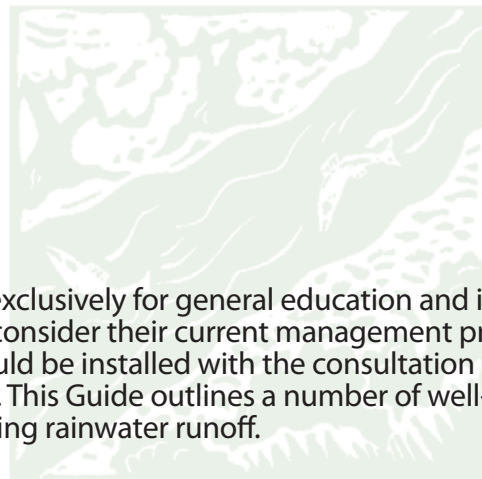
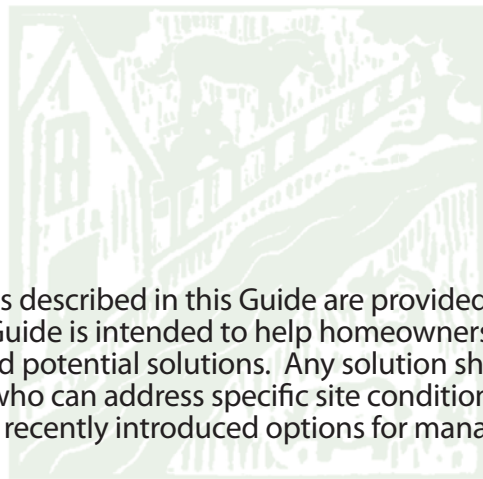
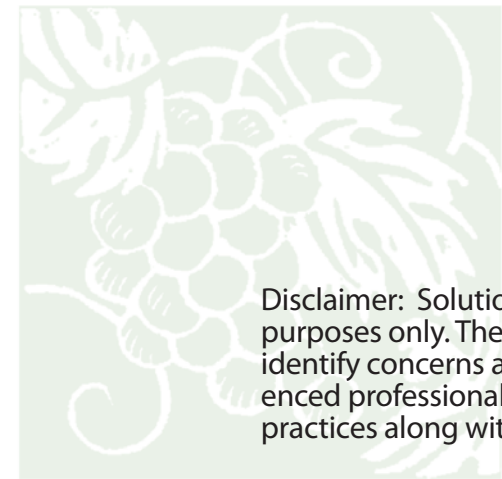


# Slow it. Spread it. Sink it!

ECO-FRIENDLY SOLUTIONS FOR MANAGING RAINWATER ON YOUR PROPERTY







Disclaimer: Solutions described in this Guide are provided exclusively for general education and information purposes only. The Guide is intended to help homeowners consider their current management practices and to identify concerns and potential solutions. Any solution should be installed with the consultation of an experienced professional who can address specific site conditions. This Guide outlines a number of well-established practices along with recently introduced options for managing rainwater runoff.



# Slow it. Spread it. Sink it!

## Eco-Friendly Solutions for Managing Rainwater on Your Property

First Edition: July 2010  
Revised for Marin: January 2012

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The Resource Conservation District of Santa Cruz County  
Modified for a Marin Audience by: Marin County Stormwater Pollution Prevention Program  
Marin County Watershed Program  
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(415) 473-6528

[www.mcstoppp.org](http://www.mcstoppp.org) or [mcstoppp@co.marin.ca.us](mailto:mcstoppp@co.marin.ca.us)

If you are a person with a disability and require accommodations, or if you require materials in alternative formats, please call 415-473-4381 voice/TTY or e-mail [disabilityaccess@co.marin.ca.us](mailto:disabilityaccess@co.marin.ca.us)

## STATEMENT OF PURPOSE

The stormwater runoff improvement practices included in this guide are meant to be used as general educational guidelines and are not to be used as professional engineered specifications. Prior to implementation of ANY practices, seek technical assistance from a licensed professional engineer or landscape architect, and/or certified professionals in erosion and sediment control for specifications. Site-specific designs that address each individual site's needs and constraints are essential.

## WHO WE ARE

Marin County Stormwater Pollution Prevention Program (MCSTOPPP) is comprised of all eleven cities/towns and the County unincorporated areas. Since 1993, the program has worked to protect and enhance the water quality in our creeks and wetlands.

Marin County Watershed Program (MCWP) provides a framework to integrate flood protection and environmental restoration with public and private partners to protect and enhance Marin's watersheds.

North Bay Watershed Association (NBWA) comprises municipalities from Marin, Napa and Sonoma; water and sanitary districts; and non-profit organizations interested in watershed health. NBWA facilitates partnerships across political boundaries that promote stewardship of North San Pablo Bay watersheds.

## ACKNOWLEDGEMENTS

MCSTOPPP would like to thank all the individuals and organizations who contributed to the original development of this guide; and, to the following organizations who assisted with revising it for a Marin audience:

Marin County Environmental Health Department

Marin County Flood Control & Water Conservation District

Marin County Watershed Program

Southern Sonoma County RCD

OTHERS?

**IMPORTANT NOTE:** Federal, state, and local regulations in California pertain to many of the subjects presented in this guide. Regulations change quickly, as do the technical methods and standards for environmental protection. Be sure to follow applicable regulations covering private land maintenance and related activities for your area. See the Resources Guide for a list of contacts.



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## DID YOU KNOW?

Water from impervious surfaces (e.g. rooftops and other surfaces that prevent water from soaking into the soil) can contribute to erosion in local creeks because it allows a high volume of rainwater to speed over the surface and enter creeks very quickly. The high volume and speed (or velocity) of the running water can cause erosion in creeks, impact salmon habitat and damage structures.

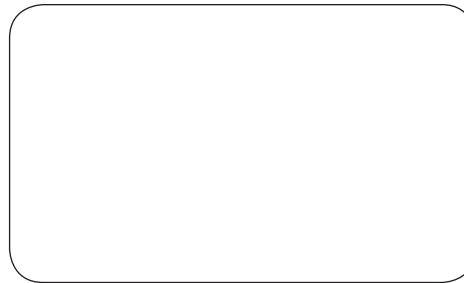
This guidebook offers a few simple measures that you can take to help decrease the volume and speed of water as it leaves your property. And many of these measures have the added benefit of beautifying your landscapes! Read on.

DO ANY OF THE FOLLOWING LOOK FAMILIAR TO YOU? CHANCES ARE, YOU'VE SEEN AT LEAST ONE OF THEM.

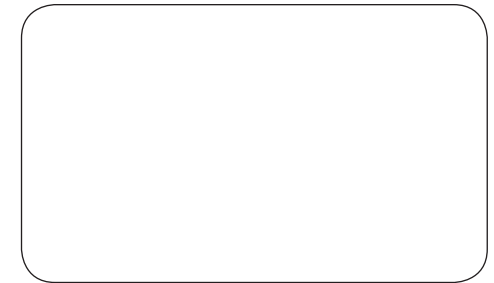
THIS GUIDEBOOK WILL OFFER A SERIES OF ECO-FRIENDLY SOLUTIONS TO A NUMBER OF PROBLEMS - INCLUDING THOSE SEEN BELOW



"POTHOLE" CAUSED BY...



ROOFTOP WATER EMPTIES INTO A PIPE CONNECTED TO AN UNDERGROUND SERIES OF PIPES THAT LEAD TO A STORM DRAIN SYSTEM.



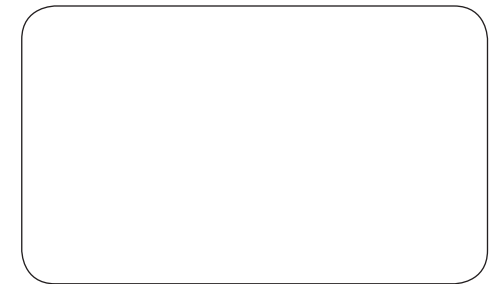
CULVERT CARRIES RUSHING WATER. SEE PAGE XX FOR ALTERNATIVES THAT SLOWS WATER DOWN & SINKS IT INTO THE GROUND RATHER THAN HAVING IT RUSH OFFSITE.



OILY SHEEN RUNS OFF YOUR DRIVEWAY AND INTO THE GUTTER ON ITS WAY TO A LOCAL CREEK.



AFTER A RAINSTORM, SEDIMENT RUNS OFF A ROAD AND INTO A GUTTER. SEDIMENT IS THE NUMBER ONE POLLUTANT IN MARIN CREEKS!



ROOFTOP DOWNSPOUT IS DISCONNECTED FROM GUTTER.

## KEEP RAINWATER ON YOUR PROPERTY (TO LEARN “WHY, SEE NEXT PAGE!)

Here are just a few of the ideas you’ll find in this guide to address rainwater (or stormwater) runoff around your property.

Collect your roof water in a CISTERN.



Cost: LOW TO HIGH  
Installation difficulty: EASY TO MODERATE  
See page xx

Plant a RAIN GARDEN in your landscape.



Cost: LOW to MEDIUM  
Installation difficulty: EASY to MODERATE  
See page xx

Install a WATERBAR on your driveway.



Cost: LOW TO MEDIUM  
Installation difficulty: EASY TO MODERATE  
See page xx

Use PERVIOUS PAVERS when renovating your patio or driveway



Cost: MEDIUM - HIGH  
Installation difficulty: MEDIUM TO COMPLEX  
See page xx



## Why Capture Rain?

Before the cities, towns and unincorporated areas of Marin became the developed communities they are today, small creeks in upland areas carried rainwater downstream to larger creeks, wetlands, bays and the Pacific Ocean. A diverse collection of habitats - including redwood forests, oak woodlands, native grasslands, riparian areas (also known as creekside forests), coastal dunes, and wetlands - were virtually undisturbed. These habitats functioned as natural filters and buffered creekbanks and/or shorelines from major storms.

Under these pre-development conditions, as much as 50% of rainwater infiltrated (soaked into) the soil replenishing groundwater supplies, contributing to year-round creek flows, and sustaining wildlife and aquatic habitat. Another 40% was released into the atmosphere through evapotranspiration (i.e. evaporation of surface and ground water plus water loss from plants). Only about 10% was attributed to stormwater RUNOFF (i.e. rainwater that flows or “runs off” the land).

Our modern day urban centers and rural neighborhoods are made up of impervious surfaces (i.e. hardened surfaces that do not allow water to pass through) such as roofs, streets, driveways and parking areas. When

rain falls on impervious surfaces, it flows faster and in greater amounts than it would have under pre-development conditions. This significantly increases runoff and decreases infiltration and evapotranspiration.

Runoff is typically carried by pipes, driveways, streets, and storm drains directly to creeks where it can contribute to flooding, road damage, creek erosion, and landslides. Runoff also carries sediment and other pollutants to creeks and beaches, where it can have an adverse effect. The following are just a few examples of pollutants that have been found in rainwater runoff: pesticides from landscapes, nutrients from fertilizers, pet waste, soap from car washing, oil and grease from leaking engines, zinc from tires, excess sediment from erosion, and copper from brakes.

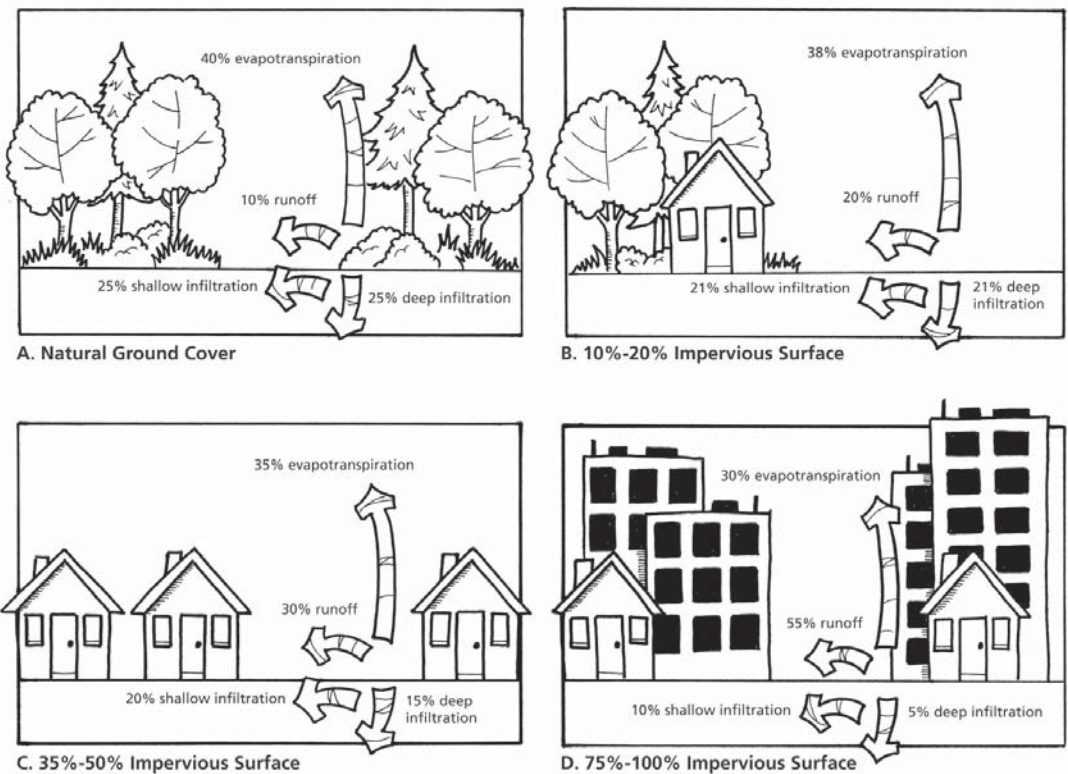
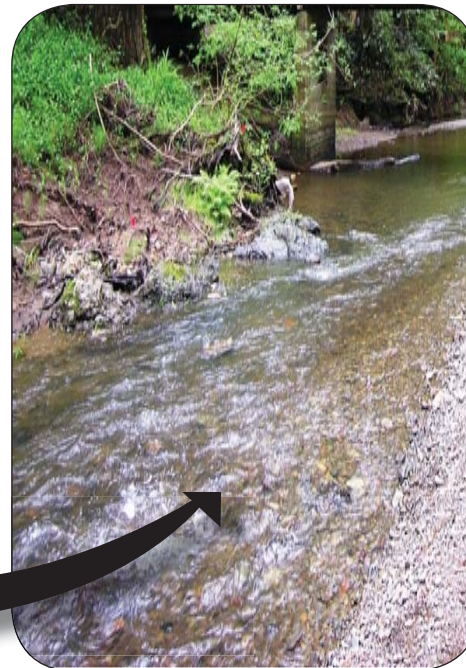


FIGURE 1: PERCENTAGE RUNOFF GENERATED FROM IMPERVIOUS SURFACES, ADAPTED FROM FISRWG 1998



RUNOFF FROM THE SURROUNDING HOMES AND STREETS FLOWS THROUGH THE STORM DRAIN SYSTEM...



...AND DIRECTLY ENTERS LOCAL CREEKS AND BAYS.

The above photos illustrate why it's so important to keep runoff as pollutant-free as possible - because if it gets into the runoff, it can enter the storm drain system and go directly to local creeks and the Bay! One way to help reduce - or even eliminate - potential pollutants in our runoff is by changing the way we approach new construction, remodels, or other changes to our property. Through good planning and design, we can accomplish the following:

- Conserve and protect groundwater resources
- Create healthier habitats for native plants and wildlife
- Clean up our creeks, streams, and the bay
- Protect infrastructure and reduce flooding

This guidance document can help you get started with your planning and design process. You can begin by assessing your property (see page XX) to identify more eco-friendly solutions for managing rainwater and runoff. Examples are provided throughout this publication as well.

In addition, you can contact the Marin County Stormwater Pollution Prevention Program (MCSTOPPP) for free materials that are listed in the Resource section of this guide. You can also visit online at [www.mcstoppp.org](http://www.mcstoppp.org) or send an e-mail to [mcstoppp@co.marin.ca.us](mailto:mcstoppp@co.marin.ca.us).

## WHAT'S A WATERSHED?

Just as a city, county, or state, has boundaries, so does a watershed. A watershed is all of the land - including the properties where we live - that drains to a particular creek, river, bay or ocean.

When watersheds are healthy and functioning well, they provide food, clean water, and habitat for native plants and animals. They cycle nutrients and convert them into forms that living organisms can use. They store water and meter its release into creeks to reduce flooding and erosion in the winter and to sustain flows and cooler temperatures during the dry season. Because everyone lives in a watershed, everyone can help improve a watershed's health.

To find out which watershed YOU live in, go to:

[www.mcstoppp.org](http://www.mcstoppp.org) or  
[www.marinwatersheds.org](http://www.marinwatersheds.org)



## Protecting Our Creeks: Reducing Runoff in Marin



Runoff refers to water that “runs off” city streets, parking lots, driveways, hilltops, roofs - in fact, from all impermeable surfaces - and enters our local waterways directly, or through the vast network of above-ground and underground pipes that are all part of the storm drain system. Unfortunately, runoff carries with it pollutants such as pesticides, fertilizers, lead, motor oil, paint, sediment, etc. In Marin, - as in most municipalities - all storm drains flow directly to local waterways - including the Bay and Ocean.

In response to State and federal mandates to reduce runoff, the Marin County Stormwater Pollution Prevention Program (MCSTOPPP) was formed in 1993 by Marin’s 11 cities, towns, and unincorporated areas. Each municipality has their own local program to manage runoff and reduce stormwater pollution. Local stormwater coordinators in each municipality work with local planners, building inspectors, business inspectors, street maintenance crews, and others to accomplish this goal.

MCSTOPPP serves as the overall coordinating body and the link between state regulatory agencies and local programs. Staff provides workshops for municipal staff and the community, develops annual reports, and provides information for the general public - like this guidebook.

This guidebook provides straightforward guidance (often referred to as best management practices or BMPs) that will ultimately help protect surface water - and reduce erosion in local creeks - by keeping more rainwater on your property. You will learn how to SLOW down rainwater before it leaves your property, SPREAD it out by creating permeable surfaces, and SINK it into the ground by diverting it to a landscaped area!

Photo Credit: Craig Solin





### Marin County Watershed Program

Building on the success of MCSTOPPP, the Marin County Watershed Program was developed in 2009. The Program provides a framework to integrate flood protection and environmental restoration with public and private partners in order to protect and enhance Marin's watersheds.

A watershed includes all of the land that drains to a particular creek, bay or ocean. All land, from the wildest preserve to the most densely developed urban neighborhood, is part of a watershed.

Learn what comprises a healthy watershed - and what watershed you live in - by going to [www.marinwatersheds.org](http://www.marinwatersheds.org)

### North Bay Watershed Association (NBWA)

The North Bay Watershed Association (NBWA) was created to help regulated local and regional public agencies work cooperatively on water resources issues that impact areas beyond traditional boundaries in order to promote stewardship of the North Bay watershed. Agencies participate in the NBWA in order to discuss issues of common interest, explore ways to work collaboratively on water resources projects of regional concern, and share information about projects, regulations, and technical issues.

The North Bay Watershed Association is a group of 15 regional and local public agencies located throughout Marin, Sonoma, and Napa counties.

For more information on NBWA, go to [www.nbwatershed.org](http://www.nbwatershed.org)

## CHAPTER 1

# UNDERSTANDING AND EVALUATING STORMWATER RUNOFF AROUND YOUR HOME & PROPERTY

Before you start implementing some of the practices highlighted in this guidebook, it's important to first understand the flow of water on your property. To do that, you might want to walk around it in a heavy rain and observe what happens. At the end of this chapter, instructions are provided for a simple do-it-yourself runoff evaluation. This will assist you in choosing solutions that suit your specific needs.

Below are a few things to consider when walking and evaluating your property:

- if you have a rain gutter and downspout, is the water flowing directly to the street
- is there an area on your property that floods during a heavy rain
- does water “pond” near the foundation of your home, on your patio, or elsewhere
- does your driveway become a sheet of fast-moving water during a storm
- is the water from your deck pounding the soil beneath it
- has foot traffic caused your soil to become compacted

If you answered “yes” to any of the above questions, this guide will help you find eco-friendly solutions to slowing, spreading, and sinking rainwater on your property. Most solutions are not complicated - and they are geared toward residential homes or small developments.

### The 5 Zones of “runoff”

This chapter divides your property into five major areas or “zones” that can contribute to runoff. Each zone is examined for common problems related to runoff. Suggestions are given for potential solutions.

The 5 zones are:

- 1) roofs
- 2) elevated structures
- 3) walkways and patios
- 4) driveways and parking areas, and
- 5) bare soil and landscapes.



## ZONE 1: ROOFS

Your roof likely generates the most runoff from your home. While the majority of roofs are outfitted with gutters and downspouts, some are not. Measures for addressing either possibility are discussed. Regardless of which system you use, all eaves and downspouts should be routed away from sensitive areas such as septic system leachfields, hillsides, and building foundations.

### WHAT IS YOUR ROOF MADE OF?

Metal and tile roofs are preferred catchment surfaces because they don't contain the asphalt and other contaminants present in composite roofs. If water is used for irrigating an edible garden - and you have a composite roof - install a downspout diverter to filter out such contaminants. (WHAT ABOUT COPPER ROOFS?)

### NON-GUTTERED ROOFS

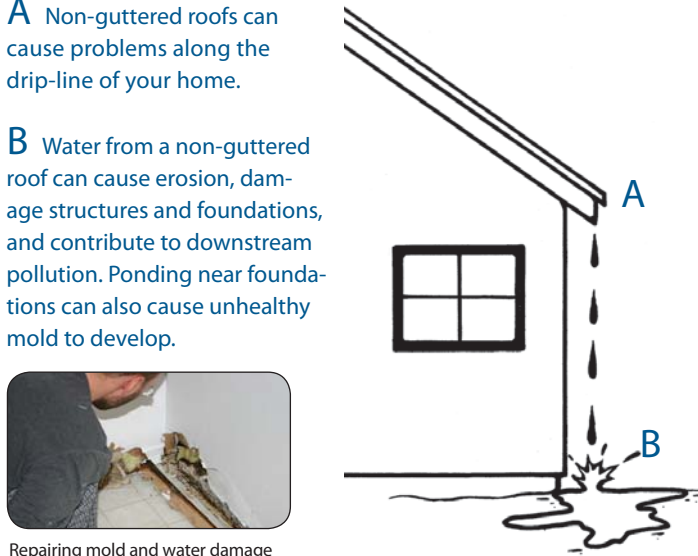


If it is not possible to install gutters because of cost or other issues, you will need to protect the ground below the eaves which is referred to as the "drip-line". Runoff from eaves can cause significant erosion and the resulting moisture can damage foundations and cause unhealthy mold to develop. A rain chain (page XX) is an inexpensive option that can help direct water away from your foundation to an area where you can slow, spread and sink it.

## GUTTER TYPES CAN MATTER!

Sediment and debris that collect in the corners and edges of gutters support the growth of bacteria, mosquitos and other organisms that could contaminate rainwater and spread disease.

Because rounded gutter systems have fewer edges than their square-cornered counterparts, they provide cleaner water for rainwater catchment systems

Learn more about gutters and downspouts on Pages XX-XX.

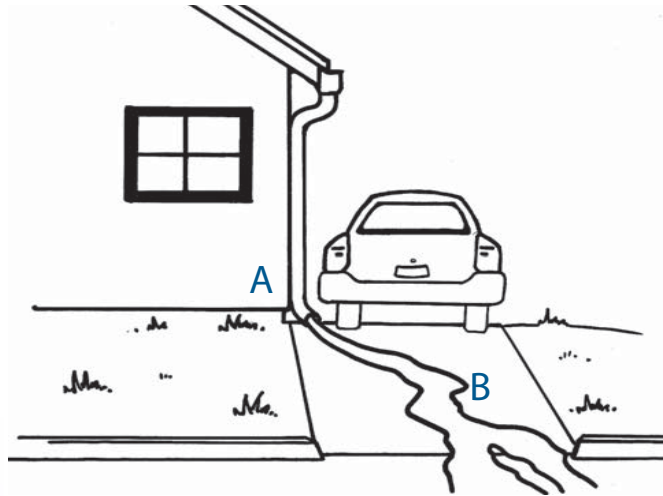
POTENTIAL PROBLEMS	BMP SOLUTIONS
<p><b>A</b> Non-guttered roofs can cause problems along the drip-line of your home.</p> <p><b>B</b> Water from a non-guttered roof can cause erosion, damage structures and foundations, and contribute to downstream pollution. Ponding near foundations can also cause unhealthy mold to develop.</p>  <p>Repairing mold and water damage</p>	 <p><b>A</b> Adding gutters and downspouts work to direct water to a safe location away from bare soil and buildings (see page XX).</p>  <p><b>B</b> Vegetated or rock drip-line protection SLOWS runoff thus reducing erosion and promoting infiltration. It is also designed so that the ground slopes away from the home's foundation (see page XX)</p>



## GUTTERED ROOFS

Gutters and downspouts are excellent choices for handling roof runoff; however, they must be properly sized, managed, and maintained to prevent damage to property and the environment. Undersized gutters clog and overflow more frequently, which can damage foundations. Directing downspout runoff toward impervious surfaces - like some driveways - is common but can contribute to downstream flooding, surface water pollution, potholes and other issues. ALWAYS avoid sending runoff toward streets, storm drains, hillsides, septic system leachfields, and building foundations where it could cause significant damage to your property.

## POTENTIAL PROBLEMS



**A** The downspout is directed toward an impervious (e.g. concrete) driveway that drains to the street. The resultant runoff may damage roads, exacerbate downstream flooding, or carry pollutants to nearby waterways.

**B** This driveway is constructed of impervious materials (concrete), and all of the runoff is directed toward the street. As above, the unconstrained runoff may result in detrimental effects to infrastructure and the environment.



When used motor oil washes off driveways, parking lots and streets, it enters local waterways. Water birds are more susceptible to pollutants - like oil - that float on the surface.

## BMP SOLUTIONS

**A** Rain barrels, downspout diverters, and rain gardens are all potential solutions for treating downspout runoff by SLOWING water down and SPREADING it out (pages XX, XX, XX).

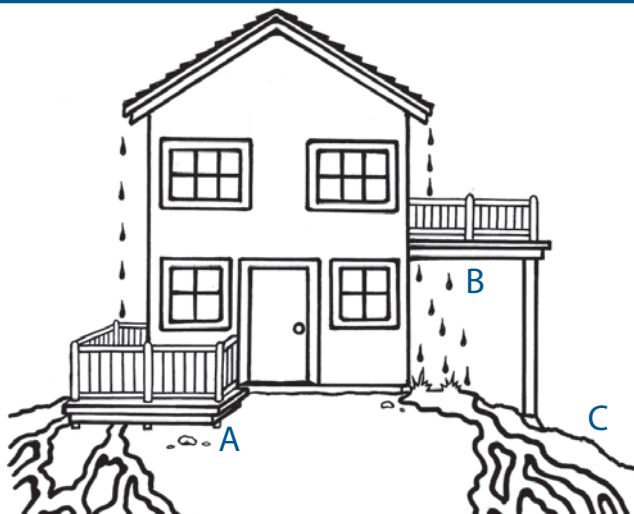


**B** See Driveways and Parking Areas (page XX).

## ZONE 2: ELEVATED STRUCTURES & DRIP LINE PROTECTION

The area underneath decks, outdoor stairs, and other elevated structures where water impacts the ground is called the drip-line. Significant soil loss, damage to supporting structures - or worse - can occur if this area is not adequately protected. Where signs of erosion are present - such as soil loss or uneven ground from water flow - it is important to take protective measures. Locations with over a 50% slope are particularly vulnerable and may require treatments designed and installed by a qualified licensed professional - e.g. (WHAT TYPE OF ENGINEER - i.e. who would they contact).

### POTENTIAL PROBLEMS



**A** Low decks may prohibit the addition of protective ground cover, leaving bare soil to erode.

**B** The runoff from high decks impacts the soil with greater force than low decks. It can cause structural damage to supports and contribute to sediment and other pollutants entering storm drains and creeks.

**C** Runoff on steep slopes with bare soil can cause significant erosion and even landslides. Ground covers such as rock and mulch are hard to keep in place and can easily wash away.



Visible erosion under a deck is common.

### BMP SOLUTIONS



**A** Adding vegetation to the perimeter SLOWS and SPREADS water limiting the transport of sediment (page XX)



**B** Adding drain rock SLOWS runoff and safeguards the drip-line area under elevated surfaces. Mulch around the perimeter adds extra protection to the surrounding bare soil (pages XX-XX).



**C** Terracing or retaining walls may be added to sloped areas to keep rock or other mulch in place and protect hillsides (pages XX-XX). Straw blankets and wattles can also be used for erosion control. (EXPLAIN WHAT THEY ARE)



### “BAG IT!”

According to the Center for Disease Control, pet droppings can contribute to diseases animals pass to humans. For example, when infected dog waste is left on your lawn, the eggs of certain roundworms and other parasites can live in your soil for years. Children are more at risk to infections caused by these parasites since they often play in the dirt and get things in their mouths or eyes.

In addition, pet waste has been implicated in higher than normal levels of bacteria found in Richardson Bay and Tomales Bay.

Pick up after your pet – not only on your property, but on public lands as well. Keep creeks clean and families healthy:

1. Scoop the poop
2. Put it in a bag
3. Place it in the trash
4. Wash your hands!

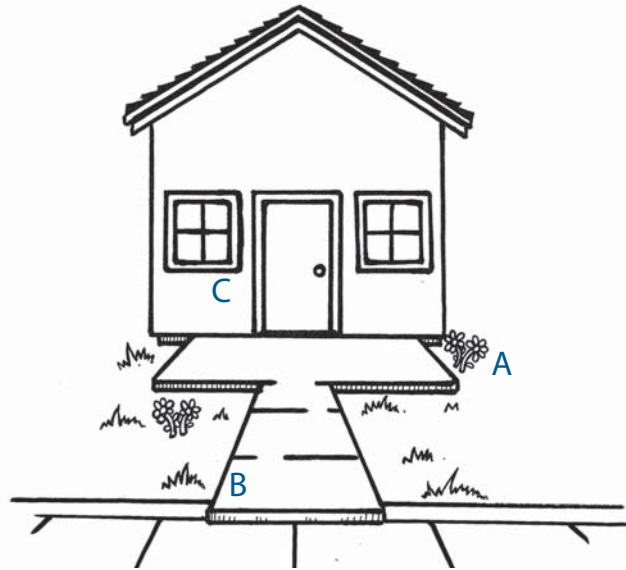
Call MCSTOPPP at 499-6528 to request a bookmark on picking up after your pet!



## ZONE 3: WALKWAYS AND PATIOS

Walkways and patio areas often become conduits for runoff. For existing paved paths or patios look for areas of standing water or visible signs of erosion where the path or patio surface meets the soil. Does your walkway drain to the street or toward your house? When constructing a new walkway or patio, always consider where it will drain. Angle it toward a vegetated area or try one of the new porous materials that reduce runoff and promote infiltration.

### POTENTIAL PROBLEMS



**A** Foot traffic, even in low use areas, can inhibit plant growth and leave bare soil to erode.

**B** Walkways or other hard surfaces that drain to the street increase runoff causing problems downstream.

**C** Hard durable surfaces such as patios are often constructed of concrete or other impervious materials that don't allow runoff to infiltrate.



Residential runoff that drains to the street contributes to localized flooding.

### BMP SOLUTIONS



**A** Gravel, mulch or wood chips work well in low-traffic areas and allow for more runoff to SINK into the ground (page XX).



**B** Turf block (e.g. grassy pavers) works by allowing water to SINK into the soil in medium-traffic areas or driveways with separate parking areas (pages XX).



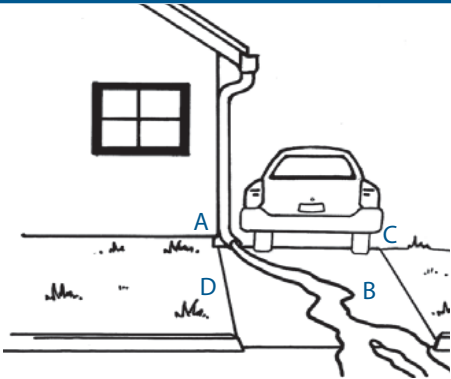





**C** Paver stones, gravel, flagstone or decomposed granite can be used for high-traffic areas and patios. For areas with excess runoff, use plant borders to allow more water to SINK into the ground (page XX)



## ZONE 4: DRIVEWAYS AND PARKING AREAS

Driveways, historically, have been constructed to divert runoff directly to the street. That runoff can carry with it a variety of pollutants such as used motor oil and grease, soaps from car washing, pesticides and fertilizers from lawn runoff and more.

Your driveway also acts as a conduit for large volumes of roof runoff. Concentrating large volumes of water that “run” to the street increases the chances of potholes, flooding, erosion, adverse affects to wildlife and habitat degradation. Check to see where your driveway water goes and locate the nearest storm drain. There are now many alternatives available to replace impervious concrete and a variety of solutions for addressing runoff on your driveway or parking areas.

POTENTIAL PROBLEMS	BMP SOLUTIONS
<p><b>A</b> The downspout is directed toward an impervious (concrete) driveway that drains to the street. The resultant runoff may damage roads, exacerbate downstream flooding, or carry pollutants to nearby waterways.</p>  <p><b>B</b> This driveway slopes toward the street and creates runoff potentially contributing to flooding, erosion, and pollutants in nearby storm drains and streams.</p> <p><b>C</b> This driveway is constructed of impervious materials (concrete), and all of the runoff is directed toward the street. The resultant runoff may damage roads, exacerbate downstream flooding, or carry pollutants to nearby waterways.</p>  <p><b>D</b> Driveways that do direct water runoff away from the street can still contribute to erosion if the area collecting the runoff is not properly protected or maintained.</p> <p>Driveways can act as conduits for excess amounts of runoff that can damage roads.</p>	<p><b>A</b> See Guttered Roofs on page XX.</p>  <p><b>B</b> A small speed bump known as a waterbar can be added to existing driveways to SLOW and SPREAD runoff to vegetated or rocky infiltration areas (page XX).</p>  <p><b>C</b> Pervious concrete (pictured) or other materials such as paver stones or turf block, allow water to SINK into the soil decreasing runoff (pages XX-XX).</p>  <p><b>D</b> A rocky or vegetated swale lining the edge of a road or driveway reduces erosion potential by SLOWING runoff and then SINKING it back into the soil or directing it to a safer outlet (pages XX-XX).</p> 

### CAR WASHING? MAKE IT FISH-FRIENDLY!

Oil, grease, zinc and copper are just a few of the pollutants that are washed into local creeks as dirty washwater makes its way down storm drains. And soap - whether biodegradable or not - can harm aquatic life .

The best way to wash your vehicle is taking it to a commercial car wash where water is recycled before being discharged to a water treatment plant. If you must wash your car at home, call MCSTOPPP for tips on how to do it in a fish-friendly manner. If you're involved with car wash fundraising efforts, call MCSTOPPP at 473-6528 and ask about borrowing their Fish Friendly car wash kit (see below).



## ZONE 5: BARE SOILS AND LANDSCAPES

Bare soils and sloped areas are the parts of any landscape which are most vulnerable to the impacts of runoff. Without a protective cover of vegetation, duff (decaying leaves and needles), or mulch (wood chips, etc.), these areas erode and increase runoff. Erosion reduces soil fertility, can compromise support structures for decks and buildings, and - in extreme cases - can lead to catastrophic events such as landslides. Erosion on bare soils can be identified, for example, by uneven soil surfaces or depressions in the soil that create small gullies. If water is flowing across bare soil anywhere on your property, at least some soil is being carried away (eroding). Since vegetation plays an important role in preventing soil loss, it is important to use plants adapted to your site. Some plants - e.g. English or Algerian Ivy or certain types of ivy plant (*Carpobrotus edulis*) - can actually hinder the stability of sloped areas due to poor root structure or added weight. They can also provide habitat for rats.

### POTENTIAL PROBLEMS



**A** Bare soils are highly susceptible to erosion.

**B** In steeply sloped or hilly areas soil erosion is not only harmful to the environment, but can pose a serious threat to life and limb when land movement occurs.

**C** Moderately sloped areas are also prone to erosion and can cause damage to surrounding structures if they become unstable.



Bare soils are susceptible to erosion and increase runoff that delivers sediments and other pollutants to streets and storm drains and eventually to local waterways.

### BMP SOLUTIONS



**A** Mulch protects soil from direct rain impact and SLOWS runoff across bare soils (page 40).



**B** Retaining walls help hold sloped areas in place and SLOW runoff. They also add beauty to a landscape and can double as benches and planter boxes (page 44).



**C** Using carefully chosen vegetation can help SLOW and SPREAD runoff in order to prevent soil erosion on hillsides. Ceanothus (pictured) is one example of a shrub that does well in areas with full sun and requires little to no summer water once established. For examples of plants useful in controlling erosion, see the Resource section of this guide.



## DO-IT-YOURSELF STORMWATER RUNOFF EVALUATION

1) To discover where you can implement solutions that help keep rainwater from running off your property, we recommend that you conduct a simple do-it-yourself evaluation. The evaluation consists of a walk around your property on a rainy day to record observations of the 5 zones (see bottom of page XX) and how runoff is currently handled, where runoff is going, and where there might be potential for installing solutions that are better for you and the environment. The kids can even don their rubber boots and join you!

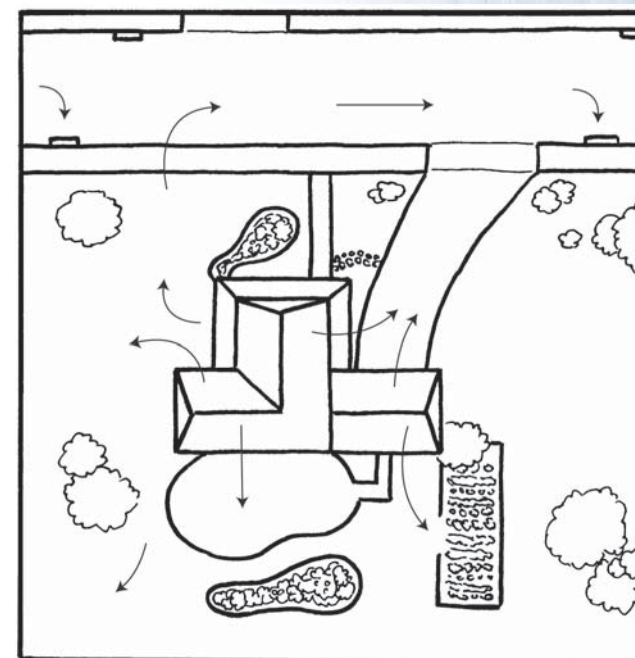
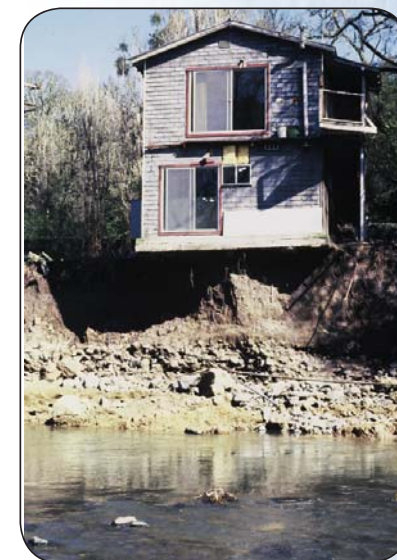
1) TOOLS. Below is a list of items you will need:

- rain gear
- clipboard with scratch paper
- simple sketch of your property
- pencil (ink may run if it gets wet)
- umbrella (to keep the paper dry)
- camera

2) SKETCH YOUR PROPERTY. Your sketch will be used to record observations about where the runoff comes from and flows to. The sketch can be very simple. It should include property boundaries, an outline of your house and foundation, outbuildings, driveways, areas of bare soil and any major vegetation (trees, lawns, etc.). Also note how close you are to the nearest creek, storm drain, or ditch that carries water away from your property. If you aren't sure, see if you can find it on your walk!

3) WALK YOUR PROPERTY. Once you've gathered all of the tools and completed an initial property sketch, head outside on a rainy day for the stormwater evaluation walk. It's always good to take photographs when water is flowing so don't forget your camera! For the most accurate results, do not choose the first storm of the season or go out during the first few minutes of rain. Wait until there have been at least one or two good rainfalls and go out when more than a ½ inch of rain has fallen. Go out after you see water flowing on your property. This will also help you identify creeks that are dry in summer but "wet" in the rainy season. During the walk, you can record stormwater runoff observations by drawing arrows that follow the direction of water movement on your property (see sample drawing). You can also record potential locations where you might apply some of the solutions listed in Chapter 2. For example, if you have a downspout that currently drains to a driveway, look around and note locations where you might direct the runoff to a rain garden or hook up a rain barrel.

4) KNOW YOUR RAINFALL RATES! You can check average rainfall amounts by adding your zip code to the end of the following web address: <http://www.weather.com/outlook/health/fitness/wxclimatology/monthly/graph/>.



5) **KNOW YOUR SOIL!** Soil maps are available for review at the Marin Civic Center, Land Development, 3rd Floor or go online to the Natural Resources Conservation Service (NRCS) website at <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm> . When you link to the page, click on the button that is marked “WSS”. On the map, hit CA and keep zooming in until you reach the area you want. Once you have zoomed in on the site, choose the Area of Interest (AOI) tool and then pick either the rectangle or polygon. (They are the last 2 squares right above the map on your screen.) Either choice will help you outline the area for which you want soils info. Then, from the yellow tabs at the top of the map interface, select soils info, soils data or custom soils report. You can also choose the “quick navigation” button under AOI. This will allow you to input a specific address. In this case, you will not need to outline an area with the polygon or rectangle. Soil maps for Marin can also be viewed at the Southern Sonoma County Resource Conservation District, 1301 Redwood Way, Suite 170, Petaluma - or call 707-794-1242.

Before you start “moving dirt” to implement some of the solutions mentioned in this Guide, it is highly recommended that you also consult a professional (e.g. a soils engineer) for an evaluation of the soils at your location. Soils with poor infiltration rates might require additional steps in order for some of the solutions listed in this Guide to work effectively.

6) **ASSESS POTENTIAL POLLUTANTS.** Ask some questions like: Do you have an asphalt roof? Does your automobile leak oil and/or antifreeze in your driveway? Do pesticides and/or fertilizers run off your lawn or garden? Are paints, pesticides, or piles of dirt/leaves left exposed to the rain? Are downspouts disconnected from gutters? Are downspouts causing water to puddle or erode soil?

7) **LOCATE SEPTIC SYSTEMS AND WELL WATER, IF APPLICABLE.** Determine required local, county or state setbacks from septic tanks, leach fields, interceptor drains and wells. If you have a septic system, be sure to also locate your replacement leach field area – which must remain undeveloped. It is critical that storm water projects be designed so that water is not diverted to, or intercepted from an existing septic system.

8) **EVALUATE YOUR RESULTS.** Using your results and the solutions listed in Chapter 2, you can determine what practices you might want to employ to beautify your landscape, protect your property, reduce flooding, and help improve local water quality.

## A WORD ABOUT PERMITS AND WORK NEAR A CREEK

Small-scale projects can often be implemented without the need for designs or a permit. Medium to large-scale projects will often trigger the need for engineered designs and one or more permits. Sometimes, this can be as straightforward as obtaining a building permit from your local municipality. Reconfiguring the stormwater flow regime on a large parcel with substantial earth movement may require engineered designs, and multiple agency permits.

If you are working within 30 feet of a creekbank, contact your local stormwater coordinator. See the Resource section of this Guidebook.



## A WORD ON STORMWATER MANAGEMENT AND MOSQUITO CONTROL

A single mosquito can breed in 1 tablespoon of water producing over 150 offspring! In addition to the nuisance of an itchy bite, mosquitoes also have the capability to transmit disease. And, once a mosquito has hatched, it's far more difficult to manage. Even if you wanted to spray, it's not effective. The trick to mosquito control is eradicating the larvae and not encouraging breeding sites. Below are some things you can do:

### FOR RAIN BARRELS:

- Use barrels with a mosquito-proof screen (fine mesh - 1/16th of an inch) under the lid and covering the overflow hole.
- Keep your rain barrel lid and all connectors in the system sealed.
- If possible, place your barrel on a surface that will soak up or promptly drain water that has overflowed.
- Keep your barrel free of organic materials such as leaves and debris.
- Remove water that may have pooled on top of the barrel at least 1 to 2 times a week or use a barrel with a self-draining lid. When no chlorine is present in the water, it takes about 5 days for a mosquito to go from an egg to an adult.
- Use a downspout diverter to direct water into the barrel.
- Inspect the system on a regular basis to be sure there are no cracks or leaks and that all seals and fittings remain intact.
- Keep gutters and downspouts clean and free of debris.

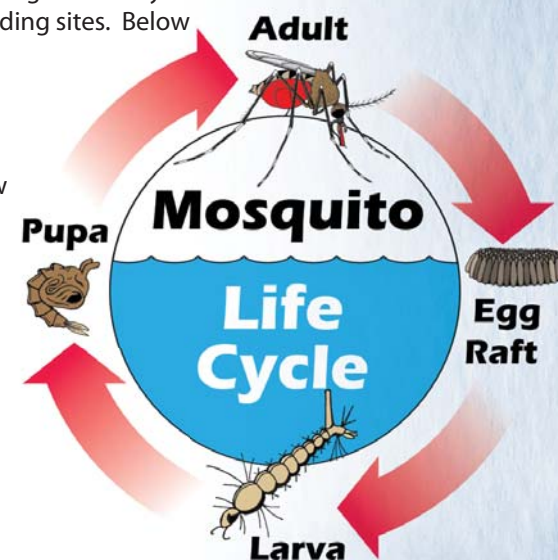
### FOR LARGE WATER TANKS/CISTERNS:

- Cisterns (above and below ground) should be completely enclosed with no openings to the outside environment.
- Tightly seal cistern lids and connections.
- Cover all inlets, outlets, and vents with mosquito-proof screening (fine mesh -1/16 of an inch).
- Inspect on a regular basis to be sure there are no cracks or leaks and that all seals and fittings remain intact.
- The area surrounding cisterns should be designed to either divert or absorb excess water from overflow.
- The inside of the cistern must be accessible for periodic maintenance as well as inspection by mosquito control personnel.

### FOR SWALES, RAIN GARDENS AND OTHER INFILTRATION SYSTEMS

It is important that stormwater treatment, storage, infiltration structures and systems are designed and properly maintained. Correct design and maintenance minimizes the potential for mosquito production, repeated mosquito larvicide applications, mosquito-borne disease transmission, and other public health issues.

- Select and maintain the proper grade for water conveyance (e.g. swales, retention features like rain gardens, cross drains).
- Systems should completely de-water (drain) within 72 hours to prevent mosquito breeding.
- Avoid loose-fitting rock or rip rap that may trap water, creating an ideal environment for mosquito production.
- Systems should be easily accessible.
- Use caution when installing any catchment system that holds 18 or more inches of water as this poses a potential drowning hazard.



## PLANT SELECTION

- Choose appropriate vegetation for the specific project.
- Native, low-growing vegetation is preferred to minimize the potential for mosquito production in stormwater treatment systems and allow for efficient mosquito control, if necessary.
- Do not plant cattails or other aquatic plant species that can become invasive - such as creeping water primrose (*Ludwigia* species), water hyacinth (*Eichhornia*), and parrot feather (*Myriophyllum* species). For more information on plants to avoid in water features, go to [www.cal-ipc.org](http://www.cal-ipc.org) and look for their Aquatic Plants brochure.
- Do not surround rain gardens, swales, or retention features with dense vegetation that could hinder access.

## MAINTENANCE

- Develop and adhere to a maintenance plan and schedule.
- Periodic sediment removal may be necessary to minimize mosquito habitat (e.g. swales, retention features, cross drains) and maintain proper function.
- Aggressively manage unwanted vegetation.
- Mow or thin out vegetation regularly to avoid overgrowth, ensure proper system function, and facilitate access.
- Keep inlets and outlets serviceable and free of debris.

If you are experiencing a mosquito problem or would like more information about controlling mosquitoes, contact:

Marin/Sonoma Mosquito and Vector Control District (MSMVCD)

595 Helman Lane  
Cotati, Ca 94931  
1-800-231-3236 or 707-285-2200  
[www.msamosquito.com](http://www.msamosquito.com)





## CHAPTER 2

# IDEAS FOR MANAGING RAINWATER RUNOFF AROUND YOUR HOME

### CALL BEFORE YOU DIG!

Underground Service Alert (USA) is a FREE service available to anyone planning a project that entails digging. It is simple and easy to use. Before calling USA, outline your digging location with white chalk, paint or another medium clear enough to enable USA underground facility members to determine the area of digging.

Two working days BEFORE you start your project, call 811 or 1-800-227-2600. USA will contact the appropriate agencies to come and mark any utilities that may interfere with your project location. For more detailed information, visit USA North online at [www.usanorth.org](http://www.usanorth.org).

Managing rainwater (or stormwater) on your property is not a new idea. Most residential homes were constructed using the runoff methods of the era in which they were built. For the past 50 years, that approach has been to direct runoff away from the property as quickly as possible using pipes and pavement. While largely effective at the time, we are now experiencing the adverse consequences of those methods in a variety of ways including increased potential for flooding, damage to public and private property, stress on our water supplies, and degradation of our local waterways and habitats.

Consequently, this Guide was developed to present some practical and cost-effective solutions that move away from the old “pipe it and pave it” model toward the newer “slow it, spread it, sink it” approach: slow the water down, spread the water out, and sink the water into the land.

Find the solution that best fits your needs, your pocketbook, and your unique site conditions.

Following this chapter is a must-read section on difficult locations and site constraints. While this Guide presents great ideas, it is critical to recognize when and where they are NOT appropriate.














### THINGS TO KEEP IN MIND BEFORE EMBARKING ON ANY NEW PROJECT:

1. It is important to recognize that each solution presented in this Guide requires ongoing maintenance to remain effective. If you already use one of the listed solutions, review the maintenance section for tips on maximizing its effectiveness.
2. Vegetation plays several important roles in the proper functioning of solutions presented. These may include:
  - Slowing down water and physically removing sediments
  - Helping to stabilize slopes through their root structure and reducing the impact of rain on the soil
  - Biological removal of nutrients and other pollutants (Called bioremediation, it uses plants to help filter out some pollutants)
  - Improving soil infiltration
3. Structural practices are usually more expensive to install and maintain. They should only be used when modifying your existing practices will not increase the effectiveness of your current system.
4. ALWAYS check with applicable regulatory agencies to determine if a permit is necessary for any project. Examples of projects for which a permit may be required include building a retaining wall, installing a large cistern, sending runoff to a creek or stream, and directing water to a neighboring property. For a list of resource agency contacts see page XX.
5. CALL BEFORE YOU DIG! Call 811 or 1-800-227-2600 for assistance from Underground Service Alert (USA). See expanded information to the left.



6. Important Considerations for Properties with Septic Systems: Throughout Marin, there are about 9,000 homes served by onsite sewage disposal systems (i.e. septic systems). Not only do these systems have subsurface leach fields where the household sewage is treated and disposed of, but many also have subsurface drains (interceptor drains) associated with their design. It is imperative that any planned solution to reduce or prevent rainwater runoff be designed to not intercept subsurface sewage or interfere with the functioning of a septic system or interceptor drain. When you are in the design phase, always check with your local jurisdiction first for the location of your septic system and leach field replacement area. If there are no records available, consult with a qualified individual to locate your system and its replacement area prior to the design of your new project. Septic systems also have statutory setback requirements that you will need to consider. Contact Marin County Environmental Health for more information on septic systems. If a permit is needed, only the following agencies can issue one for their jurisdictions: Marin County Environmental Health (415-499-6907), Stinson Beach Water District (415-868-1333), and the City of Novato (415-899-8900).

## BENEFITS OF USING ECO-FRIENDLY SOLUTIONS TO REDUCE OR PREVENT RAINWATER RUNOFF FROM YOUR

BENEFITS	
	Conserves water
	Promotes groundwater recharge
	Enhances & creates wild-life habitat
	Improves landscape aesthetics
	Decreases potential for flooding
	Reduces erosion
	Protects infrastructure
COST	
	Low cost
	Medium cost
	High cost
INSTALLATION DIFFICULTY	
	Easy
	Moderate
	Complex

The solutions described in this chapter include general information on the benefits of each practice, an estimated cost range of low to high, and a level of difficulty for installation by the homeowner. It is also noted where using a qualified licensed professional is highly recommended.

Potential benefits to reducing/preventing rainwater from leaving your property include the following:

- Conserves water: Potable water use for irrigation can be offset by capturing rainwater, using plants with low water needs OR directing runoff water to areas where it can be stored in the soil for later use by plants.
- Promotes groundwater recharge: Allowing more water to sink into the soil helps protect our aquifers by enhancing recharge.
- Enhances and creates wildlife habitat: When installing BMPs that use vegetation, choosing appropriate plants can create habitat for local wildlife and act as natural pest control.
- Improves landscape aesthetics: Many of the BMPs in this Guide can actually beautify your landscape.
- Decreases potential for flooding and creekbank erosion: Increasing permeable surface area slows the rate and reduces the volume of our residential runoff. This, in turn, will reduce high volume (peak) flows that contribute to flooding and the potential for erosion in local creeks.
- Reduces erosion: Practices that reduce erosion limit the loss of top soil and reduce the volume of sediments entering local creeks.
- Protects infrastructure & increases property value: These practices help reduce runoff that could damage structures, foundations, or public infrastructure such as roads. Sound stormwater BMPs will also increase the value of almost any property.

### USE OF MULTIPLE, INTEGRATED SYSTEMS

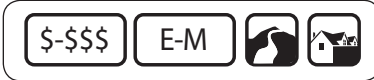
A multiple treatment system uses two or more solutions in an integrated fashion.

Many of the solutions in this manual can be easily integrated on a small or medium residential scale.





# Gutters and Downspouts



## USES: ROOF RUNOFF

Marin County and the incorporated cities/towns may each have specific requirements for installing gutters and downspouts. Since requirements often change, only general guidelines are provided below. Contact your respective planning/building department for more detailed information. See the Resources section on page XX for agency contact information.

## NEW INSTALLATIONS OR RETROFITS

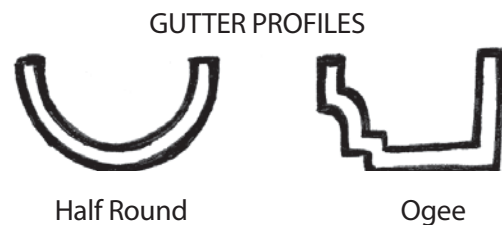
Properly sized gutters and downspouts are crucial for proper performance. While installation is fairly simple, calculating the correct size system for your roof can prove more difficult. You will need to know your roof area and pitch or slope and your location's annual rainfall. A local qualified professional can assist with calculating correct gutter and downspout sizes.

Also consider where your downspouts drain. Wherever possible and safe, divert downspouts AWAY from impervious surfaces such as concrete driveways, walkways, or compacted soils. Instead, direct them to well vegetated areas of your property to allow runoff to SINK into the soil. This decreases water volume on streets and in storm drains. It also reduces the potential for downstream flooding that could occur when too much fast-running water enters the creeks - either directly or through the storm drain system.

General guidelines for selecting and installing gutters and downspouts or improving capacity:

## GUTTERS

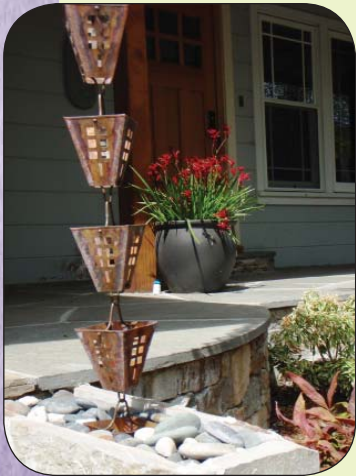
Select gutters at least 5 inches wide. Use materials made from galvanized steel (29 gauge minimum) or aluminum (.025 inch minimum). To enhance flow, slope gutters according to the manufacturer's recommendations (commonly 1/16 inch to 1/8 inch per 1 foot of sectional gutter; or 1/16 to 1/8 inch per 10 feet of seamless gutters). Tilt the gutter forward keeping the front 1/2 inch lower than the back. For straight runs exceeding 40 feet, use expansion joints at connections. Select elbows with 45, 60, 75 or 90 degree angles, as needed.



Gutters come in a variety of different sizes and shapes. It's important to understand that the shape of your gutter determines the amount of water it can handle from your roof during a storm. For example, the Ogee shaped gutter on the left can handle more water than rounded gutters. However this ogee gutter's sharp edges and corners can collect sediment and debris that might require more maintenance. The sharp edges and corners can be avoided in newer models.

## RAIN CHAINS

A RAIN CHAIN can be used instead of a downspout. Rain chains ('kusari dio' in Japanese) have been used for hundreds of years in Japan. Not only are they visually appealing, they also provide some runoff reduction through evaporation and spillage. When installing rain chains, make sure to take the same precautions for outlet protections as you would with standard downspouts. For more information visit a local retailer or [www.rainchains.com](http://www.rainchains.com).



## DOWNSPOUTS

Space downspouts from 20 to 50 feet apart. Adding additional downspouts can increase capacity where necessary and help SLOW water down and SPREAD it out. Do not exceed 45-degree angle bends. Where needed, use 4-inch-diameter extensions (flexible or rigid) to convey water to infiltration areas such as rain gardens and swales or to other safe outlets away from structures and steep slopes. All downspouts and pipes that flow onto surfaces without substantial vegetation cover should use one of the outlet protection options described on page XX. Do not direct downspout outlets to driveways or other impervious surfaces. Instead, route them to vegetated areas or storage tanks. Loose asphalt, leaves and twigs can be prevented from entering storage tanks by installing a downspout diverter when harvesting water from your roof.

**MAINTENANCE:** Setting up a maintenance schedule is one of the easiest and most cost-effective solutions to many roof runoff issues. Clean your gutters at the beginning of each rainy season and as needed throughout the winter. In areas with dense trees or vegetation, trim trees and vines away from gutters to maintain a minimum 24-inch clearance zone. Add gutter guards to reduce debris buildup. You can also add a drip-line treatment (page XX-XX) below gutters that clog often. Check your system for leaks, damaged parts, rust, and evidence of past erosion. Make sure to check hidden sources for where roof runoff might be directed causing problems - e.g. under outdoor decks or staircases. Also see page XX for information on how to prevent mosquito breeding while managing runoff.

Always check and clean gutters after severe storm

### DO

- Direct runoff to landscape, a rain garden or swale.
- Collect runoff in a rain barrel or cistern.
- Check and clean gutters after severe storms.
- Install downspout diverters when harvesting water from your roof.



Adding additional downspouts helps reduce the volume and velocity of runoff at any given point. This, in turn, reduces the potential for erosion as it comes out the downspout.

### DON'T

- . . . release water onto bare soil.
- . . . direct runoff to steep slopes or foundations.
- . . . send runoff onto a neighbor's property.
- . . . promote standing water.



# Drip-Line Protection



**USES:** BELOW ROOF EAVES, UNDER DECKS OR ELEVATED STRUCTURES

A drip-line is the area below any elevated surface that receives runoff. For roofs, it's the ground below the eaves that doesn't have gutters installed. For decks and other elevated surfaces, it's the area underneath where water drips through (e.g., the area between and below the deck boards). Drip-lines create a barrier to protect exposed soil and reduce erosion. The protective cover also SLOWS runoff and allows it to SINK back into the soil. This is critical in areas where runoff-induced erosion could reduce the effectiveness of support structures and footings. Drip-line protection is also a great addition where gutters frequently overflow due to large amounts of debris.

## VEGETATION PROTECTION FOR DRIP-LINES

**Roof drip-lines:** Homeowners can establish and maintain mature vegetation below their roof drip-lines. If there is existing vegetation (such as turf or a bordered planter bed), simply maintain these areas. Examples of adequate drip-line vegetation include the following:

- Healthy grass or turf that has been established directly up to the foundation of your home . THIS DOES NOT SEEM LIKE A GOOD SUGGESTION. SHOULDN'T WE AT LEAST BE RECOMMENDING MOW STRIPS?
- Plants, shrubs, or flower beds that are completely bordered by wood, rock, or turf that slows rainwater down while allowing it to pass through; and, uses mulch to cover bare soil.

Consider using native plants. Call MCSTOPPP and request a free copy of "Go Native" to learn about native plants that can be used in your landscape. A local nursery or a qualified landscape professional (go to [www.bayfriendlycoalition.org](http://www.bayfriendlycoalition.org)) can assist you with selecting plants well-adapted to your specific location. You can also call the Marin Master Gardeners at 499-4204 or visit their offices in Novato at 1682 Novato Blvd., Suite 150B. And, you can contact the Marin Native Plant Society ([www.marin.cc.ca.us/cnps/index.html](http://www.marin.cc.ca.us/cnps/index.html)).

**Deck/stair drip-lines:** Where adequate sunlight is available, planting hardy ground cover, grasses, or other low growing vegetation is a good low-cost option for protecting soil from erosion beneath decks and stairs. Use drought tolerant plants that do not require supplemental watering, once established, to prevent additional runoff or water near a structure. If you have structures on your property that are low to the ground and are inaccessible underneath, try planting around the perimeter.

**MAINTENANCE:** Periodic mowing, pruning, and replacement of plants is needed. Inspect the foundation to ensure water is not saturating or eroding the structure or foundation. Keep fertilization to a minimum as it can contribute to excess nutrients in runoff. If you do fertilize, always follow the manufacturer's instructions and never apply in excess or prior to forecasted rain. Always use a slow release fertilizer. Better yet - make your own compost! Learn how by requesting a free copy of "Growing Gardens from Garbage" by MCSTOPPP at 499-3202 or visit them at [www.mcstoppp.org](http://www.mcstoppp.org)



### DO

- Use California natives or drought tolerant plants.
- Keep plants well pruned to allow adequate ventilation.
- Keep soil a minimum of 6 inches below siding.
- Minimize fertilization to prevent water contamination.
- Try organic fertilizers and pest controls.

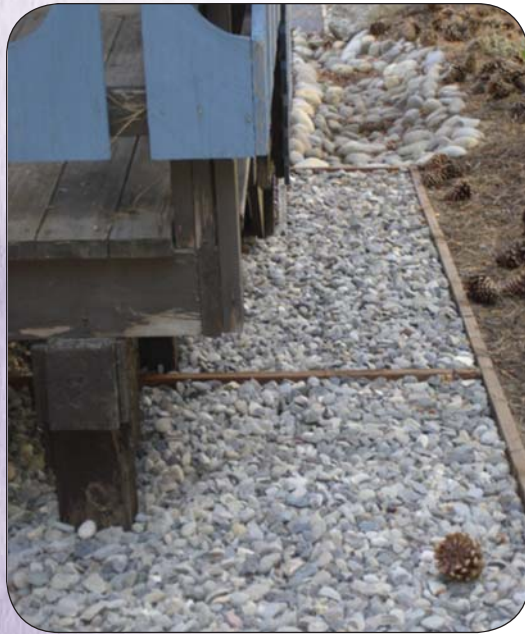
### DON'T

- ... plant invasive species such as periwinkle (Vinca Major) or ivy. See Resources for more info on invasive species.
- ... plant highly flammable vegetation.
- ... allow irrigation water to drain to your driveway, the street, or onto bare soil.

## HARDSCAPE" PROTECTION FOR DRIP-LINES

Roof drip-lines: "Hardscape" (or non plant-based materials) like wood chips, mulch, or gravel can be used to protect soil from erosion and promote infiltration into soils with high permeability (e.g. sandy soils). Install gravel or mulch under the drip-line at a minimum depth of 3 inches. This treatment must extend 6 inches inside the eave and a minimum of 12 inches beyond the eaves of a single-story roof, 18 inches beyond the eaves of a two-story roof, and 24 inches beyond the eaves of a three-story roof. This treatment prevents erosion and allows runoff to infiltrate. Three-quarter inch to one and a half inch washed drain rock is an adequate size to prevent the rock from being moved by rainfall; however, you can use any kind of rock you like, in order to achieve a desired aesthetic effect on your property. Installing non-woven geotextile fabric beneath the rock - and then bordering the rock with wood or other material - will reduce maintenance

and increase effectiveness. You also need to ensure that the ground slopes a minimum of 5% AWAY from the foundation for a minimum of 10 feet.



Deck/stair drip-lines: To protect the soil under elevated decks, stairs, and walkways from erosion, install a three-inch layer of drain rock under the entire footprint of the structure and extend one foot past its edge. If you have structures on your property that are low to the ground and are inaccessible underneath, install a three-inch layer of rock or other mulch approximately twelve inches wide around the outside perimeter of the structures. This treatment will slow runoff velocity and reduce erosion potential. It is only necessary to install drain rock under and around these structures if there is not adequate vegetation established. Installing non-woven geotextile fabric beneath the rock and then bordering the rock with wood or other material will reduce maintenance, help control weeds, and increase effectiveness. You also want to ensure that the ground slopes a minimum of 5% AWAY from the foundation for a minimum of 10 feet.

**MAINTENANCE:** Periodic replacement of gravel or mulch will be needed. Inspect the foundation to ensure that water is not saturating or eroding either the structure or the foundation.

### DO

- Use existing rock or mulch from your property.
- Use rock from a local quarry.
- Make sure rock is washed. WHY???

### DON'T

- . . . use rock under three-quarter inch in size.
- . . . allow runoff to flow TOWARD the house or structure.



# Rainwater Collection Systems

\$-\$\$\$
E-M

## USES: COLLECT AND STORE WATER FROM ROOFS

Rainwater tanks and cisterns can be placed outside buildings to store water collected from roof downspouts. The stored water can then be used for irrigation. Collecting and storing water from roofs is an excellent way to SLOW water down by temporarily storing it. Captured water can be reused for irrigation or other non-potable options. It can also be metered off slowly after a storm to allow it to infiltrate the ground and help reduce flooding.

**RAIN BARRELS** are small to medium-sized containers placed outside buildings and also connected to roof downspouts to collect runoff for later use in non-potable applications - e.g. rain gardens. Rain barrels have many advantages in urban settings: They take up very little space, are inexpensive, and are easy to install. They can be emptied after each storm and then refilled with the next rain.



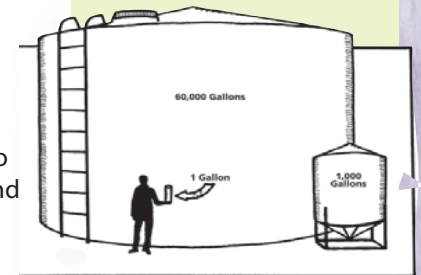
Photo above by \_\_\_\_\_, SPAWN

## CATCH THE RAIN!

It takes only 1" of rain falling on a typical 1500 square foot roof to generate approximately 1,000 gallons of runoff.

Annual rainfall in Marin County averages 44 inches. This means that in one winter, your roof alone could generate 44,000 gallons of water!

Instead of running off your property, this water can be put to use by implementing some of the measures found in this guidebook.



**MAINTENANCE:** Rain barrels require regular draining after rainstorms and removal of leaves and debris collected on screens. Always check that the overflow is clear and directed to an appropriate location. Fine mesh screens should be used to seal lids and vents. A hole as small as 1/16 of an inch can allow mosquito access and result in significant larvae production.

Photo on left by Bene Da



### DO

- Use water regularly.
- Use gravity to your advantage.
- Use multiple barrels where possible.
- Keep barrels sealed and maintained to eliminate debris and mosquito breeding. See Pages XX-XX.

### DON'T

- . . . allow access for mosquitos, rodents, children, pets, or debris.
- . . . use for drinking.
- . . . capture water from roofs with excessive debris (e.g. leaves, pine needles, or bird droppings).

**RAINWATER TANKS (CISTERNS)** are manufactured water storage containers for non-potable use in residential, commercial, or industrial applications. Such tanks can be installed both above and below ground. Some tanks come as sectional pieces that can be put together to fit different space constraints. Tanks can be used with most guttered roofs to collect runoff and reduce runoff volume. Both rainwater tanks and rain barrels can be used without pumping devices, instead relying on gravity flow. However, depending on the desired use for the water, a pump may be necessary for best performance.

Larger tanks can be designed to also function as privacy screens, fences, or small retaining walls. Tanks or other large rainwater collection devices can also be hidden under decks (see Page XX) or serve as the foundation for play structures or other landscape features.

Underground tanks are excellent options for areas with limited space. However, do not install underground systems beneath the path of vehicles or heavy machinery or traffic unless they have been engineered for that purpose. Extra precautions may be needed when placing tanks in locations with high water tables or saturated clay soils. Contact an experienced licensed professional for tank installations under these conditions.

Basic components of a rainwater collection system:

- Catchment surface  
(This is normally a roof, but there are other options.)
- Gutters and downspouts  
(Round gutters are recommended because they are less likely to collect sediment in corners and edges. Such sediment can then support bacteria growth.)
- Screening of tanks or barrels and downspout openings
- First-flush device/Downspout Diverter
- Water tanks  
(There are various options including manufacturing on-site.)
- Water tank vent
- Overflow device  
(This should be equal to or larger in diameter than the inflow pipe to avoid backup.)
- Faucet and valve
- Filters and pumps (optional)



Underground outdoor systems can be customized to fit various shapes and sizes using these modular RainBoxes.



**MAINTENANCE:** Remove accumulated sediment and debris annually and inspect all components such as gutters and downspouts regularly. The inside of the tank must also be inspected. Look for system leaks and cracks. Check all connections and hoses for wear and all screens or mesh for debris accumulation and holes. Make sure overflow is clear and directed to an appropriate location. Inspect all seams for leaks. Follow all manufacturers' recommended maintenance for any storage device.

### DO

- Obtain necessary permits for tanks over 500 gallons.
- Secure tanks with straps for protection from earth movement.
- Use gravity to your advantage wherever possible.
- Keep underground tanks a minimum of ¼ full at all times to prevent collapsing of certain tank types.
- Place tank in an accessible location.

### DON'T

- . . . place tanks on steep hillsides.
- . . . place water tanks below ground unless they are approved for this use.
- . . . collect water from cedar or highly degraded roofs.
- . . . collect roof water from areas prone to large amounts of debris (leaf litter, etc.).
- . . . use or install older type cisterns with open tops or sides.



Two large cisterns were placed under a deck at a residence in Kentfield. See page XX for more information.

# Outlet Protection



**USES:** DOWNSPOUT, PIPE, OR CULVERT OUTLETS

One of the most overlooked parts of a drainage system is the outlet from downspouts and pipes. Outlets should not release water onto bare soil or to an area prone to erosion. Discharging water onto a hardened impervious surface reduces its ability to be absorbed (infiltrate) by the soil and increases the volume and speed of water that is directed to streets and creeks. This creates a new set of challenges. All outlets that drain onto soils or other erodible surfaces should have some type of mechanism that allows the water to SLOW down and/or SPREAD out so it can SINK back into the soil. A few ideas are presented below.



**SPLASH GUARDS** (pictured to your right) are simple devices that reduce the initial force of the water at the outlets and allow it to SPREAD out into an area of vegetation or other appropriate infiltration area and then SINK back into the soil.



**HOSE ADAPTERS** are a neat option (a Drought Buster East Connect is pictured to the left) that allow a standard garden hose to connect directly to a downspout. The hose can then be moved to different locations of your yard when it rains. It is perfect for watering trees or keeping any one area from becoming too saturated by allowing the water to SPREAD out through the landscape.



**ROCK DISSIPATORS** are placed at outlets to SLOW runoff by reducing the initial impact of concentrated, high velocity runoff. For downspout outlets there are several easy creative options like filling a large plant container (it must have drain holes) with pebbles or placing rock on the ground. The rock could be surrounded by a wood border (similar to a rock drip-line) to hold it in place. Large containers (1/2 wine barrels are an inexpensive option) with established plants and a thick layer of mulch (wood chips or gravel) also work well. Make sure that the drainage from under the pots flows away from your foundation.

For culverts or outlets with drain pipes over 8 inches in diameter, rock must be properly sized to prevent movement and placed with filter fabric underneath. Angular rock (shown in photo to the left) is typically recommended for high velocity flows because it locks in place and has a greater capacity to slow the water than rounded rock or broken concrete which tends to have some smooth edges. Rock should be carefully laid by hand forming an evenly lined depression or basin with no spaces between the rocks. It is highly advisable to contact a licensed qualified professional for design assistance. Generally speaking, work done at any outlets that drain directly into a local waterway will need a permit. Contact your local building/planning department for permit guidance. See page XX for contact information.

## DO

- Direct downspouts to vegetated areas or rock dissipators.
- Protect ALL outlets on your property.

## DON'T

- . . . allow water to pond near foundations.
- . . . direct water to driveways or other impervious surface that drain directly to the street.
- . . . allow large spaces between rocks that can hold stagnant water.



# Rain Gardens



**USES:** ROOF, WALKWAY, DRIVEWAY, OR PARKING AREA RUNOFF

A rain garden is a specialized landscape design that captures stormwater runoff from roofs, driveways, or other impervious surfaces and allows water to SINK back into the ground. Rain gardens are a beautiful way to protect your property from erosion and protect the water quality of local creeks. They can enhance the aesthetic value of a site; be used on small parcels of land, easements, and right-of-ways; and are easily incorporated into existing landscapes or open space.

A rain garden design can be as simple as a shallow depression filled with plants that can flourish in both moist and dry conditions. The required size, shape, and depth of the garden depend on how much water you are trying to capture. For large amounts of runoff or areas with insufficient infiltration, there are a full spectrum of engineered features - such as specialized soil mixtures, an aggregate base, and subsurface drains - that can be added. These more complex designs are often referred to as bioretention cells and require the use of qualified professionals - e.g. \_\_\_\_\_ engineers.

Rain gardens should be located a minimum of 5 feet from structures without a basement or 10 feet with one - and at least 40 feet from a septic system or steep slope. They should also be designed to drain within 48 hours to reduce the risk of standing water and mosquito breeding (see page XX).

When planting a rain garden, use the center of the garden for species that tolerate wet conditions, such as native sedges and rushes. Around these, put plants suited to occasional standing water - e.g. Yellow Monkeyflower (*Mimulus guttatus*) or California Aster (*Aster chilensis*). At the furthest edges, place a variety of native evergreen and deciduous shrubs that prefer drier soil. Contact a local plant nursery (see page XX) knowledgeable in native and drought tolerant species for ideas. You might also try calling the Marin Master Gardeners at 415-499-4204. For more information on rain gardens, go to the Green Sheet developed by UCCE at Green Sheet by UCCE: [http://www-csgc.ucsd.edu/BOOKSTORE/Resources/GS3%20Rain%20Gardens\\_8-10-09.pdf](http://www-csgc.ucsd.edu/BOOKSTORE/Resources/GS3%20Rain%20Gardens_8-10-09.pdf). Though the information is intended for a Southern CA audience, most of it is appropriate for Northern CA as well.

**MAINTENANCE:** Routine maintenance is required and can be performed as part of the regular site landscaping program. Weeding and irrigation are essential in the first couple of months while plants become established. Annual pruning and mulching are recommended. Additional irrigation may be necessary during drought years. The use of native, site-appropriate vegetation reduces the need for fertilizers, pesticides, excessive water, and overall maintenance.

## DO

- Use California native or drought tolerant plants as appropriate.
- Minimize fertilization to prevent water contamination and try organic options.

## DON'T

- ... site in soils with high water tables or clay soils without an overflow device.
- ... place too close to your home's foundation.





## Swales

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E-M



**USES:** ROOF, WALKWAY, DRIVEWAY, OR PARKING AREA RUNOFF; LOW TO MODERATELY SLOPED HILLSIDES

Swales are shallow channels designed to SLOW water down, SPREAD it out and allow it to SINK into the soil during low flows. Once saturated, they convey water to a safe outlet such as a rain garden (page XX) or other infiltration areas. They can be formed to fit almost all site conditions and landowner objectives. Depending on the existing landscape and available space, swales can have a meandering or nearly straight alignment. An advantage to a meandering swale is that its geometry maximizes the time water spends in the swale thus aiding the trapping of pollutants and sediments while promoting infiltration. There are two types of swale systems: vegetated or rock-lined (sometimes called dry creek beds).

### VEGETATED SWALES

Grassed swales typically contain native soil and are vegetated with native perennial grass species along the bottom and sides of the channel. The vegetation in the channel slows runoff, allows sediments to filter out, and can help remove nutrients. Bioswales are vegetated swales that use engineered media (usually a specially designed soil mix consisting of sand, loam soil and hardwood mulch) beneath the swale to improve water quality, reduce runoff volume, and control peak runoff rates. Although their functions are similar to grassed swales, bioswales have a greater capacity for water retention, nutrient removal, and pollutant removal. Adding gravel or other permeable material below the soil mixture further enhances infiltration.

When installing a swale, use a minimum 2% slope from beginning to end (longitudinal slope) to ensure that water is conveyed away from any structures and to a desired destination. Vegetation in the swale should be established before the first winter storms, so plant accordingly. Once saturated, swales function as conveyance structures carrying runoff to a rain garden, wetland, infiltration area, or other safe location. Swales are not recommended for areas that receive large amounts of sediment that can prematurely fill the swale and impede its functionality.

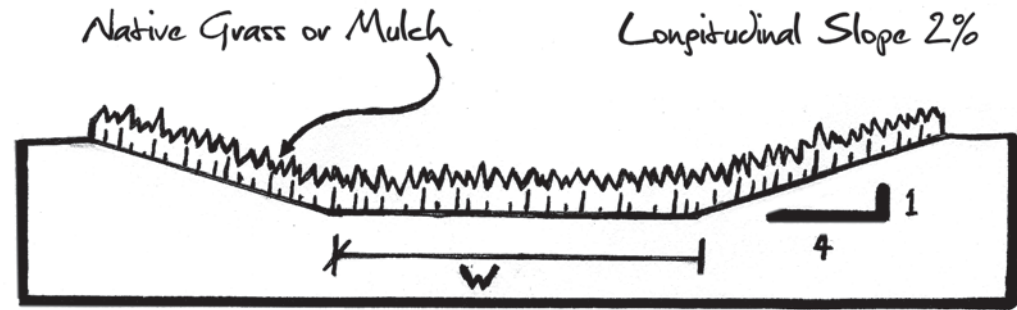
**MAINTENANCE:** Routine maintenance is required. Before a planted swale is densely vegetated, it is extremely vulnerable to erosion and must be protected with straw matting and other erosion control materials. Maintenance of a dense, healthy vegetated cover consists of periodic mowing (keep grass 2-4 inches high), weed control, reseeding of bare areas, and clearing of debris and accumulated sediment. The swales should be regularly inspected for pools of water, formation of gullies, and for uniformity in cross section width and longitudinal slope. When the uniformity is compromised it should be corrected quickly.

### DO

- Use CA native plants or drought tolerant plants.
- If a pesticide is needed, use only the least toxic.
- Enrich your soil with mulch and compost.
- If a fertilizer is needed, use "slow release".

### DON'T

- . . . walk or drive machinery directly in the swale as this will cause soil compaction.
- . . . place it too close to your home's foundation.
- . . . allow water to stand or stagnate.





## DRY CREEK BEDS (OR ROCK-LINED SWALES)

A dry creek bed (or rock-lined swale) uses rock instead of grass or other vegetation to safely infiltrate and convey runoff. Most are designed with rounded rock for an aesthetically pleasing landscape feature that mimics a creek bed.

When installing a swale, use a minimum 2% slope from beginning to end (longitudinal slope) to ensure that water is conveyed away from any structures and to a desired destination. Non-woven geotextile fabric can be used underneath the rock.

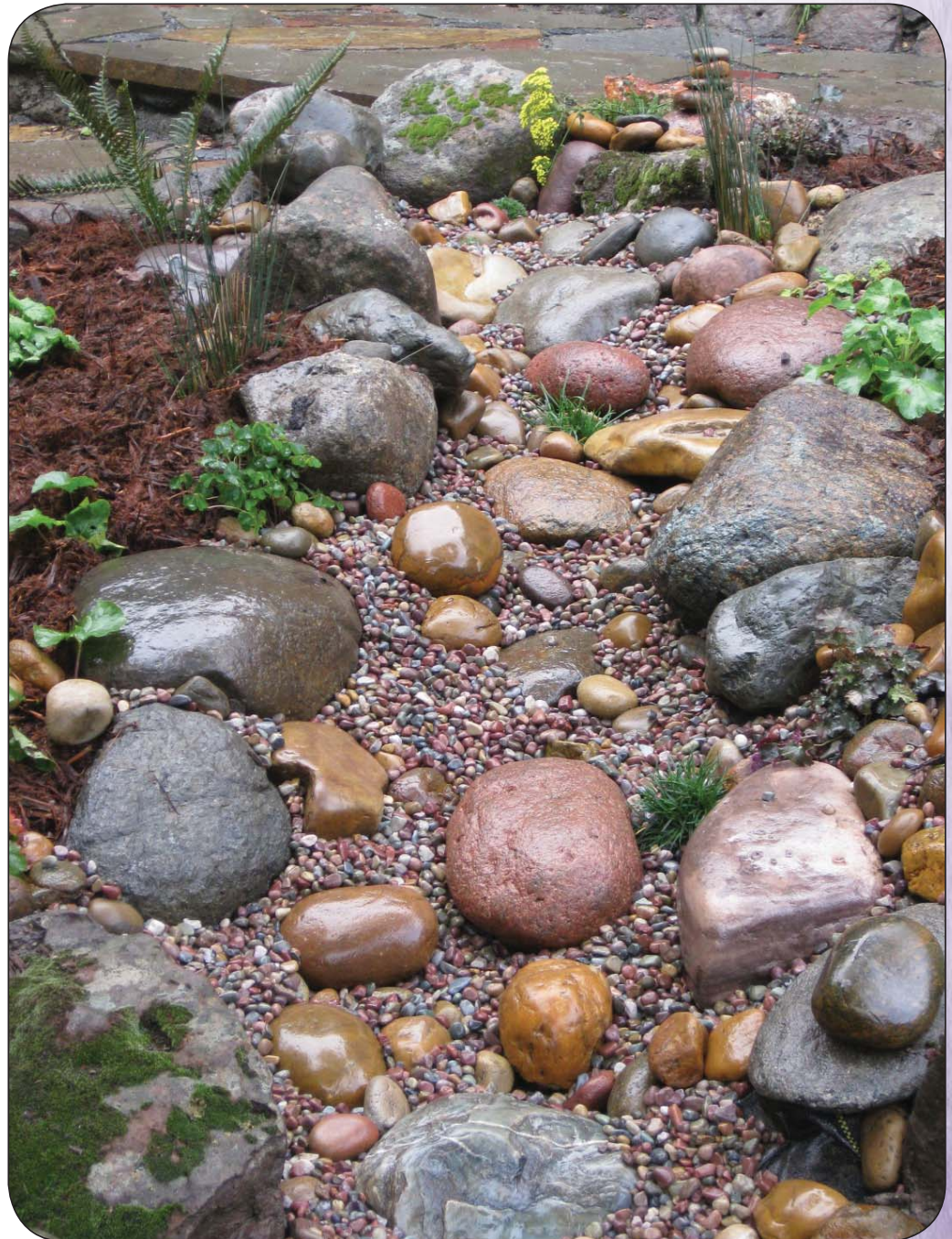
**MAINTENANCE:** Periodically remove leaves and replace rocks moved by surface flow.

### DO

- Use existing rock from your property if available.
- Use washed rock from a local quarry.
- Make sure the outlet does not cause erosion or clog.
- Use non-woven geotextile fabric beneath the rock.

### DON'T...

- ... install in soils with high water tables or saturated clay soils without an overflow device.
- ... place too close to your home's foundation.
- ... allow leaf litter to accumulate.





## INFILTRATION STRUCTURES

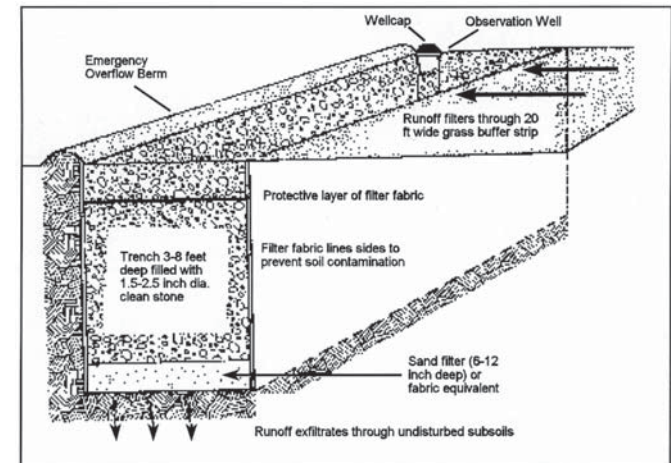


**USES:** ROOF, WALKWAYS OR OTHER HARDSCAPES, VEGETATED AND/OR UNDEVELOPED AREA RUNOFF; LOW TO MODERATELY SLOPED AREAS

**INTRODUCTION:** Unlike vegetated or bio-retention swales discussed on Pages XX-XX, an infiltration structure has NO RUNOFF. Infiltration structures are typically underground storage chambers designed to collect stormwater and allow it to infiltrate into the surrounding soil for groundwater recharge. They go by many names including; infiltration gallery, seepage pit, drainage well, dry well etc. In addition to promoting groundwater recharge, they can also help to increase water coming from groundwater sources in nearby creeks (called base flow), reduce runoff volume, and improve water quality by helping to remove sediment and pollutants. Downspout diverted water is often the best source for an infiltration structure as it typically does not have pollutant and sediment filtration requirements. Infiltration structures are generally considered an advanced technique and should only be undertaken with sufficient planning and professional assistance.

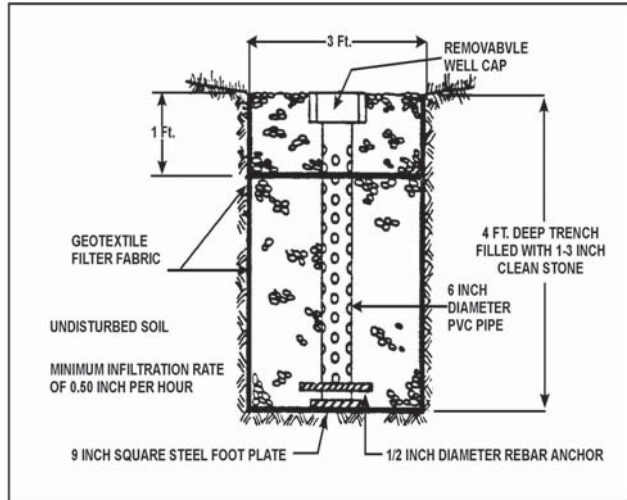
In some areas, the water table may be shallow (“perched”) or have seasonal variation which will not lend itself to an infiltration structure. Soil types and ground disturbance also need to be considered and vary by site location. Infiltration structures rely on proper design, appropriate soil types and a minimum depth of underlying soil (above the water table) to help filter pollutants before stormwater reaches the aquifer so groundwater contamination does not occur. Therefore, extreme care must be undertaken to ensure that infiltration structures are properly sited, designed, constructed, and maintained.

**INFILTRATION TRENCHES:** Infiltration trenches are fabric-lined, rock-filled trenches or shallow rock-filled pits that receive and infiltrate stormwater runoff. They are designed to capture runoff and SINK it into the soil, helping to restore infiltration function, replenish groundwater supplies and restore base flows in nearby creeks. Infiltration trenches also help to filter runoff pollutants and alleviate negative environmental impacts such as erosion. The potential property and environmental benefits of installing an infiltration trench are considerable, but the design and installation of an infiltration trench should only be undertaken in consultation with a qualified professional. Proper site conditions are critical to avoid groundwater contamination. In addition, infiltration trenches often need to be used in conjunction with other measures that pre-treat the stormwater. Good pretreatment practices are important because they remove suspended solids before they enter the trench to prevent clogging and possible failure. WITH OTHER OPTIONS AVAILABLE, WHY WOULD THE PUBLIC WANT TO USE A TRENCH - I.E. UNDER WHAT CIRCUMSTANCES --- SEPTIC SYTEMS???? LEACHFIELDS????



Source: Schueler et al, 1992.





Source: Southeastern Wisconsin Regional Planning Commission, 1991.

FIGURE 1 TYPICAL INFILTRATION TRENCH

**INFILTRATION PITS:** An infiltration pit is nearly identical in principal and design to a trench but is typically smaller and vertically aligned. Like a trench, they have similar design, pre-construction site evaluation and analysis requirements. The advantage is that they can be installed with minimal space requirements. Note that infiltration pits also have setback and site requirements that must be considered. (SETBACKS FROM CREEKS? HOMES? WHAT?)

**SITE AND DESIGN REQUIREMENTS:** Consideration of an infiltration trench must start with a thorough, professionally performed site analysis. This site analysis should carefully examine if soil types, percolation rates, required setbacks from roads, wells and septic systems, and depth to groundwater table are appropriate and possible. Infiltration trenches are not for all sites and only a professionally performed site analysis can determine if your property is suitable. The analysis should also consider runoff water quality, quantity and whether or not pre-treatment of the water will be required to remove suspended solids. If the analysis indicates

that the site is appropriate, the trench should be designed and installed by a qualified professional. You should also be sure to notify the appropriate building or planning agency before the site analysis to determine if there are any special permitting requirements, site limitations, or restrictions.

**MAINTENANCE:** Regular maintenance is required for the proper operation of an infiltration structure; however, such maintenance requirements are reasonable. Future planning should take into account maintenance requirements associated with pre-treating the stormwater and include a specific inspection and maintenance schedule as well as acceptable performance guidelines.

General guidelines recommend that in the first year, inspections of the infiltration structure should be done during and after several major rainstorms to confirm that it is functioning properly. After the first year, it should be inspected at least twice a year. Trash and plant debris should be removed from the surface on a regular basis to ensure optimal function and prevent clogging. A properly functioning infiltration structure should dewater within 72 hours. Even a partially clogged trench can lead to standing water which is conducive to mosquito breeding. If inspection indicates that the structure is partially or completely clogged, consult a professional immediately to identify the problem and requirements for repair. The probability of failure for an improperly sited, designed or maintained infiltration structure is nearly 100%.

### DO

- Consult a professional before considering installation
- Perform a thorough site analysis before building.
- Have the BMP professionally designed and constructed. BMP CONSTRUCTED???????
- Plan on regular maintenance.

### DON'T

- . . . attempt to install without a site analysis .
- . . . build an infiltration STRUCTURE? in an area with high sediment input or excessive slopes.
- . . . install a trench or pit that is greater than 3' deep.

## Pervious Surfaces

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M-C



**USES:** WALKWAYS, PATIOS, PARKING AREAS AND DRIVEWAYS

Pervious hardscapes is another term for discussing pervious surfaces and the many new types of materials that allow runoff to pass through and SINK back into the soil. Some popular choices are paver stones, turf block and permeable asphalts and pavements. There are now pervious options for almost any application. Since the variety of options is growing rapidly, we will only discuss them generally. For specifics on installation and use, contact your local retailer or product manufacturer. For information on pavers and their applications, go to <http://www.paversearch.com> and [http://extension.ucdavis.edu/unit/center\\_for\\_water\\_and\\_land\\_use/pervious\\_pavement.asp](http://extension.ucdavis.edu/unit/center_for_water_and_land_use/pervious_pavement.asp).



### PAVER STONES/FLAG STONES

Paver stones are normally made of pre-cast brick, concrete, stone or other material and installed over a sand base. They come in various shapes and normally interlock and can form different shapes and patterns. Pervious pavers are designed to allow more runoff to SINK into the ground than traditional pavers. Each paver has a spacer that ensures the ideal distance between placed stones for maximum infiltration. Each piece is placed with gaps between to allow the infiltration of water. Flag stones are larger and may be placed directly on the soil. A low-growing ground cover may be planted between flag stones to allow for greater infiltration. Pavers can be used in high use area such as parking lots, patios and walkways.

**MAINTENANCE:** Keep the area clear of sediment to prevent clogging. Annual vacuum sweeping with a shop vac helps maintain permeability. The gaps between pavers may require occasional weeding or scorching and sand or gravel replenishment. Because pervious pavers are easily lifted and reset, they are easy to repair or replace.

### DO

- Use only in gravelly sand, loamy sand or other pervious native soils.
- Plant vegetation in between or around pavers.

### DON'T...

... use in areas with high sediment loads that can clog porous areas.



## TURF BLOCK

Turf block (concrete blocks with holes) and similar products can be filled with sand or plantings. They provide soil stability for driveways and walkways. Sometimes the pores are filled with gravel or cobble. They are not ideal for everyday parking, because of irrigation and maintenance demands, and if they are planted, long term parking inhibits sunlight required for plant growth. (SO SHORT TERM PARKING IS OKAY?)

**MAINTENANCE:** Planted turf block may require regular mowing (depending on plant choices) as well as irrigation, fertilization and weeding.

### DO

- Choose low water grasses such as native fescues.
- Use only in gravelly sand, loamy sand or other pervious soils.

### DON'T

- ... use in high traffic areas or permanent parking areas.
- ... aerate?????????



## PERVIOUS PAVEMENT

Pervious pavements contain pore spaces that allow infiltration of runoff. The water seeps through the material to a rock base layer underneath and is naturally filtered through the underlying soil. There are different types of pervious (or porous) pavements including porous asphalt and pervious concrete. Soil must have permeability between 0.5 and 3.0 inches per hour to be considered for pervious concrete installations. The bottom of the rock base/reservoir should be completely flat so that runoff will be able to infiltrate through the entire surface. Pervious pavement should be located a minimum of 2 to 5 feet above the seasonally high groundwater table and at least 100 feet away from drinking water wells. Ideal uses include walkways, residential parking areas, and driveways.

Although installation is becoming an easier and more cost-effective alternative to traditional paving methods, appropriate construction techniques are necessary to ensure the effective performance of pervious pavements. Hiring a licensed contractor experienced in these materials is highly recommended and may even be required depending on the application.

**MAINTENANCE:** Keep clear of soil, rocks, leaves, and other debris. Vacuuming annually, using a shop vac or specialized vacuum for larger areas, may be necessary to remove debris from the surface of the pavements. Other cleaning options may include power blowing and pressure washing. Always follow the manufacturer's maintenance recommendations.

### DO

- Consult a professional to recommend a design customized to your site.
- Treat surrounding bare soil areas by planting or mulching.

### DON'T...

- ... use in areas where there is a possibility of sand drifts.
- ... seal or repave with non-porous materials.

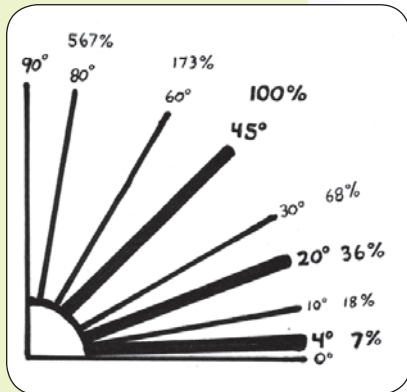


Pervious concrete is used in parking areas at The Marine Mammal Center, Sausalito.

## MEASURING THE SLOPE: DEGREES VS. PERCENTAGE

There is much confusion when referring to the “steepness” of slope. We sometimes find a slope measured in degrees and other times as a percentage such as a 20% slope.

To figure out the percentage slope, you would use the rise over run formula. For instance, a distance of one foot horizontally with a one foot rise over that distance would give you the formula  $1/1$  or 100% slope. The equivalent angle or degree would be a 45° angle. The chart below is an easy conversion table to calculate the equivalent % grade to degree of slope. **CONFUSING!!!**



SLOPE GRADIENT CONVERSION TABLE

## Ground Covers



**USES:** TEMPORARY AND PERMANENT SOIL COVER, LOW USE WALKWAYS, AND SLOPE PROTECTION



Using mulches (e.g. wood chips or gravel) or vegetation to cover bare soil is a key ingredient to **SLOWING** down and thus preserving valuable top soil, preventing sediment from being carried downstream, and reducing the potential for erosion. Mulches are a good choice for areas with **LESS THAN** a 33% slope. Vegetation works well on areas with **LESS THAN** a 50% slope.

### MULCH (ROCK, WOOD CHIPS, OR OTHER MATERIALS)

Mulching is a simple and beneficial conservation practice you can use in your yard. Mulch is simply a protective layer of material that is spread on top of the soil. Mulches can be organic such as grass clippings, straw, bark chips, and similar materials; or, it can be inorganic such as stones, brick chips, and recycled glass. Mulching has many benefits - e.g. protecting soil from erosion, reducing compaction from the impact of heavy rains, conserving soil moisture, maintaining an even soil temperature, and preventing weed growth. It is also useful as temporary ground cover until supplemental vegetation becomes established.

For a free copy of A Landscaper's Guide to Mulch, contact MCSTOPPP at 499-3202.

**MAINTENANCE:** Organic mulch may need to be replaced annually. Removal of old mulch and plant debris each Fall prevents growth of fungus and other unwanted pests and diseases. Keep any organic materials at least 6 inches from building siding. Gravel or rock should be raked regularly to prevent the buildup of organic matter.

### DO

- Use recycled material whenever possible.
- Keep rock free of organic materials.

### DON'T

- ... use wood chips from diseased trees.
- ... use straw mulch near creek channels.



## VEGETATION/PLANTING

Plants cover and protect the soil. Once established, plants provide excellent long-term erosion control. Their roots knit together to hold the soil in place. Their leaves, needles and twigs reduce the impact of rain, and the organic matter they add to the soil improves soil health. A drip irrigation system provides slow delivery of water to plants, so water infiltrates the soil with little or no runoff.

When selecting plants for a landscape, it is important to understand the site conditions. While most property owners select plant materials for their form and color, it is essential to know their sun, soil, and moisture requirements. Plants that do well in specific microclimates on a site are termed “site appropriate.” For the purpose of improving stormwater runoff, choose plants that improve infiltration, decrease runoff, filter pollutants, and help stabilize slopes. Contact the MCSTOPPP at 499-6528 for a free copy of “Go Native: Using Native Plants for Your Yard, Patio and Creek”. And, contact your local water district (see Resource Section) for a list of drought tolerant plants. You can also call the Marin Master Gardeners, UC Cooperative Extension at 499-4204 or visit a local plant nursery with staff knowledgeable in native and drought tolerant species.

Native plants (vegetation that grows naturally in particular climates or regions) are a great choice because of their performance, site enhancement, and life cycle cost/benefits. Native plants typically are more cost-effective in the long run because they require less water and fertilizer. They are also more resistant to local pests and diseases than nonnative ornamentals. Costs are also reduced due to lower maintenance and replanting requirements. Additionally, native plants provide habitat for local/regional wildlife. If you choose nonnative plants, care should be taken to not plant invasive species as they tend to crowd out the native species. Contact the California Invasive Plant Council for a list of plants that should be avoided. Go to [www.cal-ipc.org](http://www.cal-ipc.org).

**MAINTENANCE:** Routine maintenance is required and can be performed as part of the regular site landscaping program. Weeding and irrigation are essential in the first couple of months while plants become established. Annual pruning and mulching are recommended. Additional irrigation may be necessary during drought years. The use of native, site-appropriate vegetation reduces the need for fertilizers, pesticides, excessive water, and overall maintenance requirements.



### DO

- Use California natives or drought tolerant plants that can also endure periods of heavy rain.
- Keep plants well pruned near foundations and siding to allow adequate ventilation.
- Minimize fertilization or try organic options to prevent water contamination.

### DON'T

- . . . plant invasive species such as periwinkle (Vinca) and certain ivys and ice plants.
- . . . plant highly flammable vegetation near buildings.
- . . . allow irrigation water to drain to your driveway, the street, or bare soils.

## Erosion Control Blankets (ECBs)

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**USES:** BARE SOIL COVER AND SLOPE PROTECTION WHILE ESTABLISHING VEGETATION

Erosion control blankets are a good tool to improve the success rate of new plantings and can quickly add a layer of protection to bare soils. Some of the benefits of ECBs include reducing seed and soil loss, decreasing runoff volume and velocity, reducing top soil disturbance and loss, encouraging plant root developments and suppressing weeds. It's important to choose the correct ECB for the site conditions (slope, runoff velocity, and purpose). Ask your local retailer for assistance in choosing the correct blanket. The following are some basic installation instructions, but ALWAYS follow the manufacturer's recommendations.

Before laying the blanket, prepare the soil surface making sure it is smooth to maximize soil-blanket contact. At the top of the slope, at least 2 feet from the crest, dig a 6-inch minimum ditch (called an anchor ditch). Line the ditch with the top of the ECB leaving enough to roll back over once the ditch is filled. Now fill the ditch back in over the ECB and wrap the extra over the top and secure with staples. Next, carefully roll the ECB vertically down the slope in the same direction as the water flows. (If a slope isn't very steep, horizontal placement can be used.) Overlap the side edges of the contiguous blankets by at least 4 inches and overlap the top and bottom edges of the blankets by at least 3 inches. When positioned horizontally, the uphill roll should overlies the downhill roll. This allows water to flow over the blanket, as opposed to undermining the integrity by flowing under it. Stake the blanket, at a minimum, horizontally every 2 feet and vertically every 3 feet. Stake at least every foot where an uphill and downhill blanket overlap. If the ground is soft, staples can be used to hold the blanket down. Otherwise, 4 inch nails and a washer should be used. For more information on erosion control, call MCSTOPPP at 499-6528 and request a free copy of "GROUNDWORK: A Handbook for small-scale Erosion Control in Coastal California".



**MAINTENANCE:** Monitor for erosion until vegetation becomes established. Check for proper placement that could be disturbed by animals or a large rain storm. Ensure that overlaps remain correctly in place as necessary.

### DO

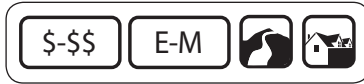
- Make sure to choose the appropriate ECB for the desired use and conditions.
- Use decomposable netting.

### DON'T . . .

- . . . walk on the ECB after it is in place.
- . . . allow gaps between the blanket and the soil.
- . . . let concentrated runoff flow onto the ECB from above.



# Cross Drains



**USES:** DRIVEWAYS, PRIVATE ROADS

Cross drains are used to SLOW water down by breaking up the impervious surface area into smaller sections. Smaller sections help divert the water to a point where it can SINK in to help combat the ill effects of driveway and road runoff. The BMPs described here can be installed on existing driveways and roads, both paved and unpaved. If you are constructing or reconstructing a road, other techniques such as outsloping can be used but are beyond the scope of this guide. You may, however, want to read the FishNet4C “Roads Manual” by going to <http://fishnet.marin.org/roads-manual.html>. Though written with public agencies in mind, parts of it are applicable to projects in the private sector.

**WATERBARS (ACCORDING TO GROUNDWORKS, THIS IS A TEMPORARY MEASURE. WHY ARE WE INCLUDING IT HERE?)** Waterbars are used to break up runoff into small units so that it does not have enough energy to erode soils. They also divert water away from streets and allow it to infiltrate. On unpaved roads, an earthen waterbar, also known as a water break, consists of a shallow trench with a parallel berm or ridge on the downslope side which is angled down across the road. On these surfaces they can be constructed by hand, with a backhoe, or with a blade-equipped tractor. Optimal size of an earthen waterbar is 12 inches above the road surface and 6 inches below the road surface. Asphalt or cement waterbars can be smaller in size (6 inches) and thereby provide greater ease of access. Water bars should be installed at a 30 to 45 degree angle and in most cases the outlet of waterbars should be protected with rock dissipaters.

**MAINTENANCE:** Keep the outlets clear of debris and sediment so water drains freely. Inspect annually and make necessary repairs to earthen berms that break down over time and ensure there is no erosion.

**SLOTTED CHANNEL DRAIN - ISN'T THE WATER GOING TO A STORM DRAIN? I THOUGHT WE WANTED TO FOCUS ON KEEPING WATER ONSITE???)**

A slotted drain installed across the width of your driveway is another option to address surface runoff. It consists of a metal-grated conveyance structure that transports water to a safe location. Decorative varieties are also available. Slotted channel drains are installed flush with the driveway surface, a feature that makes these conveyance devices more appealing for aesthetic reasons. The drain should be sloped no less than a 1/2 inch per foot of length to prevent clogging from sediment and debris. It should also be angled at 30-45 degrees. Although slotted channel drains may be installed on any driveway, they are recommended for driveways with slopes greater than five percent.



It should also be angled at 30-45 degrees. Although slotted channel drains may be installed on any driveway, they are recommended for driveways with slopes greater than five percent.

**MAINTENANCE:** Ensure that the grate is open before and during storm events (not covered by leaf litter). Check that the outlet is protected, non-eroding, and clear of debris and sediment so water drains freely.



## DO

- Install energy dissipaters at all outlets.
- Install at 30 to 45 degree angles.

## DON'T ...

- ... direct runoff to erodible surfaces.
- ... direct water onto steep slopes.
- ... direct water to a neighbor's property.

## DO

- Ensure the drain is large enough so that the majority of water enters the drain and doesn't flow over.
- Install energy dissipaters at all outlets.
- Install at 30 to 45 degree angles.

## DON'T ...

- ... install channel drains in areas with large amounts of leaf debris.
- ... direct water onto steep slopes.
- ... direct water to a neighbor's property.
- ... allow drain to clog and trap water.

# Retaining Walls and Terracing

\$\$\$-\$\$\$

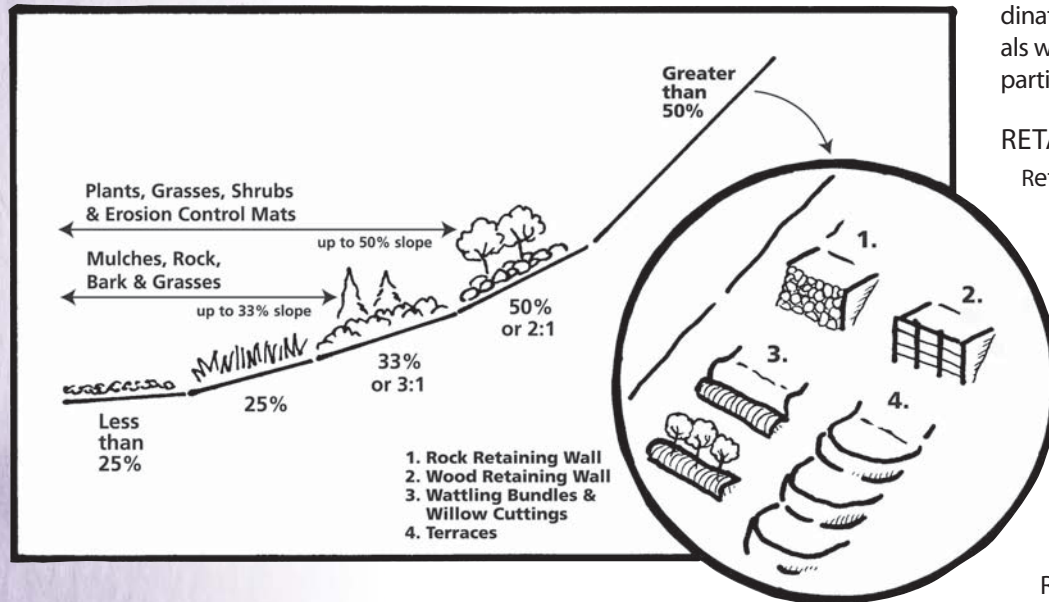
M-C



## SLOPED AREAS

Protecting steep slopes is very serious! Improperly installed systems can pose a serious threat to life and property. It is recommended that ALL retaining wall and terraced areas be designed and installed by a licensed qualified professional. In addition, always check with your municipal building department before embarking on terracing projects to determine local compliance and permitting requirements. In

Marin, permit assistance is also provided through the bi-monthly Project Coordinator Meetings where permit applicants are invited to discuss plans/proposals with regulatory agencies. To learn about these meetings and how you can participate, call MCSTOPPP at 499-6528.



## RETAINING WALLS

Retaining walls and terraces are used to reduce the gradient or slope and provide level or gently sloping areas for establishing vegetation. Retaining walls and terrace walls are constructed with boulders, treated timber, bricks and/or interlocking concrete blocks. (Walls over 3 feet high must be designed by an engineer). There are MANY different types of retaining walls, each with a different purpose, so always check with a qualified professional before embarking on any wall project for soil retention. A building permit and engineering expertise are required to build many retaining walls. Always check with your local planning/building department to determine if a permit is necessary for your project. Contact information can be found on page 61.

Rock retaining walls are an alternative to wood retaining walls and are often used next to a roadway or drainage way. They are freestanding walls built from rock 10 inches to 2 feet in diameter. A footing trench is dug along the toe of the slope, and the largest boulders are placed in the trench. Subsequent rocks are laid with at least three bearing points on previously laid rocks. The external face of the wall should incline slightly uphill, though the wall itself is freestanding and does not lean. As the wall is built, fill material is placed around and behind the rocks and packed in. Since the finished slope behind the wall will be flatter than before treatment, possibly a level terrace, it should be easier to establish all-important perennial plants on and above the wall.

Wood retaining walls can be used on slopes steeper than 50 percent and are often located between the base of a slope and an adjacent road, driveway or drainage way. Lumber and posts should be treated with an approved wood preservative (not creosote). Ensure proper drainage methods behind the wall are utilized. As always, vegetation should be established on the slope above the wall.



### WILLOW CUTTINGS

Willow cuttings are used under very specific site conditions and are normally recommended only through the guidance of a qualified professional.

### TERRACES

Many materials are available for building terraces. Treated wood is easy to work with, blends well with plants, and is often less expensive than other materials. Interlocking concrete blocks are made specifically for walls and terraces and are more easily installed by a homeowner than other materials, such as fieldstone and brick. The steepness of the slope dictates wall height. Make the terraces in your yard high enough so the land between them is close to level. This soil surface should be carefully revegetated. Be sure the terrace material is strong and anchored well to stay in place through cycles of freezing, thawing, and heavy rainstorms. Large terraces should be tied back into the slope and properly drained. This takes expertise and equipment, so you may want to restrict the terraces you build to a foot or two in height. Get help from a professional to make sure higher walls stand up to the forces of gravity and water pressure in the soil.

**MAINTENANCE:** Always check retaining walls to make sure they are not leaning or failing. Ensure there is adequate drainage behind walls and the drains remain functional.



#### DO

- Provide adequate drainage behind retaining walls.
- Use a qualified professional to design your wall.

#### DON'T...

- ... install without checking on permit requirements.
- ... use creosote-treated wood.



## Check Dams



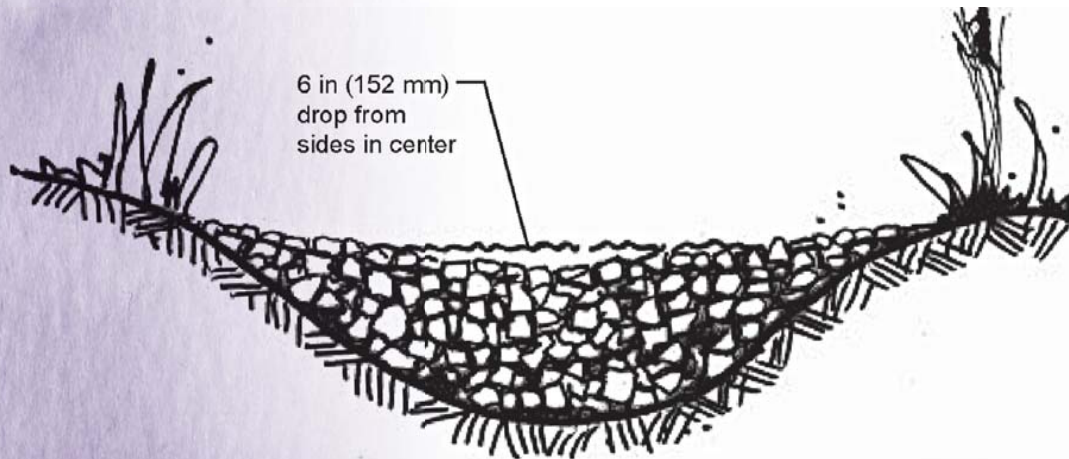
**USES:** IN ROCK-LINED DRAINAGE CHANNELS; VEGETATED DITCHES AND SWALES; LOW TO MODERATELY SLOPED AREAS (SINCE THIS IS A TEMPORARY MEASURE, DO WE REALLY WANT TO EVEN TALK ABOUT IT HERE? IF WE'RE TELLING PEOPLE TO CONSIDER OTHER OPTIONS, WHY EVEN MENTION THIS ONE?????)



A check dam is a small structure constructed of rock, gravel bags, logs or sandbags generally used in vegetated swales, constructed channels or drainage ditches to lower the speed of stormwater flows. They reduce flow velocity by temporarily ponding water and decreasing the effective slope. Stormwater enters a swale or rock-lined channel and is ponded behind the check dam which allows sediment and other pollutants to settle out. Check dams can help to SLOW and SINK stormwater by reducing peak flows and runoff timing. In certain situations they can provide other benefits such as limited sediment trapping, erosion control and partial removal of other pollutants. They are relatively inexpensive and easy to install depending on the site conditions.

Multiple check dams are often used in succession to further reduce velocity and increase effectiveness. They can also be useful for establishing vegetation and preventing erosion in newly constructed swales. It is important to note that check dams must not be used in creeks, streams, or any other type of natural watercourse or wetlands. Consult with a professional during the planning stages to ensure proper design and site suitability.

**GENERAL INFORMATION:** Proper site selection, maintenance and installation of check dams is crucial for successful implementation. Size of the drainage area, construction materials, spacing, and water quality are some of the important issues that must be addressed prior to installation.



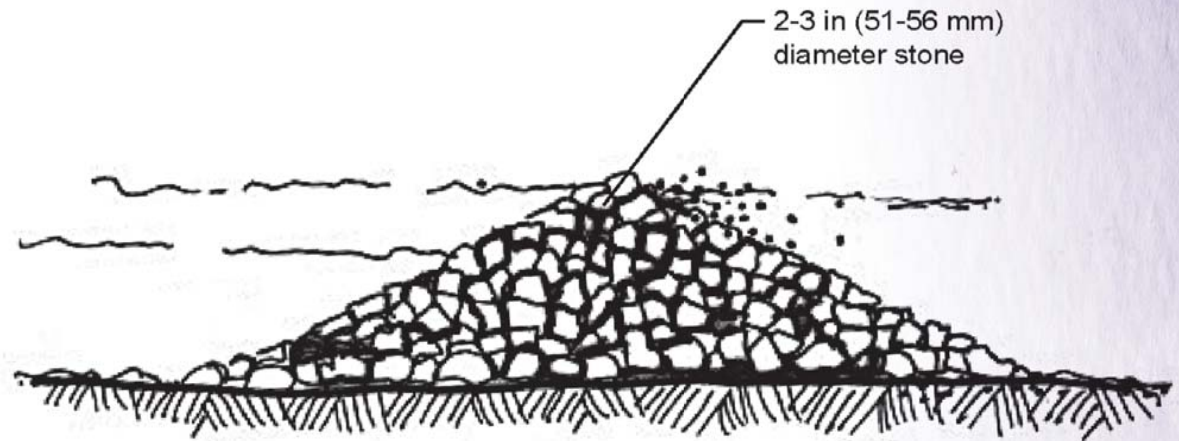
**Rock Check Dam  
Section View**

Check dams should only be used in small open channels in areas that drain less than ten acres. They must not be installed - or substantially alter flows - in a natural watercourse. When installing in drainage channels or swales with established vegetation, it is important to make sure that measures are taken to prevent erosion if vegetated areas are disturbed during the installation process. Conversely, small check dams are particularly useful when installed at the same time of a vegetated swale to help establish vegetation. They are carefully removed once sufficient vegetation is established. They may also be useful in rock-lined drainage channels for slowing water down to manage peak flows. Erosion control blankets are typically installed under and around a check dam to prevent unwanted erosion. A local professional can assist you with site analysis, design, possible permitting requirements and installation.



**DESIGN:** The size and structure of a check dam will depend on the site but should be no greater than two feet in height and extend across the entire water conveyance channel. The center of the check dam must be at least 6 in (152 mm) lower than the outer edges. They may kill grass linings in channels if water stays high or sediment load is excessive.

**MAINTENANCE:** Be prepared for regular maintenance and repairs for the life of the BMP. Check dams should be inspected after rainfall events and repairs made immediately. Accumulated sediment and debris must also be removed when it reaches one half the original height of the structure. If this material is left in place, it can become re-suspended and released in a subsequent storm event – sometimes known as “fill and spill”. Erosion around the edges of check dams is a serious problem and must be avoided.



**Rock Check Dam  
Section View**

### DO

- Consult a professional before considering installation
- Plan on regular maintenance for the life of the BMP
- Consider other options when channel stabilization is the primary objective

### DON'T

- Install in drainage areas with excessive erosion or sediment input
- Alter natural drainages and water courses



## GOING BEYOND SINGLE FAMILY HOMES: Using BMP's for MultiFamily Housing and Commercial/Industrial Sites

Many of the practices and basic principals in this guidebook can be scaled-up to yield greater benefits or to address multiple stormwater management goals (e.g. reducing both the volume and speed at which stormwater runs off properties and into creeks). When used on small-scale projects, the principals can often be implemented without the need for designs or a permit. Medium to large-scale projects will often trigger the need for engineered designs and one or more permits. Sometimes, this can be as straightforward as obtaining a building permit. Reconfiguring the stormwater flow regime on a large parcel with substantial earth movement may require engineered designs, and multiple agency permits. Large-scale integrated systems can benefit the landowner and environment in many ways. They do, however, require careful planning and professional consultation before implementation. Listing every available principal - or stormwater BMP - and potential combination is well beyond the scope of this guidebook. Size and selection will largely be driven by site-specific conditions, management goals, costs, engineering limits, and regulatory compliance needs.



### MAINTENANCE CONSIDERATIONS

Each BMP will require maintenance. Be sure to identify your maintenance needs in the design phase of your project and determine if BMPs could have an effect on each other. Improper maintenance of one BMP can lead to failure and adversely affect others. In a small-scale residential environment, maintenance requirements are typically reasonable for most of the described techniques. For large-scale, complex systems, maintenance requirements will be greater.

PHOTO ABOVE BY JAN GROSS OF HERITAGE LANDSCAPES. IT SHOWS BEGINNING STAGE OF AN EXTENSIVE SHEET MULCHING PROJECT AND PARTIAL LAWN REMOVAL. PHOTO TO THE LEFT BY CRAIG SOLIN.



Below are some Best Management Practices (BMPs) employed in non-residential settings in Marin.





## SWALES

In the photo above, you can see a bioswales or bioretention swale. Native bunchgrass is used to vegetate the soil. Since permeable asphalt wasn't used on the parking lot, curb cuts were placed along the parking spots. These curb cuts allow water to drain off the parking lot and into the vegetated area. A special mixture of soil (i.e. engineered soil) increases the absorption rate of the soil. A drain system was installed to handle overflow during severe storms. As water enters the drain (that is placed several inches above ground level), it will flow slowly through a series of underground pipes.

For more information, go to \_\_\_\_\_



## OTHER IDEA FOR WHAT GOES HERE INSTEAD OF FLOODING?

Under a widespread heavy rain scenario (accumulation of .30 inches of rain per hour or more), severe flooding is likely in low-lying areas within a basin. If you are unsure about the potential for flooding on your property, contact your City's building department (see page 61) for more information. If your home is within a flood prone area, consult an expert before considering home drainage projects.

To determine if you are in a flood plain, go to <http://gis.abag.ca.gov/website/FloodZones> .

For more information on Flood Control, go to: <http://www.co.marin.ca.us/depts/pw/main/floodcontrol.cfm>



## EROSION CONTROL

Seeding your site is a great way to reduce the potential for erosion and landslides. The above image shows ... (show image of fabric being placed across soil oor mayb compost fabric??)

For plants iwth good erosion conrol properties, go to \_\_\_\_\_

If your property is located in a landslide zone, consult an expert before considering home drainage projects. To determine where rainfall induced landslides have occured in the past in Marin, go to <http://gis.abag.ca.gov/website/LandslideDistribution> and use the navigation bar on the left to zoom in on street names. Or, go to <http://quake.abag.ca.gov/landslides> for more info.



## CHAPTER 3

# DIFFICULT SITES AND SITE CONSTRAINTS

There are a wide variety of soil types found in Marin County. When attempting to implement any BMP that increases the infiltration of water into the soil, it is critical that the soils have the capacity to handle the amount of water being directed to the area. Conducting a thorough analysis of your soils and ascertaining if a BMP will function in these soils is critical to the success of any project. In order to evaluate your soils, check the Web Soil Survey at <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>. Be sure to verify that the soil conditions noted on the website are accurate by observing your own soils or by contacting a qualified drainage professional. Also make sure to look for areas of infiltration-limiting layers such as hardpans.

Frequently, site conditions make it difficult or impossible to implement certain home drainage practices on your property. For example, sites that are on steep slopes, located in a wet area with a high water table, or soil conditions that have poor infiltration rates, can be problematic.

Although there are many opportunities to control runoff on site, it is important to CONSULT A DRAINAGE PROFESSIONAL to ensure that all options are thoroughly considered and to avoid unforeseen consequences.

Below, and on the next page, you will find a list of primary site constraints that should be considered when evaluating drainage practices for your home or business.

### STEEP SLOPES

The severity of the slope plays a significant role in determining the practices that can be installed. Avoid installing practices on slopes that are greater than 50% without professional consultation. Use caution when installing practices on any steep slopes. By directing and infiltrating runoff to these sites you run the risk of saturating soils and promoting slumping and conditions that promote landslides. Out-letting drainage systems on steep slopes can also cause erosion that can lead to gully formation and even landslides.

For a free handbook on small scale erosion control, call MCSTOPPP at 499-3202 and ask for a copy of GROUNDWORK.



### PRE-EXISTING EROSION

In some cases, pre-existing erosion problems may complicate the site and preclude the implementation of drainage practices. It is important to be aware of your current erosion issues and be sure that the drainage practices you implement will not make your drainage and erosion issues worse. Of particular importance is ensuring that you do not exacerbate current conditions by diverting flows into already unstable systems.

### EARTHQUAKE FAULTS

Land uses vary in their sensitivity to geologic hazards. State law requires a geologic report for projects along known active faults. "Special Studies" zones have been designated along faults in Marin where surface movement has taken place.

To determine earthquake shaking potential in areas of Marin, go to <http://gis.abag.ca.gov/Website/shakingpotential/index.html> and use the navigation bar on the left to zoom in on your area of interest.



### COASTAL BLUFFS

Coastal bluffs are inherently geologically unstable and prone to erosion. You should avoid placing any additional drainage on these sites whenever possible.

Careful management of site drainage is probably the most cost-effective approach to minimizing bluff hazards. Even where circumstances dictate significant structural stabilization efforts such as construction of seawalls or regrading of slopes, site drainage remains an essential component of the solution. Consult a drainage professional/contractor when designing drainage system for sites on coastal bluffs.

For more information, go to \_\_\_\_\_



### FLOODING

Under a widespread heavy rain scenario (accumulation of .30 inches of rain per hour or more), severe flooding is likely in low-lying areas within a basin. If you are unsure about the potential for flooding on your property, contact your City's building department (see page 61) for more information. If your home is within a flood prone area, consult an expert before considering home drainage projects.

To determine if you are in a flood plain, go to <http://gis.abag.ca.gov/website/FloodZones>.

For more information on Flood Control, go to: <http://www.co.marin.ca.us/depts/pw/main/floodcontrol.cfm>



### LANDSLIDE ZONES

Some areas of Marin are susceptible to landslides due to topography and geological soil characteristics. Installing complex drainage systems that promote infiltration might promote landslide activity if slopes become saturated.

If your property is located in a landslide zone, consult an expert before considering home drainage projects.

To determine where rainfall induced landslides have occurred in the past in Marin, go to <http://gis.abag.ca.gov/website/LandslideDistribution> and use the navigation bar on the left to zoom in on street names. Or, go to <http://quake.abag.ca.gov/landslides>.





## CHAPTER 4

### LOCAL PROJECTS

#### LAWN CONVERSION - AFTER

Location: San Rafael

Raised vegetable beds, gravel paths, low rock walls, boulders and succulents now replace what was once a main lawn area of this San Rafael home. There are also four different types of low water use grasses in the area that provide year-round beauty. The area is maintained without the use of pesticides or chemical fertilizers.

Photo Credit and Design Installation: Simmonds & Associates Landscape Architecture

#### LAWN CONVERSION - BEFORE





## LAWN CONVERSION - AFTER

Location: Novato

Design Installation: Melanie Moran

The front lawn (seen below) was converted into a wildlife friendly, drought tolerant native plant garden (see photo to right) by using sheet mulching. The transformation from “before” to “after” took place within 6 months.

## BEFORE



## SHEET MULCHING

To the right is an image of the lawn being converted to the native plant garden pictured above, by applying layers of sheet mulch and compost over the lawn. Sheet mulching is a simple and excellent way to rid yourself of lawn without removing it -- and having to dispose of it. Using this technique helps to enrich the soil - allowing soil microorganisms and the natural process of decomposition to do the work of preparing the soil for planting. For more information on sheet mulching, go to <http://www.stopwaste.org/home/index.asp?page=398>

Photo Credits: Melanie Moran







## LAWN REMOVAL AND REPLACEMENT WITH NATIVE, DROUGHT TOLERANT LANDSCAPING

Location: Corte Madera CA

Design and Installation: Flora Shanti Designs

### BEFORE

The front lawn was removed and replaced with drought tolerant native plants. Wood chip mulch was applied to provide ground cover, prevent erosion, conserve water and to provide aesthetic appeal.



### AFTER

Native plantings near the home enjoy drip-line protection and erosion control by helping to slow stormwater runoff. The new landscape conserves thousands of gallons of water per year, greatly reduces property maintenance requirements, creates a beautiful outdoor space and provides habitat for a variety of native birds and beneficial insects.

Reducing water use saves the homeowners hundreds of dollars per year on water bills and eliminates costs associated with mowing and fertilizing the lawn.

Photo Credits: Anne Rogers

## FROM LAWN TO RAINWATER COLLECTION

Location: Fairfax

Three years ago this yard was nearly all lawn, but now it's home to a thriving ecological garden - incorporating a stormwater retention pond (photo on far right). Rooftop runoff is diverted to a rainwater collection tank. The overflow enters an infiltration - i.e. a small lined pond. The pond provides habitat for mosquito fish and dragonflies.

Flagstone patios are dry-laid and grouted with decomposed granite. A 2% slope away from the house ensures drainage toward the center of the garden where two gravel-filled trenches underneath the flagstone infiltrate excess water.







## SIMPLE RAINWATER COLLECTION SYSTEM

Location: Marin Art & Garden Center, Ross, CA

This 2,500 gallon cistern collects water from a roof that is approximately 115 square feet. The overflow from the cistern is directed to a basin-and-berm rain garden situated in an adjacent planting area.

Water stored in this cistern is distributed by low-pressure gravity irrigation to existing and new native and water-wise plantings in and around the rain garden. Even in winter, the collected rainwater can be released on dry days. This allows the cistern to be re-filled with the next rainfall - and the release of water will percolate through soils to replenish groundwater supplies.



Rainwater catchment systems can also be small (see photo below right). For example, this small shed with a \_\_\_ square foot roof can collect \_\_\_ gallons of water in \_\_\_ wet months. Notice the rain chain dropping from the roof to the cistern. It helps to slow down the water and is more aesthetically pleasing than a drain pipe.

For more information on cisterns, go to [www.spawnusa.org](http://www.spawnusa.org)



Design Installation: SPAWN

Photos by: Gina Purin, MCSTOPPP

## RAINWATER COLLECTION SYSTEM UNDER DECK

Location: Kentfield

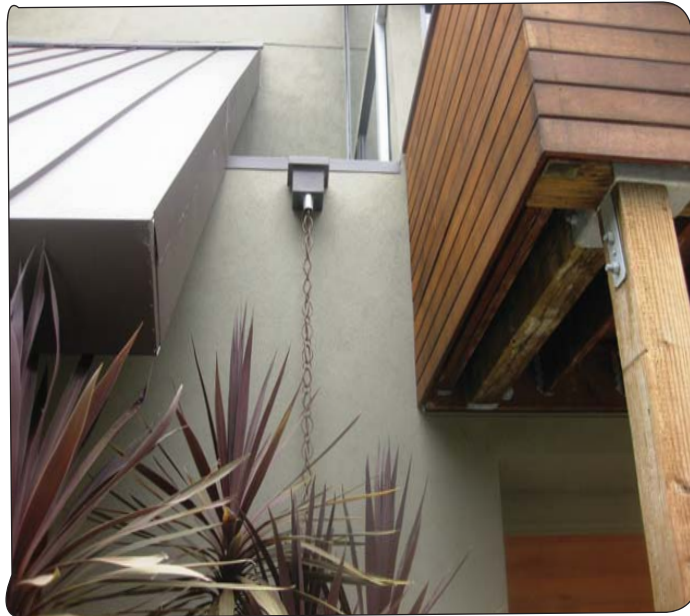
Landscape Design: Dig-It Landscaping Maintenance: S. Jordan Landscaping & Design

Enclosed beneath the deck, with easy access, are, two large collection tanks that total nearly 5,000 gallons. They are used to water the vegetable gardens. Rainwater from this home's metal roof is collected during winter storms and diverted to two large collection tanks (see below right) totaling nearly 5,000 gallons. The water is used to water the vegetable gardens in dry weather.

For more information on rainwater collection systems, go to <http://raingardens.spawnusa.org/>

Rain chains (below) were added for aesthetic beauty as well as functionality - they slow water down as it is collected from rooftop gutters and channels the water away from the house.

Photos: Gina Purin, MCSTOPPP





## RAIN GARDENS

Location:

Design Installation: SPAWN

Say what it is and what it does.

Generally speaking, it takes one inch of rain falling on a typical 1,500 square foot roof to generate approximately 1,000 gallons of runoff.

T

Location: Lagunitas

Designed by: Salmon Protection and Watershed Network (SPAWN)

This rain garden was designed to catch roofwater via a main downspout, and allowed to percolate through soil to recharge groundwater. At the base of the main downspout on the house is a large metal gravel-filled "pot" that slows down the heavy flow coming out of the downspout.

For more information on rain gardens, go to:

[http://www-csgc.ucsd.edu/BOOKSTORE/Resources/GS3%20Rain%20Gardens\\_8-10-09.pdf](http://www-csgc.ucsd.edu/BOOKSTORE/Resources/GS3%20Rain%20Gardens_8-10-09.pdf)

Photo Credits: Lisa Chipkin, SPAWN

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Above is the rain garden. Though not visible, ceramic salmon were placed in tributaries.

To the right is the planning stage where it was sketched to resemble a mini-watershed with headwaters, gravel-lined tributaries, woody debris and native plantings.





## RAIN GARDEN

Location: Novato

Landscape Design: Urban Habitat Design

This rain garden/demonstration site is a collaborative effort of North Marin Water District and Fire Station 3. A water thirsty lawn, a sickly sequoia tree and several liquidambers that cracked the sidewalks provided incentives to create this site with plants approved by local fire departments. A creekbed (or bioswale) controls site drainage by slowing water movement and allowing it to percolate into the soil. The entire site was regraded to direct all surface water runoff into the bioswale - including water from downspouts that were redirected to the bioswale.

For more information on rain gardens, go to: [http://www-csgc.ucsd.edu/BOOKSTORE/Resources/GS3%20Rain%20Gardens\\_8-10-09.pdf](http://www-csgc.ucsd.edu/BOOKSTORE/Resources/GS3%20Rain%20Gardens_8-10-09.pdf)

Photo Credit: Gina Purin, MCSTOPPP



SPAWN MAY HAVE OTHERS



## RAIN GARDEN

Location:

Landscape Design:

Photos: Lisa Chihpkin, SPAWN

The required size, shape and depth of the rain garden depends on how much water you're trying to capture, your soil type, the slope of your property, and existing landscaping or structures.



## EROSION CONTROL USING DRY CREEK BEDS (OR ROCK-LINED SWALES) . . .

Location: Kentfield (photo to right); Mill Valley (bottom two)

Dry creek beds help prevent erosion and channel the high volumes of winter rain away from the house and into proper drainage - NOT the storm drain system. (See Page 35.)



## . . . AND STRAW MULCH

Location: Mill Valley

Design & Installation: Art Gardens Landscape Company

Project Description: Hillside erosion control was maintained when installing this new garden by including swales, wattles and plantings. The steep portion of the hillside was terraced and used straw mulch and wattles to help control erosion until vegetation matured.

Instead of fences on this property, native plant screens of *Myrica Californica* was used.

For more information on erosion control, go to: <http://www.fishnet4c.org/roads-manual-online.html>

For more information on swales, go to <http://www-csgc.ucsd.edu/BOOKSTORE/Resources/SwalesReduceRunoff.pdf> or <http://ca-sgep.ucsd.edu/focus-areas/resilient-coastal-communities/green-flyers>



## ON-CONTOUR SWALE

Location: San Anselmo

Design & Installation: Studio Green

Project Description: On this property (to your right), swales have been laid out on the hillsides above a creek. These swales are dug along perfectly level lines - i.e. contours. This creates long, skinny, cross-slope water reservoirs that interrupt and capture rainwater runoff as it flows downhill. This will control erosion as the water is absorbed into the ground by the swale.

Below you will see.....

A DIFFERENT PHOTO NEEDS TO BE PLACED HERE in addition to the one on the right

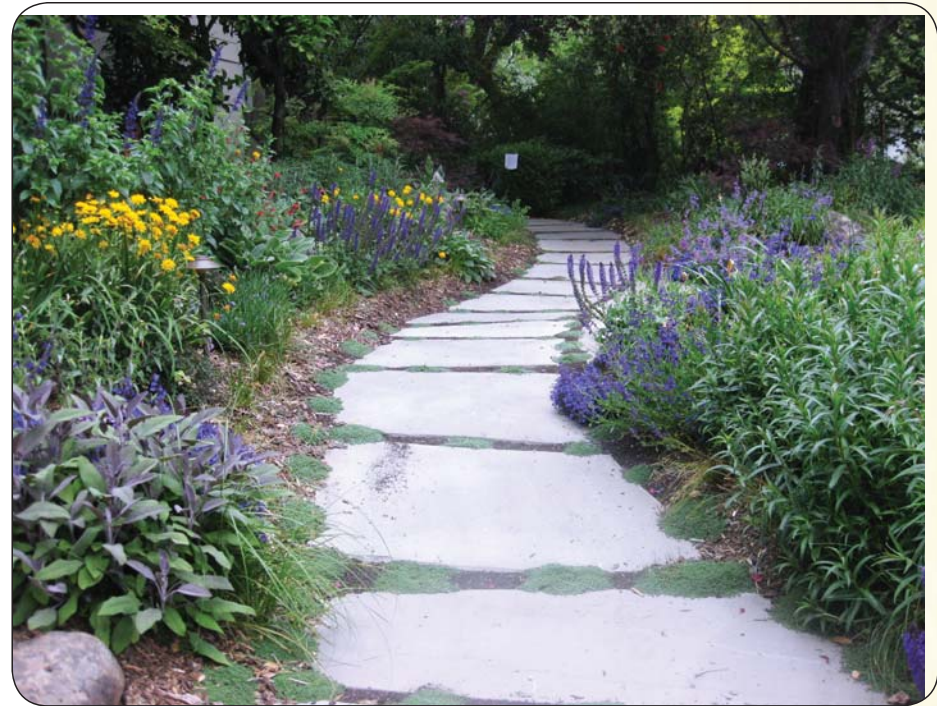


## PERMEABLE PATHWAYS

Location: Greenbrae

Design and Installation: AvidGreen Fine Landscaping & Vineyards

This flagstone pathway is porous, enabling water to infiltrate during the rainy season. It is set in a base of \_\_\_\_\_ (rather than concrete), which again allows water to seep into the ground . . . . .?????????



Location: Fairfax

Design and Installation: Barbara Huntingdon Landscape Design

Gravel, decomposed granite, reused aggregate, and flagstones are the principal materials used throughout this landscape. The photo to the right shows use of river rock, cut aggregate, and pea gravel to make an “artsy” permeable walkway. Pea gravel is also used in the driveway!

Photo Credits: Gina Purin



## PERMEABLE DRIVEWAYS

Location:

Design and Installation:

This flagstone pathway is porous, enabling water to infiltrate during the rainy season. It is set in a base of \_\_\_\_\_ (rather than concrete), which again allows water to seep into the ground . . . . .?????????



Location:

Design and Installation:

Gravel, decomposed granite, reused aggregate, an

Photo Credits: Dave Nicholson



## PERMEABLE DRIVEWAYS

A simple vegetated strip placed next to your home, and used as a parking space can help reduce rainwater from running off your property.







## HORSEKEEPING FACILITY

Location: Olema, CA

Design and Installation: ????????

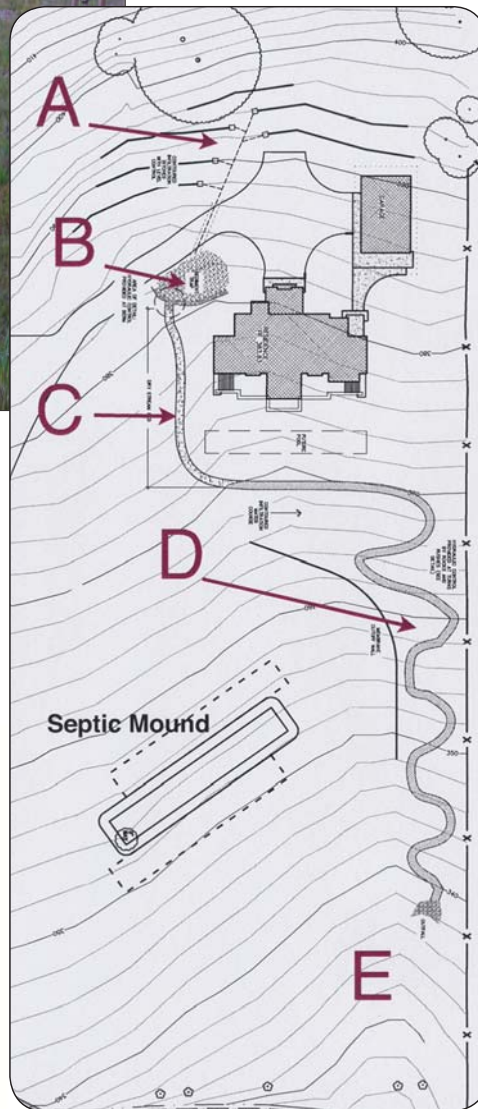
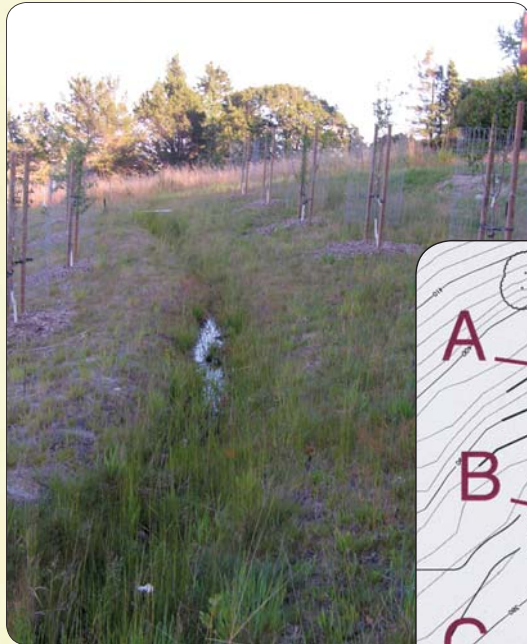
This grassed waterway (pictured to the left) was installed at a horse boarding facility. It was designed to accept runoff from the manure transfer pad. This grassed waterway slows down the water on its way to the nearby creek (located near the treeline in the photo); and, it provides a place for the water to sink into the ground - acting as a filter for any contaminants before it reaches the creek.



Before the grassed waterway was installed, runoff from the manure transfer pad ran very close to the creek - with nothing to slow it down or sink it into the soil.

For more information on how to manage rainwater on sites that house horses, contact the Marin County Stormwater Pollution Prevention Program for free information. Call 415-499-6528 or go to [www.mcstoppp.org/horses.htm](http://www.mcstoppp.org/horses.htm)

Photo Credits: Before: Brent Schumacher After: Nancy Scolari



## VINEYARD ORCHARD STORMWATER MANAGEMENT INTEGRATING MULTIPLE BMPS

Location: Greenbrae???

Design and Installation: AvidGreen Fine Landscaping & Vineyards???

The garden and vineyard were designed with the natural hillside contours in mind which kept grading of the site at a minimum.

Following the needs and guidelines of soils and civil engineering, septic field setbacks, and county permitting oversight. This approach provides multiple benefits, which include, responsible stormwater management, fertility development of upland soils, habitat creation/restoration, and food production with reduced water use, all while creating a beautiful space. Section A (see schematic) is an integrated system of engineered, contoured infiltration trenches that mitigate soil erosion and catch surface flow for percolation on a hillside orchard. Fruit trees are planted on the berm portion of the trenches. The infiltration trench system feeds into a lateral line that discharges into a sediment trap planted with native grasses and berries that can handle both inundation with water and long dry spells.

Section D consists of a series of short infiltration trenches connected by switchbacks that extend out beyond the 50' required septic setback. A subsurface, impermeable membrane was installed along the setback to further reduce the possibility of surface water contamination. For soil stabilization, a hydroseed of Native California, deep rooting, perennial grasses and wildflowers as well as plugs of native grasses were planted directly into the watercourse. Rock aprons were installed on the banks of the switchbacks. A rock diffuser was also required on the lowest trench where it is designed to breach in an overflow event. A pond is proposed in the area below the lowest trench to further slow and store stormwater. The system is also plumbed to allow diversion of road runoff through the infiltration switchbacks once vegetative cover matures. The lower portion of the water course attracts a diverse array of wildlife.

Photo Credit: Rick Taylor



## INTEGRATED STORMWATER MANAGEMENT SYSTEM

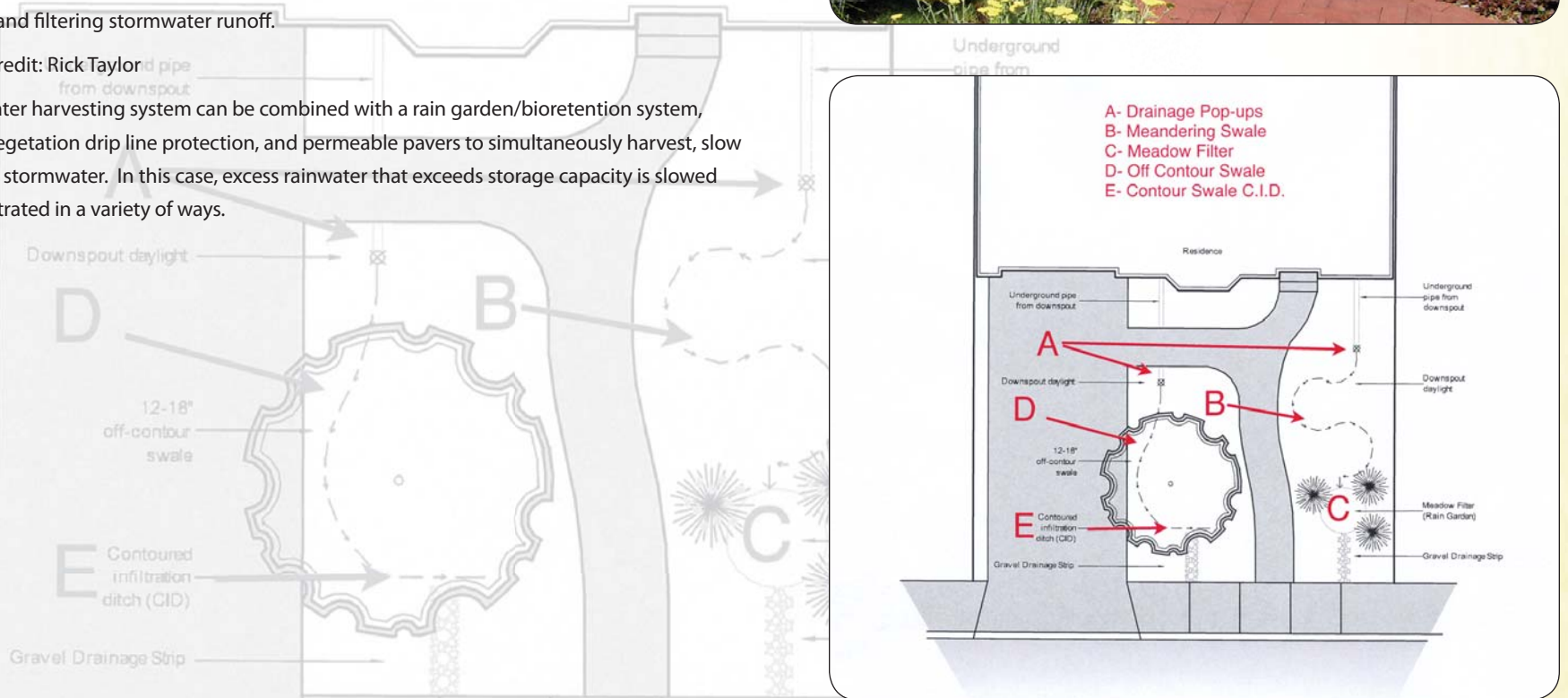
Location:

Design and Installation:

This unique system replaced a lawn with a landscaped, integrated stormwater management system. The system integrates a rain garden, conveyance swales, diverse native plantings, and a completely revised drainage plan. Drainage downspouts were disconnected from a traditional system that diverted all roof runoff to the street. The roof water was diverted to bioswales to slow the water down, reduce suspended sediment and eventually drain into a specially designed rain garden with a diverse palette of native plants. The system slows and retains some water for the plants, and promotes infiltration. It also includes a gravel bed to accommodate significant storm events by allowing for overflow and providing another sediment filter. This project greatly reduces potable water use by replacing a lawn with drought tolerant native plants that create a lush beautiful landscape. The integrated bioswales and rain garden protect the home structure while slowing, spreading, sinking and filtering stormwater runoff.

Photo Credit: Rick Taylor

A rainwater harvesting system can be combined with a rain garden/bioretention system, native vegetation drip line protection, and permeable pavers to simultaneously harvest, slow and sink stormwater. In this case, excess rainwater that exceeds storage capacity is slowed and infiltrated in a variety of ways.



# RESOURCE GUIDE

## AGENCIES & NON-PROFITS

Low Impact Development Center  
California Branch Office  
P.O. Box 747  
San Luis Obispo, CA 93406-0747  
805-540-9772  
[www.lowimpactdevelopment.org](http://www.lowimpactdevelopment.org)

Occidental Arts & Ecology Center  
Water Institute  
15290 Coleman Valley Road  
Occidental, CA 95465  
707-874-1557 x 206  
[waterinstitute@oaec.org](mailto:waterinstitute@oaec.org)

Our Water - Our World  
[www.OurWaterOurWorld.org](http://www.OurWaterOurWorld.org)

Sonoma Ecology Center  
P.O. Box 1486  
Eldridge, CA 95431  
707-996-0712  
[www.sonomaecologycenter.org](http://www.sonomaecologycenter.org)

Salmon Protection and Watershed Network  
415-  
[www.spawnusa.org](http://www.spawnusa.org)

University of California Cooperative  
Extension, Marin Master Gardeners  
1682 Novato Blvd., Suite 150B  
Novato, CA 94947  
415-499-4204

USDA-Natural Resources  
Conservation Service (NRCS)  
1301 Redwood Way  
Petaluma, CA 94954  
707-794-1242  
[www.ca.nrcs.usda.gov](http://www.ca.nrcs.usda.gov)

## BUILDING/PLANNING DEPARTMENTS

Belvedere  
Planning and Building - 435-3838

Corte Madera

927-5062 - Building  
927-5064 - Planning

County UnIncorporated  
Building & Planning - 499-6550

Fairfax  
Planning & Building - 453-1583

Larkspur  
Planning & Building - 927-5038

Mill Valley  
Planning & Building - 388-4033

Novato  
Planning & Building - 899-8989

Ross  
Plannin - 453-1453, Ext. 121  
Building - 453-1453, Ext. 119

San Rafael  
Planning - 485-3085  
Building - 485-3367

Sausalito  
Planning & Building - 289-4128

Tiburon  
Building - 435-7380  
Planning - 435-7390

## STORMWATER COORDINATORS

To report illegal discharges to storm drains, creeks, or wetlands, call the numbers below. You can also report a complaint online at [www.mcstoppp.org](http://www.mcstoppp.org). After normal business hours, call the County Sheriff's non-emergency line at 499-7233.

Belvedere - 435-3838

Corte Madera - 499-3748

County UnIncorporated - 473-6528

Fairfax - 453-1584

Larkspur - 927-5017

Mill Valley - 388-4033

Novato - 899-8246

Ross - 453-1453, ext. 163

San Rafael - 485-3355

Sausalito - 289-4100

Tiburon - 435-7399

## WATER DISTRICTS

Local water districts offer water conservation and efficiency programs, provide technical support materials, and offer rebates for water saving techniques.

Marin Municipal Water District (MMWD)  
220 Nellen  
Corte Madera, CA  
415-945-1455  
[www.marinwater.org](http://www.marinwater.org)

North Marin Water District (NMWD)  
999 Rush Creek Place - P.O. Box 146  
Novato, CA 94948  
415-897-4133  
[www.nmwd.com](http://www.nmwd.com)

## PROFESSIONAL ASSOCIATIONS

American Rainwater Catchment  
Systems Association  
919 Congress Ave., Ste. 460  
Austin, TX 78701  
[www.arcsa.org](http://www.arcsa.org)

Bay-Friendly Landscape Coalition  
[www.bayfriendlycoalition.org](http://www.bayfriendlycoalition.org)

California Landscape Contractors Association  
North Coast Chapter  
707-  
[www.clca.org](http://www.clca.org)  
CLCA can help you find a qualified and licensed landscape professional to assist with your home drainage needs.

California Native Plant Society  
Marin Chapter  
[www.marin.cc.ca.us/cnps/index.html](http://www.marin.cc.ca.us/cnps/index.html)

California Stormwater Quality Association  
P.O. Box 2105  
Menlo Park, CA 94026-2105  
650-366-1042  
[www.casqa.org](http://www.casqa.org)

Certified Professionals in Erosion and Sediment  
Control, Inc. (CPESC)  
49 State Street  
Marion, NC 28752-4020  
828-655-1600  
[www.cpesc.org/cc-info/cc-dir-list.asp](http://www.cpesc.org/cc-info/cc-dir-list.asp)  
Link to CPESC professionals in California who can assist you with erosion and drainage concerns

Ecological Landscape Association  
1257 Worcester Road #262  
Framingham, MA 01701  
617-436-5838  
California chapter web site  
[www.ecolandscaping.org/ela-CA.html](http://www.ecolandscaping.org/ela-CA.html)  
Contact the local ELA chapter for information on regional landscape professionals

San Francisco Public Utilities Commission  
[www.sfwater.org](http://www.sfwater.org)  
Publishes excellent resource guides for rainwater harvesting and advanced stormwater design BMPs



# RESOURCE GUIDE

## REGULATORY AGENCIES

California Coastal Commission  
North Central Coast District Office  
45 Fremont Street, Suite 2000  
San Francisco, CA 94105-2219  
415- 904-5260  
[www.coastal.ca.gov](http://www.coastal.ca.gov)

California Department of Fish and Game (CDFG)  
P.O. Box 47  
Yountville, CA 94599  
(707) 944-5500  
[www.dfg.ca.gov](http://www.dfg.ca.gov)

National Marine Fisheries Service  
(NOAA Fisheries)  
777 Sonoma Ave.  
Santa Rosa, CA 95404  
707- 575-6050  
[www.nmfs.noaa.gov](http://www.nmfs.noaa.gov)  
NOAA must be consulted when steelhead or salmon are potentially affected by an activity

Regional Water Quality Control Board  
San Francisco Bay RWQCB, Region 2  
1515 Clay Street, Suite 1400  
Oakland, CA 94612  
510-622-2300  
[www.waterboards.ca.gov/sanfranciscobay](http://www.waterboards.ca.gov/sanfranciscobay)

Marin County Agricultural Weights & Measures  
1682 Novato Blvd., Suite 150A  
Novato, CA 94947  
415-473-6700

U.S Army Corps of Engineers (ACOE)  
333 Market Street, 8th Floor  
San Francisco, CA 94195  
415-977-8462  
[www.usace.army.mil](http://www.usace.army.mil) ACOE regulates the discharge of dredged or fill materials in most creeks, rivers, and wetlands

US Fish and Wildlife Service  
Region 8 – Covers Sonoma County  
Sacramento Office  
2800 Cottage Way, Room W-2605  
Sacramento, California 95825  
916-414-6600  
[www.fws.gov/sacramento](http://www.fws.gov/sacramento)

## RAINWATER MANAGEMENT

California's Integrated Water Re-Use Management Center - <http://www.whollyh2o.org>

International Rainwater Catchment Systems Association  
[www.eng.warwick.ac.uk/ircsa](http://www.eng.warwick.ac.uk/ircsa)  
Oasis Design - Rainwater Harvesting/ Coliform Concerns  
[www.rainwaterharvesting.net](http://www.rainwaterharvesting.net)  
[www.oasisdesign.net/water/quality/coliform.htm](http://www.oasisdesign.net/water/quality/coliform.htm)

Permacultura America Latina  
[www.permacultura.org](http://www.permacultura.org)

Penn State School of Forest Resources  
– Water Facts #13 – Coliform Bacteria  
[www.pubs.cas.psu.edu/FreePubs/pdfs/XH0019.pdf](http://www.pubs.cas.psu.edu/FreePubs/pdfs/XH0019.pdf)

San Francisco Public Utilities Commission  
– Rainwater Harvesting  
[www.sfwater.org/mto\\_main.cfm/MC\\_ID/14/MSC\\_ID/361/MTO\\_ID/559](http://www.sfwater.org/mto_main.cfm/MC_ID/14/MSC_ID/361/MTO_ID/559)

The Rainwater Calculator  
[www.rain-barrel.net/rainwater-calculator.html](http://www.rain-barrel.net/rainwater-calculator.html)

The Centre for Science and Environment  
Rainwater Harvesting Technology and Systems  
[www.rainwaterharvesting.org](http://www.rainwaterharvesting.org)

UCCE Green Sheets  
<http://ca-sgep.ucsd.edu/focus-areas/resilient-coastal-communities/green-flyers>

## NATIVE PLANT NURSERIES

BUCKEYE NURSERY, PETALUMA  
[WWW.BUCKEYENURSERY.COM](http://WWW.BUCKEYENURSERY.COM)  
707-559-7081

## CALIFORNIA NATIVE PLANT EXCHANGE

[WWW.CNPLX.INFO/](http://WWW.CNPLX.INFO/)

GREEN JEAN'S, MILL VALLEY – 415-389-8333

HARMONY FARM SUPPLY  
3244 GRAVENSTEIN HWY. NORTH, SEBASTOPOL, CA  
[WWW.HARMONYFARM.COM](http://WWW.HARMONYFARM.COM) 707-823-9125

LARNER SEEDS, BOLINAS - [HTTP://WWW.LARNER-SEEDS.COM/INDEX.HTML](http://WWW.LARNER-SEEDS.COM/INDEX.HTML) OR 415-868-9407

LAS PILITAS NURSERY - LAS PILITAS RD., SANTA MARGARITA, CA, (805) 438-5992  
[WWW.LASPILITAS.COM/PLANTS/PLANTS.HTM](http://WWW.LASPILITAS.COM/PLANTS/PLANTS.HTM)

MOSTLY NATIVES, TOMALES  
27235 HIGHWAY ONE, TOMALES, CA  
[WWW.MOSTLYNATIVES.COM](http://WWW.MOSTLYNATIVES.COM)  
707-878-2009,

NATIVE HERE NURSERY, 101 GOLF COURSE ROAD, BERKELEY, CA 94708, (510) 549-0211  
[HTTP://WWW.EBCNPS.ORG/NATIVEHERE.HTML](http://WWW.EBCNPS.ORG/NATIVEHERE.HTML)

NORTH COAST NATIVE NURSERY, PETALUMA  
2710 CHILENO VALLEY RD., PETALUMA, CA (707) 769-1213  
[WWW.NORTHCOASTNATIVENURSERY.COM](http://WWW.NORTHCOASTNATIVENURSERY.COM)

O'DONNELL'S NURSERY, FAIRFAX – 453-0372

PEACEFUL VALLEY FARM AND GARDEN SUPPLY,  
[WWW.GROWORGANIC.COM](http://WWW.GROWORGANIC.COM)

PLANT NATIVE  
[HTTP://WWW.PLANTNATIVE.COM/ND\\_CA.HTM](http://WWW.PLANTNATIVE.COM/ND_CA.HTM)

THE WATERSHED NURSERY, RICHMOND  
[WWW.THEWATERSHEDNURSERY.COM](http://WWW.THEWATERSHEDNURSERY.COM)  
510-234-2222

## PLANTS - GOOD FOR EROSION CONTROL

For examples of plants useful in controlling erosion, go to [http://www.elnativogrowers.com/SuitabilityLists/CaNatives\\_Erosion%20Control\\_Slope%20Stabilization.htm](http://www.elnativogrowers.com/SuitabilityLists/CaNatives_Erosion%20Control_Slope%20Stabilization.htm)

PLANTS - INVASIVES  
[www.cal-ipc.org](http://www.cal-ipc.org)

PLANTS - PYROPHETIC (FIRE RESISTANT)  
[www.firesafemarin.org](http://www.firesafemarin.org)

## CONTRACTORS/DESIGN CONSULTANTS

AP Rainwater Harvesting & Graywater Gardens - David Ortiz  
707-874-9460 in Sebastopol, CA  
[www.aprainwaterharvesting.com](http://www.aprainwaterharvesting.com)

Artisans Ecological Landscapes and Farms - Erik Ohlsen  
707-332-8100 in Sebastopol, CA  
[www.permacultureartisans.com](http://www.permacultureartisans.com)

Bay Friendly Landscape Coalition  
[www.bayfriendlycoalition.org](http://www.bayfriendlycoalition.org)

Bill Wilson Environmental Planning  
310-441-3861 in Mill Valley, CA

Design Ecology - Josiah Raison Cain  
415-888-8515 in Petaluma, CA  
[www.designecology.com](http://www.designecology.com)

Earth Craft Design - Bobby Markowitz  
831-475-9355 in Soquel, CA  
[www.earthcraftdesign.com](http://www.earthcraftdesign.com)

Elder Creek Landscapes - Rick Taylor  
707-529-3008 in Sebastopol CA

Prunuske Chatham, Inc. – Mike Jensen  
707-824-4601 ext. 107 in Sebastopol, CA,

NOTES:





Marin County Stormwater Pollution Prevention Program (MCSTOPPP)

3501 Civic Center Drive, San Rafael, CA 94903  
(415) 473-6528

[www.mcstoppp.org](http://www.mcstoppp.org) or [mcstoppp@co.marin.ca.us](mailto:mcstoppp@co.marin.ca.us)



Printed on paper partially consisting of recycled post-consumer waste

## ZONE 1: ROOFS

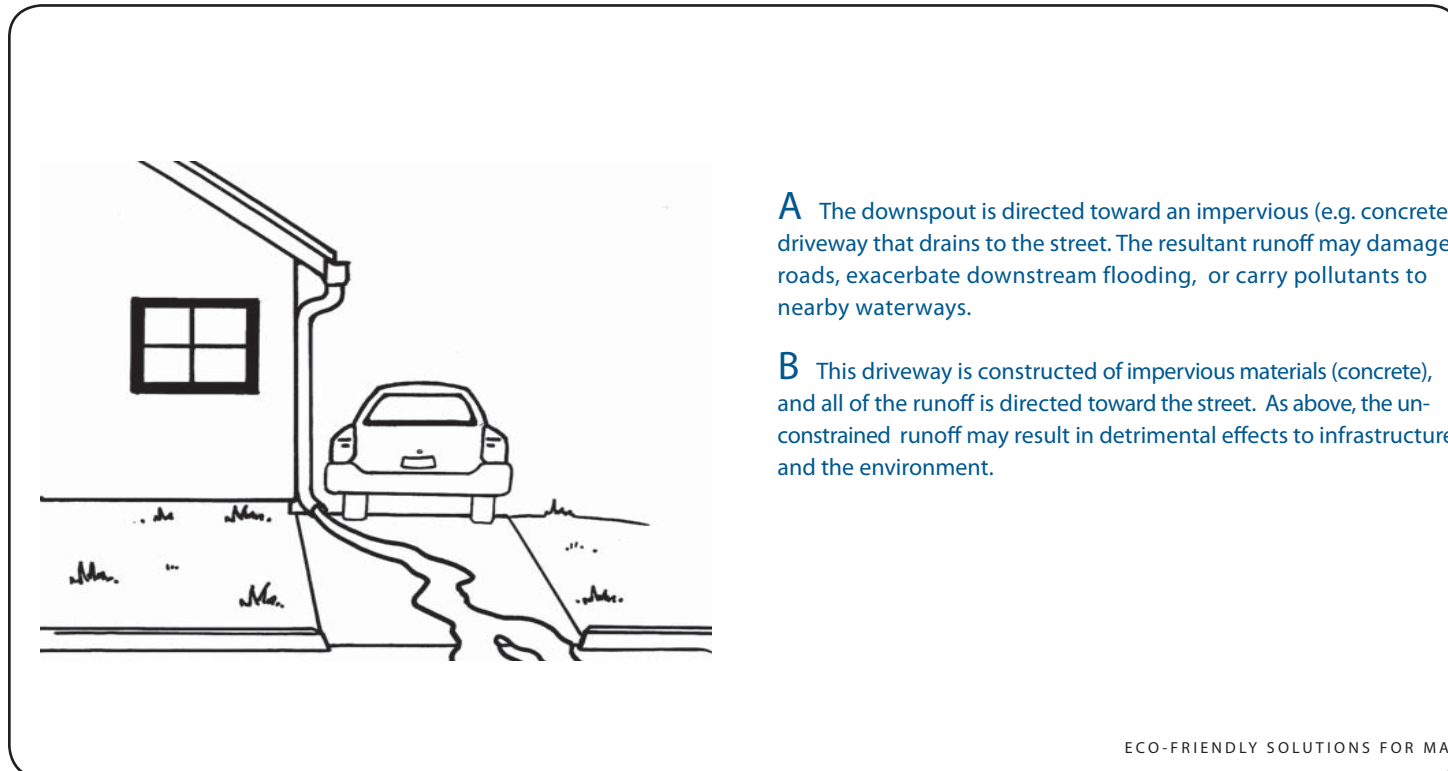
Your roof likely generates the most runoff from your home. While the majority of roofs are outfitted with gutters and downspouts, some are not. Measures for addressing either possibility are discussed. Regardless of which system you use, all eaves and downspouts should be routed away from sensitive areas such as septic system leachfields, hillsides, and building foundations.

### WHAT IS YOUR ROOF MADE OF?

Metal and tile roofs are preferred catchment surfaces because they don't contain the asphalt and other contaminants present in composite roofs. If water is used for irrigating your garden, the installation of a downspout diverter should be used to filter out such contaminants from a composite roof.

### GUTTERED ROOFS

Gutters and downspouts are excellent choices for handling roof runoff; however, they must be properly sized, managed, and maintained to prevent damage to property and the environment. Undersized gutters clog and overflow more frequently, which can damage foundations. Directing downspout runoff toward impervious surfaces - like some driveways - is common but can contribute to downstream flooding, surface water pollution, potholes and other issues. ALWAYS avoid sending runoff toward streets, storm drains, hillsides, septic system leachfields, and building foundations where it could cause significant damage to your property.



## CATCH THE RAIN!

It takes only 1" of rain falling on a typical 1500 square foot roof to generate approximately 1,000 gallons of runoff.

Annual rainfall in Marin County averages 44 inches. This means that in one winter, your roof alone could generate 44,000 gallons of water!

Instead of running off your property, this water can be put to use by implementing some of the measures found in this guidebook.