exceeded. ■ Inspect for bare areas in grass coverage of turf block and other filter media (e.g. sand, gravel, and mulch) ■ Inspect porous asphalt and concrete surfaces to determine if debris, organic matter and sediment are clogging pore spaces.	Annually, after large storms
Maintenance Activities	**Suggested Frequency**
■ Remove excess sediment from construction area and stabilize adjacent areas with vegetation.	Post-construction
■ Prevent soil from being washed onto pavement. Keep landscape areas well maintained. ■ Rake and remove fallen leaves and debris from deciduous trees and shrubs to reduce the risk of clogging. ■ Mow grass in turf blocks to less than four inches and remove grass clippings. Mowing is generally not required in areas of frequent traffic. Avoid use of fertilizers and pesticides. Reseed bare spots. ■ Remove debris and clear obstructions from overflow devices (pipes). ■ Re-supply pervious material between modular pavements, which may include sand, gravel or mulch.	Annually, as needed
■ Vacuum sweep porous asphalt or concrete systems (with proper disposal of removed material), followed by high-pressure hosing to free pores on the surface.	2-3 times per year
■ If ponding persists, clogged concrete and asphalt pavement can be restored by drilling holes, 0.25 inch in diameter on one-foot centers. Sections of porous pavement can be saw cut and removed, along with replacement of subbase if ponding persists.	As needed (infrequent)

Additional Information

The maintenance requirements of a pervious surface will depend on 1) type of use, 2) ownership, 3) level of traffic, and 4) the local environment and contributing catchments.

References

Operations, Maintenance, and Management of Stormwater Management Systems (Watershed Management Institute, Inc., 1997)

Stormwater Management Manual, Chapter 6, O & M Requirements, City of Portland, 2002.

Guidance on Selection of Stormwater Quality Control Measures, City of San Jose, Department of Planning, Building and Code Enforcement, 1998

Porous Pavement

Storm Water Technology Fact Sheet. EPA 832-F-99-023, September 1999.

Niemczynowicz J, Hogland W, 1987. Test of porous pavements performed in Lund, Sweden, in Topics in Drainage Hydraulics and Hydrology. BC Yen (Ed), pub. Int. for Hydraulic Research, pp 19-80.

Roof Gardens

Source: www.map21ltd.com, 2003

Maintenance Concerns, Objectives, and Goals

- Clogged Soil
- Vegetation Management
- Energy Conservation
- Aesthetics

General Description

Roof gardens, or green-roofs, are vegetated roof systems that retain and filter stormwater and provide aesthetic and energy conservation benefits. A green roof is built on top of a new or existing roof and consists of a special root repelling membrane, a drainage system, a lightweight growing medium and plants.

Inspection/Maintenance Considerations

Rooftop gardens need to be watered and weeded, similar to any other garden. The frequency of watering will depend on types of plants used and climate conditions. Irrigation systems need to be checked for proper operations, including water leaks and proper drainage. Water not absorbed into soil and plants must be effectively transported and drained from the rooftop. Drainage systems need to be inspected, including gutters, downspouts, drains and screens that prevent erosion to growing media and clogging of drainage pipes. Roof systems need to be inspected for water damage.

Targeted Constituents

✓	Sediment	■
✓	Nutrients	■
✓	Trash	●
✓	Metals	■
✓	Bacteria	■
✓	Oil and Grease	■
✓	Organics	■
✓	Oxygen Demanding	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

Santa Clara Valley Urban Runoff Pollution Prevention Program

Inspection Activities	Suggested Frequency
■ Inspect to ensure irrigation and drainage systems are working properly.	Immediately following construction
■ Inspect for evidence of erosion from wind or water. ■ Inspect automated irrigation systems for leaks or malfunctions. ■ Inspect drainage inlets to roof drainage system for obstructions. ■ Inspect vegetation for health and check if plant growth is interfering with planter operation. ■ Inspect membrane and roof structure for proper operations.	Monthly, or as needed
Maintenance Activities	**Suggested Frequency**
■ Replace plants once per month as needed during establishment period.	Post-construction
■ Supplement soil substrate/growth medium and control any existing erosion. ■ Remove obstructions from drainage inlet. Repair or replace drain inlet pipe. ■ Remove all fallen leaves and debris from surrounding roof area. ■ Remove dead vegetation and weeds. Do not use pesticides or herbicides. Replace plants to maintain 90% plant cover. ■ Repair or replace parts of irrigation systems. Test automated systems to ensure proper operation.	Monthly, or as needed

References

Stormwater Management Manual, Chapter 6, O & M Requirements, City of Portland, 2002.

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Appendix F: Flow-based and Volume-Based Sizing Examples

BMP Sizing Example for Building 1 Redevelopment F-3

Volume Method 1: Urban Runoff Quality Management (URQM) Approach Example F-4

Volume Method 2: California Storm Water BMP Handbook Approach Example F-5

Volume Method 3: ADAPTED California Storm Water BMP Handbook Approach Example F-6

Flow Method 1: Factored Flow Approach Example F-7

Flow Method 2: California BMP Approach Example F-8

Flow Method 3: Uniform Intensity Approach Example F-9

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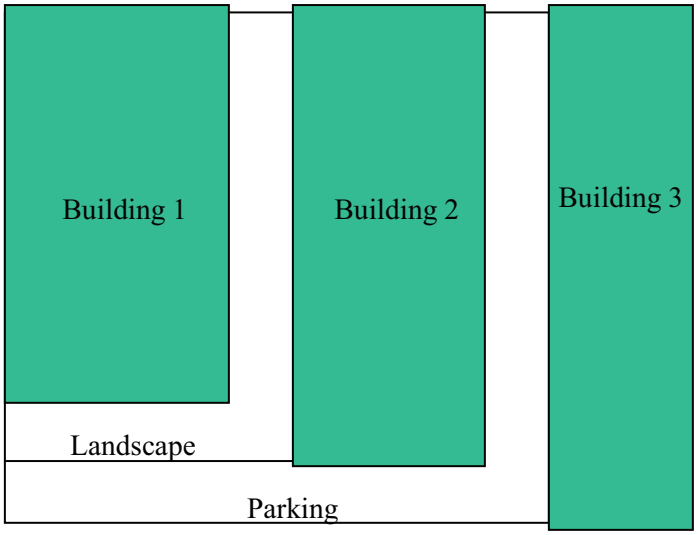
BMP Sizing Example for Building 1 Redevelopment

Original Site Description

Building 1 = 30,000 ft^2
Building 2 = 36,000 ft^2
Building 3 = 24,000 ft^2
Parking = 19, 000 ft^2
Landscaping = 15,000 ft^2
Total Site = 124,000 ft^2
Total Impervious Surface = 109,000 ft^2
50% of Impervious surface =54,500 ft^2



Assumptions

Imperviousness of Building 1: i = 1 (100% impervious)

Roof dimensions of Building 1: 100-feet x 300-feet

Area of Building 1 = 30,000 square feet x (1 acre/43,560 square feet) = 0.69 acres

Length from farthest point on roof to downspout (discharge point – assuming downspout discharges directly to BMP) = 300-feet

Slope of roof = 0.5%

Project is in southern Sunnyvale with Silt Loam soils

Volume Method 1: Urban Runoff Quality Management (URQM) Approach Example

Step		Step	Value	Units
1	Mean storm precipitation volume at Sunnyvale (P_6): (Based on rainfall intensity at San Jose airport = 13.9 inches and Event Rainfall vs. Mean Annual Rainfall)	1	0.5	inches
2	Calculate runoff coefficient (C) for i = 1 using: $C = 0.858(i^3) - 0.78(i^2) + 0.77(i) + 0.04$	2	0.89	unit less
3	Select time to drain BMP Usually 48 hours, 24 hours, or 12 hours (Use 48 hours as most conservative) and enter appropriate Regression constant (a): If drain time is 48 hours, enter 1.963 on Step 3 If drain time is 24 hours, enter 1.582 on Step 3 If drain time is 12 hours, enter 1.312 on Step 3	3	1.963	unit less
4	Determine the area that will drain to BMP (1 acre = 43,560 sq ft):	4	0.69	acres
5	Calculate detention storage volume (P_0) from: P_0 = a C P_6	5	0.87	inches
6	BMP volume required: Multiply Step 4 by Step 5 Conversion: 1 acre-inch = 3,630 cubic feet	6	0.60	acre-inches

Volume Method 2: California Storm Water BMP Handbook Approach Example

Step		Step	Value	Units
1	Calculate composite runoff coefficient (C): $C_{combined} = \frac{(\text{area-1 (acres)} \times \text{C-1}) + (\text{area-2} \times \text{C-2}) + \ldots}{\text{total area (acres)}}$ See **Appendix F, Table 1** for typical C-factors	1	0.80	unit less
2	Select the appropriate Capture vs. Unit Basin Storage Volume chart (**Appendix F, Figure 2a or Figure 2b**) based on time to drain BMP: Usually 48 hours or 24 hours (48 hours as most conservative)	2	Figure 2a	
3	Estimate Unit Basin Storage Volume a. Enter vertical axis of chart with % of runoff capture (80% minimum) b. Move horizontally right until intersection with the curve corresponding to the runoff coefficient determined in Step 1 (interpolation between curves may be necessary). c. Move down vertically from the intersection point (or interpolated intersection point) d. Read off the corresponding Unit Basin Storage Volume.	3	0.5	Inches
4	Determine the area that will drain to BMP	4	0.69	acres
5	BMP volume required:	5	0.345	acre-inches

Volume Method 3: ADAPTED California Storm Water BMP Handbook Approach Example

Step		Step	Value	Units
1	Percent imperviousness: Determine percent imperviousness for the area draining to the BMP.	1	100	%
2	Determine Soil Type from: **Appendix F, Figure 3**, **Map of Soil textures in Santa Clara Valley**: Loam, Sandy Loam, Silt Loam, Clay, or Clay Loam. North Sunnyvale is typically clay and South Sunnyvale is typically Silt Loam	2	Silt Loam	N/A
3	Estimate Unit Basin Storage Volume for 80% capture: a. Enter horizontal axis of **Appendix F, Figure 4**, Unit basin Storage for 80% capture vs. % Imperviousness chart with value from Step 1 b. Move vertically until intersection with the curve corresponding to the soil type determined in Step 2. c. Move horizontally left from the intersection point and read off the corresponding Unit Basin Storage Volume for 80% capture.	3	0.58	inches
4	Determine the area that will drain to BMP:	4	0.69	acres
5	BMP volume required from: *(Unit Basin Storage for 80% Capture) x·(Area that drains to BMP)*	5	0.40	acre-inches

Method based on SCVURPPP C.3 Stormwater Handbook, Sizing Criteria Worksheets.

Flow Method 1: Factored Flow Approach Example

Step		Step	Value	Units
1	Time of concentration:			

	Length (L) (feet)	Ground Type	Slope (S) (%)	T_c* (minutes)
1a	300	roof top	0.5	7.8 (Used (a) below

* T_c = Time of concentration - use any of the following to estimate T_c:

a) **Appendix F, Figure 5**, Overland Flow Time nomograph (L<= 1000 feet)

b) **Appendix F, Figure 6**, Velocities for Upland Method of Estimating T_c (L>1000 feet)
Divide length by velocity to find T_c.

c) Manning's equation (for pipe or channel flows)
Divide length by velocity to find T_c.

Step	Value	Units
1	0.13	hours

2 Estimate Rainfall Intensity:

a. Enter **Appendix F, Figure 7**, Intensity vs. Duration chart with Time of Concentration value from line 1 (Duration = Time of Concentration)

b. Move vertically until intersection with the curve.

c. Move horizontally left from the intersection point

d. Read off the corresponding intensity value. **If time of concentration < 0.5 hours, use rainfall intensity of 2 inches.**

Step	Value	Units
2	2	inches

3 Factored Intensity for 10 percent:
Multiply Step 2 by 0.10.

Step	Value	Units
3	0.2	inches

4 Calculate runoff coefficient (C):

$$C_{combined} = \frac{(\text{area-1 (acres)} \times \text{C-1}) + (\text{area-2} \times \text{C-2}) + \ldots}{\text{total area (acres)}}$$

See **Appendix F, Table 1** for typical C-factors

Step	Value	Units
4	0.80	unit less

5 Determine the area that will drain to BMP:

Step	Value	Units
5	0.69	acres

6 Design Flow (Q = Cia):
Multiply Step 3 by Step 4 and by Step 5

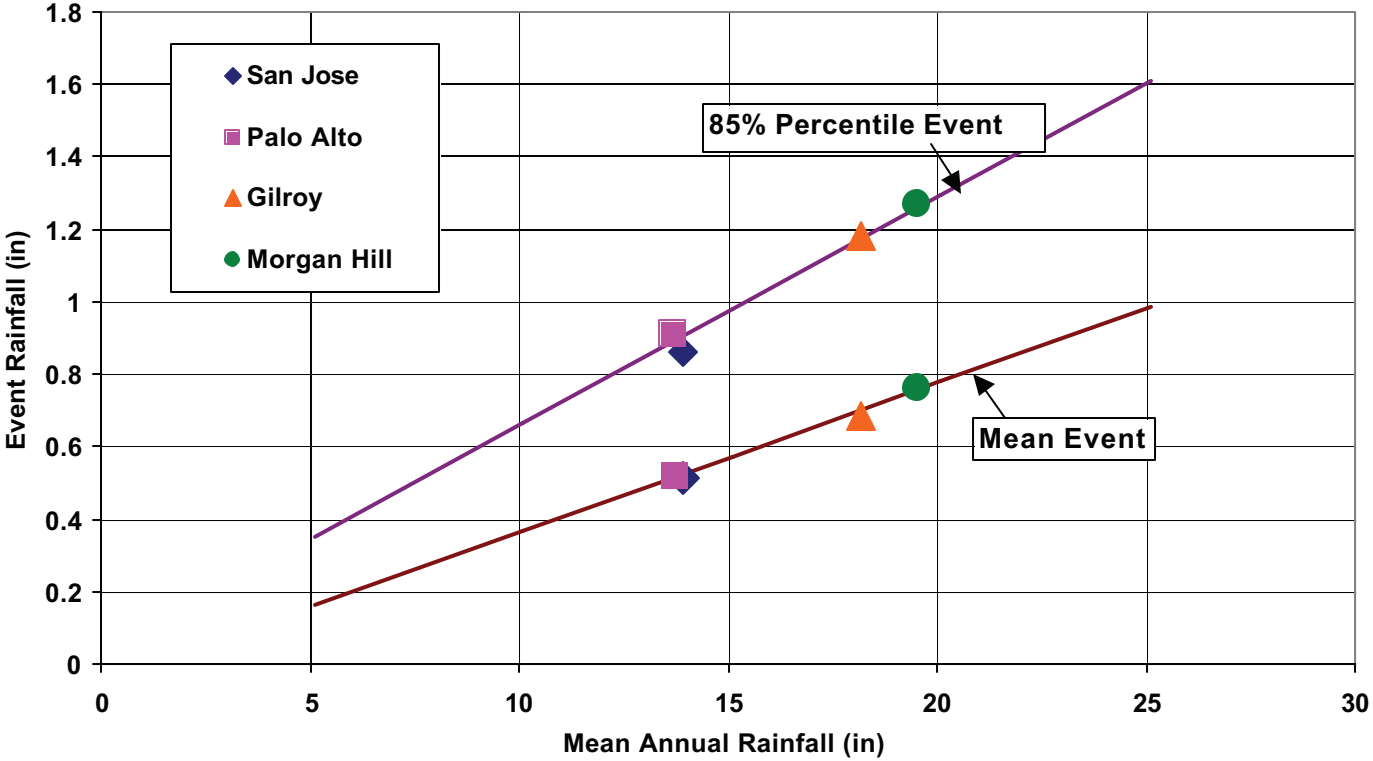
Step	Value	Units
6	0.11	cfs

Flow Method 2: California BMP Approach Example

Step		Step	Value	Units
1	Estimate Rainfall Intensity: California BMP Handbook recommends 2 x 85th percentile hourly rainfall intensity which equals 0.21 in/hr for Sunnyvale.	1	0.21	in/hr
2	Calculate runoff coefficient (C): $C_{combined} = \frac{(\text{area-1 (acres)} \times \text{C-1}) + (\text{area-2} \times \text{C-2}) + \ldots}{\text{total area (acres)}}$ See **Appendix F, Table 1** for typical C-factors	2	0.80	unit less
3	Estimate the area that will drain to BMP:	3	0.69	acres
4	Design Flow (Q = Cia): Multiply line 1 by line 2 and by line 3	4	0.12	cfs

Flow Method 3: Uniform Intensity Approach Example

Step		Step	Value	Units
1	Rainfall Intensity: Runoff flow is based on rainfall event that is at least 0.2 inches per hour.	1	0.2	in/hr
2	Calculate runoff coefficient (C): $C_{combined} = \frac{(\text{area-1 (acres) x C-1}) + (\text{area-2 x C-2}) + \ldots}{\text{total area (acres)}}$ See **Appendix F, Table 1** for typical C-factors	2	0.80	unit less
3	Determine the area that will drain to BMP:	3	0.69	acres
4	Design Flow (Q = Cia): Multiply line 1 by line 2 and by line 3	4	0.11	cfs



85th Percentile Storm Depth vs. Mean Annual Rainfall

Table F-1: Typical C Factors

Surface	C-factor
Concrete, roof-tops	0.80
Asphalt	0.70
Pervious concrete	0.60
Cobbles	0.60
Pervious asphalt	0.55
Natural stone without grout	0.25
Turf block	0.15
Brick without grout	0.13
Unit pavers on sand	0.10
Crushed aggregate	0.10
Grass	0.10
Grass over porous plastic	0.05
Gravel over porous plastic	0.05

Source: Bay Area Stormwater Management Agencies Association. May 2003. Using Site Design Techniques to Meet Development Standards for Stormwater Quality.

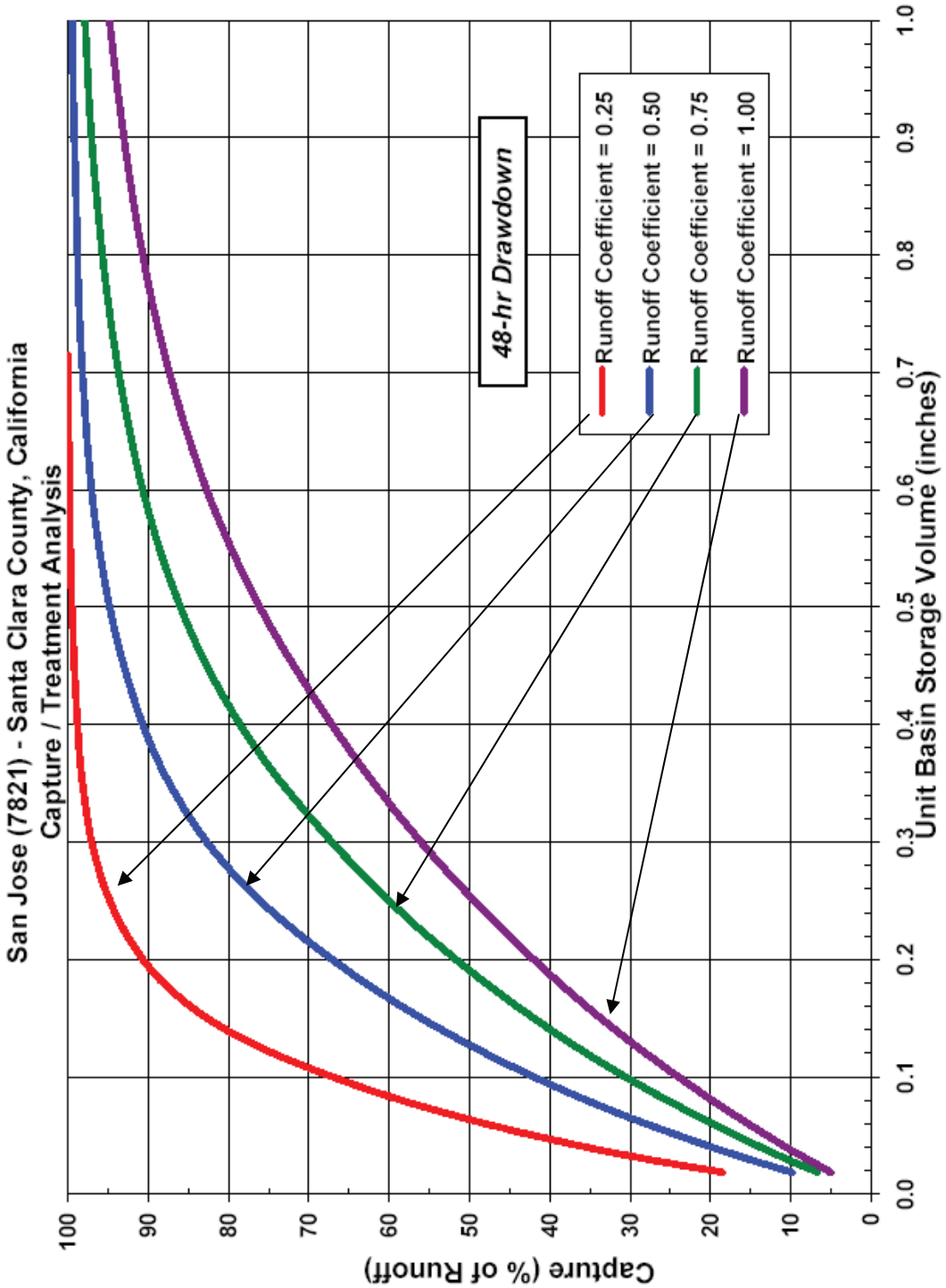


Figure 2a – Capture Curve for 48-hour Draw Down

Source: California Stormwater Quality Association. January 2003. Stormwater Best Management Practice Handbook, New Development and Redevelopment.

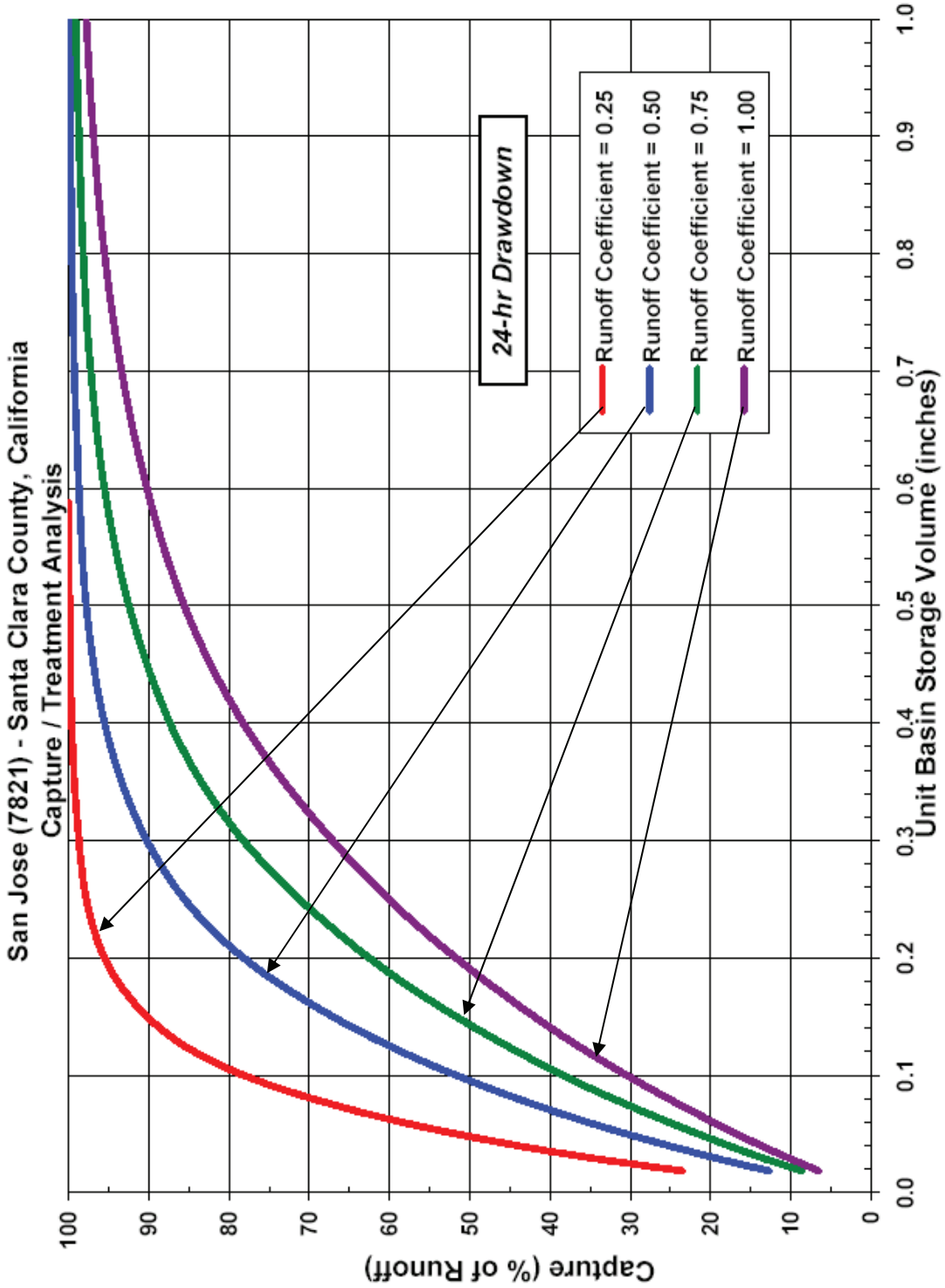
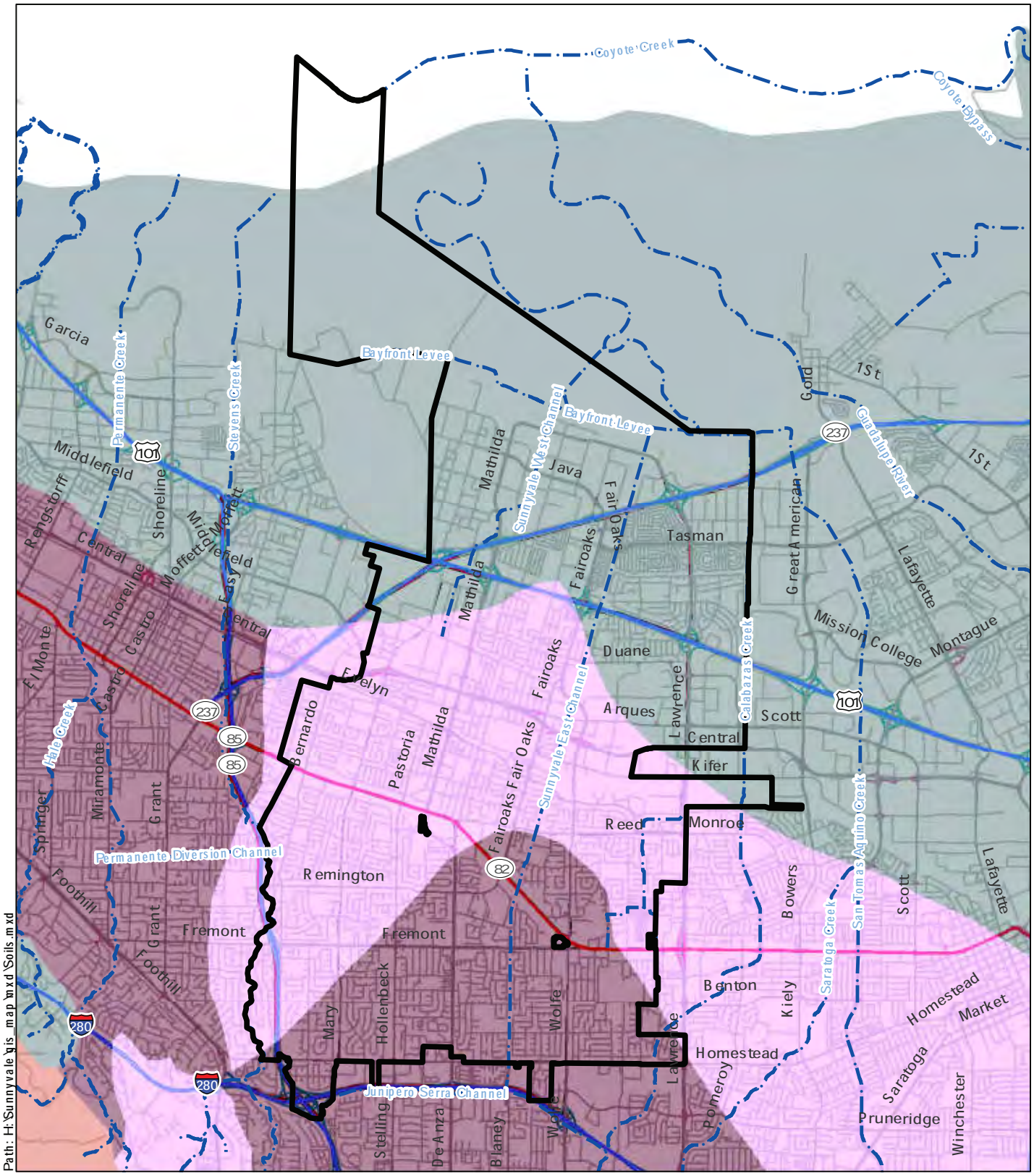


Figure 2b – Capture Curve for 24-hour Draw down

Source: California Stormwater Quality Association. January 2003. Stormwater Best Management Practice Handbook, New Development and Redevelopment.



Path: H:\Sunnyvale\gis_map\mxd\Soils.mxd

Legend

- Clay (D)
- Clay Loam (D)
- Loam (B)
- Sandy Clay (D)
- Silt Loam (B)
- City Boundary
- Creeks

N

0 1

Miles

Kennedy/Jenks Consultants

Santa Clara Valley Water District
City of Sunnyvale, Stormwater BMP
Guidance Manual

Soils Map

December 2011

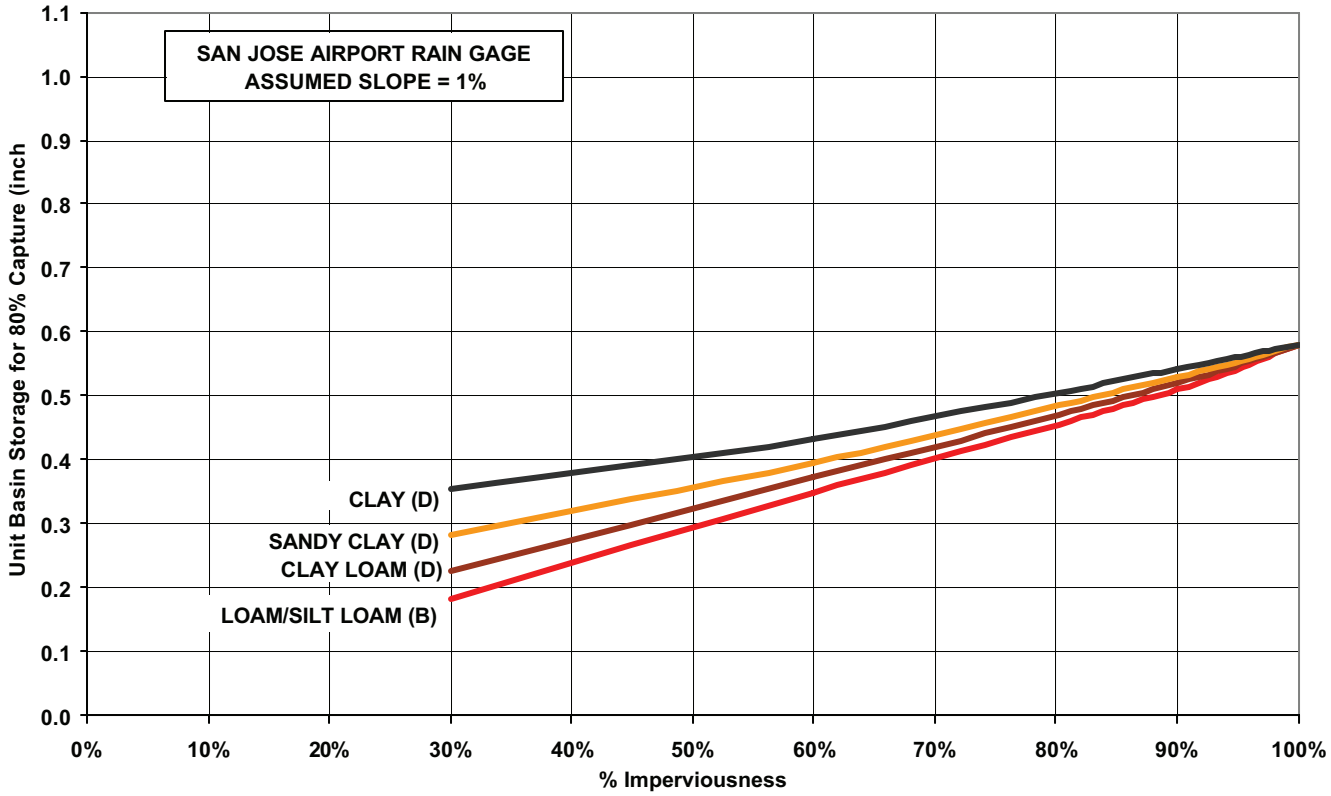


Figure 4 Unit Basin Volume for 80% Capture - **San Jose Airport** Rain Gage

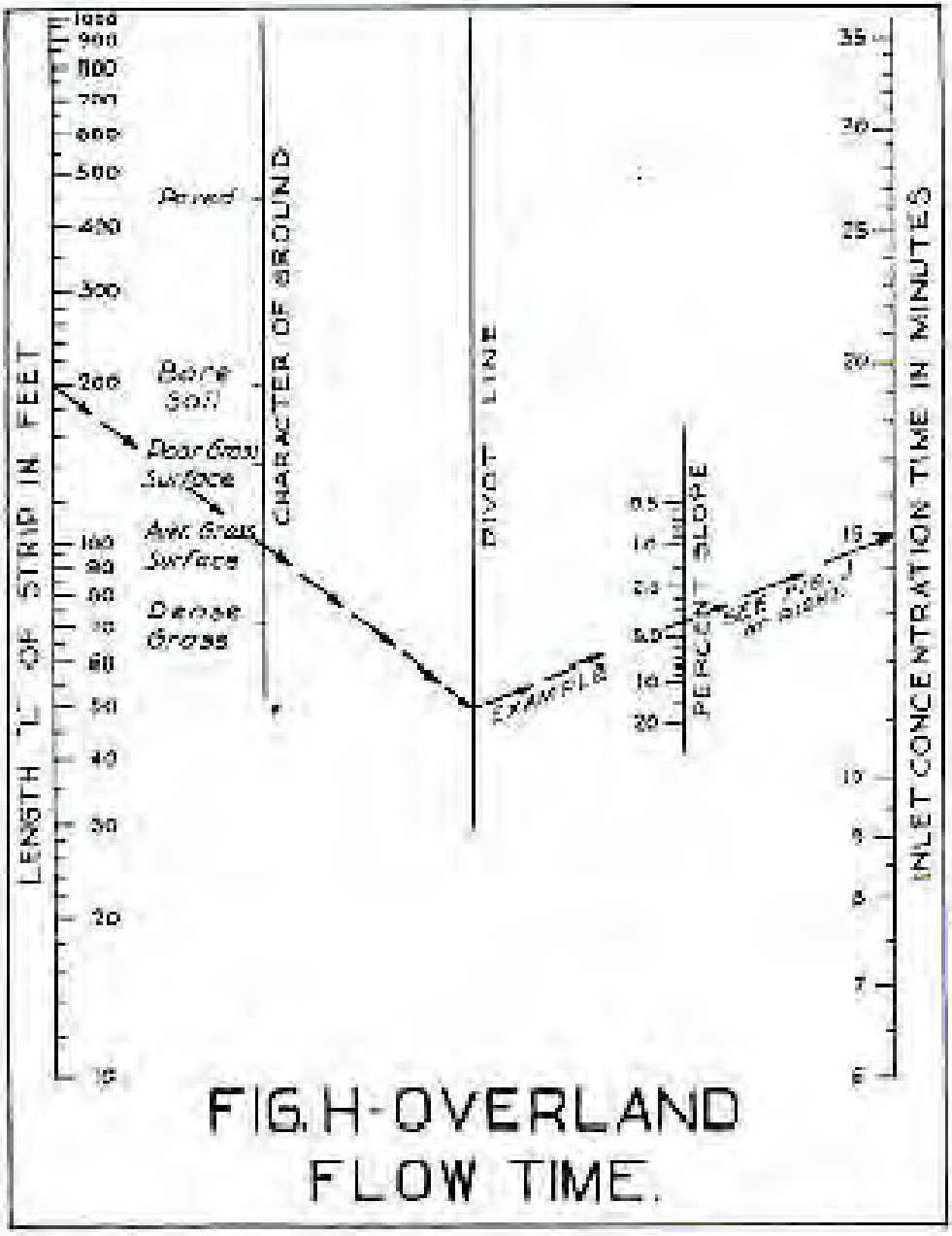


Figure 5 – Overland Flow Time

Source: Seelye, Elwyn E. 1945. Data Book for Civil Engineers, Design, Volume 1. John Wiley and Sons, Inc. New York.

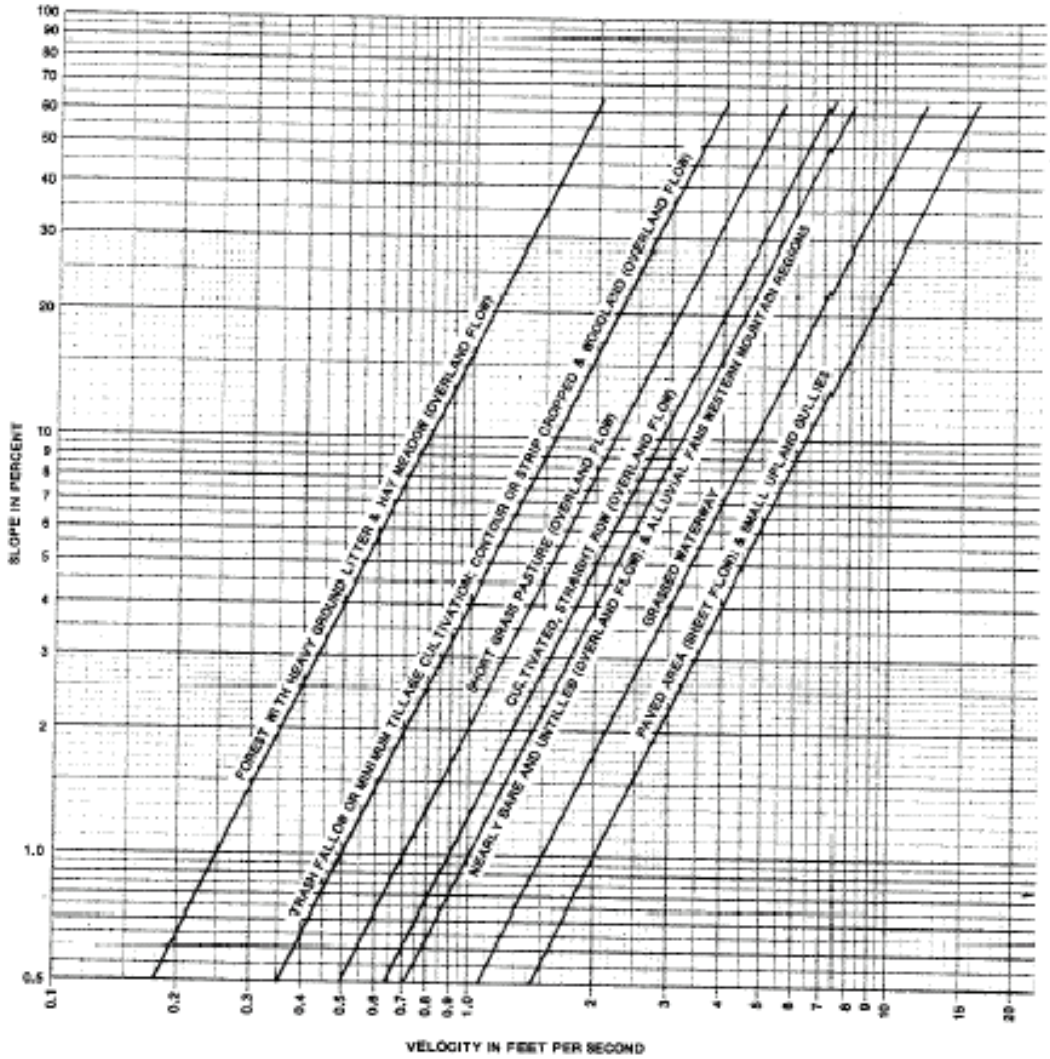


Figure 6 - Velocities for Upland Method of Estimating T_c

Source: Kent, Kenneth M. 1972. National Engineers Handbook, Section 4 Hydrology, Chapter 15 Travel Time, Time of Concentration and Lag. United States Department of Agriculture, Natural Resources Conservation Service.

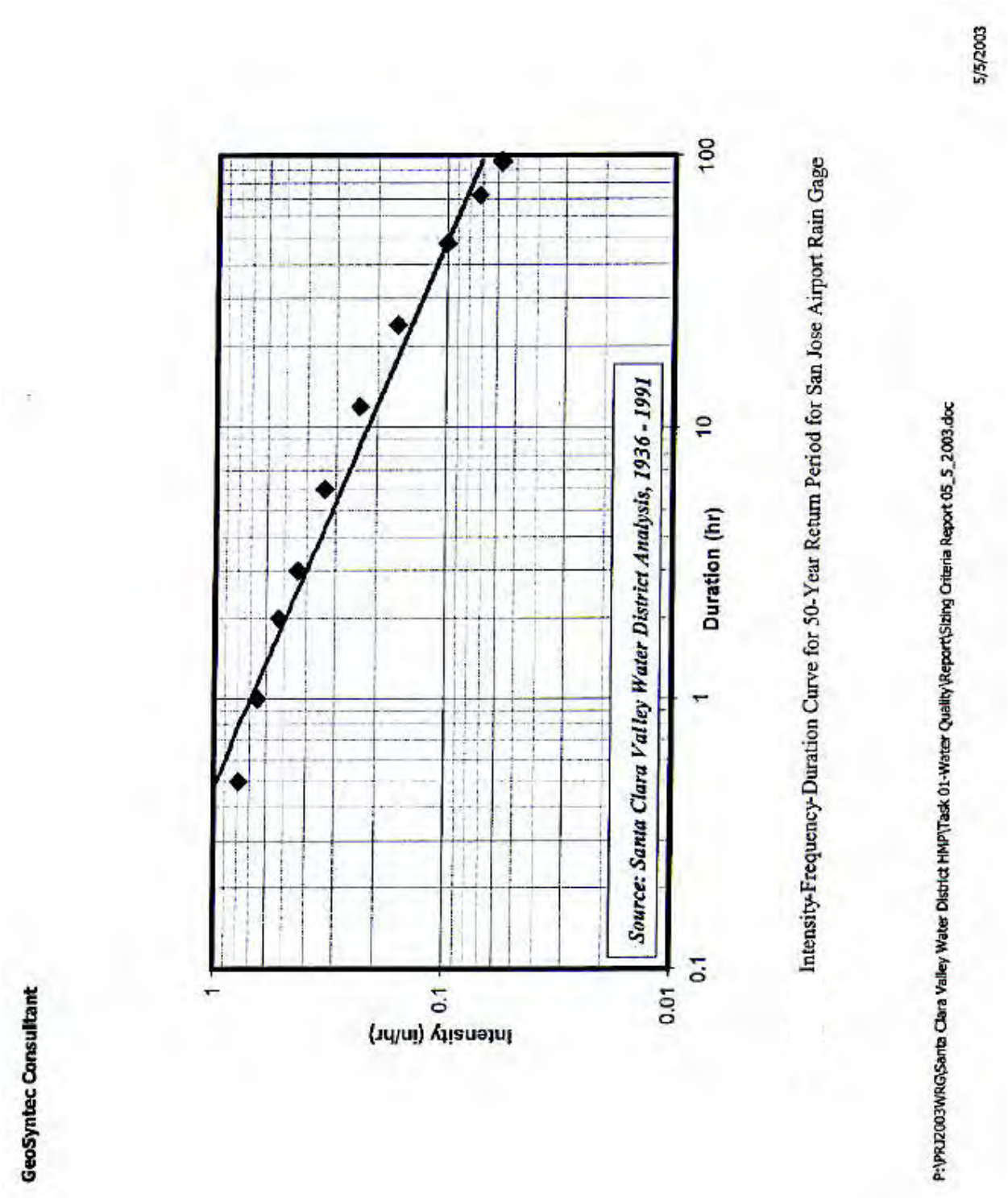


Figure 7 – IDF Curve for 50-Year Return Period for San Jose Airport Rain Gauge

Source: Geosyntec Consultants. May 2003. Draft Report, Sizing Criteria for Stormwater Treatment.

Appendix G: Post-Construction Inspection Checklist Example

StormWater Treatment Control Measure (TCM)/ Hydromodification (HM) Control Installation Inspeciton G-3

Treatment Control Measure (TCM)/Hydromodification (HM) Control Data Sheet G-4

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STORM WATER TREATMENT CONTROL MEASURE (TCM)/ HYDROMODIFICATION (HM) CONTROL INSTALLATION INSPECTION

THE FOLLOWING STORM WATER DEVICES SHALL BE INSPECTED WITHIN 45 DAYS OF INSTALLATION

Inspection Date:_____ **Inspector:** _____

SITE INFORMATION

Site Address: _____

Site Project Number: _____

Location of Treatment Control Measure: ❑ On-Site ❑ Off-Site (public right-of-way)

INSPECTION RESULTS

Treatment Control Measure Inspected	Location/ Area	Date Installed	Installed in Accordance with Approved Plans?
❑ Basin			
❑ Bioretention Area			
❑ Green Roof			
❑ Hydrodynamic Separator (HDS)			
❑ Infiltration Trench			
❑ Media Filter System			
❑ Permeable Paving			
❑ Planter Box			
❑ Sand Filter			
❑ Swale (Vegetated/ Bioswale)			
❑ Tree Filter			
❑			

NOTES

_____

_____

_____

_____

Inspector Signature _____

Treatment Control Measure (TCM)/Hydromodification (HM) Control Data Sheet

BASIN
Grading
Width, Length & Depth
Outflow & Inlet
Inflow & Inlet
Drain Rock/Riprap @ Inlet
Weir & Orifice in Manhole/Inlet
Correct Orifice Size/Opening
Vegetation

BIORETENTION AREA
Grading
Width, Length & Depth
Perforated Pipe (size, slope, connection)
Inlet and/or Curb Opening
Drain Rocks/Riprap @ Inlet
Overflow Inlet – Pipe / Connection
Vegetation
Minimum Ponding Depth

GREEN ROOF
Drainage (pipe)
Roofing Membrane / Water Proofing
Drainage Layer
Filter Fabric
Planting Soil
Vegetation

HYDRODYNAMIC SEPARATOR (HDS)
Base Rock
Correct Manufacture & Model
Correct Number of Connection (in and out)
Correct Pipe Size Connected
Test(s) Performed
Sign Off from Manufacturer's Representative

INFILTRATION TRENCH
Width, Length & Depth
Depth of Material Section(s)
Observation Well
Overflow Facility
Filter Fabric – Side Only
Test Performed / Drainage Working

MEDIA FILTER SYSTEM
Placement / Installation
Correct Manufacture & Model
Correct Number of Cartridges
Inflow & Outflow Pipe Connections
Flow Not Bypassing Facility
Sign Off from Manufacturer's Representative
Test Performed

PERMEABLE PAVING
Grading
Perforated Pipe & Correct Size
Depth of Material Section – Aggregate Base
Depth of Material Section – San (if applicable)
Depth of Material Section – AC or Concrete Pavers (if applicable)
Test Performed / Drainage Working

PLANTER BOX
Correct Box Size (width, depth & length)
Depth of Drain Rocks
Media Section (soil & mulch) & Depth
Outflow Pipe & Inlet
Inflow Pipe & Inlet
Test Performed / Drainage Working
Vegetation

SAND FILTER
Grading
Sand Filter Material
Drain Rocks
Filter Fabric
Outflow Pipe & Inlet
Inflow Pipe & Inlet
Test Performed / Drainage Working

SWALE (Vegetated & Bioswale)
Grading
Width, Depth & Length of Swale
Side Slope (1:3 max.)
Drain Inlet (correct location and elevation)
Drain Rocks / Riprap @ Inlet or Curb Opening
Vegetation
Test Performed / Drainage Working

TREE FILTER
Correct Location
Correct Manufacturer & Model
Media Section & Depth
Bypass Inlet (if shown on plans)
Vegetation

Appendix H: Special Projects Worksheet

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Special Projects Worksheet

Project Name:

Project Address:

Applicant/Developer Name:

1. "Special Project" Determination:

Special Project Category "A"

Does the project have ALL of the following characteristics?

- ☐ Located in a municipality's designated central business district, downtown core area or downtown core zoning district, neighborhood business district or comparable pedestrian-oriented commercial district, or historic preservation site and/or district[1];
- ☐ Creates and/or replaces 0.5 acres or less of impervious surface;
- ☐ Includes no surface parking, except for incidental parking for emergency vehicle access, ADA access, and passenger or freight loading zones;
- ☐ Has at least 85% coverage of the entire site by permanent structures. The remaining 15% portion of the site may be used for safety access, parking structure entrances, trash and recycling service, utility access, pedestrian connections, public uses, landscaping and stormwater treatment.

☐ No (continue) ☐ Yes – complete Section 2 of the Special Project Worksheet

Special Project Category "B"

Does the project have ALL of the following characteristics?

- ☐ Located in a municipality's designated central business district, downtown core area or downtown core zoning district, neighborhood business district or comparable pedestrian-oriented commercial district, or historic preservation site and/or district[1];
- ☐ Creates and/or replaces an area of impervious surface that is greater than 0.5 acres, and no more than 2.0 acres;
- ☐ Includes no surface parking, except for incidental parking for emergency access, ADA access, and passenger or freight loading zones;
- ☐ Has at least 85% coverage of the entire site by permanent structures. The remaining 15% portion of the site may be used for safety access, parking structure entrances, trash and recycling service, utility access, pedestrian connections, public uses, landscaping and stormwater treatment;
- ☐ Minimum density of either 50 dwelling units per acre (for residential projects) or a Floor Area Ratio (FAR) of 2:1 (for commercial or mixed use projects)

☐ No (continue) ☐ Yes – complete Section 2 of the Special Project Worksheet

Special Project Category "C"

Does the project have ALL of the following characteristics?

- ☐ At least 50% of the project area is within 1/2 mile of an existing or planned transit hub[2] or 100% within a planned Priority Development Area[3];
- ☐ The project is characterized as a non-auto-related use[4]; and
- ☐ Minimum density of either 25 dwelling units per acre (for residential projects) or a Floor Area Ratio (FAR) of 2:1 (for commercial or mixed use projects)

☐ No ☐ Yes – complete Section 2 of the Special Project Worksheet

---

[1] And built as part of a municipality's stated objective to preserve/enhance a pedestrian-oriented type of urban design.

[2] "Transit hub" is defined as a rail, light rail, or commuter rail station, ferry terminal, or bus transfer station served by three or more bus routes. (A bus stop with no supporting services does not qualify.)

[3] A "planned Priority Development Area" is an infill development area formally designated by the Association of Bay Area Government's / Metropolitan Transportation Commission's FOCUS regional planning program.

[4] Category C specifically excludes stand-alone surface parking lots; car dealerships; auto and truck rental facilities with onsite surface storage; fast-food restaurants, banks or pharmacies with drive-through lanes; gas stations; car washes; auto repair and service facilities; or other auto-related project unrelated to the concept of transit oriented development.

2. LID Treatment Reduction Credit Calculation:

Category	Impervious Area Created/Replaced (acres)	Site Coverage (%)	Project Density or FAR	Density/Criteria	Allowable Credit (%)	Applied Credit (%)
A			N.A.	N.A.	100%	
B				Res ≥ 50 DU/ac or FAR ≥ 2:1	50%	
				Res ≥ 75 DU/ac or FAR ≥ 3:1	75%	
				Res ≥ 100 DU/ac or FAR ≥ 4:1	100%	
C				**Location credit (select one)[5]:**		
				Within ¼ mile of transit hub	50%	
				Within ½ mile of transit hub	25%	
				Within a planned PDA	25%	
				Density credit (select one):		
				Res ≥ 30 DU/ac or FAR ≥ 2:1	10%	
				Res ≥ 60 DU/ac or FAR ≥ 4:1	20%	
				Res ≥ 100 DU/ac or FAR ≥ 6:1	30%	
				Parking credit (select one):		
				≥ 10% at-grade surface parking[6]	10%	
				No surface parking	20%	
				TOTAL TOD CREDIT =		

[5] To qualify for the location credit, at least 50% of the project's site must be located within the ¼ mile or ½ mile radius of an existing or planned transit hub, as defined on page 1, footnote 2. A planned transit hub is a station on the MTC's Regional Transit Expansion Program list, per MTC's Resolution 3434 (revised April 2006), which is a regional priority funding plan for future transit stations in the San Francisco Bay Area. To qualify for the PDA location credit, 100% of the project site must be located within a PDA, as defined on page 1, footnote 3.

[6] The at-grade surface parking must be treated with LID treatment measures.