

## General Technical Guidance for Treatment Measures

### *This Chapter contains guidance on:*

- ▶ *Hydraulic sizing criteria,*
- ▶ *Applicability of various manufactured treatment measures,*
- ▶ *“Treatment trains,”*
- ▶ *Using Infiltration,*
- ▶ *Low-flow systems,*
- ▶ *Plant selection/maintenance in landscape-based treatment measures,*
- ▶ *Mosquito control requirements,*
- ▶ *Incorporating treatment with hydromodification management measures,*
- ▶ *Treatment measures in areas of Bay fill, and*
- ▶ *Treatment measures in seismic hazard areas.*

This general technical information in this section applies to the full range of stormwater treatment measures for all types of new development and redevelopment projects. See Chapter 6 for technical guidance on specific types of stormwater treatment measures.

### 5.1 Hydraulic Sizing Criteria

#### Key Point



Stormwater treatment measures must be sized to treat stormwater runoff from **relatively small sized storms** that comprise the vast majority of storms. The intent is to treat most of the stormwater runoff while recognizing that it would be infeasible to size stormwater treatment measures to treat runoff from very large storms that occur every few years. (See Section 5.6 for more information on how stormwater treatment measures that are sized to treat runoff from small, frequent storms can be designed to also handle flows from large, infrequent storms.)

#### How Much of Project Site Needs Stormwater Treatment?

The NPDES stormwater permit requires that all of a project site receive stormwater treatment. Exceptions to this are landscaped areas that are “self-treating” (including green roofs and areas of turf block) as described in Section 4.1. Other than these “self-treating”



landscaped areas that do not receive stormwater runoff from roofs, pavement and other impervious surfaces, **ALL AREAS FROM A PROJECT SITE** must receive stormwater treatment.

#### Flow-Based Versus Volume-Based Treatment Measures

For hydraulic sizing purposes, stormwater treatment measures can be divided generally into two groups: those that are flow-based, and those that are volume-based. The **flow-based treatment measures** remove pollutants from a moving stream of stormwater, and the treatment measures are sized based on hourly or peak flow rates. Examples of flow-based treatment measures include vegetated swales, flow through planter boxes, and media filters. The **volume-based treatment measures** detain stormwater for periods of between 24 hours and 5 days, so the sizing is based on detaining a large volume of water for treatment and/or infiltration to the ground. Examples of volume-based stormwater treatment measures include extended detention basins, wet ponds, and constructed wetlands. Table 5-1 shows which hydraulic sizing method is appropriate for the commonly used stormwater treatment measures.

Type of Treatment Measure	Sizing Design
Vegetated swale	Flow
Vegetated buffer strip	Flow
Tree well filter	Flow
Media filter	Flow
Flow-through planter box	Flow and Volume
Bioretention area	Flow (or Volume if it relies on infiltration to ground)
Infiltration trench	Volume
Extended detention basin	Volume

#### Volume-Based Sizing Criteria

The NPDES stormwater permit specifies two alternative methods for hydraulically sizing volume-based stormwater treatment measures. One of the permit-approved methods is based on simplified procedures that are not recommended for use when information is available from continuous hydrologic simulation of runoff using local rainfall records (see "Urban Runoff Quality Management, WEF Manual of Practice No. 23/ASCE Manual and Report on Engineering Practice No. 87.) Because the results of continuous simulation modeling based on local rainfall are available, the Countywide Program recommends the use of the sizing method **shown in the text box.**

#### **Volume-Based Sizing Criteria**

Design volume-based treatment measures to treat stormwater runoff equal to the volume of annual runoff required to achieve **80 percent or more capture**, determined in accordance with methodology set forth in Appendix D of the California Stormwater Best Management Practices Handbook, using local rainfall data.

Try this!



Please note that the local jurisdiction may also allow project applicants to use an even **simpler sizing method** for sizing flow/volume-based treatment measures such as flow-through planters and bioretention areas, in which the area of the treatment measure is designed to be 4 percent of the area that will receive treatment. Appendix C includes an example (Example 2) of sizing flow-through planter boxes using this simplified method. A simplified method for sizing extended detention basins is provided in Chapter 6, under the heading, “Simplified Sizing Methods.” When using the simplified methods, be aware that they can result in a **conservatively large** treatment measure. If space is at a premium, it may be cost effective to use the 80 percent capture sizing method, described below.

The **80 percent capture method** should be used when sizing extended detention basins. The 80 percent runoff value is determined by the Storage, Treatment, Overflow, Runoff Model (STORM), which uses continuous simulation to convert rainfall to runoff based on local rainfall data. STORM was developed by the U.S. Army Corps of Engineers. (See <http://www.hec.usace.army.mil/publications/ComputerProgramDocumentation/CPD-7.pdf>).

The method for sizing volume-based stormwater treatment measures is described in the California Stormwater Quality Association’s 2003 Stormwater Best Management Practice Handbook New Development and Redevelopment available at [www.cabmphandbooks.com](http://www.cabmphandbooks.com). The method used to size volume-based treatment measures in this guidance involves the following steps.



Figure 5-1: Extended Detention Basin, San Jose (example of a volume-based treatment measure)

1. Determine which rainfall region the project site is located in using the figure in Appendix E. San Mateo County has been divided into seven different regions based on local rainfall patterns.
2. Determine the **drainage area** that will contribute flow to the volume-based treatment measure. This includes all areas that will contribute runoff to the stormwater treatment measure, including pervious areas, impervious areas, and off-site areas, regardless of whether they are directly or indirectly connected to the stormwater treatment measure. Self-treating areas (see Section 4.1) that discharge to the storm drain system without directing flows to the treatment measure are excluded from the treatment measure drainage area.
3. Determine the **composite runoff coefficient** for the area at the project location that is tributary to the volume-based treatment system. The runoff coefficients for stormwater

A **runoff coefficient** is the ratio of the runoff rate to rainfall and it is dimensionless. For example, a runoff coefficient of 0.70 means that 70 percent of the rainfall that falls on this type of surface will flow off as runoff.



treatment are lower than for flood control. Runoff coefficient “C” factors from BASMAA include the estimated values shown in Table 5-2 for use in sizing stormwater treatment measures. These “C” factors are only appropriate for stormwater treatment designs that are based on **small, frequent storms**. Flood control sizing must be based on coefficients approved by the local jurisdiction. Contact the local municipality for local requirements. The composite runoff coefficient is calculated as a weighted average. Multiply the area of each type of surface tributary to a stormwater treatment measure by the respective runoff coefficient. Add the results and divide by the total area that drains to a stormwater treatment measure.

The runoff coefficients in Table 5-2 are for use only in stormwater treatment designs based on **small, frequent storms**. Flood control sizing must be based on coefficients approved by the local jurisdiction. Contact the municipality for local requirements.

<b>Table 5-2 Estimated Runoff Coefficients for Various Surfaces During Small Storms<sup>1</sup></b>	
Type of Surface	Runoff Coefficients “C” factor
Concrete	0.80
Roofs	0.75
Asphalt	0.70
Pervious concrete	0.65
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 and landscaping	0.10
Source: BASMAA 2003	

4. Use the composite runoff coefficient to interpolate a **unit basin storage volume value** for composite runoff coefficients that are different from the four (0.25, 0.50, 0.75, and 1.00) listed in Table 5-3. For example using the Region 6 values, if the composite runoff coefficient was calculated to be 0.55, the unit basin storage volume would be 0.46 inches. The 0.55 composite runoff coefficient is one-fifth of the way between the table’s 0.5 and 0.75 composite runoff coefficient
5. Calculate the **required capture volume** by multiplying the drainage area from step 2 by the unit basin storage volume value. Due to the mixed units that result, such as acre-inches, it is recommended that the resulting volume be converted to cubic feet for use during design.

Table 5-3 Unit Basin Storage Volumes in Inches for 80 Percent Capture Using 48-Hour Drawdowns					
		Composite Runoff Coefficient for Area Tributary to the Volume-Based Treatment Measure			
Region <sup>1</sup>	Meteorological Station	0.25	0.50	0.75	1.00
1	Boulder Creek	0.51 inches	1.02	1.53	2.04
2	La Honda	0.21	0.42	0.64	0.86
3	Half Moon Bay	0.20	0.41	0.60	0.82
4	Palo Alto	0.16	0.32	0.49	0.64
5	San Francisco	0.18	0.36	0.54	0.73
6	San Francisco airport	0.21	0.42	0.63	0.85
7	San Francisco Oceanside	0.18	0.35	0.53	0.72

Source: CDM memo dated May 14, 2004

<sup>1</sup> See Appendix E to locate the applicable Treatment Measure Design Criteria Region.

The other critical issue for the design of volume-based stormwater treatment measures that temporarily pond water is the **drawdown time**. The outlet structure’s orifices should be designed to draw down the stormwater flow being treated within 48 hours.

Flow-Based Sizing Criteria

The NPDES stormwater permit specifies three alternative methods for hydraulically sizing flow-based stormwater treatment control measures, such as vegetated swales, flow through planter boxes, and media filters. The percentile rainfall intensity method is based on ranking the hourly depth of rainfall from storms over a long period, and determining the 85<sup>th</sup> percentile hourly rainfall depth and multiplying this value by two. In the Bay Area this value is generally around **0.2 inches/hour**. The permit also allows the use of 0.2 inches/hour as one of the three alternative methods regardless of the results from calculating values from local rainfall depths.



Figure 5-2: Vegetated Swale, City of San Mateo (example of a flow-based treatment measure)

Because two of the permit allowed methods yield similar results and the third method is difficult to apply, and not as well supported by technical studies, the Countywide Program

**Key Point**

recommends the use of a **rainfall intensity figure of 0.2 inches/hour** to design flow-based treatment systems.

The amount of flow that the stormwater treatment measure must be sized to treat is calculated using the rational method:

$$Q = CiA$$

Where

Q = flow in ft<sup>3</sup>/second

i = rainfall intensity in inches/hour

C = composite runoff coefficient (unitless – see Table 5.2)

A = drainage area in acres

A rainfall intensity figure of **0.2 inches/hour** is recommended for designing flow-based treatment systems.

To calculate the required treatment flow, simply multiply the **drainage area** that contributes flow to the treatment measure by the **composite runoff coefficient** by 0.2 inches/hour of rainfall intensity. The drainage area and composite runoff coefficient are determined by following steps 1 through 3 described above under the Volume-Based Sizing Criteria. Appendix C includes an example (example 1) of sizing vegetated swales and bioretention areas using this sizing method.

**Try this!**

The local municipality may allow project applicants to use **simplified sizing methods** for some flow-based treatment measures. This is described in Chapter 6, under the heading, “Simplified Sizing Methods.”

## 5.2 Applicability of Inlet Filters, Oil/Water Separators, and Hydrodynamic Separators

One way to categorize the various types of stormwater treatment measures is whether they are **landscape-based or non-landscape-based**. Generally landscape-based treatment measures are non-proprietary while non-landscape-based treatment measures are proprietary. Some examples of landscape-based, non-proprietary treatment measures include vegetated swales, bioretention areas, extended detention basins, and flow-through planter boxes. These contrast with the manufactured, proprietary treatment measures that tend to be installed below ground and operate using some type of proprietary filter media, hydrodynamic separation, or sedimentation and screening.

The municipalities encourage the use of **landscape-based** treatment measures.

**Key Point**

The municipalities in the Countywide Program encourage the use of **landscape-based** treatment measures. Underground, non-landscape-based treatment measures typically require frequent maintenance to function properly, and experience has shown that because these systems tend to be “out of sight, out of mind,” they often do not receive adequate maintenance. Where underground vaults are allowed, they must be designed to prevent access by mosquitoes, and they must also include suitable access doors and hatches to

allow for inspections and maintenance. But even when maintained properly, many underground vault systems lack the detention time required to remove ***pollutants associated with fine particles***.<sup>1</sup> The following types of underground systems have been shown to have particular difficulty meeting the NPDES stormwater permit standard of removing pollutants to the maximum extent practicable (MEP):

- Inlet Filters (also called manufactured drain inserts),
- Oil/Water Separators (also called water quality inlets), and
- Hydrodynamic Separators.

In August 2004 the Water Board's Executive Officer wrote a letter stating that a project relying on inlet filters or oil/water separators as the sole treatment measure would be ***unlikely to meet the maximum extent practicable*** (MEP) standard.<sup>2</sup> The letter does note, however, that oil/water separators may be acceptable as part of a "treatment train," or series of stormwater treatment measures at sites with high concentrations of oil and grease, and that inlet filters may be appropriate as part of a treatment train in areas where trash is a concern.

The Executive Officer's August 2004 letter also cautions that most new development projects need stormwater treatment measures "that address the broad spectrum of urban runoff pollutants, from trash to fine particulates and soluble pollutants..." The Contra Costa Clean Water Program has established a policy that hydrodynamic separators, when used as a sole method of stormwater treatment, do not meet the MEP standard for stormwater treatment effectiveness.<sup>3</sup> The policy was based, in part, on a literature review that found that hydrodynamic separators were substantially less effective than various landscape-based treatment measures for removing pollutants that are attached to fine particles, but that they could be used to remove trash and coarse sediment from stormwater upstream of other treatment measures.



The Countywide Program has not developed a countywide policy on hydrodynamic separators. Check with the municipal staff for local requirements. The August 2004 letter is included in Appendix F, along with additional information regarding inlet filters, oil/water separators and hydrodynamic separators.

### 5.3 Using Manufactured Treatment Measures

In cases where a municipality approves the use of one or more manufactured treatment measures in a development project, the project applicant is responsible for installing the unit(s) so that they will function as designed and for following the manufacturer's instructions

<sup>1</sup> Contra Costa County Stormwater Quality Requirements for Development Applications. Stormwater C.3 Guidebook, 3<sup>rd</sup> Draft, January 2005.

<sup>2</sup> Letter from Bruce H. Wolfe, Executive Officer of the San Francisco Bay Regional Water Quality Control Board to the Bay Area Stormwater Management Agencies Association (BASMAA), dated August 5, 2004, [http://www.cleanwaterprogram.org/uploads/RWQCB\\_letter\\_re\\_inlet\\_filters\\_etc.pdf](http://www.cleanwaterprogram.org/uploads/RWQCB_letter_re_inlet_filters_etc.pdf).

<sup>3</sup> Contra Costa Clean Water Program, November 16, 2005. Policy on the Use of Hydrodynamic Separators to Achieve Compliance with NPDES Provision C.3. [http://www.cccleanwater.org/construction/Publications/HydrodynamicSeparatorsPolicy\\_11-16-05.pdf](http://www.cccleanwater.org/construction/Publications/HydrodynamicSeparatorsPolicy_11-16-05.pdf).

for maintenance. When installed and maintained properly, manufactured media filters (see Section 6.4) may have adequate pollutant removal levels for fine particles and their attached pollutants. Media filters typically include two chambers: the first chamber allows coarse solids to settle, and the second contains the filters that consist of a proprietary media. When installed and maintained properly, hydrodynamic separators may be effective in removing trash and coarse sediment, but not dissolved pollutants, and they may be installed upstream of other treatment measures.

The **applicant is responsible** for ensuring that the manufactured treatment measures used in the project are sized in accordance with the NPDES stormwater permit hydraulic sizing criteria to treat the amount of runoff that will flow to these treatment measures.

**Planning permit submittals** should include a description of the product(s) proposed for use, along with preliminary sizing calculations, and conceptual plans showing the proposed locations of treatment measures on the site. **Building permit submittals** should include detailed sizing calculations, construction-level drawings, and a copy of the manufacturer's instructions for construction and maintenance. Maintenance plans for manufactured treatment measures must follow the manufacturer's maintenance instructions.



Listed below are some issues project engineers have encountered when selecting and incorporating manufactured stormwater treatment measures into development projects:<sup>4</sup>

- **Consider hydraulic depth.** Different types of manufactured treatment measures have different head losses. Your options may be limited if the site has limited hydraulic depth or other constraints.
- **Allow for necessary field changes.** In the planning permit application submittal, request approval to use more than one manufactured treatment measure product in the project. Format the design, details, and specifications to identify the approved, alternative manufactured treatment measures, and include these documents in the building permit application submittal. Giving the contractor options to work with will help avoid delays to your project.
- **Allow design flexibility.** Some manufactured treatment measures have the same invert elevation in and out, while some require a change in elevation between the invert and outlet. If possible, provide for a design that allows for a change in invert elevations.
- **Include sufficient information.** Contract documents should include enough design information so that the contractor can evaluate and demonstrate that the treatment measure meets the design objectives.
- **Avoid approval problems.** If applicable, clarify in the design and construction documents that the contractor will be responsible for obtaining approval from the local jurisdiction for any changes that violate the approved permit plans or conditions.

<sup>4</sup> Decker, Thomas R., "Specifying and Permitting Alternative MTDs", in the January/February 2006 edition of the journal Stormwater. [http://www.stormh2o.com/sw\\_0601\\_guest\\_editorial.html](http://www.stormh2o.com/sw_0601_guest_editorial.html).

## 5.4 Using Treatment Trains

Key Point



Stormwater can be directed to flow through a series of different types of stormwater treatment measures that are each designed to treat different broad categories of stormwater pollutants. These groupings of stormwater treatment measures have been called “stormwater treatment trains” or “multiple treatment systems.” The definition of treatment train given in Fact Sheet TC-60 of the CASQA Handbook is shown in the text box. The use of a **series of treatment measures** is most effective where each treatment measure optimizes the removal of a particular type of pollutant, such as coarse solids and debris, pollutants associated with fine solids, and dissolved pollutants. Stormwater treatment measures operate by using physical processes, such as sedimentation and filtration, to remove solids suspended in stormwater runoff. The removal of dissolved pollutants requires chemical adsorption or biological uptake. Each of the stormwater treatment measures in a treatment train should be sized using the Provision C.3 numeric sizing criteria.

### **What Is A Treatment Train?**

A treatment train is a multiple treatment system that uses two or more stormwater **treatment measures in series**.

Examples include: a settling basin/sand [or media] filter combination, a settling basin/infiltration trench combination, and an extended detention zone on a wet pond.

The **simplest version** of the treatment train concept consists of pretreatment prior to the stormwater reaching the main treatment system. For example, bioretention areas commonly use vegetated buffer strips to pretreat stormwater to settle out sediment prior to the stormwater being treated by a bioretention area. This type of pretreatment helps to prevent sediment from clogging the bioretention area, which maximizes its life. Another example of a coupled **pretreatment and treatment system** is used in extended detention basins that have a small, sediment forebay where most of the larger sediment settles and can be easily removed.

The combining of **three or more** stormwater treatment measures in series is often limited in practice because of the expense and additional space required. Some prototypes exist,



Figure 5-3: Tule Pond, Fremont

such as the Tule Pond at Tyson Lagoon in Fremont. This stormwater treatment system was constructed in 1998 by the Alameda County Flood Control and Water Conservation District. It includes a wet pond where most of the sediment in the incoming stormwater settles. The wet pond also includes log booms to trap floating debris. From the wet pond the water flows into two other treatment ponds that are shallower in depth and where finer sediments and their attached

pollutants settle and some dissolved pollutants may be removed by aquatic vegetation. The entire system also allows infiltration of the stormwater into the underlying soils.

## 5.5 Infiltration Guidelines

Infiltration can be a very cost-effective method to manage stormwater – if the conditions on your site allow. A wide-range of site-design measures and stormwater treatment measures can be used to increase stormwater infiltration and can be categorized as follows:

- **Site design measures** -- such as clustering development or otherwise laying out the site to reduce impervious area, routing drainage from building roofs to landscaped areas, and using pervious pavement.
- **Indirect infiltration** methods, which allow stormwater runoff to percolate **into surface soils**. Runoff may reach groundwater indirectly, or it may be underdrained into subsurface pipes. Examples of indirect infiltration methods include bioretention areas and vegetated swales.
- **Direct infiltration** methods, which are designed to **bypass surface soils** and transmit runoff directly to subsurface soils for groundwater recharge. These types of devices must be located and designed to limit the potential for stormwater pollutants to reach groundwater. Examples of direct infiltration methods include infiltration trenches and dry wells.

Warning



The local jurisdiction may require a geotechnical review for your project. When selecting site design and stormwater treatment measures that promote on-site infiltration, be sure to **follow the geotechnical engineer's recommendations** based on soil boring data, drainage pattern, and the current requirements for stormwater treatment. The geotechnical engineer's input will be essential to prevent damage from underground water to surrounding properties, public improvements, slope banks, and even mudslides from accumulated below-ground water.

**Appendix G** provides guidelines to help you determine whether your project site is suitable for using site design and/or stormwater treatment measures that increase stormwater infiltration and include regulatory requirements that apply to direct infiltration methods, as well as practical tips for the design and construction.

## 5.6 Technical Guidance for Low-Flow Systems

Remember



Although stormwater treatment measures are sized to remove pollutants from flows resulting from frequent, small storms, projects must be designed to handle flows for stormwater treatment and drainage from large infrequent flows to **prevent flooding**. The integration of flood control and stormwater treatment may be accomplished in one of two ways, which are described below.

One option is to have the flows that are larger than those required by the hydraulic sizing criteria (given in Section 5.1) handled **within the stormwater treatment measure**. This includes making sure that landscape-based treatment measures do not re-suspend and flush out pollutants that have been accumulating during small storms, and that landscape-based stormwater treatment measures do not erode during flows that will be experienced during larger storms. Most vegetated swales, vegetated filter strips, and extended detention basins are designed to handle flood flows, although they would not be providing much

treatment during these flows. The technical guidance in Chapter 6 for treatment measures that operate in this manner includes design standards to accommodate flood flows associated with larger storms.

The other option is to **bypass the high flows** around the stormwater treatment measure so that they flow to a storm drainage system designed to handle the high flows. Bioretention areas, flow-through planter boxes, and other treatment systems that rely on filtration or infiltration must have overflow systems that allow flood flows larger than the increment of flow that can be treated to bypass the stormwater treatment measure. These filtration-based systems have to include an alternative flow path for high flows, otherwise stormwater would back up and flood the project area. The technical guidance in Chapter 6 for treatment measures that operate in this manner includes design standards for high-flow bypasses.

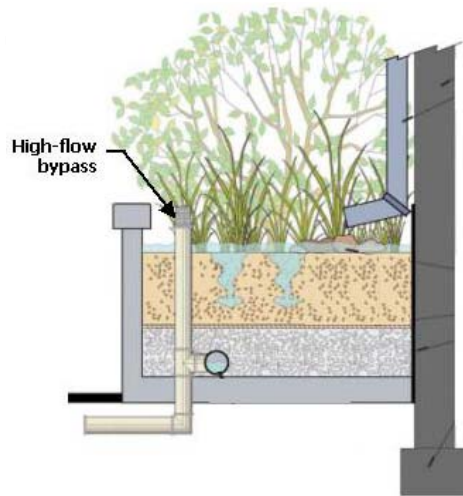


Figure 5-4: Flow-through planter with high-flow bypass (Source: City of Portland, 2004)

These filtration-based systems have to include an alternative flow path for high flows, otherwise stormwater would back up and flood the project area. The technical guidance in Chapter 6 for treatment measures that operate in this manner includes design standards for high-flow bypasses.

## 5.7 Selecting and Maintaining Plantings in Landscape-Based Treatment Measures

Selecting the appropriate plants and using sustainable, horticulturally sound landscape installation and maintenance practices are essential components of a successful landscape-based stormwater treatment measure.

### Plant Selection Guidance



Plant selection must consider the type of development and location, uses on the site and an appropriate design aesthetic. Ideally, a Landscape Architect will be involved as an active member of the design team **early in the site design phase** to review proposed stormwater measures and coordinate development of an integrated solution that responds to all of the various site goals and constraints. In some cases, one professional will design a stormwater control, while another designs the rest of the landscaping. In these situations it is essential for the professionals to work together very early in the process to integrate their designs.

Appendix B provides user-friendly guidance in selecting planting appropriate to the landscape-based stormwater treatment measures included in Chapter 6 and the site design measures in Chapter 4.

### 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 local watershed. Project sponsors are encouraged to use landscape professionals who are familiar with and committed to implementing Bay (and ocean) -Friendly landscaping practices from the initial

plant selection through the long-term maintenance of the site. Appendix B summarizes Bay Friendly Landscaping Practices that may be implemented to benefit water quality of the bay, ocean and their tributaries, based on the Bay-Friendly Landscaping Guidelines prepared by Stopwaste.Org (available at [www.bayfriendly.org](http://www.bayfriendly.org)).

#### Integrated Pest Management

Integrated pest management (IPM) is a holistic approach to mitigating insects, plant diseases, weeds, and other pests. Projects that require a landscaping plan as part of a development project application are encouraged to use IPM, as indicated in each agency's source control measures list. **Avoiding pesticides and quick release synthetic fertilizers** is particularly important when maintaining stormwater treatment measures to protect water quality.



Figure 5-5: Beneficial insects can help control pests.

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. As a last resort some pesticides with low levels of toxicity may be used. More information on IPM is included in Appendix B.

#### Wetland Regulations and Treatment Measures

The Water Board's "Policy on the Use of Constructed Wetlands for Urban Runoff Pollution Control" (Resolution No. 94-102) recognizes that stormwater treatment wetlands that are constructed and operated pursuant to Resolution 94-102 and are constructed outside a creek or other receiving water are stormwater treatment systems, and, as such, are not waters of the United States subject to Sections 401 and 404 of the federal Clean Water Act.

## 5.8 Mosquito Control

Some types of stormwater treatment measures are designed to include standing water, and even treatment measures that are designed to eliminate standing water between storms have the potential to **retain standing water** if they are not properly designed, constructed and maintained.

The Countywide Program developed a Vector Control Plan to help reduce the potential for stormwater treatment measures to breed mosquitoes. The Vector Control Plan describes the need to include physical access for mosquito control staff to monitor and treat mosquitoes, and it includes guidance for designing and maintaining stormwater treatment measures to control mosquitoes. The San Mateo County Mosquito Abatement District staff has identified a **five-day maximum** allowable water retention time, based on actual incubation periods of mosquito species in this area. With the exception of certain stormwater treatment measures that are designed to hold water permanently (e.g., CDS

units and wet ponds), all treatment measures should drain completely within five days to prevent mosquito breeding. *Please note that the design of stormwater treatment measures **does not require** that water be standing for five days. During five days after a rain event, standing water is allowable but not required for the stormwater treatment measure to function effectively.*



Treatment measure designs and maintenance plans must include mosquito control **design and maintenance strategies** from the countywide Vector Control Plan, which are included in Appendix H. Project plans that include stormwater treatment measures (and their maintenance plans), will be routed to the San Mateo County Mosquito Abatement District for review. Project applicants may wish to consult with Mosquito Abatement District staff for guidance.

Treatment measure designs and maintenance plans must include mosquito control **design and maintenance strategies** from the Vector Control Plan, which are included in Appendix H.

## 5.9 Incorporating Treatment with Hydromodification Management

In addition to the requirement to treat stormwater runoff to remove pollutants, the countywide stormwater NPDES permit also requires that stormwater runoff be detained and released in a way that **prevents increased creek channel erosion** and siltation. The Program has prepared a Hydromodification Management Plan (HMP) showing how these requirements will be met in San Mateo County. The hydromodification management (HM) requirements apply to projects that create and/or replace one acre or more of impervious surface, in most areas of the county. The requirements do not apply to projects that drain directly to the bay or tidal channels nor to projects where stormwater flows into channel segments that have been hardened on three sides and/or are culverted continuously downstream to their outfall in a tidal area. Projects that must meet the HMP requirements need to limit the post-project amount of stormwater flow and the duration of the flow to match what occurred under pre-project conditions.

To help implement the HMP, the Program collaborated with Santa Clara and Alameda county stormwater programs to develop a Bay Area Hydrology Model (BAHM). Project applicants can access the BAHM on the Internet to **automatically size stormwater detention measures** such as detention vaults, tanks, basins and ponds for Flow Duration Control of post-project runoff. The BAHM will also check these facilities for performance as volume-based stormwater treatment measures, to meet the permit requirements for both stormwater treatment and hydromodification management. Chapter 7 gives more information on the HMP and BAHM.

## 5.10 Treatment Measures in Areas of Bay Fill

Extensive portions of San Mateo County's bayside consist of historic Bay wetlands that were filled long ago to accommodate development pressure. These areas typically have **high water tables**, and the fill soils have a tendency to settle. Both of these characteristics



can lead to problems with building foundations. Treatment measures that rely on direct infiltration to treat stormwater, such as infiltration trenches, are inappropriate to use on properties with a high water table. Be sure to consult the ***infiltration guidance in Appendix G*** when considering a stormwater treatment measure that relies on infiltration to treat stormwater for your site.

## 5.11 Treatment Measures in Seismic Hazard Areas



The San Andreas Fault passes through the county near the Skyline Boulevard and I-280 corridors areas before exiting the coast at Mussel Rock Park in Daly City. State law prohibits the location of developments and habitable structures across the trace of active faults, and limits the placement of these types of structures to no less than 50 feet of an active fault trace. Projects located near a fault typically need to incorporate special design features. For example, ***pipes built across a fault*** need to accommodate the gradual movement of the tectonic plates that meet at the fault line. If your project is located near a fault line, contact your local jurisdiction to obtain any special requirements for storm drain pipes or other stormwater facilities included in your project.

Steep slopes and areas of Bay fill may also be identified as seismic hazard areas, based on the damage to buildings, bridges, and other structures that may occur in these areas during a major earthquake. To date, stormwater professionals have not identified seismic-induced failure as a threat to stormwater treatment measures located in Bay fill areas or on steep slopes. There are, however, special concerns associated with stormwater treatment measures that rely on infiltration in areas with high water tables or steep slopes. These concerns are addressed in ***Appendix G***.

## 5.12 Artificial Turf and Stormwater Treatment

Artificial turf often has a permeable synthetic grass layer over a permeable underlay, such as gravel, and a compacted subbase, with a subdrain to collect water and convey it to the storm drain system. The design and installation of artificial turf typically prevent infiltration of runoff to the underlying soils. When calculating the total area of a project's new and/or replaced impervious surface, areas of artificial turf must be counted as impervious surface. Although using artificial turf in place of natural turf can help conserve water and reduce pesticide and fertilizer use, it is advisable to ***weigh the benefits against environmental costs***, such as the reduced infiltration of rainfall runoff, and the heating effect of artificial turf (as opposed to the cooling effect of natural turf). Concerns have also been raised regarding the potential for toxic chemicals in artificial turf to pollute stormwater. At present, no runoff coefficient for artificial turf is available.

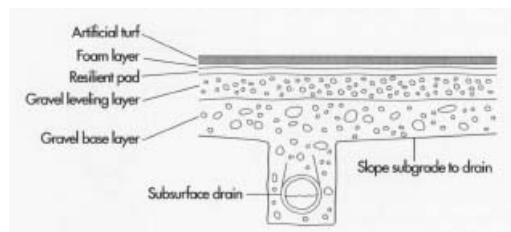


Figure 5-5: Example of artificial turf installation ([www.madehow.com/Volume-7/Artificial-Turf.html](http://www.madehow.com/Volume-7/Artificial-Turf.html))